

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES  
OF WILD FAUNA AND FLORA



Seventeenth meeting of the Conference of the Parties  
Johannesburg (South Africa), 24 September – 5 October 2016

SUPPLEMENTARY INFORMATION ON CAPE MOUNTAIN ZEBRA – BIODIVERSITY MANAGEMENT PLAN

1. This document has been submitted by South Africa in relation to amendment proposal CoP17 Prop. 6 on Cape mountain zebra (*Equus zebra zebra*)\*.
2. The Cape mountain zebra is not currently considered to be threatened with extinction. Although the wild population is still comparatively small, it has increased steadily at 8-9% per year since the early 1990s.
3. There are concerns about a loss of genetic diversity from the Cape mountain zebra population and a lack of management to address this. The national population is fragmented into at least 75 subpopulations of which 37% are small (20 or fewer animals). All subpopulations (except for that of De Hoop Nature Reserve) originate from Mountain Zebra National Park. This has resulted in low genetic variation and a risk of inbreeding depression.
4. Genetic management of the Cape mountain zebra population will however soon be implemented in accordance with a Biodiversity Management Plan that was recently developed through an inter-agency collaboration between the South African National Parks, CapeNature, Eastern Cape Parks and Tourism Agency, the National Zoological Gardens of South Africa, the National Department of Environmental Affairs, Northern Cape Department of Environment and Nature Conservation, Eastern Cape Department of Economic Development, Environmental Affairs and Tourism, and Free State Department of Economic, Small business, Tourism and Environmental Affairs.
5. The vision for the Biodiversity Management Plan is stated as “An increasing, genetically healthy meta-population, supporting sustainable off-takes, with an increased conservation value and private sector investment in Cape mountain zebra”.
6. In accordance with this vision and Objective 1, “to maintain genetic diversity in the Cape mountain zebra meta-population”, the following actions will be undertaken:
  - Maintain a centralized national Cape mountain zebra population database.
  - Develop and implement a sound meta-population management guideline.
  - Develop a list of priority sites for reinforcement and reintroduction.
  - Establish and reinforce Cape mountain zebra subpopulations on prioritized sites.
  - Investigate the genetic diversity of the Cape mountain zebra meta-population.
  - Monitor and manage the impacts of meta-population translocations on genetic diversity.
  - Quantify the extent of hybridization of Cape mountain zebra with plains zebra, Hartmann’s mountain zebra and other equids.
  - Conduct research to quantify the extent and severity of possible disease occurrence in Cape mountain zebra.

---

\* The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.

- Assess the reproductive fitness of Cape mountain zebra subpopulations.
- Manage the risk of hybridization of Cape mountain zebra with plains zebra, Hartmann's mountain zebra and other equids.
- Implement a sarcoid surveillance protocol linked to the national Cape mountain zebra population monitoring database.
- Promote and facilitate research on Cape mountain zebra parasite load and host-pathogen interactions.

7. The full Biodiversity Management Plan for the Cape mountain zebra is presented in Annex I.

# **BIODIVERSITY MANAGEMENT PLAN FOR THE CAPE MOUNTAIN ZEBRA**

## ***Equus zebra zebra***

### **IN SOUTH AFRICA**



Photo: R. Smith

**Jointly developed by  
CapeNature, South African National Parks, Eastern Cape Parks and  
Tourism Agency, National Zoological Gardens, Department of  
Environmental Affairs, Northern Cape Department of Environment and  
Nature Conservation, Eastern Cape Department of Economic  
Development, Environmental Affairs and Tourism and Free State  
Department of Economic, Small business, Tourism and Environmental  
Affairs**

**Coral Birss<sup>1</sup>, Carly Cowell<sup>2</sup>, Natalie Hayward<sup>1</sup>, Dean Peinke<sup>3</sup>, Halszka Hrabar<sup>4</sup> and  
Antoinette Kotze<sup>5</sup>**

<sup>1</sup> CapeNature

<sup>2</sup> South African National Parks

<sup>3</sup> Eastern Cape Parks and Tourism Agency

<sup>4</sup> Nelson Mandela Metropolitan University

---

<sup>5</sup> National Zoological Gardens of South Africa

Citation

*Birss, C., Cowell, C., Hayward, N., Peinke, D., Hrabar, H.H. and Kotze, A. 2016. Biodiversity Management Plan for the Cape mountain zebra in South Africa. Jointly developed by CapeNature, South African National Parks, Eastern Cape Parks and Tourism Agency, National Zoological Gardens, Department of Environmental Affairs, Northern Cape Department of Environment and Nature Conservation, Eastern Cape Department of Economic Development, Environmental Affairs and Tourism and Free State Department of Economic, Small business, Tourism and Environmental Affairs. Version 1.0*



## FOREWORD – Dr Peter Novellie

This draft Biodiversity Management plan (BMP) constitutes an important milestone in the conservation of Cape mountain zebra. It traces the long history of conservation measures and research aimed at ensuring the future of the subspecies, from the early efforts of the first half of the twentieth century to the most recent update on its conservation status. This well documented history, together with an extensive consultation process, enabled the BMP to accurately identify the threats currently facing Cape mountain zebra, as well as to formulate a set of objectives designed to counter the threats. Finally the BMP outlines the next important steps, which constitute the governance arrangements for the implementation of the plan, and then its submission to the Department of Environmental Affairs for gazetting for public participation.

From the perspective of a thirty year personal association with the conservation of Cape mountain zebra I see in this plan a significant new approach. Responsibility for the conservation of mountain zebra has always been shared across a range of authorities and individuals, but never previously has there been such close collaboration between them. The BMP is the product of extensive consultation and information sharing between diverse role players in different levels of government and in the private sector. This collaborative process has not been finally concluded, but will continue after gazetting, and indeed throughout the implementation of the plan. The emphasis on monitoring, data collection and adaptive management in the BMP will ensure an ongoing process of information sharing and joint learning.

In providing for collaborative adaptive management the BMP resonates well with emerging ideas in the scientific literature on species conservation. A threatened species cannot be protected in isolation, only in the context of the social ecological system in which it occurs. Social ecological systems are complex and inherently unpredictable. Traditional species protection measures often assume predictability, requiring conservation authorities to decide in advance whether a given activity may or may not have deleterious consequences for the species.





Authorization for the activity is then granted or withheld, usually without any monitoring of the consequences. This is unrealistic for complex, unpredictable systems, which are more appropriately dealt with by adaptive management (Doremus 2001; Green and Garmestani 2012). The BMP for Cape mountain zebra departs from traditional predictivist measures, committing to adaptive management and to the essential requirements of monitoring and review.

Unless adaptive management is conducted within a governance framework that is itself adaptive it has little chance of success (e.g. Walker 2012). This realization has produced a growing body of scholarship on adaptive governance (reviewed by Chaffin *et al.* 2014). Provision for monitoring, information sharing and collaborative learning are seen by many authors as essential to adaptive governance of complex systems (e.g. Dietz *et al.* 2003; Cilliers *et al.* 2013). Another feature conducive to adaptive governance is a diversity of authorities, each with its own geographic area and domain of authority, with each authority linking with others on common issues (Olsson *et al.* 2007; Biggs *et al.* 2012). Diverse governance can enable dynamic responses in the face of rapid change and uncertainty, whereas single-level, centralized governance units do not have the variety of response capabilities necessary to deal with complexity (Olsson *et al.* 2007). Another advantage of diversity is that strengths at one level can offset weaknesses at another (Biggs *et al.* 2012). Far from being an encumbrance, the diversity of institutions involved in the conservation of Cape mountain zebra may actually be a strength.

The Cape mountain zebra currently faces a number of complex challenges, not least the unavoidable shortage of human and financial resources to implement required conservation measures and monitoring. Perfect solutions will seldom be possible but, through collaboration across diverse levels, the BMP promises to find innovative, workable solutions.

## EXECUTIVE SUMMARY

Endemic to South Africa, Cape mountain zebra (*Equus zebra zebra*) numbers declined to less than 60 individuals at the beginning of the 20<sup>th</sup> century. These animals were isolated in three locations: Cradock (Eastern Cape), Kammanassie and Gamkaberg (Western Cape). Since then, conservation action has resulted in steady increases in the overall population number and distribution, however, the residual effects of a potential genetic bottleneck currently threatens the long term survival of the species throughout its natural distribution range. Cape mountain zebra now occur in a number of genetically separate and isolated populations and are threatened by, among other, small sub-population sizes, habitat fragmentation and hybridization with other equid species. Collaborative and integrated management among stakeholders, as well as public support, is required for effective management of the sub-populations to ensure the maintenance of genetic diversity within the meta-population and to promote sustainable utilisation by the private sector.

Cape mountain zebra is listed as Vulnerable (D1) by the IUCN and on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; a convention which regulates the international trade of the species, and requires a non-detriment finding for export permits to be granted.

At the end of 2015, the Cape mountain zebra meta-population comprised approximately 4,872 individuals in 76 sub-populations throughout South Africa. The meta-population is considered stable, increasing and has exceeded the previous target set in the 2002 IUCN Equid Specialist Group Status Action Plan for the mountain zebra as a species. Apart from the three relict sub-populations occurring on protected areas (Kammanassie Nature Reserve, Gamkaberg Nature Reserve and Mountain Zebra National Park), Cape mountain zebra have been reintroduced to another nine protected areas within their natural distribution range and 7 protected areas outside the natural distribution range, comprising approximately 70% of the population. Cape mountain zebra populations on private land were estimated at 1,481 individuals, in 2015, comprising approximately 30% of the total population.

In 2011, a partnership between CapeNature, the Wilderness Foundation, the World Wildlife Fund - South Africa and the Table Mountain Fund was initiated towards the drafting of a Biodiversity Management Plan (BMP-S) for Cape mountain zebra. The initiative was primarily aimed at integrating the efforts of the then Mountain Zebra Working Group into the BMP-S. An inter-agency collaboration between the South African National Parks, CapeNature, Eastern Cape Parks and Tourism Agency, National Zoological Gardens of South Africa, the National Department of Environmental Affairs, Northern Cape Department of Environment and Nature Conservation, Eastern Cape Department of Economic Development, Environmental Affairs and Tourism and Free State Department of Economic, Small business, Tourism and Environmental Affairs, ensued and acknowledged the need for a Cape mountain zebra BMP-S to ensure the long term survival of the species in nature.

Stakeholder engagements identified threats and challenges including the loss of genetic diversity through inbreeding and genetic drift, diseases such as equine sarcoidosis, the risk of hybridization, predation, poaching, emigration threats, and the lack of implementation of a meta-population strategy. The selection of the Cape mountain zebra for a BMP-S is based on the requirements of the NDF, its threat status, the requirement for meta-population management and inter-agency

cooperation towards shared objectives for the conservation of the species, standardised monitoring, collaborative research, increased participation by landowners and opportunities as a flagship for protected area expansion and stewardship initiatives.

During the Cape mountain zebra BMP-S development process, both internal and external stakeholder consultation developed the following **desired state** for the Cape mountain zebra:

*The scientifically sound conservation (including regulation) of an ecologically healthy and genetically diverse meta-population of Cape mountain zebra*

The **vision** is:

*An increasing, genetically healthy meta-population, supporting sustainable off-takes, with an increased conservation value and private sector investment in Cape mountain zebra.*

The desired state is underpinned by the following **goals**.

1. Conservation of the Cape mountain zebra meta-population.
2. Advancement of knowledge and understanding regarding the genetic diversity of the Cape mountain zebra meta-population.
3. Eliminate risk for genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their natural distribution range.
4. Mitigate and manage the impact of current and emerging diseases.
5. Long-term monitoring of Cape mountain zebra meta-population dynamics and habitat.
6. Aligned legislation and mandates.
7. Effective communication, collaboration and coordination among stakeholders.

The prioritised **strategic objectives** of the Cape mountain zebra BMP-S are as follows:

1. to maintain genetic diversity in the Cape mountain zebra meta-population,
2. to implement monitoring and research to inform adaptive management,
3. to consistently and uniformly implement legislation, regulations, policies and guidelines, and
4. to ensure effective communication, collaboration and coordination between stakeholders and the public for Cape mountain zebra conservation.

The implementation of this BMP-S will have the following **benefits**.

1. The Cape mountain zebra population remains stable and increasing.
2. Scientifically-sound meta-population management is implemented, and through this, the full extent of the genetic diversity is represented throughout the population.
3. The population is ecologically healthy and secure (including being regulated effectively and efficiently).
4. Implementation and maintenance of sustainable off-takes to support the NDF.
5. Private sector support and investment in Cape mountain zebra conservation.

The Biodiversity Management Plan for the Cape mountain zebra is aimed at **identifying, allocating** and **undertaking** the required, identified actions to enable stakeholders to contribute to the overall desired outcome of ensuring the long term survival of the subspecies in nature and thereby ensuring



the sustainable, non-detrimental harvest and off-take as an economic incentive for private land owners participating in the meta-population strategy.

The BMP-S therefore focusses on actions and strategies to strengthen the overall population performance, distribution and genetic diversity to ensure overall population fitness and resilience of the meta-population within the natural distribution range (and including protected areas with populations outside the natural distribution range).

## ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all those who contributed to the development and compilation of this biodiversity management plan:

- The South African National Parks (SANParks), the Department of Environmental Affairs and the South African National Biodiversity Institute for hosting the first Stakeholder workshop at Tokai in November 2013.
- Participants in the Stakeholder Workshop held at Tokai, November 2013 (list attached as Appendix A).
- CapeNature Staff and Technical Working Group for contributions to the first draft (list attached as Appendix B).
- SANParks Scientific Services and Veterinary Wildlife Group for contributions to the first draft (list attached as Appendix B).
- Annelise le Roux for proof reading the first draft.
- Dr Peter Novellie for conducting the expert review and writing the foreword.
- Dr Lauren Waller for facilitating the Cape mountain zebra Biodiversity Management Plan: Actions and Relevant Agreements Workshop held at Driftsands Nature Reserve, May 2016.
- Guy Palmer for contributions and edits to the final draft.
- Humbu Mafumo (Department of Environmental Affairs) for contributions and edits to the final draft.
- Jeanetta Selier (South African National Biodiversity Institute) for contributions and edits to the final draft.
- Cobus Theron (Endangered Wildlife Trust) for contributions to the final draft.
- Participants in the Actions and Relevant Agreements Workshop held at Driftsands Nature Reserve, May 2016 (attendance list attached as Appendix E).
- Christine Kraft, Elsabe Swart and Marnus Smit (Northern Cape Department of Environment and Nature Conservation) for contributions and edits to the final draft.

## ABBREVIATIONS AND ACRONYMS

AHS	African Horse Sickness
BES	Biodiversity Economy Strategy
BMP-S	Biodiversity Management Plan for Species
BPV	Bovine papillomavirus
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species in Wild Fauna and Flora
CN	CapeNature
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEA: BC	Department of Environmental Affairs – Biodiversity and Conservation Branch
ECPTA	Eastern Cape Parks and Tourism Agency
EWT	Endangered Wildlife Trust
DNA	Deoxyribonucleic acid, the molecule that carries most of the genetic instructions used in the development, functioning and reproduction of all known living organisms
EC DEDEAT	Eastern Cape Department of Economic Development, Environmental Affairs and Tourism
FPA's	Fire Protection Associations
FS DESTEA	Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs
HEI	Higher Education Institutions
HMZ	Hartmann's mountain zebra
IUCN	International Union for Conservation of Nature
MOU	Memorandum of Understanding
MSE	Management Strategy Evaluation
MZWG	Mountain Zebra Working Group
NC DENC	Northern Cape Department of Environment and Nature Conservation
NDF	Non-detriment Finding
NDR	Natural distribution range
NEM: BA	National Environmental Management: Biodiversity Act 10 of 2004
NEM: PAA	National Environmental Management: Protected Areas Act 57 of 2003
NEMA	National Environmental Management Act 107 of 1998
NP	National Park
NR	Nature Reserve
NRF	National Research Foundation
NZG	National Zoological Gardens of South Africa
PHASA	Professional Hunters Association of South Africa
PMG	Parliamentary Monitoring Group
PZ	Plains zebra
SAHGCA	South African Hunters and Game Conservation Association
SANBI	South Africa National Biodiversity Institute
SANParks	South African National Parks
SCC	Species Survival Commission
TMF	Table Mountain Fund
ToPS	Threatened or Protected Species Regulations
ToR	Terms of Reference

---

WCNCB	Western Cape Nature Conservation Board
WC GDDB	Western Cape Game Distribution Database
WC DEA & DP	Western Cape Department of Environmental Affairs and Development Planning
WCP	Western Cape Province
WCPAES	Western Cape Protected Area Expansion Strategy
WG1	Working Group on Biodiversity and Conservation
WRSA	Wildlife Ranching South Africa
WWF	World Wildlife Fund
WWF-SA	World Wide Fund for Nature – South Africa

---

## GLOSSARY OF DEFINITIONS, SCIENTIFIC AND TECHNICAL TERMS

In this BMP-S, unless the context indicates otherwise, a word or expression defined in the National Environmental Management: Biodiversity Act (NEM: BA, Act 10 of 2004) or Protected Areas Act (NEM: PAA, Act 57 of 2004) has the same meaning.

Genetic diversity	Genetic diversity is the total number of genetic characteristics in the genetic makeup of a species. It is distinguished from genetic variability, which describes the tendency of genetic characteristics to vary. Genetic diversity is required for populations to adapt to environmental change. It is measured using an array of molecular and quantitative methods. Large populations of naturally outbreeding species usually have extensive genetic diversity, but it is usually reduced in populations and species of conservation concern (Frankham <i>et al.</i> 2006).
Monitoring	The collection and analysis of repeated observations or measurements to evaluate change in status, distribution or integrity in order to track the impacts of directed management implemented to achieve a stated management objective.
Protected areas	<ul style="list-style-type: none"> <li>Any area declared or proclaimed as such in terms of Section 3 or listed in the Second Schedule to the Western Cape Nature Conservation Management Act, 1997 (Act No. 9 of 1997); or</li> <li>Any of the protected areas referred to in Section 9 of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003).</li> </ul>



## TABLE OF CONTENTS

FOREWORD – Dr Peter Novellie .....	3
EXECUTIVE SUMMARY	5
ACKNOWLEDGEMENTS	8
ABBREVIATIONS AND ACRONYMS .....	9
GLOSSARY OF DEFINITIONS, SCIENTIFIC AND TECHNICAL TERMS .....	11
TABLE OF CONTENTS	12
LIST OF TABLES	14
LIST OF FIGURES	14
<b>1) INTRODUCTION</b>	<b>15</b>
1.1 The need for a BMP-S for Cape mountain zebra .....	15
1.2 Vision and desired state .....	16
1.3 Objectives of the BMP-S .....	17
1.4 Benefits of the BMP-S.....	17
1.5 Anticipated outcomes of the BMP-S.....	17
<b>2) SPECIES BIOLOGY AND BACKGROUND INFORMATION</b> .....	<b>18</b>
2.1 Species ecology and biology .....	18
2.1.1 Taxonomic description.....	18
2.1.2 Distribution of Cape mountain zebra .....	18
2.1.3 Status of Cape mountain zebra sub-populations.....	20
2.1.4 Genetic status of Cape mountain zebra sub-populations .....	23
2.1.5 Life history and reproduction .....	25
2.1.6 Habitat requirements and resource assessment .....	26
2.1.7 Known diseases	29
2.2 Population statistics and trends.....	29
2.3 Research	30
2.4 Utilisation and socio-economic context .....	31
2.5 Conservation measures .....	32
2.5.1 The Mountain Zebra Working Group (MZWG) .....	33
2.5.2 Metapopulation management.....	35
2.5.3 Non-detriment finding (NDF).....	36
2.5.4 Population viability analysis.....	37
2.6 Conservation status and legislative context .....	38
2.6.1 International obligations .....	39
2.6.2 National legislation .....	40
2.6.3 Other relevant South African legislation .....	40
<b>3) PLANNING FRAMEWORK</b> .....	<b>42</b>
3.1 The planning context .....	42
3.2 Key role players	42
3.3 Stakeholder engagement.....	43
3.4 Relevant agreements .....	44
3.5 Identification of lead and implementing agencies.....	44
3.6 Expert verification for quality of content and context.....	44
<b>4) BIODIVERSITY MANAGEMENT PLAN</b> .....	<b>46</b>
4.1 Lead and implementing agencies .....	46
4.2 Identified threats and challenges .....	46

4.2.1	THREAT: Population Fragmentation .....	46
4.2.2	THREAT: Inbreeding .....	46
4.2.3	THREAT: Hybridisation .....	46
4.2.4	THREAT: Habitat alteration and fragmentation .....	47
4.2.5	THREAT: Insecure habitat .....	47
4.2.6	CHALLENGE: To implement effective metapopulation management .....	47
4.2.7	CHALLENGE: To provide incentives for private land owners to maintain viable sub-populations of Cape mountain zebra.....	47
4.2.8	CHALLENGE: To consistently and uniformly implement legislation, policies and IUCN guidelines .....	48
4.2.9	CHALLENGE: To communicate and collaborate effectively among stakeholders.....	48
4.2.10	CHALLENGE: To overcome management and capacity constraints.....	48
4.2.11	CHALLENGE: To create awareness.....	48
4.2.12	CHALLENGE: To integrate conservation planning.....	48
5)	<b>ACTION PLAN AND MONITORING FRAMEWORK.....</b>	<b>49</b>
6)	<b>CAPE MOUNTAIN ZEBRA BMP-S REPORTING FRAMEWORK .....</b>	<b>62</b>
7)	<b>REFERENCES</b>	<b>67</b>
	<b>APPENDIX A: CAPE MOUNTAIN ZEBRA BMP-S WORKSHOP PARTICIPANTS AND WORKSHOP INVITATION .....</b>	<b>73</b>
	<b>APPENDIX B: CONTRIBUTORS TO COMPILING FIRST DRAFT .....</b>	<b>75</b>
	<b>APPENDIX C: TEMPLATE FOR SUGGESTED EDITS / ADDITIONS / CHANGES .....</b>	<b>76</b>
	<b>APPENDIX D: ATTENDANCE REGISTER AND INVITEE LIST FOR THE ACTIONS AND RELEVANT AGREEMENTS WORKSHOP FOR HTE IMPLEMENTATION OF THE CAPE MOUNTAIN ZEBRA BMP-S.....</b>	<b>78</b>
	<b>APPENDIX E: VENN DIAGRAMS ON STAKEHOLDER RELATIONSHIPS TOWARDS ACHIEVING THE OBJECTIVES OF THE BMP-S: ACTIONS AND RELEVANT AGREEMENTS WORKSHOP FOR THE IMPLEMENTATION OF THE CAPE MOUNTAIN ZEBRA BMP-S .....</b>	<b>80</b>
	<b>APPENDIX F: NOTES</b>	<b>82</b>

## LIST OF TABLES

- Table 1:** Cape mountain zebra sub-population sizes, distribution, sub-population source/s and management authority in 2015.
- Table 2:** Summary of Cape mountain zebra distribution by Province: percentage contribution to metapopulation and NDR.
- Table 3:** Cape mountain zebra sub-populations threatened by hybridisation with other equids.
- Table 4:** Cape mountain zebra population trends by management authority.
- Table 5:** Organisations that are involved in developing and implementing various aspects of the Cape mountain zebra BMP-S.

## LIST OF FIGURES

- Figure 1.** Cape mountain zebra natural distribution range.
- Figure 2.** Occupied and Potential Cape mountain zebra habitats – Initial Assessment of Protected Areas in the WCP only.
- Figure 3:** IUCN Species Survival Commission (SSC) schematic for species conservation planning.
- Figure 4:** Action Plan and Monitoring Framework derived from IUCN Species Survival Commission schematic for species conservation planning methodology applied for this BMP-S.

## 1) INTRODUCTION

The Cape mountain zebra (*Equus zebra zebra*) is endemic to South Africa. It is a subspecies of Mountain zebra (*Equus zebra*) which historically occurred in the mountains of the Great Escarpment from the south west of Angola, through Namibia, the Northern Cape of South Africa, and the Cape Fold mountains in the Western and Eastern Cape Provinces. Gradual separation over time resulted in two distinct subspecies, namely the Hartmann's mountain zebra (*Equus zebra hartmannae*) to the north and Cape mountain zebra to the south.

Cape mountain zebra numbers declined drastically to less than 60 individuals at the beginning of the twentieth century. These animals were isolated in three locations: Cradock, Kammanassie and Gamkaberg. Conservation action has resulted in steady increases in the overall population numbers and distribution, however the residual effects of the genetic bottleneck currently threatens the long term survival of the species throughout its natural distribution range (NDR).

Cape mountain zebra now occur in a number of genetically depauperate and isolated populations and are threatened by small sub-population sizes, habitat fragmentation and by hybridisation with other equids.

Collaborative and integrated management among stakeholders, as well as public support, is required for effective management of the sub-populations to ensure the maintenance of genetic diversity and sustainable utilisation by the private sector.

### 1.1 The need for a BMP-S for Cape mountain zebra

Cape mountain zebra have a limited NDR confined to the extreme south-south west of the country. They are a near endemic to the Cape Floristic Region (Boshoff *et al.* 2015; Hrabar and Kerley 2015; Birss *et al.* 2015; Hrabar and Kerley 2013), an internationally recognised global Biodiversity Hotspot (Myers *et al.* 2002).

At the end of 2015, the Cape mountain zebra metapopulation comprised approximately 4,872 individuals in 76 sub-populations throughout South Africa. Apart from the three relict sub-populations occurring on protected areas (Kammanassie Nature Reserve (NR), Gamkaberg NR and Mountain Zebra National Park), Cape mountain zebra have been reintroduced to another 9 protected areas within their NDR and 7 protected areas outside the NDR. Approximately 70% of the population occurs in state owned protected areas (Hrabar and Kerley 2015).

Cape mountain zebra is listed as VULNERABLE (D1)<sup>1</sup> by the IUCN (Novellie 2008) and on Appendix I of the Convention on International Trade in Endangered Species (CITES), which regulates International trade, and requires a non-detriment finding (NDF) for export permits to be granted.

In 2011, a partnership between CapeNature, the Wilderness Foundation and the World Wildlife Fund (WWF): Table Mountain Fund (TMF), was initiated toward the drafting of a BMP-S for Cape mountain zebra. The initiative was primarily aimed at contextualising the efforts of the Mountain Zebra Working Group (MZWG) into the BMP-S, being considered the most appropriate legislative

<sup>1</sup> VULNERABLE D1: A taxon is VULNERABLE (VU) when the best available evidence indicates that it meets any of the criteria VU, and it is therefore considered to be facing a high risk of extinction in the wild. This criterion identifies very small or restricted populations. A taxon qualifies for criterion D if the population of mature individuals is smaller than the threshold set for each of the categories of threat. Under the VU category there are two options, D1 and D2. A taxon qualifies for VU D1 if the population size is estimated to number fewer than 1,000 mature individuals.

provision for realising the collective objectives and building on the successes of the MZWG, for Cape mountain zebra conservation, however, financial and logistical constraints impeded the initiative.

An inter-agency collaboration between the South African National Parks (SANParks), CapeNature and the Eastern Cape Parks and Tourism Agency (ECPTA) acknowledges the need for the Cape mountain zebra BMP-S, to ensure the long term survival of the species in nature, and to formalise the collaborative efforts of participatory parties of the MZWG.

During two consecutive stakeholder workshops (CITES NDF and initial BMP-S in 2013), threats identified included the loss of genetic diversity through inbreeding and genetic drift, diseases such as equine sarcoidosis, the risk of hybridisation, predation, poaching and emigration threats, and the absence of a metapopulation management strategy, thus the need for an integrated inter-agency cooperative, including broader stakeholder involvement, towards the objectives of a BMP-S was initiated.

The selection of the Cape mountain zebra for a BMP-S is based on the requirement of the NDF; its threatened status; the requirement for metapopulation management and inter-agency cooperation towards shared objectives for the conservation of the species; standardised monitoring; collaborative research; increased participation by landowners, and opportunities as a flagship for Protected Area expansion and stewardship initiatives.

## 1.2 Vision and desired state

The global Cape mountain zebra population is considered stable and increasing and has exceeded the previous target set in the 2002 IUCN Equid Specialist Group Status Action Plan for the Mountain Zebra (Novellie *et al.* 2002). However, the long term survival of the species is considered to be dependent on the implementation of a sound metapopulation management strategy and integrated action plans in order to mitigate the threats of inbreeding, hybridisation, loss of genetic variation, disease resilience and fragmentation.

During the Cape mountain zebra BMP-S stakeholder consultation workshop held in November 2013, the following desired state for the Cape mountain zebra was developed:

### **The scientifically sound conservation (including regulation) of an ecologically healthy and genetically diverse metapopulation of Cape mountain zebra.**

The vision is an increasing, genetically healthy metapopulation, supporting sustainable off-takes, with an increased conservation value and private sector investment in Cape mountain zebra.

The desired state is underpinned by specific goals which guided the development of the BMP-S. These are:

1. Conservation of the Cape mountain zebra meta-population.
2. Advancement of knowledge and understanding regarding the genetic diversity of the Cape mountain zebra metapopulation.
3. Eliminate genetic contamination due to hybridisation with other equine species and safeguard Cape mountain zebra in their NDR.
4. Mitigate and manage the impact of current and emerging diseases.
5. Long-term monitoring of Cape mountain zebra meta-population dynamics and habitat.



6. Aligned legislation and mandates.
7. Effective communication, collaboration and coordination among stakeholders.

### 1.3 Objectives of the BMP-S

The prioritised strategic objectives of the Cape mountain zebra BMP-S are as follows.

1. To maintain genetic diversity in the Cape mountain zebra metapopulation.
2. To implement monitoring and research to inform adaptive management.
3. To consistently and uniformly implement legislation, regulations, policies and guidelines.
4. To ensure effective communication, collaboration and coordination between stakeholders and the public for Cape mountain zebra conservation.

### 1.4 Benefits of the BMP-S

The envisaged benefits of implementing this BMP-S are:

- The Cape mountain zebra population remains stable and increasing.
- Scientifically-sound metapopulation management is implemented, and through this, the full extent of the genetic diversity is represented throughout the population.
- The population is ecologically healthy and secure (including being regulated effectively and efficiently).
- Implementation and maintenance of sustainable off-takes to support the NDF.
- Private sector support and investment in Cape mountain zebra conservation.

### 1.5 Anticipated outcomes of the BMP-S

The Biodiversity Management Plan for the Cape mountain zebra is aimed at identifying, allocating and undertaking the required, identified actions to enable stakeholders to contribute to the overall desired outcome of ensuring the long term survival of the subspecies in the wild and thereby ensuring the sustainable, non-detrimental harvest and off-take as an economic incentive for private land owners participating in the metapopulation strategy. The BMP-S therefore focusses on actions and strategies to strengthen the overall population performance, distribution and genetic diversity to ensure overall population fitness and resilience of the metapopulation within the NDR (and including protected areas populations outside the NDR).

The BMP-S further highlights the research and monitoring activities which will provide:

1. A snapshot of current genetic structure within and among the sub-populations.
2. Determine the phylogenetic relationships to ensure maximum biodiversity for future evolutionary change.
3. Ensure an increasing metapopulation to prevent loss of genetic variation.
4. Sub-population source, structure, distribution, size and management data to inform adaptive implementation and management of translocations and harvesting quotas at site and national level.

## 2) SPECIES BIOLOGY AND BACKGROUND INFORMATION

### 2.1 Species ecology and biology

#### 2.1.1 Taxonomic description

**Taxon name:** *Equus zebra zebra* Linnaeus, 1758 (Novellie 2008).

**Common names:** Cape mountain zebra (English), Kaapse bergsebra / bergkwagga (Afrikaans), idauwa (isiXhosa), Dou (San), Daou (Khoikhoi) (Skinner and Chimimba 2005).

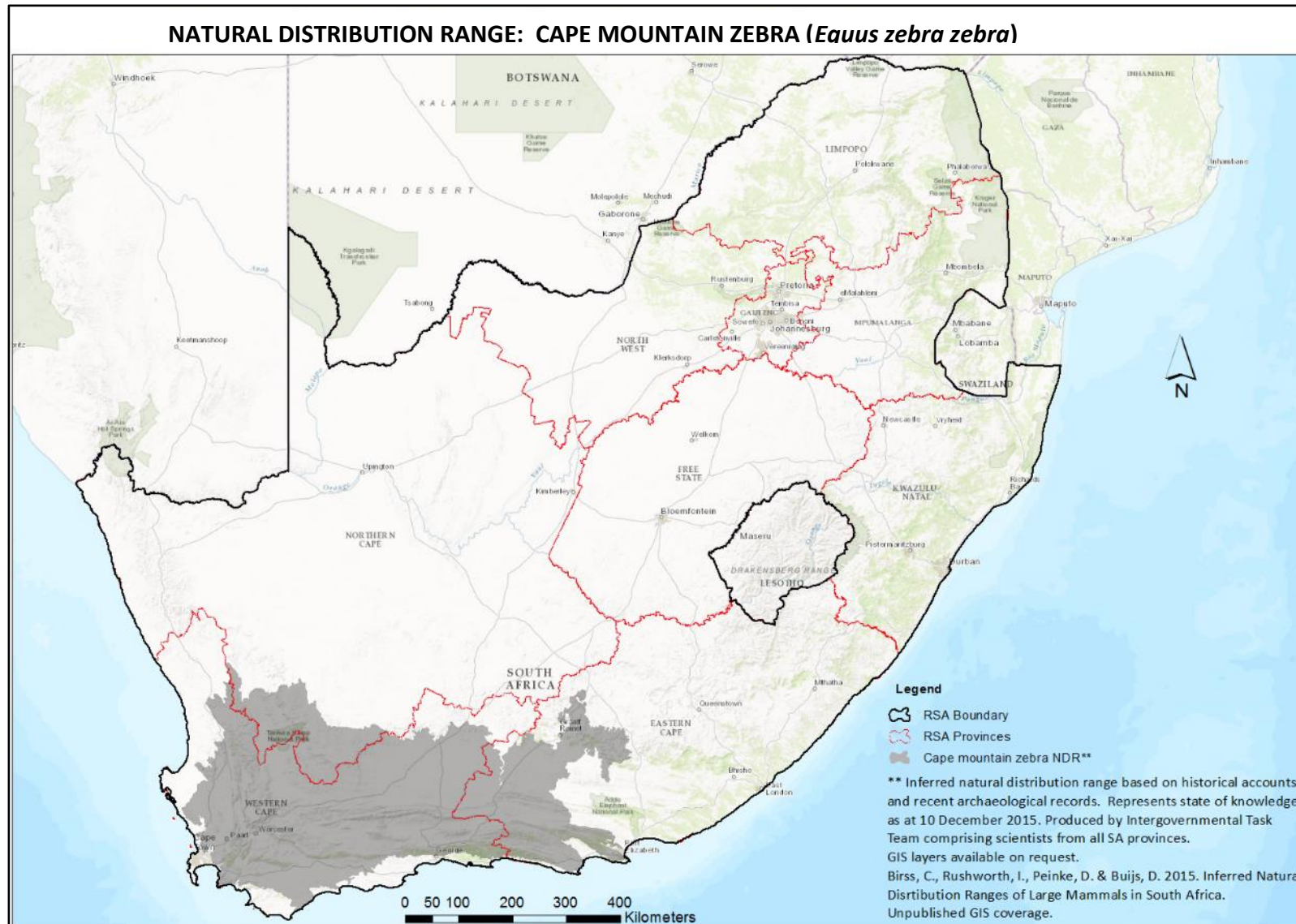
**Taxonomic level:** Subspecies

Groves and Bell (2004) investigated the taxonomy of the mountain zebras and concluded that the Cape mountain zebra and Hartmann's mountain zebra are distinct, and suggested that the two would be better classified as separate species, *Equus zebra* and *Equus hartmannae*. However, Moodley and Harley (2005) concluded that the two taxa could not be described as different species but, on the basis of their nuclear genetic distinctiveness, indicated that it is appropriate to regard them as different subspecies. That is the approach adopted for this BMP-S.

Mountain zebra are medium-sized, striped equids and differ from plains zebras (*Equus quagga*) in that the dark stripes on the head and body are narrower and more numerous and are without shadow stripes on the hindquarters. Mountain zebra has white underparts with a narrow black centre line extending over the chest and belly, a black tipped muzzle, a distinct dewlap and the markings over the sacral area form a gridiron pattern. The dewlap is more conspicuous in the Cape mountain zebra. Adult Cape mountain zebras have a shoulder height ranging from 116 to 128 cm and weigh between 204 and 372 kg (Penzhorn 1988).

#### 2.1.2 Distribution of Cape mountain zebra

Mountain zebra historically occurred in the mountainous habitats associated with the availability of fresh water on the Great Escarpment from the extreme south west of Angola, through Namibia, the Northern Cape of South Africa, and the Cape Fold belt in the Western and Eastern Cape Provinces (Novellie *et al.* 2002). A large plain of unsuitable or marginal habitat known as the Knersvlakte, (an area between the northernmost extent of the Cederberg and Bokkeveld mountain ranges, and the southernmost extent of the Kamiesberg mountain range), is postulated by Novellie *et al.* (2002) to have inhibited gene flow between those mountain zebra occurring to the north and those occurring further south. However, Boshoff *et al.* (in Skead 2011) suggests that the population segregation may have occurred further north. Irrespective of where the separation occurred, it over time resulted into two distinct subspecies, namely the Hartmann's mountain zebra to the north and Cape mountain zebra to the south (Refer to Figure 1).



**Figure 1.** Cape mountain zebra natural distribution range.

Cape mountain zebra inhabit rugged, broken mountainous and escarpment areas up to 2,000 m above sea level with a diversity of grass species and perennial water (Moodley and Harley 2005, Penzhorn in press). They are predominantly grazers, only browsing during unfavourable conditions i.e. during drought. 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 (Skead 2011, Boshoff *et al.* 2015, Birss *et al.* 2015).

Hunting and habitat loss had reduced Cape mountain zebra numbers to only 58 individuals in a few relict populations by the beginning of the 20th century (Novellie *et al.* 2002, Moodley and Harley 2005, Hrabar and Kerley 2015). By 1998 the total Cape mountain zebra population had grown to approximately 1,200 animals with the largest population estimated at 250 animals, at Karoo National Park (NP) where they had been reintroduced from the relict Cradock population (Lloyd 2002; Novellie *et al.* 2002).

### **2.1.3 Status of Cape mountain zebra sub-populations**

Today, Cape mountain zebra occur in a number of protected areas within their NDR, these include the Baviaanskloof Nature Reserve (NR), Mountain Zebra NP, Karoo NP, Camdeboo NP, Tankwa Karoo NP, Bontebok NP, De Hoop NR, Hottentots-Holland NR, Anysberg NR, Kammanassie NR, Gamkaberg NR and Oorlogskloof NR. The total estimated population on protected areas within the NDR is close to 2,650 individuals. A further 690 individuals occur in sub-populations outside the NDR, these include Addo Elephant NP, Table Mountain NP, West Coast NP, Commando Drift NR, Tsolwana NR and Gariep NR. Combined, there are a total of approximately 3,391 animals in 19 sub-populations, 3 have 14 or less individuals. Refer to Table 1 for Cape mountain zebra sub-population sizes, distribution, sub-population source/s and relevant management authority in 2015.

The Cape mountain zebra populations on private land were estimated at 1,481 individuals in 2015, comprising approximately 30% of the total population (Hrabar and Kerley 2015). All are assumed to have been derived from the relict Cradock sub-population and are similarly expected to be exposed to limited gene flow. The number of Cape mountain zebra sub-populations on private land has increased notably from 38 in 2009 to 59 in 2015 and contribute significantly to an increased distribution and abundance of Cape mountain zebra. The average sub-population size increased from 25 to 29, and range from 5 to 120 individuals in a sub-population (Hrabar and Kerley 2015).

The Cape mountain zebra population has maintained an overall average growth rate of between 8.6% and 9.6% since 1985 and animals have been successfully reintroduced into various protected areas and onto private land across its former range (Novellie *et al.* 2002; Hrabar & Kerley 2015). Cape mountain zebra has also been introduced into protected areas and private land outside its former range, in the Eastern Cape, Western Cape, Northern Cape and the Free State Provinces.

SANParks has nine National Parks on which Cape mountain zebra occur. Three of these parks are outside of the NDR (West Coast, Table Mountain and Addo Elephant National Parks). Table Mountain and Bontebok National Parks have small populations and due to the size of the parks will not support population growth but can form a key role in the maintenance of genetic diversity. West Coast, Addo and the remaining National Parks (Tankwa Karoo, Mountain Zebra, Karoo and Camdeboo National Parks) are of sufficient size for population growth. All of the National Parks have

---

habitat in suitable condition for maintenance of Cape mountain zebra populations, given that SANParks allows for natural flux in systems and populations across space and time.

CapeNature has five Nature Reserves with Cape mountain zebra at present. Four of these reserves are suitable for the maintenance and growth of Cape mountain zebra sub-populations (Anysberg NR, Gamkaberg NR, Kammanassie NR and De Hoop NR), whilst the other Cape mountain zebra sub-population (Hottentots-Holland NR) has performed poorly and is not expected to improve.

Eastern Cape Parks and Tourism Agency manages 3 populations of Cape mountain zebra. Commando Drift and Tsolwana Nature Reserves, which are outside of the NDR both have good habitat and have healthy and productive populations from which animals are regularly harvested for the purposes of live sale. The Baviaanskloof NR population, which is located within the natural range, has by comparison performed very poorly, and is believed to have suboptimal habitat.

The Northern Cape Province has one Provincial nature reserve with Cape mountain zebra present (Oorlogskloof NR). The habitat is marginal for Cape mountain zebra and is one of the main factors attributed to the slow population growth rate of Cape mountain zebra on the reserve. One reserve (Doornkloof NR) has also been identified as having suitable habitat for Cape mountain zebra but falls outside the NDR of the species.

Even though the Free State sub-population is outside the NDR, the habitat of Gariep NR has proven to be suitable for the maintenance of a Cape mountain zebra sub-population. The same habitat extends to Tussen die Riviere NR (Free State Province) and Oviston NR (Eastern Cape Province) and the opportunity exists to extend the Cape mountain zebra sub-population to occupy an area that would comprise approximately 45 000 ha.



**Table 1:** Cape mountain zebra sub-population sizes, distribution, sub-population source/s and management authority in 2015.

Property Name	Property Type	Management Authority / Conservation Agency	In Natural Distribution Range	Population Estimate	Source Population
Anysberg NR	Protected Area	CapeNature	Yes	21	Karoo NP
De Hoop NR Complex (Includes Overberg Test Range)	Protected Area	CapeNature	Yes	115	Cradock and Kammanassie NR
Gamkaberg NR	Protected Area	CapeNature	Yes	42	Gamkaberg NR
Hottentots-Holland NR	Protected Area	CapeNature	Yes	5	De Hoop NR
Kammanassie NR	Protected Area	CapeNature	Yes	70	Kammanassie NR
Oorlogskloof NR	Protected Area	Northern Cape DENC	Yes	18	Gariiep NR, Bontebok NP
Tsolwana NR	Protected Area	ECPTA	No	162	Cradock
Commando Drift NR	Protected Area	ECPTA	No	156	Unknown
Baviaanskloof NR	Protected Area	ECPTA / CapeNature	Yes	51	Unknown
Gariiep NR	Protected Area	Free State DESTEA	No	103	Cradock, Karoo NP
Karoo NP	Protected Area	SANParks	Yes	842	Cradock
Tankwa Karoo NP	Protected Area	SANParks	Yes	41	Cradock, Karoo NP
Mountain Zebra NP	Protected Area	SANParks	Yes	1,191	Cradock
West Coast NP	Protected Area	SANParks	No	42	Cradock, Karoo NP
Bontebok NP	Protected Area	SANParks	Yes	14	Cradock
Addo Elephant NP	Protected Area	SANParks	No	120	Cradock, Karoo NP
Camdeboo NP	Protected Area	SANParks	Yes	236	Cradock, Karoo NP
Table Mountain NP	Protected Area	SANParks	No	4	Cradock, Karoo NP

Property Name	Property Type	Management Authority / Conservation Agency	In Natural Distribution Range	Population Estimate	Source Population
Addo Elephant NP (and Contractual)	Protected Area	SANParks	No	103	Cradock, Karoo NP
Private	Private	Private	Yes	750	Cradock
Private	Private	CapeNature	Yes	45	De Hoop NR
Private	Private	NC DENC / CapeNature	Yes	10	Oorlogskloof NR
Private	Private	Private	No	786	Cradock
Private	Private	Private	Unknown	Unknown	Northern Cape
<b>TOTAL</b>				<b>4,872</b>	

# Data courtesy of Dr H Hrabar and CapeNature WC GDDB

**Table 2:** Summary of Cape mountain zebra distribution by Province: percentage contribution to metapopulation and NDR.

Province	% Contribution to Cape mountain metapopulation	% Contribution to Cape mountain zebra NDR
Western Cape Province	37%	64%
Eastern Cape Province	59%	23.5%
Northern Cape Province	2%	12.5%
Free State Province	2%	0%

#### 2.1.4 Genetic status of Cape mountain zebra sub-populations

Past research mostly focused on investigating the genetic factors influencing the persistence of the Cape mountain zebra. Moodley and Harley (2005) found low genetic variability within individual Cape mountain zebra sub-populations, but that there is moderate variability within the metapopulation. They assessed the genetic status of the three relict Cape mountain zebra sub-populations, including the Cradock, Gamkaberg and Kammanassie populations. They found that the small populations are grossly inbred, with low numbers of alleles/locus and resultant low heterozygosity. As a consequence of inbreeding, genetic drift and marked reduction of genetic variation, all three relict Cape mountain zebra stocks were significantly differentiated from each other. The entire metapopulation has still maintained much of its historical variation, albeit in three separate and highly inbred stocks. It was recommended that a management strategy that supports the mixing of relict Cape mountain zebra populations be drafted in order to halt the further loss of Cape mountain zebra genetic diversity (Moodley and Harley 2005; Hrabar and Kerley 2015).

Moodley and Harley (2006) indicated that the population size of the relict sub-populations of Kammanassie and Gamkaberg Nature Reserves had not yet recovered, with estimates of 38 and 28 respectively (1999 to 2000 data), and that fundamental genetic information was required to inform conservation management strategies. They postulated that, in enduring severe and sustained population bottlenecks, further major losses in genetic variation are expected to occur in Cape mountain zebra populations as well as the appearance of more divergent sub-populations, due to

inbreeding and genetic drift. The Cradock population, has the highest number of founder animals shows recovery from a demographic bottleneck but low genetic variation due to inbreeding was observed. This is in contrast to the Hartmann's mountain zebra. Evidence from the De Hoop population where two relict populations (Cradock and Kammanassie), both with low genetic variation, were mixed shows genetic variation comparable to that of natural free-ranging populations (where genetic bottlenecks are not indicated).

The number of individuals for the sub-populations were estimated at 70 for Kammanassie and 42 for Gamkaberg, in 2015, with a growth rate that decreased substantially, averaging at 0 to 2% over the last 10 years. This emphasises the importance of accurate population census (Birss 2016 pers comm.). Both these populations are critically important to maintain genetic diversity in Cape mountain zebra as the loss of one of these will reduce the genetic variability substantially.

The effective management of genetic diversity can be complex as the mixing of genetic material within and between populations might be necessary to avoid future loss of allelic variation. In addition, inbreeding and genetic drift may compromise genetic fitness and may lead to the extinction of some sub-populations or the sub-species. The recommendation to ensure that conservation efforts are directed at safeguarding smaller populations against isolation and limited gene flow are critical to maintain viable populations (Moodley and Harley 2005, Hill 2009).

Data collected for 58 of the 75 Cape mountain zebra sub-populations by Hrabar and Kerley (2015) identified 13 (7 protected areas and 6 private land) sub-populations as having a reduced threat of inbreeding due to founder populations being equal to or more than 14 individuals and not being exposed to hybridisation with plains zebra, and also indicates that 12 of these sub-populations co-occur with plains zebra, 3 of which are protected area populations. The Cradock population, which has the highest number of founder animals, shows recovery from a demographic bottleneck, but low genetic variation due to inbreeding was observed. It is therefore critical that sub-populations do not become isolated and that gene flow between populations is maintained or simulated to prevent further deleterious genetic consequences, including genetic drift (Moodley and Harley 2005, Hill 2009).

Hybrids of Cape mountain zebra with plains zebra have been confirmed for one protected area and recommendations for the conservation management of Cape mountain zebra include the assessment of habitat condition and management, population size, prevalence of skewed sex ratios and to develop risk averse strategies to minimise risk of future translocations and the probability of producing hybrids. Evidence that the difference in chromosomal numbers may not be a barrier to the exchange of genes between equid species warrants further research and reproductive assessments of Cape mountain and plains zebra hybrids (Dalton *et al.*, in press).

**Table 3.** Cape mountain zebra sub-populations threatened by hybridisation with other equids (Hartmann's mountain zebra-HMZ; horses, donkeys and plains zebra-PZ.) (CapeNature 2016; Hrabar and Kerley 2015; FS DESTEA; NC DENC; ECP DEDEAT).

Property Name	Cape mountain zebra sub-population with presence of other equids	Cape mountain zebra sub-population bordering other equids
Anysberg NR	No	Yes (Horses)
De Hoop NR Complex (Includes Overberg Test Range)	No	Yes (Horses, donkeys)
Gamkaberg NR	No	No
Hottentots-Holland NR	No	No
Kammanassie NR	No	Yes (PZ)
Oorlogskloof NR	No	No
Tsolwana NR	No	Yes (HMZ)
Commando Drift NR	No	No
Baviaanskloof NR	No	No
Gariep NR	No	No
Karoo NP	Yes (PZ)	Yes (PZ)
Tankwa Karoo NP	No	Yes (PZ)
Mountain Zebra NP	Yes (PZ)	Yes
West Coast NP	No	Yes (PZ)
Bontebok NP	No	No
Addo Elephant NP	No	Unknown
Camdeboo NP	No	No
Table Mountain NP	No	No
Addo Elephant NP (Contractual)	No	No
Private (number of sub-populations known)	10	20
<b>TOTAL COUNT</b>	<b>12</b>	<b>25</b>

# Data courtesy of Dr H Hrabar and CapeNature WC GDDb

Hybridisation between Cape and Hartmann's mountain zebra (Gray 1971), due to injudicious translocations results in fertile offspring. Genetic test results for a translocation consignment between private properties confirmed hybridisations between Cape and Hartmann's mountain zebra as well in both mountain zebra sub-species and plains zebra (*Equus quagga burchelli*), (Birss, personal communication 2015).

Historically, the ranges of Cape mountain zebra would have overlapped with the now extinct sub-species of plains zebra (*Equus quagga quagga*) but habitat preferences would have caused them to rarely occur in sympatry. Introductions of the extant subspecies of plains zebra in sympatry with Cape mountain zebra onto protected areas and private land were not discouraged. It was assumed that if hybridisation does occur, offspring would be infertile due to different chromosome numbers (Dalton *et al.* 2016 in press).

### 2.1.5 Life history and reproduction

Lloyd and Rasa (1989) attempted to determine the effects of status of the reproductive success and fitness of both males and females, and relate these findings to the sex ratios of offspring for dominant and subordinate mares, and to determine the subsequent fate of these offspring. The social structure of Cape mountain zebra was shown to be complex with very specific spatial structures. This is generally characterised by small breeding units that remain stable, both numerically and hierarchically over extended periods of time. The typical social structure is one of small harems comprising an adult stallion and one to three (maximum five) mares and their dependent foals; non-breeding groups consist primarily of bachelors, but sometimes include young fillies (Penzhorn 1984; Rasa and Lloyd 1994; Penzhorn 2016 in press). The majority of harem-forming species have a social structure typified by short male tenure periods and dispersal of male offspring only into bachelor groups.

In equids, where male herd tenure can be long, both males and females disperse; males forming a bachelor group and females either joining other breeding units. Dispersing Cape mountain zebra colts and fillies both tend to join a non-breeding group (Rasa and Lloyd 1994). Cape Mountain zebra breeding units are characterised by long stallion herd tenure, averaging 7 years, but usually for life, and breeding mares typically remain in the same breeding units until their own death or the death or sup-plantation of the breeding stallion. Since father's herd tenure and daughter's oestrus, which occurs at a relatively early age, overlap, dispersal of daughters as well as sons is an effective means of circumventing inbreeding (Penzhorn 1984; Rasa and Lloyd 1994).

Cape mountain zebra has a low reproductive rate due to a long gestation period of approximately 12 months, after which a single foal is produced with foaling peaking in the rainy season, however, foaling can occur year round. Life expectancy is over 20 years and breeding herds remain stable for many years, averaging 1 male to 2.4 unrelated females. Socially ranked mares produce their first offspring between 4 and 5 years of age with an average foaling interval of 25 months, however, dominant mares produce significantly more offspring and mares can continue to produce up to the age of 21. Stallions remain fertile for up to 19 years. Both male and female offspring leave the herd after approximately 22 months, or within four months after the birth of a sibling, and join non-breeding groups which are important for the forming of nucleus breeding pairs (Penzhorn 1982; Penzhorn 1985; Skinner and Smithers 1990; Penzhorn and Novellie 1991).

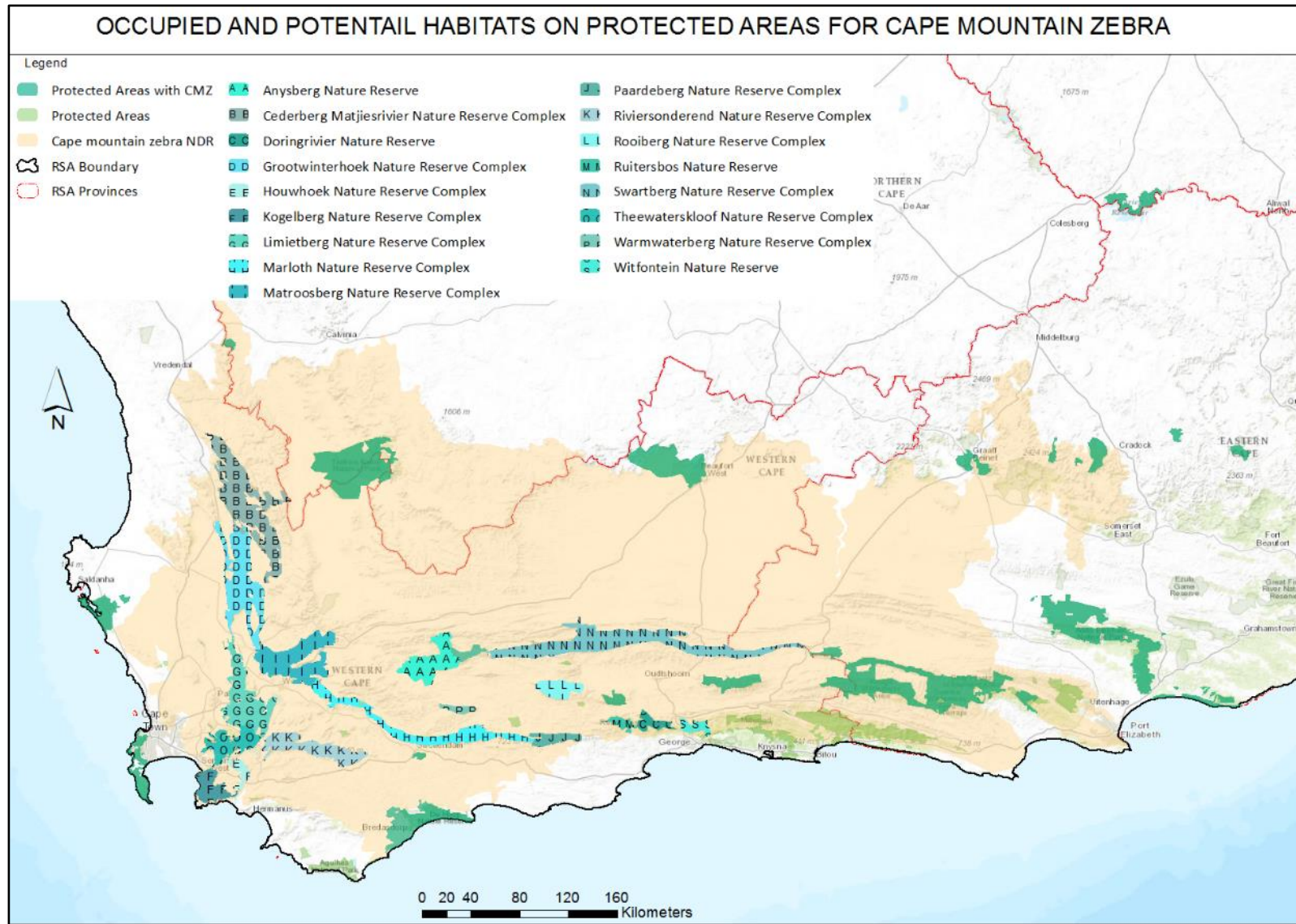
Foal mortality is related to behavioural factors, where dominant mares attack the foals of subordinate mares, possibly causing broken legs and fatalities (Lloyd and Rasa 1989; Skinner and Smithers 1990), potentially related to competition for resources (Hrabar 2015 pers. comm.).

Cape mountain zebras are not territorial and home ranges of breeding herds overlap with seasonal variation. Home range sizes for Mountain Zebra NP were estimated to range between 3.1 – 16.0 km<sup>2</sup>, averaging 9.4 km<sup>2</sup> (Penzhorn 1982; Skinner and Smithers 1990).

#### **2.1.6 Habitat requirements and resource assessment**

As mentioned previously, Cape mountain zebra naturally inhabit rugged, broken mountainous and escarpment areas and are dependent on the presence of grass and perennial water. Remaining, untransformed natural areas representing these habitats are largely confined to protected areas. Cape mountain zebra seasonally migrate, where possible, between habitat types and predominantly select areas with high grass cover and limited population growth may be the result of confinement to upland areas with restricted access to year-round grass-rich habitats and drinking water.





**Figure 2.** Occupied and Potential Cape mountain zebra habitats – Initial Assessment of Protected Areas in the WCP only.

Cape mountain zebra is regarded as a partial refugee species, as some populations have been confined to suboptimal areas of its historic range contributing to poor population performance (Lea *et al.* in press). Estimates of potential suitable biomass production in some reserves indicate that populations may have reached their optimum stocking potential. These reserves are inadequate in size or densely stocked with other game species and cannot accommodate higher densities of Cape mountain zebra (Birss and Schutte-Vlok 2015 pers comm.). Using inadequate assessments of habitat suitability may grossly over-estimate the conservation potential of existing protected areas where current populations are confined to marginal habitats. As habitats shift with land use and climate change, the current distribution of protected areas may be inappropriate to meet future conservation goals (Lea *et al.* in press). Additional protected areas within the NDR have suitable habitat, but it is essential to apply appropriate stocking models considerate of the forage production potential, climate, total game stocking, size of suitable habitat, accessibility to water and areas of high grass cover. It has also been suggested that environments transformed by agriculture may be suitable for Cape mountain zebra (Smith *et al.* 2011).

A large proportion of research conducted on Cape mountain zebra focus on habitat suitability for the species. Habitat suitability studies were conducted for Bontebok NP (Kraaij and Novellie 2010; Watson *et al.* 2011; Strauss 2015), De Hoop NR (Smith *et al.* 2007; Hurzuk 2009; Smith *et al.* 2011), Gamkaberg NR (Watson *et al.* 2005), Mountain Zebra NP (Winkler and Owen-Smith 1995) and Kammanassie NR (Watson and Chadwick 2007). All studies showed that Cape mountain zebra prefer habitat with a high grassy component, and that only small portions of these reserves have suitable habitat for the species (Hurzuk 2009; Strauss 2015). Winkler and Owen-Smith (1995) suggested that seasonal variations in vegetation communities utilised by zebra were not only influenced by changes in grass quality, but also by variations in grass quantity. It was also highlighted that habitat selection (including availability) must not be viewed in isolation since water, mineral licks, shelter, as well as social factors, are also known to influence habitat use in large herbivore species (Winkler and Owen-Smith 1995). Penzhorn and Novellie (1991) suggested that ideally conservation areas should be large with sufficient varied habitats to sustain populations throughout summer and winter. The existence of large populations of antelope could be detrimental to zebras due to interspecific competition (Hurzuk 2009). Strauss (2015) suggests that Cape mountain zebra have season-specific and site-specific feeding strategies to ensure adequate quantity and quality of forage throughout the year.

There appears to be considerable scope, >935,191 ha, for increasing the area and number of sub-populations of Cape mountain zebra (Hrabar and Kerley 2013). An assessment of the CapeNature protected areas consolidated with mountain catchment areas in the Western Cape indicates that potential habitat of <855,940 ha could be available for the reintroduction and reinforcement of a number of viable Cape mountain zebra populations, (populations >100 individuals), (Birss *et al.* 2016). However, a careful and systematic evaluation of potential sites for habitat suitability, area of suitable habitat, stocking potential, security and manageability will have to be carried out. Several Nature Reserves (some are clusters of several protected areas) have the potential to contribute significantly to new sub-populations of Cape mountain zebra including Bokkerviere NR, Cederberg NR, Matjiesrivier NR, Groot Winterhoek NR, Outeniqua NR, Rooiberg NR and Swartberg NR. Although these areas have suitable habitat, some will need additional and/or improved fencing to facilitate management of Cape mountain zebra and other species which may influence Cape mountain zebra population health.

In order to assess the priority potential sites for Cape mountain zebra in the Western Cape, CapeNature applied a two-step process to evaluate sites within its protected area network. The method starts with a desktop assessment and concludes with an on-site assessment of the habitat. This method may be used as a template for developing a more general prioritisation approach that could be applied to Cape mountain zebra across its NDR.

Marais *et al.* (2007) proposed that, since the entire Cape mountain zebra population originates from a very small genepool, a reduced innate immune system diversity exists which leads to the increased susceptibility of some smaller populations to equine sarcoids. Genetic diversity and levels of heterozygosity have been shown to be lower in populations of Cape mountain zebra that are affected by sarcoids (Sasidharan 2004; Nel *et al.* 2006). Equine sarcoid is a virus causing tumours in horses and donkeys and is associated with high levels of inbreeding. It is thought to manifest in animals due to complex interactions between the aetiological agent, the environment and the host genome. In horses, the bovine papillomavirus (BPV) types 1, 2 and 13 are involved in the pathogenesis of sarcoids (Alcântara *et al.* 2015). In a comparison of genetic parameters and sarcoid tumours in Cape mountain zebra affected populations showed low levels of heterozygosity, genetic diversity and polymorphisms. These populations were also highly inbred (Sasidharan 2004, Sasidharan *et al.* 2011).

The persistence of sarcoids in a population could potentially be linked to the social structures of herds where one stallion will breed with a harem for long periods of time (Sasidharan 2004). Tumour-affected Cape mountain zebra exhibit higher mortality rates than non-affected due to reasons that seem unrelated to any apparent climatic variations. Sasidharan (2004) recommends research on the comparative investigation on the immunological status of different Cape mountain zebra populations and epidemiological studies towards shedding more light on equine sarcoids.

Sasidharan (2004) suggests that anecdotal evidence may point to impaired immune function in Cape mountain zebra populations. Necropsy reports for Cape mountain zebra that died of disease symptomatic of African Horse Sickness (AHS) or equine encephalosis is unique in that zebras in general have been reported to be resistant to both. Equid movement quarantines for AHS are expected to impact on gene flow simulations through translocations.

Cape mountain zebra generally harbour high tick loads but no comparative studies have been done on parasitic loads between sarcoid-affected and non-affected zebras. Incidences of subclinical equine babesiosis have been reported in Cape mountain zebra (Young *et al.* 1973).

## 2.2 Population statistics and trends

The overall population growth rate of the Cape mountain zebra metapopulation has remained positive (Hrabar and Kerley 2013; Hrabar and Kerley 2015), however, not all sub-populations are maintaining a positive growth rate (Hrabar *et al.* 2015; CapeNature 2016). The mean annual rate of increase was maintained at 10% from 2002 – 2009, compared to 8.6% from 1985 to 1995 (Novellie *et al.* 1996), 9.6% from 1995 and 1998 (Novellie *et al.* 2002) and 8.4% from 1998 and 2002.

It should be noted that when assessing population numbers and their changes over time, that due to the unknown error around the estimates for the count of the entire population it is difficult to assess the accuracy of the trends or to be able to put confidence bounds around the increase figures.

In total the Cape mountain zebra population is estimated to have increased by 75% (from 2,790 to 4,872 individuals) over the period 2009 to 2015 (Hrabar and Kerley 2015) which translates to an average annual increase of 11%. Historical national population growth figures were as follows: from 1985 to 1995: 8.6% and from 1995 to 1998: 9.6% (Novellie *et al.* 2004).

**Table 4:** Cape mountain zebra population trends by management authority.

Province	Number of sub-populations	Population estimate	Population trend	Challenges or threats
SANParks	9	2,593 (1,089 in 2010 to 2,525 in 2015)	11.8% average increase	Low genetic diversity, predation effects unknown, hybridisation, sarcoids
ECPTA	3	369 (261 in 2007 to 369 in 2015)	9% average increase	Low genetic diversity
CapeNature	5	253 (228 in 2010 to 253 in 2015)	1.12% average increase	Poor population performance, hybridisation, habitat insecure, habitat alteration (water abstraction)
FS DESTEA	1	103 (45 in 2004 to 103 in 2015)	6.5% average increase <sup>4</sup>	Low genetic diversity
NC DENC	1	18	1.33% average increase	Low genetic diversity, sarcoids, poor population performance, insecure habitat, management and regulatory capacity constraints
Private	55	1,481 (946 in 2010 to 1,481 in 2015)	9.47% average increase	Low genetic diversity

## 2.3 Research

A scientific literature review has produced a list of important research findings, outcomes and recommendations to be taken into account in designing action plans for this BMP-S. These research findings and recommendations are incorporated into the relevant sections of this document.

The National Zoological Gardens of South Africa (NZG), a declared National Research Facility of the National Research Foundation (NRF) since 2004, is uniquely placed to generate new knowledge, core technologies and data pools/collections commensurate with international standards. It now has a critical mass of equipment, skills and users and the potential for networking and attracting collaboration. The facility offers unique opportunities for the advancement of science and for an interface between science and the public, and the additional provision of opportunities for skills development. Within the broad strategic context of the NZG, the thematic driver for research focuses on ways to attract, develop and retain talent and to uphold excellence in all investments in knowledge, people and infrastructure. In its role as a national research



facility, the NZG assist agencies and organisations, in collaboration, to fulfil their collective mandates for the conservation of biodiversity, ultimately enhancing the collective efforts in southern Africa for the conservation of regional biodiversity (Kotze and Nxomani 2011).

The NZG's strength is bringing together expertise from a variety of disciplines in synergy and an interdisciplinary approach rarely encountered in other research institutions. This strength is supported by appropriate human capacity, infrastructure and sustained funding for core scientific activities in both conservation biology and wildlife health.

The NZG has built up a unique resource to conduct and promote molecular genetic research in Africa, in response to a need to understand the relationships between the degree of genetic diversity, molecular diagnostics, phylogenetics and genetic factors that determine population viability of threatened species as a result of habitat fragmentation. National genetic databases have been established for a variety of species, including bontebok (*Damaliscus pygargus pygargus*), and are being expanded for species such Cape mountain zebra.

The implementation of effective metapopulation management for Cape mountain zebra aimed at conserving and maximising genetic diversity (inclusive of reproductive vigour and disease resilience) of the metapopulation, with due consideration of the potential deleterious genetic consequences, is heavily reliant on the undertaking to implement focussed applied research in partnership with the NZG.

## 2.4 Utilisation and socio-economic context

The decimation of wildlife through trophy hunting by early settlers and explorers in the 19<sup>th</sup> century promoted the recognition among some hunters of the need to protect remaining game populations (Lindsey *et al.* 2007). Van Stittert (2005) suggests that the privatisation and commercialisation of wild “game” animals was already well-advanced in the Cape in the late 19<sup>th</sup> century and driven by the ostrich feather trade and local demand for meat and skins, and in the twentieth by commercial sport hunting. Formally protected Nature Reserves were an anomaly in the Cape. After establishment, public game reserves were reallocated for farming and were restricted where they survived at all.

Ostrich domestication was a watershed in the wild animal history of the Cape. The recognition of land owner rights and suppression of itinerant hunting and trading in game provided an effective legal monopoly over game animals that could be converted into either profit or patronage resulting in steady enclosure of private farms in the east and north (Transvaal) after 1883, financed by profits from the ostrich feather boom. The first record of a farmer fencing part of his farm to protect animals refers to Mr Alexander van der Byl who enclosed bontebok on approximately 2,500 ha near Bredasdorp. The establishment of National Parks by central government due to the potential tourism value and precarious position of the remnant royal game in the Cape was intended to rescue the surviving gemsbok (*Oryx gazella*) (Gordonia), bontebok (Bredasdorp) and elephant (*Loxodonta africana*) (Uitenhage/Alexandria) in 1931, and Cape mountain zebra (Cradock) in 1937, from the threat of 'provincial prejudice' and private parsimony by creating a national park for each animal (Van Stittert 2005; Du Toit 2012).

Examples of conservation success by private land owners (including wildlife ranchers) commonly cited are the cases of the southern white rhinoceros (*Ceratotherium simum simum*), bontebok, black wildebeest (*Connochaetes gnou*), Cape mountain zebra and the geometric tortoise (*Psammobates geometricus*) (Lindsey *et al.* 2007; Cousins *et al.* 2008). Cousins *et al.* (2008) states that the maintenance of natural areas through wildlife ranching is obviously beneficial to conservation and protects habitat from radical transformation and also provides additional space which supports formal conservation as ranchers become “custodians of components of metapopulations” for a variety of species, both introduced and non-introduced.

The role of wildlife ranching for landscape level conservation, in general, is thought to be essential due to the limited government funding available for conservation, however, the practicality of ranching wildlife for conservation is challenging. In addition to the challenges of combining economic gain with conservation objectives, ranchers are often faced with relatively smaller enclosed areas and this necessitates the need for intensively managed wildlife populations. In order to enhance the role of wildlife ranching within conservation, clear guidance and support for ranchers is likely to be required to boost endorsement and minimise economic loss to ranchers (Cousins *et al.* 2008; Lindsey *et al.* 2007).

Hrabar and Kerley (2013; 2015) report that the most common motivation for stocking Cape mountain zebra on private land was for the conservation of the species and the least common motivation was hunting. Private land stakeholders, however, have expressed aspirations for Cape mountain zebra derived incentives through hunting, trading and stocking accessibility (Birss personal communication 2016) as well as stocking of Cape mountain zebra on private land, outside of their NDR (Hrabar and Kerley 2015; Taylor *et al.* 2016).

Hunting of Cape mountain zebra by South African hunters and land owners for population management and ecotourism purposes is permitted and granted by the relevant provincial conservation authorities on the merit of applications. Cape mountain zebra, being listed on CITES, requires a positive NDF in order to allocate hunting quotas for international export and in some cases additional requirements may include enhancement findings (i.e. United States of America: Endangered Species Act) – this limits accessibility of international clients to hunt Cape mountain zebra.

According to Lindsey *et al.* (2007), South Africa has the largest hunting industry in Africa in terms of number of operators, visiting hunters, animals shot and revenues generated, however, also cautions that the value of wildlife trophies create pressure for the issuance of large and increasing CITES quotas. Further, they refer to the insistence by hunters and hunting advocates that trophy hunting is of major importance for conservation in Africa, involves low off-takes, high prices and is sustainable, thus plays a role in creating incentives for the conservation of threatened species, but that CITES restrictions on trophy exports impose limitations on revenues from trophy hunting and incentives gained from restricted species. Discussions concerning trophy hunting are polarised which is exacerbated by the lack of reliable data on the impact of trophy hunting.

## 2.5 Conservation measures

Historically, excessive hunting as well as habitat loss and fragmentation due to agriculture reduced Cape mountain zebra numbers to less than 80 individuals in just three localities in the 1950s. Since the 1950s the number of Cape mountain zebra has gradually increased through translocations to ensure 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). According to Hrabar and Kerley (2015) over 70% of the national population is strictly protected within National Parks and provincial Nature Reserves.

The two smallest remnant populations of Cape mountain zebra occur in the Kammanassie and Gamka Mountains. The registered title deeds recognising the State Forest portions of the Kammanassie date back to 1878, the area was then known as the Langkloof State Forest (Schutte-Vlok *et al.* 2012). The earliest records of Cape mountain zebra census dates back to July 1986 when the Kammanassie NR was still managed by the National Department of Forestry. Kammanassie only became part of the provincial department during 1988, and prior to this very little attention had been given to the Cape mountain zebra population on this NR. When the reserve was established in 1978 the estimated number of Cape mountain zebra was six

(Odendal 1978). The earliest record of Cape mountain zebra on the Kammanassie mountain dates back to 1949, with a total of 15 animals recorded. Today the population is estimated at 70 animals (Cleaver 2004).

Gamkaberg NR was purchased by the Department of Nature and Environmental Conservation in 1974 for the express purpose of conserving, in their natural habitat, the remaining population of Cape mountain zebra occurring there (Barry *et al.* 2016). The Gamkaberg population was estimated at 42, in 2015, from a founder population of 6 animals (Barry *et al.* 2016).

Challenges around the survival of the Gamkaberg population include limited suitable habitat as they are fenced within the approximately 10 000 ha with limited availability of water during the dry months. The recent addition of the Fontein property means that the Cape mountain zebra now have access to two additional reliable borehole water points (Barry *et al.* 2016).

Cape mountain zebra occurred on the Outeniqua NR (established in 1936) but this population went extinct in the early 1970s possibly due to translocations and poaching was largely uncontrolled (Lloyd 1984).

In 1956 and 1957, the then Cape Provincial Administration purchased the properties De Hoop and Windhoek, east of Bredasdorp, and later the farm The Nook was added. The original De Hoop NR was proclaimed in 1957, as the first Provincial nature reserve, and used as an experimental game breeding farm (Scott and Scott 2002). The De Hoop Cape mountain zebra population was estimated at 115, in 2015, and animals move between De Hoop NR and the adjacent Denel Overberg Test Range. Ten animals were introduced to De Hoop in the 1970s, five from Mountain zebra NP and five from Kammanassie (Hey 1995). They are subject to low incidence of sarcoid tumour caused by the bovine papillomavirus (BVP) DNA types (Novellie *et al.* 2002; Sasidharan 2005).

In 1999, nine Cape mountain zebra from Karoo NP were introduced into the Anysberg NR at Vrede Valley. On 16 August 2004, a further eight zebra from Karoo NP was released into the reserve. Today the Cape mountain zebra sub-population is estimated at 21 animals. In 2012, the Anysberg NR was expanded by 12,832 ha with assistance from WWF-SA and funding from the Leslie Hill Succulent Karoo Trust, and this has increased the reserve to over 80 000 ha in size (Schutte-Vlok 2015).

### 2.5.1 The Mountain Zebra Working Group (MZWG)

A further overview of past conservation measures for Cape mountain zebra indicates that the conservation management of the South African Cape mountain zebra metapopulation is shared by five conservation agencies, namely SANParks (a parastatal organisation responsible for the management of South Africa's National Parks), CapeNature (public entity of the Western Cape Department of Environmental Affairs and Development Planning), Eastern Cape Parks and Tourism Agency (public entity of the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism), the Northern Cape Department of Environment and Nature Conservation and the Free State Department of Economic, Small business development, Tourism and Environmental Affairs.

The MZWG was established to coordinate the conservation of mountain zebras in South Africa. Initially the focus was on the Cape mountain zebra, but was later expanded to include the Hartmann's mountain zebra in South Africa. The MZWG acted as a national body of interested and affected parties established to implement the Action Plan for Mountain Zebra as outlined in *Equids: zebras, asses and horses – status survey and conservation action plan*, published by the IUCN Equid Specialist Group in 2002. The primary role of the MZWG was to ensure that mountain zebra populations in South Africa are regularly monitored and to revise the strategy outlined in the Action Plan, when necessary. The MZWG has not officially been active since 2010 although much of the intentions of the working group had been adopted by participatory conservation agencies, either through policy or management commitment. Doctor Halszka Hrabar and Professor Graham



Kerley, associated with the Nelson Mandela Metropolitan University, Port Elizabeth, have been primarily responsible for regular population status reports and liaison with private land owners, conservation agencies and conservation managers towards maintaining the momentum of the MZWG mandate.

The MZWG adopted a Terms of Reference which was aimed at *inter alia*:

1. To coordinate the future conservation of mountain zebras in South Africa;
2. To act as local body of interested and affected parties whose mandate is to implement the Equid Specialist Group Action Plan for Mountain Zebra as outlined by Novellie *et al.* (2002);
3. To monitor mountain zebra populations on a regular basis, and to revise the strategy outlined in the Action Plan when and where necessary using the monitoring information obtained;
4. To ensure appropriate implementation of the Action Plan, as well as scientific advisory personnel to ensure the Action Plan is followed and that the necessary revisions and any other sources of relevant information are brought to the attention of those responsible for implementation; and
5. Recognising the role that private landowners played historically in saving this animal from extinction, promoting a spirit of co-operation with current and future landowners, and regularly communicating relevant information to the private sector to achieve this goal.

Conservation management policies were developed and adopted by provincial conservation agencies for the translocation and hunting of Cape mountain zebra (the latter dating back to the early 1980s). Protocols for the monitoring of Cape mountain zebra in various reserves were developed and distributed in order to coordinate this matter and produce a reliable database on population status. A draft protocol for assessing the habitat of any receiving property was also developed.

In 2010 attempts to reconvene the MZWG failed and therefore CapeNature in partnership with SANParks initiated the BMP-S process, aiming to disband the MZWG in favour of a BMP-S steering committee and to drive towards a stakeholder workshop to draft a BMP-S for the Cape mountain zebra.

At present there is no formal management plan for Cape mountain zebra. SANParks currently has no specific management strategy for Cape mountain zebra, and management follows the general policy for the management of large mammals in SANParks. The Mountain Zebra and Karoo National Parks, which have the largest populations, have been increased greatly in area over the past decade, and consequently the Cape mountain zebra populations have been expanding in these parks. Both parks have introduced lions and other large predators, and their impact on the mountain zebra populations are being monitored (Novellie, personal communication).

An inter-agency collaboration between SANParks, CapeNature and ECPTA acknowledges the need for the Cape mountain zebra BMP-S, to ensure the long term survival of the species in nature, and to formalise the collaborative efforts of participatory parties of the MZWG.

CapeNature, in partnership with SANParks and the Eastern Cape Parks and Tourism Agency, initiated a process to develop a BMP-S for Cape mountain zebra, in terms of the NEM: BA, in collaboration with the Northern Cape Department of Environment and Nature Conservation, the National Zoological Gardens of South Africa and the Free State Department of Economic, Small business development, Tourism and Environmental Affairs.

Finally, in the development of this BMP-S, it is envisaged that the governance of Cape mountain zebra metapopulation management and the implementation of the BMP-S will be taken over by a BMP-S steering committee, including regulatory and other conservation authorities to provide oversight and accountability for the implementation of actions as detailed in the Action Tables.

### 2.5.2 Metapopulation management

A metapopulation is defined as a group of geographically isolated populations of the same species that may exchange individuals through dispersal, migration or, when implemented as a management strategy, human-controlled movement and the availability of empty habitats that are largely connected (Hanski 1999; Olivier *et al.* 2009). Implementation of human-mediated metapopulations becomes necessary when individuals no longer have the ability to move between patches or to recolonise empty patches (Akçakaya *et al.* 2007). The implementation of metapopulation processes may improve the persistence of mammals in fragmented habitats (Olivier *et al.* 2009). The managed metapopulation approach has been proposed for large herbivores in South Africa, where extensive areas are needed to hold a viable population (Elmhage and Angerbjörn 2001). Akçakaya *et al.* (2007) propose that what conservation needs is not necessarily metapopulations *per se*, but the metapopulation approach and concepts, which allow for the assessment of the persistence of a species that happens to exist in a metapopulation, either naturally or due to habitat loss and fragmentation.

Elmhage and Angerbjörn (2001) suggested a managed metapopulation approach as a means to solve problems of inbreeding in small, isolated populations with a high extinction risk, when:

1. There are discrete habitat patches large enough to hold breeding sub-populations (Hanski 1999); and
2. Ecological processes that work on both local and regional (metapopulation) scales (Hanski 1999).

Elmhage and Angerbjörn (2001) cautioned against the assumption that all populations with patchy distributions and some degree of connectivity are metapopulations. They emphasise the importance to investigate the demographic properties of sub-populations in different population networks, on a case by case basis in order to contribute to the conservation and management of large mammals in fragmented habitats. In addition to human-mediated dispersal through reintroduction and translocation, dispersal can be increased by conserving or restoring the habitat between existing populations. This can reduce local extinctions by facilitating the ‘rescue effect’ of colonization, and it can increase the rate of recolonization following local extinction. One example to increase the overall persistence of the species is linking populations through habitat corridors (Akçakaya *et al.* 2007).

Effective metapopulation management for Cape mountain zebra by the conservation agencies involved (see above), should aim to conserve the allelic diversity and promote and maintain genetic diversity within and between the relevant sub-populations of the metapopulation, in particular the potential loss of rare alleles in the isolated relict populations at Kammanassie and Gamkaberg, either caused by genetic drift or genetic swamping. Genetic data are often used to assess “population connectivity” because it is difficult to measure dispersal directly at large spatial scales, however, estimates of genetic divergence alone provide little information on demographic connectivity (Allendorf *et al.* 2012). “Genetic rescue” is considered to play a crucial role in the persistence of small natural populations and is an effective conservation tool under certain circumstances, however, the occurrence of outbreeding depression following heterosis in the first generation in some cases indicates that care is needed when considering the source of populations for rescue (Allendorf *et al.* 2012).

It has been recommended by various authors (Hrabar *et al.* 2015; Hrabar and Kerley 2013; Hrabar and Kerley 2015; Hill 2009; Sasidharan *et al.* 2011; Moodley and Harley 2006) that the three relic populations should be mixed. With due consideration to the potential deleterious genetic consequences as indicated by Frankham

*et al.* (2002) and Allendorf *et al.* (2012), introductions into either Kammanassie and or Gamkaberg sub-populations must be avoided and alternative locations for mixing and monitoring the effects of mixing must be considered. In this regard, it would be recommended that the mixing of sub-populations first takes place between those contained in state-owned protected areas, for proper monitoring of the result, before translocations to private properties are considered.

As animals are available to be sourced from the De Hoop NR, Gamkaberg NR and Kammanassie NR populations, new populations derived from various mixtures of these source animals and carefully selected numbers of Cradock-source animals should be established. These new populations should be introduced into the top priority sites as determined by the prioritisation and site selection criteria listed in this BMP-S.

More than 40 individuals in various groups have escaped from De Hoop NR and now occur on private land. In some instances these animals are being persecuted and poached. Hybridisation with horses and donkeys have been observed (Marais 2015).

The Cape mountain zebra metapopulation comprises the following four main elements:

1. A good number of widely distributed sub-populations derived from the Cradock lineage that form the bulk of the Cape mountain zebra population (including private land sub-populations),
2. The Gamkaberg NR population,
3. The Kammanassie NR population,
4. The De Hoop population which is a Cradock- and Kammanassie-derived population which does still represent rare alleles from the Kammanassie population (Moodley and Harley 2006).

Finally, the management and monitoring of the Cape mountain zebra metapopulation should be guided by this BMP-S and all agencies and eventually, private and corporate landowners, should strive to promote the conservation of the Cape mountain zebra. Only a collaborative and focused science-based effort, supported by sound management principles and best practice will ensure the success and future survival of the species.

It appears from the available body of knowledge, that many and rather specific recommendations to improve the survival of Cape mountain zebra in the wild and within its NDR have been made throughout the years, but that little action has been taken in this regard.

### 2.5.3 Non-detriment finding (NDF)

Hrabar and Kerley (2015) estimate that the potential Cape mountain zebra population on occupied private land could have been between 2,205 and 2,427 individuals in 2015. They also indicated that the most common motivation for stocking Cape mountain zebra on private land was for the conservation of the species while the least common motivation was hunting. However, during a workshop convened by SANBI in order to prepare a Non-detriment Finding, private land stakeholders expressed aspirations for Cape mountain zebra derived incentives through hunting, trading and stocking accessibility (Birss personal communication 2016). Although hunting by South African hunters and land owners for population management and ecotourism purposes is permitted and granted on the merit of applications, Cape mountain zebra, being listed on CITES, requires a positive Non-detriment Finding in order to allocate hunting quotas for export – thus limits accessibility of international clients to hunt Cape mountain zebra.

In May 2015 the Scientific Authority of South Africa, as established in terms of Section 60(1) of the NEM: BA, conducted an NDF assessment for the Cape mountain zebra in terms of the CITES Regulations (Equ\_zeb\_zeb\_May2015). As stated previously, the purpose of this NDF was to assess whether or not the trade (international) in Cape mountain zebra is likely to have a detrimental impact on the population(s) of the species.

The NDF undertaken for the Cape mountain zebra demonstrates that legal local and international trade in live animals and the export of hunting trophies at present poses a moderate to high risk to the survival of this subspecies in South Africa. It continues to state that if a small hunting quota were to be introduced, it would in all likelihood increase the economic value of the Cape mountain zebra, which is anticipated to generate species and habitat conservation incentives. Subsequently, if the Cape mountain zebra had a higher economic value, there would be more of an incentive to conserve the subspecies and limit the introduction of alternative high-value extra-limital species that can lead to habitat deterioration.

Recommendations from the NDF include the development and effective implementation of a Biodiversity Management Plan for Cape mountain zebra to improve metapopulation management and the parallel implementation of a small cautious hunting quota supported by a population viability analysis which considers genetic diversity within the population, with effective monitoring and research (Scientific Authority. 2015).

The intention of this BMP-S is to promote the conservation and future survival in the wild of the Cape mountain zebra within its NDR with the actions flowing from the planning process to achieve this goal.

#### 2.5.4 Population viability analysis

Local extinction refers to the extinction of a single population in a spatially separate patch, global extinction refers to the loss of all members of a species in all of its constituent populations, and quasi-extinction (Ginsberg *et al.* 1982) to the risk of decline below a specified population size within some specified time (Lindenmayer and Burgman 2005). Population viability analysis is a modelling tool which is used to predict the likelihood of a population reaching a minimum size and threshold in the future. Ginzburg *et al.* (1982) cautioned decision makers to ensure a good understanding of predictive modelling and to, not merely rely on experts' ability to obtain a result or the interpretation of a final conclusion. Previous models (using a quasi-extinction threshold of 10 individuals at the time horizon of 50 years) deployed for both Kammanassie and Gamkaberg Cape mountain zebra sub-populations, indicated that the viability of the Gamkaberg NR was uncertain and argued that limited suitable habitat and the absence of regular fires increased the probability of quasi-extinction (based on population growth rates between 1973 and 2004). The predicted low probability of a quasi-extinction for the Kammanassie sub-population is influenced by rapid population growth after the series of fires from 1997 onwards, and above average rainfall. Although the study suggests that the risk of quasi-extinction of the Cape mountain zebra sub-populations were relatively low over the next 50 years, it was still higher than expected and highly dependent on environmental factors and management decisions (Watson *et al.* 2005, Watson and Chadwick 2007). This risk is exacerbated by small population sizes, inbreeding and competition with other species for suitable habitat (Penzhorn and Novellie 1991; Novellie *et al.* 2002, Watson *et al.* 2005, Watson and Chadwick 2007).

The main management recommendations to reduce this risk of quasi-extinctions of Cape mountain zebra include:

- Deliberate mixing of relict populations in order to maintain and improve genetic diversity;
- Re-enforcement of existing populations prioritised over the establishment of new populations;
- Regulation of translocations to prevent hybridisation;
- Research into the implications of disease and disease risk management;
- Translocation of animals to other protected areas;
- Acquisition of land adjacent to protected areas with Cape mountain zebra;
- Changing fire management in the habitat preferred by Cape mountain zebra to increase the availability of palatable grasses; and
- Formation of conservancies with adjacent landowners.

(Novellie *et al.* 2002; Moehlman 2002; Moodley and Hartley 2005; Watson *et al.* 2005; Watson and Chadwick 2007; Sasidharan *et al.* 2011; Hrabar *et al.* 2011; Hrabar and Kerley 2015; Strauss 2015).

The 2002 IUCN Status and Action Plan for the Mountain Zebra *Equus zebra* (Novellie *et al.* 2002) suggested a Cape mountain zebra population target of 2,500. This number, now exceeded, needs to be reassessed (Hrabar and Kerley 2013). Kerley *et al.* (2003) suggests Cape mountain zebra population targets of 7,249 for pre-transformation areas and 5,194 excluding transformed areas within the NDR in the Cape Floristic Region. The population estimate of 4,791, in 2015, of which 3,268 occurs on protected areas, could potentially increase by 3,240 on protected areas in the NDR, in the long term, with the effective implementation of a sound metapopulation strategy, thereby indicating that a target population of 6,500 on protected areas may be an attainable goal (Birss *et al.* 2016).

During 2015 and 2016, SANBI convened a number of workshops to facilitate the development of Cape mountain zebra population simulation models to inform formal evaluation of management strategies (including harvesting). The workshops introduced the basic principles of the Management Strategy Evaluation (MSE) framework. The model 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 2016a).

A time-series analysis of long-term established mountain zebras within protected areas was aimed at: (1) to predict and forecast the absolute numbers of long-term protected subpopulations, (2) to determine the average rate of increase across populations and (3) to provide robust population trend estimates, and associated uncertainties, with implications for the IUCN Red list status. The estimated global mean of the rate of increase across the 10 subpopulations was 6.9% per annum and suggests a potential further increase of at least 4,073 animals by 2025, depending on the availability of habitat (Winker 2016b).

Incorporating carrying capacity limits into forward projections is expected to constrain future growth potential of the nine identified source populations. To maintain rates of increase in source population numbers, the expansion of available land or the founding of new source populations on suitable land will be required (Winker 2016c).

The development and implementation of site and national level MSE models to provide decision support for the evaluation of off-takes is recommended. These models should support the implementation of a CITES quota, providing for constant monitoring and evaluation. A hunting quota determined through a population viability analysis that considers genetic diversity within the population is being developed and the implementation thereof will be monitored through a research project.

## 2.6 Conservation status and legislative context

In South Africa, legislative jurisdiction regarding the conservation and management of wildlife is shared between the national and provincial governments. The Constitution mandates that “nature conservation, excluding National Parks, national botanical gardens and marine resources,” is one of the functional areas in which there is concurrent national and provincial legislative jurisdiction.

South Africa has nine provinces: Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West, and Western Cape. A great deal of legislative and executive jurisdiction over issues of conservation and management of wildlife, including regulation of imports and exports, is exercised by these provincial governments. National government wields significant legislative jurisdiction over the protection of wildlife, in large part to create national uniformity on the matter.



The NEM: BA and its subsidiary legislation put in place protections for various species that are threatened or otherwise in need of protection. It also provides the authority for consolidating fragmented biodiversity legislation in the country through the establishment of national norms and standards specific to certain particularly vulnerable animals. Enforcement of the NEM: BA and its subsidiary legislation is shared across various tiers of government (Goitom 2013).

### 2.6.1 International obligations

#### The Convention on Biological Diversity (CBD)

South Africa is a Party to the CBD. Parties to the CBD adopted the Strategic Plan for Biodiversity 2011-2020, in 2010 in Nagoya, Japan, with the purpose of inspiring broad-based action in support of biodiversity over the following decade by all countries and stakeholders. In recognition for the urgent need for action the United Nations General Assembly also declared 2011-2020 as the United Nations Decade on Biodiversity. The Strategic Plan is comprised of a shared vision, a mission, strategic goals and 20 targets and serves as a framework for the establishment of national and regional targets, promoting the three objectives of the CBD.

The development and implementation of this BMP-S addresses Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity. This BMP-S specifically aims to contribute to the Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly to those in decline, has been improved and sustained. This target specifically related to IUCN listed threatened species and has two components:

- Preventing extinction. Preventing extinction entails that those species which are currently threatened do not move into the extinct category; and
- Improving the conservation status of threatened species. An improvement in conservation status would entail a species increasing in population to a point where it moves to a lower threat status.

Progress towards this target would help reach other targets contained in the Strategic Plan, including Target 13. Further actions taken towards this target could also help to implement commitments related to the species focussed multilateral agreements such as CITES (CBD 2013).

#### The World Heritage Convention

Cape mountain zebra occur on 7 protected areas within the Cape Floristic Region World Heritage Site: Table Mountain NP, Anysberg NR, Kammanassie NR, Gamkaberg NR, Theewaterskloof NR and the Baviaanskloof NR.

#### IUCN Red List

In 2008, the IUCN Red List status for Cape mountain zebra changed from “Endangered” to “Vulnerable” (VU D1) as the total population was estimated at approximately 500 mature individuals and increasing.

#### CITES

South Africa is a Party to the CITES, which thus governs and controls South Africa’s international trade in CITES-listed species. The Cape mountain zebra is listed in Appendix I of CITES i.e. species threatened with extinction which are or may be affected by trade. Refer to South Africa’s CITES Regulations (see below).



### NEM: BA

The NEM: BA gives effect to the constitutional commitment to take reasonable legislative measures that promote conservation by providing for the management and conservation of biological diversity and the sustainable use of indigenous biological resources.

### Threatened or Protected Species (ToPS) Regulations, 2007

The ToPS Regulations, 2007, promulgated in terms of NEM: BA came into force in February 2008. The regulations provide for the protection of species that are threatened or in need of protection to ensure their survival in the wild and give effect to the Republic's obligations. At the time of writing (February 2016), the ToPS Regulations are going through a comprehensive process of review, amendment and repeal.

### CITES Regulations, 2010

The CITES Regulations under NEM: BA came into force in March 2010. The regulations give effect to South Africa's obligations as a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (see above) insofar as creating a permitting system to regulate the international trade (import, export and re-export) of listed species (live animals as well as specimens / products) as well as concomitant administrative, compliance and enforcement structures.

In terms of Regulation 6(3)(c) of the CITES Regulations (read with Article IV of the CITES (Convention) and Section 1 of the NEM: BA), an export permit shall only be granted for an Appendix I (or II) listed 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.

A NDF is defined in the CITES Regulations to mean a finding by the Scientific Authority advising that a proposed export of an Appendix I (or II) specimen will not be detrimental to the survival of the species and that a proposed import of an Appendix I specimen is not for purposes that would be detrimental to the survival of the species.

### NEM: PAA

NEM: PAA provides for the protection and conservation of ecologically viable areas representative of South Africa's biodiversity and natural landscapes and seascapes in protected areas. Protected areas in South Africa offer a viable tool for habitat protection and the protection and maintenance of ecologically viable numbers of the Cape mountain zebra and their associated species and habitats.

## 2.6.3 Other relevant South African legislation

Apart from the National Environmental Management Act, 107 of 1998 (NEMA) and its related Acts and Regulations, the nine provincial conservation ordinances / acts are the major regulatory instruments for the regulation of wild animal species in South Africa.

Transvaal Nature Conservation Ordinance, 12 of 1983 (implemented in Gauteng; Limpopo including Gazankulu and Venda; North West including Bophuthatswana and Lebowa and Mpumalanga Provinces) and augmented by:

- Gauteng Nature Conservation Ordinance, 1983 - Gauteng Nature Conservation Act, 2014;
- Limpopo Nature Conservation Ordinance, 1983 - Limpopo Environmental Management Act, 2003;
- Gazankulu Nature Conservation Act, 5 of 1975, Venda Nature Conservation Act, 10 of 1973;
- Mpumalanga Ordinance, 1983 - Mpumalanga Nature Conservation Act, 10 of 1998;

- North West Nature Conservation Ordinance, 1983; Bophuthatswana Nature Conservation Act, 1973; Lebowa Nature Conservation Act, 1973, and tribal rule.

Cape Province Nature Conservation Ordinance, 19 of 1974 (implemented in the Western Cape; Eastern Cape including Ciskei and Transkei; Northern Cape and North West Provinces) and augmented by:

- Western Cape Nature Conservation Ordinance, 19 of 1974 - Western Cape Biodiversity Bill *in prep.*
- Northern Cape Nature Conservation Ordinance, 19 of 1974 - Northern Cape Nature Conservation Act, 9 of 2009
- Eastern Cape Nature Conservation Ordinance, 19 of 1974; Ciskei Nature Conservation Act, 10 of 1987; Transkei Decree 9 of 1992.

Natal Nature Conservation Ordinance, 15 of 1974 (implemented in KwaZulu-Natal Province, including KwaZulu)

- KwaZulu Nature Conservation Act, 29 of 1992 - KwaZulu-Natal Nature Conservation Management Act, 9 of 1997; KwaZulu Nature Conservation Act, 8 of 1975

Free State Nature Conservation Ordinance, 1969 (implemented in the Free State Province, including QwaQwa) and augmented by:

- Free State Nature Conservation Ordinance, 8 of 1969; QwaQwa Nature Conservation, 5 of 1976.

Supporting decision making instruments include National Norms and Standards and Provincial Conservation and Regulatory Policies.

Other Acts such as the Animals Protection Act, 71 of 1962 as amended, which regulates animal welfare in South Africa is also applicable to wildlife.

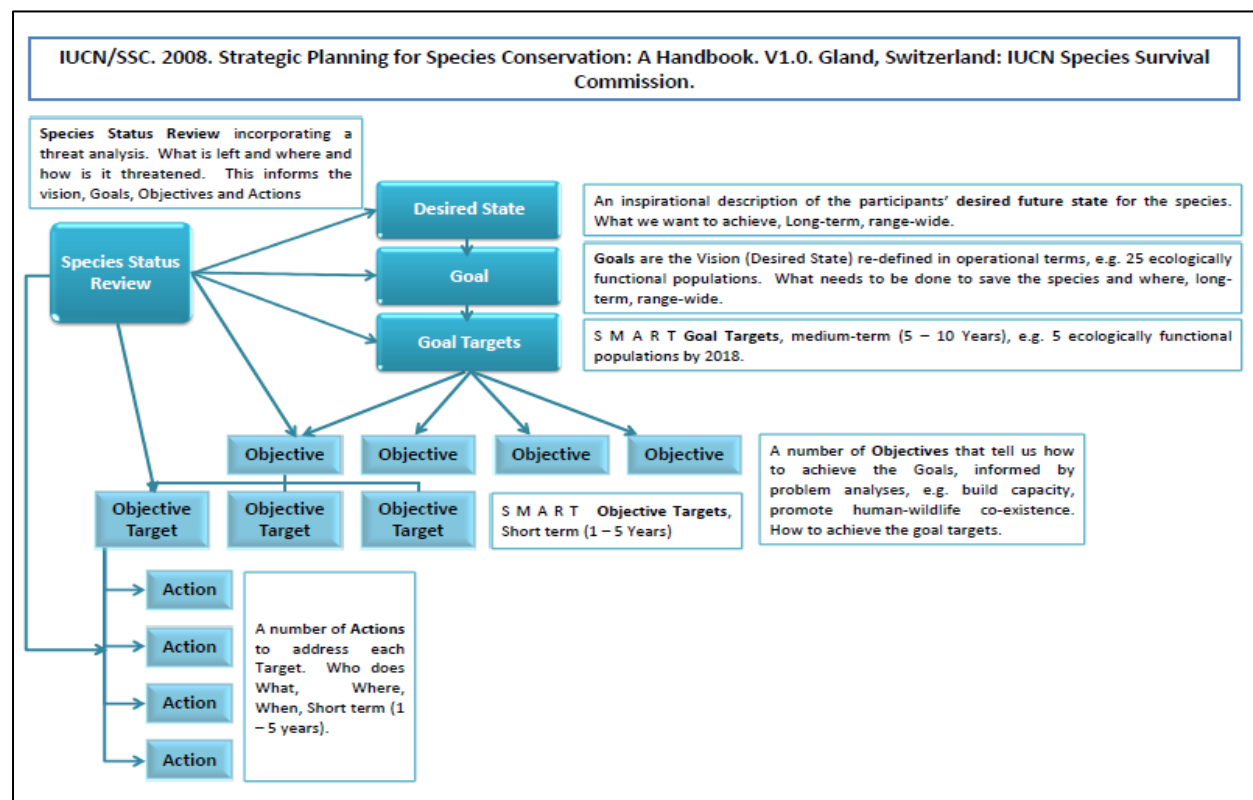
The Game Theft Act, 105 of 1991, the Fencing Act, 31 of 1963; the Animal Health Act, 7 of 2002, Animals Diseases Act, 35 of 1984, Medicines and Related Substances Control Act, 101 of 1965, and the Animal Matters Amendment Act, 42 of 1993, may also be relevant to Cape mountain zebra conservation as it plays a significant role in veterinary care of animals, as well as their translocation.

Furthermore, Cape mountain zebra is a carrier of AHS. As a result, certain restrictions (Animal Diseases Act) 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).

### 3) PLANNING FRAMEWORK

#### 3.1 The planning context

The Cape mountain zebra BMP-S workshop planning process was aligned to the framework provided by the IUCN Species Survival Commission for species conservation planning. Refer to Figure 3. It has guided the stakeholder engagement and planning workshops in defining the desired state, objectives and actions for this BMP-S. The outputs have guided the compilation of the Action Plan and Monitoring Framework (Section 5) to enable effective monitoring and reporting, based on appropriate indicators of success (measurable indicators/outputs) for each action. This enables the tracking of progress towards achieving objectives and thus allow for the adaptive review of objectives (IUCN 2008).



**Figure 3:** IUCN Species Survival Commission (SSC) schematic for species conservation planning.

#### 3.2 Key role players

Key role players and stakeholders in the management of the Cape mountain zebra are the following (Table 5).

- Those government departments and agencies (at a national, provincial and local level) that have been mandated in terms of legislation, to protect this species, and to implement the actions identified in this plan in order to ensure the long term survival of this species in the wild.
- Other government departments involved in regulating activities that may impact on achieving the conservation objective for the species.
- Private land owners, (including wildlife ranchers), with sup-populations of Cape mountain zebra on their land;
- Researchers and research institutions involved with research relevant to the species.
- Non-governmental organisations, at both a national and international level providing funding for management implementation, research, students and projects.

**Table 5.** Organisations that are involved in developing and implementing various aspects of the Cape mountain zebra BMP-S.

National Government	<ul style="list-style-type: none"> <li>• Department of Agriculture, Forestry and Fisheries</li> <li>• Department of Environmental Affairs Branch: Biodiversity and Conservation (DEA: BC)</li> <li>• Department of Environmental Affairs: ToPS and CITES</li> <li>• South African National Biodiversity Institute</li> <li>• South African National Parks</li> <li>• National Zoological Gardens of South Africa</li> </ul>
Provincial Government	<ul style="list-style-type: none"> <li>• CapeNature</li> <li>• Northern Cape Province: Department of Environment and Nature Conservation</li> <li>• Eastern Cape Province: Department of Economic Development, Environmental Affairs and Tourism</li> <li>• Free State Province: Department of Economic, Small Business Development, Tourism and Environmental Affairs</li> <li>• Eastern Cape Parks and Tourism Agency</li> </ul>
Higher Education Institutions	<ul style="list-style-type: none"> <li>• Centre for African Conservation Ecology, Nelson Mandela Metropolitan University</li> <li>• Manchester University</li> <li>• University of the Free State</li> </ul>
Non-Government	<ul style="list-style-type: none"> <li>• World Wild Fund for Nature – South Africa (WWF-SA)</li> <li>• Table Mountain Fund (TMF)</li> <li>• Wilderness Foundation</li> <li>• Endangered Wildlife Trust (EWT)</li> <li>• Wildlife Ranching South Africa (WRSA)</li> <li>• Professional Hunters Association of South Africa (PHASA)</li> <li>• South African Hunters and Game Conservation Association (SAHGCA)</li> </ul>
Other	<ul style="list-style-type: none"> <li>• Perdeberg Winery</li> </ul>

### 3.3 Stakeholder engagement

Identified interested and affected parties were invited to participate in the initial Cape mountain zebra BMP-S workshop via e-mail in October 2013. The list of participants and provisional agenda for the workshop is attached as Appendix A and includes experts on Cape mountain zebra, representatives of conservation management agencies, representatives of wildlife ranching and hunting associations, private land owners and researchers (many already participated in a SANBI facilitated workshop for the compilation of the CITES NDF). Invitees were requested to participate in the workshop to facilitate the drafting of a Biodiversity Management Plan for Cape mountain zebra and were requested to recommend additional stakeholders who they thought could contribute to the proposed workshop.

The Stakeholder Workshop was held on 29 November 2013. The workshop included presentations on the current state of knowledge for Cape mountain zebra. The group as a collective developed the Desired State and identified the key threats to the long term survival of Cape mountain zebra in nature. Break-away groups led by an expert in that particular field, then facilitated the compilation objectives and action plans for each threat. The proceedings of the workshop were used to compile the draft Biodiversity Management Plan for Cape mountain zebra. This draft was compiled by representatives of SANParks and CapeNature. CapeNature engaged in two internal workshops to facilitate the adoption of a CapeNature Cape mountain zebra

metapopulation management strategy based on the outcomes of the BMP-S workshop and to contribute to developing mechanisms to enable the achievement of the objectives of the BMP-S.

The draft Cape mountain zebra Biodiversity Management Plan will be submitted to the Department of Environmental Affairs for gazetting for public participation. Stakeholders involved in the initial workshop will be provided with the draft Cape mountain zebra BMP-S and encouraged to provide further inputs via the public participation process to promote transparency.

### **3.4 Relevant agreements**

There is currently no formal inter-agency agreement as far the management of Cape mountain zebra is concerned. Apart from the three stakeholder and internal workshops held, a meeting held between the Eastern Cape Parks and Tourism Agency, SANParks and CapeNature in January 2016 in Stellenbosch will form the basis of future inter-agency cooperative agreements, formal Memoranda of Understanding and/or protocols to be developed.

A draft inter-agency protocol for dealing with the potential threat of hybridisation between Cape mountain zebra and plains zebra, and the translocation of surplus Cape mountain zebra from National Parks is under development (Zimmermann personal communication).

### **3.5 Identification of lead and implementing agencies**

A final BMP-S workshop with conservation agencies and other stakeholders was held on 25 May 2016 (Agenda and Attendance Registers are attached as Appendix D). During this workshop all stakeholders for the BMP-s were identified and confirmed, and the relationships between stakeholders were workshopped by small working groups as an introduction to the rest of the proceedings. The outputs of this (Venn diagrams representing different stakeholders and their respective relationships) are attached as Appendix E. This exercise informed further discussion and final agreement on who the respective lead and responsible agencies are, as well as the collaborators.

CapeNature was proposed and accepted as the overall lead agency for the CMZ BMP-S, and the workshop identified additional lead and implementing agencies, and collaborators for the respective actions under each Objective Target. The workshop and all stakeholders present concluded and reached consensus on all identified actions under each objective target.

It should be noted that the NC DENC could not attend the workshop but provided extensive comments on the document. Similarly, the EC DEDEAT and FS DESTEA could not attend either, but have also supplied comments on earlier versions of the BMP-S.

### **3.6 Expert verification for quality of content and context**

The Biodiversity Management Plan for Cape mountain zebra (Draft Cape mountain zebra BMP-S\_V2\_24 April 2016.pdf) was reviewed by Dr Peter Novellie for expert verification of quality of content and context.

Dr Novellie recently retired after 32 years with SANParks, working mainly at the interface between park management planning, wildlife management and national law and policy. His other research interests include the management of ungulate herbivory in protected areas, and the conservation of threatened species. His involvement with Cape mountain zebra started in 1983 when he was appointed to a research position in the Mountain Zebra NP.

Dr Novellie is generally regarded as the Cape mountain zebra “guru” and has authored and co-authored numerous publications and recommendations on the conservation status, ecology, behaviour, monitoring and management of Cape mountain zebra during his tenure with SANParks.

Dr Novellie found the draft BMP to be thorough and excellently compiled, has endorsed this BMP and provided suggestions which have been incorporated into the content.



## 4) BIODIVERSITY MANAGEMENT PLAN

### 4.1 Lead and implementing agencies

Lead agencies: CapeNature

Implementing Agencies: DEA: Regulation, coordination of implementation, monitoring, evaluation and annual reporting.

CapeNature: Regulation, research collaboration, population management, monitoring and reporting.

SANParks: Population management, monitoring, research collaboration and reporting.

ECPTA: Population management, monitoring, research collaboration and reporting.

EC DEDEAT: Regulation, monitoring and reporting.

NC DENC: Regulation, population management, monitoring, research collaboration and reporting. [Comments received from NC DENC indicate that they do not currently have the capacity (staff, budget and resources) to implement this BMP-S.]

FS DESTEA: Population management, monitoring, research collaboration and reporting.

NZG: Research, monitoring and reporting.

SANBI: Monitoring, reporting and research facilitation.

### 4.2 Identified threats and challenges

#### 4.2.1 THREAT: Population Fragmentation

An increase in fragmented, small, isolated sub-populations derived from an already genetically compromised population, with inhibited or non-existent gene flow, injudiciously translocated and or introduced into habitats based on poorly informed assessments of associated risks (IUCN 2013), promotes the creation of population sinks and exacerbates genetic drift (Ginzburg *et al.* 1982; Penzhorn and Novellie 2001; Elmhage and Angerbjörn 2001; Novellie *et al.* 2002; Frankham *et al.* 2002; Moodley and Harley 2006; Allendorf *et al.* 2012; Hrabar and Kerley 2013; Hrabar and Kerley 2015). Restrictions on the movement of equid animals across Horse sickness quarantine zones, will hinder the flow of genetics between sub populations (Cowell pers. comm.)

#### 4.2.2 THREAT: Inbreeding

Breeding of closely-related individuals exacerbates the deleterious genetic consequences of enduring severe and sustained population bottlenecks in Cape mountain zebra, with continued loss of heterozygosity. The establishment of small, single source populations impedes the natural inbreeding avoidance behaviour, naturally exhibited in large viable populations through the dispersal of progeny. This compounded loss of genetic diversity predisposes the sub-populations to decreased resistance of the metapopulation to diseases and adaptation to environmental changes and stochastic events (Penzhorn 1982; Penzhorn 1984; Penzhorn 1985; Skinner and Smithers 1990; Penzhorn and Novellie 1991; Rasa and Lloyd 1994; Frankham *et al.* 2002; Moodley and Harley 2006; Allendorf *et al.* 2012).

#### 4.2.3 THREAT: Hybridisation

Hybridisation between Cape and Hartmann's mountain zebra, due to injudicious translocations result in fertile offspring. Hybridisation between Cape mountain and plains zebra has been confirmed and concerns of introgression have been raised. Introgression is the incorporation of genes from one species or subspecies

to another through hybridisation that results in fertile offspring that further hybridise and backcross to parental populations. Typically, hybridisation occurs when humans introduce exotic species in the range of rare species, or alter habitat so that previously isolated populations are now in secondary contact. Hybridisation with other equid species have also been confirmed and are concerning as this results in displaced reproductive effort of the metapopulation (Gray 1971; Frankham *et al.* 2002; Allendorf *et al.* 2012; Marias 2015; Dalton *et al.* 2016).

#### **4.2.4 THREAT: Habitat alteration and fragmentation**

Habitat quality and quantity is negatively impacted by modification, groundwater abstraction, erosion, alien invasive species, inappropriate fire management, overstocking and transformation (Penzhorn and Novellie 1991; Winkler and Owen-Smith 1995; Watson and Chadwick 2007; Hurzuk 2009; Kraaij and Novellie 2010; Smith *et al.* 2011; Watson *et al.* 2011; Schutte-Vlok *et al.* 2012; Strauss 2015; Birss *et al.* 2016;).

#### **4.2.5 THREAT: Insecure habitat**

Inability to secure habitat (funding dependant), expand protected areas, fence and provide adequate infrastructure threaten the continued success of the Cape mountain zebra metapopulation (Hurzuk 2009; Schutte-Vlok *et al.* 2012; Hrabar and Kerley 2015, Marais 2015; Birss *et al.* 2016).

#### **4.2.6 CHALLENGE: To implement effective metapopulation management**

The implementation of an effective metapopulation management strategy in order to ensure the establishment and maintenance of viable populations on suitable habitat within the NDR, maintain allelic diversity, promote and maintain genetic diversity and the reinforcement of reproductive potential, based on sound conservation genetic principles has been recommended by various authors, however, purposeful intervention have not been implemented on a metapopulation level. The increasing establishment of small founder sub-populations, lack of reinforcement and inaction towards understanding and implementing measures to increase genetic diversity of sub-population results in inbreeding, genetic drift, and loss of allelic diversity within sub-populations, and potentially results in decreasing the effective population size (a measure of its genetic behaviour, relative to that of an ideal population) (Hrabar *et al.* 2015; Hrabar and Kerley 2015; Hrabar and Kerley 2013; Hill 2009; Sasidharan *et al.* 2015; Moodley and Harley 2006; Frankham *et al.* 2002; Allendorf *et al.* 2012; Dalton *et al.* 2016; Akçakaya *et al.* 2007; Elmhage and Angerbjörn 2001; Hanski 1999; Olivier *et al.* 2009; Ginsberg *et al.* 1982; Lindenmayer and Burgman 2005; Novellie *et al.* 2002; Moehlman 2002; Watson *et al.* 2005; Watson and Chadwick 2007; Strauss 2015).

#### **4.2.7 CHALLENGE: To provide incentives for private land owners to maintain viable sub-populations of Cape mountain zebra**

Hunting, trading and stock accessibility, have been identified as potential Cape mountain zebra derived incentives. Conservation accreditation schemes, metapopulation participation and the provision of conservation management guidelines and support have also been identified as potential incentives, whereas strict policy and legislative requirements have been noted as disincentives. South Africa is very well positioned to accommodate international hunters, however CITES restrictions on trophy exports limits revenue potential and investment. Hunting advocates promote the importance of hunting for conservation in Africa, citing low off-takes, high prices and sustainability as incentives for the conservation of threatened species. Combining economic gain with conservation objectives are challenging for wildlife ranchers and strict conservation policies related to the stocking of Cape mountain zebra limits opportunities for wildlife ranchers to invest in the species, however, wildlife ranching is accredited with conservation successes for a number of species and contributing to landscape level conservation (Van Stittert 2005; Lindsey *et al.* 2007; Cousins *et al.* 2008; Du Toit 2012; Hrabar and Kerley 2015; Scientific Authority 2015).

#### **4.2.8 CHALLENGE: To consistently and uniformly implement legislation, policies and IUCN guidelines**

A concurrent legislative jurisdiction is exercised by the appointed agencies or departments of nine provinces, the national DEA and SANParks. Provinces have differing conservation legislations, policies, priorities and objectives and are funded via provincial treasuries aligned with the provincial priorities, resulting in variation in the allocation of capacity and resources for nature conservation. Collectively, the provinces have incorporated approximately 22 sets of nature conservation legislation, including decrees and tribal rules effected in previous homeland states. The concurrent competence issue (environment and nature conservation) between the national and provincial departments creates confusion for the public and potentially obscures specific mandates. The NEM: BA and its subsidiary legislation is implemented by the DEA as well as provinces and incorporates various mandatory obligations in terms of international conventions and agreements. The magnitude of legislation, processes and mandates may appear poorly aligned and inconsistently implemented, resulting in over or under regulation of specific activities towards different objectives, (Goitom 2013; Birss 2014; PMG 2014).

#### **4.2.9 CHALLENGE: To communicate and collaborate effectively among stakeholders**

The MZWG which was established in 1990, has not been officially active since 2006, but served as an engagement forum for interested and affected parties on aspects of mountain zebra conservation and management. An increase in the number of sub-populations of Cape mountain zebra on private land, an increased interest in utilisation of the species and the increased interest by NGO governing bodies within the wildlife industry in addition to the inactive MZWG, resulted in increased challenges for reconciling the objectives of conservation agencies with the objectives of wildlife ranchers, hunters, animal activists, animal welfare organisations and academia (Novellie *et al.* 2002; Hrabar and Kerley 2015; Scientific Authority 2015; Donian 2016 pers. comm.).

#### **4.2.10 CHALLENGE: To overcome management and capacity constraints**

Conservation management agencies are constrained by limited and decreasing funding for the implementation of conservation action plans, compliance and enforcement. Inadequate or inappropriate equipment, capacity and expertise within the formal conservation agency sector as well as in the private ranching sector encumbers effective management of some sub-populations. The deficiency of site-level management plans and an overall management strategy further disables effective and efficient metapopulation-oriented management of Cape mountain zebra sub-populations (Novellie *et al.* 2002; Lindsey *et al.* 2007; Cousins *et al.* 2008; Hrabar and Kerley 2013; Hrabar and Kerley 2015).

#### **4.2.11 CHALLENGE: To create awareness**

Cape mountain zebra are not currently perceived to have a conservation value. A major challenge in conservation is influencing people's behaviour. Most conservation issues are complicated and are seen by many people as a luxury, an irrelevance or a threat, despite the many benefits that it provides mankind. Cape mountain zebra has been identified as a flagship species to focus broader conservation marketing campaigns and foster awareness to gain public support, appreciation and a nurturing attitude towards Cape mountain zebra and its habitats (Smith *et al.* 2012; Hrabar and Kerley 2015).

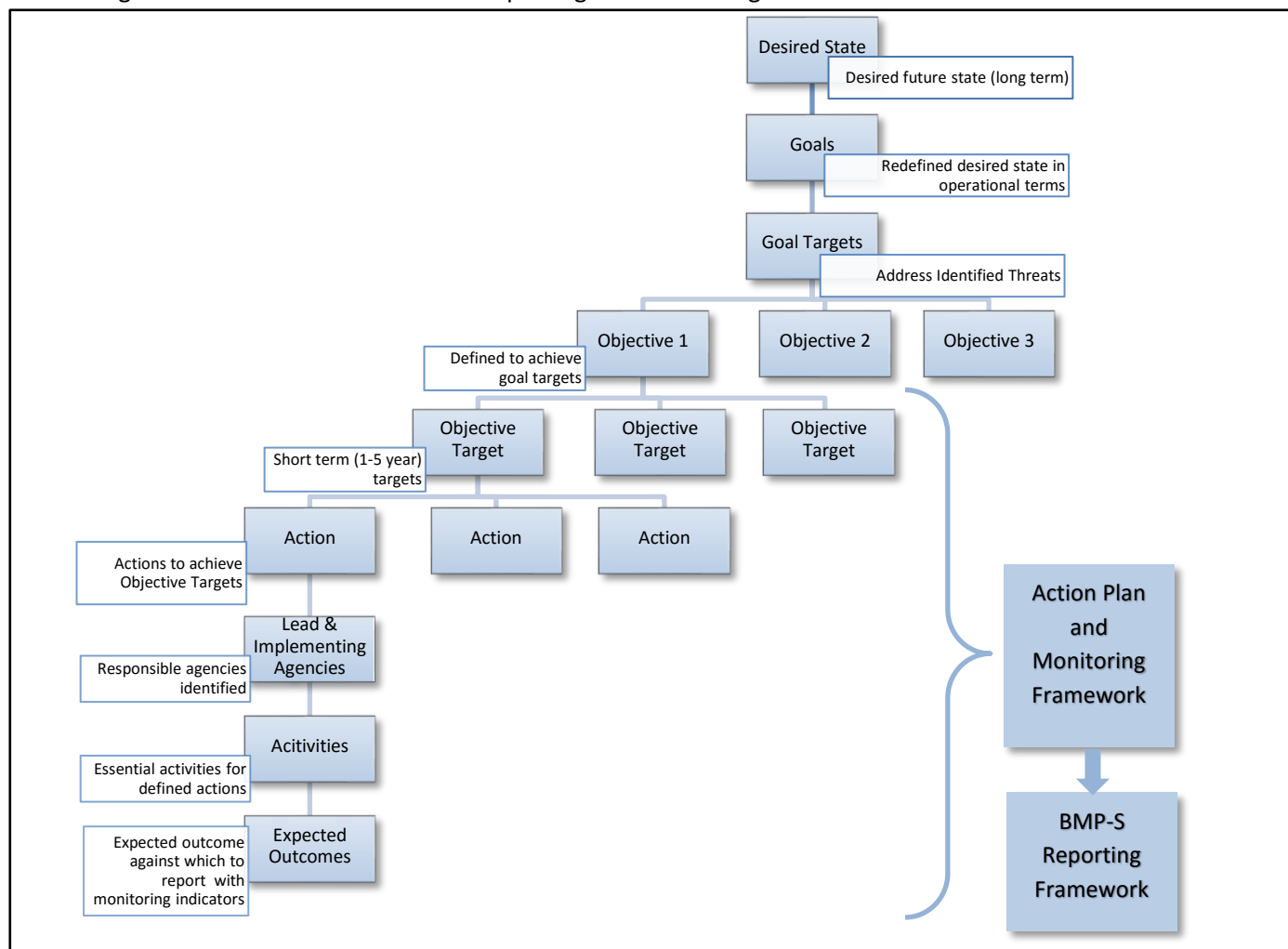
#### **4.2.12 CHALLENGE: To integrate conservation planning**

The existing network of protected areas, protected area expansion strategies and the establishment of connectivity corridors, do not adequately incorporate Cape mountain zebra metapopulation conservation objectives. The long term conservation of Cape mountain zebra requires connectivity of suitable habitat,

access to water and optimal forage across landscapes which needs to be incorporated into integrated conservation plans (i.e. identifying spatially explicit priorities and actions for the conservation of Cape mountain zebra) (Penzhorn and Novellie 1991; Winkler and Owen-Smith 1995; Margules and Pressey 2000; Kerley *et al.* 2003; Watson *et al.* 2005; Smith *et al.* 2007; Hurzuk 2009; Ryers *et al.* 2010; Kraaij and Novellie 2010; Watson *et al.* 2011; Smith *et al.* 2011; Hrabar and Kerley 2013; Birss and Schutte-Vlok 2015 pers. comm.; Strauss 2015; Hrabar and Kerley 2015; Lea *et al.* 2016; Birss *et al.* 2016).

## 5) ACTION PLAN AND MONITORING FRAMEWORK

The Cape mountain zebra BMP-S planning process is aligned to the framework provided by the SSC for species conservation planning. It has guided the stakeholder engagement and planning workshops in defining the objectives and actions for this BMP-S. The various workshop outputs have guided the compilation of the Action Plan and Monitoring Framework to enable effective reporting as shown in Figure 4.



**Figure 4:** Action Plan and Monitoring Framework derived from IUCN SSC schematic for species conservation planning methodology applied for this BMP-S.

## 5.1 OBJECTIVE 1: MAINTAIN GENETIC DIVERSITY IN THE CAPE MOUNTAIN ZEBRA META-POPULATION

To achieve the above objective, the following action plans have been developed for implementation through this BMP-S. These actions will need to be implemented by the identified lead and implementing agencies to mitigate the identified threats (inbreeding; population fragmentation; insecure habitat; and hybridisation) and challenges (implementation of metapopulation management; provision of incentives for private land owners; effective communication and collaboration among stakeholders; consistent and uniform implementation of legislation; management and capacity constraints; and the integration of conservation planning).

### 5.1.1 Objective target: Meta-population management

5.1.1.1 ACTION: ESTABLISH AND MAINTAIN A CENTRALISED NATIONAL CAPE MOUNTAIN ZEBRA POPULATION DATABASE.		
Lead agencies:	SANBI, CN, SANParks	
Implementing agencies:	NZG; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	1) Collate and update Cape mountain zebra distribution, population source, population dynamics, introductions and off-take data annually.	
Expected Outcome in 5 yrs.:	1) An up to date Cape mountain zebra distribution and population numbers database.	
Monitoring and Evaluation:	1) Effective sub-population reporting.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 1 year of gazetting BMP-S.	National centralised database established.
Challenges: NC DENC has capacity constraints.		

5.1.1.2 ACTION: DEVELOP AND IMPLEMENT A SOUND META-POPULATION MANAGEMENT GUIDELINE.		
Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	Higher Education Institutions (HEI)	
Essential activities:	1) Compile Cape mountain zebra meta-population management guidelines with clear objectives and principles for contributing sub-populations (including criteria for identifying source, sink and reinforcement sub-populations and meta-population management methodology); 2) Evaluate the status of all sub-populations and make recommendations for the management and contribution toward the objectives of the Cape mountain zebra meta-population.	
Expected Outcome in 5 yrs.:	1) Improved genetic diversity.	
Monitoring and Evaluation:	1) Number of meta-population strategy participants.	

Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 1 year of gazetting BMP-S; Meta-population guideline implemented within 3 years of gazetting BMP-S.	Meta-population management guideline developed and implemented
Challenges: NC DENC has capacity constraints.		

#### 5.1.1.3 ACTION: DEVELOP A LIST OF PRIORITY SITES FOR REINFORCEMENT AND RE-INTRODUCTION

Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	EWT; WRSA	
Essential activities:	1) Develop assessment guidelines for potential reinforcement and reintroduction sites; 2) Develop prioritisation guideline for potential Cape mountain zebra reinforcement and reintroduction sites; 3) Conduct site assessments and develop prioritised list of sites.	
Expected Outcome in 5 yrs.:	1) List of priority sites for reinforcement and reintroduction; 2) Cape mountain zebra re-introduction and re-enforcement site assessment guidelines.	
Monitoring and Evaluation:	1) Increased distribution of Cape mountain zebra sub-populations in the NDR towards conservation targets.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 1 year of gazetting BMP-S; Implementation within 2 years of gazetting BMP-S.	Priority sites identified, site assessment, prioritisation and conservation translocation guidelines developed and implemented.
Challenges: NC DENC has capacity constraints.		

#### 5.1.1.4 ACTION: ESTABLISH AND REINFORCE CAPE MOUNTAIN ZEBRA SUB-POPULATIONS ON PRIORITISED SITES.

Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	SANParks; CN; ECPTA	
Collaborators:	EWT	
Essential activities:	1) Develop and implement guidelines for the conservation translocations, establishment and monitoring of mixed source Cape mountain zebra sub-populations (informed by expert genetic management recommendations). 2) Translocate surplus available Cape mountain zebra from source sub-populations to identified priority sites, in accordance with meta-population management guidelines.	
Expected Outcome in 5 yrs.:	1) Increased Cape mountain zebra distribution and sub-population performance.	
Monitoring and Evaluation:	1) Increased establishment and reinforcement of Cape mountain zebra sub-populations.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Funds to be raised.	Within 2 years of gazetting BMP-S.	Cape mountain zebra sub-populations re-enforced and established; increased number of Cape mountain zebra in the NDR; increased average sub-populations size.
Challenges:		



### 5.1.2 Objective target: Conserve a genetically diverse meta-population

5.1.2.1 ACTION: INVESTIGATE THE GENETIC DIVERSITY OF THE CAPE MOUNTAIN ZEBRA META-POPULATION.		
Lead agencies:	NZG, CN, SANParks	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	<ol style="list-style-type: none"> <li>1) Collect samples and analyse data from maximum number of sub-populations;</li> <li>2) Research, develop and implement a cost-effective genetic sampling protocol, investigate non-invasive sampling techniques, prioritise sub-populations to be sampled and recommend minimum sample size per sub-population;</li> <li>3) Research and develop suitable genetic markers using modern technologies to conduct analyses of genetic diversity within sub-populations and consequences of implemented and proposed management actions.</li> </ol>	
Expected Outcome in 5 yrs.:	1) Baseline of genetic diversity within sub-populations.	
Monitoring and Evaluation:	<ol style="list-style-type: none"> <li>1) Increased sampling efficiency and efficacy;</li> <li>2) Reduced risks associated with invasive sampling techniques;</li> <li>3) Reliable, repeatable genetic test results achieved;</li> <li>4) Decreased risk of loss of allelic diversity;</li> <li>5) Improved sub-population performance.</li> </ol>	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazettement BMP-S; Consolidated baseline information within 5 years of gazettement BMP-S.	Standardised Protocols for genetic sampling; Standardised genetic diversity markers developed.
Challenges: NC DENC has capacity constraints.		

5.1.2.2 ACTION: MONITOR AND MANAGE THE IMPACTS OF META-POPULATION TRANSLOCATIONS ON GENETIC DIVERSITY.		
Lead agencies:	NZG, CN, SANParks	
Implementing agencies:	DEA: ToPS; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	<ol style="list-style-type: none"> <li>1) Research and develop appropriate monitoring framework to detect and predict potential impacts on the genetic diversity resulting from translocations, reinforcements and mixing or original source populations;</li> <li>2) Develop genetic management recommendations for reintroduced, reinforced and mixed sub-populations;</li> <li>3) Implement and monitor the effects of implementing genetic management recommendations for reintroduced, reinforced and mixed sub-populations.</li> </ol>	
Expected Outcome in 5 yrs.:	1) Sound meta-population management and translocations for improved sub-population performance.	
Monitoring and Evaluation:	<ol style="list-style-type: none"> <li>1) Decreased risk of loss of allelic diversity;</li> <li>2) Improved sub-population performance.</li> </ol>	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazettement BMP-S; Consolidated assessment after 5 years of gazettement BMP-S.	Monitoring framework, scientific genetic management and monitoring recommendations developed.
Challenges: NC DENC has capacity constraints.		

<b>5.1.2.3 ACTION: QUANTIFY THE EXTENT OF HYBRIDISATION OF CAPE MOUNTAIN ZEBRA WITH PZ, HMZ AND OTHER EQUIDS.</b>		
Lead agencies:	NZG, CN, SANParks	
Implementing agencies:	NZG; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	SANBI (on database development)	
Essential activities:	1) Collate and centralise distribution data for Cape mountain zebra, PZ and HMZ and known hybrids (Cape mountain zebra with PZ, other equids); 2) Research and develop standardised genetic markers to detect hybrids and genetic profiling for the assessment of genetic integrity; 3) Develop and maintain a centralised database of genetic sequences associated with sub-population distribution.	
Expected Outcome in 5 yrs.:	1) Quantified and effectively managed hybridisation risks.	
Monitoring and Evaluation:	1) Decrease in instances of hybridisation; 2) Eliminate translocation of hybrids.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazetting BMP-S; Genetic markers and profiling after 3 years of gazetting BMP-S.	Spatial dataset for distribution of Cape mountain zebra, PZ, and HMZ developed; standardised hybridisation detection and genetic profiling developed; genetic sequences database established.
Challenges: NC DENC has capacity constraints.		

<b>5.1.2.4 ACTION: CONDUCT RESEARCH TO QUANTIFY THE EXTENT AND SEVERITY OF POSSIBLE DISEASE OCCURRENCE IN CAPE MOUNTAIN ZEBRA.</b>		
Lead agencies:	NZG, CN, SANParks	
Implementing agencies:	NZG; SANParks; CN; ECPTA; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	1) Research and develop the screening of innate immunity genes in Cape mountain zebra to identify disease associated mutations as well as determine diversity of these genes; 2) Research and develop a genetic test for the screening of babesiosis in Cape mountain zebra; 3) Research and develop a genetic test to detect the prevalence and or presence of equine sarcoids in Cape mountain zebra.	
Expected Outcome in 5 yrs.:	1) Effective disease detection and quantified disease susceptibility of Cape mountain zebra sub-populations.	
Monitoring and Evaluation:	1) Known prevalence and distribution of disease; 2) Effective management of disease risk.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 2 years of gazetting BMP-S.	Standardised genetic tests for disease susceptibility and detection developed.
Challenges: NC DENC has capacity constraints.		

<b>5.1.2.5 ACTION: ASSESS THE REPRODUCTIVE FITNESS OF CAPE MOUNTAIN ZEBRA SUB-POPULATIONS.</b>		
Lead agencies:	NZG, CN, SANParks	
Implementing agencies:	NZG; SANParks; CN; ECPTA; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	1) Opportunistic research and develop reproductive fitness assessment of Cape mountain zebra: conduct fundamental and applied research to further knowledge and understanding of Cape mountain zebra reproduction and integrate results into management recommendations.	
Expected Outcome in 5 yrs.:	1) Sound meta-population management for improved reproductive fitness and sub-population performance.	
Monitoring and Evaluation:	1) Sub-populations' reproductive performance assessed.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Opportunistic (as animals become available).	Reproductive fitness assessment report for sampled sub-populations (opportunistic during translocations).
Challenges: NC DENC has capacity constraints. Access to animals and high cost and risk of moving animals, so optimise opportunity.		

### 5.1.3 Objective target: Safeguard Cape mountain zebra against hybridisation

<b>5.1.3.1 ACTION: MANAGE THE RISK OF HYBRIDISATION OF CAPE MOUNTAIN ZEBRA WITH PZ, HMZ AND OTHER EQUIDS.</b>		
Lead agencies:	SANParks, CN	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	1) Assess, quantify and prioritise Cape mountain zebra sub-populations at risk of hybridisation; 2) Develop a hybrid detection guideline based on phenotypic identification and traits.	
Expected Outcome in 5 yrs.:	1) Reduced risk of hybridisation for Cape mountain zebra sub-populations.	
Monitoring and Evaluation:	1) Decrease in hybridisation risk.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 1 year of gazetting BMP-S.	Cape mountain zebra sub-populations at risk of hybridisation assessed; hybridisation detection guideline developed (phenotypic assessment).
Challenges: NC DENC has capacity constraints.		

### 5.1.4 Objective target: Known impact of disease in Cape mountain zebra

<b>5.1.4.1 ACTION: IMPLEMENT A SARCOID SURVEILLANCE PROTOCOL LINKED TO THE NATIONAL CAPE MOUNTAIN ZEBRA POPULATION MONITORING DATABASE.</b>		
Lead agencies:	SANParks	
Implementing agencies:	CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	NZG; DAFF: State Veterinarian; DEA: ToPS	
Essential activities:	1) Develop and maintain a reporting protocol for sarcoidosis in Cape mountain zebra sub-populations;	

	2) Develop and implement Cape mountain zebra sarcoidosis post mortem protocol for collection and banking of relevant material with the NZG Biobank.	
Expected Outcome in 5 yrs.:	1) Known prevalence and distribution of disease, associated with understanding of genetic diversity of sub-populations.	
Monitoring and Evaluation:	1) Known prevalence and distribution of disease; 2) Disease risk mitigation.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazettement BMP-S.	Disease surveillance and post mortem protocols developed; Disease prevalence reported.
Challenges: NC DENC has capacity constraints.		

5.1.4.2. ACTION: PROMOTE AND FACILITATE RESEARCH ON CAPE MOUNTAIN ZEBRA PARASITE LOAD AND HOST-PATHOGEN INTERACTIONS.		
Lead agencies:	NZG	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	1) Research aetiological agents of disease to further knowledge and understanding of epidemiology.	
Expected Outcome in 5 yrs.:	1) Parasite prevalence data.	
Monitoring and Evaluation:	1) Known parasite load and distribution.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazettement BMP-S.	Parasite Load Assessments for sampled sub-populations (Opportunistic during translocations)
Challenges: NC DENC has capacity constraints.		

## 5.2 OBJECTIVE 2: UNDERTAKE MONITORING AND RESEARCH TO INFORM ADAPTIVE MANAGEMENT

To achieve the above objective, the following action plans have been developed for implementation through this BMP-S. These actions will need to be implemented by the identified lead and implementing agencies to mitigate the identified threats (inbreeding; habitat fragmentation and alteration; and hybridisation) and challenges (implementation of metapopulation management; effective communication and collaboration among stakeholders; management and capacity constraints; and the integration of conservation planning).

### 5.2.1 Objective target: Long term monitoring of Cape mountain zebra sub-populations

5.2.1.1 ACTION: IMPLEMENT STANDARDISED CAPE MOUNTAIN ZEBRA SURVEY AND MONITORING PROTOCOLS FOR PROTECTED AREAS TO INFORM ADAPTIVE MANAGEMENT.	
Lead agencies:	CN, SANParks, ECPTA
Implementing agencies:	SANParks; CN; ECPTA; FS DESTEA; NC DENC
Collaborators:	SANBI
Essential activities:	1) Develop standardised data collection and population monitoring protocols for Cape mountain zebra sub-populations on protected areas (incorporating the guidelines compiled by the MZWG);

	2) Develop standardised population monitoring protocols for Cape mountain zebra sub-populations on private land (incorporating the guidelines compiled by the MZWG); 3) Conduct regular standardised sub-population assessments according to guidelines (precision based, game census).	
Expected Outcome in 5 yrs.:	1) Quality population monitoring data to inform assessments of sub-population performance and determination of off-take quotas.	
Monitoring and Evaluation:	1) Improved and consistent population trend monitoring and reporting.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funds to be raised for total census.	Initiate within 1 year of gazettement BMP-S; Total census conducted at least once per sub-population in 5 years.	Precision based total census of protected areas with Cape mountain zebra; Standardised data collection and population monitoring protocols developed and implemented.
Challenges: NC DENC has capacity constraints.		

5.2.1.2 ACTION: IMPLEMENT RESEARCH ON HABITAT MANAGEMENT (INCLUDING IMPROVEMENT AND REHABILITATION) FOR CAPE MOUNTAIN ZEBRA.		
Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	SANParks; CN; ECPTA; FS DESTEA; NC DENC	
Collaborators:	Manchester University, EWT	
Essential activities:	1) Facilitate research to inform appropriate Cape mountain zebra habitat management, (incorporate fire, alien vegetation, predation and game stocking where applicable). 2) Implement best-practice and research findings for integrated fire-alien vegetation-game stocking-predation for Cape mountain zebra habitat management.	
Expected Outcome in 5 yrs.:	1) Applied research informing management actions for Cape mountain zebra sub-populations.	
Monitoring and Evaluation:	1) Research publications, draft publications and reports.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Research funding to be sourced.	Initiate within 1 year of gazettement BMP-S.	Applied research on habitat management conducted, informs adaptive management of Cape mountain zebra sub-population sites.
Challenges: NC DENC has capacity constraints.		

5.2.1.3 ACTION: SUBMIT ANNUAL CAPE MOUNTAIN ZEBRA SUB-POPULATION STATUS REPORTS.		
Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	SANBI	
Essential activities:	1) Develop and implement standardised annual reporting formats for Cape mountain zebra sub-populations; 2) Collate sub-population status reports and analyse overall meta-population performance.	
Expected Outcome in 5 yrs.:	1) Quality population data to inform conservation assessments.	
Monitoring and Evaluation:	1) Improved meta-population performance. 2) Improved knowledge and understanding of meta-population performance.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 1 year of gazettement BMP-S; Annually.	Standardised reporting formats developed and implemented.
Challenges: NC DENC has capacity constraints.		

<b>5.2.1.4 ACTION: ASSESS POPULATION PERFORMANCE AND HABITAT CONDITION FOR CAPE MOUNTAIN ZEBRA ON PRIVATE LAND.</b>		
Lead agencies:	CN, EC DEDEAT	
Implementing agencies:	CN; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	SANBI; SANParks; ECPTA; HEI; EWT	
Essential activities:	1) Regulatory agencies to develop and implement standardised habitat and population assessments for Cape mountain zebra on private land (incorporating the guidelines compiled by the MZWG); 2) Conduct assessment of habitat quality, habitat area availability, intra-specific competition and water availability for Cape mountain zebra sub-populations on private land.	
Expected Outcome in 5 yrs.:	1) Quality population and habitat conditions data to inform conservation assessments.	
Monitoring and Evaluation:	1) Improved meta-population performance; 2) Maintenance of ecological processes.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 2 years of gazetting BMP-S.	Standardised habitat and population assessments for Cape mountain zebra on private land developed and implemented.
Challenges: NC DENC has capacity constraints.		

### 5.3 OBJECTIVE 3: CONSISTENTLY AND UNIFORMLY IMPLEMENT LEGISLATION, REGULATIONS, POLICIES AND GUIDELINES

To achieve the above objective, the following action plans have been developed for implementation through this BMP-S. These actions will need to be implemented by the identified lead and implementing agencies to mitigate the identified threats (insecure habitat; and hybridisation) and challenges (provision of incentives for private land owners; effective communication and collaboration among stakeholders; consistent and uniform implementation of legislation; and management and capacity constraints).

#### 5.3.1 Objective target: Consistent and uniform development and implementation of legislation and policy.

<b>5.3.1.1 ACTION: DEVELOP NATIONAL TRANSLOCATION GUIDELINES</b>		
Lead agencies:	CN, SANParks, DEA: ToPS	
Implementing agencies:	DEA: ToPS; NZG; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	EWT	
Essential activities:	1) Develop a national guideline to avoid and manage the risks of Cape mountain zebra hybridising with PZ, HMZ and other equids, including mitigation of hybridisation risks to be implemented in the event of escapes from protected areas and stewardship (including custodianship) sites; 2) Develop and implement a national protocol for DNA sampling, testing and reporting on hybridisation; 3) Develop a national translocation guideline (Norms and Standards in terms of section 9, read with section 100, of NEM: BA, which includes a requirement for genetic testing and translocation policy) for Cape mountain zebra, incorporating the risks posed by AHS on translocations.	
Expected Outcome in 5 yrs.:	1) Appropriate regulatory measures developed and gazetted to reduce hybridisation and genetic risks to Cape mountain zebra sub-populations.	



<b>Monitoring and Evaluation:</b> 1) Uniform policy and regulation.		
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazettement BMP-S; Norms and Standards after 5 years of gazettement BMP-S.	National guidelines and protocols for avoiding and mitigating the risks of hybridisation developed; National norms and standards for translocation of Cape mountain zebra developed.
Challenges: NC DENC has capacity constraints.		

<b>5.3.1.2 ACTION: IMPLEMENT AN ADAPTIVE MANAGEMENT STRATEGY FOR SUSTAINABLE OFF-TAKES OF CAPE MOUNTAIN ZEBRA CAPE MOUNTAIN ZEBRA</b>		
Lead agencies:	SANBI, CN, SANParks	
Implementing agencies:	SANParks; CN; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	DEA; ECPTA	
Essential activities:	1) Develop an appropriate adaptive MSE model for determining sustainable Cape mountain zebra hunting quotas; CITES removed so that local and international hunting (removal of the animal) is captured 2) Develop and implement standardised site-level decision support and assessment models for evaluating and advising on the potential site level impacts of off-takes.	
Expected Outcome in 5 yrs.:	1) Sustainable off-takes and management of Cape mountain zebra sub-populations.	
Monitoring and Evaluation:	1) Trophy hunting exports. 2) Permits issued for translocation or hunting.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Within 1 year of gazettement BMP-S.	A system for the allocation of CITES hunting quota; Site level off-take assessment model developed.
Challenges: NC DENC has capacity constraints.		

#### **5.4 OBJECTIVE 4: EFFECTIVELY COMMUNICATE, COLLABORATE AND COORDINATE BETWEEN STAKEHOLDERS AND THE PUBLIC FOR CAPE MOUNTAIN ZEBRA CONSERVATION**

To achieve the above objective, the following action plans have been developed for implementation through this BMP-S. These actions will need to be implemented by the identified lead and implementing agencies to mitigate the identified threats (inbreeding; habitat and population fragmentation; insecure and altered habitat; and hybridisation) and challenges (implementation of metapopulation management; provision of incentives for private land owners; effective communication and collaboration among stakeholders; consistent and uniform implementation of legislation; management and capacity constraints; integration of conservation planning; and increasing awareness).

### 5.4.1 Objective target: Establish and maintain partnerships for Cape mountain zebra conservation.

5.4.1.1 ACTION: FORMALISE INTER-AGENCY COLLABORATION TO COORDINATE AND REVIEW THE IMPLEMENTATION OF THE CAPE MOUNTAIN ZEBRA BMP-S.		
Lead agencies:	DEA: BC	
Implementing agencies:	CN; SANParks; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:		
Essential activities:	<ol style="list-style-type: none"> <li>1) Establish a Steering Committee for the implementation and review of the Cape mountain zebra BMP-S;</li> <li>2) Develop Steering Committee terms of reference and reporting framework;</li> <li>3) Develop and implement an inter-agency capacity development and exchange strategy;</li> <li>4) Draft an inter-agency MOU for the exchange, and or donation of Cape mountain zebra to attain the objectives of the Cape mountain zebra BMP-S.</li> </ol>	
Expected Outcome in 5 yrs.:	1) Effective, collaborative coordination among stakeholders.	
Monitoring and Evaluation:	1) Steering Committee Terms of Reference; Inter Agency MOUs.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funding to be raised to enable agency capacity building and knowledge exchange.	Initiate within 1 year of gazetting BMP-S.	Cape mountain zebra BMP-S Steering Committee established; Inter-agency capacity developed; Cape mountain zebra sourced and donated.
Challenges: NC DENC has capacity constraints.		

5.4.1.2 ACTION: ENGAGE AND COLLABORATE WITH STAKEHOLDERS TO ACHIEVE THE OBJECTIVES OF THE CAPE MOUNTAIN ZEBRA BMP-S.		
Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	DEA; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	Private Sector; WRSA; NZG	
Essential activities:	<ol style="list-style-type: none"> <li>1) Evaluate the potential for and implement custodianship agreements and fence-permeability agreements for Cape mountain zebra sub-populations exposed to habitat availability pressure;</li> <li>2) Communicate Cape mountain zebra BMP-S aligned research, implementation progress, research needs and requirements to stakeholders, research partners and research institutions;</li> <li>3) Compile a Cape mountain zebra driven People and Parks conservation strategy.</li> <li>4) Investigate and report on National Biodiversity Economy Strategy (BES) ventures appropriate for Cape mountain zebra.</li> </ol>	
Expected Outcome in 5 yrs.:	1) Cape mountain zebra sub-populations secured on good habitat and effectively managed; Knowledge generated and disseminated.	
Monitoring and Evaluation:	1) Agreements and MOUs signed; Research and People and Parks projects implemented.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget	Initiate within 1 year of gazetting BMP-S.	Stewardship; Custodianship agreements; Collaborative research projects; People and Parks projects implemented; identified BES ventures implemented.
Challenges: NC DENC has capacity constraints.		

<b>5.4.1.3 ACTION: IMPLEMENT HABITAT EXPANSION THROUGH STEWARDSHIP, CUSTODIANSHIP AND CONNECTIVITY CORRIDORS.</b>		
Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	EWT; WWF; DEA: BC	
Essential activities:	1) Integrate Cape mountain zebra habitat requirements into conservation planning processes and identify priority Cape mountain zebra habitat sites at provincial and national level to inform expansion and custodianship initiatives; 2) Prioritise and implement Cape mountain zebra stewardship and custodianship agreements at priority sites; 3) Purchase suitable land for Cape mountain zebra habitat expansion.	
Expected Outcome in 5 yrs.:	1) Cape mountain zebra sub-populations secured on good habitat and effectively managed.	
Monitoring and Evaluation:	1) Integrated conservation planning with Cape mountain zebra habitat priorities; 2) Cape mountain zebra habitat expansion and land acquisition.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funding to be raised for land acquisitions.	Initiate within 1 year of gazetting BMP-S.	Integrated conservation planning, prioritised Cape mountain zebra stewardship and land acquisition sites identified.
Challenges: NC DENC has capacity constraints.		

#### **5.4.2 Objective target: Increase private sector investment and support for Cape mountain zebra conservation.**

<b>5.4.2.1 ACTION: DEVELOP INCENTIVES FOR STAKEHOLDERS TO PARTICIPATE IN AND CONTRIBUTE TO ACHIEVING THE OBJECTIVES OF THE CAPE MOUNTAIN ZEBRA BMP-S.</b>		
Lead agencies:	CN, SANParks, ECPTA	
Implementing agencies:	DEA: BC; NZG; SANBI; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	
Collaborators:	EWT; Private Sector, WRSA; Birdlife; DEA: ToPS	
Essential activities:	1) Investigate and develop appropriate incentives for participation in Cape mountain zebra conservation, in consultation with stakeholders;	
Expected Outcome in 5 yrs.:	1) Increased participation in Cape mountain zebra conservation by private land owners.	
Monitoring and Evaluation:	1) Distribution of Cape mountain zebra sub-populations - number of properties and extent of occurrence.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funding to be raised for stakeholder workshops.	Within 1 year of gazetting BMP-S.	Incentives schemes developed for participation in Cape mountain zebra conservation, BES ventures implemented.
Challenges: NC DENC has capacity constraints.		

<b>5.4.2.2 ACTION: DEVELOP INCENTIVES FOR THE EFFECTIVE IMPLEMENTATION OF THE META-POPULATION MANAGEMENT STRATEGY BY ALL STAKEHOLDERS.</b>	
Lead agencies:	CN, SANParks, ECPTA
Implementing agencies:	DEA: BC; SANParks; CN; ECPTA; EC DEDEAT; NC DENC
Collaborators:	
Essential activities:	1) Develop and implement Cape mountain zebra meta-population custodianship endorsement scheme.
Expected Outcome in 5 yrs.:	1) Increased participation by Cape mountain zebra custodians.

<b>Monitoring and Evaluation:</b> 1) Distribution of Cape mountain zebra sub-populations - number of properties and extent of occurrence.		
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funding to be raised for stakeholder workshops.	Within 2 years of gazetting BMP-S.	Cape mountain zebra meta-population custodians endorsed.
Challenges: NC DENC has capacity constraints.		

<b>5.4.2.3 ACTION: DEVELOP INCENTIVES FOR THE EFFECTIVE AVERSION AND MITIGATION OF CAPE MOUNTAIN ZEBRA HYBRIDISATION THREATS.</b>		
<b>Lead agencies:</b>	CN, SANParks, ECPTA	
<b>Implementing agencies:</b>	SANParks; CN; ECPTA; EC DEDEAT; NC DENC	
<b>Collaborators:</b>	Private Sector; WRSA	
<b>Essential activities:</b>	1) Investigate, develop and implement incentives for extirpation of HMZ from prioritised areas in the Cape mountain zebra NDR.	
<b>Expected Outcome in 5 yrs.:</b>	1) Increased participation in Cape mountain zebra conservation by private land owners and other stakeholders.	
<b>Monitoring and Evaluation:</b>	1) Distribution of Cape mountain zebra sub-populations - number of properties and extend of occurrence.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funding to be raised for stakeholder workshops.	Within 3 years of gazetting BMP-S.	Extirpation of HMZ and Cape mountain zebra hybrids in priority Cape mountain zebra areas.
Challenges: NC DENC has capacity constraints.		

**5.4.3 Objective target: Increase public awareness and education on the status and threats facing Cape mountain zebra.**

<b>5.4.3.1 ACTION: IMPLEMENT ENVIRONMENTAL EDUCATION AND EXTENSION INITIATIVES TO PROMOTE AWARENESS ON THE STATUS AND THREATS FACING CAPE MOUNTAIN ZEBRA.</b>		
<b>Lead agencies:</b>	CN, SANParks	
<b>Implementing agencies:</b>	SANParks; CN; ECPTA; NC DENC	
<b>Collaborators:</b>	NZG; EWT	
<b>Essential activities:</b>	1) Develop resources and tools to facilitate environmental education and extension, focussing on the status and threats facing Cape mountain zebra; 2) Incorporate Cape mountain zebra as a case study in environmental education initiatives, i.e. the Green Matter Gamification Initiative.	
<b>Expected Outcome in 5 yrs.:</b>	1) Increased awareness of stakeholders and public on the importance of Cape mountain zebra as an indicator species.	
<b>Monitoring and Evaluation:</b>	1) Resources and tools developed and number of people targeted.	
Funding / Resources	Timeframe	Measurable Indicators / Outputs
Agency operational budget; Supplementary funding to be raised for environmental education activities.	Within 2 years of gazetting BMP-S.	Resources and tools developed for environmental education and extension; environmental education activities conducted.
Challenges: NC DENC has capacity constraints.		

## 6) CAPE MOUNTAIN ZEBRA BMP-S REPORTING FRAMEWORK

Below is the outline of the reporting framework based on the draft provided by DEA. It indicates the actions and the responsible reporting agencies.

ACTIONS	RESPONSIBLE AGENCY	TIMELINE	RESOURCES NEEDED	IMPLEMENTING AGENCIES / COLLABORATORS	DELIVERABLES	MEASURABLE OUTCOMES	PROGRESS	CHALLENGES / CORRECTIVE MEASURES
<b>OBJECTIVE 1</b>	<u>MAINTAIN GENETIC DIVERSITY IN THE CAPE MOUNTAIN ZEBRA META-POPULATION</u>							
<b>Objective Target 1.1</b>	Meta-population management							
1.1.1 Maintain a centralised national Cape mountain zebra population database.	SANBI, CN, SANParks			NZG; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	Spatial Cape mountain zebra distribution databases	National centralised database established		
1.1.2 Develop and implement a sound meta-population management guideline.	CN, SANParks, ECPTA			CN; SANParks; ECPTA; EC DEDEAT; FS DESTEA; NC DENC; HEI	Meta-population management guideline; Assessment of sub-populations	Meta-population management guideline developed and implemented		
1.1.3 Develop a list of priority sites for reinforcement and reintroduction.	CN, SANParks, ECPTA			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC; EWT; WRSA	Priority sites identified; Site assessment, translocation and prioritisation guideline	Priority sites identified; Increased distribution of Cape mountain zebra sub-populations in NDR		
1.1.4 Establish and reinforce Cape mountain zebra sub-populations on prioritised sites.	CN, SANParks, ECPTA			SANParks; CN; ECPTA; EWT	Translocation of Cape mountain zebra to priority sites	Increased distribution of viable Cape mountain zebra sub-populations		
<b>Objective Target 1.2</b>	Conserve genetically diverse meta-population							
1.2.1 Investigate the genetic diversity of the Cape mountain zebra meta-population.	NZG, CN, SANParks			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	Genetic sampling protocol; Genetic markers developed; Samples collected.	Baseline of genetic diversity in sub-populations		
1.2.2 Monitor and manage the impacts of meta-population translocations on genetic diversity	NZG, CN, SANParks			SANParks; CN; DEA; ToPS; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	Genetic monitoring framework and management recommendations	Sound meta-population translocations		
1.2.3 Quantify the extent of hybridisation of Cape	NZG, CN, SANParks			NZG; SANParks; CN; ECPTA; EC DEDEAT;	Centralised distribution data for Cape mountain zebra, HMZ and PZ;	Managed hybridisation risk		

ACTIONS	RESPONSIBLE AGENCY	TIMELINE	RESOURCES NEEDED	IMPLEMENTING AGENCIES / COLLABORATORS	DELIVERABLES	MEASURABLE OUTCOMES	PROGRESS	CHALLENGES / CORRECTIVE MEASURES
mountain zebra with PZ, HMZ and other equids.				FS DESTEA; NC DENC	Genetic markers for hybridisation; Genetic sequence database			
1.2.4 Conduct research to quantify the extent and severity of possible disease occurrence in Cape mountain zebra.	NZG, CN, SANParks			NZG; SANParks; CN; ECPTA; FS DESTEA; NC DENC	Innate immunity genes screened; genetic tests for babesiosis and sarcoidosis	Disease risk mitigated		
1.2.5 Assess the reproductive fitness of Cape mountain zebra sub-populations.	NZG, CN, SANParks			NZG; SANParks; CN; ECPTA; FS DESTEA; NC DENC	Reproductive fitness of Cape mountain zebra sub-populations assessed	Improved reproductive fitness in Cape mountain zebra sub-populations		
<b>Objective Target 1.3</b>	<b>Safeguard Cape mountain zebra against hybridisation</b>							
1.3.1 Manage the risk of hybridisation of Cape mountain zebra with PZ, HMZ and other equids.	SANParks, CN			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	Hybrid detection and hybrid risk assessment protocols	Decrease in instances of hybridisation		
<b>Objective Target 1.4</b>	<b>Known impact of disease in Cape mountain zebra</b>							
1.4.1 Implement a sarcoid surveillance protocol linked to the national Cape mountain zebra population monitoring database.	SANParks			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC; NZG; DAFF: State Veterinarian; DEA: ToPS	Sarcoid surveillance	Disease prevalence and impact documented		
1.4.2 Promote and facilitate research on Cape mountain zebra parasite load and host-pathogen interactions.	NZG			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	Parasite load assessments and epidemiology research	Research outputs		
<b>OBJECTIVE 2</b>	<b>IMPLEMENT MONITORING AND RESEARCH TO INFORM ADAPTIVE MANAGEMENT</b>							
<b>Objective Target 2.1</b>	<b>Long term monitoring of Cape mountain zebra sub-populations</b>							
2.1.1 Implement standardised Cape mountain zebra survey and monitoring protocols for protected	CN, SANParks, ECPTA			SN; SANParks; ECPTA; FS DESTEA; NC DENC; SANBI	Precise game censuses; standardised monitoring protocols	Accurate population trend data		



ACTIONS	RESPONSIBLE AGENCY	TIMELINE	RESOURCES NEEDED	IMPLEMENTING AGENCIES / COLLABORATORS	DELIVERABLES	MEASURABLE OUTCOMES	PROGRESS	CHALLENGES / CORRECTIVE MEASURES
areas to inform adaptive management.								
2.1.2 Implement research on habitat management (including improvement and rehabilitation) for Cape mountain zebra.	CN, SANParks, ECPTA			CN; SANParks; ECPTA; FS DESTEA; NC DENC, Manchester University; EWT	Research informing and implementation of integrated habitat management for Cape mountain zebra	Research publications; Improved habitat management		
2.1.3 Submit annual Cape mountain zebra sub-population status reports.	CN, SANParks, ECPTA			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC; SANBI	Standardised annual reporting and status reports	Quality Cape mountain zebra sub-population data		
2.1.4 Assess population performance and habitat condition for Cape mountain zebra on private land.	CN, EC DEDEAT			CN; EC DEDEAT; FS DESTEA; NC DENC; SANBI; SANParks; ECPTA; HEI; EWT.	Standardised habitat and population assessments for introductions	Viable populations introduced		
<b>OBJECTIVE 3</b>	<u>CONSISTENTLY AND UNIFORMLY DEVELOP AND IMPLEMENT LEGISLATION, REGULATIONS, POLICIES AND GUIDELINES</u>							
<b>Objective Target 3.1</b>	Consistent and uniform implementation of legislation and policy							
3.1.1 Develop national translocation guidelines.	CN, SANParks, DEA: ToPS			DEA: ToPS; NZG; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC; EWT	National guidelines for mitigation of hybridisation risk, DNA testing and translocation of Cape mountain zebra	Uniform policy and regulation – managed hybridisation risk		
3.1.2 Implement an adaptive management strategy for sustainable off-takes of Cape mountain zebra.	SANBI, CN, SANParks			SANParks; CN; EC DEDEAT; FS DESTEA; NC DENC; DEA; ECPTA	MSE for sustainable harvesting and Cape mountain zebra quotas	Sustainable hunting quotas		
<b>OBJECTIVE 4</b>	<u>EFFECTIVELY COMMUNICATE, COLLABORATE AND COORDINATE BETWEEN STAKEHOLDERS AND THE PUBLIC FOR CAPE MOUNTAIN ZEBRA CONSERVATION</u>							
<b>Objective Target 4.1</b>	Establish and maintain partnerships for Cape mountain zebra conservation							
4.1.1 Formalise inter-agency collaboration to coordinate and review the implementation of the	DEA: BC			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEA; NC DENC	Cape mountain zebra BMP-S Steering Committee; Inter-agency MOU and capacity exchange	Inter-agency collaboration		

ACTIONS	RESPONSIBLE AGENCY	TIMELINE	RESOURCES NEEDED	IMPLEMENTING AGENCIES / COLLABORATORS	DELIVERABLES	MEASURABLE OUTCOMES	PROGRESS	CHALLENGES / CORRECTIVE MEASURES
Cape mountain zebra BMP-S.								
4.1.2 Engage and collaborate with stakeholders to achieve the objectives of the Cape mountain zebra BMP-S.	CN, SANParks, ECPTA			DEA; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEAT; NC DENC; Private Sector; WRSA; NZG	Stewardship; Custodianship agreements; MOUs; Research partnerships	Stakeholder participation in Cape mountain zebra conservation		
4.1.3 Implement habitat expansion through stewardship, custodianship and connectivity corridors	CN, SANParks, ECPTA			SANParks; CN; ECPTA; EC DEDEAT; FS DESTEAT; NC DENC; EWT; WWF; DEA: BC	Integrated conservation plans informing stewardship and land acquisition	Stewardship agreements and land acquisition for Cape mountain zebra conservation		
<b>Objective Target 4.2</b> Increase private sector investment and support for Cape mountain zebra conservation								
4.2.1 Develop incentives for stakeholders to participate in and contribute to achieving the objective of the Cape mountain zebra BMP-S.	CN, SANParks, ECPTA			DEA: BC; NZG; SANBI; SANParks; CN; ECPTA; EC DEDEAT; FS DESTEAT; NC DENC; EWT; Private Sector; WRSA; Birdlife; DEA: ToPS	Stakeholder consultations and participation in BES ventures	Incentives developed		
4.2.2 Develop incentives for the effective implementation of the meta-population management strategy by all stakeholders.	CN, SANParks, ECPTA			DEA: BC; SANParks; CN; ECPTA; EC DEDEAT; NC DENC	Custodianship endorsements	Cape mountain zebra meta-population custodianships		
4.2.3 Develop incentives for the effective aversion and mitigation of Cape mountain zebra hybridisation threats.	CN, SANParks, ECPTA			SANParks; CN; ECPTA; EC DEDEAT; NC DENC; Private Sector; WRSA	Incentives for HMZ extirpation from Cape mountain zebra NDR	Incentives developed		

Objective Target 4.3	Increase public awareness and education on the status and threats facing Cape mountain zebra							
4.3.1 Implement environmental education and extension initiatives to promote awareness on the status and threats facing Cape mountain zebra.	CN, SANParks			SANParks; CN; ECPTA; NC DENC; NZG; EWT	Environmental education and awareness incentives	Environmental education and awareness tools; Target groups engaged		

## 7) REFERENCES

- De Alcântara B.K., Alfieri A.A., Headley S.A., Rodrigues W.B., Otonel R.A.A., Lunardi M. and Alfieri A.F. 2015. Molecular characterization of bovine Deltapapillomavirus (BPV1, 2, and 13) DNA in equine sarcoids. *Pesquisa Veterinária Brasileira* 35(5):431-436. Brazil.
- Allendorf, F.W., Luikart, G.H. and Aitken, S.N. 2012. *Conservation and the Genetics of Populations*. Blackwell Publishing. Hoboken, United States.
- Akçakaya, H.R., Mills, G. and Doncaster, C.P. 2007. The role of metapopulations in conservation. In: *Key Topics in Conservation Biology* (Ed. by D. Macdonald and K. Service), pp. 64–84. Blackwell Publishing, Oxford, UK.
- Barry, T., Schutte-Vlok, A. and Wheeler, A.D. 2016. Gamkaberg World Heritage Site and Nature Reserve Complex: Protected Area Management Plan. Unpublished report, CapeNature, Cape Town.
- Biggs, R., M. Schlüter, D. Biggs, E.L. Bohensky, S. Burnsilver, G. Cundill, V. Dakos, T. Daw, L. Evans, K. Kotschy, A. Leitch, C. Meek, A. Quinlan, C. Raudsepp-Hearne, M. Robards, M.L. Schoon, L. Schultz and P.C. West. 2012. Towards principles for enhancing the resilience of ecosystem services. *Annual Review of Environment and Resources* 37, 421-448.
- Birss, C., Rushworth, I., Peinke, D. and Buijs, D. 2015. Inferred Natural Distribution Ranges of Large Mammals in South Africa. Unpublished GIS coverage.
- Birss, C., Saul, L. and Schutte-Vlok, A. 2016. Draft CapeNature Report: A method for assessing potential re-introduction sites for Cape mountain zebra in the Western Cape Province.
- Birss, C. 2014. Conservation in a Regulatory Framework in: Kotze, A., Lane, E. and Nxomani, C. (eds). *One Health*. Centre for Wildlife Health, National Zoological Garden of South Africa, Pretoria. ISBN: 978-0-620-59504-9.
- Boshoff, A.F. Landman, M. and Kerley, G.I.H. 2015. Filling the gaps on the maps: historical distribution patterns of some larger mammals in part of southern Africa. *Transactions of the Royal Society of South Africa*. University of South Africa Press, Pretoria.
- Convention on Biological Diversity. 2013. <https://www.cbd.int/sp/elements/default.shtml>; <https://www.cbd.int/sp/targets/> and <https://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf> downloaded on 21 June 2016.
- Chadwick, P. and Watson, L. H. 2007. Management of Cape mountain zebra in the Kammanassie Nature Reserve, South Africa. *South African Journal of Wildlife Research* 37: 31-39.
- Chaffin, B. C., H. Gosnell, and B. A. Cosens. 2014. A decade of adaptive governance scholarship: synthesis and future directions, *Ecology and Society* 19(3): 56. <http://dx.doi.org/10.5751/ES-06824-190356>.
- Cilliers, P., H. C. Biggs, S. Blignaut, A. G. Choles, J. S. Hofmeyr, G. P. W. Jewitt, and D. J. Roux. 2013. Complexity, modeling, and natural resource management. *Ecology and Society* 18(3): 1. <http://dx.doi.org/10.5751/ES-05382-180301>.
- Cleaver, G. 2004. Environmental impacts of large-scale groundwater abstraction on eco-systems of the Kammanassie Mountain. M. Tech. thesis. University of South Africa. Pretoria.
-

Cleaver, G., Brown, L.R., Bredenkamp, G.J., Smart, M. and Rautenbach, C.J. de W., 2003. Assessment of environmental impacts of groundwater abstraction from Table Mountain Group (TMS) Aquifers on ecosystems in the Kammanassie Nature Reserve and environs. Water Research Commission Report No. 1115/1/03.

Clinchy, M., Haydon, D.T. and Smith, A.T. (2002) Pattern does not equal process: what does patch occupancy really tell us about metapopulation dynamics? *The American Naturalist*, 159, 351–362

Cousins, J.A., Sadler, J.P. and Evans, J. 2008. Exploring the role of private wildlife ranching as a conservation tool in South Africa: stakeholder perspectives. *Ecology and Society* 13 (2): 43.

Dalton, D.L., Zimmerman, D., Mnisi, C., Taplin, M., Novellie, P., Hrabar, H. and Kotze, A. in press. Hiding in plain sight: evidence of hybridisation between Cape mountain and plains zebra.

Dietz, T., E. Ostrom, and P. C. Stern. 2003. The struggle to govern the commons. *Science* 302:1907-1912. <http://dx.doi.org/10.1126/science.1091015>.

Doremus, H. 2001. Adaptive Management, the Endangered Species Act, and the Institutional Challenges of New Age Environmental Protection, *Washburn Law Journal* 41: 50-89, Available at: <http://scholarship.law.berkeley.edu/facpubs/973>.

Du Toit, J.G. and Van Schalkwyk, O.L. 2012. How to improve wildlife production in South Africa. Unpublished Report. Pretoria.

Elmhagen, B. and Angerbjörn, A. 2001. The applicability of metapopulation theory to large mammals. *Oikos*, 94, 89–100.

Frankham, R., Ballou, J.D. and Briscoe, D.A. 2002. *Introduction to Conservation Genetics*. Cambridge University Press. Cambridge. United Kingdom.

Friedman, Y. and Daly, B. 2004. *Red Data Book of the Mammals of South Africa: A Conservation Assessment*. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa

Ginzberg, L.R., Slobodkin, L.B., Johnson, K. and Bindman, A.G., 1982. Quasi-extinction probabilities as a measure of impact on population growth. *Risk Anal.* 2: 171–181.

Goitom, H. 2013. *Wildlife Trafficking and Poaching: South Africa*. The Law Library of Congress. <https://www.loc.gov/law/help/wildlife-poaching/southafrica.php> Accessed on 17 February 2016.

Gray, A.P. 1971. *Mammalian Hybrids – A Checklist with Bibliography*. Commonwealth Agricultural Bureaux. Farnham Royal, Slough SL2 3BN. England.

Green, O.O. and Garmestani, A.S. 2011, Adaptive Management to Protect Biodiversity: Best Available Science and the Endangered Species Act, *Diversity* 4, 164-178; doi:10.3390/d4020164.

Groves, C.P. and Bell, C.H. 2004. New investigations on the taxonomy of the zebras genus *Equus*, subgenus *Hippotigris*. *Mammalian Biology*, 69: 182 - 196.

Hanski, I. 1999. *Metapopulation Ecology*. Oxford University Press, Oxford, UK.

Hill, A.H. 2009. Is isolation the major genetic concern for endangered equids? *Animal Conservation* 12: 518 – 519. The Zoological Society of London.

- Hrabar, H. and Kerley, G.I.H. 2013. Conservation goals for the Cape mountain zebra *Equus zebra zebra* – security in numbers? *Fauna and Flora International. Oryx* 47 (3): 403 – 409.
- Hrabar, H. and Kerley, G.I.H. 2015. Cape mountain zebra 2014/15 Status Report. Port Elizabeth: Centre for African Conservation Ecology, Nelson Mandela Metropolitan University Report 63.
- Hrabar, H. Birss, C. Peinke, D. King, S. Novellie, P. Kerley, G. and Child, M. 2015. A Conservation Assessment of *Equus zebra ssp. zebra*. In: M.F. Child, E. Do Linh San, D. Raimondo, H. Davies-Mostert and L. Roxburgh (ED), *The Red List of Mammals of South Africa, Swaziland and Lesotho*. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.
- Hurzuk, A.H. 2009. The DHNRC Cape mountain zebra Management Plan First Draft. Cape Peninsula University of Technology. Unpublished.
- IUCN/SSC. 2008. Strategic Planning for Species Conservation: A Handbook. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission. 104pp.
- IUCN/SSC (2013). Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission, viiii + 57 pp. ISBN: 978-2-8317-1609-1
- Kerley, G.I.H., Pressey, R.L., Cowling, R.M., Boshoff, A.F. and Sims-Castley, R. 2003. Options for the conservation of large and medium-sized mammals in the Cape Floristic Region hotspot, South Africa. *Biological Conservation* 112: 169 - 190.
- Kotze, A. and Nxomani, C. 2011. The National Zoological Gardens of South Africa: a National Research Facility. *International Zoo Yearbook*. (2011) 45: 30 – 37.
- Kraaij, T. and Novellie, P.A. 2010. Habitat selection by large herbivores in relation to fire at the Bontebok National Park (1974-2009): the effects of management changes. *African Journal of Range and Forage Science* 27(1): 21-27.
- Lea, J.M.D., Kerley, G.I.H., Hrabar, H., Barry, T.J. and Schultz, S. in press. Conservation of ecological refugees: habitat suitability and population performance across fragmented Cape mountain zebra populations.
- Lindenmayer, D. and Burgman, M. 2005. *Practical Conservation Biology*. CSIRO Publishing, Collingwood, Australia. ISBN 0 643 09089 4.
- Lloyd, P.H. and Rasa, O.A.E. 1989. Status, reproductive success and fitness in Cape mountain zebra (*Equus zebra zebra*). *Behavioural Ecology and Socio-biology* 25: 411-420.
- Lloyd, P. H. 2002. Cape mountain zebra conservation success: an historical perspective. In: B. L. Penzhorn (ed.), *Proceedings of a Symposium on Relocation of Large African Mammals*, pp. 39-41. Onderstepoort, South Africa.
- Lindsey, P.A., Roulet, P.A. and Romanach, S.S. 2007. Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa. *Biological Conservation* 134 (2007): 455 – 469.
- Margules, C.R. and Pressey, R.L. 2000. Systematic Conservation Planning. *Nature* 405: 243 – 253.
- Marais, A. 2015. Cape mountain zebra outside De Hoop Nature Reserve. CapeNature Unpublished Report. Hermanus.
- Marais, H.J., Nel, P., Bertschinger, H.J., Schoeman, J.P. and Zimmerman, D. 2007. *Journal of the South African Veterinary Association* 78(3): 145-148.



- Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature*. Vol 403. 24 February 2000. Macmillan Magazines Ltd.
- Moehlman, P.D. (ed.) 2002. *Equids: Zebras, Asses and Horses. Status Survey and Conservation Action Plan*. IUCN/SSC Equid Specialist Group.
- Moodley, Y. and Harley, E.H. 2005. Population structuring in mountain zebras (*Equus zebra*): the molecular consequences of divergent demographic histories. *Conservation Genetics* 6: 953-968.
- Mucina, L. and Rutherford, M.C. (eds.) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Nel, P.J., Bertschinger, H., Williams, J. and Thompson, P.N. 2006. Descriptive study of an outbreak of equine sarcoid in a population of Cape mountain zebra (*Equus zebra zebra*) in the Gariep Nature Reserve. *Journal of the South African Veterinary Association* 77(4): 184-190.
- Novellie, P. 2008. *Equus zebra ssp. zebra*. The IUCN Red List of Threatened Species 2008: e.T7959A12876612. <http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T7959A12876612.en>. Downloaded on 09 February 2016.
- Novellie, P., Lindeque, M. Lindeque, P., Lloyd, P. and Koen, J. 2002. Status and Action Plan for the mountain zebra (*Equus zebra*). In: P. D. Moehlman (ed.), *Equids: Zebras, Asses and Horses. A Status Survey and Conservation Action Plan*, pp. 28-42. IUCN, Gland, Switzerland.
- Novellie, P. A., Millar, P. S. and Lloyd, P. H. 1996. The use of VORTEX simulations models in a long-term programme of re-introduction of an endangered large mammal, the Cape mountain zebra (*Equus zebra zebra*). *Acta Oecologica* 17: 657-671.
- NRF. 2008. NRF Vision 2015: Strategic Plan of the National Research Foundation. Accessed on 15 February 2015. <http://www.nrf.ac.za/sites/default/files/documents/NRF%20Vision%202015.pdf>
- Olsson, P., C. Folke, V. Galaz, T. Hahn, and L. Schultz. 2007. Enhancing the fit through adaptive co-management: creating and maintaining bridging functions for matching scales in the Kristianstads Vattenrike Biosphere Reserve Sweden. *Ecology and Society* 12(1): 28. [online] URL: <http://www.ecologyandsociety.org/vol12/iss1/art28/>.
- Olivier, P.I., Van Aarde, R.J. and Ferreira, S.M. 2009. Support for a metapopulation structure among mammals. *Mammal Review* 39: 178-192.
- Parliamentary Monitoring Group (PMG). 2014. Minutes - Provincial conservation: support, resources, challenges and constraints in implementing conservation mandate: Department of Environmental Affairs briefing. <https://pmg.org.za/committee-meeting/17878/> Accessed on 17 February 2016.
- Penzhorn, B. In press. *Equus zebra*. In: J. S. Kingdon and M. Hoffmann (eds.). *The Mammals of Africa*, Academic Press, Amsterdam, The Netherlands.
- Penzhorn, B.L. and Novellie, P.A. 1991. Some behavioural traits of Cape mountain zebras (*Equus zebra zebra*) and their implications for the management of a small conservation area. *Applied Animal Behavioural Science* 29: 293-299.
- Penzhorn, B.L. 1988. *Equus zebra*. In: *Mammalian Species*. The American Society of Mammalogists. No. 314, pp. 1-7.
- Penzhorn, B.L. 1984. A long-term study of social organisation and behaviour of Cape mountain zebras. *Zeitschrift für Tierpsychologie* 64: 97-146.

- Pietersen, J. 2005. Population viability of Cape mountain zebra in the Gamka Mountain Nature Reserve, South Africa: the influence of habitat and fire. *Biological Conservation* 122 (2005): 173 – 180.
- Rasa, O.A.E. and Lloyd, P.H. 1994. Incest Avoidance and Attainment of Dominance by Females in Cape mountain zebra (*Equus zebra zebra*). *Behaviour* 128 (3 – 4).
- Ryers, B., Roux, D., Cowling, R.M., Ginsburg, A.E., Nel, J.L. and O'Farrell, P. 2010. Conservation Planning as a Transdisciplinary Process. *Conservation Biology* 24 (4): 957 – 965.
- South African Constitution. 1996. Schedule 4.  
<http://www.info.gov.za/documents/constitution/1996/96conssec4.htm>
- SABSTC2370.48\_SABS0331\_3. SABS 0331. 1999. Code of Practice for the Translocation of certain species of wild herbivores. South African Bureau of Standards.
- Sasidharan, S.P. 2004. Comparative genetics of selected Southern African mountain zebra (*Equus zebra zebra* and *Equus zebra hartmannae*) populations. Unpublished MSc Thesis. Department of Production Animal Studies, Faculty Veterinary Science, University of Pretoria. 115pp.
- Sasidharan, S.P., Ludwig, A., Harper, C., Moodley, Y., Bertshinger, H.J. and Guthrie, A.J. 2011. Comparative genetics of sarcoid tumour-affected and non-affected mountain zebra (*Equus zebra*) populations. *South African Journal of Wildlife Research* 41(1): 36 – 49.
- Schulze, E. 2016. Free State Department of Economic, Small business development, Tourism and Environmental Affairs Report: Cape mountain zebra population data – Gariep Nature Reserve. Unpublished.
- Schutte-Vlok, A., Wheeler, A. and Cleaver-Christie, G. 2012. Kammanassie Nature Reserve Management Plan 2013 – 2018. CapeNature.
- Scientific Authority of South Africa. 2015. Non-detriment finding for *Equus zebra zebra* (Cape mountain zebra). Reference Number: Equ\_zeb\_zeb\_May2015. Date: 20 May 2015. Issued by the Scientific Authority of South Africa.
- Skead, C.J. 2007. Historical Incidence of the Larger Land Mammals in the broader Eastern Cape, Second Edition (eds. Boshoff, A.F., Kerley, G.I.H. and Lloyd, P.H.). Port Elizabeth: Centre for African Conservation Ecology, Nelson Mandela Metropolitan University. ISBN 1-920176-08-X
- Skead, C.J. 2011. Historical Incidence of the Larger Land Mammals in the broader Western and Northern Cape, Second Edition (eds. Boshoff, A.F., Kerley, G.I.H. and Lloyd, P.H.). Port Elizabeth: Centre for African Conservation Ecology, Nelson Mandela Metropolitan University. ISBN 1-920176-08-X
- Skinner, J.D. and Chimimba, C.T. (revisers) 2005. The Mammals of the Southern African Subregion. Third Edition. Cambridge University Press, Cape Town. ISBN 978-0521-84418-5.
- Skinner, J.D. and Smithers, R.H.N. 1990. The Mammals of the Southern African Subregion. Pretoria University Press.
- Smith, R.J., Verissimo, D. and MacMillan, D.C. 2012. Marketing and Conservation: How to Lose Friends and Influence People. Durrell Institute of Conservation and Ecology, University of Kent, Caterbury, UK.
- Smith, R.K., Marais, A., Chadwick, P., Lloyd, P.H. and Hill, R.A. 2007. Monitoring and management of the endangered Cape mountain zebra *Equus zebra zebra* in the Western Cape, South Africa. *African Journal of Ecology* 46: 207-213.

- Smith, R.K., Ryan, E., Morley, E and Hill, R.A. 2011. Resolving management conflicts: could agricultural land provide the answer for an endangered species in a habitat classified as a World Heritage Site. *Environmental Conservation* 38: 325 - 333.
- Strauss, T. 2015. Cape mountain zebra (*Equus zebra zebra*) habitat use and diet in the Bontebok National Park, South Africa. Nelson Mandela Metropolitan University, unpublished thesis, 179pp.
- Taylor, A., Lindsey, P., and Davies-Mostert, H. 2016. An assessment of the economic, social and conservation value of the wildlife ranching industry and its potential to support the Green Economy in South Africa. The Endangered Wildlife Trust, Johannesburg.
- Van Stittert, L. 2005. Bringing in the Wild: The Commodification of Wild Animals in the Cape Colony/province c. 1850 – 1950. *The Journal of African History* 46, No 2 (2005): 269 – 291.
- Vlok J. and Coetzee K. 2008. Ecological capacity of the Little Karoo for larger wildlife. Report and maps compiled for Gouritz Initiative. ([www.gouritz.com](http://www.gouritz.com))
- Watson, L.H., Odendaal, H.E. Barry, T.J. and Pietersen, J. 2005. Population viability of Cape mountain zebra in Gamka Mountain Nature Reserve, South Africa: the influence of habitat and fire. *Biological Conservation* 122: 173-180.
- Watson, L.H. and Chadwick, P. 2007. Management of Cape mountain zebra in the Kammanassie Nature Reserve, South Africa. *South African Journal of Wildlife Research* 37(1): 31-39.
- Watson, L.H., Kraaij, T. and Novellie, P. 2011. Management of rare ungulates in a small park: habitat use of bontebok and Cape mountain zebra in Bontebok National Park assessed by count of dung groups. *South African Journal of Wildlife Research* 41(2): 158-166.
- Winker, H. 2016a. Technical DRAFT Report: Development of a population simulation model for Cape mountain zebra towards formal evaluation of management strategies. Unpublished SANBI report. SANBI/BAM/STATS/2016/MZ/H2.
- Winker, H. 2016b. Technical Report: Time-series analysis of long-term established mountain zebras within protected areas (1985-2015) with implications for IUCN listing. Unpublished SANBI report. SANBI/BAM/STATS/2016/MZ/H1.
- Winker, H. 2016c. Technical Report: Incorporating carrying capacity limits into forward projection of source populations of Cape mountain zebra. Unpublished SANBI report. SANBI/BAM/STATS/2016/MZ/H1S1.
- Winkler, A. and Owen-Smith, N. 1995. Habitat utilisation by Cape mountain zebras in the mountain Zebra National Park, South Africa. *Koedoe*, 38(1): 83 - 93.
- Young, E., Zumpt, F., Boomker, J., Penzhorn, B.L. and Erasmus, B. 1973. Parasites and diseases of Cape mountain zebra, black wildebeest, mountain reedbuck and blesbok in the Mountain Zebra National Park. *Koedoe* 16: 77-81.

## APPENDIX A: CAPE MOUNTAIN ZEBRA BMP-S WORKSHOP PARTICIPANTS AND WORKSHOP INVITATION

### Cape mountain zebra BMP-S Stakeholder Workshop, SANParks CRC, Tokai, 27 November 2013

Name	Organisation	Email
Alan Wheeler	CapeNature	<a href="mailto:adwheeler@capenature.co.za">adwheeler@capenature.co.za</a>
Carly Cowell	SANParks	<a href="mailto:Carly.Cowell@sanparks.org">Carly.Cowell@sanparks.org</a>
Coral Birss	CapeNature	<a href="mailto:cbirss@capenature.co.za">cbirss@capenature.co.za</a>
Danelle Kleinhans	CapeNature	<a href="mailto:dkleinhans@capenature.co.za">dkleinhans@capenature.co.za</a>
Dick Carr	Private	<a href="mailto:dickcarr@hilbert.co.za">dickcarr@hilbert.co.za</a>
Dr David Zimmerman	SANParks	<a href="mailto:david.zimmerman@sanparks.org">david.zimmerman@sanparks.org</a>
Dr Dean		
Peinke	Eastern Cape Parks	<a href="mailto:dean.peinke@ecpta.co.za">dean.peinke@ecpta.co.za</a>
Dr Peter Novellie	SANParks	<a href="mailto:novellie@netactive.co.za">novellie@netactive.co.za</a>
Christine Kraft	NC DENC	<a href="mailto:christine.dtec@gmail.com">christine.dtec@gmail.com</a>
Guy Palmer	CapeNature	<a href="mailto:gpalmer@outlook.com">gpalmer@outlook.com</a>
Halszka Hrabar	NMMU	<a href="mailto:halszkahcovarr@gmail.com">halszkahcovarr@gmail.com</a>
Jaco van Deventer	CapeNature	<a href="mailto:jvdeventer@capenature.co.za">jvdeventer@capenature.co.za</a>
Jeanetta Selier	SANBI	<a href="mailto:J.Selier@sanbi.org.za">J.Selier@sanbi.org.za</a>
Justin Buchman	SANParks	<a href="mailto:Justin.Buchman@sanparks.org">Justin.Buchman@sanparks.org</a>
Andre Geldenhuys	Private	<a href="mailto:nicki@ege.co.za">nicki@ege.co.za</a>
Roland January	SANParks	<a href="mailto:Roland.January@sanparks.org">Roland.January@sanparks.org</a>
Trevor Adams	SANParks	<a href="mailto:Trevor.Adams@sanparks.org">Trevor.Adams@sanparks.org</a>
Bontle Morwe	DEA	<a href="mailto:morweb@detea.fs.gov.za">morweb@detea.fs.gov.za</a>
	Manchester	
Sussane Schultz	University	<a href="mailto:susanne.shultz@manchester.ac.uk">susanne.shultz@manchester.ac.uk</a>
	Manchester	
Jess Lea	University	<a href="mailto:jessica.lea@postgrad.manchester.ac.uk">jessica.lea@postgrad.manchester.ac.uk</a>
Tebogo Mashua	DEA	<a href="mailto:TMashua@environment.gov.za">TMashua@environment.gov.za</a>
Natalie Hayward	CapeNature	<a href="mailto:nhayward@capenature.co.za">nhayward@capenature.co.za</a>
	Chairman Western	
Stephen Mitchell	Cape WRSA	<a href="mailto:smitchell@nashuaisp.co.za">smitchell@nashuaisp.co.za</a>
Gail Cleaver	CapeNature	<a href="mailto:gail@capenature.co.za">gail@capenature.co.za</a>
Fergill Fortiun	Paardeberg Winery	<a href="mailto:fergill@perdeberg.co.za">fergill@perdeberg.co.za</a>
Buntu Mzamo	DEDEAT	<a href="mailto:buntu.mzamo@dedea.gov.za">buntu.mzamo@dedea.gov.za</a>
Nicola Van Wilgen	SANParks	<a href="mailto:Nicola.VanWilgen@sanparks.org">Nicola.VanWilgen@sanparks.org</a>



## CAPE MOUNTAIN ZEBRA BIODIVERSITY MANAGEMENT PLAN WORKSHOP

VENUE: CRC HALL

29 November 2013

### Purpose of Workshop:

The aim of this workshop is to produce a draft biodiversity management plan for Cape mountain zebra. The draft BMP-S will then be summarized and presented to the workshop participants for comment. Following this the BMP-S will be submitted for gazetting and on approval will be published.

<b>WELCOME AND INTRODUCTION</b>	08h30-08h45	Carly Cowell
Feedback of NDF	08h45-09h15	Jeanetta Selier
Presentation status of Cape mountain zebra, selection for BMP-S	09h15-09h30	Coral Birss
Overview of BMP-S	09h30-10h00	Coral Birss
<b>TEA</b>	<b>10h00-10h30</b>	
BMP-S Planning Outline	10h30-10h50	Coral Birss
Desired state formulation	10h50-11h50	Carly Cowell
Hierarchy of objectives	11h50-12h45	Carly Cowell
<b>LUNCH</b>	<b>12h45-13H30</b>	
Threat identification	13h30-14h00	Carly Cowell
Action plans outlines	14h00-15h00	Group work
<b>TEA</b>	<b>15h00</b>	
Close and way forward	15h00-15h30	Coral and Carly



environmental affairs

Department:  
Environmental Affairs  
REPUBLIC OF SOUTH AFRICA



## APPENDIX B: CONTRIBUTORS TO COMPILING FIRST DRAFT

- CapeNature Technical Working Group and Contributors  
Jonkershoek (25-27 November 2015); Vrolijkheid (21 – 22 January 2016)
  - Kevin Shaw
  - Dr Andrew Turner – Editing
  - Natalie Hayward – Workshop Facilitation
  - Lee Saul
  - Johan Huisamen
  - Dr AnneLise Schutte-Vlok
  - Alexis Olds and Dr Antoinette Veldtman – Literature Review and Research Summary
  - Dr Ernst Baard - Editing
  - Gail Cleaver-Christie – Action Plans
  - Jaco van Deventer
  - Deon Hignett – Legislative context
  - Tom Barry
  - Graham Lewis
  - Blanche de Vries
  - Coral Birss
  - Ivan Donian
- SANParks Reference Group and Contributors (Scientific Services and Veterinary Wildlife Unit)
  - Carly Cowell
  - Nicola van Wilgen
  - Dr Sam Ferreira
  - Dr Markus Hofmeyr
  - Dr David Zimmerman
  - Dr Angela Gaylard
- February 2016: Comments and Contributions to Authors' Draft
  - Nicola van Wilgen      -      SANParks
  - Alan Southwood      -      EC DEDEAT
  - Erika Schulze      -      FS DESTEA
  - Christine Kraft      -      NC DENC
  - Marnus Smit      -      NC DENC
  - Dr Ernst Baard      -      CapeNature
  - Gail Cleaver-Christie      -      CapeNature
  - Dr Andrew Turner      -      CapeNature



## APPENDIX C: TEMPLATE FOR SUGGESTED EDITS / ADDITIONS / CHANGES

TEMPLATE FOR SUGGESTED EDITS / ADDITIONS / CHANGES TO THE DRAFT	
Section:	Page:
Section content:	
Nature of comment:	Edit / Change / Deletion / Addition / Recommendation
Action taken:	
NOTES:	
Section:	Page:
Section content:	
Nature of comment:	Edit / Change / Deletion / Addition / Recommendation
Action taken:	
NOTES:	
Section:	Page:
Section content:	
Nature of comment:	Edit / Change / Deletion / Addition / Recommendation
Action taken:	
NOTES:	
Section:	Page:
Section content:	
Nature of comment:	Edit / Change / Deletion / Addition / Recommendation
Action taken:	
NOTES:	
Section:	Page:
Section content:	
Nature of comment:	Edit / Change / Deletion / Addition / Recommendation
Action taken:	
NOTES:	
Section:	Page:
Section content:	
Nature of comment:	Edit / Change / Deletion / Addition / Recommendation
Action taken:	
NOTES:	

## APPENDIX D:

# AGENDA

## CAPE MOUNTAIN ZEBRA BIODIVERSITY MANAGEMENT PLAN: ACTIONS AND RELEVANT AGREEMENTS WORKSHOP

**VENUE: Driftsands Nature Reserve**  
**25 May 2016**

### Purpose of Workshop:

The aim of this workshop is to facilitate further collaboration between stakeholders to enable agreement between Lead and Implementing Agents for the successful implementation of the Cape mountain zebra BMP.

<b>Tea</b>	8:30 – 9:00	
Welcome & Introduction	9:00 – 9:10	Ernst Baard
Overview of Process & Plan for the Day	9:10 – 9:30	Lauren Waller
Icebreaker: VENN	9:30 – 10:30	All
<b>Tea</b>	10:30 – 10:45	
Session 1: Agreement on Action Plan	10:45 – 12:15	Lauren Waller & All
<b>Lunch</b>	12:15 – 13:00	
Session 2: Agreement on Action Plan	13:00 – 14:30	Lauren Waller & All
Wrap Up	14:30	Lauren Waller
DEA – The Way Forward	14:40	Humbu Mafumo
<b>Close</b>	15:50	Ernst Baard



# APPENDIX D: ATTENDANCE REGISTER AND INVITEE LIST FOR THE ACTIONS AND RELEVANT AGREEMENTS WORKSHOP FOR HTE IMPLEMENTATION OF THE CAPE MOUNTAIN ZEBRA BMP-S



## Attendance Register

Page 1 / 1

Name of Event	Cape mountain zebra BMP actions and relevant agreements Workshop	Facilitator/s	Lauren Waller
Venue	Boardroom, Driftsands Nature Reserve	Service Provider	
Date(s)	25 May 2016	Time / Duration	

Participant Details					
No.	Name and Surname	Organisation/Institution	Telephone	Email	Signature
1	JACO VAN HEURST	CAPE NATURE	0824555564	j.vanheurst@capenature.co.za	[Signature]
2	Carly Coetzee	SANParks	021737510	carly.coetzee@sanparks.org	[Signature]
3	Coral Dicks	CapeNature	0818668015	cdicks@capenature.co.za	[Signature]
4	WILHELM HARENBURG	GRACIA HARENBURG	0825239810	lharenbu@gracia.co.za	[Signature]
5	SYNDONIE HARENBURG	GRACIA HARENBURG	0824400522	syndonie@gracia.co.za	[Signature]
6	Deshane Pillay	SANBI	0834882275	d.pillay@sanbi.org.za	[Signature]
7	ANDREW TURNER	CAPE NATURE	0218668000	aturner@capenature.co.za	[Signature]
8	Ernst Haard	CapeNature	0214830005	ehaard@capenature.co.za	[Signature]
9	Gareth Mortimer	CapeNature	0794908887	gmortim@capenature.co.za	[Signature]
10	Natalie Hansen	"	0218668000	nhansen@capenature.co.za	[Signature]
11	Michael Hansen	"	0257132366	m.hansen@capenature.co.za	[Signature]
12	RAE SMITH	NZG	0732598542	rae@nzg.ac.za	[Signature]
13	Lauren Waller	CapeNature	0725923915	lwaller@capenature.co.za	[Signature]

1



## Attendance Register

Page 1 / 2

Name of Event	Cape mountain zebra BMP actions and relevant agreements Workshop	Facilitator/s	Lauren Waller
Venue	Boardroom, Driftsands Nature Reserve	Service Provider	
Date(s)	25 May 2016	Time / Duration	

Participant Details					
No.	Name and Surname	Organisation/Institution	Telephone	Email	Signature
14	Antoinette Kote	NZG	0834566902	antoinette@nzg.ac.za	[Signature]
15	Seanele Sele	SANBI	0334585063	s.sele@sanbi.org.za	[Signature]
16	Gail Cleaver-Christie	Cape Nature	0823772040	gail@capenature.co.za	[Signature]
17	Craig Geldenhuys	Swartburg Game Prods	0825772875	craig.geldenhuys@gmail.co.za	[Signature]
18	Stephen Mitchell	UKUSA	086765434	smitchell@ukusa.org.za	[Signature]
19	DICK CARR	PR: ROSSAKEN CNR	0722484832	dickcarr@hilbert.co.za	[Signature]
20	Azwinqi Muringi	DEA	0123999608	amuringi@environment.gov.za	[Signature]
21	OLGA KUMEL	DEA	0123998518	okumelo@environment.gov.za	[Signature]
22	Mogdel Boshoff	DEA	012-3999606	mboshoff@environment.gov.za	[Signature]
23	Dean Penick	ECTA	0824162562	dean.penick@ecta.co.za	[Signature]
24	David Zimmermann	SANPARKS	0836304593	david.zimmermann@sanparks.org	[Signature]
25	Angelo Gouland	SANPARKS	0829466176	angel.gouland@sanparks.org	[Signature]
26	Monette Engebrecht	CapeNature	0828143359	mengebrecht@capenature.co.za	[Signature]


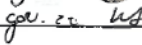
2

## Attendance Register

Page 1 / 1

Name of Event	Cape mountain zebra BMP actions and relevant agreements Workshop	Facilitator/s	Lauren Waller
Venue	Driftsands Nature Reserve	Service Provider	
Date(s)	25 May 2016	Time / Duration	

### Participant Details

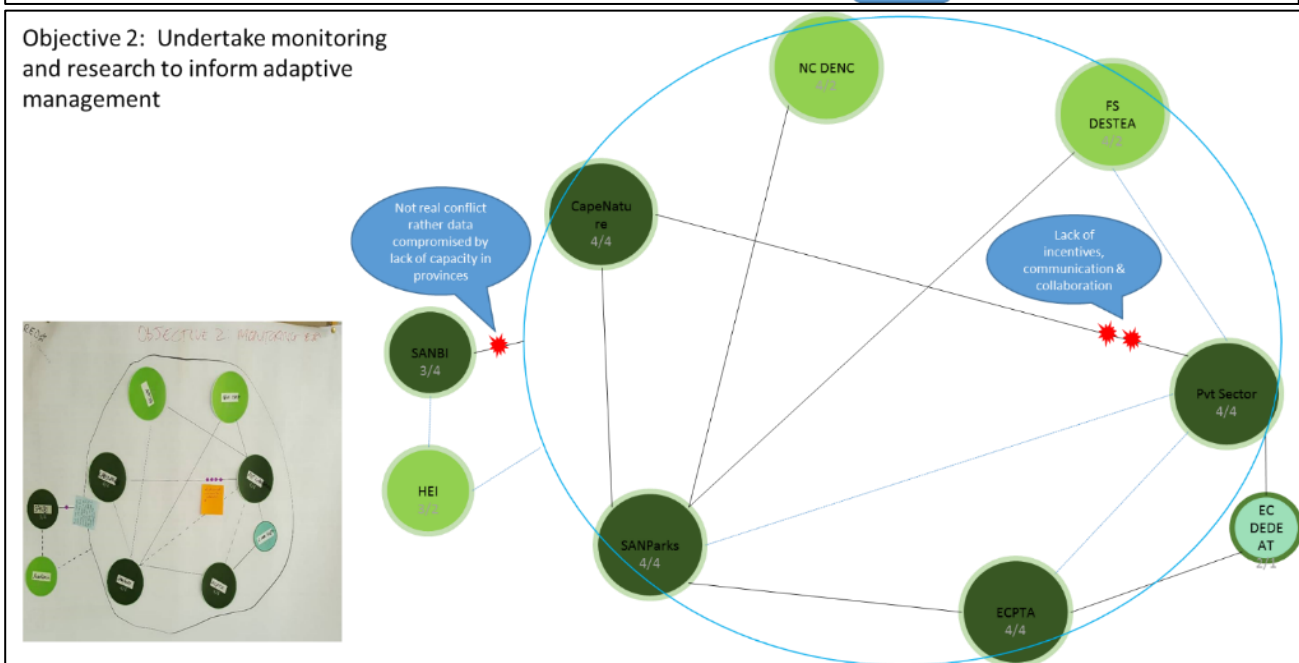
No.	Name and Surname	Organisation/Institution	Telephone	Email	Signature
27	Humbani Momo	DEA	021 485 6100	humbani@environment.gov.za	
28	Willem Jansen	DEA	082 657 2522	wjansen@environment.gov.za	
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					

3

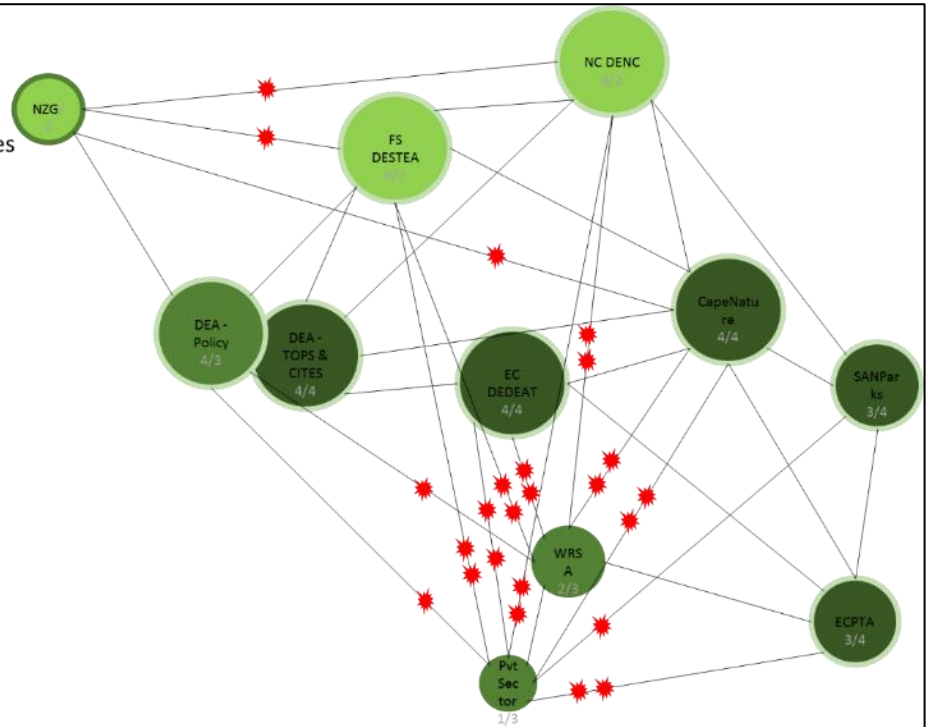
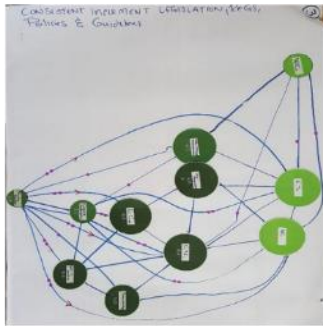


Objective 1: Maintain genetic diversity in the Cape mountain zebra meta-population

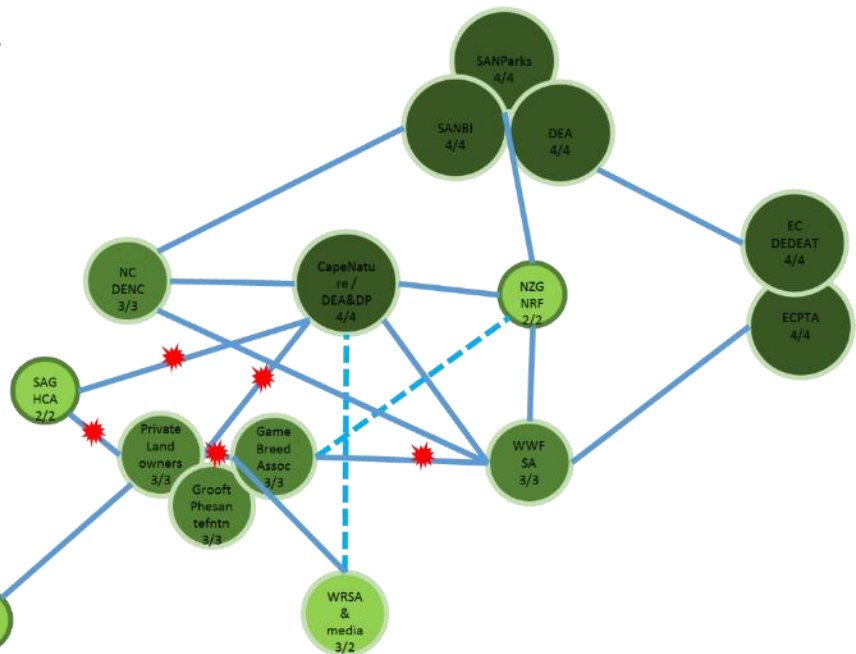
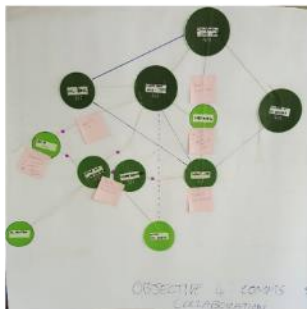
Genetics Discussion



Objective 3: Consistently and uniformly implement legislation, regulations, policies and guidelines



Objective 4: Effectively communicate, collaborate and coordinate between stakeholders and the public for Cape mountain zebra conservation





APPENDIX F: NOTES