

Non-detriment finding for *Philantomba monticola* (blue duiker)

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Summary of findings

Philantomba monticola (blue duiker) is included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Blue duiker are currently hunted as trophies in South Africa, with 83% (a total of 1,219 specimens) of international exports between 2002 and 2015 reported as trophies. In accordance with 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 export will not be detrimental to the survival of that species. Blue duiker is also currently listed as vulnerable in terms of section 56 of the National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004, and as Vulnerable on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Venter *et al.* 2016). A non-detriment finding (NDF) for this species is therefore required. This document details the undertaking of a NDF (Figure 1) for blue duiker and is based on the best current available information, current as of February 2017.

Blue duiker occurs in forested areas throughout western, central, eastern and southern Africa. Within southern Africa, blue duiker occurs in eastern Zimbabwe, parts of central Mozambique and along the eastern seaboard of South Africa. The South African population of blue duiker is however considered to be isolated as there are no confirmed records from Swaziland, Lesotho or southern Mozambique, which suggests a discontinuous distribution between South African, eastern Zimbabwean and central Mozambican populations. In South Africa the species is confined to the evergreen coastal and scarp forests and thickets along the coast from the iMfolozi River in northern KwaZulu-Natal southwards to the eastern parts of the Western Cape. The distribution is fragmented. Using only recent distribution records (post-2000), the estimated area of currently occupied forest is 1,415 km² (comprised of 350 forest patches within 51 clusters), assuming that any forest patch within 0.88 km² of another forest patch is occupied.

It is estimated that there are between 3,538 and 50,015 mature blue duiker in South Africa. Due to the large variation in the population estimate, the national abundance of the species is considered uncertain, and surveys, density estimates and occupancy levels across the various habitat types are needed to generate better population estimates. It is however clear that overall the blue duiker population in South Africa is declining. Preliminary data show that around half the subpopulations in KwaZulu-Natal protected areas (47%, N=33) and private lands (53%, N=30) are declining or have unknown trends. The Wild Coast and Amatole populations in the Eastern Cape are under huge pressure due to poaching and habitat transformation related to increased cattle densities. A population decline to its lowest level over the past 50 years, which has been attributed to climatic changes, has been documented in some of the largest forest reserves (Knysna-Tsitsikamma complex, Western Cape) since 1970. These estimates are based on good local knowledge sourced from field studies (unpublished), indirect information (literature, expert knowledge, landowners) and population censuses conducted by Ezemvelo KwaZulu-Natal Wildlife (EKZNW), SANParks and CapeNature.

The blue duiker is long-lived with animals recorded to live up to 6-8 years in the wild and 15 years in captivity. Their reproductive rate is low due to the relatively long gestation period of approximately 207 days and the production of a single lamb and a mean lambing interval of 202-265 days. Blue duikers are considered forest specialists and are confined to forest, thickets or dense coastal bush. They require closed canopy forest, with a high tree stem density, sparsely vegetated ground layer and lots of leaf litter. In addition to canopy cover, blue duiker require dense understorey bush for bed sites as well as protection against predators, but also open glades to forage in. In South Africa their distribution is also determined by a 15°C effective temperature isocline, which may be related to maintaining a body temperature of 39°C in ambient temperatures of 14-30°C. They can thus be classified as closed canopy habitat specialists. The species also has a highly specialized diet and blue duikers are classified as concentrate selective browsers and considered to be high carbon / nitrogen (C/N) diet selectors. Depending on the

forest habitat occupied the species either select for growing shoots, flowers and fruit (forest) or are considered forest floor gleaners, with their diet consisting primarily of fallen mature leaves and, to a lesser extent, fallen fruit, seeds and flowers where available (Fynbos and thicket habitats). Blue duiker is considered to have a poor dispersal ability since it is unlikely that they would be able to disperse between suitable habitat patches that are greater than 1.5 km apart. The species is tolerant of human activities where disturbance is limited and domestic animals are absent.

The current, predominant threat to blue duiker is forest habitat loss and fragmentation caused by ongoing development along the coastal belt and indigenous timber extraction. This threat is considered substantial. In the Eastern Cape, the most limiting factor is the lack of connectivity between habitat patches. Habitat degradation as a result of alien species and the out of range introductions of bushpig (*Potamochoerus larvatus*), zebra (*Equus zebra*), blue wildebeest (*Connochaetes taurinus*) and nyala (*Tragelaphus angasi*) further exacerbate the main threat to the species. Poaching for bushmeat is an additional threat to the species, while nocturnal warming as a result of climate change has been suggested as a further threatening factor. The extent of the illegal offtake of this species is currently uncertain. It is certainly large enough to cause a noticeable decline in blue duiker populations on private land and within some protected areas where snaring and hunting with dogs is a known problem. The disappearance of blue duiker from Weza-Ngele Forest in KwaZulu-Natal is thought to be due to illegal off-take. Similarly, illegal dog hunting for sport is suspected to be causing localised subpopulation declines or extinctions.

There are no national or provincial quotas for the off-take of blue duiker in South Africa and provincial Management Authorities issue permits on a case-by-case basis. At present the overall aim of harvesting is economic gain, although this harvest generates significant conservation benefits in the Kowie-Kariega Conservancy in the Eastern Cape where approximately 52% of all blue duiker hunting trophies exported from South Africa between 2010 and 2015 were hunted. It is estimated that there are around 1,375 blue duikers within this conservancy comprising 35,000 ha, based on the availability of suitable habitat (5,500 ha), though this is considered a conservative estimate by the landowners in the area. The blue duiker population in the conservancy is believed to be stable to increasing due to effective predator control measures, the removal of domestic small livestock and well-managed trophy hunting. Applications for trophy hunting and live exports are made on an annual basis on the basis of an annual assessment of animal availability and is coordinated within the conservancy. The conservancy applies rotational patch-based hunting, supported by camera trap generated evidence of re-occupation of hunted patches, which gives patches time to recover. Hunting of blue duiker within the conservancy is conducted in only a small proportion (less than 22%) of the available blue duiker habitat, ensuring substantial reserve or “no take” areas from which duikers can disperse to repopulate hunted areas. Trophy hunting of blue duiker in the conservancy is considered well-managed and sustainable.

The effects of harvesting blue duiker are not currently monitored, although both CITES exports and local hunting and translocation are monitored, the latter through a permit system. Due to budgetary and capacity constraints in the provinces, as well as a lack of population data, there is a low confidence in the monitoring methods. However, there is a high confidence in the camera trap monitoring that takes place within the Kowie-Kariega Conservancy to assess the impact of hunting on the blue duiker population. The national management system for blue duiker is informal as there is no set structure with activities measured against a larger adaptive framework. In some cases, such as the Kowie-Kariega Conservancy, local management plans are available. Off-takes are managed on a local scale through a permit system on a case -by -case basis, based on local knowledge, but there is no approved national plan that is aimed at managing blue duiker. There is a low confidence in the harvest management of blue duiker due to budgetary constraints, lack of capacity and proper planning, the lack of a national blue duiker management plan, as well as a permitting system that is inadequate for the regulation of blue duiker. In contrast, the confidence in the harvest management of blue duiker within the Kowie-Kariega Conservancy in the Eastern Cape, is high. There is thus an overall medium confidence in harvest management.

The conservation value accrued to the species through harvesting is high in the Kowie-Kariega Conservancy due to the high economic value of blue duiker at present, but incentives for species or habitat conservation through hunting are absent in the remainder of the species’ range. However, well-managed trophy hunting could be used as an effective conservation tool incentivising both the protection of the species as well as the habitat occupied by the species throughout its natural distribution range. Income generated through trophy hunting of blue duiker has incentivized landowners within the Kowie-Kariega Conservancy to change land use practices to benefit the blue duiker. Trophy hunting income is further used for habitat management for example by funding alien invasive

eradication programmes, and to increase protection for the species through frequent patrols and the removal of snares.

At present both hunting and translocation of blue duiker are regulated through a system of permits, which is considered effective. There is currently no hunting season for blue duiker in the Western Cape. Hunting of blue duiker is not allowed in any national parks or within provincial protected areas. Therefore more than 15% of the species is afforded strict protection within its natural distribution range. There is however uncertainty whether current protection measures such as the erection of fences and deployment of anti-poaching patrols are effective for the protection of blue duiker within protected areas.

In conclusion, the non-detriment finding (Figure 1) undertaken for blue duiker, based on the key considerations above, demonstrates that legal local and international trade in live animals and the export of hunting trophies at present poses a moderate to high risk to the survival of this species in South Africa and is detrimental to the species in the wild (Figure 2 point A). This outcome is mostly due to a lack of monitoring of blue duiker populations and off-takes. With improved monitoring of blue duiker populations in key protected areas and sound monitoring protocols with agreed thresholds to guide adaptive harvest management in all areas where blue duiker are hunted, trade will be non-detrimental (Figure 2 point B).

The following is thus recommended:

1. Monitoring of blue duiker populations within key protected areas are improved to better understand population trends and the effectiveness of protection for blue duiker within protected areas.
2. Exports of specimens originating from the Kowie-Kariega Conservancy in the Eastern Cape may continue after a monitoring protocol with agreed thresholds to guide adaptive harvest management and ensure sustainable offtakes is approved by the Scientific Authority.
3. All other exports of blue duiker should cease.
 - a. Exports of specimens originating from other potential hunting areas within the blue duiker distribution range will be considered after an adaptive harvest management model is approved by the Scientific Authority for implementation within a conservancy framework.

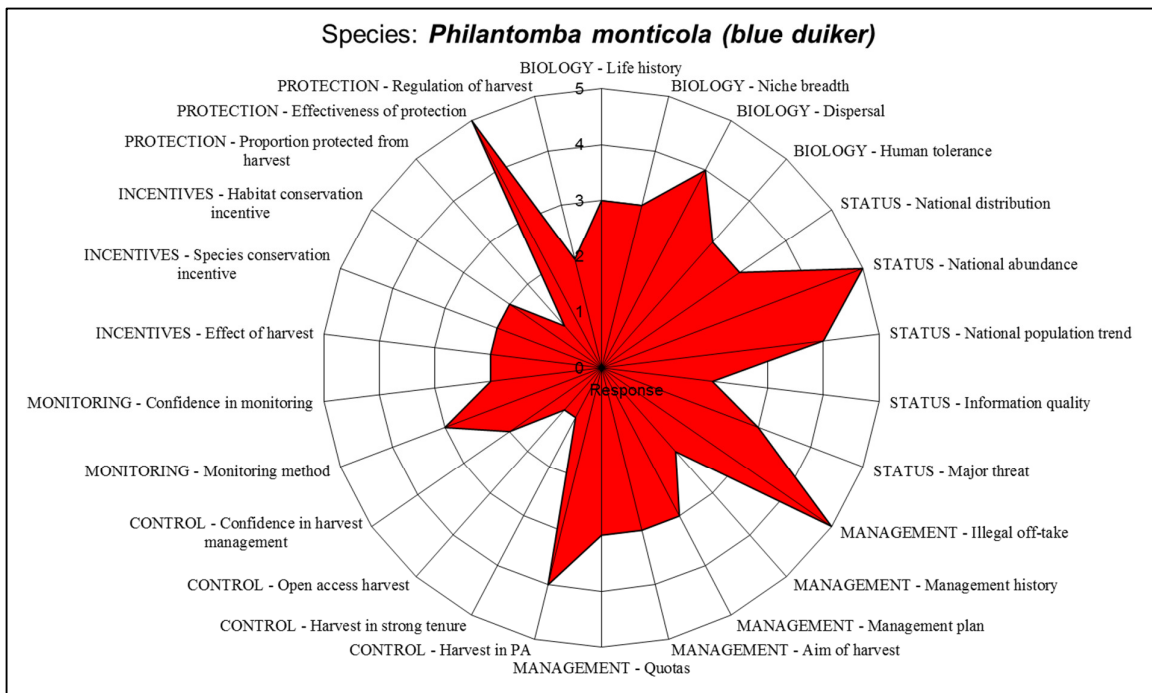


Figure 1: Radar chart summarizing the non-detriment finding assessment undertaken for *Philantomba monticola* (blue duiker) in South Africa, accordance with the CITES NDF checklist. Explanations of scores given are detailed

in Table 1. Higher scores are indicative of higher risks to the species. The extensive shaded area in the radar chart demonstrates an overall moderate to high risk to the species.

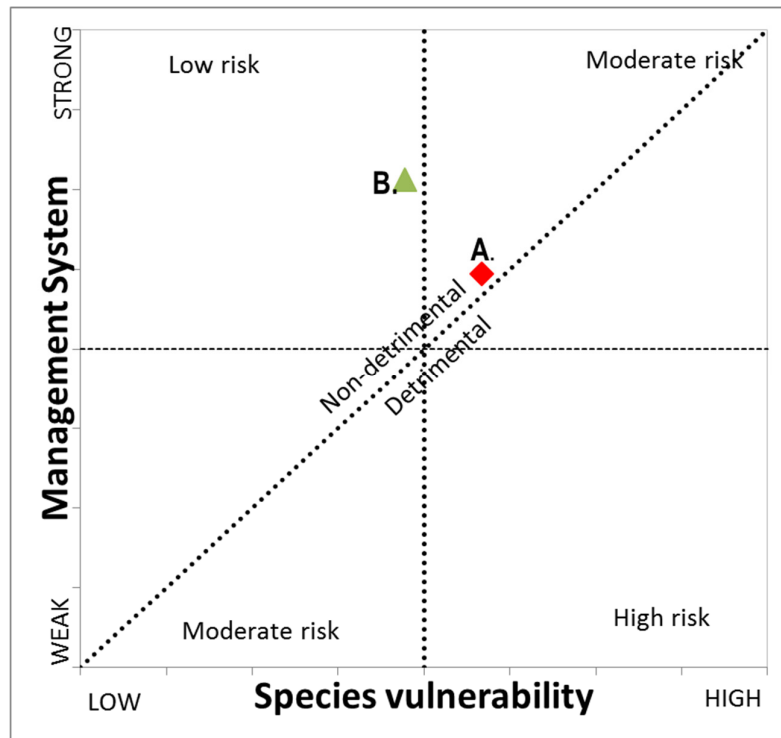


Figure 2: The risk of trading in *Philantomba monticola* (blue duiker) by South Africa, as represented by the relationship between species vulnerability (biology and status) and the strength of the management system to which the species is subjected (management, control, monitoring, incentives and protection). The figure demonstrates that the species is assessed as at a moderate to high risk and trade is detrimental. Point A (red) on the graph is an indication of the current situation where the species is at high risk and trade is detrimental, while point B (green) indicates the potential risk to the species after improved monitoring of blue duiker populations in key protected areas and sound monitoring protocols with agreed thresholds to guide adaptive harvest management in all areas where blue duiker are hunted. In this scenario the species is at moderate risk and trade is not detrimental.

Table 1. Detailed non-detriment (NDF) assessment for *Philantomba monticola* (blue duiker) undertaken in South Africa 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 history: What is the species' life history?	High reproductive rate, long-lived	1
	High reproductive rate, short-lived	2
	Low reproductive rate, long-lived	3
	Low reproductive rate, short-lived	4
	Uncertain	5
The blue duiker has a low reproductive rate and is long-lived. Longevity of only captive individuals is known and is estimated to be up to 15 years (Weigl 2005). Lifespan in the wild is unknown, but is thought to be shorter than in captivity. Pitzer and Colenbrander (2005) suggest a lifespan in the wild of 6-8 years. The oldest documented individual in the wild reached an age of 12 years (Grzimek 1990). The species has a low reproductive rate with an average gestation period of 207 days (6 – 7 months, range 196 – 216 days), after which a single lamb is born (Boehner et al. 1984). The mean lambing interval is 8 to 9 months (265 days) (Boehner et al. 1984). However, Pitzer and Colenbrander (2005) found a slightly shorter lambing interval ranging between 202 and 248 days. In the wild, breeding occurs all year round, although Bowland (1990) found some seasonal variation in KwaZulu-Natal. In captivity females become sexually mature between 6 and 17 months (Boehner et al. 1984). Pitzer and Colenbrander (2005) list ewe maturity at 8 to 12 months (mean 10 months) and rams at 11 to 14 (mean 12.5) months.		
2. Ecological adaptability: To what extent is the species adaptable (habitat, diet, environmental tolerance etc.)?	Extreme generalist	1
	Generalist	2
	Specialist	3
	Extreme specialist	4
	Uncertain	5
<u>Diet</u> Blue duiker have physiological adaptations that classify them as concentrate selective browsers, which select for growing shoots, flowers, and fruit (Jarman 1974; Field 1975; Jarman & Sinclair 1979; Spinage 1986; Bowland 1990). Pitzer and Colenbrander (2005) suggest that 75% of the stomach contents are attributed to fruit and 15% to browse. However, direct observations and rumen-content analysis indicate that they are forest floor gleaners, with their diet consisting primarily of fallen mature leaves and, to a lesser extent, fallen fruit, seeds and flowers where available. This feeding behaviour would be typical of fynbos and thicket areas where the species would be unable to select fruit because of the fruiting phenology and uneven availability of fruit in these habitat types. Additionally, within drier habitats such as thicket, water availability may also be a limiting factor. However, within prime forest habitats the species is not reliant on water sources. Blue duiker often utilise food items dislodged from the tree canopy by primates and frugivorous birds. Where fallen leaves are concerned, they are also highly selective. Bowland (1990) found a preference for dietary items with high tannin content. Also during food preference tests, 12 out of 21 species offered were rejected. Faurie (1990) also found that many plant species selected by blue duiker were considered unpalatable by other browser species. Seydack and Huisamen (1999) take the high tannin preference as an index for a preference for high total non-structural carbon content. Thus, blue duikers are considered to be high carbon / nitrogen (C/N) diet selectors. This degree of selectivity implies a highly specialized diet. <u>Habitat</u> Blue duikers are considered forest specialists and are confined to forest, thickets or dense coastal bush. They can be classified as closed canopy habitat specialists. Blue duikers occupy lowland coastal, scarp and afro-temperate forests, ranging up to 1,370 m in altitude within KwaZulu-Natal, Eastern Cape and Western Cape provinces. The forest biome is South Africa's smallest biome, comprising less than 0.6% (7,177 km²) of South Africa's land surface (Low & Rebelo 1996).		

Their habitat requirements are specific in terms of habitat quality for feeding requirements, bed sites (natal care and rumination) and predator avoidance. Both the availability of suitable food items as well as habitat structure are important. Blue duiker require closed canopy forest (Seydack 1984; Struhsaker 1997; Seydack et al. 1998), with a high tree stem density (Seydack et al. 1998), sparsely vegetated ground layer (Struhsaker 1997) and lots of leaf litter (Ehlers Smith 2016). They avoid forest types with a large abundance of deciduous trees (Bowland 1990) as deciduousity implies a higher nutrient content and supports higher plant tissue turnover (Seydack & Huisamen 1999). In addition to canopy cover, blue duiker require dense understorey bush for bed sites as well as protection against predators, but also open glades to forage in (Bowland 1990).

Environmental tolerance

In South Africa blue duiker distribution is also determined by a 15°C effective temperature isocline (Vincent 1962; Stuckenberg 1969; Howard & Marchant 1984), which may be related to maintaining a body temperature of 39°C in ambient temperatures of 14 - 30°C. In temperatures above 30°C they exhibit signs of hyperthermia, raising their body temperature to 40°C (Haim & Skinner, 1991 – cited in Skinner and Chimimba, 2005).

3. Dispersal efficiency: How efficient is the species' dispersal mechanism at key life stages?	Very good	1
	Good	2
	Medium	3
	Poor	4
	Uncertain	5

Blue duiker live in pairs, sometimes with sub-adult offspring (Skinner & Chimimba 2005), which will disperse between the age of 18 months and 2 years (Boehner et al 1984; Bowland 1990).

Blue duikers are highly territorial and monogamous pairs maintain small exclusive home ranges (territories, 0.6 -0.7 ha), regardless of habitat type. A territory must meet all their requirements in terms of suitable bed sites, food quality and availability, but also be of a defensible size. Where population densities are high, demand for territories is greatest, thus putting blue duiker under pressure to patrol and maintain their strict boundaries, increasing encounter rates with other individuals and ultimately increasing defensive activities. High territoriality between individuals in high density areas makes it difficult for individuals to disperse into unoccupied territories (Bowland 1990). Due to the fragmented and isolated nature of forest patches in South Africa, competition between dispersing individuals is fierce in areas with high blue duiker density. Along the eastern seaboard of South Africa, the coastal scrub within the Admiralty Nature Reserve (200 m inland from the high-water mark) provides an important dispersal route in areas where the vegetation remains intact.

Lawes *et al.* (2000) found that blue duikers are sensitive to forest patch isolation. They calculated that there is a less than 10% probability of a patch smaller than 5 ha and more than 1 km away from a mainland patch being occupied by blue duiker. They further showed that if suitable habitat patches are greater than 1.5 km apart, blue duiker would be unable to disperse between these patches. The maximum distance observed between occupied forest patches was 0.88 km, which means that dispersal beyond 1 km is unlikely. In addition, Mockrin (2010) found that in an area where hunting pressures were present (a large contiguous forest patch in Congo-Brazzaville), the dispersal rate was 25% and, although limited by sample size (n=2), immature animals' dispersal distances were relatively high (1.5 km). Thus the continuity of habitat (interconnectedness) plays an important role in dispersal.

Unlike other parts of Africa (e.g. Central Africa) blue duiker in South Africa occur in relatively small patches of suitable habitat within a forest/non-forest mosaic, which makes recolonization of locally depleted patches difficult. Throughout the region there are six vegetation biomes (Fynbos Biome; Succulent Karoo Biome; Desert Biome; Nama-Karoo Biome; Grassland Biome; Savanna Biome; Albany Thicket Biome; Indian Ocean Coastal Belt & Forests, Musina & Rutherford, 2011), which include non-traversable habitats that limit movement naturally. Continuity of habitat (interconnectedness) plays an important role in dispersal. The availability of corridors and stepping stones varies across its distribution range. Thus overall the dispersal ability of blue duiker is considered poor.

4. Interaction with humans: Is the species tolerant to human activity other than harvest?	No interaction	1
	Pest / Commensal	2
	Tolerant	3

	Sensitive	4
	Uncertain	5
Blue duiker are considered tolerant of humans, where disturbance is limited and domestic animals are absent. In estates and lodges, they are often fed and can become relatively tame. A recent study by Ehlers-Smith (2016) has shown that blue duiker inhabit coastal forest patches in areas with dense human settlements, implying some degree of tolerance towards human disturbance, however high human relative abundance negatively impacts their detection probability. In areas with dense human settlements, a behavioural shift from crepuscular to nocturnal habits has been observed (Ehlers Smith 2016).		
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
The South African population of blue duiker is considered to be isolated as there are no confirmed records from Swaziland, Lesotho or southern Mozambique, which suggests a discontinuous distribution between South African, eastern Zimbabwean and central Mozambican populations (Venter <i>et al.</i> , 2016).		
Blue duiker occupy lowland coastal, scarp and afro-temperate forests ranging up to 1,370 m in altitude from George, as the most southern extent in the Western Cape, throughout forests patches, dense bush and thicket of the Eastern Cape and KwaZulu-Natal provinces. In KwaZulu-Natal they occur along the coastal region, with their coastal distribution digressing inland north of Durban at Umdloti (Bowland 1990). Their historic distribution extended along the KwaZulu-Natal coast to the Imfolozi river as their most northern distribution; however the population within the Hluhluwe-Imfolozi Game Reserve is thought to be extinct (Bowland 1990).		
The population is fragmented into smaller sub-populations. According to the national Red List assessment (Venter <i>et al.</i> , 2016), there are approximately 637 viable forest clusters (applying a 0.44 km buffer around patches larger than 0.045 km ² and merging patches that intersect) within the distribution range of the blue duiker, based on maximum dispersal distances between patches. Not all available patches are occupied by blue duiker. Using only recent distribution records (post-2000), the estimated area of currently occupied forest is 1,415 km ² (comprised of 350 forest patches within 51 clusters), assuming that any forest patch within 0.88 km ² of another forest patch is occupied (Venter <i>et al.</i> , 2016).		

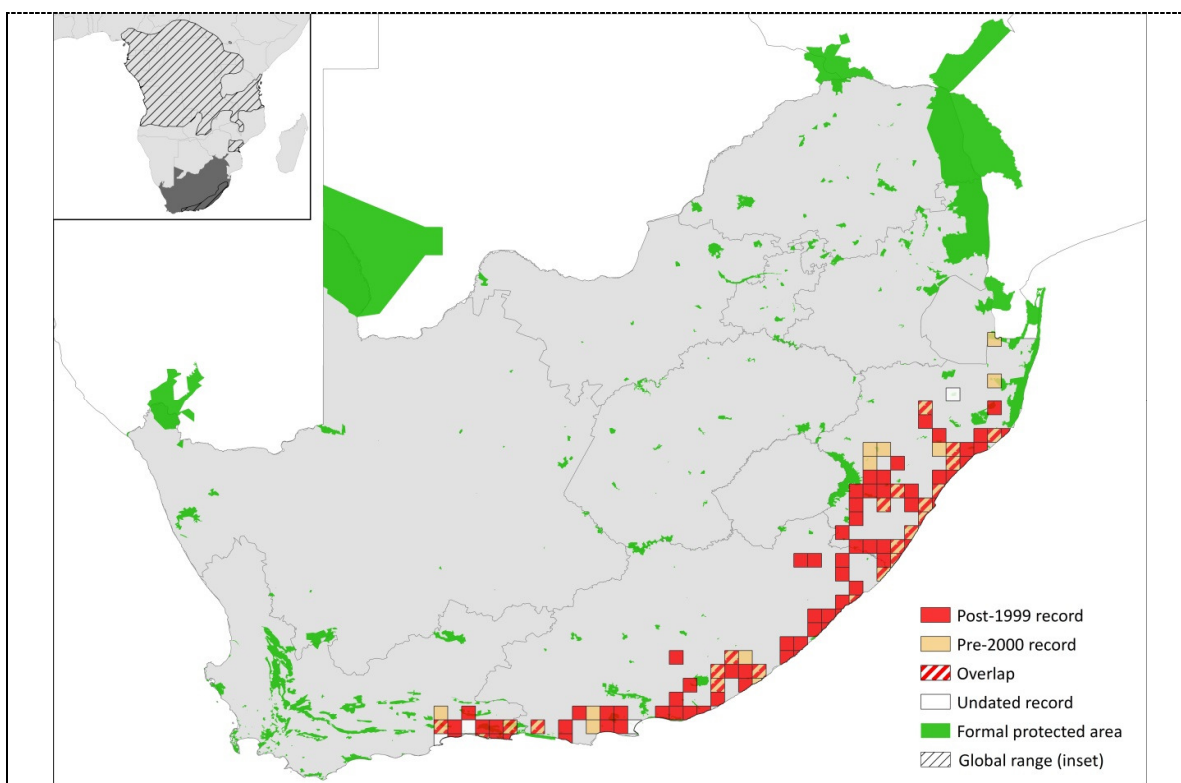


Figure 3: Distribution records for blue duiker (*Philantomba monticola*) within South Africa, Lesotho and Swaziland (Venter *et al.* 2016).

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

According to Venter *et al.* (2016), the estimated area of occupancy (AOO) for blue duiker ranges from 1,415 km² to 2,858 km², depending on whether only currently occupied forests or all potentially viable forests within the extent of occurrence (EOO) are included. Population estimates range widely: using a density range of 5–35 individuals / km² yields a total mature population estimate of 3,538–50,015 individuals (using a 50% mature population structure). Blue duiker are considered to be unable to disperse further than 0.88 km between forest patches. Using forest clusters that fall within this dispersal distance as proxies for subpopulations, the largest cluster is estimated to be 314–687 km², which yields 785–12,023 mature individuals. Applying the precautionary principle, it is suspected that the lower estimates are more realistic given the wide variation in density and occupancy between patches on fine spatial and temporal scales, combined with multiple ongoing threats that may be causing local subpopulation decline or extinction. Thus, blue duiker is listed as Vulnerable B2ab(ii,iii,v) and C2a(i) using the lower estimates of AOO and mature population size. Further surveys, density estimates and occupancy levels across its range are necessary to more accurately calculate key parameters. This species should be reassessed when such data are available (Venter *et al.* 2016).

This is a very conservative population estimate however as blue duiker densities are extremely variable across their range depending on habitat type. For example, in KwaZulu-Natal, there is a huge disparity between patch occupancy rates within the large isolated inland forest patches (48% occupancy) and the smaller coastal patches (94% occupancy, Ehlers Smith *et al.*, 2015). In a 2014 camera trap survey within the Garden Route National Park only two individuals were captured across 13 camera trap sites. Similarly only one was photographed within the park buffer zone (M. Alant, unpublished data). The national Red List

assessment estimate further does not include some of the thicket and fynbos areas in the Eastern Cape where the species occurs.

In the Kowie-Kariega Conservancy in the Eastern Cape for example, where available suitable habitat amounts to 5,500 ha, it is estimated that there are approximately 1,375 blue duiker in total. This estimate was calculated using the method in Boshoff *et al.* (2002), which is applicable to blue duiker within Addo Elephant National Park. Based on the most closely matched vegetation types to those found in Addo Elephant National Park, an average of 4 ha per blue duiker was assumed for the conservancy and accords with on the ground knowledge of landowners.

Thus based on the uncertainties surrounding population estimates and wide confidence intervals, the abundance of the species in South Africa is considered uncertain.

Limited information is available within the provinces on the number of blue duiker bred in controlled environments. In the Western Cape there are approximately 62 blue duikers kept in six breeding facilities, while captive breeding of blue duiker is not allowed in KwaZulu-Natal. In Limpopo Province, eight facilities keep approximately 51 blue duikers collectively. Blue duikers are predominantly bred in captivity for live sales, for tourism purposes and for introduction around tourism lodges and seem to breed well in captivity.

In recent years there has been a growing interest in breeding small antelope species, such as the blue duiker, commercially on game farms. Limited information is available on the number of farmers breeding blue duiker as well as the origin of the animals (captive-bred or sourced from the wild). According to the Small Game Breeders Association, blue duikers for captive breeding purposes should only be sourced from populations under threat i.e. development, injured animals or from other captive facilities.

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

The overall population trend of blue duiker in South Africa is declining (Venter *et al.* 2016). Preliminary data show that around half the subpopulations in KwaZulu-Natal protected areas (47%, N=33) and private lands (53%, N=30) are declining or have unknown trends (Jones 2014). The Weza-Ngele Forest in KwaZulu-Natal has also reported declines in blue duiker numbers and it is believed that blue duiker might have disappeared from this system, as researchers have yet to confirm their presence in the forest after 30 km of transect surveys (Ehlers-Smith pers. obs. 2015).

The Wild Coast and Amatole populations in the Eastern Cape are under huge pressure due to poaching and habitat transformation related to increased cattle densities. The Assegaai Conservancy in the Eastern Cape Province has also reported a decline in blue duiker numbers, whereas the blue duiker population in the Kowie-Kariega Conservancy is purported to be stable to increasing due to effective predator control measures and the removal of domestic small livestock. Trophy hunting of blue duiker in the conservancy is well-managed and together with the extensive no take area (78% of conservancy area), provide a good safeguard against over-exploitation of the blue duiker population (Novellie 2017). According to SANParks, blue duiker are regularly seen in the Kabouga section and in the Alexandria forests in Addo Elephant National Park, Eastern Cape, and the population is considered stable to increasing.

A population decline to its lowest level over the past 50 years, which has been attributed to climatic changes, has been documented in some of the largest forest reserves (Knysna-Tsitsikamma complex, Western Cape) since 1970 (Gadow 1978; Seydack *et al.* 1998).

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

The most recent conservation assessment of the South African blue duiker population was conducted in 2015 as part of the national Red List assessment (Venter *et al.* 2016). The data were sourced from field studies (unpublished), indirect information (literature, expert knowledge, landowners) and population censuses conducted by Ezemvelo KwaZulu-Natal Wildlife (EKZNW), SANParks and CapeNature. Blue duiker populations are currently not monitored in ECPTA parks and as a result no data on trends for these populations are available. No formal census of blue duiker has been conducted on the Kowie-Kariega Conservancy. However, patrolling game guards, cattle herders and predator control teams regularly cover a large area of the conservancy and their sightings give a general and subjective impression of the abundance of blue duiker (Novellie 2017). In the Western Cape, CapeNature monitors blue duiker populations in Keurbooms, Goukamma and Robberg Nature Reserves. In the coastal regions of KwaZulu-Natal, EKZNW monitors blue duiker populations in two protected areas using drive counts, namely Kenneth Stainbank (237 ha) and North Park Nature Reserves (53 ha). In other protected areas within the province, ad hoc sightings of blue duiker are recorded, while in some areas camera-traps have been deployed for general monitoring for the presence of more cryptic species, which would include blue duiker. In 1970, SANParks established an official blue duiker monitoring program, using pellet counts, in the Garden Route National Park. Additional areas within the park were added to the program in 1990 and again in 2000. More recently, trail cameras have also been added to certain areas to monitor blue duiker presence.

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

Thirteen subspecies have been named (Hart & Kingdon 2013), where *Philantomba monticola monticola* is isolated from the others, occurring from northern KwaZulu-Natal to the Eastern and Western Cape provinces of South Africa. This sub-Saharan African subspecies (*Philantomba monticola monticola*) has a disjunct distribution between the eastern coastal forests of South Africa and the rest of its range, which implies that no rescue effect is possible. The following are considered to be the main threats facing the species.

1. Habitat loss, alteration and fragmentation

Within South Africa the species is declining due to forest habitat loss and fragmentation from ongoing development along the coastal belt and indigenous timber extraction. Though forest patch fragmentation in the Eastern Cape has ceased in recent years and appears to be stable, the most limiting factor is the lack of connectivity between habitat patches. Large forest patches seem to be the most isolated (more than 1.5 km apart), which has implications for dispersal events and may affect the genetic integrity of these small populations. Small population size offers low resilience to stochastic events such as forest fires. Private properties are often fenced within the Garden Route area, and this limits dispersal and movement between suitable habitats, however much of the Garden Route National Park, Western Cape is not fenced. Habitat patches are increasingly becoming isolated islands. The lack of corridors within communal land also remains a problem.

Blue duikers are also sensitive to habitat alteration/degradation by larger herbivores. For example, the population of blue duiker in Hluhluwe-Imfolozi Game Reserve is thought to be extinct due to changes in understorey cover and degradation through the activities of bushpig (*Potamochoerus larvatus*). Similar trends are being investigated in southern KwaZulu-Natal where bushpig are present and zebra (*Equus zebra*), blue wildebeest (*Connochaetes taurinus*) and nyala (*Tragelaphus angasi*) have been introduced and are potentially affecting seedling recruitment and forest understorey dynamics with consequences for blue duiker presence within forest reserves (Ehlers Smith 2016).

2. Invasive species, out of range introductions and domestic animals

The extinction of blue duiker in the Hluhluwe-Imfolozi Game Reserve has been attributed to a change in forest structure (reduced understorey cover and degradation) through the activities of bushpig, an introduced species. There may be similar trends in southern KwaZulu-Natal where bushpig are present and where zebra, blue wildebeest and nyala have been introduced. These species are potentially affecting seedling recruitment and forest understorey dynamics with consequences for blue duiker presence within forest reserves (Ehlers Smith *et al.*, in prep). The movement of bushpig into previously unoccupied areas is thought to be linked to the expansion of the forestry industry. Trampling by livestock and alien plants (e.g. lantana (*Lantana camara*) and bugweed (*Solanum mauritianum*) monocrops) are further responsible for the deterioration of suitable habitat. Blue duikers are preyed on by uncontrolled domestic cats and dogs in areas where they are in close contact with humans. In areas where larger carnivores have been eradicated, an eruption and expansion of range in smaller carnivores such as caracal (*Caracal caracal*) and black-backed jackal (*Canis mesomelas*) have occurred, especially where there are no active removals of these

meso-predators by farmers. This meso-predator release and the resulting high predation rates are negatively affecting blue duiker populations.

3. Overutilization

Increasing bush meat poaching, snaring and dog-hunting are also suspected to be factors causing the decline in the number of mature individuals. Ignorance, poor governance, and inadequate law enforcement has led to the over exploitation of the species in some areas.

4. Climate change

The effects of climate change on the blue duiker are currently being studied as some of the documented declines are likely to be a result of nocturnal warming, which may have a negative effect on the digestible non-structural carbon contents of forage items preferred by blue duiker (Seydack *et al.* in prep). A study is currently being conducted to explore the possible implications of climate change on the drastic reduction in numbers of blue duiker in the Knysna-Tsitsikama forest complex. Climate change induced nocturnal warming negatively affects the digestible non-structural carbon contents of forage items for blue duiker (Seydack *et al.* in prep). A switch in plant carbon / nitrogen (C/N) ratios will not favour blue duiker's dietary preference, which has consequences for the remaining population within the largest forest complex in the region.

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

The extent of the illegal offtake of this species is currently uncertain. It is certainly large enough to cause a noticeable decline in blue duiker populations on private land and within some protected areas where snaring and hunting with dogs is a known problem (Jones 2016). The disappearance of blue duiker from Weza-Ngele Forest in KwaZulu-Natal is thought to be due to illegal off-take, and researchers have yet to confirm their presence in the forest after 30 km of transect surveys (Ehlers-Smith pers. obs. 2015). Similarly, illegal dog hunting for sport is suspected to be causing localised subpopulation declines or extinctions. Within the Eastern Cape's Wild coast and Amatole region, 60-70% of the blue duiker range falls within communal lands in the former Transkei and Ciskei coastal belt, and illegal offtakes are high in unmanaged or poorly managed areas. However, within the Kowie-Kariega Conservancy, the illegal offtake of blue duiker is small, due to regular anti-poaching patrols and snare removal (Novellie 2017).

Snare removal on private and municipal properties is ongoing, which suggests continuous trapping effort within semi-urban areas. Snaring within rural and farming communities is a major problem, where continual snare removal on a regular basis is necessary in order to keep poaching at bay. Often animals are left in snares, dead or dying, suggesting that the practice of snaring is not out of desperation for food (C. Hoskins, Craggs View Rehabilitation Centre, pers. comm. 2015). Blue duiker are easily caught in snares as they create well-marked paths between bed sites and feeding sites, along which snares can be set (Skinner & Chimimba 2005). Blue duikers are also frequently caught in snares in areas where bushpig is the target species.

Often when poachers are caught hunting with dogs in the Eastern Cape and parts of KwaZulu-Natal, e.g. the Umzimkhulu Valley, they are in possession of blue duiker (D. De Villiers, pers. comment). Hunting for the bushmeat trade in Africa is increasing and could, in many cases, be considered commercial rather than subsistence (Robinson & Bennett 2004; Andrew *et al.* 2013). Demand tends to exceed supply, which puts tremendous pressure on wild populations of forest animals (Robinson & Bennett 2004). Between June 2004 and November 2005, 47% of traders at the Faraday market in Johannesburg (N = 32) sold duiker products such as horn and skin (Whiting *et al.* 2011).

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

	Unmanaged harvest: ongoing or new	4
	Uncertain	5
The species is listed as vulnerable in terms of section 56 of NEMBA and various provincial Ordinances and Acts provide further legislative protection. Permits are therefore required to undertake a variety of activities in relation to blue duiker, e.g. hunting and other forms of direct use. There is currently no adaptive framework for blue duiker management and no quota system, but off-takes are managed on a local scale through a permit system on a case-by-case basis, based on local knowledge. Due to observed declines (through camera trap monitoring and people no longer seeing blue duiker) the Western Cape no longer has a hunting season for blue duiker. In KwaZulu-Natal, it is the responsibility of a district conservation officer to assess a property in order to determine whether harvesting blue duiker would have a detrimental impact on the population. In the Eastern Cape, most permits for the hunting of blue duiker are currently issued to the 35,000 ha Kowie-Kariega Conservancy, made up of approximately 38 properties. Approximately 52% (297) of all blue duiker hunting trophies exported from South Africa between 2010 and 2015 were hunted on this conservancy. In the Amatole Region of the Eastern Cape inspections are carried out prior to a permit being issued to determine the suitability of the habitat on the specific property for blue duiker but no data or information is available on blue duiker numbers on these properties. Although cattle provide the main source of income for many landowners within the conservancy, hunting and live sales of game make an important contribution. Not all landowners engage in hunting; some maintain game for personal pleasure or for ecotourism. The conservancy also includes a residential area, the Kasouga Village. Hunting does not take place around the village, and householders regularly see blue duikers in their gardens. The vegetation within the Kowie-Kariega Conservancy comprises a mosaic of thicket patches and open grassland. Habitat patches suitable for blue duiker are well-interconnected by corridors that could allow blue duiker to disperse between patches. At present hunting of blue duiker does not take place on 78% (4,305 ha) of suitable thicket patches within this conservancy, either because the thicket patches are inaccessible (approximately 920 ha) or because the landowners do not conduct hunting on their properties (Novellie 2017). Two methods of hunting are used, ambush hunting and drive hunting. Thicket patches where drive hunting and ambush hunting have been conducted amount to 695 ha (13%) and 435 ha (8%), respectively. In only one patch, about 65 ha (1%) in area, both drive and ambush hunts are conducted (Novellie 2017). To date 35% of the blue duiker in the Conservancy were hunted by the ambush method and 65% by drive hunting (Novellie 2017). Owing to the specific site requirements for both ambush and drive hunting, only a proportion of blue duiker habitat in the Kowie-Kariega Conservancy is actually impacted by hunting during a particular season. This allows for a system of patch rotation hunting that is guided by monitoring in the case of ambush hunts. Rotational hunting by this means ensures that patches are given time to recover (Novellie 2017).		
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 no national management plan for the species. National and provincial parks have general ecological management plans, but none specifically for blue duiker. A management plan is not required for the introduction and keeping of blue duiker on private land. Private landowners however may have general ecological management plans for their specific properties. The Kowie-Kariega Conservancy in the Eastern Cape, the source of over half (297 out of 567 trophies exported) of the blue duiker hunting trophies exported from South Africa between 2010 and 2015, has a formal harvest management plan for blue duiker. The conservancy applies rotational patch-based hunting, supported by monitoring of re-occupation of hunted patches (Novellie 2017). Hunting in the conservancy is conducted in only a small proportion (less than 22%) of the available blue duiker habitat, thus ensuring substantial reserve or "no take" areas from which duikers can disperse to repopulate hunted areas. Trophy hunting of blue duiker in the conservancy is thus well-managed and sustainable (Novellie 2017). In the Amatole Region of the Eastern Cape, a total of 20 blue duikers (4%) have been hunted between 2010 and 2015. These hunts were spread throughout the region on properties that do not have a Certificate of Adequate Enclosure (CAE) for blue duiker. None of these properties have a harvesting or off-take management plan.		
	Generate conservation benefit	1
	Population management/control	2

13. Aim of harvest regime in management planning: What is harvest aiming to achieve?	Maximize economic yield	3
	Opportunistic, unselective harvest, or none	4
	Uncertain	5
Currently, the majority of the annual off-take originates from one conservancy, Kowie-Kariega Conservancy, in the Eastern Cape. Approximately 52% of all blue duiker hunting trophies exported from South Africa between 2010 and 2015 were hunted on this conservancy. The hunting quota for blue duiker hunting in the Kowie-Kariega Conservancy is established by landowners through an annual assessment of animal availability and is coordinated within the conservancy (Novellie 2017).		
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 are no national or provincial quotas for the off-take of blue duiker in South Africa and provincial Management Authorities issue permits on a case-by-case basis. The majority of current legal off-take occurs on the Kowie-Kariega Conservancy, where approximately 52% of all blue duiker hunting trophies exported from South Africa between 2010 and 2015 were hunted. The hunting quota for blue duiker hunting in the Kowie-Kariega Conservancy is established by landowners through an annual assessment of animal availability and is coordinated within the conservancy (Novellie 2017). The remainder of the properties where blue duiker are hunted have no quota or adaptive hunting framework. The above score is allocated based on the property with the greatest off-take (Kowie-Kariega).		
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
Hunting of blue duiker is not practiced in any of the provincial or national parks within its natural distribution range.		
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
All of the legal national harvest occurs outside of protected areas on private land. Currently, the majority of the annual off-take originates from one conservancy, Kowie-Kariega Conservancy, in the Eastern Cape. Approximately 52% of all blue duiker hunting trophies exported from South Africa between 2010 and 2015 were hunted on this conservancy. Trophy hunting of blue duiker in the Kowie-Kariega Conservancy is considered to be well-managed and sustainable (Novellie 2017).		
	None	1

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?	Low	2
	Medium	3
	High	4
	Uncertain	5
To date, no permits have been issued for the harvesting of blue duiker within open access areas.		
18. Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?	High confidence	1
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5
In all provinces where blue duiker occur, budget and human resources required for the development and implementation of species management plans are limited. There is a low confidence in the harvest management of blue duiker due to budgetary constraints, lack of capacity and proper planning, the lack of a national blue duiker management plan, as well as a permitting system that is inadequate for the regulation of blue duiker. Provincial Management Authorities do not have sufficient resources to confirm whether permitted trophy hunts actually take place. Furthermore, the effectiveness of the current management system is in doubt as the outcomes of current management practices are seldom measured, and when measured, monitoring and evaluation are not standardized or formalized. In contrast, the confidence in the harvest management of blue duiker within the 35,000 ha Kowie-Kariega Conservancy in the Eastern Cape, is high (Novellie 2017). There is thus an overall medium confidence in harvest management.		
Monitoring of harvest		
19. Methods used to monitor the harvest: What is the principal method used to monitor the effects of the harvest?	Direct population estimates	1
	Quantitative indices	2
	Qualitative indices	3
	National monitoring of exports	4
	No monitoring or uncertain	5
At present harvest of blue duiker is being monitored through a provincial permit system and records of CITES exports. An analysis of the CITES trade data for 2002 – 2015 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) showed that 1,183 blue duiker trophies and 42 live animals were exported over a 14 year period. The Kowie-Kariega Conservancy applies for and receives a substantial portion of the blue duiker hunting permits issued in a year. The conservancy hunted approximately 297 blue duikers between 2010 and 2015, approximately 52% of all blue duiker hunting trophies exported from South Africa (567) between 2010 and 2015. The effects of harvest, including both translocation and hunting, are however not currently monitored and there is often a lack of knowledge of what happens on the ground. Copies of Professional Hunters registers and permits are sent to the relevant government departments, but it is difficult for scientists/ecologists within the Department to access these records and they therefore cannot be used as a monitoring tool. At present no monitoring or procedures are in place to quantify illegal harvest. In the Kowie-Kariega Conservancy, permits to harvest are issued on the basis of requests from the respective properties within the conservancy. For ambush hunts, camera traps are used in advance of the hunt to check the presence of mature individuals, mostly males, suitable for hunting. Ambush hunting sites are not re-hunted for at least a year, and then only if camera trapping reveals the presence of mature blue duiker. Drive hunts are also informed by monitoring of repopulation of hunted patches, but this is less systematic and quantitative than for ambush hunting (Novellie 2017). Before a repeat drive hunt is conducted in a		

patch, landowners verify the presence of blue duiker from reports of game guards, predator control hunters and cattle herders, and in some cases also from the presence of spoor and dung middens (Novellie 2017).

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

Due to budgetary and capacity constraints within all provinces where blue duiker occur, farms are not inspected nor is the information submitted by private game farms analysed. There is thus a low confidence in monitoring the effects of the harvest of blue duiker. In the Western Cape there is no capacity to evaluate the impact of the closing of the blue duiker hunting season due to a lack of population data pre and post closure. In the Eastern Cape there is an overall low confidence in harvest monitoring due to a lack of resources. There is however a high confidence in the harvest monitoring implemented within the Kowie-Kariega Conservancy where records are kept of blue duikers hunted or sold. Hunting of blue duiker in a specific forest patch (the ambush method) only occurs when camera trap observations indicate that the hunted patch has been re-occupied by mature individuals. Monitoring of the impact of drive hunting also takes place, although less systematically. There is a low confidence in SANParks' capacity to monitor the illegal harvest of blue duiker since monitoring is only undertaken in potential problem areas, not the entire forest.

There is thus an overall medium confidence in harvest monitoring.

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

Trophy hunting as practised in the Kowie-Kariega Conservancy is deemed to be beneficial. Income generated is used to manage habitat and improve the protection of species in general. Landowners in the conservancy are sensitive to the potential impacts domestic livestock can have on blue duiker habitat, while game patrols monitor poaching and actively remove snares. Predators are actively managed to reduce impacts on the blue duiker and other small antelope populations (Novellie 2017). Outside of this conservancy, utilization of the species is likely to be harmful if taken together with the major threat of habitat loss and fragmentation. The overall effect of harvest is thus neutral.

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

At present trophy hunting and live sales provide the only incentives for the conservation of the species. The current live trade value for blue duiker is approximately R26,000 per individual and blue duiker trophies sell for US\$1,175 (R15596 @ \$1 = R13.27). Income generated through trophy hunting within the Kowie-Kariega Conservancy is used to manage habitat, for example by funding alien invasive eradication programmes, and to improve the protection of the species through the employment of game guards and anti-poaching patrols (Novellie 2017). Conservancies in KwaZulu-Natal, such as Kloof, Southbroom, Clansthal, Leisure Bay, Pumula, and Umtentweni to name but a few, have measures in place to actively conserve blue duiker and other forest/bush associated species purely for their intrinsic conservation value such as alien plant removal, snare removal, habitat

restoration programmes and public awareness drives. Trophy hunting could however be used as a conservation tool to incentivize other landowners to better manage blue duiker habitat and improve the protection of the species on their properties.

At present captive breeding facilities keeping blue duiker are benefiting financially from keeping and selling the species, but do not directly or indirectly contribute to the conservation of the species. The objective of these captive breeding facilities is economic gain and not for the re-introduction of the species back into the wild.

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

Landowners have changed land uses to improve the habitat for blue duiker within the Kowie-Kariega Conservancy. Income generated through the trophy hunting of blue duiker is used for the management of habitat, for example by funding alien invasive eradication programmes, and for the protection of the species in general. However, there is no incentive for habitat conservation elsewhere through the harvesting of the species.

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

More than 15% of the blue duiker population occurs on formally protected land, including the following protected areas and state forests: Addo Elephant National Park, Baines Nature Reserve, Dlinza Forest Nature Reserve, Durban Bluff Nature Reserve, Dwesa-Cwebe Nature Reserve (Hayward et al. 2005), East London Coast Nature Reserve, Enseleni Nature Reserve, Entumeni Nature Reserve, Fort Fordice Nature Reserve, Garden Route National Park, Goukamma Nature Reserve, Harold Johnson Nature Reserve, Hluleka Nature Reserve, Kenneth Vernon Crookes Nature Reserve, Keurboomsriver Nature Reserve, Krantzklouf Nature Reserve, Mbumbazi Nature Reserve, Mkambati Nature Reserve, Mpenjati Nature Reserve, Mpofu Nature Reserve, Nkandla Forest Nature Reserve, Ongoye Forest Nature Reserve, Oribi Gorge Nature Reserve, Silaka Nature Reserve, Stainbank Nature Reserve, Thomas Groendal Nature Reserve, and Umtamvuna Nature Reserve. Hunting of blue duiker is not allowed in any of the national or provincial parks where blue duikers occur.

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

The majority of the protected areas with blue duiker are fenced and fences are maintained, although it can be argued that fences are detrimental to blue duiker survival as it restricts movement and dispersal of the species between suitable habitat patches. Much of the Garden Route National Park, Western Cape is however not fenced. Field rangers are employed in all of the protected areas. The effectiveness of these measures is not currently being monitored, though there is some camera trap monitoring underway to assess the population densities of blue duiker within protected areas. Furthermore, the impacts of other species on blue duiker have not been investigated. There is thus uncertainty whether current protection measures are effective. There is a medium confidence in the control of illegal harvest in protected areas managed by SANParks. Anti-poaching controls are

undertaken primarily in high risk areas, and there are no known incidences of blue duikers illegally harvested in Garden Route National Park forests.		
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
At present both hunting and translocation of blue duiker are regulated through a system of permits, which is considered effective. There is currently no hunting season for blue duiker in the Western Cape.		

List of participants

1. Alan Southwood (DEDEA)
2. Barend le Roux (CapeNature)
3. Brent Coverdale (Ezemvelo-KZN Wildlife)
4. Dale Cunningham (WRSA)
5. Dean Peinke (Eastern Cape Parks and Tourism Agency)
6. Deon Hignett (CapeNature)
7. Div De Villiers (DEDEAT)
8. Gerhard Heyneke (WRSA)
9. Graham Kerley (NMMU)
10. Ipeleng Machwisa (DEA)
11. Jeanetta Selier (SANBI)
12. Michele Pfab (SANBI)
13. Mncedisi Cindi (DEA)
14. Mpho Tjiane (DEA)
15. Noluthando Bam (DEDEA)
16. Pieter Novellie
17. Quintus Hahndiek (DEDEA)
18. Ricky Hannan (DEDEA)
19. Tharia Urwin (PHASA)
20. Walter Currie (WRSA)
21. Yvette Ehlers-Smith (UKZN)

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