

Non-detriment finding assessment for *Leptailurus serval* (serval)

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Summary of findings

Leptailurus serval (serval) is included in Appendix II to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In terms of 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. This non-detriment finding (NDF) for *Leptailurus serval* (serval) was compiled through a review of the relevant literature and deliberations held at an NDF expert workshop convened by the South African National Biodiversity Institute on 13 February 2020 (workshop participants and references included at the end of this document), and amended through various further consultations. The information presented is current as of May 2021.

Relative to other carnivores, the serval has a high reproductive rate, though within the context of the continuum of mammal species, serval is deemed to have a low reproductive rate, and is long-lived. Servals can live up to 20 years in captivity, while in the wild, servals have been recorded to live up to 13 years. Servals start breeding at the age of 18-24 months and on average produce a litter of 1-3 kittens every 12 to 15 months. The species is regarded as a habitat specialist due to its preference for tall grassland, riverine areas, wetlands and rank vegetation. Importantly, these habitats harbour high rodent densities and substantial cover. The species seems to be adaptable to human altered landscapes where artificial water sources or wetlands are available, and have been observed to occur in higher densities in these landscapes than in protected areas, most likely due to the absence of large carnivores, as competitors and predators to serval. In terms of diet, servals specialise on small mammals, particularly murids, with vlei rats (*Otomys spp.*) considered the preferred prey species. A wide variety of additional prey is taken, especially birds, contributing approximately 10% to their diet. The species can thus be regarded as a small mammal dietary specialist. The wide range of prey species reported in their diet indicate that servals can use other types of prey when vlei rats are at low densities.

The species is likely a good coloniser of newly found suitable habitat, and servals can disperse along corridors such as drainage lines, thereby ameliorating fragmentation effects and ensuring gene flow between subpopulations. An unpublished genetics study showed that there is little to no genetic structuring among serval populations in Mpumalanga and KwaZulu-Natal. The study also documented high gene flow between these populations, with a net migration rate favouring westward or north-westward movement from KwaZulu-Natal to Mpumalanga. Servals are considered tolerant of humans, where disturbance is limited and domestic animals (especially dogs) are absent. Some of the largest serval populations in the species' range outside of protected areas occur within areas of extensive agricultural and industrial land uses, highlighting the importance of these areas for serval conservation.

Until the 1980s, servals only occurred in the western and northern parts of KwaZulu-Natal and were absent from the southern parts of the province, the Free State, and the Northern, Western, and Eastern Cape Provinces. The species was considered rare in Gauteng, Mpumalanga, Limpopo, and North West Province. More recently, the species has expanded its range in several regions of South Africa. For example, servals have gradually re-colonised the Free State, this colonisation probably associated with agriculture and the creation of man-made wetlands, and they have marginally entered the eastern Northern Cape and western parts of the North West Province. Within the North West Province, serval range was estimated at 59,366 km² in extent by 2010, which represented a 37% increase in range since 2000. Servals have also been reintroduced on a number of properties in the Eastern Cape and have recently been recorded in the Western Cape. The species is thus widespread throughout South Africa, but their distribution is considered fragmented. However, when comparing the most recent distribution map, to past distribution maps, it appears that their distribution is less fragmented now. Although the

species is considered common within wetland habitats of the Drakensberg Midlands, it is considered rare in the lowland wetlands of South Africa. The species is considered rare in the Northern Cape, and uncommon in the Eastern Cape, Western Cape, KwaZulu-Natal and the Free State. In general, good data exist on the localised abundance of the species across its range in South Africa. The captive serval population in South Africa is estimated to number more than 600 servals in about 93 facilities in seven of the nine provinces.

There are limited data on long term trends and survival of the species and no repeat studies for comparisons. As such, the population trend on a national level remains uncertain. Serval populations are currently not directly monitored in any of the state protected areas or private reserves, and as a result no data on trends for these populations are available. Serval populations are indirectly monitored through several camera trap projects managed by Panthera and SnapShot, but data are recent and population trends cannot yet be established. Data from North West Province are quantitative, but outdated (surveys conducted in 2014). In addition, little is known about the status and trend of the Kruger National Park serval population.

It is posited that the primary threat facing serval is the loss and degradation of wetland and associated grasslands. The 1990–2013/14 (24-year period) South African National Land-Cover change report found a 32.8% decline in natural wetlands on a national scale due to a combination of anthropogenic degradation and currently drier conditions. However, the relationship between natural wetland loss and trends in serval populations is unknown. In addition, the extent to which natural wetland loss is mitigated by the development of artificial wetlands is uncertain, and there is currently no direct evidence for population declines. Other factors impacting the species include road kill mortalities, persecution for alleged predation, and traditional and medicinal use. However, at present little is known about the magnitude and severity of each of these impacts and how these affect the serval population within South Africa.

The use and trade in serval parts for cultural purposes have been documented in at least 32 African countries (literature from 1970s to present), primarily southern and West Africa. Serval parts, primarily skin, are used for traditional attire, decoration, traditional medicine, bushmeat, rituals and curios for the tourist trade, and this use may be more widespread than previously realised. Likewise, the presence of servals in traditional medicine markets is likely more prevalent than previously thought. Challenges exist with identifying material in markets, especially if skins are cut up into small pieces and/or are made into traditional attire. During a survey in four provinces from 2017 to 2019, 16% of supposed leopard and cheetah samples were identified as serval through DNA testing, and all were from unique animals. Data collected by Panthera at religious gatherings of the Shembe between 2015 and 2020 indicated that between eight and 30 serval skins are present per religious gathering with no clear directional trend. The national problem of illegal or unmanaged off-take or trade is thus considered medium. In addition, due to inconsistencies among provinces in the implementation of the permit system and specifically around captive breeding there is the potential for the laundering of wild caught serval into the captive trade. How a specific individual got into a captive facility is seldom tracked especially if the specimen is traded among captive facilities in different provinces. There is currently anecdotal evidence that this may be happening.

All of the legal national harvest occurs outside of protected areas on private land, where the species is hunted as a trophy animal, and hunting is predominantly opportunistic and unselective. Trade in live animals originates mainly from captive breeding facilities. Trade from these facilities is mainly to maximize economic yield. There is an overall low confidence in the harvest management of serval due to budgetary constraints, lack of capacity and proper planning, and in some provinces a permit system that is inadequate for the regulation of serval, most specifically Mpumalanga where the serval does not benefit from any legislative protection. There is no national management plan for the species. National and provincial parks have general ecological management plans, but no species management plans for serval. There is currently no adaptive framework for serval management and no quota system, except for local quotas instituted in two provinces. Since 2018, North West Province has implemented a sport hunting quota of four serval, with two serval allocated to the Bushveld and two to the Highveld ecoregions, and with a seasonal restriction of July-September. The reproductive biology of the species and its relative abundance across the province form the basis of this quota. In Limpopo, one serval is allocated per professional hunter per farm per year, but there is no ecological basis for this quota and its sustainability remains unverified.

At present, the harvest of serval is primarily monitored through CITES trade records, but also through the provincial permit systems and the Professional Hunter's (PH) Register. An analysis of the CITES trade data for 2000 – 2017

showed that 723 serval trophies and 761 live animals were exported from South Africa over an 18 year period. Since 2014 there has been a marked increase in the number of live serval exported annually. Ninety-six percent of live serval exported were captive-bred, with 54% and 29% exported for commercial purposes and to zoos respectively. According to the PH Register, 585 serval were hunted between 2010 and 2019 by international hunters, averaging 59 serval per annum. More than half of these hunts took place in the province of Mpumalanga, where only the export of serval hunting trophies and live serval are regulated through the CITES permit process, with limited monitoring to ensure sustainability. In addition, across all provinces, the effects of harvest are not currently monitored, and there is often a lack of knowledge of what happens on the ground.

The harvest of servals as it currently occurs in South Africa is unlikely to incentivize the conservation of the species or its habitat. Given the recent range expansion of the species it is likely that the largest portion of the species range occurs outside of formally protected areas, highlighting the importance of private land for the conservation of the species. A questionnaire survey in 2005 suggested that the attitudes of landowners to predators that can be hunted is better than for those predator species which cannot be hunted. Sustainable hunting of serval could potentially benefit the management and conservation of the species, though no data are available to show if or how utilisation affects tolerance of landowners towards the species. More than 50% of the trophy hunts occur within the Mpumalanga province, where the hunting of serval is poorly regulated and not monitored, therefore limiting any opportunity to generate conservation incentives.

Only a relatively small proportion of the species range (<5%) is excluded from harvest as most serval habitat in South Africa is found outside protected areas. There is a medium confidence in the effectiveness of these protected areas to protect the species. Even though some animals living primarily in protected areas may be vulnerable to illegal hunting or snaring when ranging beyond the borders, the cores of larger protected areas such as the Kruger National Park (KNP), uKhahlamba Drakensberg, and iSimangaliso Wetland likely constitute inviolate refuges for servals. Even though there is good legislation in place both on a national (ToPS Regulations under the National Environmental Management Biodiversity Act (NEMBA) and a provincial level for most provinces, and all use activities relating to serval are regulated, not all provincial conservation agencies implement the current legislation effectively due to a lack of capacity. Mpumalanga province does not currently implement the Threatened or Protected Species Regulations (ToPS) under NEMBA, and a permit is not required under the provincial ordinance for the harvest of serval in the province. Only the export of serval trophies is regulated through the CITES permit process. The lack of legal restrictions in Mpumalanga has led to much higher levels of serval off-takes than in any other province. Anonymous reports in KwaZulu-Natal suggest that permit costs are prohibitive, and illegal hunting and harvests are therefore likely to occur.

In conclusion, the evidence considered in this NDF for *Leptailurus serval* (serval), as summarized in the analysis of 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 (Fig. 1 and Fig. 2). This is mostly due to poor management of harvest practices and a lack of reliable monitoring of serval populations. There is no evidence to suggest that the export of captive-bred specimens is detrimental to the wild population.

With respect to the export of hunting trophies, trade can proceed under the following conditions:

1. On a provincial level, a scientific method that will ensure a sustainable harvest quota for serval within the respective province has been established and endorsed by the Scientific Authority.
2. Submission of hunt return forms on all trophy hunts to the relevant provincial authority.

With respect to captive-bred specimens:

1. An audit of the captive facilities responsible for the majority of the live serval exports is required to verify compliance with Resolution Conf. 10.16 (Rev.) on specimens of animal species bred in captivity.

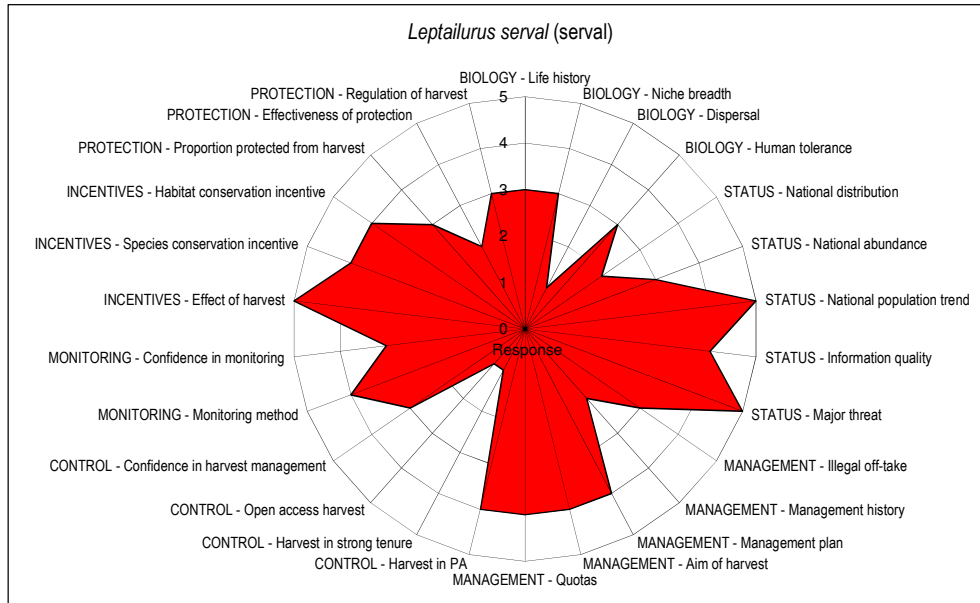


Figure 1: Radar chart summarizing the non-detriment finding assessment undertaken for *Leptailurus serval* (serval) in South Africa in accordance with the CITES NDF checklist. Explanations of scores given are detailed in Table 1. Higher scores are indicative of higher risks to the species. The extensive shaded area in the radar chart demonstrates an overall high risk to the species.

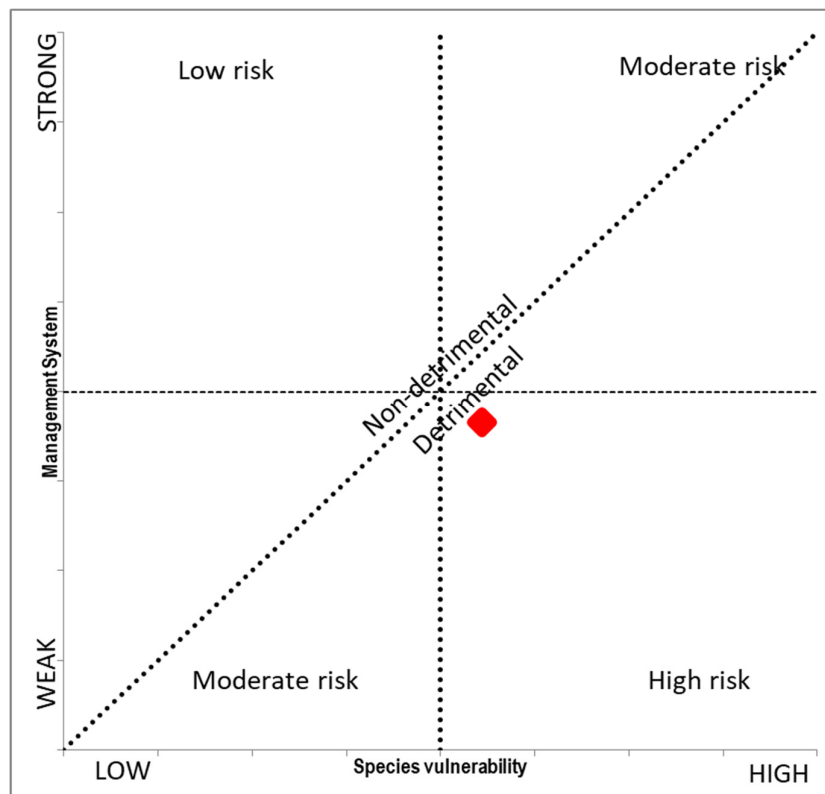


Figure 2: The risk of trading in *Leptailurus serval* (serval) by South Africa, as represented by the relationship between species vulnerability (biology and status) and the strength of the management system to which the species is subjected (management, control, monitoring, incentives and protection). The figure demonstrates that the species is at a high risk and that trade is detrimental.

Table 1. Detailed non-detriment (NDF) assessment for *Leptailurus serval* (serval) in South Africa undertaken 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
Servals have a low reproductive rate and are long-lived. In captivity, servals are known to live for 13-20 years (Kingdon, 1997; Stuart & Stuart, 2015), while in the wild, females have been recorded living to 11 years (Hunter, 2011). Both sexes reach sexual maturity at 18-24 months (Bowland, 1997; Kingdon, 1997; Ray <i>et al.</i>, 2005; Thiel, 2011), and in captivity stop reproducing at approximately 12-14 years of age (Pienaar, <i>et al.</i>, 1996; Stuart & Stuart, 2015). Kittens are born after a gestation period of 73 days (range 70-79 days, n=15) (Stuart & Wilson, 1988), and mean litter size at emergence is 1-3 kittens (Smithers, 1978), but can be as high as five kittens (Stuart & Wilson, 1988). The sex ratio at birth is 1:1 (Skinner & Chimimba, 2005). The mean inter-birth interval is 12 to 15 months (Geertsema, 1985). The kittens are normally born in the warm summer months from September to April, peaking between mid (Skinner & Chimimba, 2005) and late summer, i.e., January and February (Smithers, 1978). As with most felids, the young remain with their mothers for between 6-8 months (Hunter, 2011), but can be as long as a year (Bowland, 1997; Kingdon, 1997). Males are expelled from their mother's range as soon as they can hunt, while females are tolerated for a longer period (Geertsema, 1985; Kingdon, 1997). There are no data on age-specific mortality, including litter survival. In comparison with other carnivores, serval have a high reproductive rate, but within the context of the continuum of mammal species, the reproductive rate of serval is considered to be low.		
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
Servals use open to closed savannas (Dorst & Dandelot, 1972; Kingdon, 1997), but have a local preference for tall grassland (Pienaar <i>et al.</i>, 1996), riverine areas, wetlands and rank vegetation (Smithers, 1978) as these habitats harbour high rodent densities (Bowland, 1990; Geertsema, 1985). Home-range cores for both male and female servals are centred around wetlands (Ramesh <i>et al.</i>, 2015b; c). Servals appear adept at using agricultural land (Bowland, 1997; Ramesh & Downs, 2013; 2015a; Ray <i>et al.</i>, 2005); no significant differences in population densities were found between natural habitats and modified agricultural landscapes (Ramesh & Downs, 2013), provided that there are natural vegetation patches available within the landscape mosaic (Ramesh <i>et al.</i>, 2015b). In South Africa, serval home-ranges are between 15 and 30 km² (Bowland, 1990) with small core areas (Minimum Convex Polygons (MCPs)), ranging from 2 km² (Van Aarde & Skinner, 1986) to 3 km² (Perrin, 2002; Van Aarde & Skinner, 1986), mainly within wetland areas where their preferred prey, vlei rats (<i>Otomys spp.</i>) are most abundant (Bowland, 1990; Bowland & Perrin, 1993; Geertsema, 1985; Van Aarde & Skinner, 1986). Males tend to use forest and dense bushland more than females (Ramesh <i>et al.</i> 2015c). As with most felids, females have smaller home-ranges (Bowland 1990; Geertsema, 1985), and male home-ranges overlap several female home-ranges, with home-range size being inversely proportional to population density (Sandell, 1989). In a recent study in the KwaZulu-Natal midlands, male home-ranges averaged 38 km², while overlapping female ranges were approximately 6.2 km² (Ramesh <i>et al.</i>, 2015b); male home-ranges seem to decline with age (Ramesh <i>et al.</i>, 2015b). In an Africa-wide assessment of carnivores, species were scored for their presence in different habitats as an indication of their relative specialisation using the Habitat-Specialisation Index (HSI) devised by Brashares (2003) as done by Ray <i>et al.</i>, (2005). The index is relative to the number of distinct habitat types a carnivore can occur in. The highest score (i.e. most specialised) represented those species present in the least number of habitats (1-HSI; Ray <i>et al.</i>, 2005). The serval was rated as intermediate, i.e., 0.3, and thus not very specialised across Africa, due to its relatively wide distribution (Ray <i>et al.</i>, 2005). In South Africa, radio-tracked (Perrin, 2002; Van Aarde & Skinner, 1986) and GPS collared individuals (Ramesh, <i>et al.</i>, 2015b) were located in riverine and wetland habitats more than expected (Perrin, 2002; Van Aarde & Skinner, 1986), and were less frequently detected in open grasslands (Perrin, 2002) and croplands (Ramesh, <i>et al.</i>, 2015a). Thus, the species has a localised preference for wetlands, and areas close to water, where there is substantial cover and prey (Bowland, 1990; Ramesh <i>et al.</i>, 2015a; b; c). The species can thus be considered a habitat specialist as well as a keystone species for the Endangered wetland habitat of montane grasslands due to its close association with these habitats (Bowland, 1990). The species seems to be adaptable to human altered landscapes where artificial water sources or wetlands are available and occur in higher densities in these landscapes (artificial water sources / wetlands) than in protected areas, most likely due to the absence of predators.		

According to past species' accounts, serval were rarely found in arid areas, and their distribution was restricted to high rainfall areas with riparian habitat (Nowell & Jackson, 1996; Pienaar, 1969; Skinner & Chimimba, 2005). However, serval records from sign and questionnaire surveys were evenly divided between sites with an annual rainfall of <400 and >400 mm, indicating that the species is more tolerant of arid conditions than previously thought (Thorn *et al.*, 2011). Hermann *et al.*, (2008) contended that this is mainly due to the creation of human-made water bodies (i.e. farm dams), which provide suitable habitat for serval prey.

Servals specialise on small mammals, particularly murids. Rodents and shrews accounted for over 80% of serval diet in Bwindi Impenetrable National Park, Uganda (Andama, 2000) and 93.5% on farmland in the Drakensberg Mountains, South Africa (Bowland & Perrin, 1993). Small mammals comprised 89% of observed kills in the Ngorongoro Crater, Tanzania (Geertsema, 1985). A wide variety of additional prey is taken, especially birds, but servals appear to attain high densities only where rodents are abundant. Vlei rats (*Otomys* spp.) account for approximately 94% numerically, and 60% of the total biomass consumed (Bowland, 1990). Even though vlei rat numbers may be under-estimated because of low capture rates (Perrin, 2002), they regardless contribute only a small percentage to the overall biomass in wetland habitats, approximately 2.8% (Perrin, 2002), with birds contributing approximately 10% to their diet (Bowland, 1990). Serval can thus be regarded as a small mammal dietary specialist, though the wide range of prey species reported in their diet, indicate that servals can use other types of prey when vlei rats are at low densities (Bowland, 1990; Bowland & Perrin, 1993; Ramesh & Downs, 2015a).

Larger prey are reported in their diet, including hares (*Lepus* sp.), cane rats (*Thryonomys* sp.) (Smithers, 1978), genets (*Genetta* sp.) (Ramesh & Downs, 2015a), and various antelope (Smithers, 1978), including reedbuck (*Redunca arundinum*) (Ramesh & Downs, 2015a). Most of the observations regarding large prey are incidental and anecdotal (Bowland & Perrin, 1993; Smithers, 1978), however there have been confirmed occurrences in contemporary studies to suggest the relevant importance of these observations (Ramesh & Downs, 2015a). This suggests that servals may be more adaptable in their prey requirements than what has previously thought. Serval rarely prey upon livestock (Somers *et al.*, 2017), and they have been implicated in losses of 0.8% of livestock lost to predators in KwaZulu-Natal (Lawson, 1989), though it is not known to what extent these reports were verified.

The long neck and limbs allow the serval to gain elevation in tall grass areas, and its rounded ears are used to detect rodents from sound (Kingdon, 1997; Skinner & Chimimba, 2005; Smithers, 1978). It seems that these features are adaptations for the behaviour of rodent hunting in tall grass conditions (Smithers, 1978), which intrinsically categorise this species as a habitat and dietary specialist.

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

Serval young remain with their mother for between 6 (Hunter, 2011) and 12 months (Bowland, 1997; Kingdon, 1997). Male offspring tend to disperse earlier than females (Geertsema, 1985; Kingdon, 1997). In the releases on Kgaswane Mountain Reserve wetland, initial dispersal directions were dictated by known habitat preferences, and the core areas eventually selected coincided with the release points (Van Aarde & Skinner, 1986). An analysis of temporal changes in the cumulative area used by radio-tracked male servals released, suggested the home-range size was established within 20-30 days after being released (Van Aarde & Skinner, 1986). This suggests that the species can readily establish themselves, given suitable habitat. However, these individuals only moved an average of 2 km per day (Van Aarde & Skinner, 1986).

Servals bred in captivity (Van Aarde & Skinner, 1986) or orphaned and captive-raised servals (Perrin, 2002) have been successfully reintroduced in the wild. Other than a reintroduction into a North West Parks reserve during the 1980s (Van Aarde & Skinner, 1986), and others during the 1990s (a time when they were declared absent), serval have become well established in several reserves within North West Province, i.e. Pilanesberg, Borakalalo and Madikwe (Power, 2014), suggesting that the species can naturally recolonise areas. Predator-proof fences may restrict the dispersal of serval – it has been observed that serval can be electrocuted when attempting to get through a park fence (S. Dell, Reserve Manager, Pilanesberg National Park, pers comm., 2019).

Servals have also been reintroduced in several Eastern Cape protected areas in the early 2000s and, although rare, are now regularly seen throughout the province (Ramesh *et al.*, 2016). Range expansion is also evident in the Western Cape and the eastern Northern Cape (Ramesh *et al.*, 2016). In addition, the dramatic range expansions of this species westward across the whole Free State province, likely due to agriculture enhancing serval habitat (Hermann, Kamler & Avenant, 2008), has taken place over a decade (i.e. ~1 serval generation, viz 11 years), highlighting the ability of the species to disperse widely.

Servals can connect with other subpopulations through corridors such as drainage lines to ameliorate fragmentation effects (Hermann, Kamler & Avenant, 2008). An unpublished genetics study using 13 microsatellites conducted by Hlangwani, Moodley & Swanepoel (2016) showed that there is little to no genetic structuring among serval populations in Mpumalanga and KwaZulu-Natal. In other words,

serval in these provinces can be considered as part of a single management unit. This study also documented high gene flow between these populations, with a net migration rate favouring westward or north-westward movement from KwaZulu-Natal to Mpumalanga. The species is thus likely a good coloniser of newly found suitable habitat.

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

Servals are considered tolerant of humans, particularly where human disturbance is limited and domestic animals (especially dogs) are absent. Serval may live in peri-urban environments near cities (Smithers, 1978) and in agricultural landscapes (Bowland, 1990; Kingdon, 1997; Ramesh & Downs, 2013; Ramesh *et al.*, 2015b, b; Stuart & Stuart, 2015), suggesting some degree of tolerance to human activities. The species is mostly nocturnal in semi-disturbed landscapes (Bowland, 1990; Perrin, 2002; Ramesh & Downs, 2013; Van Aarde & Skinner, 1986), and only in wilderness areas e.g. Ngorongoro Crater in Tanzania, away from humans are they diurnal (Geertsema, 1985; Pienaar *et al.*, 1996). In the upland grasslands of KwaZulu-Natal, they tend to be both crepuscular and nocturnal, but on intensely farmed sites, where there is day time human activity, they are strictly nocturnal (Ramesh & Downs, 2013). The species' preference for rodent prey would incidentally help control rodent pests in agricultural landscapes (Bowland & Perrin, 1993; Ramesh & Downs 2015a).

Some of the largest serval populations in the species' range outside of protected areas occur within areas of extensive agricultural and industrial land uses (Bowland, 1990; Loock *et al.*, 2018; Ramesh & Downs 2013; Rowe-Rowe 1992). The absence of large carnivores as competitors and predators to serval has apparently benefitted servals in these parts of KwaZulu-Natal (Bowland, 1990; Ramesh & Downs, 2013; Rowe-Rowe, 1992) and Mpumalanga (Loock, *et al.*, 2018).

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

Servals occur throughout most of subtropical Africa south of the Sahara, but due to their habitat requirements, they are confined to areas with adequate cover where water is permanently available (Dorst & Dandelot, 1972; Kingdon, 1997; Smithers, 1978). The species is still widely distributed within its historical range. Elsewhere it has been extirpated from areas densely populated with people or where habitat conversion is extreme (Nowell & Jackson, 1996; Smithers, 1978). Servals possibly benefitted from forest clearing and resultant encroachment of savanna habitats at the equatorial forest belt edges in Central Africa (Nowell & Jackson, 1996; Ray *et al.*, 2005).

In the southern African sub-region they are found throughout Zimbabwe and Mozambique, as well as the north-east of Botswana and Namibia (Skinner & Chimimba, 2005). In addition, occurrence records seem to indicate a southward expansion of their range in Namibia, with several records from the central Namibian escarpment (Stratford *et al.*, 2016).

In South Africa, up until the 1980s, servals only occurred in the western and northern parts of KwaZulu-Natal and were absent from the southern parts (Bowland, 1990; Von Richter, 1972; Rowe-Rowe, 1992). They were mentioned to be relatively rare in the old Transvaal, viz Gauteng, Mpumalanga, Limpopo, North West (Pienaar *et al.*, 1996; Von Richter, 1972), and thought to be absent from the Free State (Bowland, 1990; Von Richter, 1972) and the Cape Province (Northern Cape, Western Cape, Eastern Cape, North West). Serval did formerly occur along the coastal belt from Cape Town eastwards, but were by the 1970s thought to be extinct or rare (Stuart, 1985; Von Richter, 1972).

More recently, the species has expanded its range in several regions of South Africa (Hermann, Kamler & Avenant, 2008; Power *et al.*, 2019; Ramesh *et al.*, 2016; Stuart & Stuart, 2015). For example, serval have gradually re-colonised the Free State, this probably associated with agriculture, viz dam impoundment and the creation of associated 'pseudo-wetlands' (Hermann, Kamler & Avenant, 2008), and serval have marginally entered the eastern Northern Cape and parts of the North West province (Fig. 3). Within the North West Province, by 2010, serval range was estimated at 59,366 km² in extent, which represented a 37% increase in range since 2000 (Thorn *et al.*, 2011). There was also a considerable change in the Area of Occupancy (AOO), which is estimated at 16,333 km², a 110% increase over the same time period (Thorn *et al.*, 2011). Though not considered common, the species now also sporadically occurs in the Eastern Kalahari Bushveld (Power *et al.*, 2019). The high occupancy for the serval, with a large increase in AOO and apparent range expansion, suggests continued recovery from historical threats (Thorn *et al.*, 2011).

Skead (2007), reported that servals historically occurred along the entire coastal and sub-coastal belt of the Eastern Cape, and that they were nearly extinct in that province in 1987. In the early 2000s, servals were reintroduced into Shamwari and Kwandwe private game reserves in the Eastern Cape (Hayward, *et al.*, 2007). Although they are still considered rare, they are also present in the following reserves in the Eastern Cape (D. Peinke pers. comm. 2015): Amakhala, Lalibella, Hopewell, Kariega Park, Samara, and Mount Camdeboo. They have also recently been recorded in the Western Cape (Fig. 3).

When comparing the most recent distribution map (see Ramesh *et al.*, 2016), to past distribution maps (Skinner & Chimimba, 2005; Smithers, 1978), it appears that the species distribution is less fragmented now. Servals also have a broad habitat tolerance and can exist in agricultural landscapes (Ramesh *et al.*, 2016). Although these habitats are fragmented, servals are able to connect with other subpopulations through corridors such as drainage lines to ameliorate fragmentation effects (Hermann, Kamler & Avenant, 2008).

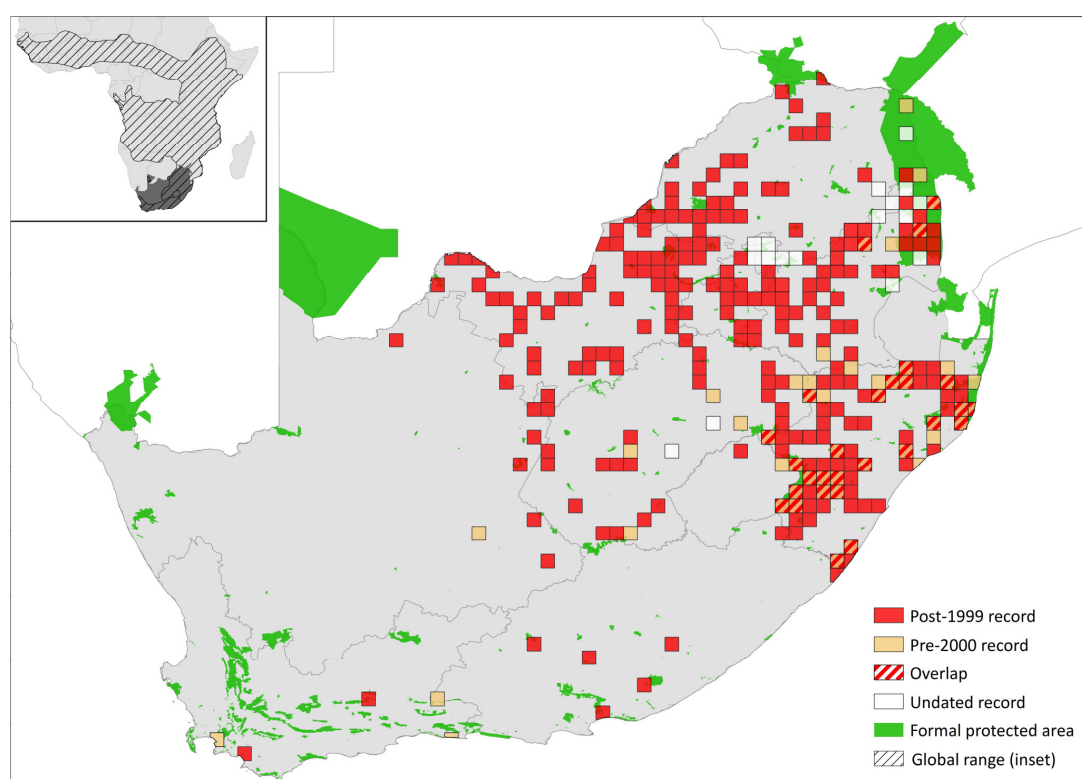


Figure 3: Distribution records for serval (*Leptailurus serval*) within South Africa (Ramesh *et al.*, 2016).

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

Although the species is considered common within wetland habitats of the Drakensberg Midlands, it is considered rare in the lowland wetlands of South Africa (Ramesh & Downs, 2013; Ramesh, *et al.*, 2016). The species is considered rare in the Western Cape and Northern Cape, and uncommon in the Eastern Cape, KwaZulu-Natal and the Free State. Some of the largest serval populations in the species' range outside protected areas seem to occur within areas of extensive agricultural and industrial land use (Bowland, 1990; Look *et al.*, 2018; Ramesh & Downs 2013; Rowe-Rowe 1992). The absence of large carnivores, as competitors and predators of serval, appear to have benefitted servals in parts of KwaZulu-Natal (Bowland, 1990; Ramesh & Downs, 2013; Rowe-Rowe, 1992) and Mpumalanga (Look, *et al.*, 2018).

In the Midlands below the Drakensberg in KwaZulu-Natal, serval abundance was assessed in a matrix of farmland, where three sites were camera-trapped using Spatially Explicit Capture Recapture (SECR) methods (Ramesh & Downs, 2013). The sites differed in their intensity of use (including farmlands and natural rangelands), but there was no significant difference in estimated density, which across the whole study area varied from 6.2 ± 1.9 to 7.7 ± 1.6 servals/100 km² (Ramesh & Downs, 2013).

In the Secunda area of Mpumalanga, and specifically in refugia surrounding an industrial plant, Look *et al.* (2018) reported the highest population density known for serval. Using conventional camera trapping methods (cf Ramesh & Downs, 2013), densities ranged from

76.2–101.2 animals/100 km² (Loock *et al.*, 2018). Other site-specific estimates for the species include a density estimate of 1.6 animals/100 km² for Welgevonden Nature Reserve in Limpopo (2015 estimate), 2.49 animals/100 km² for Ithala Game Reserve in KwaZulu-Natal (2019) (Taylor, 2020) and 14 animals/100 km² for Verloren Valley in Mpumalanga (2017 estimate).

Other than the KwaZulu-Natal Midlands and Mpumalanga Highveld studies, there are no other abundance estimates for this species in South Africa. However, based on a local estimate at the time (after Ramesh & Downs, 2013), and wetland habitat mapping procedures, a total national population size was estimated at 10,264 ± 812 by adjusting the density estimate per vegetation type (after Mucina & Rutherford, 2006), and estimating population size using the proportion of untransformed land across the serval's range (Ramesh *et al.*, 2016). However, this may equate to fewer than 10,000 mature individuals in total (Ramesh *et al.*, 2016).

Servals seem to breed easily in captivity, and several facilities in South Africa are keeping and breeding serval. It is estimated that 606 serval are kept in 93 breeding facilities throughout the country (Table 2). One facility in the Limpopo province reported keeping 30 breeding pairs of serval.

Table 2: Captive breeding facilities within the various provinces and the number of servals within the facilities. (The Northern Cape province does not allow the captive breeding of serval within the province.)

Provinces	No of facilities	No of serval
Eastern Cape	5	50
Free State	46	315
Gauteng	9	83
KwaZulu-Natal	1	12
Limpopo	13	65
Mpumalanga	0	0
Northern Cape	0	0
North West	12	55
Western Cape	7	26
Total	93	606

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

According to Ramesh, *et al.* (2016) the national serval population is possibly declining due to net loss of wetland habitat, road mortalities, uses directly related to traditional medicine or cultural regalia (which may represent an emerging threat within the assessment region), or indirectly as collateral in snares laid out for other species or through general predator control and pest control through poisons by farmers and landowners. However, in the last decade, two provinces (North West, Free State), have registered increasing population sizes (based on range change as a proxy) and the species' range has expanded to a lesser extent into the Northern Cape, Eastern Cape and Western Cape. In addition, a recent population viability analysis (PVA) on the species calculated a relatively high potential population growth rate of 62.7% (Mangele, 2017), which if threats are nullified, could suggest that local sub-populations can increase readily. The increase in both extent of occurrence (EOO) and area of occupancy (AOO), probably due to the creation of artificial water-bodies and a subsequent increase in prey, may indicate continuing recovery from historical persecution and habitat loss (Thorn *et al.*, 2011) and thus a stable to increasing population. In addition, roadkill data recorded between 2014 and 2017 along a 400 km strip of the N3 between Johannesburg and Durban has remained stable at about 5.24 serval carcasses/100km/year evenly spaced along the strip of road (Williams *et al.*, 2019). This may indicate a stable population.

Within KwaZulu-Natal, the population appears stable, especially as densities are comparable across a range of farming intensities (Ramesh & Downs, 2013), as long as there are sufficient wetlands with natural vegetation evenly spaced within the landscape (Ramesh *et al.*, 2015b). Taylor (2020) used the long-term leopard survey data to produce annual density estimates for serval over a seven-year period (2013-2019) at Ithala Game Reserve, KZN. There the serval population declined from 9.66 individuals/100km² in 2014 to 1.42 individuals/100km² in 2018 (Taylor, 2020). Though, for the past two years the population remained stable at 2.49 ± 0.81 (1.24-4.63) individuals/100 km². On a provincial level, there is low confidence in the available population trend data as no regular population surveys are conducted across the province.

The population in the Eastern Cape increased due to successful introductions into Sibuya Game Reserve and Lalibela Game Reserve. Limited data exist on the population trends for the species in Limpopo, Gauteng and the Northern Cape. Population trends in Mpumalanga appear to be stable, but there are no long term data to support this statement.

Population trends on a national level remains uncertain. There are limited data on long term trends and survival and no repeat studies for comparisons.

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 serval population was conducted in 2015 as part of the national Red List assessment (Ramesh, *et al.* 2016) and listed the species as Near Threatened A2c + C2a(i). The data were sourced from field studies (literature) and indirect information (literature, unpublished). Serval populations are currently not directly monitored in any of the state protected areas or private reserves and as a result no data on trends for these populations are available. However, through several camera trap projects, managed by Panthera and SnapShot, serval populations are indirectly monitored, but data are recent and limited trend data are available for these populations. Thus, the majority of information available on population trends is anecdotal. Data from North West Province are quantitative, but outdated (surveys conducted in 2014). Recent quantitative roadkill data are available along major routes in parts of the species range, for example a 400 km strip along the N3 between Johannesburg and Durban (Williams *et al.*, 2019). Little is known about the status and population trend of the Kruger National Park serval population. In general, good data exist on the localised abundance of the species across its range in South Africa, but limited data exist for population trends at a national scale.

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

Looking at the pan-African context, habitat decline, road mortalities, hunting and conflict were the four most important threats facing servals (Ray *et al.*, 2005), which parallels a regional Red List assessment for South Africa (Ramesh *et al.* 2016). The global Red List assessment was based on an approach where the relative severity (its effect on the species), urgency (timescale over which it is most likely to occur), probability (likelihood of occurrence), and geographical extent of each of the threats faced by a species were assessed throughout the species' range in Africa (Ray *et al.*, 2005). The species was listed as a species of concern by Ray *et al.*, (2005).

According to the latest Regional Red List of Mammals (Ramesh, *et al.*, 2016), habitat destruction, or its alteration, road kill mortalities, persecution for alleged predation, and their use for traditional and medicinal uses are considered threats to servals in South Africa. However, at present little is known about the magnitude and severity of each of these threats and how these threats affect the serval population within South Africa (and seem at odds with the recent range expansion observed for the species).

a) Habitat loss

The major threat to serval is loss and degradation of wetland and associated grassland (Bowland, 1997; Hunter, 2011; Ramesh, *et al.*, 2016; Ray *et al.*, 2005). The degradation of grasslands through deforestation (Bowland, 1997), burning and over-grazing by livestock is likely to lead to a decline in small mammal prey densities, which in turn is likely to drive local extirpations of serval (Bowland, 1997; Hunter, 2011; Rowe-Rowe, 1992). Wetlands have also been drained in the past, which has had a significant impact on serval space use, and their populations (Bowland 1990; 1997; Hunter 2011). These losses are however balanced to some extent by the species' apparent tolerance of agriculture, where it benefits from increased rodent densities provided that sufficient cover and water are available (Bowland, 1990; 1997; Kingdon, 1997; Nowell & Jackson, 1996; Ramesh, *et al.*, 2015b). The continuing loss and degradation of natural wetlands and associated reed-banks can be considered the primary concern. The 1990–2013/14 (24-year period) South African National Land-Cover change report found a 32.8% decline in natural wetlands on a national scale, a combination of anthropogenic degradation and currently drier conditions (Ramesh *et al.*, 2016). This is almost exactly three generations for serval (c. 25 years). This decline in wetlands is corroborated by general natural habitat loss on a provincial scale (Ramesh *et al.*, 2016). However, the relationship between natural wetland loss and population trends is unknown. In addition, the extent to which natural wetland loss is mitigated by the development of artificial wetlands is uncertain, and there is no direct evidence for population declines.

Given that vlei rats, the preferred prey species of serval, are concentrated in wetlands, conversion of wetland habitats into agricultural lands can both directly and indirectly affect serval populations through the decline in this prey species' abundance (Bowland & Perrin, 1993). As wetlands support a fairly dense small mammal population, the survival of serval populations are dependent on wetland

conservation in a mosaic of agricultural lands (Ramesh & Downs, 2015a). The conversion of natural habitats into intensive farming is thus expected to influence serval abundance. As such, serval may serve as an indicator of disturbance, due to their dependence on wetlands (Ramesh & Downs 2013). In addition, under current climate change scenarios it is predicted that grasslands will become even more threatened giving way to savannah and woodland areas. Many areas will also become drier, which will lead to less functional wetland areas on which this species is dependent.

b) Local and international trade

Serval have spots in ornate patterns, and exhibit variability throughout their range (Dorst & Dandelot, 1972; Kingdon 1997; Smithers 1978), which predisposes them to be of interest in the wildlife trade, whether for skins (Bowland, 1997), or as live animals (Ramesh, *et al.*, 2016), the latter facilitated by the fact that many small felids are susceptible to domestication (Cameron-Beaumont *et al.* 2002). Serval can become docile as kittens and make good pets (Pienaar *et al.*, 1996), which means there may be some demand in keeping them, and similarly, obtaining them for pets and captivity, including extractions from the wild. Deliberate hybridisation with the feral cat has resulted in a newly registered breed, the “Savannah Cat” (Eckermann-Ross 2014). However, the males tend to become sterile after a few generations (Davis, *et al.*, 2015). The “Savannah Cat” is registered with the International Cat Association as a breed, and is subject to various regulations depending on the state or province in the United States and Canada respectively. There is, however, no evidence of any threat to the serval as yet. The impact of the international trade in live serval on wild populations is thus currently unknown (Ramesh, *et al.*, 2016). At present there are no verifiable data from the provinces to suggest that wild serval kittens are captured for captive breeding. Furthermore, there seems to be a higher demand for captive-bred animals as wild serval seldom breed well in captivity.

The serval is a popular species in the local skin trade throughout Africa (Hunter, 2011; Ray *et al.*, 2005). In addition, use and trade in serval parts for cultural purposes have been documented in at least 32 African countries (literature from 1970s to present), primarily southern and West Africa (V.L. Williams, pers. comm. and in prep.). Serval parts, primarily skin, are used for traditional attire (Anthony & Bellinger, 2007), decoration, traditional medicine (Cunningham & Zondi, 1991; Williams, 2003), bushmeat, rituals and curios for the tourist trade (V.L. Williams, pers. comm. and in prep.), and it is believed that the use is more widespread than previously realised. In the past, skins were frequently sold as cheetah (*Acinonyx jubatus*) or leopard (*Panthera pardus*), which command higher prices and are sought after by tourists (Nowell & Jackson, 1996). Data collected by Panthera at religious gatherings of the Shembe between 2015 and 2020, indicated that between eight and 30 serval skins are observed per gathering with no clear directional trend (G. Whittington-Jones, pers. comms.). In KwaZulu-Natal, there is evidence that serval skins have been replaced by the skins of genets (*Genetta spp.*) mainly due to the perceived increased rarity of serval in the province (Mangele, 2017).

Within South Africa, servals have been recorded in local *muthi* markets, but in low numbers (only two traders were reported with one serval skin each within the Faraday traditional medicine market between June 2004 and November 2005) (Whiting, Williams and Hibbitts, 2011) and are currently sold for ZAR200 (US\$14.57) to ZAR250 (US\$18.21) depending on carcass size and quality (Mangele, 2017). During surveys conducted at Faraday market in 2014 and 2015, four and three serval skins were observed, respectively (Variawa, Unpublished). Then later, during a national department-led confiscation in 2019, 12 serval skins were confiscated (S. Ras, pers. comms. 2020). Small to medium sized mammals, including carnivores, have flooded the bushmeat, traditional medicine and skin trade markets and subsequently replaced their large counterparts (Fa *et al.*, 2014). Due to their relatively small sizes they are harvested in large quantities to ensure profitable sales in these markets (Mangele, 2017). The presence of servals in traditional markets are likely more prevalent than currently documented (V.L. Williams, pers. comm. and in prep.). Challenges exist identifying material in markets without a DNA test, especially if skins are cut up into small pieces and / or made into traditional attire. In a survey which ran in four provinces from 2017 to 2019, where alleged leopard and cheetah samples were purchased, 16% of these samples were identified as serval through DNA testing, and all were from unique animals (V.L. Williams, pers. comm. and in prep.). It seems servals are perceived as being immature cheetahs by some users, especially since most of the servals were identified in the cheetah samples. Servals are thus mostly substitutes for cheetahs and not genets (V.L. Williams, pers. comm. and in prep.).

c) Illegal hunting

Servals are easy to hunt, and they are said to be readily bayed by dogs. Their localised distribution near permanent water sources may increase their vulnerability (Stuart, 1985). Recreational hunting of servals with dogs is popular in KwaZulu-Natal (Mangele *et al.*, 2018), and the eastern Free State (Ray *et al.*, 2011). Recent research (Mangele *et al.*, 2018) reported that servals are rarely encountered by hunters in KwaZulu-Natal (only 27 % of hunters reported encountering them and even less reported successfully hunting them). Dogs in settlements are a threat to serval (Kingdon, 1997). Servals, like most other mammals, are inadvertently caught in snares as part of the bushmeat trade (Ramesh, *et al.*, 2015b, c). However, in KwaZulu-Natal at least, only a few hunters have caught serval as bushmeat (Mangele *et al.*, 2018). Since snares are unselective, servals are at risk, with wide-ranging males at a higher risk (Bowland, 1990; Mangele *et al.*, 2018; Ramesh *et al.*, 2015c). According to the Ezemvelo-KZN Wildlife crime database between 2008 and 2020, approximately 10 serval skins were confiscated in six separate operations within the province.

d) Human predator conflict

Servals are capable of killing lambs, although indications are that they would be unable to kill an adult sheep (Bowland, 1990). The species' interference with sheep stock is minimal (Bowland, 1990; Somers, *et al.*, 2019), and farmers taking part in a damaging causing

animal survey suggested servals were responsible for only 0.8% of stock loss (Lawson, 1989). Further, wild-caught servals were reluctant to kill small lambs in captive feeding trials, only doing so when alternative food was unavailable (Bowland, 1990). However, serval occasionally prey upon poultry, which may lead to direct persecution (Bowland, 1990; Dorst & Dandelot, 1972; Smithers, 1978), particularly with subsistence farmers (Manqele, 2017). Thorn *et al.*, (2012) showed low levels of conflict with farmers in the North West, and in their study only one predation event was attributed to serval. Servals are however often killed by farmers, either because they are mistakenly believed to kill livestock or are misidentified as leopards or caracals, or else they are killed by indiscriminate methods such as gin traps and poison (Bowland & Perrin 1993; Hermann, Kamler & Avenant, 2008; Lawson 1987). Non-selective predator control programmes in South Africa may significantly impact the species in some areas (Bowland & Perrin, 1993). By-products of hunts, such as skins, appear at rural taxidermists (Ray *et al.*, 2005; Manqele, 2017).

e) Road mortalities

Servals appear drawn to road edges, perhaps because of hunting opportunities (Stott 1980, In: Ray *et al.*, 2005) and they tend to freeze in oncoming headlights, increasing their vulnerability (L. Hunter pers. obs., In: Ray *et al.*, 2005). They are commonly reported as road kill in South Africa (Manqele, 2017; Ramesh *et al.*, 2015c; Ramesh *et al.*, 2016; Ray *et al.*, 2005; Williams *et al.*, 2019). There is little information on the impact on populations, but areas with relatively high densities of roads may be sub-optimal for the species (Ray *et al.*, 2005). Only Williams *et al.* (2019) has documented road kill patterns for various species, and reported that 5.24 serval are killed per 100 km/year (Williams *et al.*, 2019). The most vulnerable areas are high-speed roads intersecting known serval habitat along rivers and wetlands (Williams *et al.* 2019).

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

In KwaZulu-Natal, servals are susceptible to retaliatory killing for preying on poultry (Manqele, *et al.*, 2018). Moreover, snaring and road mortalities of servals are high in the region as well (Manqele, *et al.*, 2018; Williams *et al.*, 2019). According to the Ezemvelo-KZN Wildlife crime database between 2008 and 2020, approximately 10 serval skins were confiscated in six separate operations within the province. The serval is a popular species in the local fur trade throughout Africa (Hunter, 2011; Ray *et al.*, 2005). In addition, use and trade in serval parts for cultural purposes have been documented in at least 32 African countries (literature from 1970s to present), primarily southern and west Africa (V.L. Williams, pers. comm. and in prep.). During surveys conducted at Faraday market in 2014 and 2015, four and three serval skins were observed, respectively (Variawa, Unpublished). Then later, during a national department-led confiscation in 2019, 12 serval skins were confiscated (S. Ras, pers. comms. 2020). The presence of servals in traditional markets are likely more prevalent than currently documented (V.L. Williams, pers. comm. and in prep.). Challenges exist in identifying material in markets without a DNA test, especially if skins are cut up into small pieces and / or made into traditional attire. In a survey which ran in four provinces from 2017 to 2019, where supposed leopard and cheetah samples were purchased, 16% of these samples were identified as serval through DNA testing, and all were unique and not resampled (V.L. Williams, pers. comm. and in prep.). It seems servals are perceived as being immature cheetahs by some users, especially since most of the servals were identified in the cheetah samples. Servals are thus mostly substitutes for cheetahs and not genets (V.L. Williams, pers. comm. and in prep.). Data collected by Panthera at religious gatherings of the Shembe between 2015 and 2020, indicated that between eight and 30 serval skins were observed per gathering with no clear directional trend (G. Whittington-Jones, pers. comms.).

Using a Vortex simulation model to carry out population viability analyses of serval, Manqele (2017) evaluated the impact of illegal hunting on the long-term survival of a serval population. Population estimates of a sub-population in KwaZulu-Natal were examined, where life history parameters were obtained from secondary data sources. Multiple scenarios were run representing varying illegal hunting levels. According to the model, the serval population exhibited a high level of resilience to illegal hunting. This could be attributed to the species relatively high reproductive rate accompanied by rapid maturity of juveniles and the polygynous mating system (Manqele, 2017). In contrast, Ramesh, *et al.*, (2015b) found that nearly 40% of the collared servals (n = 17) in the KwaZulu-Natal Midlands died due to snaring, roadkill and possibly rodent poisoning. An average collared individual's age was 3–4 years, which indicates high mortality and low survival rate (Ramesh *et al.*, 2015b).

Due to inconsistencies among provinces in the implementation of the permit system and specifically around captive breeding there is the potential for the laundering of wild caught serval into the captive trade. How a specific individual got into a captive facility is seldom tracked especially if the specimen is traded among captive facilities in different provinces. There is currently anecdotal evidence that this may be happening.

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 protected in terms of section 56 of NEMBA, and various provincial Ordinances and Acts provide further legislative protection. Therefore, permits are required to undertake a variety of restricted activities in relation to serval, e.g. hunting and other forms of direct use such as catching, translocation, etc. However, Mpumalanga province does not currently implement the Threatened and Protected Species regulations (ToPS) under NEMBA. Harvesting of serval in the province requires the permission of the landowner and transfer of hunting rights to a hunting outfitter. However, hunting of serval by local hunters in the province is negligible. The export of serval hunting trophies is regulated through the CITES permit process. There is however limited monitoring and oversight to ensure sustainability of trophy hunting of serval in the province. At the national level, there is currently no adaptive framework for serval management, but off-takes are managed on a local scale through a permit system on a case-by-case basis in all provinces except for Mpumalanga. For the past two years (2019 and 2020), KwaZulu-Natal has not been issuing any trophy hunting permits for serval, specifically because the impacts of harvest on the species are unknown.		
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 no species management plans for serval. A management plan is not required for the introduction and keeping of serval on private land, though private landowners may have general ecological management plans for their properties. Within the Northern Cape Province, the Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform (DAERDLR) requires a habitat analysis as well as a threat analysis to be conducted before an application to introduce serval on private land will be considered.		
13. Aim of harvest regime in management planning: What is harvest aiming to achieve?	Generate conservation benefit	1
	Population management/control	2
	Maximize economic yield	3
	Opportunistic, unselective harvest, or none	4
	Uncertain	5
Harvest of the species as hunting trophies is predominantly opportunistic and unselective. Mpumalanga province does not currently implement the Threatened and Protected Species regulations (ToPS) under NEMBA, and no permit is required under the provincial ordinances for the harvest of serval in the province. The majority of live serval exported from South Africa are captive bred (96%), with 54% and 29% exported for commercial purposes and to zoos respectively. The serval is also said to domesticate readily and is popular in the international pet trade. The source of specimens for the pet trade is largely from captive breeding facilities and the main purpose of this trade is to maximize economic yield. Illegal harvest in the species is considered opportunistic and unselective.		
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
The serval is listed as a Protected species in terms of the Threatened or Protected Species Regulations (ToPS) under NEMBA, and thus a permit is required for undertaking any restricted activity including hunting, catching, capturing or killing. However, the province of Mpumalanga, where the majority of serval trophy hunts are conducted, does not currently implement ToPS, and only the export of serval hunting trophies are regulated through the CITES permit system. Between 2010 and 2019, a total of 306 serval have been hunted by international clients in Mpumalanga Province according to the Professional Hunter's (PH) Register (Table 3). There are no national or provincial quotas to manage the off-take of serval in South Africa, and provincial Management Authorities issue permits on a case-by-case basis. The exception to this is North West Province, which since 2018 has employed a policy of restricting hunting of serval to four individuals per year, with two serval allocated to the Bushveld and two to the Highveld ecoregions, and with a seasonal restriction (July-September only). The reproductive biology of the species and its relative abundance across the province form the basis of this quota. In Limpopo, one serval is allocated per professional hunter per farm per year. Between 2010 and 2019, a total of 184 serval have been hunted by international clients in the Limpopo Province according to the PH Register (Table 3).		

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 serval does not take place 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.		
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?	None	1
	Low	2
	Medium	3
	High	4
	Uncertain	5
To date, no permits have been issued for the harvesting of serval within open access areas. In KwaZulu-Natal, anonymous reporting via questionnaires has suggested that permit costs are prohibitive, and that illegal hunting and harvests are likely to occur (see Manqele, 2017).		
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 serval occur, funding and human resources required for the development and implementation of species management plans are limited. There is low confidence in the harvest management of serval, due to budgetary constraints, lack of capacity and proper planning, the lack of a national serval management plan, and in some provinces a permit system that is inadequate for the regulation of serval. Provincial Management Authorities do not have sufficient resources to confirm whether permitted trophy hunts actually took 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 standardised or formalised. In the Northern Cape, the permit system is adequate to regulate the harvest of serval (based on legislative requirements). However, budget and capacity constraints limits monitoring and enforcement of permit requirements. In KwaZulu-Natal and North West Province there is a high confidence in the setting of the quota for the species, but a low confidence in the overall management due to a lack of monitoring on the impacts of harvest on the populations. For the past two years (2019 and 2020), KwaZulu-Natal has not been issuing any trophy hunting permits, specifically because the impacts of harvest on the species are unknown. In Limpopo, one serval is allocated per professional hunter per farm per year, but there is no ecological basis for this quota and its sustainability remains unverified. In Mpumalanga, where the majority of serval hunts take place, only a CITES export permit is required for the export of a serval hunting trophy. There is thus no confidence in the management of harvest in this province. No trophy hunting of serval is currently (2020-2021) allowed in the Eastern or Northern Cape because limited information is available on the species and the possible impacts of harvest on the species.		
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, the harvest of serval is monitored primarily through the CITES trade records, but also through a provincial permit system and the Professional Hunter's Register. An analysis of the CITES trade data for 2000 – 2017 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) showed that 723 serval trophies and 761 live animals were exported over an 18 year period. Since 2014 there has been a marked increase in the number of live serval exported annually (Fig. 4). The majority of live serval exported were captive bred (96%), with 54% and 29% exported for commercial purposes and to zoos respectively (Fig. 5). The major import destinations include China (16%), Denmark (12%), Malaysia (11%), Bangladesh (8%) and the USA (8%) (Fig. 6).

According to the PH Register, 585 serval were hunted by international clients between 2010 and 2019, averaging 59 serval per annum (Table 3 and Fig. 7). More than 50% of the hunts took place in the Mpumalanga province, where no permit is required to hunt serval. At present, no monitoring or procedures are in place to quantify illegal harvest.

Due to inconsistencies among provinces in the implementation of the permit system and specifically around captive breeding there is the potential for the laundering of wild caught serval into the captive trade. How a specific individual got into a captive facility is seldom tracked especially if the specimen is traded among captive facilities in different provinces. There is currently anecdotal evidence that this may be happening.

Table 3: Number of serval hunted by international clients in each of the province according to the Professional Hunters Register between 2010 and 2019.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Eastern Cape	0	35	0	0	2	3	0	0	2	4	46
Free State	0	0	0	0	0	2	0	0	0	0	2
Gauteng	0	0	0	0	0	0	0	0	0	0	0
KwaZulu-Natal	5	4	3	6	2	1	9	0	0	1	31
Limpopo	0	8	10	7	16	22	33	38	21	29	184
Mpumalanga	9	10	9	13	23	31	35	50	67	59	306
Northern Cape	0	0	0	0	0	0	0	0	0	0	0
North West	1	0	0	0	5	2	4	1	0	3	16
Western Cape	0	0	0	0	0	0	0	0	0	0	0
Total	15	57	22	26	48	61	81	89	90	96	585

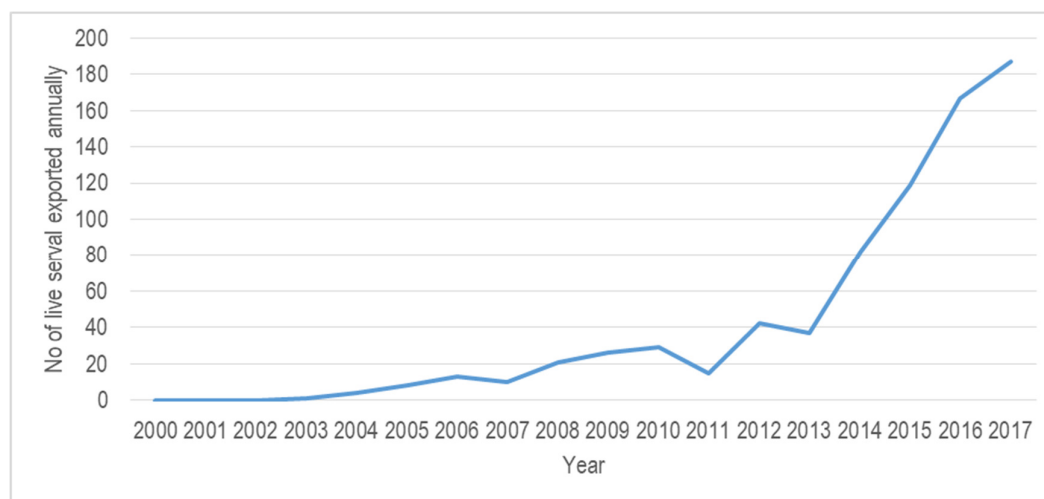


Figure 4: The number of live serval exported from South Africa from 2000 to 2017 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK).

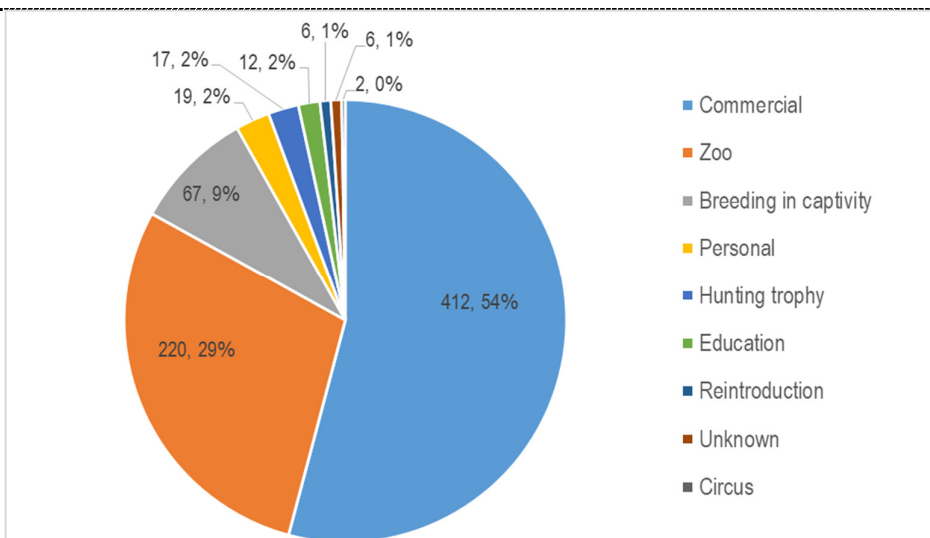


Figure 5: The number of live serval exported between 2000 and 2017 under “all purpose” codes. Numbers exported as well as percentages per trade term are indicated (e.g. 412 live serval exported (54% of total live exports) for commercial purposes).

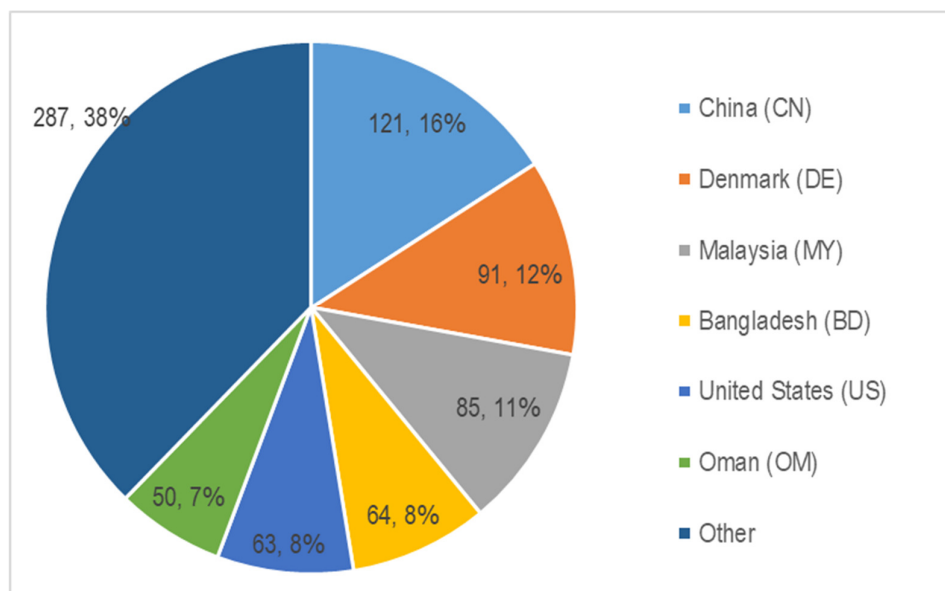


Figure 6: The percentage of total live serval exports from South Africa for the top six importing countries as determined by an analysis of CITES trade data for the period 2000 – 2017 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK).

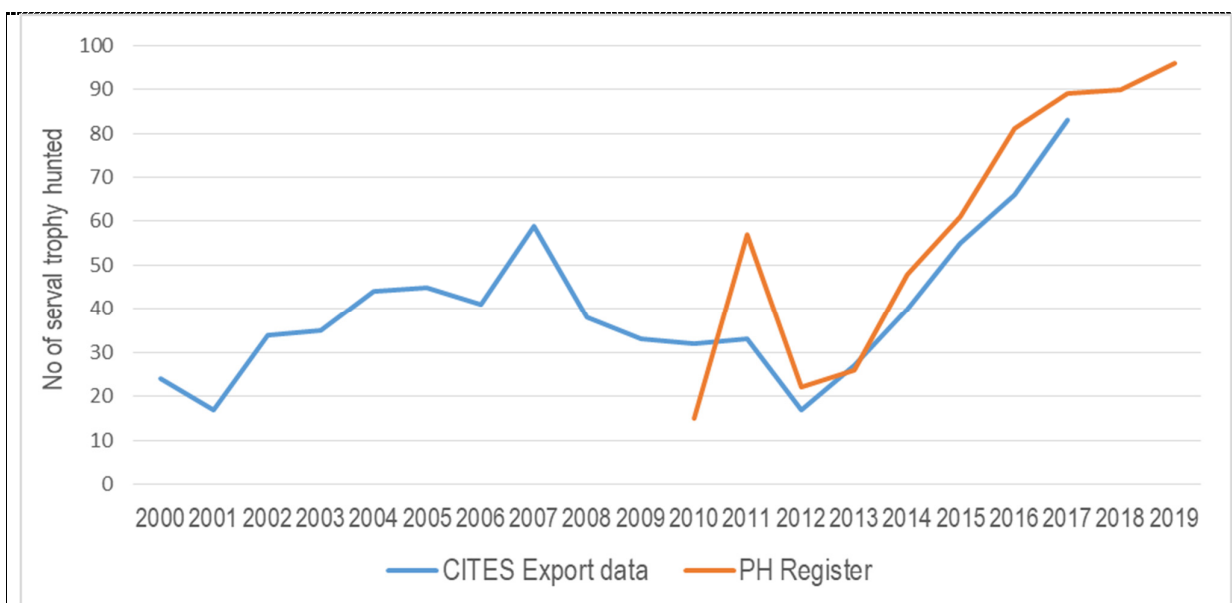


Figure 7: Number of serval hunting trophies exported according to the CITES trade database (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) between 2000 and 2017 and the number of serval trophy hunted as recorded in the Professional Hunter's (PH) Register between 2010 and 2019.

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

There is a high confidence in the monitoring of exports as sufficient budget is provided and regular analyses of CITES Trade records are conducted. The harvest of servals within the Mpumalanga province where more than 50% of trophy hunts occur, is not regulated or monitored. Across all provinces the effects of harvest are not currently monitored and there is often a lack of knowledge of what happens on the ground. It is difficult for scientists/ecologists within provincial conservation agencies to access permit records and the PH Register and as such they therefore cannot be easily used as a monitoring tool. There is thus a low confidence in monitoring the effects of the harvest of serval. Due to inconsistencies among provinces in the implementation of the permit system and specifically around captive breeding there is the potential for the laundering of wild caught serval into the captive trade. How a specific individual got into a captive facility is seldom tracked especially if the specimen is traded among captive facilities in different provinces. There is currently anecdotal evidence that this may be happening.

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

According to the latest Regional Red List of Mammals (Ramesh, *et al.*, 2016), habitat destruction, or its alteration, road kill mortalities, persecution for alleged predation, and their use for traditional and medicinal uses are considered threats to servals in South Africa. However, at present little is known about the magnitude and severity of each of these threats and how these threats affect the serval population within South Africa (and seem at odds with the recent range expansion observed for the species). Trophy hunting may incentivize the conservation and protection of serval on private land. However, more than 50% of the trophy hunts currently occur within the Mpumalanga province where the hunting of serval is not regulated or monitored. Considering that little is known about the magnitude and severity of the threats facing the species and that most of the hunting takes place in Mpumalanga where hunting is not regulated the impacts are unknown the effect of the harvest on the species is not known.

22. Incentives for species conservation: At the national level, how much conservation

High	1
Medium	2

benefit to this species accrues from harvesting?	Low	3
	None	4
	Uncertain	5
The harvest of servals as it currently occurs in South Africa is unlikely to incentivize the conservation of the species. Given the recent range expansion of the species, it is likely that the largest portion of the species range occurs outside of formally protected areas, and furthermore in areas with a predominance of agricultural and industrial land uses. The importance of private land for the conservation of the species is therefore evident. According to the PH Register, approximately 50 serval are trophy hunted per annum (2010-2019), with all of these hunts occurring on private land. However, more than 50% of the trophy hunts occur within the Mpumalanga province, where the hunting of serval is in adequately regulated or monitored, therefore limiting any opportunity to generate conservation incentives. A questionnaire survey by Lindsey <i>et al.</i> (2005) suggested that the attitudes of landowners to predators that can be hunted is better than for those predator species which cannot be hunted, such as cheetahs and wild dogs. Sustainable hunting of serval could potentially benefit the management and conservation of the species, though no data are available to show if or how utilisation affects tolerance of landowners towards the species. At present, captive breeding facilities keeping serval benefit financially from keeping and selling the species, but do not directly contribute to the conservation of the species as the main objective of these facilities is economic gain. Some of the captive facilities may however contribute indirectly to the conservation of the species through educational programs, but there is no evidence to support this. More than 50% of the international trade in live serval is for commercial purposes (purpose code T). Between 2000 and 2017, only two captive-bred servals have been reintroduced into other range countries (Eswatini). In North West, there have been three potential cases of captive bred trophy hunts of serval. This information was recorded from prospective hunters intending to hunt the species in marginal occurrence areas, and two such cases involved applicants who were also owners of captive facilities keeping serval. While circumstantial, the hunting of a species where they are extremely rare makes for a spurious incentive to legitimately utilise the species in their distribution range. The intention of captive-bred serval hunts is to guarantee a successful hunt. These hunts are unlikely to contribute to species conservation.		
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
There is no incentive for habitat conservation through the harvesting of the species. According to the PH Register, approximately 50 serval are trophy hunted per annum (2010-2019), with all of these hunts occurring on private land. However, more than 50% of the trophy hunts occur within the Mpumalanga province, where the hunting of serval is inadequately regulated or monitored, therefore limiting any opportunity to generate conservation incentives.		
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
The distribution of servals outside of protected areas is not known with any confidence, though the following are the most important protected areas in which serval are known to occur (with area sizes in parenthesis) – KNP (19,485 km²), uKhahlamba Drakensberg (2,430 km²), iSimangaliso Wetland (3,280 km²), Ithala (290 km²), Manyeleti (230 km²), Madikwe Game Reserve (600 km²), Hluhluwe iMfolozi Game Reserve (960 km²), Verloren Valley (60 km²), and Pilanesberg (500 km²). These protected areas cover less than 0.3% of the species total EOO across the country. Given the recent range expansion of the species it is likely that the largest portion of the species range occurs outside of formally protected areas and thus not legally excluded from harvest. When including other protected areas across the species range, less than 5% of the species range is legally excluded from harvest. In the North West province, approximately 3% of the province, a total area of 1, 827 km², is protected for the species.		
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

There is a medium confidence in the effectiveness of strict protection measures implemented. Even though servals within some protected areas might be exposed to strong edge effects, the cores of larger protected areas such as the Kruger National Park, uKhahlamba Drakensberg, and iSimangaliso Wetland likely constitute inviolate refuges for servals. Snaring, which is mainly incidental, does occur within some protected areas, but at present there are no records of serval being caught in snares.		
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
There is good legislation in place on both a national (ToPS Regulations) and a provincial level to regulate all use activities relating to serval. There is however a lack of capacity within the provincial conservation agencies to effectively manage the permit system in relation to serval. Mpumalanga does not currently implement the ToPS Regulations under NEMBA, and only a CITES export permit is required for the export of a serval hunting trophy. The lack of legal restrictions in Mpumalanga has led to much higher levels of serval off-takes than any other province – at present more than 50% of serval hunted takes place in Mpumalanga. The Northern Cape no permits are being issued for the hunting serval. In KwaZulu-Natal, applications to hunt serval are assessed on merit, but based on poor population data and the species biology, applications are not normally supported. Anonymous reports in KZN suggest that permit costs are prohibitive, and illegal hunting and harvests are therefore likely to occur (see Manqele, 2017). In addition to a strict quota system for hunting, seasonal restrictions have recently (2018) been imposed on the hunting of serval in North West Province. Hunting of serval in the province is restricted to a 3-month period from July to September and limited to four adults, two for the Bushveld and two for the Grassland ecoregions of the province. The season is based on the rationale that in any month outside this period, the risk of orphaning dependent young is high, despite them not being strictly seasonal breeders (Smithers, 1978), coupled with the fact that they are not overtly sexually dimorphic (i.e. difficulty in gender discrimination).		

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