

Smutsia temminckii – Temminck’s Ground Pangolin



African Pangolin Working Group and the IUCN Species Survival Commission Pangolin Specialist Group) is Temminck’s Ground Pangolin. No subspecies are recognised.

Assessment Rationale

The charismatic and poorly known Temminck’s Ground Pangolin, while widely distributed across the savannah regions of the assessment region, are severely threatened by electrified fences (an estimated 377–1,028 individuals electrocuted / year), local and international bushmeat and traditional medicine trades (since 2010, the number of confiscations at ports / year has increased exponentially), road collisions (an estimated 280 killed / year) and incidental mortalities in gin traps. The extent of occurrence has been reduced by an estimated 9–48% over 30 years (1985 to 2015), due to presumed local extinction from the Free State, Eastern Cape and much of southern KwaZulu-Natal provinces. However, the central interior (Free State and north-eastern Eastern Cape Province) were certainly never core areas for this species and thus it is likely that the corresponding population decline was far lower overall than suggested by the loss of EOO. Additionally, rural settlements have expanded by 1–9% between 2000 and 2013, which we infer as increasing poaching pressure and electric fence construction.

Estimated mature population size ranges widely depending on estimates of area of occupancy, from 7,002 to 32,135 animals. This is a long-lived species with low reproductive output that is increasingly affected by the loss of mature individuals. With the demise of the Asian pangolin populations, we suspect an increasingly severe level of poaching within southern Africa on a commercial scale, which thus represents an emerging threat to this species. Commercial harvesting pressure will synergise with the existing threats (such as high mortality rates from electric fences and local poaching for traditional medicine), as well as past habitat loss, so that a decline of 30% is likely over a 27-year period (three generations) between 2005 (c. when illegal trade began to escalate) and 2032. Thus we list as Vulnerable A4cd under a precautionary purview. Further quantification of the illegal trade is needed, as well as long-term monitoring to more accurately determine population size and trend, as this species may qualify for an Endangered listing. More accurate estimates of population size may also qualify the species as Vulnerable C1 under if the mature population size is shown to be under 10,000 mature individuals. Temminck’s Ground Pangolin should thus be reassessed as new data become available.

Additionally, as recent field surveys have extended the extent of occurrence significantly westwards the previous national Red List status should be revised accordingly as, due to the emerging threat of illicit international trade, this is a genuine and recent change since the previous assessment. Key interventions include electric fence modification to prevent electrocution, the removal of fences through conservancy formation, increased law enforcement and capacity building, and the development

Regional Red List status (2016)	Vulnerable A4cd*†‡
National Red List status (2004)	Vulnerable C1
Reasons for change	No change
Global Red List status (2014)	Vulnerable A4d
TOPS listing (NEMBA) (2007)	Vulnerable
CITES listing (2000)	Appendix II
Endemic	No

*Watch-list Data †Watch-list Threat ‡Conservation Dependent

While throughout the rest of Africa, and increasingly within the assessment region, local and international illegal trade for bushmeat and traditional medicine is the primary threat to this charismatic species, electrified fences currently pose the greatest threat within southern Africa (Pietersen et al. 2014a).

Taxonomy

Smutsia temminckii (Smuts 1832)

ANIMALIA - CHORDATA - MAMMALIA - PHOLIDOTA - MANIDAE - *Smutsia* - *temminckii*

Synonym: *Manis temminckii* (Smuts 1832)

Common names: Temminck’s Ground Pangolin, Cape Pangolin, Ground Pangolin, Scaly Anteater, South African Pangolin, Steppe Pangolin (English), Ietermagôg, Ystermagôg (Afrikaans), Inkhakha (Ndebele), Thagadu (Pedi), Shikwaru (Shangaan), Hambakubvu, Haka (Shona), Kgaga (Sotho, Tswana), Khwara (Venda), xiKhwarrhu (Tsonga), iMfinyezi (Zulu)

Taxonomic status: Species

Taxonomic notes: Included in *Manis* by most authors (with *Smutsia* usually considered a subgenus) and referred to *Phataginus* by Grubb et al. (1998), but here included in the genus *Smutsia*, along with the Giant Ground Pangolin (*S. gigantea*) following Gaudin et al. (2009). The preferred common name (as accepted by the

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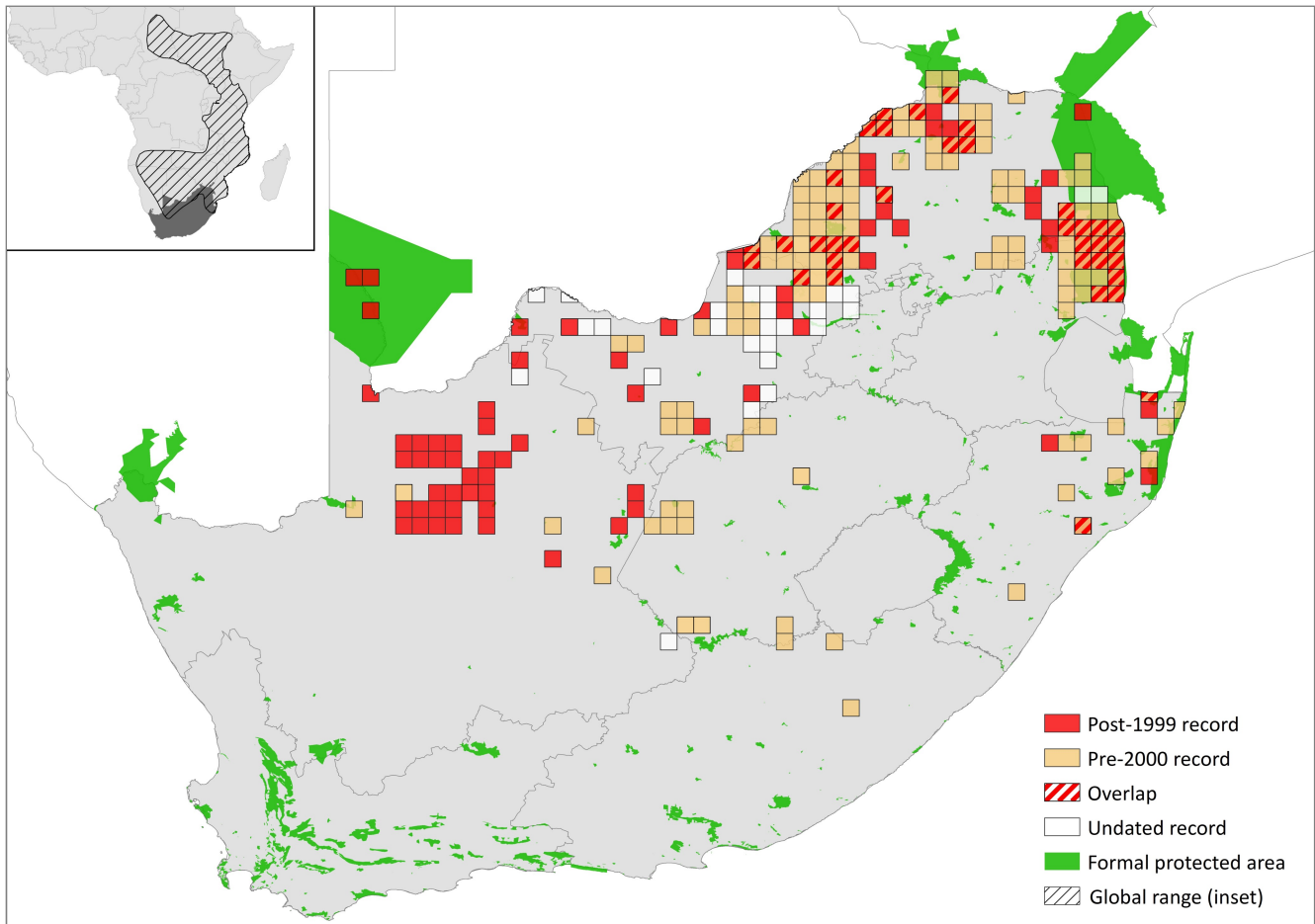


Figure 1. Distribution records for Temminck's Ground Pangolin (*Smutsia temminckii*) within the assessment region

Table 1. Countries of occurrence within southern Africa

Country	Presence	Origin
Botswana	Extant	Native
Lesotho	Absent	-
Mozambique	Extant	Native
Namibia	Extant	Native
South Africa	Extant	Native
Swaziland	Possibly extinct	Native
Zimbabwe	Extant	Native

of more stringent legislation regarding illegal trade. Awareness campaigns for end-user markets should also be trialled. This species requires active and immediate conservation interventions.

Regional population effects: Dispersal probably occurs across borders in both directions, based on mitochondrial DNA analysis (du Toit 2014), but it is not suspected to be enough to sustain or increase the local population. The regional population more likely acts as a source population for many of the neighbouring countries, especially as the majority of neighbouring populations are more greatly affected by both local and international trade due to more relaxed wildlife laws and generally lower levels of law enforcement. With the dramatic decline in the Asian pangolin populations and increased difficulties in securing pangolins in the Asian range states, trade will increasingly shift to Africa (as was observed in the increased illegal rhinoceros horn trade and suggested by

present pangolin trade data). Thus, although other southern African countries are bearing the brunt of this increased trade at present, it is believed that this illicit trade will increasingly affect the South African population as well. Based on the levels of exploitation and rate of population decline observed for the Asian pangolin species, which occur at similar densities to Temminck's Ground Pangolin, it is projected that this increased trade may rapidly lead to population reduction in the region.

Distribution

This species is the most widespread of the African pangolin species, occurring from the northern parts of South Africa, as far south as the Northern Cape, North West and north-east KwaZulu-Natal provinces, northwards through East Africa, reaching its northern limits in southern Sudan and Chad, although its northern limits are not well defined (Swart 2013).

Within the assessment region, it occurs in the Northern Cape, North West, Limpopo, Mpumalanga and KwaZulu-Natal provinces (Figure 1). They are thought to be locally extinct in the Free State Province where the last record is from 1985 (Lynch 1975, 1983). While they may still occur marginally in the western Free State Province, there are no recent records. However, the Free State Province is unlikely to have ever been a stronghold for this species, having possibly been restricted mainly to protrusions of Kalahari thornveld and shrub bushveld (Lynch 1983). Similarly, although sporadically reported until 1978 in the Eastern Cape Province, the species has historically been absent south of the Orange River (Lloyd & Millar 1983;

Lynch 1989), and such reports from the Eastern Cape Province may refer to misidentifications or confusion with the vernacular names of other myrmecophagous species, especially as many of these reports originate from questionnaire surveys. Further evidence of its absence from the Eastern Cape Province is that it was not recorded within traditional medicine markets in the region (Simelane & Kerley 1998). Overall, it is unlikely that Temminck's Ground Pangolin ever truly occurred in the Eastern Cape Province, and the Free State Province held low numbers historically. In KwaZulu-Natal Province, the population currently only occurs in the extreme north and appears to be very small (Figure 1). Historically, KwaZulu-Natal almost certainly had a larger population (Murray 2015), but it is believed that persecution for *muthi* and food, as well as animals being removed from the wild and presented to tribal chiefs and statesmen as gifts, and to a lesser extent habitat loss, has almost eradicated the species (Ngwenya 2001; Pietersen et al. 2014a).

Although not shown to occur in the Northern Cape Province during the previous National Red List Assessment (Friedmann & Daly 2004), there are previous records of this species from the Northern Cape Province dating as far back as 1912, with additional records between 1973 and 1978 (WESSA 1978; Stuart 1980). These records suggest that this species always occurred in the Northern Cape Province and that the recent records from this province do not indicate a range expansion. It may also occur further west in the Northern Cape Province than currently recorded (Figure 1), but more accurate data and further field studies are required. For example, there is a recent sight record between 2000 and 2010 from Goegap Nature Reserve near Springbok in the extreme west of the Northern Cape Province, which has been excluded from the map as its validity requires further investigation. A second record from Yzterfontein in the Western Cape Province has also been excluded from the map as it undoubtedly represents a human-assisted "dispersal" event. It has never been recorded from Lesotho (Lynch 1994), and may possibly be regionally extinct in Swaziland (Monadjem 1998, A. Monadjem pers. comm. 2014). However, individuals may sporadically disperse from neighbouring Mozambique. There are no known major barriers or discontinuities in its range.

The overall extent of occurrence (EOO) is approximately 599,670 km², with a medium to high confidence level. This calculation is based on the currently known distribution from records submitted to the African Pangolin Working Group (APWG) as well as field research. Distribution records were vetted based on past distribution and an intimate knowledge of both the habitat requirements of this species and the habitat characteristics in the reported areas. Most records submitted to the APWG were accompanied by photographs thus confirming the validity of these records, or were submitted by persons known to be familiar with this species. Old museum records and site records have largely been excluded, as this species is no longer known from many of these areas. Likewise, any questionable records have been removed. The total current EOO, using only current (post-2000) records, is 291,771 km². The EOO has thus been reduced by an estimated 48% over the past 30 years (1985 to 2015), or approximately three generations (27 years). However, if we assume that the Free State and Eastern Cape records represented the fringe of its distribution, or historical anomalies, rather than viable subpopulations, and thus assess areas outside of these provinces, the EOO has decreased by approximately 9% since 1980.

Calculating the area of occupancy (AOO) is more difficult. No specific data are available to estimate the true occupancy rates of Temminck's Ground Pangolins in the region and thus AOO calculations are based on sightings data, taking into account the habitat requirements of the species. While most land-uses (including formally protected areas, game farms and livestock ranches) within the remaining EOO are habitable for pangolins, the effects of illegal hunting and electric fences may have significantly reduced occupancy. However, occupancy in KwaZulu-Natal Province is suspected to be far lower than the rest of the current EOO due to historical overexploitation for traditional medicine; and thus we assumed occupancy in this province to be 20% (Kyle 2000), while the rest of the EOO was assumed to have an occupancy of 75% based on anecdotal information of habitat requirements and proportion of available habitat. This yields an estimate AOO of 200,846 km². If a more conservative occupancy rate of 50% is used for the rest of South Africa, the AOO is calculated as 136,077 km². Finally, if all regions of the current EOO have low occupancy (20%) due to intensifying threats, the AOO could be as low as 58,354 km². The AOO can also be estimated by calculating the amount of remaining natural habitat in vegetation types within the EOO, which yields 391,168 km² (F. Daniels unpubl. data). Future studies should, however, combine ecological niche modelling with remaining areas of natural habitat to estimate AOO more accurately. However, this is certainly an overestimate given that pangolins will not occupy all patches of natural habitat and further studies are needed to estimate AOO more accurately.

Population

This species is widely distributed, although now largely confined to protected areas and well-managed livestock and wildlife farms. Given their predominantly nocturnal and secretive nature, their abundance is probably underestimated. For example, in Kruger National Park, there were only 73 reported sightings over a period of 20 years (Swart 2013). However, greater awareness and citizen science sightings platforms have resulted in an increase in the number of pangolin sightings being reported in recent years. The total density in the Kruger National Park region has been estimated at 24 individuals / 100 km² and 12 reproductively active individuals / 100 km², while total density in western Zimbabwe has been estimated at 11 individuals / 100 km² (Swart 2013; Pietersen et al. 2014b). However, a more recent study on the Kalahari Oryx Game Farm, Northern Cape Province, estimated breeding density as 16 individuals / 100 km² and total density as 23–31 individuals / 100 km², suggesting pangolin densities may be higher in the Kalahari than they are in eastern South Africa and Zimbabwe (Pietersen et al. 2014b). The number of mature individuals is thus estimated to be half the total population (Pietersen 2013; Pietersen et al. 2014b). Using a mature individual density of 6–12 individuals / 100 km² and the AOO estimates described above, we estimate the total mature population size to range between 7,002 and 32,135 individuals, with a most likely estimate of 16,329–24,102 individuals.

The population is inferred and suspected to be declining, primarily due to increasing illicit local and international trade. The prevalence of this species in urban traditional medicine markets (Whiting et al. 2011), and the high numbers observed in the rural traditional medicine trade in

north-eastern and eastern South Africa (A. Baiyewu unpubl. data) provide empirical evidence that the species is declining in north-eastern and eastern South Africa, especially outside of conservation areas. It is thought that the subpopulation in KwaZulu-Natal Province is unviable and almost regionally extinct due to the traditional medicine and bushmeat trade (Ngwenya 2001; Pietersen et al. 2014a). The international trade of individuals collected from southern Africa has increased significantly in recent years (Challender & Hywood 2012), where local authorities in southern Africa are confiscating greater numbers of Temminck's Ground Pangolin contraband (two individuals in 2000 compared to 40 in 2013). This prompted the uplisting of the species globally to Vulnerable A4d (Pietersen et al. 2014c). While South Africa remains relatively secure (with Zimbabwe and Namibia suffering the greatest losses), we suspect poachers will increasingly target South Africa in the future. Generation length has been calculated as nine years by Pietersen et al. (2014a), as currently accepted by the IUCN SSC Pangolin Specialist Group, and five years by Pacifici et al. (2013). Future research should focus on quantifying rates of illegal harvest within the assessment region and calculating the rate of decline over three generations.

Females become reproductively mature in their second year but are most likely to first reproduce when three or four years old (D. Pietersen unpubl. data). It is believed that males reproduce for the first time when they are 6–7 years old, although they probably reach sexual maturity before this (D. Pietersen unpubl. data). The female appears to give birth after a gestation period of 105–140 days. Field observations suggest that females may only produce a single young every second year. The pup starts riding on the mother's tail when about one month old, and becomes independent at 3–4 months (Swart 2013; D. Pietersen unpubl. data). Pups probably suffer a high mortality rate initially due to starvation and hypothermia (Pietersen 2013). Additionally, young animals (up to c. 1–2 years old) would fall prey to a variety of predators as their scales are still comparatively soft and their smaller size makes them easier to fit into a predator's mouth. Young, dispersing individuals are also more likely to come into contact with a greater number and variety of natural and anthropogenic threats, and thus suffer comparatively higher mortality rates (Pietersen et al. 2014a). Longevity estimates are largely based on data from captive individuals (Hoyt 1987), combined with some field data. There is a paucity of data on the longevity of any pangolin species in the wild, making estimates of generation length difficult. Based on available growth rates, the relative late onset of the start of reproduction, the slow reproductive rate (one young per year, and perhaps only every second year), and longevity of the sympatric Aardvark (*Orycteropus afer*), which has a similar ecology and life history, they are expected to be relatively long-lived, perhaps surviving for 20 years or more in the wild.

Current population trend: Decreasing

Continuing decline in mature individuals: Yes, inferred and suspected from harvesting for both domestic and international markets, and mortality on electric fences, which is considered severe.

Number of mature individuals in population: 7,002–32,135

Number of mature individuals in largest subpopulation: If we assume that Kruger National Park and Kgalagadi Transfrontier Park represent the largest subpopulations,



then largest potential mature subpopulation size ranges from 3,118 to 4,180 individuals.

Number of subpopulations: No subpopulations known. Molecular results from on-going studies suggest that there is still gene flow across the provinces in South Africa, as well as into neighbouring countries (du Toit 2014). The KwaZulu-Natal population is isolated when viewed solely at the South Africa scale. However, this population is probably still linked with the main population through eastern Swaziland and/or southern Mozambique.

Severely fragmented: No. Despite the high levels of electrocutions, pangolins are able to move through fences (including electrified game fences) by making use of pre-existing holes or other similar weak spots. Juveniles have also been shown to be capable of long-distance dispersal, up to 49 km from their place of birth (Pietersen et al. 2014b).

Habitats and Ecology

It is a predominantly solitary, terrestrial species that is present in various woodland and savannah habitats, preferring arid and mesic savannah and semi-arid environments at lower altitudes, often with thick undergrowth, where average annual rainfall ranges between 250 and 1,400 mm (Skinner & Chimimba 2005). They also occur in floodplain grassland, rocky slopes and sandveld up to 1,700 m (Coulson 1989; Pietersen 2013), but are absent from Karroid regions, tropical and coastal forests, Highveld grassland and coastal regions. The range is believed to largely be determined by the presence and abundance of ant and termite prey species and the availability of dens or above-ground debris in which to shelter. It occupies well-managed livestock and wildlife farms, but is absent from areas under crop farming, and occupies a wide range of soil types from heavy clay soils through alluvium to Kalahari sands (Pietersen 2013).

This species is predominantly nocturnal with individuals spending the day in suitable earthen burrows, caves or in piles of plant debris, with Aardvark burrows being the most frequently used refuges (Pietersen et al. 2014b). Young animals are more diurnal than adults, and all age classes are more diurnal in the Kalahari during winter, while also becoming active earlier in eastern South Africa in winter. Pangolins are bipedal, walking on their hind legs with the front limbs and tail held off the ground and acting as a counterweight. However when they climb steep

terrain (such as steep sand dunes) or when clambering over boulders in rocky terrain, they will use all four limbs and may additionally use their tails to push themselves up or as a support when clambering down steep surfaces. They are entirely myrmecophilous and only eat a small number of specific ant and termite genera (Jacobsen et al. 1991; Swart 1996; Richer et al. 1997; Swart et al. 1999; Pietersen et al. 2016). They are largely water independent but will drink from free-standing water when it is available (Stuart 1980; D. Pietersen pers. obs. 2013). Young start dispersing when about one year old (Pietersen et al. 2014b). In the Kalahari, home ranges of adults averaged $6.5 \pm 5.9 \text{ km}^2$, while juveniles had average home ranges of $6.1 \pm 4.0 \text{ km}^2$ (Pietersen et al. 2014b).

Ecosystem and cultural services: Pangolins feed exclusively on ants and termites and are thus important predators of these invertebrate taxa. A single pangolin literally consumes millions, if not billions, of ants and termites each year. They are highly prized by the Zulu people in South Africa and the species is considered the greatest gift you can bestow upon a tribal elder or chief. Body parts are used to treat and cure a number of ailments and are still regularly prescribed and highly sought after within rural South African tribal communities by traditional healers (Bräutigam et al. 1994; A. Baiyewu unpubl. data).

Use and Trade

Temminck's Ground Pangolin is used at the local, national and international level for food, medicine and traditional ceremonies. The scales are used at local and international levels for ornaments and talismans (Kyle 2000; Manwa & Ndamba 2011). In Tanzania, Temminck's Ground Pangolins are sometimes referred to as *Bwana mganga* ("the doctor") because every body part is believed to have some medicinal value (Wright 1954). The Zulu believe that seeing a pangolin indicates that there will be a drought, and the only way to prevent the drought is by killing the animal (Kyle 2000). Numbers are difficult to estimate, but populations are believed to have drastically declined in North West and KwaZulu-Natal provinces (Kyle 2000; Ngwenya 2001; APWG unpubl. data). Similarly, in Limpopo and Mpumalanga provinces, the population has decreased in areas where there are many local communities, such as Bushbuckridge, which supports the suspicion that the traditional medicine trade is impacting this species. These observations were also confirmed by on-going field observations by students working under the auspices of the APWG.

For example, traditional medicine traders in KwaZulu-Natal Province stated that pangolins were in "high

demand" (Ngwenya 2001), despite being sold at low frequencies, which perhaps suggests the animal is increasingly rare in the province.

Local trade levels are potentially increasing, and there has been a steady, significant increase in the number of Temminck's Ground Pangolins that have been confiscated and that were destined for either the local and/or international markets (Challender & Hywood 2012; Pietersen et al. 2014a; APWG unpubl. data). International trade is increasing across Africa, and is likely to affect the local subpopulation in the near-future. There have been at least 79 confiscations in southern Africa between 2010 and 2013, with the annual number of confiscations displaying an exponential increase (Pietersen et al. 2014a). Increasingly, the nature and circumstances surrounding seizures suggest links to intercontinental trade rather than to local use (Challender & Hywood 2012). For instance, a pangolin seized in Zimbabwe in May 2012 had had most of its scales removed, which deviates from the local practice of *muthi*, where the animal is kept alive and its scales removed as and when needed for medicinal purposes. In the past few years, the value of a Temminck's Ground Pangolin in Zimbabwe has increased from USD 5,000 to USD 7,000 (Challender & Hywood 2012).

Threats

Although present in a number of protected areas within the assessment region, including Greater Limpopo Transfrontier Park and Kgalagadi Transfrontier Park, and protected by national law, numbers are declining primarily due to electrocutions on game and livestock fences and illegal harvesting for medicinal and bushmeat purposes (Bräutigam et al. 1994; Swart 2013; Pietersen et al. 2014a).

1. **Electrified fences** probably pose the largest risk, with recorded mortality rates of between 3–9 individuals / 100 km of electrified fence / year (Beck 2008; Pietersen et al. 2014a). There are an estimated 90,000 km of game fences in South Africa (Beck 2008). Temminck's Ground Pangolins occur across 21% of South Africa (excluding the KwaZulu-Natal population). Assuming that game fences are equally distributed across South Africa, there are an estimated 19,033 km of game fences overlapping the distribution of this species in South Africa. Assuming that 60% of these fences are electrified, there are an estimated 11,420 km of electrified fences in South Africa posing a direct threat to Temminck's Ground Pangolins (Pietersen et al. 2014a). Based on these figures, an estimated 377–1,028 individuals are

Table 2. Use and trade summary for the Temminck's Ground Pangolin (*Smutsia temminckii*)

Category	Applicable?	Rationale	Proportion of total harvest	Trend
Subsistence use	Yes	Bushmeat and traditional medicine.	Minority	Increasing
Commercial use	Yes	Domestic and international trade.	Majority	Increasing
Harvest from wild population	Yes	Pangolins cannot be maintained or successfully bred in captivity at present.	All	Increasing
Harvest from ranches population	No	-	-	-
Harvest from captive population	No	-	-	-

electrocuted annually, which corresponds to 2–13% of the population. The above electric fence estimate does not take into account electrified livestock fences, despite there being an increasing tendency for livestock farmers to place electrified strands on their livestock fences to control the movements of livestock predators (Beck 2008; Pietersen et al. 2014a). Thus the actual levels of mortality are likely to be higher than this.

2. **Overexploitation of the species** for the local traditional medicine (*muthi*) and bushmeat trade is known to be occurring in South Africa, where, worryingly, harvesting is increasingly focused in core conservation areas (Cunningham & Zondi 1991; A. Baiyewu unpubl. data), possibly correlating with rural settlement expansion (Wittemyer et al. 2008). Harvesting rates have not been quantified but current research suggests that the traditional use of this species is high and carcasses are regularly found in urban *muthi* markets (Whiting et al. 2011) and in rural communities (A. Baiyewu unpubl. data).
3. **There is a growing demand for African pangolins in the Asian markets**, which is resulting in an increased poaching rate in Africa (Challender & Hywood 2012; Pietersen et al. 2014a), and there has been a sharp increase in the number of Temminck's Ground Pangolins that have been confiscated in southern Africa, including South Africa, since 2010 (Pietersen et al. 2014a). Although the final market for these individuals is largely unknown, many were confiscated in ports and high-end suburbs, suggesting that at least some of these individuals were likely destined for international markets or for local consumption by foreigners. Corroborating this, a number of seizures of African pangolins or their body parts in Asia (or *en route* to Asia) provide evidence of an intercontinental trade in African pangolins to Asia (Challender & Hywood 2012; Challender, et al. 2014) and Europe (Chaber et al. 2010). The demand for, and price of, pangolin products in Asia is increasing, while the supply from the Asian species is decreasing. As syndicates smuggling pangolins (and rhino horn/ivory) from Africa to Asia become ever more sophisticated it is highly probable that African pangolin species will become more important as source populations for the Asian markets. Moreover, the average number of Asian pangolins that have been confiscated in recent years are of great concern, as these species occur at comparable population densities as Temminck's Ground Pangolin (IUCN SSC Pangolin Specialist Group unpubl. data). These data indicate that smuggling syndicates would likewise be able to obtain large numbers of Temminck's Ground Pangolin when international trade picks up, as is predicted following the collapse of many of the Asian pangolin populations. This is poised to become a substantial threat within the next few years based on current and projected levels of trade.

Minor threats to this species within the assessment region are:

1. **Road mortalities.** During a 4-year study, seven road mortalities were recorded along an approximately 50 km stretch of the N14 highway in the Northern Cape Province and at least a further four mortalities were recorded on this same stretch of road in the preceding five years (Pietersen 2013; Pietersen et al. 2014a). Extrapolating this along an estimated



Photo 1. Temminck's Ground Pangolin (*Smutsia temminckii*) entangled in an electric fence line (D. Pietersen)



Photo 2. Temminck's Ground Pangolins (*Smutsia temminckii*) are widely used for bushmeat (African Pangolin Working Group)

8,065 km of roads across its range, there are an estimated 280 pangolin deaths on roads per year. The exact extent of this threat is difficult to quantify due to persons removing carcasses from roads for *muthi* and bushmeat, and for the novelty factor (for example, having animals stuffed for display). The severity level is believed to be relatively low at present, but this should be monitored.

2. **Gin traps.** This threat is probably restricted to areas where farming with small livestock and pangolin distributions overlap (Pietersen et al. 2014a). Temminck's Ground Pangolins are accidentally caught in these traps, but if found in time can usually be released unharmed. Due to these traps being checked infrequently, a large proportion of the animals caught die of exposure, while others are severely injured and die as a result of their injuries or have to be euthanized. Owing to the limited extent of this threat, the overall severity is believed to be low at present.
3. **The pet trade.** Two reports were received of persons buying Temminck's Ground Pangolins as pets (Pietersen et al. 2014a). This species does not do well in captivity, and all individuals in the "pet" trade are likely to die due to their highly specialised diet (Van Ee 1978; Hoyt 1987; Heath & Coulson 1997; Yang et al. 2007).

Table 3. Threats to the Temminck's Ground Pangolin (*Smutsia temminckii*) ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	2.3.2 <i>Small-holder Grazing, Ranching or Farming</i> . Current stress 2.1 <i>Ecosystem Degradation</i> : electrocutions on game fences.	Beck 2008	Empirical	Local	Possibly increasing with the expansion of wildlife breeding/ranching and the increasing tendency for livestock farmers to electrify their fences.
		Pietersen et al. 2014a	Empirical	Local	
2	5.1.1 <i>Hunting & Collecting Terrestrial Animals</i> : illegal poaching for bushmeat and traditional medicine, at both subsistence and commercial scales.	Cunningham & Zondi 1991	Empirical	Local	Increasing (especially the illegal international trade) through increased demand in Asian countries coupled with collapse of Asian pangolin species.
		Whiting et al. 2011	Empirical	Local	
		Challender & Hywood 2012	Empirical	Regional	
		Pietersen et al. 2014a	Empirical	Regional	
3	4.1 <i>Roads & Railroads</i> : mortalities from road collisions.	Pietersen et al. 2014a	Empirical	Local	Estimated 280 Pangolin deaths on roads per year; increasing with road construction.
4	5.1.2 <i>Hunting & Collecting Terrestrial Animals</i> : accidental mortalities from gin traps.	Pietersen et al. 2014a	Empirical	Local	Possibly increasing with rural settlement expansion.
5	1.1 <i>Housing & Urban Areas</i> . Current stress 2.1 <i>Species Mortality</i> : settlement expansion leading to increased harvesting rates.	GeoTerralimage 2015	Indirect	National	Rural settlement expansion increased by 1–9% between 2000 and 2013.
6	2.1 <i>Annual & Perennial Non-Timber Crops</i> : habitat loss from crop agricultural expansion.	Jewitt et al. 2015	Indirect	Regional	Increasing: 7.6% loss of natural habitat in KZN from 2005 to 2011 due mainly to agriculture.

While poisoning was previously viewed as a threat (Heath 1992; Friedmann & Daly 2004), a comprehensive review of the literature suggests that it is not (Pietersen et al. 2014a). The notion that poisoning poses a threat stems from two successive pairs of Temminck's Ground Pangolins that died in the Bloemfontein Zoo in the 1970s after their enclosures were disinfected (Van Ee 1996, 1978). It is believed that these were extraordinary *ex situ* circumstances that are not likely to occur in nature. Furthermore the high pangolin population densities in the Northern Cape Province, where insecticides are regularly sprayed to control locust outbreaks, further reinforce the notion that poisoning is not a tangible threat (Pietersen et al. 2014a).

Current habitat trend: Habitat loss has played a relatively minor role in recent times as savannah habitats have not undergone significant reduction (Driver et al. 2012). This species does not occur in extensive crop agriculture or urban areas, but are seen frequently on many livestock farms and wildlife farms. Such land-uses may both form dispersing corridors between nature reserves, allowing gene flow to continue, and grant better protection from poaching. However, wildlife farms and livestock ranches are also likely to pose a threat through the erection of new electrified fences. Further research to assess the net effect of such land-uses is needed.

While habitat loss from crop agriculture expansion will pose a minor threat to this species (for example, in KwaZulu-Natal Province; Jewitt et al. 2015), human settlement expansion will arguably be more threatening as it may increase rates of illegal harvesting. In all provinces where the species currently exists, rural settlement

expansion increased by 1–9% between 2000 and 2013 (GeoTerralimage 2015), most worryingly having increased the most in the Northern Cape Province, which is suspected to be the region with the highest density of pangolins.

Conservation

Although pangolins have been locally exterminated in some areas, they occur in many national parks and other protected areas. However, the following conservation interventions are desperately needed to prevent the species from becoming increasingly threatened:

1. The exact magnitude of fence electrocutions should be quantified, and interventions to reduce or prevent these electrocutions should be urgently sought. A new 14.2 km-long internal fence was erected on a private game farm in the Kalahari and, in an attempt to reduce electrocutions, was fitted with a three-strand tripwire (rather than the standard single- or double-strand tripwire). The total height of the tripwire array remained the same, but an additional live strand was added to the configuration, which now has a live-earth-live configuration. In the 30 months since its erection, only a single Temminck's Ground Pangolin has been electrocuted on this fence, a mortality rate of 0.03 individual / km / year. This is substantially lower than the rate of 0.09 individual / km / year recorded for an established electrified fence at the same site (Pietersen et al. 2014a). Considering that newly erected fences often exhibit disproportionately high mortality rates, the data may suggest that this

configuration is effective in reducing electrocutions. However, further research is required. Additional methods to reduce or prevent electrocutions should also be sought and tested (described in Pietersen 2013).

2. Conservancy formation should be incentivised to reduce the need for internal electric fences (*sensu* Lindsey et al. 2009).
3. Law enforcement authorities should be trained as to the status of this species and be made aware of the penalties that can be imposed on persons contravening the relevant laws. Training should include both courses on identifying pangolin products and court case studies with South African Police Service officials, State Prosecutors and Magistrates. The number of pangolins being harvested should be quantified and monitored, as these trade levels are having an unknown impact on the total population. This species should be uplisted to CITES Appendix I to curb the escalating illicit international trade.
4. Efforts should also be made to educate the end-user markets about the impacts of consuming pangolin products on the population of this species.
5. Reintroduction of rehabilitated or rescued pangolins show mixed success. Jacobsen et al. (1991) reported that both released individuals died within 10 days of

release, possibly due to stress, whereas Heath and Coulson (1997) describe the successful relocation of a young male retrieved from a poacher (indicated by its successful establishment of a home range).

Ongoing rehabilitation activities in Zimbabwe have, however, been extremely successful, with a nearly 100% survival rate of rehabilitated pangolins that were released back into the wild (Tikki Hywood Trust unpubl. data). Further research and monitoring of reintroduction and relocation techniques is needed.

Recommendations for land managers and practitioners:

- The distribution of this species is continuously being monitored through ongoing field research and citizen-science-based monitoring protocols. Such data collection should continue.
- DNA forensics should be used to help monitor and trace individuals collected for wildlife trafficking, as has been done for the Sunda Pangolin (*Manis javanica*) (Zhang et al. 2015). The National Zoological Gardens is the forensic laboratory for African pangolins.
- No captive-breeding or other *ex situ* management practices are required at present, nor is it likely to be a viable avenue in the foreseeable future. This species' specialised diet and high mortality rate in

Table 4. Conservation interventions for the Temminck's Ground Pangolin (*Smutsia temminckii*) ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	2.1 Site/Area Management: modify electric fences with 3-strand trip wires.	Pietersen et al. 2014a	Empirical	Local	Mortality rate reduced by 69%.	Tswalu Kalahari Reserve fence modifications; African Pangolin Working Group
2	1.2 Resource & Habitat Protection: incentivise internal fence dismantlement through conservancy formation.	-	Anecdotal	-	-	-
3	4.2 Training: formal training for border control officials to identify and detect pangolin products being smuggled across international borders and enforce the relevant laws.	-	Anecdotal	-	-	African Pangolin Working Group
4	5.1.1 Legislation: uplist <i>S. temminckii</i> to Appendix 1 on CITES.	-	Anecdotal	-	-	Various national and international NGOs and National CITES authorities.
5	4.3 Awareness & Communications: educating end-user markets about the damage caused by pangolin consumption.	-	Anecdotal	-	-	African Pangolin Working Group
6	3.3 Species Reintroduction: reintroduce and relocate rescued or rehabilitated individuals into suitable areas to augment or establish subpopulations.	Jacobsen et al. 1991 Heath & Coulson 1997	Empirical Empirical	Local Local	Both individuals died within 10 days. One rescued male successfully established a home range. Two females showed mixed results.	Tikki Hywood Trust, Zimbabwe; African Pangolin Working Group

captivity precludes any large-scale *ex-situ* conservation programme at present.

- Alternative fence designs that maintain their effectiveness but reduce pangolin mortalities should be developed and trialled, such as the ongoing project at Tswalu Kalahari Reserve (D. MacFadyen unpubl. data).
- A global action plan for all pangolin species has recently been developed by the IUCN SSC Pangolin Specialist Group (Challender et al. 2014), which should be incorporated into a regional Biodiversity Management Plan.

Research priorities: Projects should be initiated to investigate current population densities, distribution range and rate of population decline through anthropogenic influences. These should be coupled with research into the scale of intercontinental trade in this species. Specifically:

- The area of occupancy needs to be more accurately measured by further field surveys and ecological niche models. This, combined with further estimates of density across its range, will enable more accurate calculations of population size as a baseline for quantifying population trend.
- Quantifying and determining the scale and impact of harvesting pressure from international and local trades, and relating this to its impact on the population, is a priority.
- Determining the rehabilitation success of confiscated pangolins.
- Similarly, the number of pangolins killed on electrified fences each year needs to be quantified more accurately across its range, and the effectiveness of interventions that can be applied in modifying existing electric fence structure should be tested.
- The relative impacts posed by road mortalities and accidental bycatch in gin-traps should also be investigated.
- Once these data are generated, a population viability analysis should be performed.
- Some of the reserves in northern KwaZulu-Natal should be investigated as to their suitability for future reintroductions. Many of these reserves appear to have remnant subpopulations, but these appear to be of such small scale that they are not ecologically viable. Future studies should assess the viability of reintroducing confiscated pangolins into these populations to stabilise and bolster the existing subpopulations.

Data Sources and Quality

Table 5. Information and interpretation qualifiers for the Temminck's Ground Pangolin (*Smutsia temminckii*) assessment

Data sources	Field study (literature), indirect information (literature)
Data quality (max)	Inferred
Data quality (min)	Suspected
Uncertainty resolution	Minimum / maximum values
Risk tolerance	Precautionary

Encouraged citizen actions:

- Members of the public can assist with monitoring the distribution and relative abundance of Temminck's Ground Pangolin by submitting their sightings via the portal on the African Pangolin Working Group's website at <http://pangolin.org.za/index.php/report-a-sighting/>. They can also report any cases or suspected cases of pangolins being offered for sale.
- Citizens with game farms should use the modified electric fence design outlined above, and could also report the numbers of Temminck's Ground Pangolins that are annually electrocuted on their farms to assist with quantifying this threat.
- Citizens should not buy any pangolin products or attempt to keep pangolins as pets.

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Details of the methods used to make this assessment can be found in *Mammal Red List 2016: Introduction and Methodology*.

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