Caracal caracal – Caracal

Regional Red List status (2016)	Least Concern
National Red List status (2004)	Least Concern
Reasons for change	No change
Global Red List status (2016)	Least Concern
TOPS listing (NEMBA)	None
CITES listing	Appendix II (Asian population: Appendix I)
Endemic	No

The name Caracal is derived from the Turkish word *karakulak* meaning "black ear". Caracals were once trained for bird hunting, in Iran and India, where they were put into arenas with flocks of pigeons and wagers were made as to how many these felids would take down. Hence the expression "to put a cat amongst the pigeons".

Taxonomy

Caracal caracal (Schreber 1776)

ANIMALIA - CHORDATA - MAMMALIA - CARNIVORA - FELIDAE - *Caracal - caracal*

Synonyms: *Felis caracal* Schreber 1776

Common names: Caracal, African Caracal, Asian Caracal, Desert Lynx (English), Rooikat, Lynx (Afrikaans), Indabutshe (Ndebele), Thwane (Setswana), Thooane, Thahalere (Sotho), Nandani (Tsonga), Thwani (Venda), Ingqawa, Ngada (Xhosa), Indabushe (Zulu)

Taxonomic status: Species

Taxonomic notes: The Caracal has been classified variously with *Lynx* and *Felis* in the past, but molecular evidence supports a monophyletic genus. It is closely allied with the African Golden Cat (*Caracal aurata*) and the Serval (*Leptailurus serval*), having diverged around 8.5 mya (Janczewski et al. 1995; Johnson & O'Brien 1997; Johnson et al. 2006). Seven subspecies have been recognised in Africa (Smithers 1975), of which two occur in southern Africa: *C. c. damarensis* from Namibia, the Northern Cape, southern Botswana and southern and central Angola; and the nominate *C. c. caracal* from the remainder of the species' range in southern Africa (Meester et al. 1986). According to Stuart and Stuart (2013), however, these subspecies should best be considered as geographical variants.

Assessment Rationale

Caracals are widespread within the assessment region. They are considered highly adaptable and, within their distribution area, are found in virtually all habitats except the driest part of the Namib. They also tolerate high levels of human activity, and persist in most small stock areas in southern Africa, despite continuously high levels of persecution over many decades. In some regions it is even expected that Caracal numbers might have increased. Thus, the Least Concern listing remains. The use of blanket control measures over vast areas and the uncontrolled predation management efforts over virtually the total assessment region are, however, of concern. In the North West and Limpopo provinces, concerns have also been raised about hunting and live-removals. Ongoing monitoring, education efforts, and the continuous propagation of mitigation measures such as exclusion and precautionary techniques, the removal of proven damage-causing animals (DCAs), and sustaining sufficient levels of natural prey diversity and biomass on farmlands, should be a priority to prevent possible national declines. Attention must also be paid to the paucity of existing data about Caracal, especially on rangelands in southern Africa.

Regional population effects: Namibia, Botswana and South Africa offer an important stronghold for Caracal. Radio-collared Caracals have been documented moving between Namibia and South Africa across the western fence line of the Kgalagadi Transfrontier Park (KTP) (see Melville et al. 2004), and they have been camera trapped along the Molopo River along the South Africa–Botswana border (see Power 2014). Hence, these countries' borders are no doubt permeable to Caracal transboundary movements, which may include both individual forays as well as actual dispersals. In the other transfrontier conservation areas around and inside South Africa it is

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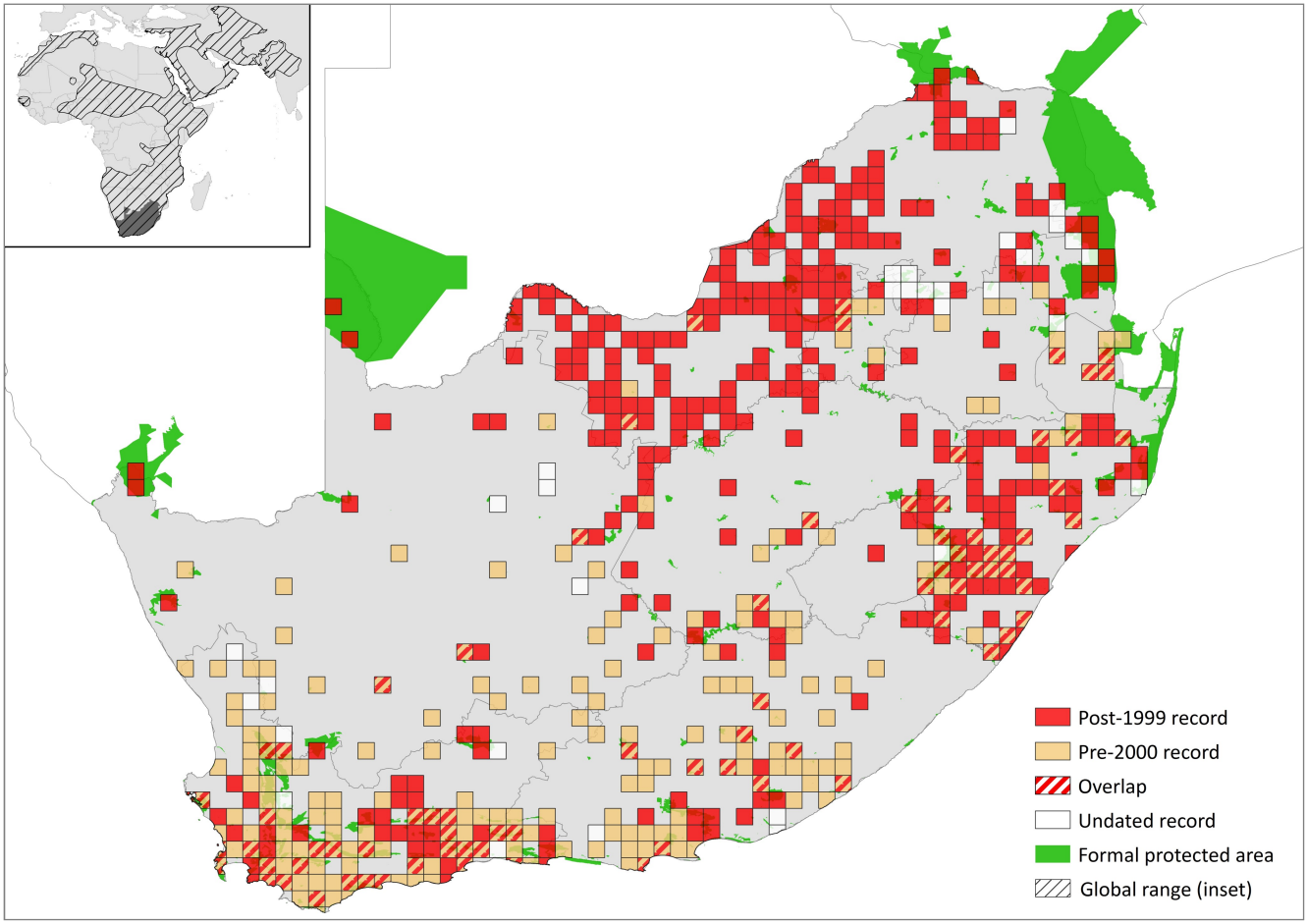


Figure 1. Distribution records for Caracal (*Caracal caracal*) within the assessment region

Table 1. Countries of occurrence within southern Africa

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

also plausible that some individuals will move between Mozambique, South Africa and Zimbabwe, and between South Africa and Lesotho; this has, however, not been documented. Further research is needed.

Distribution

Caracals are widely distributed across Africa, Central Asia, and southwest Asia into India (Avgan et al. 2016). The historical range of the Caracal mirrors that of the Cheetah (*Acinonyx jubatus*), and both coincide with the distribution of several small desert gazelles (Sunquist & Sunquist 2002).

Within the assessment region, although Caracals were amongst the species that were persecuted heavily by colonial settlers and then impacted further by crop and livestock farmers in the early part of the 20th century (Pringle & Pringle 1979; Stadler 2006; Bothma et al. 2009), Pringle and Pringle (1979) mentioned increasing numbers of Caracals in eastern areas from *c.* 1970.

Currently, the species occurs in all South African provinces, as well as in Lesotho and Swaziland. Historically, Caracals were rare in the western Kalahari (Lloyd & Millar 1983), and apparently absent from the Highveld grasslands of the North West Province (Rautenbach 1978). Caracals have responded well to game farming in especially the latter province, and today are present on over 95% of farms in the bushveld landscapes, and on at least three quarters of farms on grasslands in the North West Province (see Thorn et al. 2011; Power 2014). Accordingly, there has been an increase in area of occupancy (AOO) of the Caracal throughout the North West and western parts of the Limpopo Province (Thorn et al. 2011), while its extent of occurrence (EOO) has, from 2000 to 2010 (Thorn et al. 2011), and even up to 2013 (Power 2014), remained unchanged.

The species was absent or present in low densities in the KwaZulu-Natal Drakensberg during the 1960s, and individuals were brought in from the then Cape Province (see Barnes 1991). Since then, Caracal numbers have seemingly increased throughout the whole KwaZulu-Natal Province (Barnes 1991), barring the eastern coastal belt (Rowe-Rowe 1992; Skinner & Chimimba 2005).

The population today is probably contiguous and more widely spread over most of the assessment region than indicated by the post-1999 records in Figure 1. Skead (1980) reports that the southern Cape populations were, during dry years, regularly augmented from influxes from Karoo populations, so there may also be significant

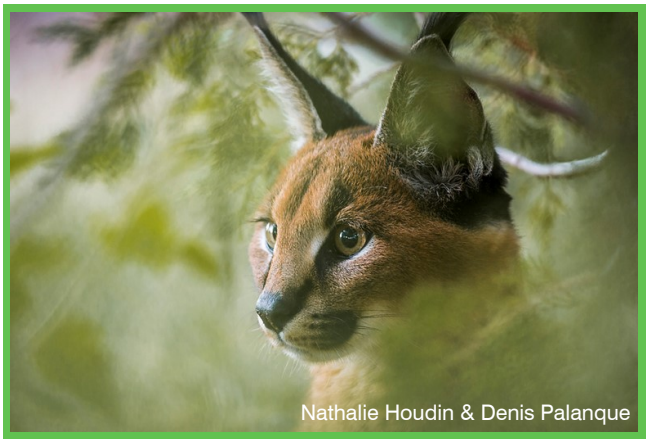
interchange at the biome level. Caracals, like most felids, do not migrate, but young individuals can disperse over extensive areas (Norton & Lawson 1985; S. Hanekom pers. comm. 1990).

Population

The Caracal is common in South Africa and southern Namibia where removed individuals seem to be quickly replaced by other individuals. No published data exist, however, to say that the species is common outside of parts of southern Africa; in fact, in comparison with the situation in the assessment region, Caracals are considered rare throughout most of their range (Avgan et al. 2016).

Early scientifically-gathered information on density estimates is virtually non-existent and makes comparison with newly gathered information, using relatively modern techniques, difficult. For the first time, benchmark information useful for future comparison has only recently been gathered, in South Africa's northern provinces (Thorn et al. 2011; Power 2014). This information suggests that, at least in the North West Province, the species' AOO has regionally increased (when compared to the information put forward in Rautenbach 1978), though, owing to differences in methodology (i.e. camera traps in later years), the significance of this is called into question. Notwithstanding, it is fact that records of this species were only forthcoming from this part of the Highveld grasslands well after the late 1990s (Transvaal Provincial Administration Records; Newbery 1995). Elsewhere, hearsay information and the proliferation of records do also support an eastward range expansion in KwaZulu-Natal. This was first observed by Rowe-Rowe (1992) when he compared his data with the earlier records of Pringle (1977) and Rowe-Rowe (1978); today, further expansion can be noticed when recent MammalMap and Figure 1 records are compared with those indicated in Rowe-Rowe (1992).

Caracal densities (as inferred from home range size) can vary markedly between habitats, depending on environmental variables such as the size, type, density and composition of prey available, habitat characteristics, and the degree of persecution by humans (Avenant 1993). For example, home ranges of males in Postberg Nature Reserve (PNR; part of the West Coast National Park) (Avenant & Nel 1998) were larger than those of males in the Mountain Zebra National Park (MZNP) (Moolman 1986), but smaller than those of males on farms around the MZNP (Moolman 1986). In turn, the home ranges in all three of these study areas were markedly smaller than that of a single male tracked in the mountains in the Western Cape (Norton & Lawson 1985). Similar differences were observed in female home ranges, with home ranges in a farming area, southwest Western Cape (Stuart 1982), significantly larger than at both MZNP (Moolman 1986) and PNR (Avenant & Nel 1998). The smaller home range size of females in the PNR could reflect the high density of rodent prey, the most common item in Caracal scats and the only prey group whose density and biomass significantly correlated with its percentage volume in Caracal scats at PNR (Avenant & Nel 1998). Fitting into the normal felid pattern, male home ranges are larger than those of females, and typically overlap with a number of female home ranges (Moolman 1986; Avenant 1993; Stuart & Stuart 2013). While sexual dimorphism, and the fact that the larger males may prefer larger prey species,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which are less densely spaced than the smaller prey species, are still debated as a possible reason for this observation, Avenant (1993) found, within each of the four study areas mentioned above (Stuart 1982; Norton & Lawson 1985; Moolman 1986; Avenant 1993), strong positive correlations between home range size and standardised metabolic needs (SMN, where SMN = body weight$^{0.75}$).

Avenant and Nel (1998) estimated a density of 0.23–0.47 Caracal / km^2 in PNR, while Moolman (1986) estimated a density of 0.38 Caracal / km^2 for MZNP. A density of 0.3 Caracal / km^2 is thus a reasonable estimate for a high-density population, should blanket extrapolations be required. Large differences may, however, occur on farmland where Caracals are actively hunted, and territoriality and social structure may differ from that in protected populations (du Plessis et al. 2015). Furthermore, in areas where Caracals and Black-backed Jackals (*Canis mesomelas*) co-occur, Caracal densities may be markedly lower in some habitats where they are excluded by Black-backed Jackals and vice versa (Ferreira 1988). Current information shows that, in such areas, Caracal seems to be the dominant species in more rocky and mountainous terrain and Black-backed jackal more dominant on open plains areas; this situation may, however, be impacted by the type and combination of prey items, as well as the persecution history of the area (see du Plessis 2013). Compensatory breeding is a factor that may explain the Caracal's resilience to persecution (Avenant & du Plessis 2008; du Plessis 2013), but this has not been confirmed for this species.

Considering the possibility of such varying density estimates, a robust population estimate would be difficult to attain based on the current lack of data. However, given their wide distribution in South Africa, that Caracals seems to prefer rocky or mountainous terrain (such as at PNR and MZNP), but are very adaptable and can occur in many different vegetation types (e.g. they also occur in the Kalahari), the total Caracal population in the assessment region could be anywhere between 45,000 and 150,000 individuals, depending on local densities (0.15–0.5 individual / km^2) and occupancy.

Current population trend: Unknown, but probably stable, based on wide habitat tolerance and extent of occurrence.

Continuing decline in mature individuals: Unknown, but unlikely.

Number of mature individuals in population: Unknown

Number of mature individuals in largest subpopulation: Unknown

Number of subpopulations: It is not currently possible to determine the extent or number of subpopulations. Caracal distribution is regarded to be continuous, with a notable exception being the population on the Cape Peninsula that may, to a large extent, be cut off from the "mainland" population by the relatively dense and vast urban area.

Severely fragmented: No, except for the population on the Cape Peninsula (see above). Caracals are highly adaptable, have a broad habitat tolerance and can exist in agricultural, rural and urban landscapes as long as there is food and cover, be it natural or alien.

Photo 1. Ewe killed by a female Caracal (*Caracal caracal*) on a farm in the central Karoo (Marine Drouilly)

Habitats and Ecology

The Caracal occupies a wide variety of habitats, from semi-desert to relatively open savannah and scrubland to moist woodland and thicket, evergreen forest, montane grassland, and arid mountains. It typically ranges up to 2,500 m and above 3,000 m asl in the Lesotho (Avenant & du Plessis 2012; du Plessis et al. 2014) and Ethiopian Highlands (Ray et al. 2005), and it occurs along the Drakensberg (Rowe-Rowe 1992) and Maluti (Avenant 2004) ranges. The species is absent from tropical forests and true deserts, and cover is needed wherever it occurs (Skinner & Chimimba 2005). In the Kalahari, Caracals showed a definite selection for dune slope aspect in relation to specific types of behaviour (Melville 2004). They did not select dune crests and dune slopes for specific activities more than expected, and the dune streets were selected less than expected except when killing prey. On rangelands where Caracals co-occur with Black-backed Jackals, the former are more common in the rocky areas than on open plains (du Plessis 2013). In the North West Province, Caracals occur in all vegetation types, but they generally prefer wooded vegetation types, especially mountain bushveld, and were found to have a local preference for the Gold Reef Mountain Bushveld (Power 2014). Caracals also occur in mountain and coastal fynbos, Strandveld, and in the various Nama and Succulent Karoo vegetation types. They are rare in Kruger National Park and adjoining private game reserves, where they appear to be more common in the mixed *Combretum spp*. woodlands on the granite landscapes. In such protected areas with large carnivores, they may be susceptible to interference competition. One particular competitor is the Leopard (*Panthera pardus*), with which they share a similar ecological role (see for example Norton & Lawson 1985; Braczkowski et al. 2012; Power 2014). Although spatial overlap between these species has been recorded (Jansen 2016: Namaqua National Park and surrounding farms; Cape Leopard Trust unpubl. data: Gouritz Corridor, Boland Mountains and Cederberg Mountains; M. Drouilly et al. unpubl. data: Anysberg Nature Reserve), interspecific killing of Caracals by Leopards has also been documented (Martins 2010) and Caracals are thus likely to avoid areas where Leopards are prevalent. In areas where large predators have been extirpated, such as on rangelands and in the Table Mountain National Park, the Caracal often assumes the role of apex predator (du Plessis 2013; Pohl 2015; L. Serieys, Urban Caracal Project, unpubl. data). On Free State farmland, Ferreira (1988) reported that Black-backed Jackal and Caracal numbers inversely fluctuated in some habitats where they co-occur, suggesting that these species may actively limit each other's numbers in certain areas; their diets do not only overlap to a large extent, but they have been reported predating on each other's young (Ferreira 1988; Pohl 2015), and adult Caracal even kill and eat adult Black-backed Jackal (Melville 2004; Q. Martins unpubl. data).

Caracal prey mainly on small- to medium-sized mammals, from small murids to antelope up to *c*. 50 kg, but they also take birds, reptiles up to the size of a large Rock Monitor (*Varanus albigularis*), and invertebrates (Stuart & Stuart 2013; Pohl 2015; Jansen 2016; M. Drouilly et al. unpubl. data). Very little plant material is ingested, and then considered mostly accidental; larger quantities have been found in scats, but then together with scorpion remains (Avenant 1993). They are known to kill and eat other carnivores, including Black-backed Jackal, Aardwolf (*Proteles cristata*), Bat-eared Fox (*Otocyon megalotis*), Cape Fox (*Vulpes chama*), Water Mongoose (*Atilax paludinosus*), Cape Grey Mongoose (*Herpestes pulverulentus*), Yellow Mongoose (*Cynictis penicillata*), Polecat (*Ictonyx striatus*), African Wildcat (*Felis silvestris*), Small-spotted Genet (*Genetta genetta*) and even conspecifics have been listed (e.g. Stuart 1982; Bekker 1994; Avenant 1993; Kok 1996; Melville 2004; Braczkowski et al. 2012; Pohl 2015). Caracals sometimes scavenge (Mills 1984; Avenant 1993; Nowell & Jackson 1996); in the PNR, however, these instances could be traced to non-territorial cats and not the dominant males or females (Avenant 1993). Like Leopards, they are known to hoist their kills into trees (see Mills 1984; Davies 1997), and may also return to carcasses; for example, in the PNR, a female with young has been documented to return to a carcass for up to four nights (Avenant 1993).

Relative to their small size, Caracals can readily capture prey larger than themselves, such as Springbok (*Antidorcas marsupialis*) (e.g. Mills 1984; Avenant 1993; Pohl 2015), Mountain Reedbuck (*Redunca fulvorufula*) (Moolman 1984; Pohl 2015), Grey Rhebok (*Pelea capreolus)* (Pringle & Pringle 1979; Palmer & Fairall 1988; Stuart 1982; Stuart & Hickman 1991; Bekker 1994), Southern Bushbuck (*Tragelaphus sylvaticus*) (Stuart 1982), sheep (e.g. Stuart 1982; Moolman 1984; Ferreira 1988; Brand 1989; Bekker 1994; Gunter 2008; Strauss 2009; van Niekerk 2010; Pohl 2015), and goats (Moolman 1984; Brand 1989; Gunter 2008; Blaum et al. 2009; van Niekerk 2010; Badenhorst 2014; Jansen 2016). Together with Black-backed Jackal, Caracal is the major damage-causing species on small livestock farms (see du Plessis 2013; Photo 1), and more recently they have also been

implicated as causing significant damage to the cattle (Thorn et al. 2012; Badenhorst 2014) and game farming (Power 2014; Schepers 2016) industries. They capture the young of virtually all game that are stocked, some of which (scarce species and colour variants) may be extremely valuable, financially. In the case of game farms, there generally is adequate small prey, as farmers are enlightened to protect buffer prey species, but the farms are so small, and likewise game populations are also small, that even modest levels of Caracal predation may have a significant impact to a landowner (Thorn et al. 2011; Power 2014; Schepers 2016). On the other hand, small stock farmers in the central parts of South Africa often complain that they do not get support from the game ranches and nature reserves in controlling Caracal (and Black-backed Jackal) as "these are the areas where the two damage-causing species multiply". Also in the small livestock and cattle industries the Caracal's direct impact is mostly on the younger individuals, but some adults are also killed. Some of these individuals (e.g. breeding stock) carry a higher than average financial value and, again, their loss is a major cause of conflict between farmers and Caracals. A few instances of surplus killing of small stock have also been documented (Skinner 1979; Stuart 1986; Brand 1989). In the field of conservation, concerns of Caracal predation upon threatened colonies of African Penguins (*Spheniscus demersus*) in the Western Cape have recently been raised (L. Serieys, Urban Caracal Project, unpubl. data). We now also know that some Caracals are habitually killing domestic cats in golf estates, in the same province (L. Serieys, Urban Caracal Project, unpubl. data).

Home range studies have mostly been conducted in South Africa and Namibia (see Bothma & Le Riche 1994; Moolman 1986; Avenant 1993; Avenant & Nel 1998; Marker & Dickman 2005). Environmental variables such as the size, density, composition and distribution of available prey, the type and density of sympatric predators, habitat characteristics (including the amount of cover), and the degree of persecution by humans have all been indicated as having a marked impact on Caracal home range size and use (see du Plessis 2013). Consequently, relatively large home ranges were observed in more arid areas (Bothma & Le Riche 1994: one male in the KTP had a range size of *c*. 300 km^2; Van Heezik & Seddon 1998; Marker & Dickman 2005: three males on Namibian rangeland, averaging 316 km^2), mountainous terrain (Norton & Lawson 1985: a single male tracked in mountains in the Western Cape, 65 km^2; Q. Martins unpubl. data: three males in the Cederberg mountains, averaging 184 km^2, and one female, 44 km^2) and on farmland (Moolman 1986: male and female home ranges larger on farms around the MZNP than inside the Park; also Marker & Dickman 2005, see above; Drouilly et al. unpubl. data: two males on Central Karoo farms, averaging *c*. 56 km^2). Inside the PNR and the MZNP, home ranges were relatively small: two male home ranges averaged 26.9 km^2 in PNR (Avenant & Nel 1998), while seven males both in and adjacent the MZNP had home ranges of between 15 and 19 km^2 (Moolman 1986). Female home ranges are considerably smaller than those of males, as is the case with most solitary felids, and can be attributed to the larger males' higher energy requirements (SMNs), the fact that they may select for larger prey, or the males' social needs, where one male's home range typically overlaps with those of a number of females (Avenant 1993).

Ecosystem and cultural services: Caracals have a wide and almost uninterrupted distribution in South Africa, where they feed opportunistically on a wide variety of prey, ranging from invertebrates, reptiles and birds to sympatric carnivores and mammals of up to > 50 kg. They, therefore, serve as key regulators in the ecosystem, suppressing both competing predators and prey populations, and are therefore important for the conservation of biodiversity (see e.g. Avenant 1993; du Plessis 2013; Pohl 2015). The importance of this role increases in the different regions of South Africa, such as the central Karoo, and large areas of the Western Cape, Gauteng and the Free State, where Caracals fill (mostly together with Black-backed Jackal) the role of apex predator. The exclusion of Caracals from, or their severe suppression in, ecosystems will almost certainly have direct negative impacts, such as smaller-predator release, an eruption of prey numbers, an overexploitation of associated species, and a decrease in vertebrate and invertebrate species. Indirectly, this may potentially also start a cascade effect leading to an overall decrease in biodiversity and healthy ecosystem functioning.

In addition, many of these competing predator and prey species can themselves be damage-causing: e.g. rodents destroying crops, Rock Hyrax (*Procavia capensis*) competing for forage with sheep, mole-rat tunnels causing damage to tractors and ploughs, carnivores (e.g. Yellow Mongoose and Black-backed Jackal) and rodents carrying disease, and carnivores that are problem predators to livestock or poultry farming (e.g. Black-backed Jackal, many of the mongooses, genets and otters) (see du Plessis 2013).

Use and Trade

Caracals can be trophy-hunted in South Africa, for a price varying from US$600–2,000, depending on the hunting company, the type of hunt, and the type of weapon used (rifle or bow). In some provinces, such as the Eastern Cape and Free State, only a hunting license is necessary to do so if the Caracal hunt takes place on own property, but a permit is needed when hunting on someone else's property; in the Western Cape and North West provinces, hunters now have to apply for a special Caracal hunting permit, even if hunting on their own property.

In their struggle to combat stock losses, some farmers hunt Caracal themselves, make use of DCA or "specialist" hunters to remove Caracal (and Black-backed Jackal) from their properties (Photo 2), or they send some of their

Photo 2. Caracal (*Caracal caracal*) control on farmlands in the central Karoo (Marine Drouilly)

Table 2 Use and trade summary for the Caracal (*Caracal caracal*)

Category	Applicable?	Rationale	Proportion of total harvest	Trend
Subsistence use	Yes	Source of meat on rangelands with predator control measures.	Minority	Locally variable, but probably stable overall.
Commercial use	Yes	Trophy hunting.	Minority	Increasing in some provinces.
		Pet trade.	Minority	Increasing in some provinces.
Harvest from wild population	Yes	Killed in DCA operations (rangelands and game farms).	Majority	Locally variable, may be increasing in some game farming and rangeland areas.
		Hunted for trophies.	Minority	Increasing in some provinces.
Harvest from ranched population	No	-	-	-
Harvest from captive population	Yes	Used for the international pet trade.	Minority	Increasing in some provinces.

workers for DCA courses which deal with a fairly large variety of precautionary and removal techniques (van Niekerk 2010; du Plessis 2013; Badenhorst 2014; Schepers 2016). These training and hunting businesses have now become small industries, and advertisements/ banners on the internet and hunters' vehicles have become commonplace. When making use of hunters, a farmer will typically cover the hunter's fuel (km) tariff plus pay an amount per DCA removed; the cost for one Caracal removed is in the order of R700. When a Caracal is caught or hunted, the carcass is often available for the farm workers to skin and eat.

An international trade exists for Caracals to be kept as pets, especially in the USA, Russia, Canada and the Netherlands (see advertisements openly available on the internet). Although the number of kittens exported is considered to be low, there are indications that this trade may be increasing (e.g. in the North West Province, no kittens were exported in 2015, 10 were exported in 2016, and within the first three months of 2017, four were already exported; North West Provincial Government records). The average price for a kitten is US$1,500–2,000, but can go up to US$7,500. These cats all seem to come from legal breeding centres (M. Drouilly pers. obs. 2014). Some provinces, including North West and the Free State, do confiscate such animals if owners do not have the correct permits to keep them.

The capture and removal of wild Caracals for import into captivity and trade is currently considered a minor threat, but the situation is monitored. A typical fine for keeping an animal not protected by Threatened or Protected Species (TOPS) legislation is R750. On farms and ranches where predators are lethally controlled, it often happens that a female is killed, leaving the kittens on their own. These kittens are then sometimes adopted as pets (Moolman 1986; M. Drouilly pers. obs. 2012–2015; N.L. Avenant pers. obs. 1996–2016), and it is thus not uncommon for farming families to raise orphaned Caracals.

Apart from a few stories in the folklore (e.g. Greaves & Clement 1993), Caracals have apparently not been used for specific cultural purposes by the Basotho (Avenant 2004; Moffett 2010) or other people in South Africa (N.L. Avenant pers. obs. 1989–2016). They are, however, eaten by a number of cultural groups, including the Basotho, Xhosa and mixed farm workers in the Free State, Nama Karoo and Succulent Karoo (N.L. Avenant pers. obs. 1989–2016; M. Drouilly pers. obs. 2012–2015).

Threats

As Caracals are causing significant damage in the small livestock (van Niekerk 2010; also see du Plessis 2013), cattle (Thorn et al. 2012; Badenhorst 2014) and game farming (Power 2014; Schepers 2016) industries, they are subject to persecution through hunting, trapping and, in some areas, even poisoning. Stuart (1982) recorded that over the years 1931–1952, an average of 2,219 Caracals / year were killed in control operations in South Africa's Karoo ecosystem. In a similar environment, Namibian

Table 3. Possible net effects of wildlife ranching on the Caracal (*Caracal caracal*) and subsequent management recommendations

Net effect	Unknown
Data quality	Estimated
Rationale	Presence recorded on many game farms, but a move from extensive to intensive wildlife production may increase persecution levels under current management regimes.
Management recommendation	Drop fences to form conservancies and mixed-wildlife economies. Employ precautionary damage-causing animal control methods, such as electrified fences and or lambing expensive game in electrified camps where feasible; can also experiment with livestock guarding dogs (effective with small stock in some areas, but game farming is expected to pose its own challenges), "curious" animals (such as donkeys and cows), farm management practises (moving specific species from specific high risk areas during specific times of the year), and some other non-lethal methods as collated in du Plessis (2013).

Table 4. Threats to the Caracal (*Caracal caracal*) ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	*5.1.3 Persecution/Control*: legal and illegal lethal control (hunting, trapping, and poisoning), either directly or as bycatch.	Stuart 1981, 1982; Ferreira 1988; Brand 1989; Nowell & Jackson 1996; Avenant & du Plessis 2008; Strauss 2009; Deacon 2010; van Niekerk 2010; Thorn et al. 2012; Bergman et al. 2013; du Plessis 2013; Badenhorst 2014; McManus et al. 2015; Schepers 2016	Empirical, indirect	Local, regional, national	Stable, possibly increasing in some areas.
2	*5.1.1 Hunting & Collecting Terrestrial Animals*: Caracals are used as bushmeat and in the pet trade.	Avenant 2004; N.L. Avenant pers. obs. 1989–2016; M. Drouilly pers. obs. 2012–2015	Empirical	Local, regional	Bushmeat stable. Pet trade: stable, possibly increasing in some areas.
3	*5.1.3 Hunting and collecting terrestrial animals:* trophy hunting.	R.J. Power pers. obs. 2014–2017	Empirical	Regional	Stable, but increasing in some areas.
4	*4.1 Roads & Railroads*: mortalities from road collisions.	L. Serieys, Urban Caracal Project, unpubl. data; W. Collinson unpubl. data; R.J. Power pers. obs. 2011–2017; M. Drouilly pers. obs. 2012–2015	Empirical	Local, regional, national	Unknown, but likely stable.

farmers responding to a government questionnaire reported killing up to 2,800 Caracals in 1981 (Nowell & Jackson 1996). Cattle farmers in the North West Province have indicated Caracal as a serious DCA (Badenhorst 2014), and game farmers in the Limpopo Province currently consider Caracal as one of the three major predators of game (Schepers 2016). In the North West Province, around 50% (N = 198) of surveyed game farms complained about the Caracal as a problem animal (Power 2014). The annual persecution rate reported by farmers in the North West Province was 1.1 Caracals / 100 km^2 (Thorn et al. 2012), which compares favourably to the scale estimated for the then Cape Province of 1.6 Caracals / 100 km^2 (Brand 1989). This rate may be higher in areas like the southern Free State where stock losses due to predation are reported to be amongst the highest in South Africa (van Niekerk 2010).

Brand (1989) found that Caracals were responsible for the loss of up to 5.3 domestic stock / 100 km^2 per year and recorded 0.02–1.6 Caracal(s) killed or captured / 100 km^2 per year in the former Cape Province of South Africa. In more recent surveys, livestock farmers have indicated that Caracal is responsible for between 9% (in Mpumalanga) and 36% (in the Western Cape Province) of small stock predations (van Niekerk 2010) and 11% of cattle calf predation in the North West Province (Badenhorst 2014). Although these figures may need further investigation to ascertain actual predation accuracy, they provide a good reflection of livestock farmers' perceptions that Caracal is an important DCA and is indicative of the danger of persecution that this species is likely facing (du Plessis et al. 2015). Severity of depredation by Caracal may be related to a number of factors, including the type, composition and density of prey, the geography of the specific area, the husbandry techniques, and the season (i.e. the reproductive season of the livestock animals, natural prey and the Caracal themselves) (see Avenant & du Plessis 2008; Stuart & Stuart 2013; du Plessis 2013; Pohl 2015; Teichman et al. 2015). This information should be taken into account when farmers plan their husbandry and management programmes. For instance, the risk of losing small stock to Caracal may increase when natural prey numbers are low – such as during the seasons when prey densities are naturally at their lowest, and or on properties where prey densities are low because of management practices. The risk may then further increase if this "lean" season overlaps with the lambing season and/or the period when Caracals have their own young, and or when the stock (lambs) spend more time in the Caracal's preferred habitat (≈ rocky areas/"kliprantjies" and kopjes) (Avenant & du Plessis 2008). Other precautionary techniques, such as the use of livestock guarding dogs (LGDs), kraaling (where feasible), electric fencing, and a range of others, and even better when using a combination of these (see du Plessis 2013), can potentially decrease the number of stock losses and therefore also the persecution on the Caracal population. Other long-term beneficial management actions may be to remove only the damage-causing individuals (with the help of e.g. poison collars) and leaving the non-damage-causing territorial cats to lessen the time that non-territorials cats spend (and feed) in the area (Avenant & du Plessis 2008; Avenant et al. 2009; du Plessis 2013).

With more farms in fewer (larger farmers') hands, as well as with South Africa's progressive labour legislation for farm workers that have led to fewer farmers being able to keep more employees on their farms (for cost and logistical reasons), fewer workers are patrolling the farms searching for predator signs, repairing fences and protecting livestock. This, together with many farmers' hopeless perceptions that the stock-loss problem is just increasing, contributes to the ongoing illegal practise of poisoning with, for example, Poison 1080 (Sodium Fluoroacetate) and Two-Step (carbamate insecticide found in the pesticide Temik) over alarmingly large areas (see van Niekerk 2010; du Plessis 2013). This and other blanket control methods are not only suspected to be ineffective in the long term, but also have severe detrimental impacts on the whole ecosystem (see du Plessis 2013).

Current habitat trend: Caracals are adaptable and occupy a wide variety of habitats, from semi-desert to relatively open savannah and scrubland, to montane grassland and forest, moist woodland, thicket and

evergreen forest. It is therefore difficult to predict how climate change might affect the Caracal population(s) in the assessment region. We can assume that desertification may, in the long run, have the greatest impact on those residing in the most arid parts of the distribution range.

The current presence of Caracal in the urban complex despite significant perturbation (e.g. Cape Town; L. Serieys, Urban Caracal Project, unpubl. data) suggests that populations may persist despite increasing urbanisation. Disease, poisons (including secondary poisoning through use of rodenticides) and genetic isolation (through intensive development and habitat fragmentation) may, however, pose threats to local populations.

Conservation

Caracal populations within their African range are included on Appendix II of CITES. In sub-Saharan Africa, the species is protected from hunting in about half of its range states (Nowell & Jackson 1996). In Namibia and South Africa, however, Caracals are considered DCAs, which permits landowners to kill the species, with varying levels of restrictions.

In the Western Cape, landowners need a specific permit that can be issued for six months by CapeNature to kill the species. No permits are issued for the use of helicopters, gin traps (which are illegal) and soft traps. In the other provinces of South Africa, an annual DCA permit is issued with unlimited species numbers to hunt at night and for the use of a helicopter. Methods include cage traps, dogs and gin traps; the Norms and Standards of the Department of Environmental Affairs for hunting and removing DCAs is currently under review and looks to encourage more humane methods/outlaw non-humane practises. In the Free State and KwaZulu-Natal, property owners do not need a permit to hunt Caracals on their own property, though in the North West Province one does require one now (but this may prove hard to enforce). In the North West, Caracals are inadvertently caught in cage traps set for routine DCA work aimed at the more important TOPS species (for example, Leopards) and many of them are simply relocated nearby.

Limpopo Province authorities are becoming concerned as to the status of the species in the province, and would want to accord it special protection there (A. Van Wetten, LEDET, pers. comm. 2015); the North West Province has done likewise, though with less concern (R.J. Power pers. obs. 2016).

Although Caracals are present in most national parks and provincial nature reserves, there are no protected areas specifically established for this species.

Caracals probably do respond well to reintroduction, as is evident in how they have seemingly colonised, or recolonised, the province of KwaZulu-Natal after introductions to the KwaZulu-Natal Drakensberg and Ithala Game Reserve (see Pringle 1977; Rowe-Rowe 1978; Barnes 1991; Rowe-Rowe 1992; Figure 1). Introduction is, however, not considered a priority intervention for this species.

Persecution on livestock and game farms remains the largest threat for Caracal. Proposed interventions and management recommendations are listed in Table 5, and discussed below.

Recommendations for land managers and practitioners: There is currently no species management plan for this species, but many researchers and the Predation Management Forum of South Africa (PMF) are working towards a more sustainable and best practise plan (Avenant et al. 2006; de Waal 2009; PMF website; PMF pers. comm. 2017). Public awareness, education of landowners, increased collaborative research with landowners, conservation managers and researchers on board, and continuous feedback to especially livestock and wildlife owners, are all necessary to address the current predation conundrum. Livestock and wildlife owners can take cognisance of the fact that such large, focussed, initiatives are already in progress. Examples include the Canis–Caracal Programme (University of the Free State and NMB); the national Predation Management Information Centre (UFS and PMF); the Scientific Assessment on the issue of predation on small livestock in South Africa (PredSA; Nelson Mandela Metropolitan University and PMF); Neil Viljoen Predation Management (assisted by the PMF); Cape Leopard Trust; Endangered Wildlife Trust, Carnivore Conservation Programme; Cheetah Conservation Fund (CCF); Cat Conservation Trust; and an increasing number of studies by the universities of Cape Town, Free State, KwaZulu-Natal, Pretoria, Stellenbosch, NMMU, and others.

At this stage, and with the knowledge that circumstances may differ markedly between areas/farms, the following general recommendations can be made to land managers (based on du Plessis 2013 and N.L. Avenant pers. obs. 1989–2016 and interpretation of the results from a number of research studies, also from other research fields, e.g. Avenant 2011):

1. Healthy natural prey populations, and temporal planning of farm management around the time of year when these densities are high or low, can significantly reduce the risk of losses; this includes when and where the stock lamb, and where they forage during which time of the year.
2. Be aware of the Caracal's behaviour, such as habitat preferences, the peak times when Caracals' energy needs are highest (for example, when females lactate/ have young), their social structure, and the important role that territorial individuals can play in limiting the time that non-territorial cats spend on the property (following Avenant 1993, it has been proposed that non-territorial cats are more prone to take the easy and "not-natural" prey; an idea currently further under research).
3. Search for and apply methods (e.g. poison collars) that only take out the culprit (in other words, strive towards a situation where territorial cats do no or relatively little damage and where they can assist in the management process by excluding non-territorial animmals); be aware that blanket control methods may only offer short-term relief on the property, and will most probably lead to escalated problems/costs for the owner, surrounding owners and the ecosystem in future.
4. Search for and apply the best precautionary methods that suit the situation and management style.
5. Use a combination of methods (and the steps indicated here), and change/rotate them to prevent habituation.

Table 5. Conservation interventions for the Caracal (*Caracal caracal*) ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	*2.1 Site/Area Management:* the promotion of the "holistic" approach to the management of DCAs, with a strong emphasis on clever farm management practises and precautionary techniques (using e.g. LGDs, electrified fences and combinations of other deterrents).	Avenant et al. 2006, 2009; Potgieter et al. 2013; McManus et al. 2015; PMF 2016.	Empirical	Regional	In two studies, predation rates decreased by 95% and 69%, respectively.	National Museum (NMB) and Centre for Environmental Management, UFS (CEM), project; also slots in under the Canis–Caracal Programme (CCP); Endangered Wildlife Trust, Carnivore Conservation Programme; Neil Viljoen Predation Management; Cheetah Conservation Fund (CCF)
2	4.3 *Awareness & Education*: addressing wrong perceptions and educating landowners on the efficacy and efficiency of holistic management.	Avenant 1992a, 1992b, 1996, 1997, 2007, 2012; Avenant et al. 2006, 2009; Avenant & du Plessis 2008; du Plessis 2014; de Waal 2009; Potgieter et al. 2013	Empirical	-	Creating awareness about the depredation conundrum on national and international levels has led to the formation of the PMF (its current format), active participation by the national Departments of Environmental Affairs and Agriculture, and a significant increase in the number of research projects on Caracal (and Black-backed Jackal). There are still only relatively few indications where farmers' perceptions have been swayed and where they have totally changed their management practises; in most cases farmers have only added some of the suggested methods to their management toolbox.	Canis–Caracal Programme (CCP); NMB and CEM project; The Karoo Predator Project; Cape Leopard Trust; Cat Conservation Trust; Cheetah Conservation Fund; PMF website
3	*2.1 Site/Area Management*: land management to sustain high density of natural prey for Caracals.	Grobler 1981; Avenant & du Plessis 2008; Avenant et al. 2009; Avenant 2011; Thorn et al. 2012; Power 2014	Empirical	-	Incidences are known where, under conditions with restored prey communities, Caracals have caused less damage on local livestock. Today we know that this intervention alone may not be equally successful in all areas, but that it remains a vital component in the "holistic" management approach	NMB and CEM projects
4	*3.1 Species Management*: stopping blanket control, using precautionary techniques, and only removing the culprits.	Avenant & du Plessis 2008; Avenant et al. 2009	Empirical	Local (1 farm)	By stopping blanket control, using precautionary techniques, and only removing the culprits (≈ looking after your territorial cats if they do not do damage), sheep losses dropped significantly, and significantly less Caracals were killed.	NMB and CEM projects

6. Be aware that success requires dedication and continuous hard work, and that there is no single method that will provide a solution on its own.
7. Know that relief from your current situation will most probably not happen overnight and that the situation will gradually change; persevere with your intended management plan.
8. Strive to get as large an area (most properties) as possible to follow the same holistic management principles.
9. Be aware that areas that have both Caracal and Black-backed Jackal present are in for a larger challenge.
10. Invite researchers and conservation officials to be involved with research on your farm, and in such way find out what works best for your specific situation.

Nature conservation agencies should strive to work together with land managers, but also support the PMF in such a way where all or most of the Caracal-killed records, as well as the stock- and wildlife-loss records, are sent to

the Predation Management Information Centre at the University of the Free State (see http://www.pmfsa.co.za/home/detection-prevention/lethal-management-method/hunting-dogs/item/271-predation-management-information-centre-now-operational), and in that way assist to get an overall picture of what happens where, what is the resulting effect of management efforts in that area, and also to assess the impact of predator control on this species' populations.

Research priorities: As an important damage-causing species in large parts (> 75%) of southern Africa, more research is needed on how to manage the species, how the species is reacting to different management strategies, and how to mitigate conflicts with human livelihoods, especially in the livestock and game farming industries. Additionally, we can benefit from a regional focus on the status and ecology of the species, especially from the northern parts of the assessment region.

More generally, research is needed on:

- Population size and trends (this can be promoted by citizen science, especially in areas where densities are low or where very specific research questions are asked).
- Impact of livestock and game farming on Caracal population size, breeding ecology and diet, compared with undisturbed large natural areas (du Plessis et al. 2015).
- Impact of human–predator conflict management strategies on Caracal numbers, reproduction and general ecology.
- Landscape genetics and determination of source/sink areas.
- At a national scale, the number of Caracals killed during predator-control operations.
- Spatial ecology of the species with size of home range in relation to prey density and human activity.
- Effects of sympatric apex predators on the population size, survival and behaviour of Caracals.
- Predatory impact of the Caracal on game ranches.
- Non-lethal control methods for the Caracal (i.e. scent avoidance, bio-fencing, etc.).
- Evidence for range expansion/contraction.
- Development of an App to record livestock depredation and mortality of Caracal on farmlands (aimed at livestock and game farmers in particular).

The following research projects are currently ongoing:

- *Canis–Caracal Programme (CCP),* run by the African Large Predator Research Unit, UFS: aims at finding solutions to reduce the widespread impact of predation on the livestock industry (national). Contact details: Prof. H.O. de Waal, Department of Animal, Wildlife and Grassland Sciences and African Large Predator Research Unit (ALPRU), PO Box 339, Internal Box 70, University of the Free State, Bloemfontein, 9300, South Africa. Email: dewaalho@ufs.ac.za.
- *Predation Management Information Centre (PMIC)*: collating and analysing reliable information on predation and predation management methods, which will be made available continuously to a management information system (MIS). A team of dedicated staff members handles calls and enquiries. Experts in the team are available to provide advice to farmers. The centre is also responsible for the management of information and resources. Aim: to generate information that can be used to reduce the widespread impact of predation on the livestock industry. A collaborative initiative between the UFS and the PMF. Contact details: Email: PredationMC@ufs.ac.za. Telephone: 051 401 2210 (on week days from 08:00–16:00).
- *Scientific Assessment on the issue of predation on small livestock in South Africa (PredSA):* a collaborative initiative between the NMMU and the PMF. Contact details: Prof. Graham Kerley, Centre for African Conservation Ecology (ACE), PO Box 77000, Nelson Mandela Metropolitan University, Port Elizabeth, 6031, South Africa. Email: graham.kerley@nmmu.ac.za.
- *National Museum (NMB) and Centre for Environmental Management (CEM), UFS:* investigating the ecology of Caracal, sympatric carnivores and prey species; investigating the effect of DCA and other management actions on ecosystem integrity (with the aim to contribute towards a more sustainable DCA management plan over larger areas). Contact details: Dr Nico L. Avenant, Department of Mammalogy, National Museum, 36 Aliwal Street, Bloemfontein. Email: navenant@nasmus.co.za.
- *Karoo Predator Project:* this project, run by the University of Cape Town (Department of Biological Sciences and the Centre for Social Science Research), aims to understand the socio-ecological mechanisms behind farmer–predator conflicts in the Karoo. Concerning Caracals in particular, the project is investigating the general ecology of the species on small-livestock farms. Contact details: Prof. Justin O'Riain, Department of Biological Sciences, John Day Zoology Building, University of Cape Town. Email: Justin.ORiain@uct.ac.za. Marine Drouilly, PhD candidate, Department of Biological Sciences, John Day Zoology Building, University of Cape Town. Email: drouillymarine@yahoo.fr; website: https://karoopredatorproject.wordpress.com.
- *Cape Leopard Trust (CLT):* studying the ecology of species such as Caracal; involved with human–predator conflict management. Research areas: Cape Town and Boland Mountains, Cederberg Mountains, Namaqualand. Contact details: Helen Turnbull, CEO. Email: contact@capeleopard.org.za; website: http://www.capeleopard.org.za.
- *Urban Caracal Project*: this project is run by the University of Cape Town, The Cape Leopard Trust, University of California (Santa Cruz and Los Angeles), South African National Parks, the City of Cape Town, and private landowners in Cape Town. This project aims to 1) establish baseline information – distribution, population size, health status of individuals – about the Caracal population in the Cape Peninsula; 2) evaluate the effects of urbanisation on the behaviour, movement patterns, diet and genetic health of Caracals; and 3) assess the threats to survival for Caracals. Contact details: Dr Laurel Serieys, Project Coordinator. Email: Caracal@capeleopard.org.za; website: www.urbancaracal.org.
- *Cat Conservation Trust:* involved in ex situ breeding, awareness and research programmes on four wild

cat species, including the Caracal, in the Eastern Cape Karoo in South Africa. Contact details: Richard and Marion Holmes. Email: info@karoocats.org; website: http://www.karoocats.org.

- *Landmark Foundation's Leopard & Predator Project*: based in the Eastern Cape, and advocate non-lethal control measures of species such as Caracal. Contact details: Dr Bool Smuts, Director. Email: bool@landmarkfoundation.org.za; website: http://www.landmarkfoundation.org.za.

Encouraged citizen actions:

- Report sightings on virtual museum/social media platforms (for example, iSpot and MammalMAP), especially outside protected areas. Caracal sightings are very rare, so the use of camera traps by citizen scientists is encouraged as more data can accrue this way than through direct observations.
- For the farmers and hunters controlling the species, it is crucial that they report all the dead animals (trapped, shot or poisoned), as well as their livestock losses due to the species, with photographs and GPS coordinates, to the national Predation Management Information Centre (PMIC; email: PredationMC@ufs.ac.za).
- Livestock farmers can get on board by encouraging scientific research on their properties.
- Livestock farmers can actively monitor and record the effectiveness of the management methods they are implementing. Of more value would be if these management methods are designed, implemented and monitored on a sound scientific basis (through liaison with the scientific community) and if the results are shared and published in peer-reviewed literature as a way to promote accuracy, reliability and application.

Data Sources and Quality

Table 6. Information and interpretation qualifiers for the Caracal (*Caracal caracal*) assessment

Data sources	Field study (literature, unpublished), indirect information (literature, expert knowledge, unpublished)
Data quality (max)	Estimated
Data quality (min)	Inferred
Uncertainty resolution	Best estimate
Risk tolerance	Evidentiary

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