

Non-detriment finding for *Equus zebra zebra* (Cape mountain zebra)

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Summary of findings

Equus zebra zebra (Cape mountain zebra) was transferred from Appendix I to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) at the Conference of the Parties (CoP17) in September 2016. 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 *Equus zebra zebra* (Cape mountain zebra) was compiled through a review of the relevant literature and deliberations held at an NDF workshop convened by the South African National Biodiversity Institute on 2 February 2023 (workshop participants and references included at the end of this document), and amended through various further consultations. The information presented is current as of February 2024.

The Cape mountain zebra is endemic to South Africa. Though once widely distributed in the mountains of the Eastern, Western and Northern Cape provinces, the subspecies is currently highly fragmented into a large number of small subpopulations isolated by fences and no meta-population management is practised. Although the subspecies occurs in the Cape Floristic Region, it is currently more common in the Nama Karoo Biome and the Grassland Biome of the Eastern Cape. Evidence suggests that this was also true in historical times. The total population is estimated at 5 693 animals in approximately 114 populations of which 3 212 animals occur within 18 State protected areas and 2 481 animals in 96 privately-owned properties. While growth rates across subpopulations are variable the overall population is increasing. Subpopulations within a number of State protected areas as well as on private properties have increased to unsustainable levels and options to reduce these subpopulations are currently under discussion. These estimates are based on recent quantitative data as the numbers of Cape mountain zebra in all of the formally protected areas (56% of the population), as well as a large portion of privately-owned properties are counted annually.

The Cape mountain zebra is long-lived, with mares of up to 21 years of age producing foals and stallions of up to 19 years of age remaining fertile in the wild. The reproductive rate is low due to the long gestation period of approximately 12 months and a single foal is born on average every 25 months (range 12 – 69 months). In the presence of a full set of competitors, the Cape mountain zebra is a specialist adapted to rugged terrain and is a selective grazer. The subspecies is considered a partial refugee species which means that populations on sub-optimal habitat have a lower realised fecundity than populations on optimal habitat. While limited data exist on the dispersal ability of Cape mountain zebra the subspecies is likely an intrinsically good disperser. However at present dispersal is severely limited by fences and for this reason the dispersal ability of the subspecies is considered medium. The subspecies is tolerant of human activities and adapts well within transformed landscapes.

The current, predominant threat to the Cape mountain zebra is the loss of genetic diversity. This threat is considered substantial. This is because all extant subpopulations stem from only three aboriginal subpopulations that survived the onslaught of colonial hunting and habitat modification. The three relict stocks now suffer from low genetic diversity, and most worryingly, approximately 97% of the present day population is derived from only one of these aboriginal stocks (Mountain Zebra National Park (Cradock stock)). Yet, the remaining stocks at Kammanassie and Gamkaberg nature reserves remain at critically low levels, despite containing 2/3rds of the genetic diversity of the subspecies. De Bruyn and Kotze (January 2023) analysed the 921 Cape mountain zebra DNA profiles within the SANBI national genetic database and estimated the national genetic diversity for Cape mountain zebra at 0.303. Furthermore, Kotze *et al.*, (2019) found a substantial loss of heterozygosity at Mountain

Zebra National Park (MZNP), De Hoop Nature Reserve and Kammanassie nature reserves over a 15-year period. This was most severe at De Hoop, where there was a 22.85% decline in heterozygosity.

Currently, no hunting of this subspecies takes place in any provincial or national parks where it occurs. Limited hunting of Cape mountain zebra occurs on private properties across its range. A simulator tool was developed in 2016 and was designed to be used to identify levels of off-take that will be sustainable under different conditions (Winker *et al.*, 2016). This tool can be used to advise on selective hunting quotas and introduction strategies or relocation schemes to achieve the targets considered for optimal resource use. However, not all provinces at present utilise the tool to inform off-takes. There is thus a cautious national quota for the subspecies. The overall aim of harvesting at present is mostly population management/control to facilitate the growth of the national population and to generate income to fund conservation efforts. At present harvesting, both translocation and hunting, is monitored through a permit system and CITES exports (hunting only) on a case-by-case basis, based on good, sound knowledge, but the effects of harvesting or the lack thereof (e.g. on heterozygosity and fitness) are not currently monitored. There is thus a medium confidence in the current monitoring of the harvest, but confidence is limited by budgetary and capacity constraints. With the implementation of the simulator tool by all provinces that have Cape mountain zebra, it is likely that the confidence in harvest monitoring will increase. In March 2018 a national Biodiversity Management Plan (BMP) for Cape mountain zebra was gazetted for implementation in terms of section 43 of the National Environmental Management: Biodiversity Act, 2004 Act No. 10 of 2004) (NEMBA) and addresses the main threats and need for meta-population management of the subspecies.

Over 56% of the national population is strictly protected within national and provincial parks, but budgetary and capacity constraints have lowered confidence in the effectiveness of these strict protection measures. The current conservation value accrued for the subspecies through harvesting is considered medium due to proposed blanket trophy hunting bans (UK), slow processing and constraints with the import of trophies to the USA that reduces the value proposition the species holds for private sector as part of a sustainable wildlife-based land-use model. The results of a survey conducted by Hrabar and Kerley (2015) and the South African National Biodiversity Institute (SANBI) in April 2016 indicate the willingness of private landowners to collaborate effectively with government as well as to expand the area available to Cape mountain zebra through taking down fences and acquiring more land. A recent survey conducted in the Eastern Cape (137 surveys equating to 758 015 ha) evaluating the contribution of working lands to ecosystem processes and rewilding of landscapes highlighted that almost all wildlife ranchers practise sustainable land management which can be seen as private investment into a public good through the provision of ecosystem services and natural capital restoration. Trophy hunting is the biggest financial contributor to revenue with positive outcomes in ecosystem restoration through land-use change from cultivated fields towards near natural habitats. Incentives for wildlife custodians to restore Cape mountain zebra habitat within the species' distribution range are limited and competition with other land uses is very high.

In conclusion, the non-detriment finding (Fig. 1) undertaken for the Cape mountain zebra as summarized in the analysis of the key considerations above, demonstrates that local and international trade in live animals and the export of hunting trophies poses a low risk to the survival of this subspecies in South Africa. International restrictions on the import of hunting trophies remains a constraint for improved conservation outcomes since the limited economic value of Cape mountain zebra undermines incentives for landowners to conserve the subspecies and its habitat. It is recommended that the off-take simulator tool developed by SANBI inform all hunting off-takes and translocations.

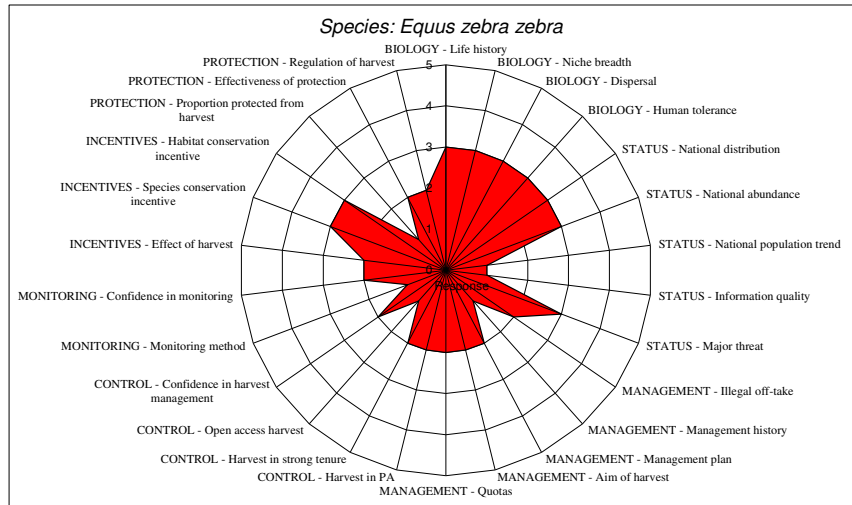


Figure 1: Radar chart summarising the non-detriment finding assessment for *Equus zebra zebra* (Cape mountain zebra) in South Africa in accordance with the CITES NDF checklist. Explanations of scores given are detailed in Table 1. Higher scores are indicative of higher risks to the subspecies. The limited shaded area in the radar chart demonstrates an overall low risk to the subspecies.

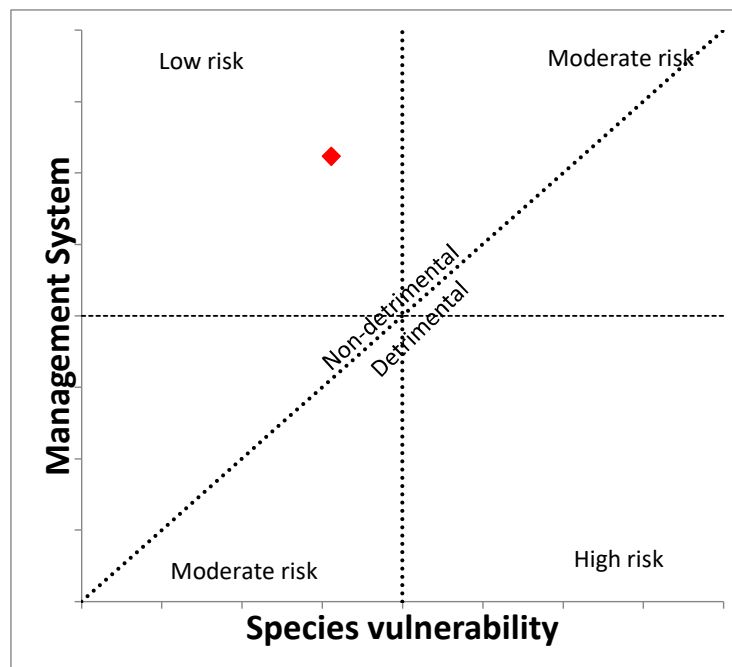


Figure 2: The risk of trading in *Equus zebra zebra* (Cape mountain zebra) by South Africa, as represented by the relationship between species vulnerability (biology and status) and the strength of the management system to which the species is subjected (management, control, monitoring, incentives and protection). The figure demonstrates that the subspecies is at a low risk, and that trade is not detrimental.

Table 1: Detailed non-detriment finding (NDF) assessment for *Equus zebra zebra* (Cape mountain zebra) by South Africa, undertaken in accordance with the CITES NDF checklist. Scores assigned to each question are indicated (bold text in shaded blocks) along with detailed explanations/justifications where relevant. Higher scores are indicative of higher risks to the species.

Biological characteristics		
1. Life history: What is the species' life history?	High reproductive rate, long-lived	1
	High reproductive rate, short-lived	2
	Low reproductive rate, long-lived	3
	Low reproductive rate, short-lived	4
	Uncertain	5
The Cape mountain zebra has a low reproductive rate and individuals are long-lived. Both males and females can live for more than 20 years. Breeding herds consist of one male and on average 2.4 females (range 1 - 5) and their offspring, which remain stable for many years (Penzhorn and Novellie 1991). Female social rank appears to affect the reproductive sex allocation with dominant females producing significantly more female offspring. The reproductive rate is low due to the long gestation period of approximately 12 months and a single foal is produced (Skinner and Smithers 1990). Further, Lea <i>et al.</i>, (2016) describe the Cape mountain zebra as a partial refugee species showing that populations on sub-optimal habitat had a lower realised fecundity than populations within optimal habitats. Foals are born all year round, but there is a definite peak of births in the rainy season. Mares generally produce their first offspring at 4-5 years of age, although younger mares have been known to breed, with an average foaling interval of 18 months. According to Penzhorn (1985) the median foaling interval was 25 months (range 13 - 69 months) in Mountain Zebra National Park (MZNP) and the annual foaling rate 32%. Mares may continue to produce foals up to the age of 21 years and possibly longer. Stallions remain fertile for up to 19 years in the wild (Skinner & Smithers 1990). Both male and female offspring leave the herd at around 22 months, often about four months after the birth of a sibling. According to Lloyd and Rasa (1989) as cited by Skinner and Smithers (1990) the mortality rate of foals appears to be high and to be related to behavioural factors. In De Hoop Nature Reserve, nine of the eleven foals that died were offspring of subordinate mares. There have been suggestions of infanticide by stallions and mares (Penzhorn 1984; Lloyd and Rasa 1989) but the only direct observation of an infanticide attempt was at Mountain Zebra National Park (MZNP) when a group of bachelor males attacked two foals in a family group during a herd takeover (Britnell <i>et al.</i>, 2021). Necropsies of three foals on Sanbona Wildlife Reserve indicated death due to infanticide, although the perpetrators were unknown (Britnell <i>et al.</i>, 2021).		
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
The natural distribution range of Cape mountain zebra includes the Cederberg-Bokkeveld mountain ranges, the mountains of the Great Escarpment and the Cape Fold Belt, extending eastward to Beaufort West and the Roggeveld mountains up to the Swaershoek mountains between Somerset East and Cradock and south east to include the Great and Little Winterhoek mountains near Uitenhage in the Eastern Cape. The north-eastern areas are characterised by summer rainfall and escarpment grasslands, whereas the southwest is dominated by winter-rainfall, with fynbos and succulent Karoo vegetation communities and low grass cover, much of which is not ideal for grazing animals (Boshoff <i>et al.</i>, 2002; Kerley <i>et al.</i>, 2003). The distribution of protected areas within the Cape Floristic Region is heavily biased towards marginal upland habitat (Rouget <i>et al.</i>, 2003a), with few lowland areas large enough to support even small populations of large mammal herbivores (Kerley <i>et al.</i>, 2003). Paleontological evidence suggests that Cape mountain zebra occupied open grassland, and persisted in low densities in fynbos habitat (Faith, 2012). There is evidence that, where possible, Cape mountain zebra move seasonally between upland and lowland habitats and predominantly select areas with high grass cover (Penzhorn, 1982; Grobler, 1983; Winkler and Owen-Smith, 1995; Smith <i>et al.</i>, 2008). Cape mountain zebras are predominantly grazers. Being hind-gut fermenters, they require large volumes of forage. However, they are selective feeders, mainly favouring large-tufted, leafy perennial grass species. In Gamkaberg Nature Reserve, for example, Cape mountain zebra favour habitats with high grass cover and within these habitats select sites containing high abundances of highly palatable grasses (e.g. <i>Themeda triandra</i>). In MZNP, Cape mountain zebra utilize only 26% of plants available at feeding sites and only seven of the 17 grass species present (Grobler 1983). In the Baviaanskloof Wilderness Area, 95% of the annual diet of Cape mountain zebra comprises grasses, especially <i>Tristachya leucothrix</i> and <i>Themeda triandra</i> (Weel <i>et al.</i> 2015). It has been suggested that the Cape mountain zebra is a partial refugee species in parts of the Western Cape with		

relatively low grass cover and few palatable species (Lea *et al.*, 2016). In these sub-optimal habitats, Cape mountain zebra incorporate more browse in their diets. At Bakkrans Contract Nature Reserve in the Cederberg, for example, the forb *Helichrysum dasyanthum* comprises 10.7% of the annual diet of Cape mountain zebra (Olivier 2019). Restriction to suboptimal habitat, in many cases as a result of fences, and consequent diet-switching to suboptimal forage species comes at a cost, leading to lower realised fecundity (Lea *et al.*, 2016, 2017; Britnell 2022). In Gamkaberg, for example, areas with good grass cover only comprise 30% of the nature reserve and of this only 60% qualify as good habitat for Cape mountain zebra (Watson *et al.*, 2005). Most population growth on Gamkaberg occurs after fire followed by good rainfall, resulting in a flush of grass growth but generally, population growth is slow. As grazers and hindgut fermenters, Cape mountain zebras are water-dependent and need to drink daily. In arid or semi-arid areas, they will need to travel further to access sufficient forage and sufficient water.

In the presence of a full set of competitors and in ideal habitat, the Cape mountain zebra is deemed a specialist, however in the absence of strong competition, for example on game farms, or in sub-optimal habitats, the Cape mountain zebra will display more generalist characteristics. The intrinsic nature of the species is that of a 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

At present, the dispersal of the Cape mountain zebra is restricted by fences and it is dependent on translocation (e.g. by game farmers) for dispersal. The subspecies is intrinsically mobile and its historical range included all the mountains within the Cape. There is however little scientific information on the dispersal ability of the subspecies and no historical data to suggest that the subspecies migrated long distances.

There is evidence that, where possible, Cape mountain zebra move seasonally between upland and lowland habitats but predominantly select areas with high grass cover (Penzhorn, 1982; Grobler, 1983; Winkler and Owen-Smith, 1995; Smith *et al.*, 2008). These altitudinal seasonal movements have also been observed in MZNP (D. Zimmerman, pers. comms.). Both male and female offspring leave the herd at around 22 months, often about four months after the birth of a sibling. However, it seems that foals when leaving the herd, remain close to their natal home range. Within MZNP, Cape mountain zebra very effectively colonized additional range made available within the park. Similar, Cape mountain zebras that broke through the external fence of Camdeboo National Park have established and are breeding on a conservancy in the Amandel's Hoogte area, where there are currently approximately 24 cape mountain zebras on properties neighbouring the park. However, across most of the subspecies range fence restrict the dispersal of individuals and may prevent animals from moving to preferred habitat and dispersing into new areas. Therefore the subspecies is considered to have a medium dispersal.

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

Cape mountain zebra are endemic to South Africa and were once widely distributed in the mountains of the Eastern, Western and Northern Cape provinces (Hrabar & Kerley, 2013). Excessive hunting and habitat loss due to agriculture reduced numbers of these animals to less than 80 individuals in just three localities in the 1950s. The subspecies is highly tolerant of human activity and with the removal of above-mentioned threats populations have increased significantly. They adapt to changes in the landscape and readily utilise modified habitats.

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

Cape mountain zebra are endemic to South Africa and were once widely distributed in the mountains of the Eastern, Western and Northern Cape provinces (Hrabar & Kerley, 2013). Excessive hunting and habitat loss due to agriculture reduced numbers of these animals to less than 80 individuals in just three localities in the 1950s. Most importantly, the

entire subspecies was reduced to just three aboriginal populations, at the Mountain Zebra National Park, Kammanassie Nature Reserve and Gamka Mountain Nature Reserve. The number of founding animals of these relict populations was approximately 16, 5 and 6 respectively (Moodley and Harley, 2005). Therefore, all subsequent populations descended from a single aboriginal population will have a major problem with decreased genetic diversity. While the Mountain Zebra National Park (MZNP) population grew rapidly, fuelling translocations to many other reserves, Kammanassie Nature Reserve and Gamka Mountain Nature Reserve (which together harbour 2/3rds of the subspecies genetic diversity) are currently at around 40 (due to terrain very hard to count and identify individuals, thus a min. count) and 31 individuals respectively. Thus about 97% of the over 4,000 Cape mountain zebra in existence owe their ancestry solely to the MZNP stock. Regardless of current numbers, loss of genetic diversity constitutes the single biggest threat to the continued survival of the subspecies.

At present the subspecies has a limited distribution within the Western, Eastern and Northern Cape provinces. The population is fragmented into small sub-populations (Fig. 3 & Fig. 4), which are isolated by fences and transformed landscapes. Although the subspecies occurs in the Cape Floristic Region, it is currently more common in the more grassy habitats of the Nama Karoo and Grassland Biomes of the Eastern Cape. Evidence suggests that this was also true in historical times. In 2014/15, 66% of the area of occupancy (AOO) constituted formally protected areas (562 512 ha) and 34% private areas which yielded a total AOO of 858 653 ha (Hrabar *et al.*, 2016). The percentage of privately owned land has increased from 14% in 1998 to around 32% in 2009 and to 47% in 2022. The expansion of formally protected areas have allowed the growth of the two largest sub-populations, MZNP and Karoo National Park (KNP), which now make up 22% and 13% of the global population, respectively (SANBI database).

The total area likely available to the Cape mountain zebra is > 935 191 ha and could potentially support a considerably larger population. In 2015, the average size of private properties with Cape mountain zebra was approximately 6 000 ha compared to formally protected areas of 30 000 ha (Hrabar & Kerley, 2015). It is estimated that the average size of private properties specifically in the Eastern Cape have increased to approximately 6 900 ha by end of 2022. This is largely due to the recent consolidation of smaller properties, and the removal of internal fences. However, on a local level there is large variation in property sizes (Fig. 4).

The subspecies has also been translocated extraliminally and extra-limital populations exist in the Free State (Gariep Nature Reserve and Gariep Eco Reserve)(Boshoff & Kerley 2013), North West and Northern Cape provinces (Hrabar *et al.* 2016).

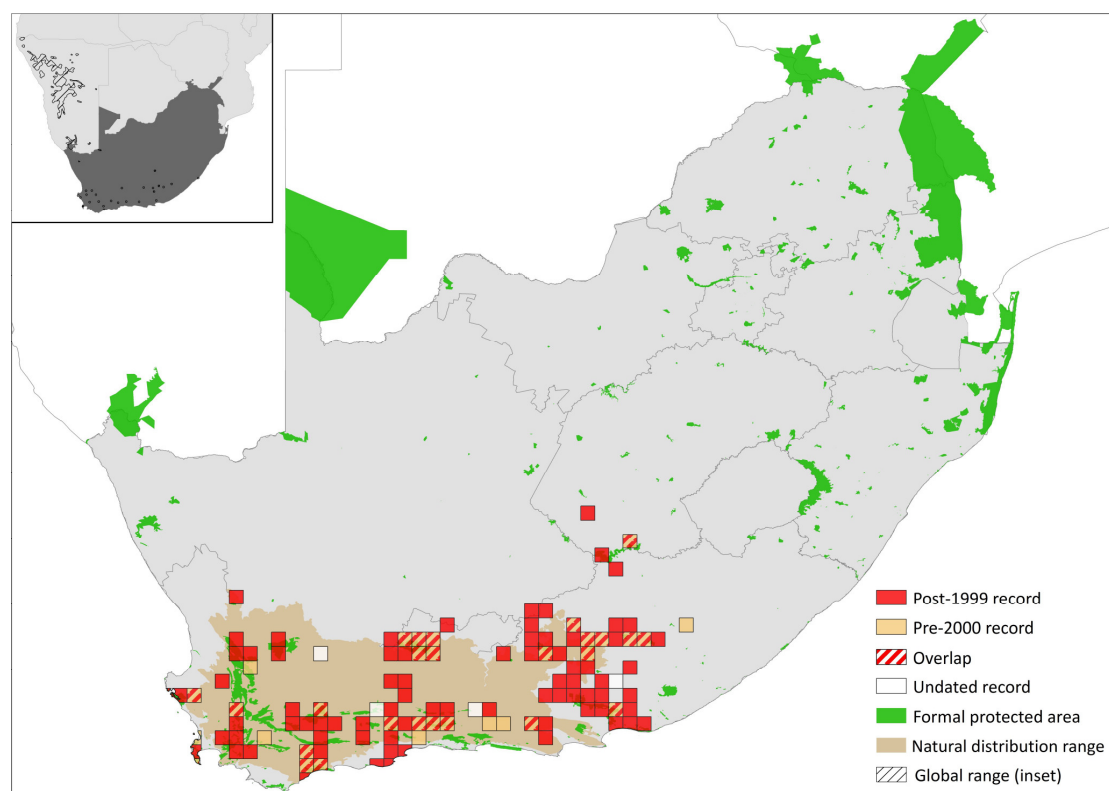


Figure 3: Distribution records for Cape mountain zebra (*Equus zebra zebra*) within the assessment region (global range)

(Hrabar *et al.*, 2016).

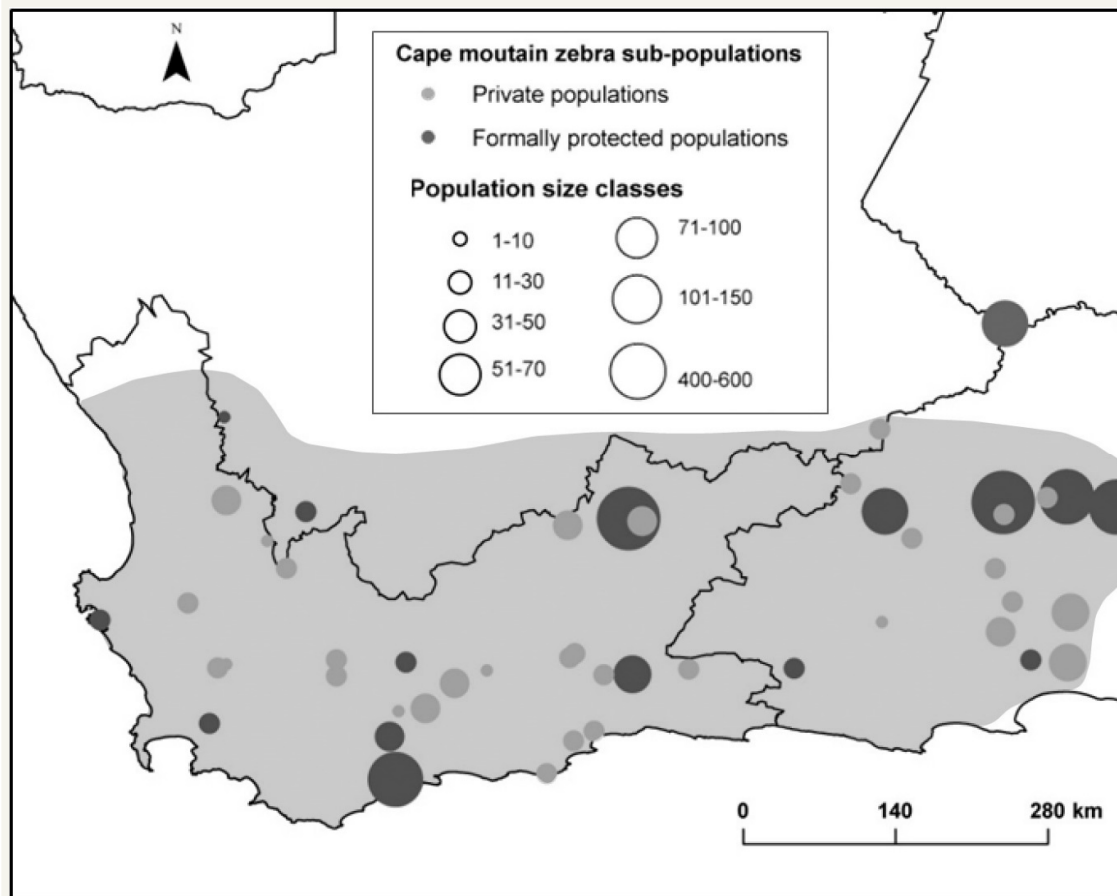


Figure 4. Approximate historical (shaded region; Novellie *et al.*, 2002) and distribution of all privately owned (as identified in Hrabar & Kerley 2013) and formally protected Cape mountain zebra *Equus zebra zebra* subpopulations in South Africa. (Figure copied from Hrabar & Kerley 2013, Oryx.)

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

The Cape mountain zebra is considered uncommon in South Africa with a limited distribution associated with the southernmost biomes occurring in the Western, Eastern and Northern Cape provinces. The subspecies is currently considered as Least Concern on the IUCN Red List both nationally and globally. In 2015, the population was estimated at a minimum of 4 733 animals in no fewer than 75 subpopulations (Hrabar and Kerley 2015). The minimum national population is currently (end of 2021) estimated at 5 693 (Table 2). Ninety-six populations (2 481 individuals) are on privately-owned land and 18 are on formally protected areas (3 212 individuals) (Table 2). The majority of the population (56%) remains on formally protected land.

The subspecies has also been translocated extraliminally and extra-limital populations exist in the Free State (Gariep Nature Reserve and Gariep Eco Reserve)(Boshoff and Kerley, 2013), North West and Northern Cape (Hrabar *et al.* 2016).

Table 2: Estimated number of properties and Cape mountain zebra numbers kept on State and private land across all provinces within South Africa as per provincial records at the end of 2021.

	Eastern Cape		Free State		Northern Cape		North West		Western Cape		Total	
	No of properties	No of CMZ	No of properties	No of CMZ	No of properties	No of CMZ	No of properties	No of CMZ	No of properties	No of CMZ	No of properties	No of CMZ
National Parks	3	1629	0	0	0	0	0	0	5	892	8	2521
Provincial reserves	3	362			1	17	0	0	5	113	9	492
Private land, NDR*	56	1736	0	0	0	0	0	0	32	619	88	2355
Provincial reserves outside NDR			1	199							1	199
Private land, extralimital			1	9	0	0	2	10	5	107	8	126
Total	62	3727	2	208	1	17	2	10	47	1731	114	5693

*Includes OTR

NDR = Natural distribution range

*Overberg Test Range (OTR) included.

7. National population trend: What is the recent national population trend?	Increasing	1
	Stable	2
	Reduced, but stable	3
	Reduced and still decreasing	4
	Uncertain	5

The national population has continued to increase, with variable growth rates across populations. Hrabar *et al.*, (2016) estimated the population in 2015 at 4 733 individuals. The national population is currently estimated at 5 693 (end of 2021) (Table 2). The extant population exceeds the target size of 2 500 individuals set by the 2002 IUCN Action Plan (Novellie *et al.*, 2002). The mean annual rate of increase was 9.2% from 2009 – 2014 and 10% from 2002 – 2009, compared to 8.6% from 1985 to 1995 (Novellie *et al.*, 1996), 9.6% from 1995 to 1998 (Novellie *et al.*, 2002) and 8.4% from 1998 to 2002. Given the fact that most populations have recently been founded and new populations are being added, it is likely that the Cape mountain zebra population has the potential to double in size (Hrabar and Kerley, 2013). The expansion of formally protected areas such as the MZNP and Karoo National Park (KNP) have allowed the growth of the two largest sub-populations, which now make up 22% and 13% of the global population, respectively (SANBI database). While the Cape mountain zebra population in MZNP is still increasing and reaching a point of saturation, the KNP population, however, has fluctuated in the past few years as a result of the 2018/2019 drought severely impacting this population (Table 3). The total existing area available to the Cape mountain zebra is > 935 191 ha and could potentially support a considerably larger population. In addition, due to restricted habitat available for Cape mountain zebra on a number of properties, populations are managed. At present Cape mountain zebra populations managed by SANParks appear to be stable (Table 3).

Populations within two State protected areas as well as on private land have increased to unsustainable levels and options to reduce these populations are currently under discussion. Historically, State protected areas sold excess animals to the private sector which increased both the area available to Cape mountain zebra as well as the number of populations. However, due to current international restrictions on trophy hunting the market for both the live sales as well as hunting of Cape mountain zebra seems to be saturated (Fig. 6 and Table 4).

Table 3: National parks Cape mountain zebra population census data for 2017 to 2022 (Data provided by SANParks).

	2017	2018	2019	2020	2021	2022
Mountain Zebra NP	1159	1095	847	876	1155	1223
Karoo NP ¹	913	887	803	-	743	-
Camdeboo NP	211	308	-	237	-	267
Addo Elephant NP - Darlington Section	102	67	137	-	-	139
Tankwa-Karoo NP	54	68	-	-	-	-
Bontebok	14	12	-	-	16	17
West Coast ²	27	-	47	-	-	60
Table Mountain NP ³	-	-	-	-	-	4
TOTAL	2480	2464	2222	2180	2403	2521

¹ Drought main impact on Cape mountain zebra numbers

² 2022 number provided by Postberg owners

³ Current population 4 stallions and will not be supplemented.

8. Quality of information: What type of information is available to describe	Quantitative data, recent	1
	Good local knowledge	2

abundance and trend in the national population?	Quantitative data, outdated	3
	Anecdotal information	4
	None	5
The Cape mountain zebra subpopulations on private land have been assessed by Hrabar and Kerley (2015). CapeNature maintains an annual record of Cape mountain zebra in the Western Cape. Game counts are conducted for large mammals, including Cape mountain zebra, annually or biannually in most national parks and provincial reserves. Private landowners in general also conduct regular counts of economically important mammal species such as Cape mountain zebra. In addition, landowners applying for Certificates of Adequate Enclosure (CAE or Game Farm Permit in Northern Cape) must include the species and population sizes on their permit applications. However, data obtained from private landowners are not always comprehensive and up to date. There is thus good knowledge of individual populations at the local level, but these data need to be collated and centralised. There are currently two processes underway to improve on the collation and accessibility of data. SANBI is currently in the process of developing a national online species population database. Wildlife Ranching South Africa has also started with the development of an online system for their members to submit species population data. SANBI maintains a national genetics database that currently has more than 921 Cape mountain zebra, 51 plains zebra and 48 Hartmann's zebra DNA profiles that can be used to monitor hybridization and genetic diversity in the subspecies.		
9. Major threats: What major threat is the species facing (underline following: <u>loss of genetic diversity</u> / overuse/ habitat loss and alteration/ invasive species/ other: small isolated subpopulations; disease; predation, poaching and emigration) and how severe is it?	None	1
	Limited/Reversible	2
	Substantial	3
	Severe/Irreversible	4
	Uncertain	5
Long term security of the subspecies is uncertain. The biggest threat to the subspecies is the loss of genetic diversity. This is the result of a genetic bottlenecks and isolation, poor subsequent population performance of the two relict populations Kammanassie and Gamkaberg, and until recently, by a lack of a metapopulation strategy that systematically generates herds with mixed genetic ancestry. In the absence of genetic management of the subspecies under these conditions, the likelihood of inbreeding has increased which may explain the observed increase in disease frequency. i. Loss of genetic diversity through genetic drift and inbreeding may already have led to inbreeding depression in some populations. This is currently the biggest threat to the Cape mountain zebra. Prolonged hunting and habitat destruction over the past 300 years decimated Cape mountain zebra populations within South Africa. According to Moodley and Harley (2005) this has resulted in low genetic variation within individual subpopulations indicative of population fragmentation and drift. They however found higher levels of diversity within the entire Cape mountain zebra gene pool and recommended a management strategy that entailed mixing of subpopulations, and especially the three relict stocks (Cradock, Kammanassie and Gamkaberg stocks), to halt further loss of genetic diversity. De Bruyn and Kotze (January 2023), using the 917 Cape mountain zebra DNA profiles within the SANBI national genetic database estimated the national population genetic diversity for Cape mountain zebra at 0.303. Furthermore, Kotze <i>et al.</i>, (2019) found a substantial loss of heterozygosity at MZNP, De Hoop Nature Reserve and Kammanassie Nature Reserves over a 15-year period. This was most severe at De Hoop, where there was a 22.85% decline in heterozygosity from 0.385 to 0.297. This is alarming, as De Hoop Nature Reserve was previously identified as the genetically most diverse subpopulation owing to its founders originating from two of the three remaining relict stocks. Furthermore, Kotze <i>et al.</i>, (2019) observed a loss of multiple private alleles from all subpopulations, and a subsequent reduction in genetic structure across the subspecies. These losses could lead to inbreeding depression and reduce the evolutionary potential of the Cape mountain zebra. De Bruyn and Kotze (January 2023) recommend the implementation of evidence-based genetic management and monitoring to prevent further losses, which could jeopardise the long term survival of Cape mountain zebra, especially in the face of habitat and climate change and emerging diseases. In addition to census size, genetic monitoring of multiple metrics (e.g., heterozygosity, allelic uniqueness, and effective population size) can provide early detection of loss of diversity even when a population is large or growing. In an attempt to address this threat, CapeNature translocated two escaped Cape mountain zebra (Cradock-Kammanassie stock) from the Greater De Hoop Conservation Area (De Hoop Nature Reserve and Overberg Test Range) to Bontebok National Park in 2021, and a genetic mixing project (Gamkaberg stallions with Cradock-Kammanassie mares) has begun at Sanbona Wildlife Reserve. CapeNature plans to start a second mixing project (Gamkaberg stallions with Kammanassie mares on the Zebraskop property near Gamkaberg Nature Reserve) in 2023.		

As part of the meta-population approach it has been recommended that founder populations should comprise of no less than 14 animals and that at least one new animal is introduced to the population every 5-10 years (Hrabar & Kerley, 2013). According to data gathered in 2008, 10 of the 52 known subpopulations had fewer than the recommended 14 animals (8 out of the 10 are on private land) and no new individuals had been introduced to 6 out of the 22 privately owned subpopulations that were established more than 10 years ago (Hrabar & Kerley 2009). The problem is exacerbated by the social structure of the Cape mountain zebra as the behaviour of the males tends to reduce the effective population size (a fraction of the males dominate matings for an extended period of time). A 1:1 sex ratio is recommended, yet surplus males are often removed. Surplus males are required for establishing new herds with dispersing females. Most of the meta-population is at risk of inbreeding. All reintroduced subpopulations, except for those in De Hoop Nature Reserve, Overberg Test Range and Sanbona Wildlife Reserve, originate from MZNP. The De Hoop and Overberg Test Range subpopulations are at risk because of prolonged isolation.

A metapopulation management strategy such as the one outlined above, must attempt as far as possible to integrate individuals with Gamkaberg and Kamanassie alleles into new or existing subpopulations. This management strategy must also be accompanied by monitoring and a studbook for any new reserve. This is due to two inbred populations being brought together, and where the new population, while being genetically diverse (what we want), may harbour a higher number of deleterious alleles. This should not usually be a concern if the new population increases rapidly, and ensuring that closely related animals do not breed with each other. Thus a studbook is necessary for all newly established populations with mixed ancestry (that is any combination of MZNP, Kammanassie or Gamka) to ensure sires do not breed with their own daughters in small newly seeded reserves.

ii. Risk of hybridisation

There is a risk of hybridization of Cape mountain zebra with other equids where their ranges overlap or as a result of introductions onto the same properties. Cape mountain zebra can hybridize with Hartmann's mountain zebra (*Equus zebra hartmannae*), plains zebra (*Equus quagga burchelli*) (Dalton *et al.* 2017), horses and donkeys. Foals resulting from a Cape-Hartmann's mountain zebra cross are likely fertile, resulting in contamination of both the Cape mountain zebra and Hartmann's mountain zebra gene pools. Cape mountain zebra-horse and Cape mountain zebra-donkey hybrids are infertile, and this is likely also true for Cape mountain zebra-plains hybrids, and where such crosses are wasted reproductive effort for both species. Accidental contact between Cape mountain zebra and other equid species is a risk. For example, a section of the fence at Anysberg Nature Reserve was destroyed in a fire, resulting in contact between *res nullius* Hartmann's mountain zebra and the reserve's Cape mountain zebra population, which may have resulted in the birth of at least one hybrid foal. Cape mountain zebra-horse hybrids are present on private land adjacent to De Hoop Nature Reserve.

Deliberate mixing of herds has also occurred. Results from a recent genetic analysis of translocated animals in the Eastern Cape Province showed the animals included Hartmann's mountain zebra, Cape mountain zebra and plains zebra with various hybrids between the three. In the Western Cape there are four legal Hartmann's mountain zebra subpopulations within the Cape mountain zebra's natural distribution range. On at least one property, Hartmann's mountain zebra were sold to a landowner as Cape mountain zebra. One population in the Free State is also a hybrid population. Since phenotypic assessments will not provide reliable results, the SANBI has developed genetic markers to test for hybrids, although testing for hybrids is presently not a requirement for translocation except in the Western Cape. Some provinces have policies in place to prevent extralimital establishment of this subspecies (e.g. KwaZulu-Natal). North-West Province, through their fencing policy, do not allow for the mixing of subspecies that are likely to hybridize.

Risk of hybridisation was a concern in MZNP due to the presence of both Cape mountain zebra and Plains zebra, however all plains zebra have been removed and DNA tests have repeatedly come back clear of any hybrids. More than half of the population has already been tested. Within the Western Cape and Eastern Cape, regulations require that all Cape mountain zebra translocated from a property that has both Cape mountain zebra and plains zebra needs to undergo DNA tests.

iii. Conservation in sub optimal habitat (limited grass). See paper Faith 2011 and Lea *et al.*, 2016.

The Cape mountain zebra is most likely a partial refuge species that has survived in sub-optimal habitat in the Cape Floristic Region but may in fact be more suited to grassland habitat (Lea *et al.*, 2016). In sub-optimal habitat there is a decrease in population densities and conflict in management objectives (e.g. infrequent vs. regular burning to favour grassland). For the Cape mountain zebra, reclaimed agricultural fields are a possible solution for population expansion.

iv. Disease

Equine sarcoidosis: Sarcoids are one of the most common skin tumours of equids and their prevalence seems to be on the increase worldwide. and the tumours have also been found in Cape mountain zebra. In both the Gariep Nature

Reserve and the Bontebok National Park the disease reached epidemic proportions where 22% and 53% of the population was infected, respectively (Sasidharan, 2006). Clinically and pathologically, they present most of the features of true neoplasms, suggesting that the behaviour of the tumour is unpredictable and that the treatment may be problematic – which is indeed the case especially in free-ranging equids such as Cape mountain zebra. The predominant cell type of sarcoids is transformed fibroblasts. They have a high capacity for local tissue invasion into the dermis and directly underlying subcutis, and rarely infiltration of the lymphatics. They however, do not metastasize to internal organs and as a result sarcoids are never lethal. Thus they have limited impact on the performance of a population as they generally are still able to breed. It has however been found that inbred populations are more susceptible to this disease (Sasidharan, 2006). Isolation of small populations may therefore lead to increased susceptibility to the disease due to inbreeding.

African Horse Sickness: Zebras are potential asymptomatic carriers of African Horse Sickness Virus (AHS) and therefore pose a risk for disease spread to horses via midges or biting flies. AHS is a controlled disease, with most of South Africa regarded as infected. The area around Cape Town is regarded as disease free, serving as an export port for horses from South Africa, and surrounded by a denoted surveillance and protection zone reaching to the Western Cape districts of Ceres, Clanwilliam, Montagu and Swellendam. As a result restrictions (Animal Diseases Act, 1984 (Act 35 of 1984, as amended)) are in place for the movement of Cape mountain zebra, especially into the AHS controlled areas of the Western Cape (set out by the Department of Agriculture in 2003). Translocation of any equids as potential carriers from the infected to protection/ surveillance zone is subject to equids, including zebra, being tested negative for the virus three weeks apart, while being housed in an insect proof quarantine facility during the 3-week period. The restrictions currently impact on the translocation from MZNP to some parts of the Western Cape and therewith the expansion of the population and effective implementation of a meta-population strategy. Testing and mosquito proof housing for zebra is costly and the 3-week quarantine period for zebra in a boma very likely results in prolonged stress and loss of body condition, a potential welfare issue. Appropriate mosquito proof housing for zebra would probably have to be designed and built first. So cost, housing and welfare issues (i.e. loss of condition during quarantine) have prevented importation into the Western Cape so far. Solutions to be sought engaging with State veterinary authorities, AHS-specialist in regard to spatial and temporal risk profile, Cape Nature, SANParks, land owners at the protection/infection zone interface.

AHS is thus not a threat to the subspecies persistence, but rather a threat to the effective management of the species. It thus presents a low risk to the subspecies or individual but a higher risk to the management of the subspecies.

v. Lack of economic incentives/ sustainable financing models for private landowners to contribute to conservation objectives.

Conservation within South Africa occurs within a fragmented human-dominated landscape where biodiversity land uses have to compete with other often more lucrative land uses that are seldom conservation compatible. Cape mountain zebra populations throughout South Africa in general are small and fragmented requiring a meta-population management approach. The development of protected areas has been used as a key strategy to reduce the loss of biodiversity and to conserve species globally (DeFries *et al.* 2007). This strategy, however, has had limited success in the developing world, where most of the world's biodiversity is located (Montesino Pouzols *et al.* 2014). Human populations in the developing world and particularly Africa, continue to grow rapidly (United Nations 2013). As a result, these countries often find it difficult to maintain their biodiversity due to increasing land use conflicts and insufficient funds for conservation (Krug 2001; Leader-Williams 2005). For this reason, the inclusion of private and communal lands within conservation plans, are integral to the persistence of species (Cousins *et al.*, 2008, Child *et al.*, 2012). Privately-owned land can play an important role in the protection of threatened species including the Cape mountain zebra, bontebok, black (*Diceros bicornis*) and white rhino (*Ceratotherium simum*), since these properties have much higher budgets, more resources and are more flexible and efficient in managing complex systems and reducing cost (Di Minin *et al.*, 2013, Packer *et al.*, 2013, Di Minin *et al.*, 2015). While there is little scope for the expansion of state-owned parks, the privately protected estate is growing (Gallo *et al.*, 2009). These areas have been highly profitable (60%–80% over operational costs) and have been direct contributors to community wealth (Norton-Griffiths 2007, Naidoo *et al.*, 2011, Packer *et al.*, 2013). Beside the economic benefits accruing to landowners, private reserves and game ranches provide the public good 'biodiversity' at no cost to the tax-payer (Krug, 2001). Thus, incorporating land uses and management practices which are compatible with biodiversity conservation not only helps protecting critical habitats for a variety of species (Gardner *et al.*, 2007), but also contributes to maintaining landscape connectivity (DeFries *et al.*, 2007).

However, to effectively implement and incentivize landowners within the private sector to participate in a meta-population management plan requires sustainable financial models. In addition, both the hybridization and low genetic variation within the subspecies can be addressed through this approach. Trophy hunting plays a critical role in generating income to subsidise the conservation of Cape mountain zebra as part of a sustainable funding model for wildlife-based land uses on private land that are conservation compatible. Strenuous administrative requirements impact negatively on this sustainable funding model for conservation by reducing the value proposition the subspecies holds for private wildlife

custodians. The administrative and management burden increase locally and internationally to ensure conservation outcomes, including the implementation of a meta-population management plan, whilst the ability to realize financial incentives are becoming increasingly difficult. This threat is considered substantial as it increases the risks of disinvestment in Cape mountain zebra conservation by private sector with concomitant reduction in the current conservation successes.

Improving management actions to ensure that subpopulations remain viable and breeding on good quality habitat, prevent the introduction of alien and extra-limital equid species into Cape mountain zebra range and habitat, and prevent modification of suitable habitat, is likely to improve the conservation status and management of the subspecies. At present within the Western Cape, habitat suitability assessments are done prior to any new Cape mountain zebra introductions. Genetic mixing projects are also in progress or currently planned and all Cape mountain zebra are tested for hybridization before movements of zebra allowed into or out of the province. Effective development of the meta-population strategy is urgently required.

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

Illegal translocations and poaching occurs on a limited scale. There is currently no illegal off take of Cape mountain zebra in any of the national parks or provincial reserves in the Western Cape. No illegal removals of Cape mountain zebra from Gariep Nature Reserve have been reported. However, cases of Cape mountain zebra being hunted, sold or exported as Hartmann's mountain zebra have been reported.

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

Cape mountain zebra are endemic to South Africa and were once widely distributed in the mountains of the Eastern and Western Cape Provinces (Hrabar & Kerley 2013). Excessive hunting and habitat loss due to agriculture reduced numbers to less than 80 individuals in just three localities in the 1950s. Since the 1950s the number of Cape mountain zebras has gradually increased through reintroductions aimed at ensuring continued population growth and genetic diversity (Novellie *et al.*, 2002). By 2002 the Cape mountain zebra population totalled > 1,600 individuals in six national parks, 10 provincial reserves and 17 private reserves distributed across most of their natural range (Castley *et al.*, 2002). Reintroductions in the natural distribution range and translocations between existing populations (particularly the larger populations) are considered to be necessary to ensure continued population growth, genetic diversity and increasing distribution of the subspecies within its natural range (Hrabar & Kerley 2009).

In South Africa, Cape mountain zebra are utilised for trophy hunting, local hunting, photographic tourism, live sales and recreation (e.g. captive populations) in accordance with the sustainable use policy environment prescribed by the National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA). The species is currently listed as endangered in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), meaning that a permit is required if a person intends to carry out any restricted activity involving mountain zebra such as keeping, hunting, catching, breeding, selling, conveying or exporting from the country. The permit system is regulated through the Threatened or Protected Species (TOPS) Regulations (2007 and 2023), which have been promulgated in terms of NEMBA. Various provincial ordinances and acts provide further legislative protection. The regulatory framework in place thus allows for sustainable off-takes, such as live sale, hunting and culling.

The White Paper on the Conservation of the Sustainable Use of South Africa's Biodiversity was approved by Cabinet on 29 March 2023, and published under Government Notice No. 3537 in the Government Gazette, No. 48785, for implementation on 14 June 2023. The White Paper provides a foundation for conservation and sustainable use in terms of its four goals, namely: 1) Enhanced Biodiversity Conservation (All biological diversity and its components conserved); 2) Sustainable Use (The sustainable use of biodiversity enhances thriving living land- and seascapes and ecosystems, livelihoods, and human well-being, while a duty of care avoids, minimises, or remedies adverse impacts on biodiversity); 3) Equitable Access and Benefit Sharing (Benefits are derived and shared from the use and development of South Africa's genetic and biological resources, without compromising the national interests); and 4) Transformed Biodiversity

Conservation and Sustainable Use (Effect is given to the environmental right as contained in Section 24 of the Constitution which facilitates redress, and promotes transformation). The White Paper, therefore, set out the vision: "An inclusive, transformed society living in harmony with nature, where biodiversity conservation and sustainable use ensure healthy ecosystems, with improved benefits that are fairly and equitably shared for present and future generations", with the Mission: "To conserve and manage South Africa's biodiversity, and ensure healthy ecosystems, ecological integrity and connectivity, with transformative socio-economic benefits to society for current and future generations through ecologically sustainable, and socially equitable use of what people values from nature."

Until 2016 the management system was more informal as there was no set structure with activities measured against a larger adaptive framework. In 2016, a Cape mountain zebra off-take simulator tool was developed through collaboration between the South African National Biodiversity Institute, the University of Cape Town, Nelson Mandela Metropolitan University, and CapeNature. The simulator tool allows for the adaptive management and monitoring of off-takes of Cape mountain zebra (Winker *et al.*, 2016). On a property level managers and/or landowners have an interest in ensuring the stability of their populations and manage their populations and off-takes accordingly. The harvest of Cape mountain zebra is thus dually managed by both private landowners and government within an adaptive framework. In addition, all trophy hunts by international clients must be recorded in the Professional Hunter's Register. The professional hunter accompanying the international client is responsible for completing and submitting the register to the provincial conservation authority. The Department of Forestry, Fisheries and the Environment (DFFE) collate the provincial registers into a national register on an annual basis.

According to the CITES trade database approximately 43 Cape mountain zebra trophies and 0 live Cape mountain zebra were exported between 2010 and 2021 (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK). Over the same time period according to the DFFE Professional Hunter's (PH) Register approximately 257 Cape mountain zebra were hunted by international clients. Approximately 44% of all trophy hunts occurred in the Eastern Cape Province, 19% in the Free State, 15% in the Limpopo province and less than 5% of all Cape mountain zebra trophy hunts occurred within the Western Cape (Fig. 4). It is likely that the high number reported on the PH Register is erroneous and wrongly recorded as Cape mountain zebra hunts rather than plains zebra, as no Cape mountain zebra populations occurs in the Limpopo Province.

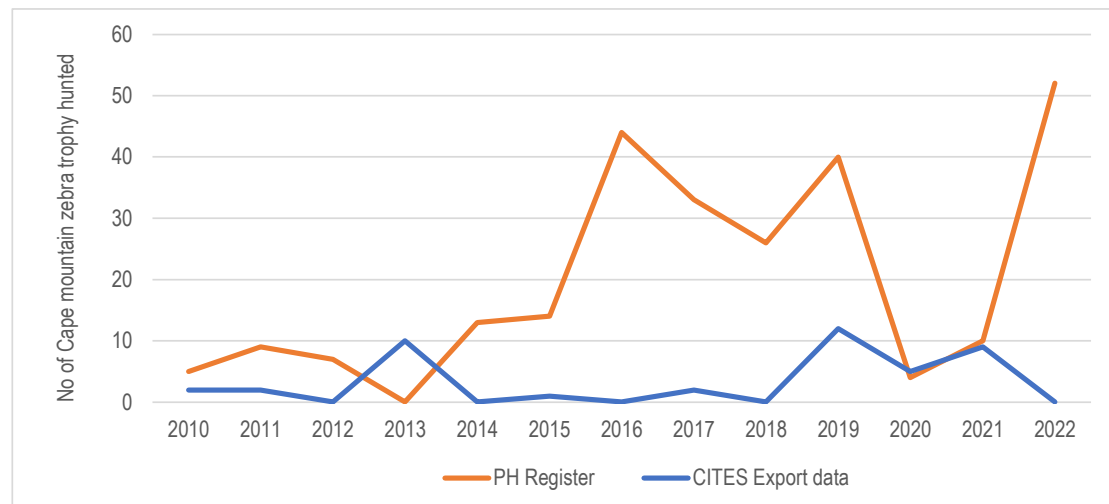


Figure 3: Number of Cape mountain zebra hunted by international clients according to the Professional Hunter's Register and the CITES trade database (CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK) between 2010 and 2022.

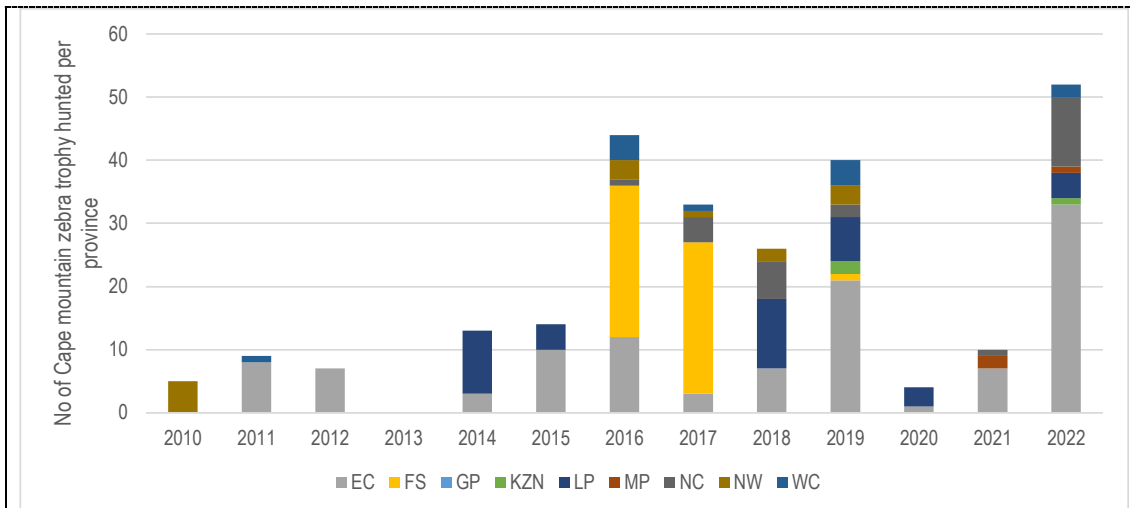


Figure 4: Number of bontebok hunted by international clients according to the Professional Hunter's Register per province between 2010 and 2022 (Data for 2022 only from PH Register). EC=Eastern Cape; FS=Free State; GP=Gauteng; KZN=KwaZulu-Natal; LP=Limpopo; MP=Mpumalanga; NC=Northern Cape, NW=North-West and WC=Western Cape.

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
A Biodiversity Management Plan for Cape mountain zebra has been developed and published for implementation in March 2018 (Gazette no. 41488). At present there is no formal meta-population management plan for CMZ, however elements of a meta-population management plan are currently implemented. Eastern Cape Parks and Tourism Agency has management plans for each of the four Cape mountain zebra subpopulations that are under their management. South African National Parks (SANParks) do not have a specific management strategy for Cape mountain zebra, although management of the subspecies follows the general policy for the management of large mammals in SANParks protected areas. A management plan is not required for the introduction or keeping of Cape mountain zebra on private land in the Western Cape. Private landowners however may have general ecological management plans for their specific properties. Cape mountain zebra monitoring and management is addressed in the relevant Protected Area Management Plans of CapeNature provincial reserves. In addition, a Cape mountain zebra off-take simulator tool was developed through collaboration between the South African National Biodiversity Institute, the University of Cape Town, Nelson Mandela Metropolitan University, and CapeNature. The simulator tool allows for the adaptive management and monitoring of off-takes of Cape mountain zebra (Winker <i>et al.</i> 2016). However, at present not all provinces make use of the simulator tool to guide their offtakes. The policy/regulatory framework in place across all provinces for Cape mountain zebra can further be considered an approved and coordinated management plan for harvest. The regulatory framework is aimed at the long term sustainable use of the species. The subspecies is currently listed as endangered in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), meaning that a permit is required if a person intends to carry out any restricted activity involving Cape mountain zebra such as keeping, hunting, catching, breeding, selling, conveying or exporting from the country. In addition, all policies / regulations are approved and subject to a public participation process.		
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

Although there are elements of population management/control, maximising economic yield and opportunistic harvesting within the harvest regime, harvest is predominantly for the purpose of managing populations which is likely to generate a conservation benefit. As part of its mandate to manage and conserve biodiversity, CapeNature is required to manage Cape mountain zebra in the Western Cape. Similarly SANParks' mandate includes population management and generating conservation benefits, while private landowners have both economic and population management objectives. However, both of these objectives in the South African context generate conservation benefit both to the subspecies as well as to the habitat of the subspecies and other biodiversity.

Even in the presence of large predators it is necessary to manage Cape mountain zebra populations either through hunting, culling or translocation to maintain appropriate population dynamics on a property. Management to prevent inbreeding is also necessary due population fragmentation and isolation. Landowners select suitable specimens for offtake based on age, sex and reproductive performance. The use of translocation, live sales and hunting is thus mainly for the purpose of population management rather than the income generated through the management action and generate an overall conservation benefit.

Due to current restrictions on the translocation of Cape mountain zebra from MZNP, SANParks is considering culling a portion of the population, as there is a limited economic market for sales (although donation is still a potential outlet that needs to be investigated/implemented). A similar situation occurs on private land where Cape mountain zebra populations are growing. In addition the current AHS restrictions within parts of the Western Cape currently impact on the translocation of Cape mountain zebra from MZNP to these parts of the Western Cape and therewith the expansion of the population and effective implementation of a meta-population strategy. Testing and mosquito proof housing for zebra is costly and the 3-week quarantine period for zebra in a boma very likely results in prolonged stress and loss of body condition, a potential welfare issue. Appropriate mosquito proof housing for zebra would probably have to be designed and built first. So cost, housing and welfare issues (i.e. loss of condition during quarantine) have prevented importation into the Western Cape so far. Solutions to be sought engaging with State veterinary authorities, AHS-specialist in regard to spatial and temporal risk profile, Cape Nature, SANParks, land owners at the protection/infection zone interface. AHS is thus not a threat to the subspecies persistence, but rather a threat to the effective management of the subspecies and expansion of the subspecies range within the Western Cape.

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

Up until 2016 there was no national quota for hunting Cape mountain zebra, although in the Eastern Cape trophy hunting of a small number of older males was allowed. In 2016, a Cape mountain zebra off-take simulator tool was developed through collaboration between the South African National Biodiversity Institute, the University of Cape Town, Nelson Mandela Metropolitan University, and CapeNature. The simulator tool allows for the monitoring of off-takes of various age and sex ratios under different management strategies. From this information robust quantitative analysis can be conducted to provide advice on selective hunting quotas and introduction strategies or relocations schemes to achieve the targets considered for optimal resource use (Winker *et al.*, 2016). This tool is currently used to determine off-takes, but not by all provinces. In addition, in all provinces off-takes are managed on a local scale by the provincial Management Authorities through a permit system on a case-by-case basis, based on direct population estimates.

At present, trophy hunting of Cape mountain zebra occurs at very low levels due to constraints on the market. If markets open up again the tool will be invaluable. In preparation, an information session is planned for all provinces and private landowners keeping Cape mountain zebra to explain how the tool works.

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 Cape mountain zebra is not carried out in any of the provincial or national parks within its natural distribution range, but is allowed within provincial reserves in the Free State where Cape mountain zebra occur extraliminally. Culling

of overabundant populations is allowed in both national and provincial reserves. To date no culling of Cape mountain zebra has taken place in these reserves, but is likely to happen in near future with continued population growth and limited new habitat available for the subspecies. However, euthanasia of Cape mountain zebra with visible sarcoids have taken place in some national parks. During 2023, Gariiep nature reserve, Free State culled approximately 30 animals for management reasons. Translocation of specimens between reserves is not considered as a harvest and forms part of the management of the subspecies.		
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
At present most of the trophy hunting of Cape mountain zebra occurs on private land. Cape mountain zebra subpopulations on private land have increased in size and as a result landowners have translocated some individuals between private properties. Translocation of specimens between reserves is however not considered as a harvest and forms part of the metapopulation management of the subspecies.		
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
There are no Cape mountain zebra occurring in open access areas.		
18. Confidence in harvest management: Do budgetary and other factors allow effective implementation of management plan(s) and harvest controls?	High confidence	1
	Medium confidence	2
	Low confidence	3
	No confidence	4
	Uncertain	5
In all provinces that have Cape mountain zebra, budgetary and human resource capacity required for the development and implementation of species management plans is limited. For example, budget constraints for fence maintenance led to Cape mountain zebra escaping from Anysberg Nature Reserve and possibly hybridizing with Hartmann's mountain zebra. There is however a medium confidence in the current permitting system. SANParks indicated a medium confidence in their harvest management because of the difficulty to translocate or sell animals as a result of disease AHS regulations and market constraints (limited market for live Cape mountain zebra and cost of DNA hybrid testing). CapeNature indicated a high confidence in their harvest management for Cape mountain zebra, while Eastern Cape Parks has a medium confidence in their management systems. Private landowners indicated a medium confidence in the provincial departments ability to implement management plans and harvest controls. The provincial conservation agency in the Free State has a high confidence in its harvest management and permitting system in relation to Cape mountain zebra. However, Free State conservation agency also expressed concerns in not being able to sell animals as there are currently limited demand for the subspecies.		
The biggest threat to the subspecies is the loss of genetic diversity. This is the result of a genetic bottlenecks and isolation, poor subsequent population performance of the two relict populations Kammanassie and Gamkaberg, and until recently, by a lack of a metapopulation strategy that systematically generates herds with mixed genetic ancestry. In the absence of genetic management of the subspecies under these conditions, the likelihood of inbreeding has increased which may explain the observed increase in disease frequency. Effective implementation of the meta-population strategy is urgently required but constraint by budget and capacity limitations.		
Budgetary constraints, lack of capacity, the lack of a national Cape mountain zebra meta-population management plan and budget for monitoring, e.g. budget for aerial counts at intervals of 3-5 years indicates a medium confidence in harvest management of Cape mountain zebra.		
Monitoring of harvest		
19. Methods used to monitor the harvest: What is the principal method	Direct population estimates	1
	Quantitative indices	2

used to monitor the effects of the harvest?	Qualitative indices	3
	National monitoring of exports	4
	No monitoring or uncertain	5
The Cape mountain zebra subpopulations on private land were assessed by Hrabar and Kerley (2015). CapeNature maintains an annual record of Cape mountain zebra in the Western Cape. Game counts are conducted for large mammals, including Cape mountain zebra, annually or biannually in most national parks and provincial reserves, including Free State. Private landowners in general also conduct regular counts of economically important mammal species such as Cape mountain zebra. There is thus good knowledge of individual populations at the local level, but these data need to be collated and centralised. There is also a concern that the effects of harvest, e.g. the effects on veld condition, and effects on age and sex ratios and breeding success of Cape mountain zebra are not currently effectively monitored. There are currently two processes underway to improve on the collation and accessibility of data. SANBI is currently in the process of developing a national online species population database. Wildlife Ranching South Africa has also started with the development of an online system for their members to submit species population data. While population numbers are well monitored, limited information exists on the impact of harvest on the social structure of the herd. This requires more research. At present harvest of Cape mountain zebra is being monitored through a provincial permit system and CITES exports. In 2016, a Cape mountain zebra off-take simulator tool was developed. The simulator tool allows for the monitoring of off-takes of various age and sex ratios under different management strategies. From this information robust quantitative analysis can be conducted to provide advice on selective hunting quotas and introduction strategies or relocation schemes to achieve the targets considered for optimal resource use (Winker <i>et al.</i> 2016). However, at present not all provinces make use of the tool to inform off-takes and translocations. A process is underway to train all provinces and the private sector in the use of the tool and in doing so improve the use of the tool across all provinces and the private sector. In addition, the policy and regulatory mechanisms require direct population estimates for any restricted activity. Through the permitting system, monitoring data on the annual off-takes of species per property are generated. Thus off-takes are managed on a local scale by the provincial Management Authorities through a permit system on a case-by-case basis, based on direct population estimates. In addition, all trophy hunts by international clients must be recorded in the Professional Hunter's Register. The professional hunter accompanying the client (a legal requirement) is responsible for completing and submitting the register to the provincial conservation authority. The DFFE collate the provincial registers into a national register on an annual basis allowing fine scale analyses of trends in trophy hunting off-takes and possible impacts on species subject to trophy hunting, such as Cape mountain zebra.		
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 an overall medium confidence in the current system for harvest monitoring, as there is currently no capacity to analyse information received from private game farms. In addition, hunt return forms are not always submitted as required. The Free State has a high confidence in monitoring the numbers of harvest operations. On a provincial level it is also becoming harder to justify annual species counts. There seem to be some errors on the reporting of hunts undertaken by international clients through the PH Register on a provincial level when there are multiple subspecies. Professional hunters often only indicate that a zebra has hunted without indicating the specific subspecies, which leads to errors where populations of more than one subspecies are kept in the province. This leads to overestimation of the off-take in one subspecies and underestimate for another subspecies. At present, the effect of such harvest on a single population is monitored, but the effect on the larger meta-population is not monitored. With the implementation of the simulator tool, it is likely that the confidence in harvest monitoring will increase. Recently, the TOPS permitting system is moved online but not all provinces are currently making use of the online permitting system. There are also currently two processes underway to improve the collation and accessibility of data. SANBI is in the process of developing a national online species population database. Wildlife Ranching South Africa has also started with the development of an online system for their members to submit species population data. It is believed that these systems will improve the confidence in population and harvest monitoring.		
Incentives and benefits from harvesting		

21. Utilization compared to other threats: What is the effect of the harvest when taken together with the major threat that has been identified for this species?	Beneficial	1
	Neutral	2
	Harmful	3
	Highly negative	4
	Uncertain	5
At present, the loss of genetic diversity is considered the major threat to the subspecies. De Bruyn and Kotze (January 2023), using 917 Cape mountain zebra DNA profiles within the SANBI national genetic database estimated the national genetic diversity for Cape mountain zebra at 0.303. Furthermore, Kotze <i>et al.</i>, (2019) found a substantial loss of heterozygosity at MZNP, De Hoop Nature Reserve and Kammanassie Nature Reserves over a 15-year period. This was most severe at De Hoop, where there was a 22.85% decline in heterozygosity from 0.385 to 0.297. Within the Eastern and Western Cape, hunting and translocation of Cape mountain zebra are regulated through a permitting system. The decision on whether to issue a permit is made on a case by case basis by determining whether the hunt/translocation will be detrimental to the specific subpopulation. Through incentivizing the keeping of Cape mountain zebra by private landowners, hunting in the Eastern Cape has led to an increase in the numbers within the province and has thus been beneficial to the subspecies, although there is no information on what effect hunting has had on the heterozygosity of the population. It is unlikely that trophy hunting will be detrimental to the persistence of the subspecies or further negatively impact on heterozygosity as in general older or excess stallions are hunted. Trophy hunting could when combined with a metapopulation management plan have a beneficial impact on genetic diversity by creating a gap for the introduction of unrelated individuals into the subpopulation, and by financing such introductions. At present, due to the low numbers of Cape mountain zebra hunted (less than 20 individuals/annum) the effect of trophy hunting is considered neutral. With the removal of USA ESA restrictions on the trophy hunting market and the implementation of a metapopulation management plan that includes a genetic component, it is believed that trophy hunting is highly likely to have a beneficial effect on both subspecies and habitat conservation and will provide the necessary incentives for private landowners to actively participate in a metapopulation management plan. A number of experts (Di Minin, Leader-Williams & Bradshaw, 2016; Dickman <i>et al.</i>, 2019; Parker <i>et al.</i>, 2020) have warned that blanket trophy hunting bans could exacerbate biodiversity loss due to the disinvestment of private landowners and communities in wildlife-based land uses, and at the same time risk disempowering and impoverishing rural communities. At present not all available hunting markets allow for the import of hunting trophies of certain threatened species such as black rhinoceros (<i>Diceros bicornis</i>), bontebok and Cape mountain zebra (<i>Equus zebra zebra</i>), for example the USA, an important hunting trophy market for South Africa, requires an enhancement finding for each trophy import of these species (since they are listed as Endangered on the Endangered Species Act). These international restrictions unfortunately hamper the conservation efforts for these species in South Africa.		
22. Incentives for species conservation: At the national level, how much conservation benefit to this species accrues from harvesting?	High	1
	Medium	2
	Low	3
	None	4
	Uncertain	5
At present (41%) of Cape mountain zebras occur within its natural distribution range and (44%) of all Cape mountain zebra populations in South Africa occurs on private land. Hunting of Cape mountain zebra is allowed in all provinces where the subspecies occurs. At the CITES Conference of the Parties in 2016, the Cape mountain zebra was transferred from Appendix I to Appendix II. Shortly after the transfer of the subspecies to Appendix II, its value has increased from approximately R20 000 in May 2016 to R65 000 per individual (Summit Wildlife Auction, Eastern Cape September 2016) (table 4). However, trophy hunting of Cape mountain zebra remains low with only 43 Cape mountain zebra trophies exported between 2010 and 2021, and less than 20 animals hunted per annum over the same time period. Despite the transfer to CITES Appendix II, the subspecies still remains listed on Appendix I on the USA Endangered Species Act (ESA) of 1973. This listing requires an enhancement finding for each trophy import of this subspecies. These continued restrictions on the importation of Cape mountain zebra trophies to the USA is impacting negatively on the current demand for Cape mountain zebra from USA trophy hunters (main trophy hunting market) (Fig. 5). This reduced demand is likely to negatively affect the value of the subspecies and incentives to keep and conserve the subspecies on private land, considering that the close relative to the Cape mountain zebra, the plains zebra, is not listed on any of the CITES appendices or the USA ESA. Weber <i>et al.</i>, (2015) highlight the unintended and negative consequences of using trade bans as blunt instruments for conserving species that are not threatened by trade. For example, the unilateral trade ban brought on by the USA ESA did not provide the intended outcome of reduced polar bear mortality through sustainable harvest opportunities but rather		

contributed to a decline in economic opportunities for Arctic communities and co-management partners. At present the live sale value of the subspecies is less than R5 000 per animal and similar to that of a plains zebra (Fig. 6). These international restrictions unfortunately hamper the conservation efforts for this subspecies and others listed on the USA ESA in South Africa.

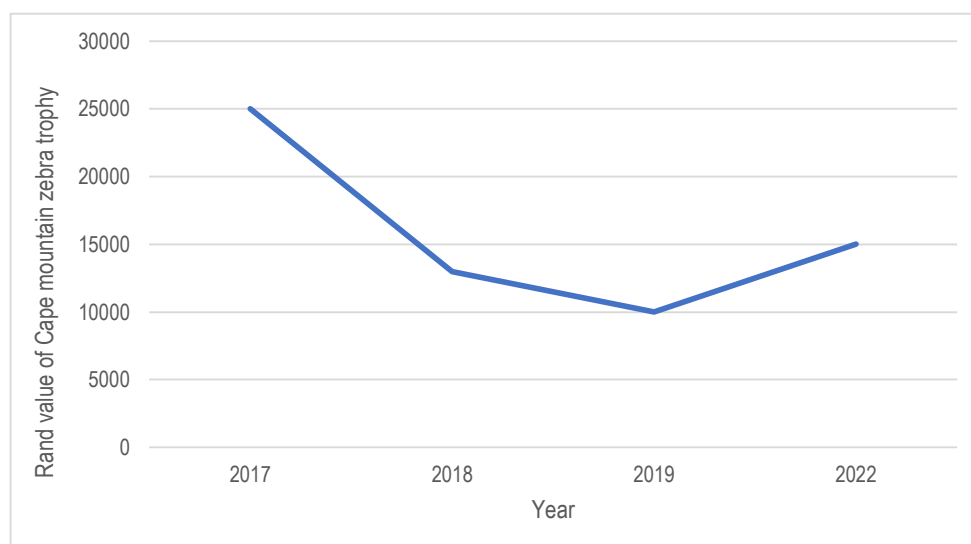


Figure 5: Rand value of Cape mountain zebra hunted within South Africa between 2017 and 2022 (Data obtained from T. van Heerden (SECSICOM))

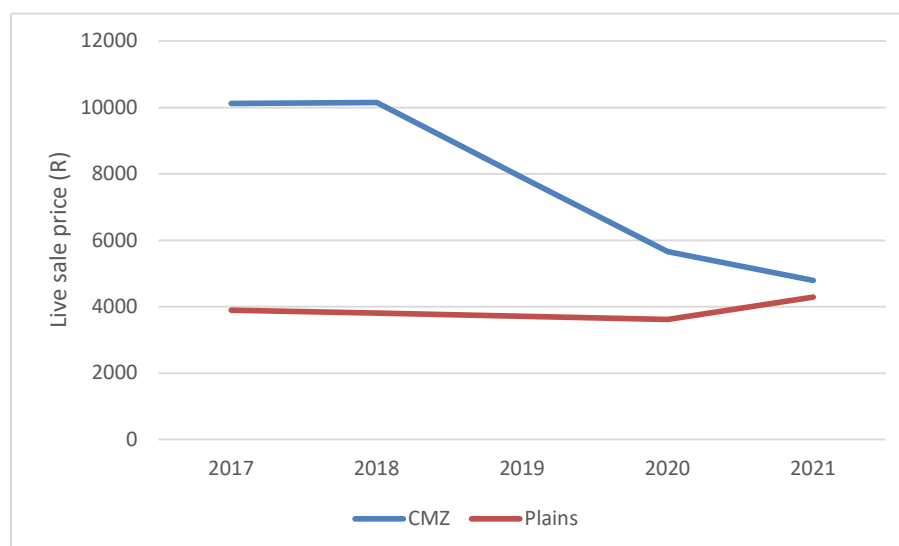


Figure 6: Average annual live sale prices of Cape mountain zebra (CMZ) and plains zebra between 2017 and 2021 (Data provided by Dr Flippie Cloete).

Table 4: Total number and prices (R) obtained for the sale of Cape mountain zebra from South African National Parks from 2015 to 2021.

Year	Total Number sold	Average Price
2015	-	-
2016	92	R10 000 – R 15 000
2017	34	R19 000 – R 21 000
2018	85	R7 000 - R11 500
2019	-	-
2020	-	-
2021	15	R5 600

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
Limited additional habitat has been added to the conservation estate as a direct result of the harvesting of Cape mountain zebra. Cape mountain zebra are introduced on already existing game farms and no other land uses are converted to game farms purely for the purposes of keeping or hunting Cape mountain zebra. However the results of questionnaire surveys conducted by Hrabar and Kerley (2015) and the South African National Biodiversity Institute (SANBI) in April 2016 indicate the willingness of private landowners to collaborate effectively with government as well as to expand the area available to Cape mountain zebra through taking down fences and acquiring more land. For example, to use Cape mountain zebra as an incentive to drop fences and acquire more land in Mountain Zebra Camdeboo Protected Environment or corridor is promising. In addition, a recent survey conducted in the Eastern Cape (137 surveys equating to 758,015 ha) evaluating the contribution of working lands to ecosystem processes and rewilding of landscapes highlighted that almost all wildlife ranchers conduct sustainable land management which can be seen as private investment into a public good through the provision of ecosystem services through natural capital restoration (Child, 2021, Unpublished data). Trophy hunting is the largest contributor to revenue and can lead to shifts towards near natural habitats from formerly cultivated fields (Child, 2021, Unpublished data). In addition the current AHS restrictions within parts of the Western Cape currently impact on the translocation of Cape mountain zebra from MZNP to these parts of the Western Cape and therewith the expansion of the population and effective implementation of a meta-population strategy. Testing and mosquito proof housing for zebra is costly and the 3-week quarantine period for zebra in a boma very likely results in prolonged stress and loss of body condition, a potential welfare issue. Appropriate mosquito proof housing for zebra would probably have to be designed and built first. So cost, housing and welfare issues (i.e. loss of condition during quarantine) have prevented importation into the Western Cape so far. Solutions to be sought engaging with State veterinary authorities, AHS-specialist in regard to spatial and temporal risk profile, Cape Nature, SANParks, land owners at the protection/infection zone interface. AHS is thus not a threat to the subspecies persistence, but rather a threat to the effective management of the subspecies and expansion of the subspecies range within the Western Cape. The current benefit is thus low, but has the potential to increase with the recent transfer of Cape mountain zebra to Appendix II, the implementation of the simulation tool to inform offtakes and if international restrictions on trophy imports could be resolved.		
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 majority of the Cape mountain zebra population (56%) occurs on formally protected land. No hunting of Cape mountain zebra is allowed in any of the National parks where Cape mountain zebra occur, nor in any of the Eastern or Western Cape Parks.		
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 the protection measures as budget and resource capacity is limited. Patel <i>et al.</i>, 2023, found that many provincial reserves are not effectively managed due to various driving factors. The top three challenges identified in this report affecting management effectiveness were capacity, poor management skills and lack of budget. Within the Western Cape there is a low to medium confidence in the effectiveness of the strict protection measures for Cape mountain zebra as budget is limited. There is limited budget to maintain and fix fences and prevent animals from escaping. Adequate monitoring is expensive, e.g. 3-5 yearly aerial counts, or camera trap censuses. There is also limited budget for the movement of animals for genetic management, or for the return of escaped animals back to protected areas. Within SANParks there is medium confidence in the effectiveness of the protection measures in place,		

while there is medium confidence in the Eastern Cape, although there are some budgetary limitations. In the Free State there is high confidence in the effectiveness of the protection measures afforded to the subspecies, which are unaffected by budgetary constraints. Overall there is medium confidence in the effectiveness of protection measures, with budgetary and capacity constraints identified as the main limitations.

26. Regulation of harvest effort: How effective are any restrictions on harvesting (such as age or size, season or equipment) for preventing overuse?	Very effective	1
	Effective	2
	Ineffective	3
	None	4
	Uncertain	5

At present all off-takes in terms of Cape mountain zebra are regulated through a system of permits. Regulatory mechanisms in place are effective as there are currently no evidence of overuse or harvest in of Cape mountain zebra. There are no additional restrictions required to manage the harvest of the subspecies. In addition, the Cape mountain zebra off-take simulator tool developed allows for the monitoring of off-takes of various age and sex ratios under different management strategies. From this information robust quantitative analysis can be conducted to provide advice on selective hunting quotas and introduction strategies or relocation schemes to achieve the targets considered for optimal resource use (Winker *et al.*, 2016). The use of this tool in regulating harvest effort is considered effective in the provinces where it is used.

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