Equus zebra hartmannae – Hartmann's Mountain Zebra


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Regional Red List status (2016)	**Vulnerable D1†**
National Red List status (2004)	Endangered D
Reasons for change	Genuine change: Population increase
Global Red List status (2008)	Vulnerable C1
TOPS listing (NEMBA)	Vulnerable
CITES listing	Appendix II
Endemic	No

†Conservation Dependent

Hartmann's Mountain Zebra may occasionally venture into Richtersveld National Park from Namibia. As they have not been reintroduced there, this movement represents natural dispersal.

Taxonomy

Equus zebra hartmannae (Matschie 1898)

ANIMALIA - CHORDATA - MAMMALIA - PERISSODACTYLA - EQUIDAE - *Equus* - *zebra* - *hartmannae*

Common names: Hartmann's Mountain Zebra (English), Hartmann se Bergsebra, Hartmann Bergkwagga (Afrikaans), Iduba le-Hartmann (Ndebele), Dou (San), Pitse ya Naga (Sepedi), Qwaha ya Thaba (Sesotho), Lidvuba (Swati), Mbidithavha (Tshivenda), Manga (Tsonga), Idauwa, Iqwarhashe (Xhosa), Izebra Lasequintabeni (Zulu)

Taxonomic status: Subspecies

Taxonomic notes: Groves and Bell (2004) investigated the taxonomy of the Mountain Zebras and concluded that the Cape Mountain Zebra (*Equus zebra zebra*) and Hartmann's Mountain Zebra (*Equus zebra hartmannae*) are distinct, and suggested that the two would be better classified as separate species, *Equus zebra* and *Equus hartmannae*. However, in a genetic study that included 295 Mountain Zebra specimens, Moodley and Harley (2005) found no evidence to regard the two taxa as anything more than different populations of a single species. They concluded that the Cape Mountain Zebra and Hartmann's Mountain Zebra should remain subspecies. Therefore, no taxonomic changes since 2004 have been made.

Assessment Rationale

Both the South African and Namibian Hartmann's Mountain Zebra populations have been increasing. For example, over three generations (1980–2015), the subpopulation at Goegap Nature Reserve has increased by 6.2% / year (from 6 to 69 individuals). Similarly, the subpopulation on Tswalu Kalahari Private Game Reserve has increased from 65 in 2005 to 203 in 2014; and that on Augrabies Falls National Park has increased from 8 in 1996 to 208 in 2016. However, subpopulation sizes remain small and rely on management to remain viable. In Gondwana Canyon Park, Namibia (adjacent to Ai-Ais/ Richtersveld Transfrontier Park) the Hartmann's Mountain Zebra subpopulation has grown at a mean rate of 22% / year (2005–2012), indicating a healthy source for dispersal and/or translocation into the South African Richtersveld National Park. From the data available, the observed and estimated current mature population size within the natural distribution range of South Africa, based on both formally and privately protected subpopulations, is at least 592–724 mature individuals (an underestimate given the lack of comprehensive data on the private sector). Although extensive extra-limital subpopulations exist in South Africa, these are not included in this assessment. The total population size in Namibia exceeds 132,000 individuals.

There are no major threats that could cause rapid population decline. However, increasing frequencies of drought from climate change may threaten the population in future, especially considering the small subpopulation size and fragmented nature of the population. Further surveys are needed to collate private subpopulation numbers and evaluate such properties for their eligibility in this assessment. A metapopulation plan, adopted by multiple stakeholders, must also be developed. Since there has been a genuine population increase since the previous estimate and total population size exceeds 250 mature individuals, this subspecies qualifies as Vulnerable D1. While the population size five years ago is unknown, it is likely, given the under-sampling and the continuous rate of population growth, that the mature population size would have exceeded the threshold for Endangered D and thus the downlisting is legitimate. While there have been confirmed dispersal of individuals from Namibia into the Richtersveld National Park, this is not considered to result in significant rescue effects. This species should continue to thrive with the expansion of the wildlife ranching industry and care should be taken to forge public-private partnerships to create conservancies and sustain wild and free-roaming herds. Reintroductions into both Richtersveld and Namaqua National Park are in motion, and this subspecies remains conservation dependent as it requires active translocation and metapopulation management.

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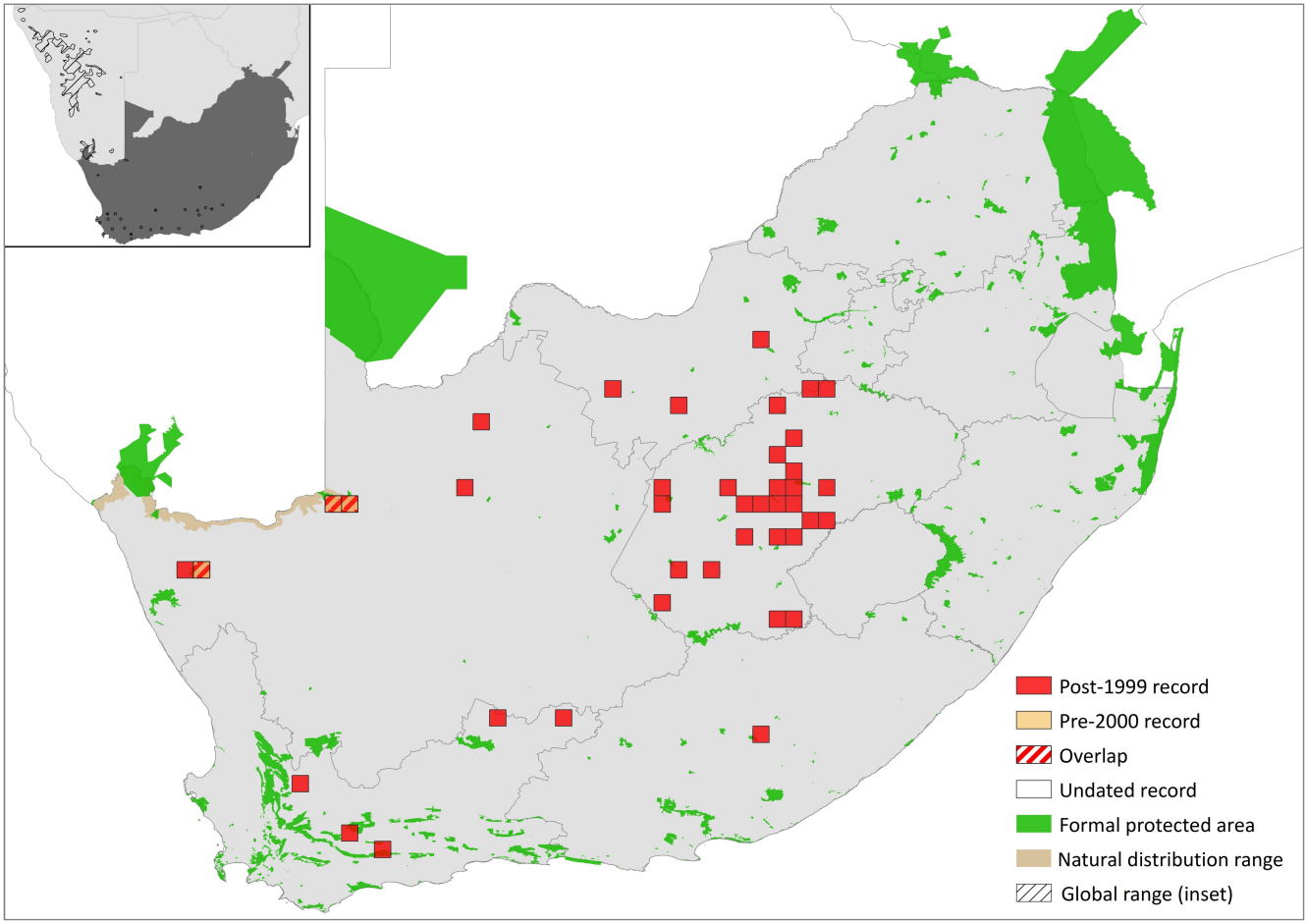

Figure 1. Distribution records for Hartmann's Mountain Zebra (*Equus zebra hartmannae*) within the assessment region. Please note, the global distribution refers to Mountain Zebra overall (both subspecies).

Table 1. Countries of occurrence within southern Africa

Country	Presence	Origin
Botswana	Absent	-
Lesotho	Absent	-
Mozambique	Absent	-
Namibia	Extant	Native
South Africa		
Northern Cape	Extant	Native
Western Cape	Extant	Native and introduced
Eastern Cape	Extant	Introduced
Free State	Extant	Introduced
North West	Extant	Introduced
Swaziland	Absent	-
Zimbabwe	Absent	-

Regional population effects: The bulk of the global population exists in Namibia and the South African population in the Northern Cape may be connected with the extensive Namibian population and conservation areas through Ai-Ais/Richtersveld Transfrontier Park. Connectivity between the South African and Namibian population has not been formally documented, and thus the South African population might be discrete from the Namibian population and possess conservation value. However, there is some anecdotal evidence that immigration does occur (see **Population**).

Distribution

Historically, Hartmann's Mountain Zebra ranged across Namibia, southern Angola, and the north-west portions of the Northern Cape Province in South Africa where they are currently established in three conservation areas: Richtersveld and Augrabies National Parks and Goegap Provincial Nature Reserve (Novellie *et al*. 2002). Hartmann's Mountain Zebras have also been introduced outside of their natural distribution range in the Western Cape, Eastern Cape, North West and Free State provinces (Table 2, Figure 1). In Namibia, the establishment of artificial water-points have allowed Hartmann's Mountain Zebra to occupy previously unsuitable habitat, such that their present range differs from that in historical times. They were thought to be regionally extinct in Angola but a recent survey conducted by the Ministry of Environment and Tourism of Namibia in Iona National Park found a subpopulation of 48 individuals (estimated total subpopulation size is 263). However, hybridisation between the Hartmann's Mountain Zebra and Donkeys (and possibly the last remaining Plains Zebra) has been reported (P. vaz Pinto unpubl. data).

Within the assessment region, the species naturally occurred from Namibia to the Kamiesberg, Northern Cape Province (for example, Sidney 1965; Skead 2011). Over the past ten years, individuals have naturally re-crossed into the Richtersveld National Park, and are sighted sporadically in small numbers (N. de Goede, pers. obs.). These individuals may have originated from Namibia since no introductions have ever been made into the Richtersveld. Even though unlikely, it is possible, due to

the remoteness and inaccessibility of much of the area that a tiny relic population persisted in the Richtersveld without replenishment from Namibia. Further, connectivity between the South African and Namibian population has not been formally documented. The minimum area of occupancy for this subspecies, including only formally protected subpopulations, is 2,555 km^2 (Richtersveld National Park, Augrabies Falls National Park and Goegap Provincial Nature Reserve). Hartmann's Mountain Zebras are present in Richtersveld National Park, at least sporadically, but in very small numbers. Additionally, the private sector is playing an important role in expanding the area of occupancy for the subspecies and thus has an important role to play in sustaining a viable South African population, but potential hybridisation with Cape Mountain Zebra and Plains Zebra (*Equus quagga*) must be managed through legislation and/or incentives. Similarly, the growth of the private sector should concentrate on establishing subpopulations inside the natural distribution range.

Population

The Hartmann's Mountain Zebra population in South Africa is observed to be increasing. The total formally protected population in 2004 was noted as being 80 collectively in Augrabies National Park (25 individuals), Richtersveld National Park (30 individuals) and Goegap Nature Reserve (25 individuals) (Friedmann & Daly 2004; M. Smit unpubl. data). The subpopulation in Goegap Nature Reserve has since doubled (69 individuals in 2015; M. Smit unpubl. data), while that of Augrabies Falls National Park has increased to 208 individuals in 2016 (Bissett et al. 2016). A current subpopulation estimate for the Richtersveld National Park is unavailable. While estimates for subpopulations on private land were unknown in the previous assessment, it is estimated that there are currently at least 570 Hartmann's Mountain Zebra on private land in the Northern Cape. This is based on both data from the permit office of the Department of Environment and Nature Conservation (DENC) where 305 individuals were moved between private properties (2009–2013, M. Smit unpubl. data), and data from a nationwide survey on wildlife ranching (2014; A. Taylor unpubl. data). The permit data and the ranch data are non-overlapping as they represent different localities. Subpopulations dependent on direct intervention are not considered wild, if they would go extinct within 10 years without intensive management (IUCN Standards and Petitions Subcomittee 2014). As such, a preliminary analysis to determine which private subpopulations can be considered wild, revealed that 64–95% of individuals on private land are eligible for inclusion in the assessment (N = 21 properties, A. Taylor unpubl. data), which means 364–542 privately owned Hartmann's Mountain Zebra are eligible for inclusion in this assessment. Private subpopulations are inferred to be increasing along with the expansion of the wildlife ranching industry. Similarly, mature population structure is inferred from demographic data from Mountain Zebra subpopulations in both the Western Cape and Goegap Nature Reserve, which corresponds to 67% (based on average numbers of mature individuals in both breeding and stallion herds; C. Birss unpubl. data) and 91% (of 47 individuals in Goegap, there are 43 adults, one sub-adult and three juveniles; M. Smit unpubl. data) respectively. To compensate for variation between areas, we used a mature population structure of 75%. More research is needed to establish the accurate proportion of mature individuals across subpopulations. Thus, overall the total mature and wild population size in the assessment region, based on available data, is at least 592–724 (Table 2). The generation length for *Equus zebra* overall has been estimated as 11 years by Pacifici et al. (2013). Over three generations (1980–2013), the subpopulation at Goegap Nature Reserve (the only site with long-term data available) has increased significantly (from 6 to 69 individuals) in total or 6.2% on average per year. Similarly, the subpopulation on Tswalu Kalahari Private Game Reserve has increased from 65 in 2005 to 203 in 2014 at a growth rate of 11.6% per year (C. Kraft unpubl. data); and the subpopulation on Augrabies Falls National Park has increased from 8 in 1996 to 208 in 2016 (Bissett et al. 2016). While the total population size in 2009 is unknown, as long-term data are unavailable, it seems likely there have been > 250 mature individuals over the last five years (IUCN Standards and Petitions Subcomittee 2014), especially seeing as in 2002 there were already a reported estimate of 279 Hartmann's Mountain Zebras in the Northern Cape (Novellie et al. 2002).

Extra-limital subpopulations have been established outside the natural distribution range and are not included in this assessment. In North West Province, there are at least three game farms (two without exemption permits) holding the subspecies (Power 2014), with a minimum of 12 individuals. There are at least 51 individuals existing on five properties (only three with certificates of adequate enclosure) in the Western Cape Province (C. Birss unpubl. data). In The Free State Province, there are at least 391 individuals existing on 31 properties (N. Collins unpubl. data). There is also at least one confirmed subpopulation in the Eastern Cape Province (D. Peinke pers. comm. 2016). These subpopulations should be monitored (and if possible removed or replaced with Cape Mountain Zebra) to ensure they do not pose a hybridisation threat with the native Cape Mountain Zebra.

Barnes et al. (2009) estimated the Namibian population at 72,736 individuals in 2004. The current estimate exceeds

Table 2. Summary of subpopulation size estimates for Hartmann's Mountain Zebra (*Equus zebra hartmannae*) in the assessment region

Province	Type	No. of properties	Subpopulation total (2004)	Subpopulation total (2014–2016)
Northern Cape	Provincial	1	25	69
Northern Cape	National	1	25	208
Northern Cape	Private	1	68	203
Northern Cape	Ranch	41	Unknown	570
Total				994
Wild and mature total				592–724

132,000 individuals (M. Gosling et al. unpubl. data). However, 73% of these are on commercial farms and under drought conditions, which occur on average every 14 years, a large proportion of these Hartmann's Mountain Zebra could die, either due to confinement within fences or through culling to protect livestock grazing.

Subpopulation growth rates are very high in the absence of Lions (*Panthera leo*) and Spotted Hyenas (*Crocuta crocuta*) (most areas within the indigenous range). There is substantial off-take from Namibian subpopulations but these are well below potential rates of increase and thus sustainable (Shapi 2014). Although some subpopulations are in relatively small (for Namibia) fenced areas (<15,000 ha), others are in very large open areas (for example, the Namib–Sossulsvlei Landscape and the Greater Fish River Canyon Landscape which both have thriving subpopulations). For example, within Gondwana Canyon Park (adjacent to Ai-Ais/Richtersveld Transfrontier Park) alone, where there are no major predators or off-take, the mean annual growth rate since 2005 is 22%, having increased from *c.* 200 to *c.* 800 individuals between 2005 and 2012 (M. Gosling unpubl. data). The effect of immigration resulting from the distribution of artificial water points must be factored into this growth rate, but the source subpopulation is likely to be growing at the same rate. However, these rates of increase within Gondwana Canyon Park are most likely the maximum rate of increase. There is evidence of substantial mortalities of Hartmann's Mountain Zebra in 2015 and it is speculated that the population could be levelling out (M. Gosling unpubl. data). Recent analysis of the national population suggests a substantial increase in the national population over recent decades (M. Gosling et al. unpubl. data). This appears to be a long-term response to the severe drought of the 1980s when Hartmann's Mountain Zebra suffered catastrophic mortalities. Management intervention may also have affected growth in numbers, notably through the creation of a network of communal conservancies in a large area of suitable habitat in the north-west and the re-introduction of Hartmann's Mountain Zebra to these areas. Thus, the large size and good growth rate of the Namibian Hartmann's Mountain Zebra population means that there is a good source pool for reintroduction and rescue of the South African population.

For example, in the Richtersveld National Park (the South African side of the Ai-Ais/Richtersveld Transfrontier Park) visitors and goat herders occasionally report sightings of small numbers of Hartmann's Mountain Zebra (the largest group numbering five). Similarly, the park rangers fairly regularly observe tracks in certain localities, and the Park Manager has found two Hartmann's Mountain Zebra carcasses during the past five years, and reports seeing groups regularly on the Namibian banks of the Orange River (P. Novellie pers. obs. 2015). Hartmann's Mountain Zebra have never been introduced into Richtersveld National Park, so it is likely that these individuals originated from Namibia.

Current population trend: Increasing

Continuing decline in mature individuals: No

Number of mature individuals in population: 592–724 (minimum)

Number of mature individuals in largest subpopulation: 156 in Augrabies Falls National Park.

Number of subpopulations: At least 44

Severely fragmented: Yes. Unlike the Namibian population, most subpopulations in South Africa exist on fenced protected areas or ranches and will require active translocation as part of a metapopulation plan.

Habitats and Ecology

Hartmann's Mountain Zebra inhabit rugged, broken mountainous and escarpment areas up to around 2,000 m asl with a rich diversity of grass species and perennial water sources (Penzhorn 2013). They are predominantly grazers. The typical social structure is one of small harems comprising an adult stallion and one to three (maximum five) mares and their dependent foals and juvenile offspring; non-breeding groups consist primarily of bachelors, but sometimes include young fillies (Penzhorn 2013). Over the past ten years, individuals have naturally re-crossed into the Richtersveld National Park, and are sighted sporadically in small numbers (N. de Goede, pers. obs.). These individuals may have originated from Namibia since no introductions have ever been made into the Richtersveld. Even though unlikely, there is a remote possibility that due to the remoteness and inaccessibility of much of the area, a tiny relic population persisted in the Richtersveld without replenishment from Namibia. Connectivity between the South African and Namibian population has not been formally documented.

Ecosystem and cultural services: Flagship species of the arid mountainous regions of the Northern Cape.

Table 3. Use and trade summary for the Hartmann's Mountain Zebra (*Equus zebra hartmannae*)

Category	Applicable?	Rationale	Proportion of total harvest	Trend
Subsistence use	Yes	6.2% of freehold farms reported losses over one recent year due to poaching.	Minority	Unknown
Commercial use	Yes	Local trade in live animals, skins and meat as well as trophy hunting.	Majority	Increasing, based on permit numbers.
Harvest from wild population	Yes	Trophy hunting	Minority	Stable
Harvest from ranched population	Yes	All commercial trade restricted to privately ranched subpopulations.	Majority	Increasing in tandem with wildlife ranching industry growth.
Harvest from captive population	Unknown	There are no captive-bred subpopulations recorded (A. Taylor unpubl. data) but further surveys are required.	None	Unknown but suspected to be minimal.

Table 4. Possible net effects of wildlife ranching on the Hartmann's Mountain Zebra (*Equus zebra hartmannae*) and subsequent management recommendations

Net effect	Positive
Data quality	Suspected
Rationale	Private landowners have successfully increased total population size.
Management recommendation	Cooperate with provincial authorities in establishing free-roaming herds within the natural range and conducting genetic purity tests for their herds. Removal of Hartmann's Mountain Zebra outside its natural distribution range to prevent hybridisation with the Cape Mountain Zebra.

Use and Trade

There is a local, commercial and international trade in live animals, skins and meat of Hartmann's Mountain Zebra. However, the effect of this trade on free-roaming populations is minimal because most trade is restricted to privately protected populations outside their natural range. Similarly, in Namibia, there is commercial trade in skins. Subpopulations need to be carefully monitored so that harvesting does not adversely affect population viability. The mean number of Hartmann's Mountain Zebra currently harvested per annum in Namibia (2008–2012) is 3,538, which is not predicted to impact population growth negatively (Shapi 2014). Given the rapid growth of the private sector, a similar trade could possibly be established in the Northern Cape. Overall, in the Northern Cape, ranchers have increased the area of occupancy of the subspecies in hilly terrain. However, the risk of hybridisation with Cape Mountain and Plains Zebra may become a problem without strict regulation on translocation.

Threats

Within the assessment region, hybridisation with Cape Mountain Zebra and Plains Zebra is the only major threat. It is unknown to what extent Hartmann's x Cape Mountain Zebra hybrids exist within South Africa. Anecdotal reports suggest that hybridisation between Hartmann's Mountain Zebra and Cape Mountain Zebra does take place in the Western and Eastern Cape. However, this is more a threat to Cape Mountain Zebra (Hrabar & Kerley 2015), as the core populations of Hartmann's Mountain Zebra (and indeed its core range throughout Namibia) remain unaffected by potential hybridisation. The exception is in western Etosha National Park where there have been incidences of hybridisation between Hartmann's and Plains Zebras (P. Vaz Pinto pers. comm. 2015). Molecular analysis of faecal DNA carried out by Pauline Kamath in western Etosha National Park showed both hybridisation and introgression, confirming that hybrids between Hartmann's Mountain and Plains Zebras are fertile (P. Kamath unpubl. data). Similarly, in 2014, two Plains x

Table 5. Threats to the Hartmann's Mountain Zebra (*Equus zebra hartmannae*)ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	*8.2.2 Problematic Native Species/Diseases*: Cape Mountain and Plains Zebra. Current stress *2.3.1 Hybridisation*.	Taplin et al. 2015	Empirical	Local	Suspected to be increasing due to continued coincidence of Cape Mountain Zebra, Hartmann's Mountain Zebra and Plains Zebra.
		Hrabar & Kerley 2015	Empirical	National	28% of Mountain Zebra population is currently at risk of hybridisation, while 35% has been previously exposed to hybridisation threat.
2	*2.3.1 Nomadic Grazing* and *2.3.2 Small-holder Grazing, Ranching or Farming*: communal grazing in formally protected areas and overstocking of ranch lands may decrease grass availability. Current stresses *1.2 Ecosystem Degradation*, *1.3 Indirect Ecosystem Effects* and *2.3.7 Reduced Reproductive Success*: degradation and fragmentation of remaining ecosystems limits resource availability and subpopulation growth.	-	Anecdotal	-	-
3	*11.2 Drought*: increasing drought frequency. Current stress *2.1 Species Mortality*: high mortality rates during droughts may lead to rapid population declines.	-	Anecdotal	-	-
4	*8.5.1 Viral/Prion-induced Diseases*: sarcoidosis. Current stresses *2.1 Species mortality* and *2.3.7 Reduced reproductive success*.	Sasidharan 2006	Indirect (review)	National	Possibly increasing through small population fragmentation and resultant inbreeding.

Cape Mountain Zebra hybrids in Mountain Zebra National Park were confirmed through genetic testing (Taplin et al. 2015). As a result all Plains Zebra were removed from Mountain Zebra National Park. Given that female hybrids between Grevy's (*Equus grevyi*) and Plains Zebras are fertile (Cordingley et al. 2009), further research is needed into the fertility of any Hartmann's Mountain Zebra hybrids. Anthropogenic environmental changes, particularly fragmentation of habitat and isolation of populations, increase the risk of hybridisation (Hill 2009) and the likelihood of inbreeding depression. Thus a metapopulation plan involving both private and state institutions is needed. Other potential threats include Equine sarcoidosis and stochastic events such as droughts. Equine sarcoidosis is widespread and has also been found in Hartmann's Mountain Zebra. It has 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. Drought conditions occur on average every 14 years. Under these conditions a large proportion of Hartmann's Mountain Zebra occurring on commercial farmland may die, either through confinement within fences or through culling to protect livestok grazing (M. Gosling unpubl. data). Thus, even though numbers are currently large, much of the increase may be quickly eliminated under predictable drought conditions. The number of Hartmann's Mountain Zebra killed illegally is not known; however 6.2% of freehold farms reported losses over one recent year due to poaching (Lindsey et al. 2006).

Current habitat trend: Habitat for this species is largely intact and the area available may be increasing through the rise of wildlife ranching. However, since Hartmann's Mountain Zebra are nearly pure grazers, overgrazing of formally protected areas by pastoralists will decrease habitat quality. Similarly, overstocked ranch lands will decrease forage availability. This is also likely to be under threat from bush encroachment and thus a conservation priority. It is unknown what effects climate change will have on habitat suitability for Hartmann's Mountain Zebra.

Conservation

In South Africa, this subspecies is well conserved in three formally protected areas (Goegap Nature Reserve, Augrabies Falls National Park and Richtersveld National Park), and the strong population in Namibia is a significant source for natural dispersal. The recent expansion of Goegap Nature Reserve (from 24,000 ha to 40,000 ha) further enables it to support a much larger number of Hartmann's Mountain Zebra. Legislation must confine the subspecies to its natural distribution range in the Northern Cape to avoid hybridisation with other zebra taxa in the future, and to establish an *in situ*, self-sustaining population within the natural range. Similarly, Hartmann's Mountain Zebra herds in the Western and Eastern Cape provinces should be replaced with the Cape subspecies in order to mitigate the risk of hybridisation for both subspecies (Novellie et al. 2002; Penzhorn 2013; Hrabar and Kerley 2015). Private landowners should be incentivised to participate in a metapopulation strategy.

Hartmann's Mountain Zebra can probably out-compete livestock and other game in rugged areas and could provide a viable source of local food and possibly cash income to local communities from trophy/meat hunting as well as photographic tourism. These benefits could be used to address the identified threats of communal grazing and land claims in protected areas within the natural range. Communal conservancy areas, similar to that of Namibia (Barnes et al. 2002; Suich 2010; Riehl et al. 2015), could be established in the Northern Cape Province and success could be measured as a decrease in observed levels of livestock grazing in protected areas as well as attitudes (pre- and post- intervention).

Reintroduction of herds into unoccupied suitable areas within the natural distribution range can also be used to

Table 6. Conservation interventions for the Hartmann's Mountain Zebra (*Equus zebra hartmannae*) ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	*3.3.1 Species Reintroduction*: translocations and reintroductions under a metapopulation strategy as informed by a Biodiversity Management Plan, including both private and formally protected areas; reintroduce and supplement Hartmann's Zebra to protected areas or key sites within the natural range.	-	Anecdotal	-	-	-
2	*3.1.2 Trade Management*: subject animals to be translocated to genetic testing to detect hybrids and euthanise hybrids to prevent spread of hybrid genes.	Taplin et al. 2015	Empirical	-	Detected hybrids were removed.	SANParks
3	*6.2 Livelihood, Economic & Other Incentives*: establish a community benefits mechanism for conservancies with Hartmann's Mountain Zebra.	Suich 2010 Riehl et al. 2015	Review Review	National National	Mixed benefits from community conservancies at household level.	None in South Africa.
4	*1.2 Resource & Habitat Protection*: biodiversity stewardship as potential reintroduction sites.	-	Anecdotal	-	-	Multiple organisations
5	*6.3 Market Forces* and *6.4 Conservation Payments*: designing incentives for private landowners to participate in biodiversity stewardship and metapopulation management.	-	Anecdotal	-	-	-

bolster a resilient national population. For example, the Namakwa National Park and Kamiesberg range near Garries, just north of the Western Cape border should be considered for the reintroduction of free roaming herds as the region might have potential for a greater conservation area.

Recommendations for land managers and practitioners:

- Develop a Biodiversity Management Plan (BMP), which includes population size and distribution goals and threat reduction strategies, as well as a metapopulation strategy (to maximise genetic diversity and subpopulation growth).
- A comprehensive monitoring plan is a priority for this subspecies to estimate overall population size and trends. For example, population data and trends from Ai-Ais/Richtersveld Transfrontier Park and the private subpopulations in the Northern Cape need to be collated.
- This subspecies needs tighter legislative control in provinces that fall outside its range both to prevent hybridisation with Cape Mountain Zebra and to focus translocations within the Northern Cape to bolster population growth in that region (Power 2014). The Department of Environmental Affairs and Nature Conservation in Northern Cape should increase the hunting quota there to encourage private population growth.
- Conservation breeding is not necessary for the subspecies.

Research priorities:

- Incidences of hybridisation with Cape Mountain Zebra and Plains Zebra and the impact of hybrids on subpopulation performance must be researched, and robust genetic markers to detect hybrids developed.
- Similarly, conduct a comprehensive social survey with stakeholders in areas that are threatened by incompatible local land uses or areas earmarked for future population re-establishment to better understand local perspectives, attitudes and potential threat-reduction strategies. This will identify social and ecological limiting factors to be incorporated into the BMP.
- Investigate the habitat requirements for Hartmann's Mountain Zebra in South Africa.
- Identify and prioritize areas for future re-introduction or translocation that improve the regional population viability.

Encouraged citizen actions:

- Report sightings on virtual museum platforms (for example, iSpot and MammalMAP), especially outside protected areas.
- Landowners should drop fences to form conservancies and create free-roaming areas.

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Data Sources and Quality

Table 7. Information and interpretation qualifiers for the Hartmann's Mountain Zebra (*Equus zebra hartmannae*) assessment

Data sources	Census (unpublished), field study (unpublished), fndirect information (expert knowledge)
Data quality (max)	Observed
Data quality (min)	Suspected
Uncertainty resolution	Best estimate
Risk tolerance	Evidentiary

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