

# Spotted Hyaena *Crocuta crocuta*



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|                              |                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Namibian conservation status | Vulnerable                                                                                                                                                                                                                                                                                                                                                    |
| Global IUCN status           | Least Concern                                                                                                                                                                                                                                                                                                                                                 |
| Namibian range               | 399,800 km <sup>2</sup>                                                                                                                                                                                                                                                                                                                                       |
| Global range                 | 14,652,100 km <sup>2</sup>                                                                                                                                                                                                                                                                                                                                    |
| Population estimate          | Namibia: 615–715<br>Total population: 27,000 to 47,000 individuals                                                                                                                                                                                                                                                                                            |
| Population trend             | Namibia: Stable<br>Globally: Decreasing with rapid decline outside protected areas                                                                                                                                                                                                                                                                            |
| Habitat                      | Woodland, savanna, semi-desert and true desert, mountainous terrain. Wide habitat tolerance throughout its range south of the Sahara but not found in tropical rain forests in West and Central Africa                                                                                                                                                        |
| Threats                      | <ul style="list-style-type: none"> <li>▶ Trophy hunting</li> <li>▶ Retaliatory killing – snares, poisoning, gin traps</li> <li>▶ Killed in snares intended for other animals</li> <li>▶ Road mortality</li> <li>▶ Negative public image leading to little conservation concern</li> <li>▶ Body parts for traditional medicine and commercial trade</li> </ul> |

## DISTRIBUTION

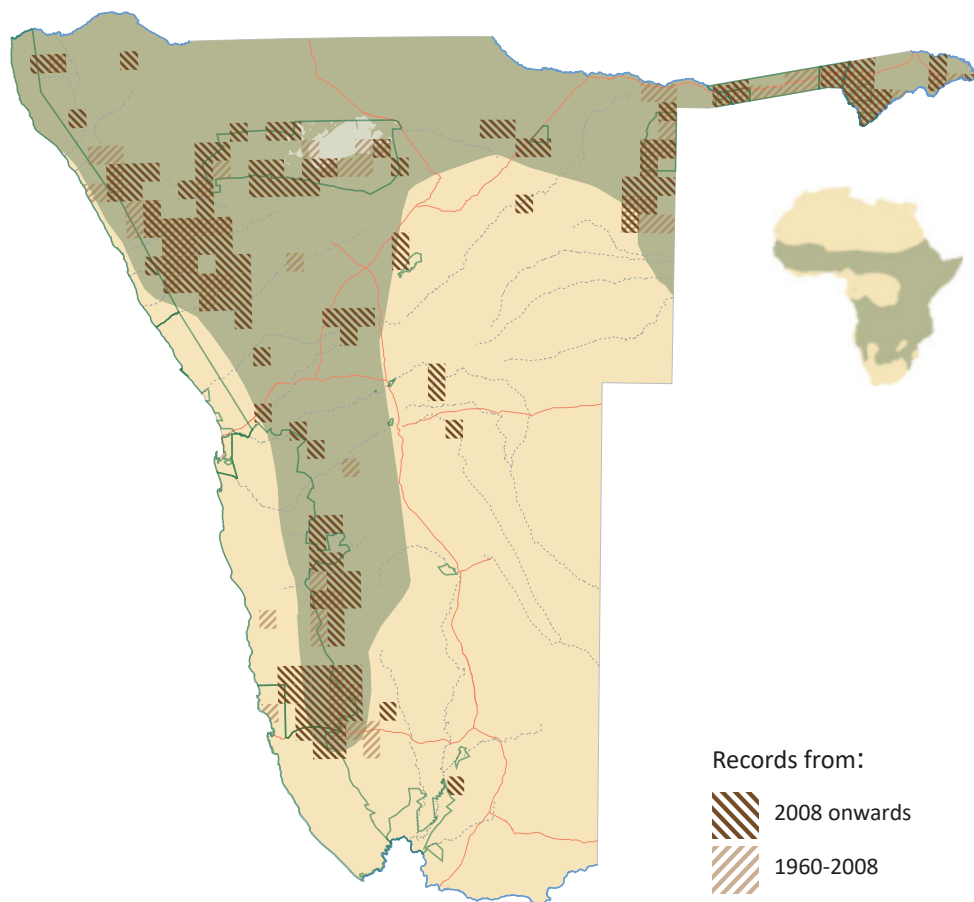
Spotted hyaenas generally occur at low densities in Namibia and are heavily persecuted outside protected areas. While the majority of the population is found in national parks and fenced-in private game reserves, they do also occur outside protected areas in the north-west and north-east but mostly in areas with few human settlements. Spotted hyaenas move into south-east Namibia from the Kgalagadi Transfrontier Park in Botswana, but are generally persecuted by farmers. It is unlikely that they are resident there.

Spotted hyaenas have a wide distribution south of the Sahara with the exception of tropical rain forests in West and Central Africa. They occur in a very wide array of habitats from semi-desert to montane forest up to 4,000 m elevation, through savannah, woodland and swamps. They are absent from lowland tropical rainforests, but can occur in very low densities in extreme deserts (East & Hofer 2013). Their presence in the southern Namib suggests that they can survive (with enormous home ranges, I Wiesel unpublished data) under these very marginal conditions.

Distribution records of spotted hyaena, and present estimated area of distribution in Namibia.

Inset: African distribution of spotted hyaena according to IUCN (Bohm & Höner 2015).

The Namibian distribution in the main map is more up to date and does not necessarily agree with the distribution shown in the inset.



Records from:



## POPULATION ESTIMATE AND TREND

The global spotted hyaena population is estimated between 27,000 and 47,000 individuals, with only a few populations in East and southern Africa exceeding 1,000 individuals (Bohm & Höner 2015). Even though they are classified as Least Concern by the IUCN (Bohm & Höner 2015), their population is decreasing across their range mainly because of habitat loss, natural prey shortages and conflict over livestock predation (Bohm & Höner 2015). Spotted hyaenas are rapidly disappearing from landscapes in West Africa including inside protected areas (Hofer & Mills 1998b). Their numbers are also declining inside some protected areas in southern Africa due to trophy hunting and snaring (Hunnicuttt *et al.* 2016). Spotted hyaena numbers are stable in Namibia, however, the total estimated population does not exceed 715 individuals according to the estimations given below derived from field research and expert knowledge.

Like most predators, spotted hyaena densities are linked to prey availability (Périquet *et al.* 2015a). In the East African plains, where prey is plentiful, hyaena densities range from 0.1 to 1 individuals/km<sup>2</sup> (Kruuk 1972, Frank 1986, Hofer & East 1993a, Ogutu & Dublin 1998, Ogutu & Dublin 2002, Boydston *et al.* 2003a, Höner *et al.* 2005, Kolowski *et al.*

2007, Kolowski & Holekamp 2009, Watts & Holekamp 2009, Pangle & Holekamp 2010). In the wooded savannahs of Kruger National Park (South Africa) and Hwange National Park (Zimbabwe), densities range from 0.09 to 0.12 individuals/km<sup>2</sup> (Mills 1985, Henschel & Skinner 1990, 1991, Périquet 2014). In the Kalahari Desert, where prey occurs at low densities, spotted hyaena densities are also low, ranging from 0.056 to 0.09 individuals/km<sup>2</sup> (Mills 1990a). Spotted hyaena density in Namibia ranges widely from 0.056–0.09 individuals/km<sup>2</sup> in Etosha National Park (Trinkel *et al.* 2004, Trinkel & Kastberger 2008) to 0.008–0.02 individuals/km<sup>2</sup> in the protected areas and peripheral conservancies of the north-east (P Beytell, L Hanssen, J Robertson & M Roodbool unpublished data). In southern Namibia, clans range over extensive areas in order to forage, resulting in exceptionally low density (I Wiesel unpublished data).

The biggest population of spotted hyaenas occurs in the Etosha/Kunene system with an estimated 340 individuals (Trinkel 2009). The southern Namibia population is not likely to exceed 50 individuals (I Wiesel unpublished data). Five clans have been identified in southern Namibia including the privately owned NamibRand Nature Reserve (I Wiesel unpublished data, M Tindall & N Odendaal pers. comm.) with transient individuals moving as far north as the Khomas Hochland (I Wiesel unpublished data). This has led to the

misperception that spotted hyaenas are recovering in freehold farming areas and that numbers are increasing nationally.

In north-eastern Namibia, spotted hyaenas are mostly restricted to small protected areas or areas peripheral to parks where there is little interference from people. The north-east population estimate range of 225–325 spotted hyaenas is based on the following:

- ▶ 60–80 in Bwabwata National Park, 10–20 in Mudumu National Park, 10–20 in a maximum of two clans in the eastern State Forest (shared with the Wildlife Management Areas of Zambia) and the woodlands of the eastern Chobe Complex. Conflict with spotted hyaenas in the Lusesse Conservancy is indicative of resident animals (L Hanssen unpublished data, Hanssen *et al.* 2017);
- ▶ 80–110 in Khaudum National Park, 10 in Mahango Core Area, 10 in Mangetti National Park (P Beytell pers. comm.);
- ▶ 30–60 in Nyae Nyae Conservancy (J Robertson & M Roodbool pers. comm.);
- ▶ Incidents of conflict in the eastern Otjozondjupa Region suggest that spotted hyaenas occur at low density ranging over extensive areas similar to southern Namibia, or there are transient individuals moving west and south from resident populations in Nyae Nyae Conservancy/ Khaudum National Park and Botswana. If resident, clan size is unlikely to exceed 15 individuals ranging over thousands of square kilometres (based on insight by researchers, expert opinion and Event Book records-monitoring records kept by Community Game Guards and Park Rangers).

Spotted hyaenas are currently non-resident in Nkasa Rupara National Park, as they require a system that supports medium-sized prey species (Purchase 2004). Nkasa Rupara is a wetland/floodplain system that is dominated by large animals such as elephant and buffalo.

Transient and dispersing spotted hyaenas occasionally move exceptionally far distances and have been observed in the freehold farming areas. Two images of spotted hyaenas were captured on camera trap in the Waterberg area in 2006 (A Stein pers. comm.), on commercial farmland in Otjiwarongo in 2017 (CCF pers. comm.) and on a freehold farm near Omaruru in 2018 (NAPHA & L Richmond-Coggan pers. comm.). A male spotted hyaena that was born into a clan near Garub, Aus was photographed by camera trap ~450 km away on a farm in the Khomas Hochland in 2018 (I Wiesel pers. comm.)

Spotted hyaena reproduction, population growth and

recovery are extremely slow but the current population trend is stable. To maintain this situation, however, it is important that the population structure also remains stable. Clan disruptions due to the removal of individuals, especially dominant ones, are costly for all clan members, and could interfere with reproduction and possibly result in the disintegration of the entire clan (Holekamp *et al.* 2007, Silk 2019, K Stratford pers. comm.). This is of particular concern where spotted hyaenas are trophy hunted within the boundaries of protected areas or in areas adjacent to them.

## ECOLOGY

In spotted hyaena, even though the skeletons of both sexes are of similar size, females are heavier than males, weighing on average 68.5 kg in southern African populations, while males average 61 kg (Skinner & Chimimba 2005). In north-eastern Namibia, adult males weigh over 50 kg and females 80–90 kg (P Beytell & K Stumphe pers. comm.).

They form large groups called clans, characterised by a strict matriarchal hierarchy where females are usually dominant over males (Kruuk 1972), and a dynamic group composition, expressed through frequent splitting and merging of groups (fission-fusion). All females in a clan reproduce, but the dominant individuals exhibit the highest reproductive success due to their privileged access to food and support (Kruuk 1972, Hofer & East 1993b, Frank *et al.* 1995, Vullioud *et al.* 2018). Clans usually consist of many related adult females and one to several breeding-age males, usually fewer than the females (Holekamp & Dloniak 2010). Young adult males emigrate from their natal clan and attempt to join other clans (Holekamp & Dloniak 2010, Höner *et al.* 2007). Immigrant males are responsible for most of the reproduction, although natal males also sire offspring when their fitness prospects in their natal clan are similar to the ones in another clan in East Africa (Davidian *et al.* 2015, Engh *et al.* 2002). Breeding occurs throughout the year and one or two, rarely three cubs per litter are born, with eyes open and teeth erupted. The cubs are dependent on their mother's milk (which has the highest protein content of all terrestrial carnivores) for the first year of their lives (Kruuk 1972). Mean litter size in the Namib and southern Namibia



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is 1.67 (range 1–3) where out of nine known litters, five had a single cub, three had two cubs and one had three cubs (M Lemerle & I Wiesel unpublished data). In the Zambezi Region's Mudumu National Park, two litters of one cub each were recorded (L Hanssen unpublished data). A litter of two cubs and a litter with a single cub were recorded in the Kwando Core Area in Bwabwata National Park. (L Hanssen unpublished data). Cubs are born in natal dens and when they are old enough they are moved to communal dens. As births are not synchronous and spotted hyaenas breed throughout the year, cubs of all ages can be found at the communal den. Spotted hyaena dens have wide entrances that are sometimes used by adults, but the tunnels narrow as they get deeper, which allows cubs to hide from all dangers including adult hyaenas from their own clan that could harm them (Holekamp & Dloniak 2010).

Clan members share the same home range, whose size and defence depends mainly on prey availability and movement patterns. In the rich plains of the Ngorongoro Crater (Tanzania) and Serengeti (Kenya), spotted hyaenas form large clans of 30–80 individuals and their home ranges are small (25–30 km<sup>2</sup>; Kruuk 1972, Höner *et al.* 2005). Where prey is resident, the home range is fiercely defended from neighbouring clans but when prey is migratory, home range boundaries are loose, and spotted hyaenas commute between their dens and migratory herds (Kruuk 1972, Hofer & East 1993a). In the Kalahari Desert, where prey is scarce and dispersed, spotted hyaenas form smaller clans (~10 individuals) and roam over very large home ranges of more than 1,000 km<sup>2</sup> (Mills 1990a). In Etosha National Park, where prey is attracted to permanent waterholes, clans of 9–18 individuals use home ranges of 325 km<sup>2</sup> (Trinkel *et al.* 2004, Trinkel & Kastberger 2008). In the Namib Desert and southern Namibia, clan size ranges between 5 and 10 adults and sub-adults. Clan structure is dependent on birth, deaths, immigration and emigration. In one study clan, 8 cubs were born over two years, but 5 individuals emigrated from the clan during the same period of time (M Lemerle & I Wiesel unpublished data). These small clans have enormous home ranges resulting in exceptionally low density. One collared adult female moved over an area of 4,584 km<sup>2</sup> in just over a year. Another collared female moved over 1,052 km<sup>2</sup> in three weeks (M Lemerle & I Wiesel unpublished data). A collared male moved over 633 km<sup>2</sup> and was recently photographed in the Khomas Hochland, 450 km from his natal home range (I Wiesel unpublished data).

In north-eastern Namibia, clan size is similar and ranges between 5 and 15 adults and sub-adults. But home range sizes are much smaller than in the Namib, ranging from 580 to 710 km<sup>2</sup>. Various clans are resident in the Mudumu and Bwabwata National Parks and adjoining conservancies, with some of them foraging into Angola. Their persistence in the parks depends as much on the surrounding conservancies as the parks themselves (L Hanssen unpublished data).

Collar data from a single spotted hyaena in the Multiple Use Area (MUA) of Bwabwata National Park showed that it moved over 1,000 km<sup>2</sup>. This is likely due to its young age and the fact that spotted hyaenas were only just establishing themselves in the MUA at the time of the study (L Hanssen unpublished data). Two clans have now established themselves in the MUA (Hanssen *et al.* 2017).

Although clans appear to be of similar size throughout Namibia, i.e. 5 to 15 individuals, a clan of 23 individuals has been recorded in southern Khudum National Park (P Beytell pers. comm.). This is likely due to higher productivity of this system along with permanent waterholes in the park, resulting in high numbers of elephant calves as well as other resident prey species. A clan of at least 30 adults has also been recorded on Ongava Game Reserve with a home range of ~370 km<sup>2</sup> extending over to Etosha National Park (Stratford & Stratford 2011, Stratford *et al.* 2019).

Spotted hyaenas are predominantly nocturnal and extremely vocal, especially around carcasses and during social interactions. They are opportunistic and highly flexible predators, capable of taking down large prey such as zebras and elephant calves (Salnicki *et al.* 2001), and are well adapted to scavenging due to their strong jaws and efficient digestive system (Kruuk 1972). About 90–95% of their daily energy requirement may comprise prey species that they kill themselves (L Hanssen unpublished data, Hayward 2006). However, this high proportion recorded by L Hanssen was carried out in a period when there were virtually no lions in the park. With recovering lion numbers, it is possible that left-over kills will provide more scavenging opportunities to spotted hyaenas. The proportion of own kills across their entire range can be as low as 43% (Holekamp & Dloniak 2010). They frequently steal kills from other predators (Kruuk 1972, Höner *et al.* 2002, Watts & Holekamp 2009). They readily scavenge on leftover kills, including elephant carcasses, and even consume elephant dung. They are able to digest all organic material except hairs, horns and hooves, and excrete mostly calcium carbonate from bones, making their faeces white (Kruuk 1972).

Spotted hyaenas take advantage of human refuse (Kolowski & Holekamp 2008, 2009, Cozzi *et al.* 2015, Yirga *et al.* 2015) and regularly visit dumpsites, as seen in the Kwando clan which pay nightly visits to the military base scavenging for left-over food. The presence of dumpsites has been known to temporarily impact on home range size and use in some areas (Plaza & Lambertucci 2017, Kolowski & Holekamp 2008), and the military base dumpsite was the second-most frequented location in their home range after their dens (L Hanssen unpublished data). Non-food items identified through scat analysis of the Kwando spotted hyaenas included wax wrap, nylon sacking, string and even a 50c coin (L Hanssen unpublished data).

In general, spotted hyaenas are considered to be generalist foragers, feeding on a wide range of available prey (Hayward 2006), and concentrating on the most abundant species of medium to large size. However, they do show some prey selectivity (Cooper 1990, Höner *et al.* 2002, Wentworth *et al.* 2011, Périquet *et al.* 2015b). Spotted hyaenas living on floodplains in the Zambezi Region have been found to prefer certain species above others and will actively seek them out (L Hanssen unpublished data). For instance, even though reedbuck occur in very low numbers due to habitat restrictions, they make up almost half the diet of floodplain spotted hyaenas. Other species that appear to be preferred are tsessebe, lechwe and buffalo calves. Impala, sable, steenbok, warthog and zebra are also taken, although probably in relation to their abundance. Surprisingly, kudu were not preyed on by spotted hyaenas in this area, possibly due to their inhabiting wooded dune areas making them harder to hunt. Wildebeest and roan are also abundant in the landscape, but appear to be avoided prey species for these spotted hyaenas (L Hanssen unpublished data).

## THREATS

Spotted hyaenas are key components of healthy ecosystems and provide valuable ecosystem services as scavengers (Moleón & Sánchez-Zapata 2015, Sonowane *et al.* 2021). They are also exceptionally slow to reproduce and often do not readily recover their numbers, even under optimal conditions such as in protected areas. Their complex hierarchical clan structure and social organisation makes spotted hyaenas very sensitive to the removal of key

individuals (Holekamp *et al.* 2007, Silk 2019, K Stratford unpublished data). Studies on spotted hyaena populations affected by human disturbance show increased vigilance, changes in home range use, and declines in local populations as a result of human-spotted hyaena interactions on the edges of protected areas (Pangle & Holekamp 2010, Boydston *et al.* 2003b).

Threats to spotted hyaenas in Namibia are wide ranging. In the north-east, they are killed in response to conflict with livestock farmers and trophy hunting is allowed inside protected areas such as in Bwabwata National Park and in mosaic landscapes such as the Mudumu North Complex, where conservancies surrounding the parks are vital for the persistence of spotted hyaenas inside parks. As most spotted hyaenas in the Zambezi Region are dependent on transboundary movements, the negative effects of hunting spotted hyaenas will impact on the protected areas of neighbouring countries too. Quotas for different conservancies all affect the same source population, which is a single clan in Mudumu National Park and a single clan in the State Forest.

Authorised “problem animal control” hunts are granted to hunting operators to mitigate human-spotted hyaena conflict and generate some money from the hunt for the local conservancies. There are severe shortcomings to hunting spotted hyaenas for either trophies or as “problem” animals, however. Firstly, it is extremely difficult to tell the sexes apart, often resulting in females being mistaken for males and shot. Any young cubs of a female that is killed



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will also die, as they are not cared for by the rest of the clan (Mills 1985). Removing the alpha female may result in the disintegration of the entire clan. Secondly, targeting and killing any specific problem individual is difficult because they range widely and have learned to avoid human activity. Finally, spotted hyaenas are opportunistic hunters that will prey on unprotected livestock at night, so no one individual can be identified as a “problem animal”; killing one individual is therefore unlikely to reduce losses to hyaenas if livestock remain unprotected (L Hanssen pers. obs.). Consequently, there is no evidence to date that trophy hunting of spotted hyaenas reduces livestock depredation and lessens conflict with humans. We therefore argue that improving the safety of livestock is preferable to killing spotted hyaenas.

Besides ecological considerations, the trophy price of spotted hyaenas is so low that the income from these hunts for local communities is negligible. The seven spotted hyaenas hunted in communal conservancies throughout Namibia in 2017 generated N\$44,100, which is only 10% of the revenue generated by hunting three lions and 6% of that generated from hunting 13 leopards in communal conservancies during the same year (MEFT 2020). Following MEFT’s new quota-setting guidelines, no quotas for spotted hyaena trophy hunts have been granted for the current three-year quota cycle (2019-2021) in communal conservancies (R Fryer pers. comm.).

In the north-western Kunene and Erongo Regions, spotted hyaenas cause more conflict incidents than any other species (>700 incidents in 2018), yet they are rarely killed as problem animals (<0.1% of the incidents caused) by government authorities or trophy hunters (MEFT/NACSO 2020). It appears that communities in this part of Namibia are more tolerant towards this species than they are towards lions, which are killed in over 10% of the conflict incidents they cause (MEFT/NACSO 2020).

Road mortality is increasing due to increased traffic on main trade routes such as the Trans-Zambezi Highway that runs through Bwabwata National Park and the Mudumu North Complex. Spotted hyaenas have also been killed by vehicles on the C49 road that runs through Mudumu National Park. The recent tarring of the road with a speed limit of 120 km/h has resulted in vehicles driving at higher speeds. Up to three spotted hyaenas a year are killed by vehicles in the Zambezi Region (L Hanssen unpublished data).

Spotted hyaenas are killed on farms bordering Etosha National Park at an estimated rate of 45 individuals per year, representing >10% of the population in the park (Trinkel 2009). This population, although the largest in Namibia, may decline as a result of perceived and actual human-predator conflict on farms bordering the park (Trinkel 2009). Gin traps are set on freehold farms around the boundaries of Etosha

to prevent spotted hyaenas from entering farms and killing livestock. Gin traps are also set at livestock carcasses killed by spotted hyaenas. How this impacts on spotted hyaenas is unknown as many incidents are not reported (L Hanssen pers. obs.).

Like other large carnivores, spotted hyaenas are susceptible to snaring as their territorial patrolling and foraging behaviour result in increased probability of encounters with snares (Woodroffe & Ginsberg 1998). Snaring has increased particularly on the northern boundary of Etosha National Park and the western boundary of Khaudum National Park as people and their cattle settle closer to park boundaries. Snaring by-catch of spotted hyaenas appears to be increasing in north-eastern Namibia. At least one snared spotted hyaena has been recorded in every recent camera trap survey in this part of the country. This includes the 2014 and 2017 camera trap surveys of the Mudumu Complexes and the 2017 camera trap survey of Khaudum National Park (P Beytell pers. comm., L Hanssen unpublished data). A spotted hyaena in Nyae Nyae had to be euthanised in 2017 due to extensive snare-related injuries (J Robertson pers. comm.) and two three-legged spotted hyaenas have been photographed in the Mudumu North Complex (L Hanssen unpublished data) including inside Mudumu National Park. As spotted hyaenas in the Zambezi Region regularly move across international boundaries, they are susceptible to snaring in the Game Management Areas of Zambia (Becker *et al.* 2013) and gin traps in Angola that are set for the extraction of bush meat (Funston *et al.* 2017b).

Spotted hyaenas are exceptionally intelligent making them difficult to shoot in retaliation for the killing of livestock. For this reason, they are occasionally poisoned by livestock farmers in retaliation for, or to prevent livestock losses (Ogada 2014). The extent of targeted hyaena poisoning is unknown as the practice is illegal, however there is one known case from 2011 where a spotted hyaena was poisoned near the settlement of Mutjiku inside the boundaries of Bwabwata National Park (F Alpers pers. comm.). Due to their willingness to scavenge, they are extremely vulnerable to poisoned carcasses where vultures have been targeted in recent years in the KAZA TFCA (O Aschenborn pers. obs., A Botha pers. comm.). It is therefore possible that the absence or only sporadic occurrence of spotted hyaenas in some landscapes is due to poisoning as well as snaring. As the demand for lion and leopard body parts for illegal markets increases (Everatt *et al.* 2019, United Nations Office on Drugs and Crime 2020; MEFT and MHAISS 2021), we can expect to see an increase in targeted poisoning/snaring of large carnivores that will have a big impact on spotted hyaenas.

In recent years, a small demand for spotted hyaena body parts has developed. In the north-east, road kills have been found with their paws cut off and two spotted hyaenas



in the Buffalo Core Area were deliberately hit with a car and skinned (M Paxton pers. comm.). The skins were then offered for sale.

The negative public image of spotted hyaenas in Namibia contributes to the lack of conservation priority for this species. This was particularly evident in a recent series of events surrounding the protection of a feral horse population in the Namib-Naukluft National Park in southern Namibia (Brown 2019). Although horses are not native to Namibia, it has been argued that this particular population has cultural and historical value, as it has persisted in this desert region for about 100 years (mainly due to the artificial provisioning of water and supplementary feeding during drought). However, during the most recent drought, which started in 2013, the feral horses' condition severely weakened and spotted hyaena predation naturally increased. As a consequence, interest groups and certain sectors of the public viewed this predation negatively, and even tried to reduce the level of predation by providing the spotted hyaenas with supplementary food. However, the unstructured feeding regime led to increased human-spotted hyaena conflict, which resulted in the killing of 13 spotted hyaenas by local farmers and the government (Wiesel *et al.* 2018, Brown 2019). The government's killing of spotted hyaenas, after unsuccessful relocation attempts, was in response to a public outcry to the loss of new-born horse foals, born following the drought, to spotted hyaenas. Clearly, the feral horses were valued more highly than the native spotted hyaena population. By contrast, the lion population in Namibian arid areas is highly valued by the public as a unique subpopulation of lions that have adapted to this harsh environment (Stander 2019).

## CONSERVATION STATUS

Spotted hyaenas provide valuable ecosystem services and are important for the healthy functioning of natural systems yet receive little conservation consideration, largely due to their negative public image. Their global conservation status is Least Concern, but due to the small population size in Namibia and the many and increasing threats, the national status of Vulnerable is justified.

## ACTIONS

### Management

- ▶ Spotted hyaenas are complex social carnivores and trophy hunting anywhere in their Namibian range, including for the removal of problem-causing individuals, should be avoided as much as possible. Only in exceptional cases where a specific recognisable individual is known to be causing a specific repeated problem, should it be dealt with by the authorities.
- ▶ Trophy hunting quotas should be set taking other anthropogenic mortalities such as vehicle accidents and retaliatory killing into account.
- ▶ Resources need to be directed towards livestock protection, preventing predation by spotted hyaenas and other large carnivores within mosaic landscapes, near park boundaries and within wildlife dispersal areas. This is an ecologically sound approach for co-existence with wildlife, and can bring other benefits to both local communities and the national economy, as fewer livestock are lost.
- ▶ Traffic slowing measures need to be implemented, particularly where transit routes bisect important spotted hyaena habitat such as where the Trans-Zambezi Highway runs through omurambas in Bwabwata National Park. In areas with high wildlife mortalities on the road, the speed limit should be reduced to 80 km/h. Speed trapping of vehicles needs to take place at these high-risk zones, with heavy penalties for non-compliance.
- ▶ Roads Authority should be approached to close Bwabwata National Park to transit traffic from sunset to sunrise. This would not impact on trucks as border posts to Zambia and Botswana close at 19h00 and open again in the morning.
- ▶ Park planning, zonation and wildlife corridors should include spatial requirements of large carnivores.

### Awareness

- ▶ Awareness training for wildlife crime law enforcement



and judiciary staff needs to include incidents of poaching for large carnivore body parts.

- Conservation authorities and the general public should be sensitised as to the value of spotted hyaenas and large carnivores in general, and in conservation landscapes specifically.

### Research

- Dispersal patterns and connectivity of spotted hyaenas in north-east Namibia needs further attention. Recent results from Khaudum National Park indicate that spotted hyaenas are dependent on trans-boundary movement and traverse over enormous distances through landscapes (P Beytell & Z Mills unpublished data), making them increasingly vulnerable to persecution. Understanding dispersal routes would assist in implementing conservation steps and interventions for spotted hyaenas.
- Long-term monitoring through camera-trap surveys and spoor surveys is important particularly in north-east Namibia where spotted hyaenas are vulnerable to anthropogenic threats in neighbouring countries.
- The results of spoor surveys for spotted hyaenas need to be calibrated against camera-trap survey results, as spotted hyaenas cover large distances at night often resulting in an inflated population estimate derived from spoor frequency.

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