Dendrohyrax arboreus – Southern Tree Hyrax


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Regional Red List status (2016)	**Endangered B2ab (ii,iii,iv,v)+C2a(i)*†**
National Red List status (2004)	Vulnerable B1ab(iii) +2ab(iii)+C1
Reasons for change	Non-genuine: New information
Global Red List status (2015)	Least Concern
TOPS listing (NEMBA)	None
CITES listing	None
Endemic	No

*Watch-list Data †Conservation Dependent

Reducing human disturbance (den-tree removal, poaching, burning) to forest patches is a key intervention as it will indirectly decrease isolation between patches and improve metapopulation connectivity and resilience (Lawes et al. 2000).

Taxonomy

Dendrohyrax arboreus (Smith 1827)

ANIMALIA - CHORDATA - MAMMALIA - HYRACOIDEA - PROCAVIIDAE - *Dendrohyrax* - *arboreus*

Synonyms: *Hyrax arboreus* (Smith 1827)

Common names: Southern Tree Hyrax, Eastern Tree Dassie (English), Boomdassie, Boomdas (Afrikaans), Umqha (isiZulu), Imbila ye ma Hlatsi (siSwati)

Taxonomic status: Species

Taxonomic notes: There are eight subspecies listed, of which only one, *D. a. arboreus*, occurs in the assessment region (Bothma 1971). This subspecies is endemic to South Africa.

Assessment Rationale

This arboreal species is restricted to well-developed and intact forests within the Eastern Cape and KwaZulu-Natal provinces of South Africa. The estimated extent of occurrence (EOO) is 49,232 km^2 and the area of occupancy (AOO), using all suitable forest patches within the EOO, is estimated to be a maximum of 1,482 km^2. However, patch occupancy is suspected to be significantly lower, since Southern Tree Hyraxes require specific den-tree species. Recent surveys (2013–2015) reveal that many ostensibly suitable patches are unoccupied, possibly due to encroaching human pressures (for example, disturbance) and habitat degradation (see below). Using only forest patches within currently occupied (post-2000) grid cells yields a minimum AOO estimate of 503 km^2.

Although many forests are well protected, there is an inferred continuing decline in the population from forest patch loss and forest quality degradation, especially along the coast, through agricultural and human settlement expansion. For example, there was a 19.7% loss of natural habitat in KwaZulu-Natal from 1994 to 2011 due to agriculture, timber plantations, settlement expansion and mining (with an average loss of 1.2% per year), with the losses mainly occurring in small (< 0.5 ha) forest patches. There has also been an estimated 7% loss of natural vegetation in the Indian Ocean Coastal Belt Biome over the past 16 years (three generations), which may impact its ability to adapt to climate change as suitable forest patches shrink and become isolated further. Additionally, from 2000–2013, there has been a 5.6% and 6.3% rate of urban expansion in KwaZulu-Natal and the Eastern Cape, respectively, which will increase the frequency of secondary threats such as tree harvesting and poaching, and thus lead to ongoing habitat degradation. As Southern Tree Hyraxes rely on relatively few tree species for nesting and food, the selective removal of such favoured species could disproportionately impact the population.

This is a low-density, selective species and thus extrapolating known density estimates across the entire forest patch can overestimate population size. However, based on estimated densities in four forest patches (3–7 individuals / km^2), mature population size ranges from 750 (confirmed occupied patches at 50% mature structure) to 7,573 (assuming all forest patches occupied at 73% mature structure) with a most likely estimate of 1,094–1,761 individuals. As most forest patches are fragmented, with limited Southern Tree Hyrax dispersal between them, isolated patches are construed as subpopulations with the largest patch/subpopulation estimated to contain 136–465 mature individuals. Due to their restricted and fragmented AOO (recently confirmed occupancy ≤ 500 km^2), inferred continuing decline, small population size and possible ongoing loss of mature individuals, we list this species Endangered B2ab(ii,iii,iv,v) +C2a(i). Current occupancy and density estimates are needed to assess whether Vulnerable is a more appropriate listing. Key interventions for this species to prevent further loss or degradation of forest patches include protected area expansion to connect remaining forest patches, metapopulation management, education and awareness in local communities, and harvest

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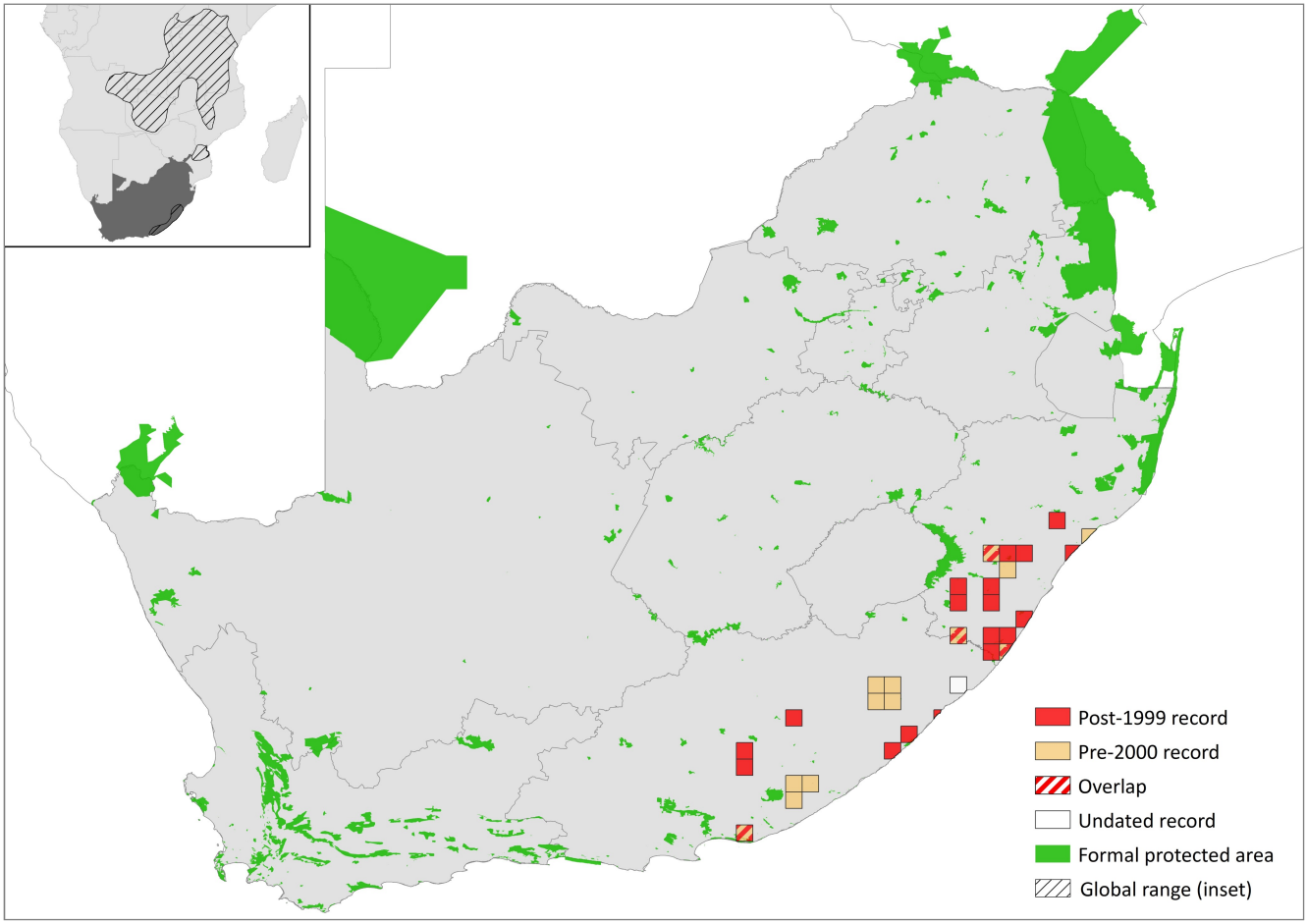

Figure 1. Distribution records for Southern Tree Hyrax (*Dendrohyrax arboreus*) within the assessment region

Table 1. Countries of occurrence within southern Africa

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

regulation of critical den-tree species needed by this species. As we have no baseline data from which to compare population trends, we cannot determine whether this is a genuine change and thus assume a non-genuine change based on new information and analyses. We urge further monitoring and surveys to confirm current patch occupancy, density and population trends. This species should be reassessed once these data are available.

Regional population effects: There is a disjunct distribution between the South African population and the rest of its range and, because of the isolation from populations elsewhere, no rescue effects in case of local extinctions are possible. Even within South Africa, the patches of forest within which they still occur are not contiguous, and they cannot disperse far without a forest corridor.

Distribution

They are dependent on well-developed woodland or forest, and the clearing of such areas for agriculture has led to a major range reduction (Skinner & Chimimba 2005). As such, they are patchily distributed in east, central and southern Africa, and have not been recorded from Namibia, Botswana, Zimbabwe or the Limpopo Province of South Africa (Skinner & Chimimba 2005; Milner & Gaylard 2013). Confined and isolated subpopulations are located south of the Zambezi River, Mozambique, and in the Eastern Cape and KwaZulu-Natal provinces of South Africa (Jennings & Jennings 1993; Milner & Gaylard 2013). The subspecies *D. a. arboreus* is thus endemic to South Africa (Figure 1).

Within the assessment region, they occur in the forests and (marginally) thickets along the coasts of the Eastern Cape and KwaZulu-Natal, with the south-western range limit being the coastal Alexandria Forest towards the Sundays River in the Eastern Cape. There is little known about its historical distribution but it was presumed to once occur more extensively before habitat loss. Remaining forest patches are heavily fragmented and it is suspected that there is little dispersal between patches. They can colonise suitable patches only up to a maximum of 0.9 km away from the "mainland" patch, and the probability of patch occupancy is zero for distances between patches in excess of 1.5 km (Lawes et al. 2000). Furthermore, experimental data confirm that Southern Tree Hyraxes can only exist in intact forests, with density dropping off in lightly disturbed forests and completely absent from formerly logged forests with intense hunting pressure (Topp-Jorgensen et al. 2008). Corroborating this,

recent data from unsuccessful call backs and anecdotal reports from landowners who have stopped hearing Southern Tree Hyraxes in various forest patches in southern KwaZulu-Natal indicate absence of the species from forest patches previously thought to be occupied (Y. Ehlers-Smith unpubl. data). Blue Duikers (*Philantomba monticola*) and Southern Tree Hyraxes most often co-occur in forest patches (Lawes et al. 2000), and the presence of one may be an indicator of the other's presence.

Using both historical and recent records, we estimate the extent of occurrence to be 54,711 km^2. Within this, the area of occupancy (AOO) is estimated to be a maximum of 1,482 km^2 based on all remaining forest patches. Both mangrove forest patches and all forest patches smaller than the minimum estimated critical patch size for the species of 0.06 km^2 (below which local extinction is expected to occur) (Lawes et al. 2000) were excluded, leaving 1,163 km^2 (N = 678 patches). The minimum observed AOO, based only on forest patches in grid cells for which there are recent (post-2000) records, is estimated to be 503–572 km^2. The lower estimate is an estimate of currently remaining (2013) natural forest within these cells.

Population

Southern Tree Hyraxes spend long periods inactive in the high canopy or in tree holes, and so often escape notice. In southern Africa, relative density has been estimated by means of counts of latrines in cavity trees (Catch Per Unit Effort, Gaylard 1994): 0.07 ± 0.29 latrines / man hour searching were found in three forests within the Eastern Cape, which can be roughly translated as 0.07 ± 0.29 individual / ha, as single individuals generally use only one latrine. In undisturbed forests of the Udzungwa Mountains in Tanzania, latrine density was estimated at 2.6 latrines / ha (Topp-Jorgensen et al. 2008). Similarly, it was estimated that at least 20 individuals occurred in the Gxalingenwa Forest Reserve, KwaZulu-Natal, in 2003, based on the assumption that they do not call more than once every 2 minutes (I. Rushworth unpubl. data), which equates to 0.03 individual / ha based on forest size. However, we caution that these may even be overestimates, as patch size of the forest is not a good proxy for abundance. Rather, the habitat quality is an important predictor of abundance, where the density of key den-trees is critical (Gaylard 1994). Although more demographic research is needed, we estimate the mature population structure to be *c*. 50%, as they are mostly solitary and exist as one adult female and her young occupying a single shelter (Skinner & Chimimba 2005). The average litter size is two (Rudnai 1984), and thus a typical group may comprise solely two adults and two juveniles. Thus, maximum mature population size, based on all available forest patches, may range from 2,209–5,187 individuals. Minimum mature population size (using confirmed occupied patches) is estimated to be 750–1,760 individuals. The latter population size range is likely to be more realistic considering that many sites identified as suitable habitat in southern KwaZulu-Natal are not currently occupied (based on surveys from 2013-2016; Y. Ehlers-Smith unpubl. data). In East Africa (Rwanda), where they can be locally abundant, estimated density using mark-recapture is 13.4 individuals / ha (10.3 adults and 3.8 juveniles) in undisturbed montane forest (Milner & Harris 1999). Using a 73% mature population structure would lead to a mature population estimate for the assessment region of 1,094–7,573 individuals, with a most likely population size of 2,570 individuals. Further density estimates are needed for the assessment region to calculate population size more accurately. However, density estimates vary greatly depending on the method used. Topps-Jorgensen et al. (2008) suggest using plot counts of calling individuals at dusk to estimate density, as these counts seem to vary less than latrine counts and daytime calling.

Unfortunately, there are no other baseline data or more recent density estimates in the same areas from which to estimate direct populations trends. For example, although the population in KwaZulu-Natal, especially Karkloof forest and other Afromontane forest patches, was deemed to be secure (Friedmann & Daly 2004), these data were collected in 1995 (Lawes et al. 2000), and are thus outdated. Recent surveys are urgently needed to confirm Southern Tree Hyrax patch occupancy and population trends.

As their habitats are fragmented, with limited dispersal and gene flow between patches, we suspect that large individual forest patches may be construed as isolated subpopulations (Lawes et al. 2000). The generation length is estimated to be 5.6 years (Pacifici et al. 2013), which equates to a 16.7 year three generation period.

Current population trend: Decreasing, based on ongoing natural habitat loss, degradation and fragmentation.

Continuing decline in mature individuals: Possibly, due to loss of large nesting trees and potential bushmeat poaching in and around forests.

Number of mature individuals in population: 750–4,071, based on available density estimates and forest patches within the EOO.

Number of mature individuals in largest subpopulation: The largest forest patch within the EOO is 91 km^2, which equates to 136–465 mature individuals (using a 50–73% mature structure).

Number of subpopulations: 678 forest patches within the EOO, so the number of subpopulations will be fewer than this given dispersal capacities (can colonise patches ≤ 0.9 km away from larger patches). Spatial calculations will enable the determination of the number of subpopulations based on isolation distances (Lawes et al. 2000).

Severely fragmented: Yes. Forest patches fragmented, and the species has low dispersal capacity in the absence of forest corridors.

Habitats and Ecology

Tree Hyraxes occur in Afromontane, scarp and coastal forests of the KwaZulu-Natal and Eastern Cape provinces. At the western coastal limit, they occur in milkwood-dominated coastal forests between Alexandria and the Sundays River, as milkwoods (*Mimosops caffra* and *Sideroxylon inerme*) are ideal den and forage trees (Gaylard 1994). Throughout their range, they are dependent on tree cavities, epiphytes or dense matted forest vegetation for shelter during the day. Primarily, they need den trees – tree species that form cavities. For example, in the Pirie Forest, Eastern Cape, only *Schotia latifolia*, *Rhus chirindensis*, *Andrachne ovalis*, *Podocarpus falcatus*, *Strychnos decussata*, *Cordia caffra* and *Sideroxylon inerme* were used, and were also a preferred

Table 2. Use and trade summary for the Southern Tree Hyrax (*Dendrohyrax arboreus*)

Category	Applicable?	Rationale	Proportion of total harvest	Trend
Subsistence use	Yes	Bushmeat and traditional medicine.	All	Possibly increasing with settlement expansion.
Commercial use	No	-	-	-
Harvest from wild population	Yes	All harvested individuals are wild.	All	Possibly increasing as forests become more fragmented and prone to edge effects.
Harvest from ranched population	No	-	-	-
Harvest from captive population	No	-	-	-

food source (Gaylard 1994; Milner & Gaylard 2013). They also prefer trees with multiple cavity entrances (Gaylard & Kerley 2001). Latrines are located in the low fork of a tree or on the ground beside the trunk. Thus, a decrease in numbers in southern Africa has been attributed to loss of structure within habitat, rather habitat loss outright (Castley & Kerley 1993). They are selective browsers, and the species selected are not related to their abundance but may instead be correlated with predator avoidance and the energetics of an arboreal lifestyle (Gaylard & Kerley 1997). Unlike other hyrax species, they are predominantly solitary, with only one adult or an adult female and her young occupying a shelter. They are arboreal and nocturnal (Skinner & Chimimba 2005). The biology and life-history of the species is summarized by Milner and Gaylard (2013).

Ecosystem and cultural services: They are an important prey species for forest predators, such as Crowned Eagles (*Stephanoeatus cornatus*) (Boshoff et al. 1994). This species has the potential to become a flagship species of eastern forests for biodiversity stewardship programmes.

Use and Trade

Hunted (through snaring) for bushmeat, traditional medicine (“hyraceum" is used primarily for gastrointestinal complaints) and perhaps their pelts (for karosses). They are thought to have been extensively hunted in the former Transkei and Ciskei (Friedmann & Daly 2004).

Threats

The main threats to Southern Tree Hyraxes within the assessment region are habitat quality degradation and direct disturbance through tree removal. While elsewhere in Africa forest habitat loss continues to be the primary threat, forests in South Africa are well protected and current rates of absolute forest loss have been low since the 1990s (see below). However, the legacy of past forest loss through agricultural, industrial and residential expansion (Lawes et al. 2004) is that remaining forest patches are highly fragmented, making Southern Tree Hyraxes more susceptible to current ongoing threats. Many forest patches are also too small to maintain viable subpopulations (Lawes et al. 2000). Currently, ongoing habitat loss of natural vegetation (see below) in the matrix between forest patches is inferred to be increasing the frequency of both fuelwood harvesting and poaching.

Southern Tree Hyraxes rely on relatively few tree species for nesting and food, and thus the selective removal of these species (through either commercial controlled logging or informal harvesting) disproportionately impacts the population. For example, Gaylard and Kerley (1997) cautioned that, because most tree species utilised by the species occur at low densities, removal of stems for fuelwood could lead to a loss of key resource areas (both dens and forage areas) and thus inhibit population growth. The felling of mature Yellowwood (mostly *Podocarpus falcatus*) and other canopy trees may be particularly damaging (Gaylard & Kerley 2001). Mahogany trees (*Trichilia dregeana* and *T. emetica*) are important species on the south coast of KwaZulu-Natal because of an association with a wood-borer beetle that creates suitable cavities (Y. Ehlers-Smith pers. obs. 2015). In the Udzungwa Mountains of Tanzania, Tree Hyrax density decreased significantly from little disturbed (closed canopy; 17.3 ± 1.9 individuals / ha) to moderately disturbed forest areas (more open canopy; 11.7 ± 1.4 individuals / ha) and individuals were completely absent in heavily hunted and formerly logged areas (Topp-Jorgensen et al. 2008). The lack of arboreal pathways in open forest may increase vulnerability to hunting by snares or terrestrial predators, as they are forced to use the ground more frequently (Topp-Jorgensen et al. 2008). In Gxalingenwa Forest Reserve, KwaZulu-Natal, approximately 6,500 building poles and 1,500 tonnes of fuel wood are harvested annually (I. Rushworth unpubl. data 2003) from these forests, which is leading to over-exploitation of the medium-sized classes of tree. Large forest trees are also being burned out and felled for fuel and construction material. Model output, based on empirical data from the Karkloof forest region of KwaZulu-Natal, corroborates these findings and indicates that Southern Tree Hyraxes are sensitive to disturbances caused by wood removal and burning (Lawes et al. 2000): occupancy was greater in patches with low wood removal, but declined significantly with high wood removal (0.3% probability of occurrence in a 10 ha patch under high wood removal). Similarly, frequent burning of small forest patch edges significantly decreased their likelihood of occupancy by Southern Tree Hyraxes (0.08% probability of occurrence in a 10 ha patch under high levels of burning). Similar studies suggest that small-scale wood harvesting may not alter canopy structure and, as long as key den trees are not removed, this should not affect Southern Tree Hyraxes. For example, in a study assessing the impact of human utilisation of woodlands and sand forests in Maputaland, while utilisation decreased the average stem diameter of trees, the height structure of the forest remained largely the same (Gaugris & Van Rooyen 2010). A further study has concluded that such understorey harvesting at low levels of harvesting does

Table 3. Threats to the Southern Tree Hyrax (*Dendrohyrax arboreus*) 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	*2.1.2 Small-holder Farming* and *2.3.2 Small-holder Grazing, Ranching or Farming*: subsistence agricultural expansion leading to forest habitat loss and degradation. Current stress *1.3 Indirect Ecosystem Effects*: fragmentation and isolation of remaining forest patches with limited dispersal between.	Jewitt et al. 2015	Indirect (land cover change from remote sensing)	Regional	Increasing: 19.7% loss of natural habitat in KwaZulu-Natal Province from 1994-2011, with an average loss of 1.2% per year.
2	*1.1 Housing & Urban Areas*: forest habitat lost to residential and commercial development. Current stress *1.3 Indirect Ecosystem Effects*: fragmentation and isolation of remaining forest patches with limited dispersal between.	GeoTerraImage 2015	Indirect (land cover change from remote sensing)	Regional	Increasing: 5.6% and 1.1% rate of urban and rural expansion in KwaZulu-Natal Province from 2000-2013.
3	*5.3 Logging & Wood Harvesting*: small-scale harvesting of pole-size trees may lead to large canopy gaps and state shifts.	Gaylard 1994	Empirical	Local	Selective harvesting at the time was targeting den-tree species and was thus unsustainable for Tree Hyraxes.
		Lawes et al. 2000	Simulation	Regional	Increasing with settlement expansion: 0.3% probability of occurrence in a 10 ha patch under high wood removal.
		Louw 2010	Indirect	Local	Harvesting of 8 adjacent pole-size trees negatively affects forest dynamics.
4	*5.1 Hunting & Collecting Terrestrial Animals*: harvesting for bushmeat and traditional medicine.	-	Anecdotal	-	-
5	*7.1.1 Increase in Fire Frequency/Intensity*: burning around forest edges for livestock or tree removal alters forest structure.	Lawes et al. 2000	Simulation	Regional	Increasing with settlement expansion: 0.08% probability of occurrence in a 10 ha patch under high levels of burning.
6	*3.2 Mining & Quarrying*: informal sand mining altering forest structure.	-	Anecdotal	-	Increasing
7	*1.3 Tourism & Recreation Areas*: holiday homes along the coast. Current stress *2.1 Species Mortality*: predation by domestic pets.	-	Anecdotal	-	Increasing

not affect the regeneration of canopy species and will not detrimentally affect the overall species composition of scarp forest (Boudreau & Lawes 2005). Similarly, Louw (2010) found that, while creating small gaps from harvesting pole-sized trees will not affect forest dynamics and species composition, harvesting in excess of eight adjacent trees, and so creating larger gaps, will potentially lead to successional shifts and alternate states in the ecosystem. Thus, harvest management should be regulated accordingly.

Southern Tree Hyraxes did not exhibit a negative response to livestock disturbance or general disturbance (e.g. past logging activities) in the Karkloof forest complex (Lawes et al. 2000). This is in contrast with Friedmann and Daly (2004), who asserted overgrazing was a threat, and Topp-Jorgensen (2008), who found zero occupancy by Southern Tree Hyraxes in previously logged patches. However, other land uses are suspected to be detrimental to Southern Tree Hyraxes. For example, if a forest patch is surrounded by plantations, it is half as likely to be occupied by Southern Tree Hyraxes than by Blue Duikers (Lawes et al. 2000). Informal sand mining on the east coast of the Eastern Cape is also causing major disturbance and forest degradation. Informal logging as well as large scale collection of firewood in this area is a further major factor in forest degradation.

Southern Tree Hyraxes are vulnerable to human disturbance and encroachment. For example, hunting with the use of dogs is common practice in the forests of the former Transkei, and has a negative effect on the population. In areas in KwaZulu-Natal, where Southern Tree Hyraxes were known to exist previously, they have now disappeared – probably due to anthropogenic disturbance (the south coast is a popular tourist destination).

Current habitat trend: Declining. Although the average rate of southern Afromontane, scarp and coastal forest loss has been low between 1990 and 2013 (0.76±0.1%), the natural habitat along the coast and between forest patches has continued. For example, the Indian Ocean Coastal Belt Biome lost an average of 10.2±2.8% of its natural habitat (across five vegetation types) between 1990 and 2013 (A. Skowno unpubl. data), which equates to a *c*. 7.1% decline over 16 years. In KwaZulu-Natal, there

was a 19.7% loss of natural habitat from 1994 to 2011, with an average loss of 1.2% per year (Jewitt et al. 2015). If this rate of loss continues into the future, there will be an estimated 19.2% loss of habitat over 16 years (three generations). Worryingly, 7.6% of all natural habitat was recently lost in KwaZulu-Natal in just six years (2005–2011). Based on the results of Berliner and Desmet (2007), it can be deduced that 2% of the natural area was lost during the period 2007 to 2015 at the rate of 0.24% per annum in the Eastern Cape. Based on the analysis of the proposals for mining applications and municipal spatial planning products, it is estimated that over 20,000 km^2 (12% of the total area) may be lost between 2015 and 2045.

Additionally, between 2000 and 2013 there has been a 5.6% and 1.1% rate of urban and rural expansion in KwaZulu-Natal, respectively; and a 0.8% and 6.3% urban and rural expansion for Eastern Cape, respectively (GeoTerraImage 2015). This indicates both a loss of habitat and possibly an increase in human encroachment on forest resources, which we infer as increasing habitat degradation for Southern Tree Hyraxes, more trees are harvested for fuel, building materials and fence posts (to keep livestock out of fields). Overall, although current rates of absolute forest habitat loss are low, loss of natural habitat in the matrix and increasing habitat degradation within and around forest patches, could rapidly affect the species in the near future.

Conservation

The species is present in many large protected areas across the assessment region, including the Alexandria Forest in the Woody Cape section of Addo Elephant National Park, and have been observed in a few protected areas in the former Transkei (for example, Dwesa and Hluleka Nature Reserves, as well as Manubi State Forest; Eastern Cape Parks and Tourism Agency unpubl. data in 2011 and 2012). The species has also been observed previously in the Matiwane Range Forests north of Mthatha (Hayward et al. 2005), as well as the Karkloof and Balgowan forests (Lawes et al. 2000). In KwaZulu-Natal, they have recently been confirmed present in Gxalingenwa, and are thought to exist in Skyline, Vernon Crookes, Mpenjati, Umtamvuna, Oribi Gorge and Mbumbazi Nature Reserves.

Forests are formally protected within the assessment region, so conservation interventions should focus on mitigating disturbance and encroachment of remaining forest patches. Protected area expansion and biodiversity stewardship schemes could be used to connect isolated forest patches, but effectively connecting patches is highly unlikely as patches are too far apart and separated by incompatible land uses like sugar cane plantations (KwaZulu-Natal) and dairy farms (Eastern Cape). The primary interventions should thus be 1) to limit harvesting of large den tree species; 2) to enforce existing legislation to reduce settlement sprawl and disturbance around forest patches; and 3) to develop and implement education and awareness campaigns.

Selective logging even within intact forests must be minimised, as Southern Tree Hyrax make dens in certain species which are also those that tend to be logged; for example, yellowwood and mahogany (Gaylard 1994). These species often are also the species that they feed on, presumably to minimise distance travelled between dens and foraging areas (Gaylard & Kerley 1997). Conservationists should also work with local communities to regulate the harvesting of pole-sized trees in forests. For example, recent research suggests that small-scale harvesting of understorey trees (around 11% of available stems) should be sustainable and not alter forest structure if fewer than eight trees are harvested adjacently in any one area (Boudreau & Lawes 2005; Boudreau et al. 2005; Louw 2010). It has also been suggested that selective

Table 4. Conservation interventions for the Southern Tree Hyrax (*Dendrohyrax arboreus*) 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	*3.1.1 Harvest Management*: regulating the harvest of understory trees in protected forests (*c.* 11% available stems, < 8 adjacent trees).	Boudreau & Lawes 2005	Empirical	Local	Canopy structure intact at 11.6% harvesting pressure.	-
		Louw 2010	Empirical	Local	Forest dynamics intact if <8 stems harvested adjacently.	
2	*5.4 Compliance & Enforcement*: local conservation agencies enforce laws to reduce poaching, harvesting and settlement sprawl.	-	Anecdotal	-	-	Ezemvelo KwaZulu-Natal Wildlife, Eastern Cape Parks and Tourism Agency
3	*1.2 Resource & Habitat Protection*: biodiversity stewardship expansion to protect remaining forest patches and raise awareness of species.	-	Anecdotal	-	-	Ezemvelo KwaZulu-Natal Wildlife protected area expansion strategy
4	*4.3 Awareness & Communications*: working with local communities and landowners to promote snare removal and sustainable harvesting.	-	Anecdotal	-	-	-

logging could help finance tree hyrax conservation by logging only tree species not used for shelter or food (Gaylard & Kerley 2001). This will have to be assessed on a forest-by-forest basis. For example, in Gxalingenwa Forest, once the forest has recovered, some level of sustainable utilisation may be considered, probably in 20–25 years (I. Rushworth pers. comm. 2003).

If this species is to have a greater chance of long-term survival, then management of the matrix is important (Lawes et al. 2000). Reducing disturbance in the matrix may indirectly decrease the isolation effect, thereby improving the ability of Southern Tree Hyraxes to colonise small patches. Enforcing existing laws established to protect forests is critical for achieving this. This includes both enforcing regulations on trespassers within forests, as well as zoning regulations to reduce settlement sprawl, especially holiday homes in coastal areas. Biodiversity stewardship schemes should be used to protect remaining patches of forest.

Some areas require significant work with local communities and landowners to inform people about the species and its requirements, which should include information on sustainable harvesting of the correct tree species and appropriate fire regimes. Snare removal should also be a priority. Anecdotal observations suggest that people are not aware of their existence and, because of their vocalisation at night, people find them threatening because they do not know that they are harmless herbivores (Y. Ehlers-Smith pers. obs. 2015).

Recommendations for land managers and practitioners:

- Conservation authorities should develop harvesting strategy guidelines for understorey trees, and engage with local communities to develop and implement co-management agreements. Small-scale wood removal is predicted not to affect Southern Tree Hyrax occupancy (Lawes et al. 2000). The size of the forest patch is not as important as its quality – determined by the presence and abundance of cavity-forming trees.
- Conservation authorities should enforce regulations on developments that potentially impact on the habitat integrity of forests.
- Further field surveys are needed to improve estimates of population numbers and status in all regions.
- Undertake studies and institute monitoring to ascertain the options to use carbon market financing to protect and monitor forests.

Research priorities:

- Further field studies are needed to determine the distribution of this species in forest patches within the matrix between protected areas. Plot counts of calling individuals at dusk should be used to estimate density (Topp-Jorgensen et al. 2008). This will help to improve the accuracy of current distribution and subpopulation size estimates.
- More research and systematic reviews are needed to determine the net effects of forest land cover change on this species.
- Further research should be undertaken on isolation distances, dispersal capacity, connectivity and metapopulation dynamics to inform conservation planning.
- Quantifying the rates and effects of bushmeat poaching on subpopulations is required.

The University of KwaZulu-Natal, in collaboration with Ezemvelo-KZN Wildlife (June 2014–June 2016), is undertaking research on the impacts of changing land-use on forest mammals, particularly on mammals such as the Southern Tree Hyrax, using vocalisation playbacks in the fragmented sub-tropical coastal forests of southern KwaZulu-Natal. Similarly, the Eastern Cape Parks and Tourism Agency is conducting ad hoc camera trap surveys focusing on protected areas and other state forests with no information.

Encouraged citizen actions:

- Report sightings of this species, especially outside protected areas, on virtual museum platforms (for example, iSpot and MammalMAP).
- Keep dogs away from trees with cavities (Port Alfred and coastal villages especially, where Tree Hyraxes are prone to predation by dogs).
- Visit forest patches and document deterioration and apply pressure to government agencies to do more to conserve/protect forests.
- Do not cut down any cavity trees in your garden unnecessarily (milkwoods are protected species, so should not be felled anyway).

Data Sources and Quality

Table 5. Information and interpretation qualifiers for the Southern Tree Hyrax (*Dendrohyrax arboreus*) assessment

Data sources	Field study (literature, unpublished), indirect information (literature, unpublished), museum records
Data quality (max)	Estimated
Data quality (min)	Inferred
Uncertainty resolution	Minimum/maximum values
Risk tolerance	Evidentiary

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