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WESTERN CAPE STATE OF BIODIVERSITY 2017

DE MOND NATURE RESERVE

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INDEX

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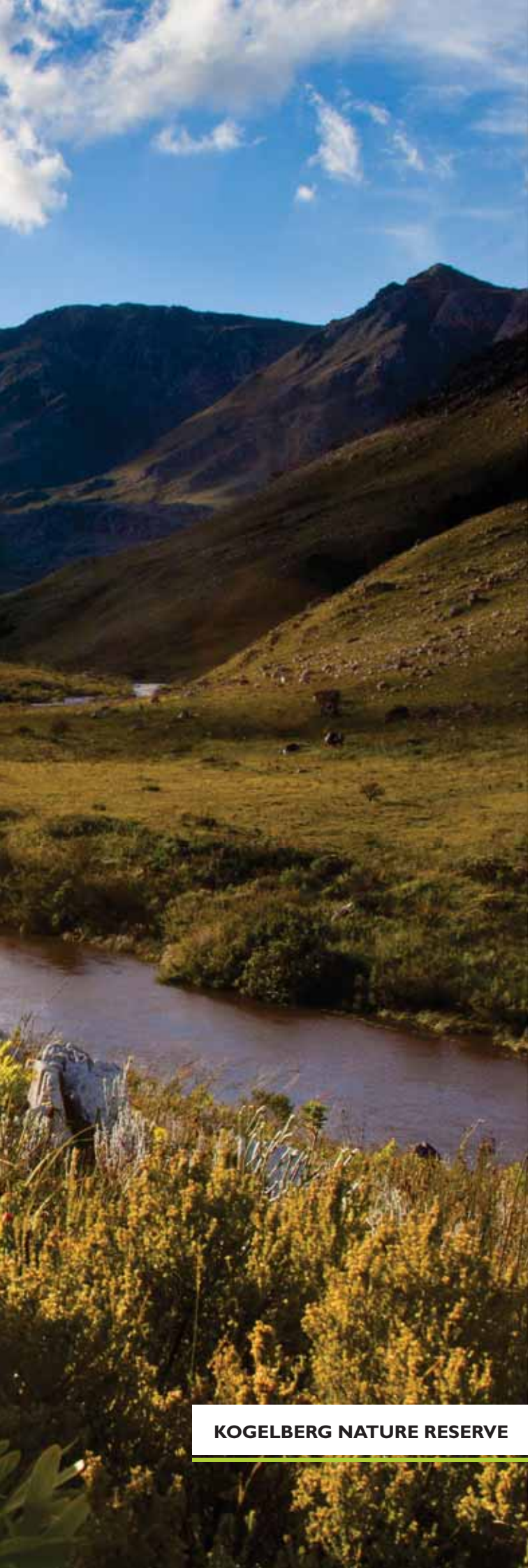

KOGELBERG NATURE RESERVE

Introduction

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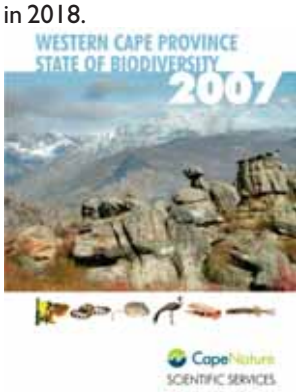
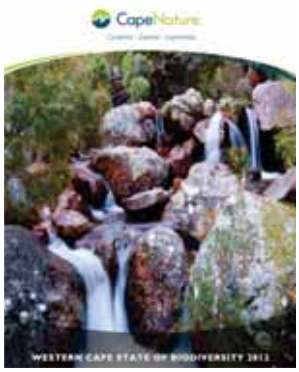
Western Cape Province State of Biodiversity 2000 - 2017

CapeNature has compiled State of Biodiversity reports every five years since 2002 and this is the fourth report. These reports aim to give some indication of the state of the ecosystems of the Western Cape Province (WCP) and their constituents which are the many species that occur in this province. These reports taken together over time should provide rough trends in the health of the WCP's biodiversity, species and ecosystems. The current report provides a brief summary of changes since the 2012 report (Turner 2012) and thus should be read in conjunction with the 2012 (and older) reports. These reports should also be seen as a useful adjunct to the Western Cape State of the Environment Outlook Report 2014 – 2017. The WCP Department of Environmental Affairs & Development Planning produces a State of Environment Report (SoER) every five years. This SoER has a wider scope than CapeNature's State of Biodiversity report and thus incorporates some of the findings in the CapeNature report. The next SoER is due in 2018.





Provincial Biodiversity Strategy and Action Plan

A very important development since the 2012 State of Biodiversity report is the publication by the Department of Environmental Affairs and Development Planning of the Western Cape Provincial Biodiversity Strategy and Action Plan for 2015 to 2025 (DEADP 2016a). This Provincial Biodiversity Strategy and Action Plan (PBSAP) and its associated Provincial Biodiversity Strategy and Action Plan Implementation Plan 2017 to 2025 (DEADP 2016b) sets the framework for managing biodiversity in the Western Cape and directs action to achieve strategic objectives which should lead to specific outcomes. These

documents represent the provincial level implementation plan of the National Biodiversity Strategy and Action Plan (DEA 2015). The PBSAP 2017 to 2025 sets the targets and objectives to be achieved within the 10 year time frame. CapeNature's State of Biodiversity report contributes to the evaluation of the PBSAP's strategic objectives 1 to 4 as follows:

Strategic Objective 1: Conservation and effective management of biodiversity contributes to a resilient and inclusive Western Cape economy.

- CapeNature State of Biodiversity Report Chapter 1 provides updated figures on total area under the various protection mechanisms.
- Chapter 1 addresses planning for the conservation of ecological infrastructure in the Western Cape and deals specifically with wetland and river functioning in Chapter 3.

Strategic Objective 2: Partner sectors contribute to achieving biodiversity conservation targets through mainstreaming biodiversity into policies, strategies, plans, practices and projects.

- Chapter 1 discusses the Western Cape Biodiversity Spatial Plan (BSP) and supporting tools which is the primary mechanism in place to enable integration of biodiversity and ecological infrastructure into municipal and provincial planning.

Strategic Objective 3: A biodiversity - based economy contributes to inclusive and sustainable livelihoods and development opportunities.

- Protected Areas serve as sanctuaries for a good deal of the WCP biodiversity and protect the majority of the Province's water source areas (Chapters 1 and 2). However, there are also many species and important ecological services associated with rivers and habitat for pollinators (see Chapter 4) which do not occur in protected areas and these species and habitats also need careful management to provide a sustainable future for the Province. There are many work opportunities created in the management of invasive alien species (see Chapter 5), and although these figures are not reported here, the scale of this problem will continue to provide employment for many years to come and is set to become more urgent and critical as climate change proceeds.

Strategic Objective 4: Knowledge management supports effective planning, decision – making, monitoring and reporting.

- The CapeNature State of Biodiversity Report is an assemblage of several basic fields of conservation knowledge which should be used to direct and focus research, monitoring and decision making. The information presented in this report should also inform achievements against Strategic Objectives 5 – 7.

Mainstreaming

Incorporation of 'biodiversity thinking' into local government is crucial for taking this fundamental aspect of the physical environment into consideration when planning development and resource utilisation in the province. This is achieved primarily through the adoption of spatial biodiversity plans in Integrated Development Plans (IDPs), Spatial Development Frameworks (SDFs) and Environmental Management Frameworks (EMFs). An initial evaluation of biodiversity mainstreaming in the province is presented in Chapter 1.

Recommendations for future research and conservation action

Responding to one of its strategic objectives, CapeNature developed a Research and Monitoring Strategy (CapeNature, 2016) to guide research and monitoring. Good monitoring and research is required to assess environmental health over time and capture these findings in State of Biodiversity Reports. Good information is also required to direct action to where and when it is most needed and there is a strong focus on managing invasive alien species, particularly those that have an impact on water resources. We have set up a web page to broadcast requests for scientific research to assist in solving our management requirements (see http://www.capenature.co.za/care-for-nature/conservation-in-action/biodiversity-sciences/research-requests/).

In this Sate of Biodiversity Report we have chapters devoted to each of the major components of biodiversity we are able to report on with chapters covering plants and vegetation; freshwater fish; amphibians, reptiles; birds; mammals and arthropods (primarily insects).

Species management plans

The current reporting period has seen the development of a Biodiversity Management Plan for species (BMP-s) for the African Penguin and the Clanwilliam sandfish; the BMP-s for the Cape Mountain Zebra has been approved for implementation; the BMP-s for the Bontebok has been submitted to DEA; the Barrydale redfin BMP-s is ready for submission to DEA; and the Geometric Tortoise BMP-s is currently being drafted.

Threats and challenges

Invasive Alien Species

Invasive alien species are also a high priority for active management in this province as they threaten indigenous species and have numerous negative impacts on ecosystem functioning. The incentive to step up control programmes is increasing with ever-worsening water shortages and damaging fires.

The National Invasive Alien Plant Survey Phase II is scheduled for completion by the end of 2017 (I. Kotze, Agricultural Research Council (ARC), pers. comm.). This is a complete revision of National Invasive Alien Plant Survey Phase I (Kotze et al. 2010) and provides higher resolution and reliable data on the occurrences of invasive alien plants species across the country. A draft version of this project indicates extensive invasive alien plant populations in the WCP which highlights the intensity of the burden placed on the province's biological and water resources.

The draft National status report on biological invasions in South Africa (van Wilgen & Wilson 2017) has been completed and provides a comprehensive overview of the growing problem of invasive alien species in South Africa.

Unfortunately the WCP was found to be one of the hotspots of alien plant species richness in the country and is likely the most invaded province. Water loss due to invasive alien species was also highest in the WCP. This report deals explicitly with the pathways that facilitate invasion which is crucial to understand and develop effective management responses. The report also categorises the invasive alien species according to their impacts which facilitates focus on those species that cause most harm.

Land use change

Habitat loss due to land use change is still generally the biggest threat to biodiversity. Of particular concern has been the ongoing loss of areas identified as Critical Biodiversity Areas (see Chapter 2). The new Biodiversity Spatial Plan and Handbook will hopefully go a long way in directing development away from the most critical biodiversity and ecological infrastructure and in so doing ensure sustainability for the WCP.

Climate change

The current reporting period spans three anomalously dry and warm years especially for the western parts of the province (Figure 1 & 2). The direct and acute effects of low water availability should hopefully now be foremost in the consciences of everyone in the Province. Provision of clean water is one of the most fundamentally important services delivered by proper management of the natural environment, and in particular the mountain catchment areas. The Western Cape Province is a water-scarce province and greater attention and funding must be directed at maintaining sustainable water provision. Key to ensuring this reliability is the active management of the natural infrastructure that traps, cleans and delivers this precious resource. Also of concern are the predictions of higher intensity rainfall events in spite of the overall drying trend. The effect of extreme events on biodiversity is largely unknown in the WCP. Elsewhere environmental effects of extreme weather have been recorded as increased mortality and fecundity for a range of species (e.g. Altwegg et al. 2017). Damage from extreme weather events places strain on ecological infrastructure and provincial disaster management budgets (which in turn affects other budgets).
Much research remains to be done on the current and predicted effects of climate change on the WCP's substantial biodiversity. Clusella-Trullas & Garcia (2017) note that there is a serious deficit in the knowledge of impacts of invasive alien plants on terrestrial ectothermic groups other than arthropods.

Weather

CapeNature is in a unique position to facilitate gathering of weather data as our Protected Areas span many of the higher-lying areas of the WCP which are historically poorly represented by weather stations. This weather data is crucial for the assessment of climate change, both for predictive modelling and for measuring local effects. This can then be used to initiate climate change mitigation and adaption strategies such as those listed in the Western Cape Climate Change Response Strategy (DEA & DP 2014). In the last five years several new weather stations have been positioned on CapeNature land and CapeNature has access to this data.

Illegal trade

During the reporting period, South Africa has seen a significant increase in the trend of the illegal wildlife trade, particularly the poaching of rhinoceroses for their horn and elephants for their ivory. The South African Government has developed several responses to this increasing illegal trade, including considering legalising the trade in rhino horn. In the WCP, apart from a healthy, significant and legal commercial trade in wildflowers, illegal harvesting of plants and animals for traditional use (mostly for traditional medicinal use for a growing urban population) and commercial purposes continue to impact on the sustainability of ecosystems and species. Another part of the illegal trade involves several species of reptiles (dwarf adders, in particular) on occasion, beetles like *Colophon*, as well as succulent plants from biodiversity hotspots such as the Knersvlakte in the northwest.

CapeNature is challenged to contain this trade, however, it has seen great successes in dealing with illegal wildlife traffickers and getting courts to hand down large fines and even jail sentences to successfully prosecuted poachers.

Emerging threats

Perhaps the most worrying of all emerging threats is one that can't be easily seen. This is the spread of microscopic pathogens such as fungi, bacteria and viruses. This threat is well known in agriculture and medicine but it is equally a threat to biodiversity. The declines in amphibian populations caused by the chytrid fungus in other countries has revealed both the severity and the difficulty in managing these pathogens in the wild. Control of the movement of plants and animals is the only sensible way to mitigate this risk.

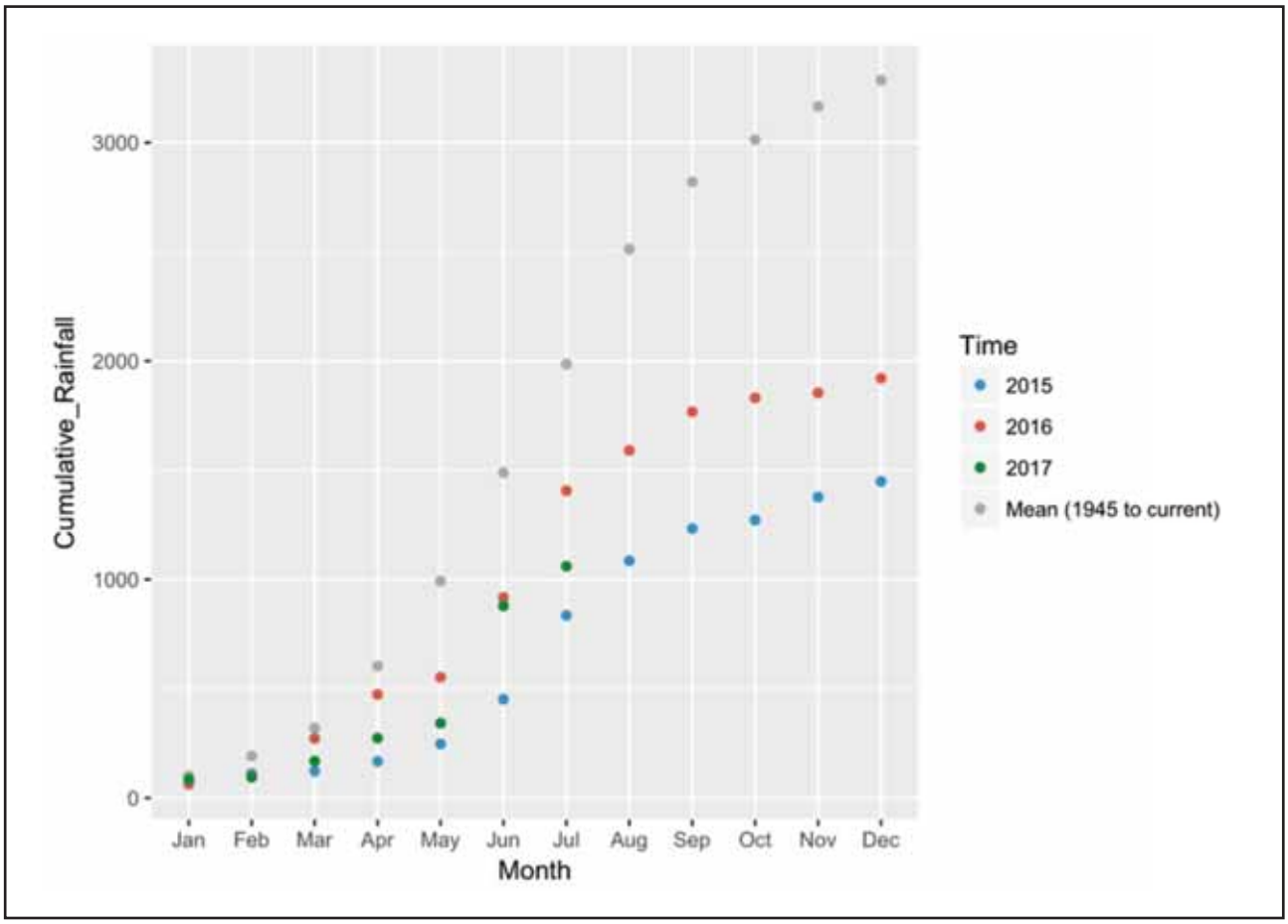


Figure 1. Cumulative rainfall for the Lang Rivier weather station in Jonkershoek courtesy of SAEON (see http://www.ecologi.st/post/2017-04-01-Langrivier/).

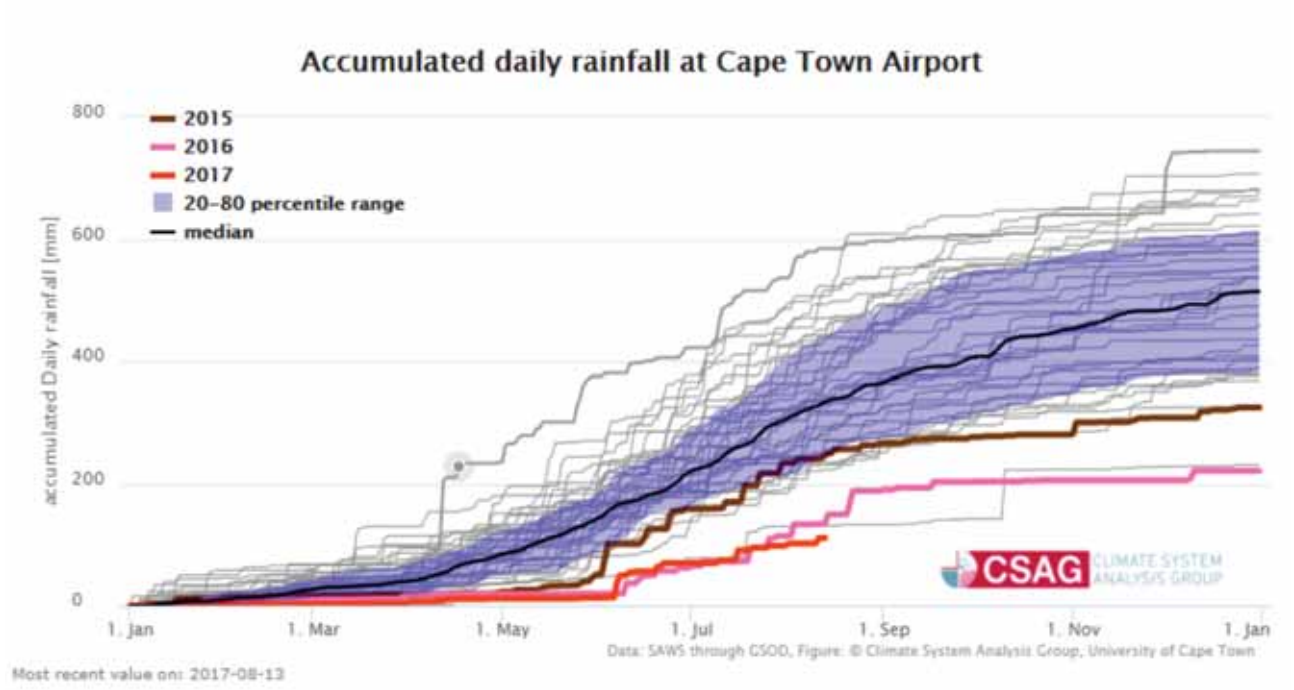


Figure 2. Cumulative rainfall for the Cape Town International Airport weather station courtesy of Climate System Analysis Group at the University of Cape Town (see http://www.csag.uct.ac.za/current-seasons-rainfall-in-cape-town/)

Mining and Shale Gas Development

In the past five years 16% of land use change applications in the WCP received for comment by CapeNature have been for mining with the majority of these applications in the West Coast District Municipality (see Chapter 1).

Large areas of the Little and Great Karoo have been identified for shale gas prospecting. A recently released scientific assessment report summarises the impacts of so-called "fracking" on water resources, biodiversity and ecosystems amongst others. Depending on the scenario that plays out – exploration without exploitation; or about 5 trillion cubic feet (Tcf) of economically recoverable gas is exploited; or about 20 Tcf is exploited, the scope of the impacts will differ (Scholes 2016).

De Kock *et al.* (2017) found that quantitative measures of residual gas indicate that the total resource is around 0.4 x 109 m^3 (13 Tcf) which is at the lower end of previous total reserve estimates. This is still a large resource with developmental potential if it is economically feasible to exploit. A major environmental concern with this development is the impact of this activity on water resources from both water consumption and water pollution perspectives. Water availability in the study area is already severely constrained, and thus the capacity to supply water for shale gas development from existing local sources is very limited (Scholes *et al.* 2016). Water from other sources is also likely to be limited and expensive to supply. The primary mitigation for active shale gas exploitation impacts on biodiversity is securing areas of very high and high ecological importance and sensitivity (Scholes *et al.* 2016).

In addition to shale gas development, large tracks of land in the Great Karoo region of the WCP have also been identified for exploration and potential mining of uranium, adding further threat to the existence and survival of these sensitive ecosystems.

Systems for monitoring State of Biodiversity

To measure trends in the state of biodiversity it is necessary that baseline data, on the distribution, conservation status and, in the case of species of conservation concern, population data, is obtained through appropriate surveillance and monitoring. To a large extent this is the mandate of CapeNature at a provincial level and requires that the organisation be effectively equipped to collect, collate and store this information and then make it available for analysis and to distribute through various channels including this State of Biodiversity report. CapeNature has reasonably good systems in place for doing this but there is much room for improvement in capacity; both technical and human resources.

Protected Area Expansion and Stewardship

CapeNature updated the provincial Protected Area Expansion Strategy for the WCP (Maree *et al.* 2015) in line with the National Protected Areas Expansion Strategy (Government of South Africa, 2010) to guide the expansion of protected areas to the locations where the most critical sites are prioritised to achieve representivity and persistence targets. The primary method for achieving this expansion is through continued employment of formal Stewardship Agreements (see Chapter 1). Biodiversity stewardship has also been identified as the most cost-effective way to achieve expansion targets (South African National Biodiversity Institute 2017).

Priority species and conservation status

As for the previous period CapeNature focusses its attention on priority species. These are species that are either formally classified as threatened, are indicator species, are endemic to the WCP or are invasive alien species in the WCP.

The WCP has a very large number of indigenous species but also a very large number of these species are considered Threatened by the International Union for the Conservation of Nature (IUCN) e.g. 1 869 plant species and a very large proportion of species are endemic to the WCP, making CapeNature the sole responsible organisation for many species. Species are evaluated as threatened or not by application of formal assessment of threat according to IUCN Red Listing criteria and CapeNature is actively involved in providing information for and conducting these assessments which are typically facilitated by SANBI's Threatened Species Programme.

Communities and ecosystems

It is difficult to keep track of all threatened species in the province and in many cases it makes sense to manage the environment at an ecosystem level although this can be very challenging in practice due to the fragmented nature of the remaining ecosystem fragments. Fortunately South Africa has a well-developed vegetation type classification which has been assessed for threat level. This is a very useful informant for both spatial planning and prioritisation of areas for protection and active conservation management. One of the very pragmatic applications of this kind of information is to incorporate it into Critical Biodiversity Areas (and Ecological Support Areas) which are a product of the Western Cape Biodiversity Spatial Plan which explicitly maps the areas that are required for the persistence of species that support the ecological infrastructure that delivers the many ecological services upon which we all depend. Chapter 1 deals with this planning product and its use in monitoring and planning for keeping the biodiversity of the WCP in a healthy condition.

Ecosystem processes

As mentioned above one of the key benefits from a healthy natural environment is the ecological infrastructure (e.g. rivers, wetlands, natural vegetation) that support continued functioning of the environment which provides increasingly valuable services such as water retention, flood attenuation, delivery of clean water, fresh air, biologically-derived foods and chemicals (e.g. rooibos, pharmaceuticals). This infrastructure and the associated species that keep these systems working often span quite large and varied tracts of land and it is vital that all the different land owners and managers work together to ensure that environmental functioning is kept in a good condition.

Chapters 2 (Freshwater ecosystems), 3 (Estuaries) and 4 (Plants and vegetation) deal with ecosystem level assessments of the state of the WCP.

Capacity and Implementation

CapeNature is in a unique position to collect information that represents the state of biodiversity and ecosystem health over a sufficiently long period of time to observe trends. To achieve this, appropriate, good quality and consistent monitoring is required. Once monitoring has been completed, data needs vetting, collation and formal storage before the important work of analysis and interpretation to translate the findings into management recommendations can be tackled. This is an ongoing challenge given the complexity and variability of the WCP environment and we are very dependent on the excellent corps of partner organisations, tertiary institutions, NGOs, government colleagues and committed individuals to work collaboratively on this common challenge.

Focus areas for the next five years

To deal with the breadth and complexity of environmental conservation in the WCP, CapeNature is employing a strategic adaptive management approach wherever possible. This approach facilitates review and adaptation of management actions to improve conservation outcomes. Where management is not efficiently achieving outcomes, management actions and goals must be reassessed. This process should focus the organisation more tightly on the most important outcomes but will necessarily also mean putting less important actions on hold till resources (time, money and human) allow expansion of activities. The current strategic goal is broadly stated to 'Reduce biodiversity loss in the Western Cape'. This includes goals for improved invasive alien species management, particularly invasive woody plants to improve water delivery; more effective fire management; expansion of the protected area estate mostly through a very focussed biodiversity stewardship programme; and additionally, an improved and modernised set of biodiversity conservation legislation for the WCP.

Acknowledgements

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Turner, A.A. (ed.) 2012. Western Cape Province State of Biodiversity 2012. CapeNature Scientific Services, Stellenbosch. ISBN: 978-0-621-41407-3.

Van Wilgen, B.W. & J.R.U. Wilson 2017 Draft National status report on biological invasions in South Africa.

MORAEA VILLOSA SUBSPECIES *ELANDSMONTANA*

Appendix 1. List of Scientific Services publications 2013 – 2017.

2013
BOOKS / GUIDES / CHAPTERS IN BOOKS
Schutte-Vlok, A.L., Raimondo, D., Grieve, K., Helme, N., Koopman, R. and Ebrahim, I. 2013. Plants in Peril. Pretoria: SANBI.
Schutte-Vlok, AL. 2013. Fabaceae. In: Plants of the Greater Cape Floristic Region 1: the Core Cape Flora. Manning, J.C. and Goldblatt, P. (eds.). Strelitzia 29, South African National Biodiversity Institute, Pretoria.
ORAL PRESENTATIONS AT SYMPOSIA / CONFEREENCES INTERNATIONAL
Birss, C. 2013. Conservation Genetics in South Africa: Policy and Management Implications for Bontebok. Oral presentation at GONGRESS SA: International Conservation Genetics Workshop 20-21 November 2013, National Zoological Gardens of South Africa, Pretoria.
Borchers, D., Stevenson, B., Kidney, D.,Rawson, B., Measey, J. Altwegg, R. and Turner, A. 2013. Efficient density estimation of visually cryptic species using acoustic detectors. Seminar delivered at Victoria University of Wellington, Wellington, New Zealand.
Crawford, R.J.M., Altweg, R., Distiller, G., Makhado, A.B., Waller, L.J. and Whittington, P.A. 2013. Winners and losers in South Africa's seabird assemblage – where was the African penguin. Oral presentation at the 8th International Penguin Conference, 2-6 September 2013, Bristol, UK.
Geldenhuys, D., Waller, L.J., Ludynia, K., Pichegru, L., Sherley, R.B. and McGeorge, C. 2013. Foraging and breeding parameters at the only consistently increasing South African colony of African penguins. Oral presentation at the 8th International Penguin Conference, 2-6 September 2013, Bristol, UK.
Pichegru, L., Steinfurth, A., Sherley, R.B., Waller, L.J., van Eeden, R., Robinson, K.L., McInnes, A., van der Lingen, C., Ryan, P.G., Underhill, L.G. and Crawford, R.J.M. 2013. Experimental fishing closures for penguins in South Africa – coasts of contrasts. Oral presentation at the 8th International Penguin Conference, 2-6 September 2013, Bristol, UK.
Shaw, K.A., Waller, L.J., Crawford, R.J.M. and Oosthuizen, H. 2013. Developing a National Management Plan for the African penguin in South Africa. . Oral presentation at the 8th International Penguin Conference, 2-6 September 2013, Bristol, UK.
ORAL PRESENTATIONS AT SYMPOSIA / CONFERENCES NATIONAL
Birss, C. 2013. Bontebok: Conservation Genetics – Some CONGRESS Basics. Oral presentation at the CITES NDF Workshop, 27 November 2013, Tokai, Cape Town.
Birss, C. 2013. Conservation Genetics – Some CONGRESS Basics and Tools. Oral presentation at the Cape Mountain Zebra BMP-s Workshop, 29 November 2013, Tokai, Cape Town.
Birss, C. 2013. BMP-s Framework. Oral presentation at the Cape Mountain Zebra BMP-s Workshop, 29 November 2013, Tokai, Cape Town.
Birss, C. 2013. Bontebok: An Overview of Bontebok Distribution in the Western Cape and Genetic Tools. Oral presentation at the CITES NDF Workshop, 27 November 2013, Tokai, Cape Town.
Birss, C. 2013. Bontebok: An Overview of Bontebok Distribution in the Western Cape, Genetic Tools and Conservation Genetics for the development of a BMP-s. Oral presentation at the Bontebok BMP-s Workshop, 28 November 2013, Tokai, Cape Town. (Included: Genetic Certification of Pure Bontebok, Dalton, D. and Kotze, A.; GONGRESS Tools; Modelling the genetic impacts of selective / intensive breeding, Grobler, P.J., Department of Genetics, University of the Free State).
Birss, C. 2013. Bontebok: BMP-s Framework. Oral presentation at Bontebok BMP-s Workshop, 28 November 2013, Tokai, Cape Town.
Birss, C. 2013. Cape Mountain Zebra: An Overview of Cape Mountain Zebra Status, Distribution in the Western Cape, the CITES NDF and Conservation Genetics. Oral presentation at the Cape Mountain Zebra BMP-s Workshop, 29 November 2013, Tokai, Cape Town.
Birss, C. 2013. Conservation Genetics in South Africa: Policy and Management Implications for Bontebok. Oral presentation at GONGRESS SA Conservation Genetics Workshop 20-21 November 2013, National Zoological Gardens of South Africa, Pretoria.
Birss, C. 2013. Bontebok: Conservation Genetics – Some CONGRESS Basics. Oral presentation at the CITES NDF Workshop, 27 November 2013, Tokai, Cape Town. (Included: Genetic Certification of Pure Bontebok, Dalton, D. and Kotze, A.)
Birss, C. and Buijs, D. 2013. Evaluating the Mapping of Natural Distributional Ranges for Eco-typical Species for the National Norms and Standards. Oral presentation at the Southern African Wildlife Management Association Symposium 15-19 September 2012, Skukuza, Kruger National Park, Limpopo.
Buijs, D. and Birss, C. 2013. Mapping Natural Distribution Ranges of Herbivores. Oral presentation by Daan Buijs at the Southern African Wildlife Management Association Symposium 15-19 September 2012, Skukuza, Kruger National Park, Limpopo.
Forsyth, A.T. 2013. 10 Years history of GIS in CapeNature. Oral presentation at GISSA AGM, Italian Club, Milnerton, Cape Town.
Forsyth, A.T. 2013. CapeNature invasive alien plant (IAP) clearing data management and protocol. Oral presentation at AVM programme operations meeting, Genadendal
Impson, D. 2013. Western Cape Regional Report. Oral presentation at the 17th National Yellowfish Working Group Conference, 20 April 2013, Vaal Stream Eco-resort, Denysville.
Impson, D. et al. 2013. Fishy news from the Fynbos - a giant redfin, alien fish control update and BMP-S for Clanwilliam sandfish. Oral presentation at the Fynbos Forum, 7-10 October 2013, Kirstenbosch. .

Pence, G.Q.K. 2013. "Setting and achieving targets for ecosystems and ecological processes". Oral presentation at the South African National Biodiversity Institute's Provincial and Metropolitan Biodiversity Planning work session, 8 October, 2013. Pretoria National Botanical Garden, SANBI, Pretoria.
Saul, L., Birss, C. and Hayward, N. 2013. Societal expectation of Protected Area Management and Effectiveness in Western Cape Provincial Nature Reserves. Oral presentation by Natalie Hayward at the Southern African Wildlife Management Association Symposium 15-19 September 2012, Skukuza, Kruger National Park, Limpopo.
Schutte-Vlok, A.L., Vlok, J. and Basson, C. 2013. Biodiversity between the grave yard and the rubbish dump. Oral presentation at the Fynbos Forum, 7-10 October 2013, Kirstenbosch, Cape Town.
Schutte-Vlok, AL. 2013. Fire ecology. Oral presentation at the CapeNature Summer School, 21 November 2013, De Hoop.
Schutte-Vlok, AL. 2013. Fires and Fynbos - What happens when thresholds are exceeded? Oral presentation at the Garden Route Initiative Forum, 2 August 2013, George.
Schutte-Vlok, AL. 2013. Restoration of Atriplex and Augea invaded areas in the Succulent Karoo - a case study. Oral presentation at the Gouritz Cluster Biosphere Reserve Forum, 26 November 2013, Rooiberg Lodge, Vanwyksdorp.
PEER-REVIEWED SCIENTIFIC ARTICLES
Crawford, R.J.M., Randall, R.M., Whittington, P.A., Waller, L., Dyer, B.Mm, Allan, D., Fox, C., Martin, P.A., Upfold, L., Visagie, J., Bachoo, S., Bowker, M., Fox, R., Huisamen, J., Makhado, A.B., Ryan, P.G., Taylor, R. and Turpie, J.K. 2013. South Africa's coastal-breeding white-breasted cormorants: population, trend, breeding season and movements, and diet. African Journal of Marine Science 35: 473-490.
Henen BT, Hofmeyr MD and Baard EHW, 2013. Body of evidence: forensic use of baseline health assessments to convict wildlife poachers. Wildlife Research 40(4): 261-268.
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AFRICAN PENGUIN

CHAPTER 1

PROTECTED AREAS, BIODIVERSITY SPATIAL PLANNING AND MAINSTREAMING

A. Duffell-Canham, G. Mortimer, G. Pence and R. Pool-Stanvliet

Scientific Services, CapeNature

CONTENTS

GROOTWINTERHOEK UPPER CATCHMENT

Executive summary

The Western Cape Nature Conservation Board (CapeNature) is mandated to conserve the unique natural biodiversity of the Western Cape for the benefit of all. The primary cause of biodiversity loss in the province is the loss of habitat. Habitat transformation, degradation and fragmentation occur primarily through changes in land use which either result in the outright loss of natural ecosystems, or create pressures which impact negatively on habitat condition. CapeNature's most challenging goal is therefore to ensure that development and conservation happens in the most appropriate places in the landscape.

Recently the Western Cape Biodiversity Spatial Plan (WCBSP) was endorsed by CapeNature and the Department of Environmental Affairs and Development Planning. This spatial product identifies the most critical areas for biodiversity conservation that are to underpin new Protected Areas (as per the Western Cape Protected Area Expansion Strategy 2015-2020), conservation actions on private land (stewardship), and environmental authorisations, as well as biodiversity spatial planning and mainstreaming more generally. These priority areas are referred to as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These are included in the Biodiversity Spatial Plan Map (BSP Map) which indicate areas that should be conserved and areas where development can take place without compromising biodiversity. The BSP Map is based on the science of systematic biodiversity planning which, among other things, aims to meet the national targets for both biodiversity pattern and process areas, in the least amount of land possible. The ultimate implementation of the BSP Map is incumbent upon a suite of mechanisms ranging from the classical Protected Area expansion mechanisms to the more contemporary biodiversity mainstreaming mechanisms such as industry engagement and spatial planning.

This chapter aims to quantify and/or qualify the contribution of various mechanisms to providing a level of safeguarding to important biodiversity areas within the province. The main mechanisms which are evaluated include formal Protected Area proclamation, the establishment of stewardship agreements or conservancies, and input into environmental assessments, spatial planning and business and biodiversity initiatives.

In addition to leading the province's Stewardship Programme and undertaking provincial biodiversity spatial planning, CapeNature has a crucial supporting role to play in directing conservation and development towards most appropriate areas as identified in the Western Cape Protected Area Expansion Strategy (WCPAES) and Western Cape Biodiversity Spatial Plan (WCBSP). However, the land use unit at CapeNature is currently under-capacitated relative to the number of development applications, as well as planning, policy and

legislation (i.e., mainstreaming) documents and processes that require input. In this regard it is important for CapeNature to maintain excellent working relations with their partners, specifically the Department of Environmental Affairs and Development Planning, the Department of Agriculture, and the various local authorities.

Considering the very recent completion of the Western Cape Biodiversity Spatial Plan, quantification or qualification of CapeNature's mainstreaming successes or failures at this stage could be considered premature. In this instance, it becomes vital for this chapter to form a baseline study which, for comparative reasons, can be replicated for the next State of Biodiversity Report in five years' time in order to provide a better reflection of true success on the ground.

1. Introduction

The archetypal form of biodiversity conservation across the world and within the Western Cape Province is the setting aside of land for the formal declaration as Protected Areas. In the Western Cape, this traditional form of biodiversity conservation is supported by the National Environmental Management: Protected Areas Act (NEM:PAA) (Act 57 of 2003), Marine Living Resources Act (Act 18 of 1998) and the Western Cape Nature Conservation Board Act (Act 15 of 1998). The underlying assumption is that once land has been set aside for conservation, the biodiversity occurring on that land will be conserved.

The centrality of Protected Areas to biodiversity conservation has remained unchallenged for decades and they continue to represent the cornerstones for regional strategies (Lovejoy 2006; Margules & Pressey 2000). Internationally, their importance has been recognised by the Convention on Biological Diversity (CBD) and by the creation of intergovernmental funding agencies such as the Global Environment Facility (Lovejoy 2006). Nationally and provincially their importance has recently been supported through the establishment of a National Protected Area Expansion Strategy (NPAES) (SANBI & DEA 2010) and a Western Cape Protected Area Expansion Strategy 2015-2020 (Maree *et al.*, 2015; Koopman & Pence 2017).

The establishment of Protected Areas alone are however not adequate for biodiversity conservation (Cowling *et al.*, 2003; Van Wilgen *et al.*, 2016) and it is now clearly understood that the attainment of our biodiversity goals requires a more complex and dynamic approach. Considering that most of our province's biodiversity lies within private ownership, the purchasing of this land by the state in order to convert it into Protected Areas is unrealistic as it would be very expensive and would entail considerable maintenance costs. It is therefore not considered a sustainable strategy. Therefore, other methods of improving biodiversity conservation have become more popular over the last few decades.

The one method has been the mainstreaming of biodiversity considerations into traditionally non-biodiversity sectors such as spatial planning, land use and development planning and decision-making, agriculture and mining and more recently, even finance and insurance. Mainstreaming is achieved when biodiversity priorities are incorporated into policies and decisions of a range of sectors so that we are able to meet our conservation targets (Driver *et. al.*, 2003).

Mainstreaming of biodiversity consideration came about as a response to Article 6 (b) and 10 (a) of the CBD which read as follows: 6 (b) General Measures for Conservation and Sustainable Use: Each Contracting Party shall, in accordance with its particular conditions and capabilities .... integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies; and 10 (a) Integrate consideration of the conservation and sustainable use of biological resources into national decision-making.

An added advantage of biodiversity mainstreaming over formal Protected Area expansion is that a broader audience is involved in conservation, implying a more sustainable solution. The responsibilities associated with biodiversity conservation are shared amongst a larger group which in turn results in improved efficiencies and reduces conflicts between sectors. Furthermore, the notion of strong sustainability whereby all sectors recognise that human well-being depends on the maintenance of our natural capital and that environmental integrity cannot be traded for economic development, is better understood and respected. The disadvantage is however that biodiversity is not necessarily protected into perpetuity but rather afforded only a limited degree of safeguarding.

Since 2012, CapeNature together with our partners [amongst others including the South African National Biodiversity Institute (SANBI), the Department of Environmental Affairs and Development Planning (DEA&DP), the Table Mountain Fund (TMF), World Wildlife Fund (WWF) and Conservation South Africa (CSA)] have targeted two main biodiversity mainstreaming avenues, namely a) environmental assessment and land use decision-making, and b) spatial land use planning.

We have aimed to quantify our impacts on biodiversity conservation achieved through both formal Protected Area expansion as well as these two mainstreaming avenues. Where adequate data exists for the period between 2012 and 2017, we have tried to compare statistics, and where there is insufficient data for the province, we have tried to generate figures for a pilot area or subregion, or employ anecdotal evidence.

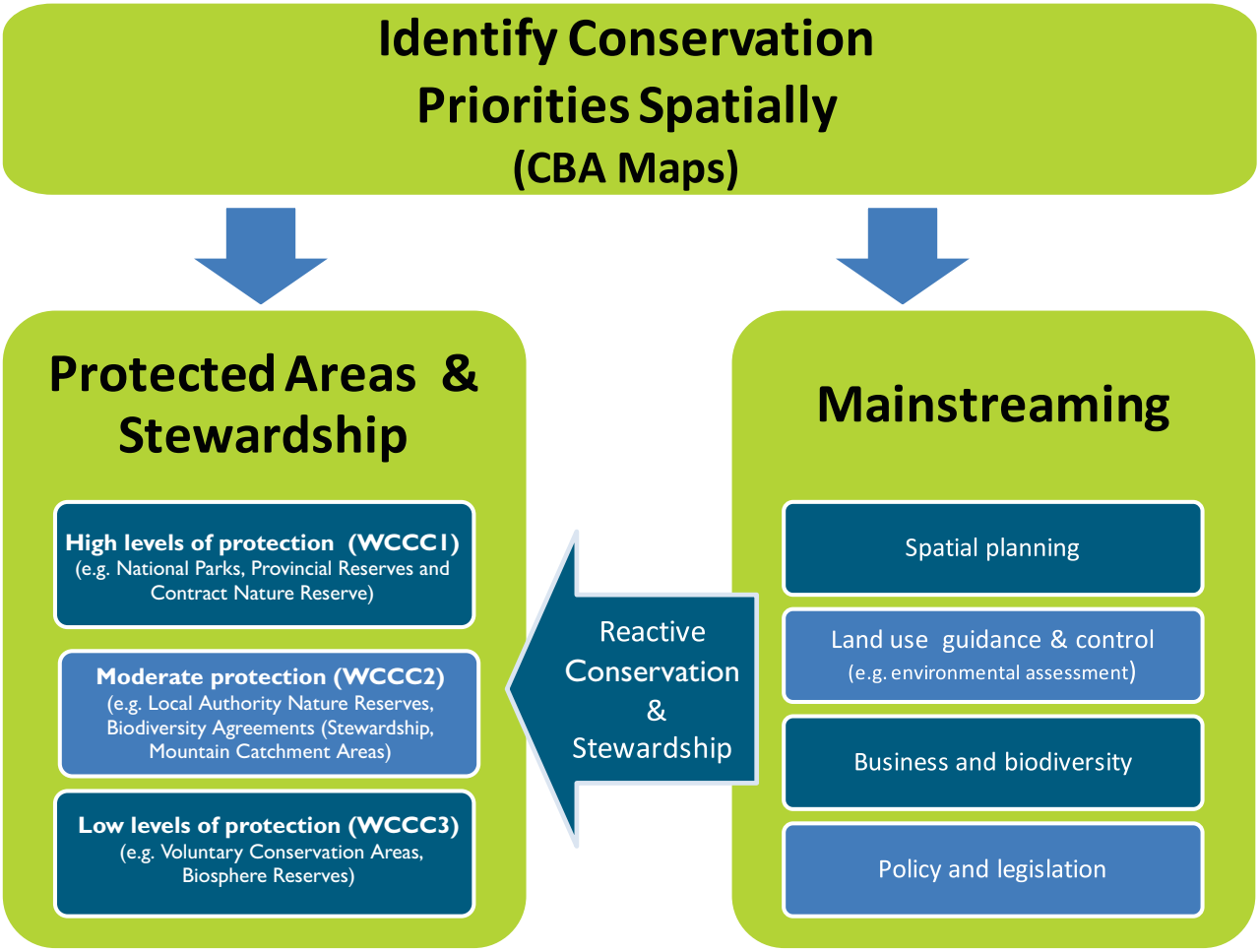

Figure 1: Strategies to reduce habitat loss and aid biodiversity conservation

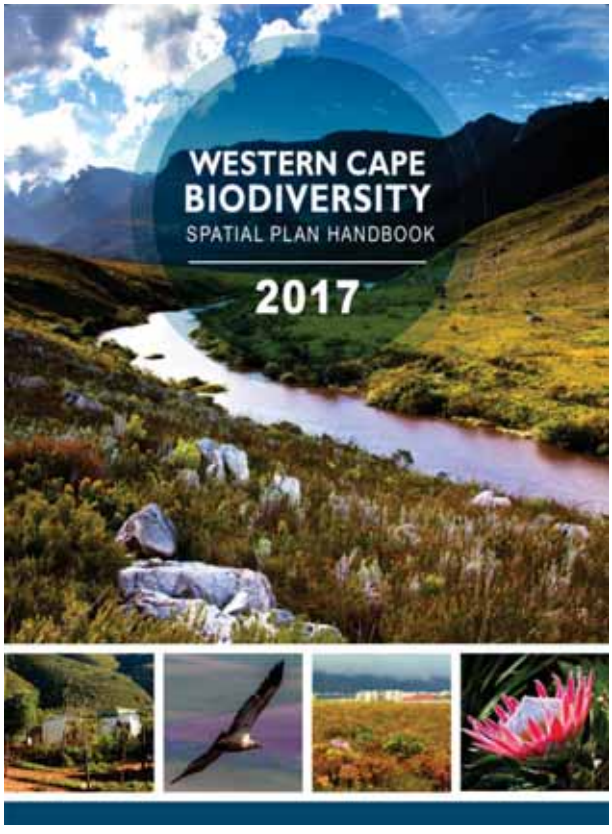

Figure 2: Western Cape Biodiversity Spatial Plan Handbook

Table 1: Systematic biodiversity planning in the Western Cape Province over the last quarter century

Year(s)	Systematic biodiversity planning product or project
1992	Protecting the floral diversity of the Cape Floristic Region (Rebelo & Siegfried 1992)
1997	Reserve selection on the Agulhas Plain (Lombard *et. al.,* 1997)
1999-2003	A conservation plan for a global biodiversity hotspot – the Cape Floristic Region, South Africa (Cowling *et. al.,* 2003)
2003	A Fine-Scale Plan for the Cape Lowlands Renosterveld (Von Hase *et al.* 2003)
2008-2009	C.A.P.E. Fine-Scale Biodiversity Planning Project, producing Biodiversity Sector Plans for Saldanha Bay, Bergrivier, Cederberg, Matzikama, Witzenberg, Breede Valley, Breede River, Winelands, Hessequa, Mossel Bay
2009	Cape Town Biodiversity Network (also 2010, 2015 & 2016 versions)
2009	Garden Route Initiative Conservation Plan
2009	Central Karoo District Conservation Plan
2010	West Coast DMA01
2010	Overberg Conservation Plan
2010	Little Karoo Biodiversity Assessment
2010	Western Cape Biodiversity Framework
2014	Western Cape Biodiversity Framework Update
2017	Western Cape Biodiversity Spatial Plan

2. Identifying Priority Conservation Areas

In South Africa, biodiversity planning is generally undertaken by provinces to identify priority areas; areas which require safeguarding to ensure the continued existence and functioning of the full array of native biodiversity – from individual populations and species, to ecosystems and biomes – and the ecological processes that not only sustain them, but deliver essential ecosystem services to people. These priority areas, known as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), inform land use and development planning, environmental assessment and regulation, and natural resource management. They also form the basis for identifying priority areas for Protected Area expansion and Biodiversity Stewardship (Figure 1).

The most recent product identifying priority areas for biodiversity conservation and ecosystem service delivery is the 2017 Western Cape Biodiversity Spatial Plan (WCBSP)[1]. The WCBSP comprises the Biodiversity Spatial Plan Map (BSP Map) of priority areas, a Handbook that includes a provincial biodiversity profile and land use guidelines (Pool-Stanvliet *et al.*, 2017; Figure 2), supporting Geographic Information System (GIS) files, and a Technical Report (Pence, 2017). The WCBSP is a product that builds on the previous systematic biodiversity planning efforts undertaken across the province over the last quarter century (Table 1); it also replaces them as best available science to inform current land use planning and decision-making.

Systematic biodiversity planning is a rigorous data-driven approach for assessing the location, status, and importance of a range of biodiversity features. As such, it is the nationally-endorsed approach for identifying spatial biodiversity priority areas.

The WCBSP includes a detailed map (the BSP Map) delineating priority areas for biodiversity conservation and ecological resilience, accompanied by contextual information and land use guidelines that make the most recent and best quality biodiversity and ecological infrastructure information available for land use and development planning, environmental assessment and regulation, and natural resource management. The BSP Map includes spatial components pertaining to endangered species of plants and animals, important terrestrial, coastal and estuarine features, and landscape features like climate adaptation corridors and strategic water source areas. The BSP Map delineates several categories of biodiversity priority areas, including CBAs and ESAs (Figure 3). The Handbook contains a comprehensive set of recommendations for applying the BSP Map and guidelines in a range of planning and decision-making processes.

The 2017 WCBSP identifies about 22% of the province as CBAs (2 859 785 ha) and a further 13% as ESAs (1 644 500 ha; Table 2). This is in addition to the approximately 14% (1 843 030 ha) of the province already within Protected Areas and 19% (2 445 210 ha) with no natural habitat left remaining. The balance of the province (12.9 million hectare) is categorised as Other Natural Areas (32%); which are not identified as provincial priorities in the current plan, but which retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions.

It is worth noting that the priority areas reported in the 2012 State of Biodiversity Report (Turner, 2012) were based on the Western Cape Biodiversity Framework (WCBF) of 2010 (Kirkwood *et al.*, 2010). The WCBF was an amalgamation of existing products to form a single integrated map of CBAs for the province, rather than a singular systematic assessment of the whole province - as has now been done. The WCBF was revisited in 2014 in order to highlight and quantify CBA loss in the province, as well as to assess the degree to which Protected Areas and CBAs met national biodiversity targets (Pence, 2014).

Importantly, the 2014 update of the WCBF highlighted the need for revision and amendment of the underlying systematic analyses; most notably, that new CBAs needed to be identified (in a single, systematic, province-wide analysis based on updated land cover information) to meet national biodiversity target shortfalls. Of 160 ecosystems assessed in 2014, 11 were found to have target shortfalls largely attributable to losses to agricultural expansion since CBA identification, and 9 had substantial shortfalls attributable to either conversion to alternative land uses, and/or to the piecemeal nature of the underlying products.

Thus, the 2017 WCBSP is an important milestone; presenting, for the first time, a provincial picture of priority areas which require safeguarding in order to not only efficiently meet national biodiversity targets and international obligations, but to ensure the persistence of

Table 2: Biodiversity priority categories in the 2017 Western Cape Biodiversity Spatial Plan

Map Category	Area (ha)	Percent (%)
Protected Area (PA)	1 843 030	14
Critical Biodiversity Area (CBA)	2 859 785	22
Ecological Support Area (ESA)	1 644 500	13
Other Natural Area (ONA)	4 137 040	32
No Natural (NN)	2 445 210	19
TOTAL:	12 944 115	100

[1] The Western Cape Biodiversity Spatial Plan Handbook and GIS data layers are available at: http://bgis.sanbi.org/Projects/Detail/194

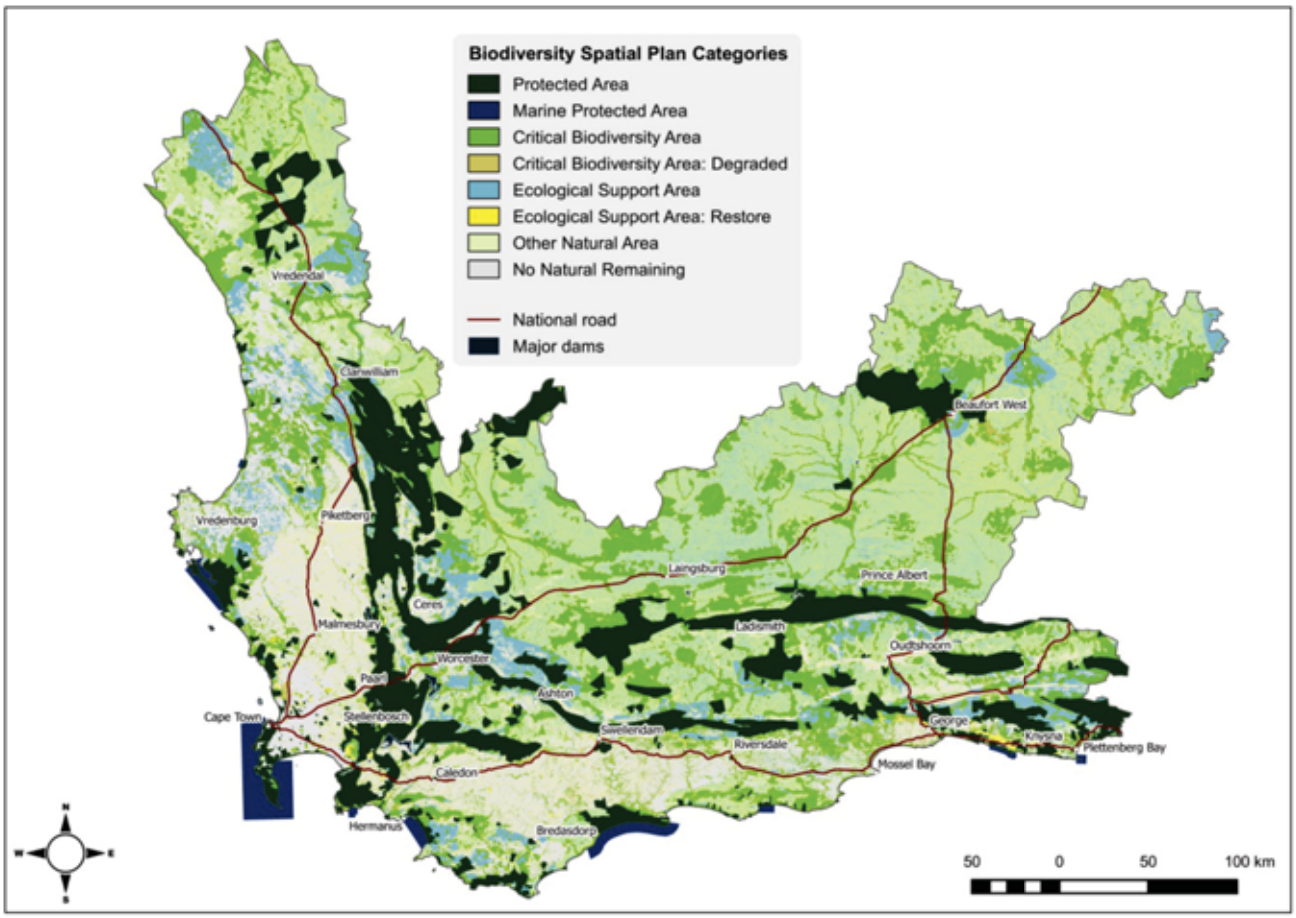

Figure 3: Biodiversity Spatial Plan Map of the Western Cape Province

healthy, functioning and representative ecosystems and associated services which benefit all.

The conservation of biodiversity underpins sustainable development. For this reason, we have identified areas which are critical for conservation (CBAs) and the maintenance of ecological processes and ecosystem services (CBAs and ESAs), as well as areas which are more suited for development (Other Natural Areas).

At a national level, biodiversity planning is supported by the Department of Environmental Affairs (DEA) and SANBI, where the focus is on maintaining a community of practice based on key principles, developing guidelines, setting targets, collating provincial and sector priorities, and identifying gaps. For example, the NPAES recognises that detailed planning, scheduling, and operational issues are all best dealt with at the provincial and agency level. Provincial and agency Protected Area expansion plans are based on provincial systematic biodiversity plans, with additional consideration given to factors such as: importance, urgency, and the appropriateness of formal protection, or Biodiversity Stewardship specifically, as the conservation mechanism of choice.

The purpose of aligning priority areas for Protected Area expansion with provincial and national biodiversity planning efforts is to be more efficient and effective in using our scarce conservation resources to secure a representative, ecologically sustainable and efficient reserve network.

3. Establishment and Enhancement of the Conservation Estate

The existence and continued establishment of the Conservation Estate remains the cornerstone of the province's conservation efforts. The Conservation Estate includes formally declared Protected Areas such as National Parks, Nature Reserves, Protected Environments, Mountain Catchment Areas (MCAs) and Marine Protected Areas (MPAs), as well as less formal conservation areas such as Biodiversity Management Agreements signed in terms of the National Environmental Management: Biodiversity Act (NEM:BA) (Act 10 of 2004), and Biodiversity Agreements signed in terms of contract law. Lastly there are the informal voluntary agreements such as Biodiversity Partnership Agreements and Conservancies. Unfortunately, however, the historical Protected Area network of the Western Cape does not adequately protect the majority of our ecosystems or biodiversity, and it is because of this that the expansion and consolidation of our conservation estate remains vital.

3.1 Western Cape Protected Area Expansion Strategy

Protected Areas are tracts of land or sea protected by law, typically in the name of biodiversity conservation. In 2008, DEA acknowledged the urgent need to better sustain biodiversity and ecological processes within our Protected Area network. This resulted in the release of

the NPAES, aimed at achieving 'cost-effective Protected Area expansion for ecological sustainability and increased resilience to climate change'. The NPAES calls on provinces to develop implementation plans in support of the NPAES and in support of provincial conservation efforts and priorities.

Filtering down from this national strategy therefore, is the Western Cape Protected Area Expansion Strategy (WCPAES), drafted by CapeNature (Maree *et al.*, 2015), and aimed at meeting province-specific ecological requirements in terms of local biodiversity thresholds, as well as contributing to political commitments made at a national level (the Western Cape's Protected Area targets correspond to the area committed to by the South African Government in the CBD's Aichi Target 11[2]). At the heart of both the national and provincial strategies is the need to ensure that biologically diverse land is kept safe from inappropriate development and that biodiversity targets are met.

This WCPAES, endorsed by the Minister of Local Government, Environmental Affairs and Development Planning, is driven by two overarching goals:

1. To expand the Western Cape Protected Area network to encompass a more representative and resilient suite of areas that support biodiversity and ecological infrastructure, especially those threatened species and ecosystems that remain unprotected as yet; and
2. To regularise existing Protected Areas so that environmental security is ensured for everyryone in South Africa, and the costs and benefits of appropriation accrue to the appropriate entity.

Based on these high-level objectives, the province's practical targets outlined for 2020 include the need to secure an additional 348 840 ha of priority terrestrial biodiversity and 25 216 km² of our marine environment, as well as increasing the proportion of the current Protected Area network which is fully compliant with NEM:PAA from approximately 40% to 50%.

The spatial product guiding the WCPAES is based on the WCBSP thereby ensuring that all provincial conservation efforts are concentrated in the same areas. The BSP Map spatially prioritises Protected Area expansion targets and makes recommendations on mechanisms to achieve this.

3.2 Classification of Protected Areas and Conservation Areas

The classification system defined in the 2012 State of Biodiversity Report, divided all Protected Areas into three Western Cape Conservation Categories (WCCCs). These WCCCs were defined according to the degree of legislative security associated with the subcategories. This 2017 State of Biodiversity report once again makes use of this system, noting, however, a few developments:

Table 3: Protected Area and Conservation Area Categories

Western Cape Conservation Category (WCCC) 1	Western Cape Conservation Category (WCCC) 2	Western Cape Conservation Category (WCCC) 3
Protected Areas with *strong* legislative security	Protected Areas and Conservation Areas with *some* legislative security	Conservation Areas with *little or no* legislative security
▪ National Parks	▪ Local Authority Nature Reserves	▪ Biodiversity Partnership Areas
▪ World Heritage Sites	▪ Mountain Catchments Areas	▪ Biosphere Reserves
▪ Wilderness Areas	▪ Private Nature Reserves	▪ Conservancies
▪ Provincial Nature Reserves	▪ Biodiversity Agreements	
▪ State Forest Nature Reserves		
▪ Marine Protected Areas		
▪ Island Nature Reserves		
▪ Contract Nature Reserves		
▪ Protected Environments		

[2] Aichi Target 11: By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.

- Additional sub-categories relevant to Biodiversity Stewardship, namely: Contract Nature Reserves, Protected Environments, Biodiversity Agreements and Biodiversity Partnership Areas.
- The Protected Area sub-category of "South African Natural Heritage Site" no longer exists.
- Private and Local Authority Nature Reserves proclaimed in terms of the Western Cape Nature Conservation Ordinance (Ordinance No. 19 of 1974) and read with section 12 of the NEM:PAA, are regarded as Nature Reserves. DEA have developed Norms and Standards for the inclusion of Private Nature Reserves and Local Authority Nature Reserves into the South African Protected Areas Register. A process of verification of the declaration and compliance with the NEM:PAA Norms and Standards for Nature Reserves needs be followed to have this category of Nature Reserve move from WCCC 2 to the WCCC 1 category.
- Declared MCAs are a form of Protected Area under NEM:PAA, however the regulations for MCAs are mostly administrative and these areas have not been regulated historically and management plans are not being implemented. For this reason MCAs have been placed under the WCCC 2 category.

The resultant WCCCs are provided in Table 3 on page 25.

3.3 Status of Protected Areas and Conservation Areas

Western Cape Conservation Category 1: In 2012, 1 126 850 ha of the Western Cape Province was classified as WCCC1. Since then, an additional 92 250 ha have been added to the WCCC 1 amounting to a total of 1 219 100 ha (8.71% of the province). The revised National Protected Area Expansion Strategy of 2016 sets a target of 13% of the province by 2028.

The significant increase in the WCCC 1 estate is mostly attributed to the additional 89 820 ha signed up by CapeNature as Contract Nature Reserves with private landowners through the Biodiversity Stewardship Programme. This brings the hectares for Contract Nature Reserves to 142 640 ha of which 55 400 ha has been formally declared and the remaining 87 240 ha are in the process of being declared as Nature Reserves in terms of section 23 of NEM:PAA. This significant contribution was as a result of the very successful Leslie Hill Succulent Karoo Trust (LHSKT) Stewardship Investment Project through which funding was provided to CapeNature through WWF-SA to provide additional capacity in the Little Karoo and the Breede River Valley for three years to secure priority Succulent Karoo habitat and species through the Biodiversity Stewardship process. The LHSKT's investment of R4 454 426 resulted in 21 landowners signing stewardship agreements with CapeNature, contributing 48 056 ha of land towards the Succulent Karoo Conservation Estate. At a low estimate of R2 000 per hectare, it would have cost some R100 million to buy this much land for conservation.

For the first time CapeNature is able to report on hectares declared in the Protected Environment (PE) category with 12 360 ha signed of which 4 720 ha is already declared (including the Robberg Coastal Corridor PE and the Groot Winterhoek PE) and 7 640 ha in the process of being declared. This 7 640 ha is attributed to the signing of the Spitzekop PE. This category of Protected Area is anticipated to grow within the next reporting period due to several negotiations under way including the Moutonshoek PE to secure the catchment of the Krom Antonies River as the main tributary of the Verlorenvlei wetland system and the ecological importance to the biodiversity of the area through the proper functioning of wetland systems in general, and the Verlorenvlei Estuary which is listed as an Important Bird and Biodiversity Area and a Ramsar site; and the Rooiberg Breede Conservancy which is in the process of upgrading to PE status to secure this Breede River Valley Succulent Karoo priority area through a second phase of the LHSKT Stewardship Project in partnership with WWF-SA.

Over the last five years there have been no changes in the Wilderness Areas, State Forest Nature Reserves, Marine Protected Areas or Island Reserve sub-categories.

In addition to the expansion of the WCCC 1 estate, it is also important to bring about improved management of the existing Protected Areas and thereby afford a higher level of protection to the existing Protected Area network. One of the main success stories in this regard is the compilation of management plans for existing Provincial Nature Reserves. In 2011, CapeNature embarked upon developing management plans for each of its nature reserve clusters. A total of 17 Protected Area Management Plans for reserve complexes have been developed. CapeNature is in the process of aligning nature reserve clusters to Cape Floral Region Protected Areas World Heritage Site complexes. CapeNature is required to submit Management Effectiveness Tracking Tool assessments to the Department of Environmental Affairs to measure management effectiveness of protected areas. Currently 74% of the Protected Areas managed by CapeNature achieved a METT score above 67% which is the threshold deemed as effective management.

The World Heritage Site sub-category has increased from 393 840 ha in 2012 to 804 260 ha in 2017. This is attributed to the successful nomination submitted by CapeNature to UNESCO for additional World Heritage Sites in the Western Cape and the Eastern Cape. The Cape Floral Region Protected Areas World Heritage Site (CFRPA WHS) is a serial nomination that was first inscribed by UNESCO in June 2004 as a series of eight natural properties. In 2015, UNESCO approved an extension nomination that includes additional areas of value and adjustments to five clusters of the originally nominated site. The CFRPA WHS currently comprises 1 135 486 ha of protected areas with 810 698 ha of buffer zones, made up of declared MCAs and other Protected Areas, further supported by the Stewardship Programme, Landscape Initiatives, Biosphere Reserves and CBAs that

are together designed to facilitate functional connectivity and mitigate for the effects of global climate change and other anthropogenic influences. The CFRPA WHS includes 13 clusters and their components in the Western Cape and Eastern Cape Provinces and is managed by three conservation authorities: CapeNature, South African National Parks (SANParks), and the Eastern Cape Parks and Tourism Agency.

Neither of these two mechanisms (drafting of Protected Area management plans or declaration of World Heritage Sites) will expand the WCCC 1 estate as they are already formally declared Protected Areas. They will however increase the protection level afforded to these Protected Areas and, in the case of the expanded World Heritage Sites, result in an additional buffer area being afforded some degree of safeguarding.

Western Cape Conservation Category 2: There have been no significant changes to the Local Authority Nature Reserves, MCAs or Private Nature Reserve sub-categories since 2012. The City of Cape Town are in the process of formally declaring their City-managed Nature Reserves as Section 23 Nature Reserves under NEM:PAA and these will be reflected under the WCCC 1 category in future. The South African Natural Heritage Sites sub-category however no longer exists and has resulted in a total loss of 31 550 ha in the WCCC 2 category.

Once again, CapeNature's Biodiversity Stewardship Programme is accountable for the addition of 10 680 ha in the Biodiversity Agreement sub-category bringing the total hectares up from 14 960 ha in 2012 to 25 640 ha.

In order to afford the WCCC 2 areas better protection, CapeNature is undertaking a verification process of all Private Nature Reserves to determine proclamation status and whether they are compliant with the NEM:PAA Norms and Standards for Nature Reserves, which, if they are, will elevate their status to a Contract Nature Reserve (WCCC 1).

Private MCAs formally declared in terms of the Mountain Catchment Areas Act (Act 63 of 1970) provide and augment vital linkages between many Protected Areas. These linkages are extremely important particularly for the support of ongoing ecological and evolutionary processes, not to mention their essential role in the production of water. Furthermore, MCAs are recognised as a type of Protected Area by the NEM:PAA.

Land use has been unregulated in MCAs in the past as the current regulations are administrative and do not adequately regulate land use activities and development in MCAs. MCAs are not being adequately managed for the purpose which they were declared i.e. for conservation and water security which includes the prevention of soil erosion, the protection of natural vegetation, and the management of invasive alien plants and wildfires, and therefore the biodiversity and ecosystem services therein cannot be considered safe.

By 2020 CapeNature aims to unlock the potential of Private MCAs as Protected Areas contributing to long-term biodiversity conservation and water security.

With regards to the marine environment, an alternative to the establishment of MPAs (WCCC 1) which also leads to an increased level of safeguarding for the marine environment, is the nomination of Ecologically or Biologically Significant Areas (EBSAs). This softer approach, which has not yet been applied within the province, will allow for the identification of significant marine areas without the requirement of the detailed management plan (Weaver & Johnson 2012). Once endorsed by the CBD, these areas will most likely be categorised as WCCC 2.

Western Cape Conservation Category 3: Since 2012, an additional 2 797 361 ha of land within the province has been classified as WCCC 3. This increase is primarily attributed to the increased hectares under Biosphere Reserves. The Biosphere Reserve estate has increased from 820 340 ha in 2012 to approximately 3 759 700 ha in 2017. This can be attributed to the addition of the substantial Gouritz Cluster Biosphere Reserve of 3 187 893 ha, designated in 2015. Some of the differences in the figures are due to inclusion across the Western and Eastern Cape Province of marine components as part of the Biosphere Reserve total figures. Although much of the Biosphere Reserves is comprised of buffer or transition zones which include transformed lands, it nonetheless is still recognised as a mechanism which impedes upon the further hardening or degradation of these areas. It should however be kept in mind that there is overlap with other WCCC 1 and WCCC 2 sub-categories that fall within the boundaries of a Biosphere Reserve and this has been taken into consideration when reflecting on total hectares contributing to the conservation estate.

Voluntary Conservation Areas are now called Biodiversity Partnership Areas and have increased from 22 350 ha in 2012 to 43 920 ha in 2017. Conservancies, included under the Biodiversity Stewardship Programme, are also considered a Voluntary Conservation Area. This category has increased since 2012 by 18 890 ha. New conservancies registered in this time include Cape Columbine 2 560 ha (rural), Waboomsberg 5 700 ha (rural), Overbot 2.27 ha (urban) and Franschhoek 10 630 ha (rural).

CapeNature is currently undertaking a review of the registered conservancies to verify which of these conservancies are still active and which are now dormant and need to be removed from the register.

A comparison between 2002, 2006, 2012 and 2017 of the Western Cape Conservation Categories and Protected Area types are provided in Table 4.

The green shading represents actual expansion in the landscape/seascape between 2012 and 2017, whereas the white blocks signify no change in extent (for that type)

since the previous reporting period (2012).

The orange block (South African Natural Heritage Sites) no longer exists. This was a programme run by DEA (i.e., not a legal designation) and the supporting programme has become defunct. The most notable successes are the increased extents of Provincial Nature Reserves, SA National Parks, Contract Nature Reserves, Biodiversity Agreements and Biosphere Reserves. Entries marked with an asterisk (*) are conservation options or designations serviced by the Stewardship Programme.

3.4 Stewardship Areas

As most of the province's biodiversity is in private ownership, CapeNature initiated the Biodiversity Stewardship Programme in 2003. This programme facilitates conservation on privately owned land by setting up agreements between the landowners and CapeNature. The landowners undertake to protect and manage their properties or parts thereof according to sound conservation management principles and CapeNature undertakes to support this management by providing advice, management plans and assistance in planning alien invasive species clearing, fire management schedules, erosion control and other technical support.

Table 4: A comparison of Western Cape Conservation Categories and Protected Area types[3]

Category	Sub-category	2002 ha	2006/2007 ha	2012 ha	2016/17 ha
Western Cape Conservation Category 1	Wilderness Area	130 430	130 430	130 430	**130 430**
	SA National Park	156 920	290 630	303 420	**309 230**
	Nature Reserve (Provincial)	152 790	189 470	234 990	**269 380**
	State Forest Nature Reserve	407 730	407 730	407 730	**407 730**
	Marine Protected Area	68 500	161 040	164 140	**164 140**
	Island Reserve	300	300	300	**300**
	World Heritage Sites	unknown	393 840	393 840	**804 260**
	Contract Nature Reserve (Stewardship) *	NA	17 600	52 820	**142 640[4] (55 400)**
	Protected Environments *	NA	NA	NA	**12 360[5] (4 720)**
TOTAL WCCC1		**891 930**	**1 088 220**	**1 126 850**	**1 219 100**
Western Cape Conservation Category 2	Local Authority Nature Reserve	25 580	26 090	32 530	**37 070**
	Mountain Catchment Area	616 270	616 270	616 270	**616 270**
	Private Nature Reserve	139 130 (59 770)	154 400 (75 050)	154 400 (75 050)	**155 580 (76 220[6])**
	Natural Heritage Sites	31 950	31 550	N/A	**N/A**
	Biodiversity Agreement *	NA	960	14 960	**25 640**
TOTAL WCCC2		**739 320**	**750 960**	**744 180**	**834 560**
Western Cape Conservation Category 3	Biosphere Reserves	320 190	321 070	820 340	**3 759 700**
	Conservancies	unknown	641 090	853 560	**872 450**
	Biodiversity Partnership Area *	NA	19 100	22 350	**43 920**
TOTAL WCCC3		**1 506 400**	**1 598 200**	**1 623 480**	**4 420 841**
TOTAL WCCC1, WCCC2 and WCCC3				**2 952 880**	**5 325 900**

[3] The figures in this table are different from figures in the previous State of Biodiversity Report (Turner, 2012) due to boundary and other spatial analysis (GIS) corrections applied for the time periods 2002, 2006/2007, and 2012.
[4] Amount (ha) both declared and with a signed Protected Area Management Plan in place (i.e., intention to declare); amount in parentheses below () is declared only.
[5] Amount (ha) both declared and with a signed Protected Area Management Plan in place (i.e., intention to declare); amount in parentheses below () is declared only.
[6] Amount (ha) verified by DEA as reflected in the South African Protected Area Database (SAPAD)

The cost of stewardship to the state is much lower than the alternative of purchasing and managing land, thereby making biodiversity stewardship a very cost effective approach. It also allows for the private landowner to benefit more from the biodiversity through ecologically sensitive income-generating avenues such as ecotourism or green labelling of agricultural produce (e.g. Business and Biodiversity Initiatives[7]) (Pence, 2011).

These stewardship agreements may take the form of one of five sub-categories each with a different level of obligation and protection offered (Figure 4):

1. **Nature Reserves** are Protected Areas declared in terms of section 23 of the National Environmental Management Act (Act 57 of 2003) with a legally recognised Management Agreement and appointment of a Management Authority. This category is aimed at protecting biodiversity in the long term and contributes to South Africa's Protected Area Estate.

2. **Protected Environments** are declared in terms of section 28 of the National Environmental Management Act (Act 57 of 2003) and are the most flexible of the formally recognised Protected Areas with legally recognised contracts and contributes to South Africa's Protected Area Estate.

3. **Biodiversity Management Agreements** are declared in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) and is a shorter term, less restrictive than Protected Area declaration and contributes to South Africa's Conservation Area Estate.

4. **Biodiversity Agreements** are negotiated contracts between CapeNature and a land-owner for conserving biodiversity in the medium term and contributes to South Africa's Conservation Area Estate.

5. **Biodiversity Partnerships** are informal, flexible options for landowners and communities who want to conserve biodiversity on their land. This category does not contribute to South Africa's Conservation Area Estate.

Due to limited resources available to the Stewardship Programme, only the top priorities can be targeted for stewardship. These priorities are identified in the WCPAES of 2015 which highlights a subset of the province's CBAs. According to this strategy, the aim for 2020 is to secure an additional 349 000 ha in the province through a combination of stewardship agreements between landowners and CapeNature or other

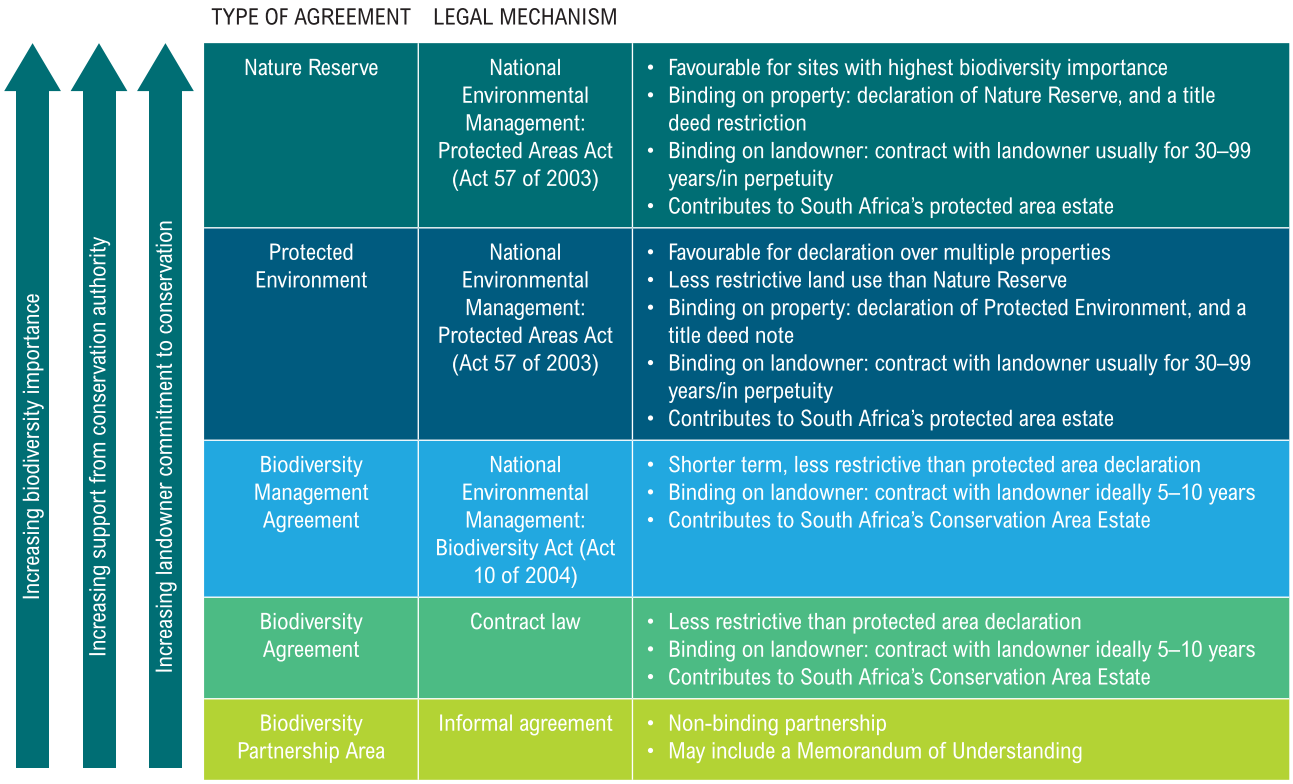

Figure 4: Biodiversity Stewardship Programme options for landowners

[7] Business and Biodiversity Initiatives involve creative partnerships between agricultural producers, industry associations, retailers, communities and conservationists, working together to conserve valuable biodiversity (https://www.sanbi.org/sites/default/files/documents/documents/biodiversitybusiness.pdf).

conservation agencies, purchase of priority properties as well as the acquisition of state land including Forestry Exit Areas of the Department of Agriculture, Forestry and Fisheries, and priority estuaries. A low target of 50 000 ha was set for new stewardship sites based on the organisation's capacity at the time of writing the WCPAES to sign up new stewardship sites and to be able to support landowners and regulate the expanding conservation estate. CapeNature has already exceeded the low level target of 50 000 ha and is now well on the way towards achieving the medium target of 100 000 ha.

Further to the Stewardship Programme, the wildlife ranching industry often creates habitats and ecosystems that are closer to what would be considered natural than is generally found on land where more standard agricultural practises are conducted (Taylor *et al.*, 2015). The growth of wildlife ranching (also referred to as game farming) has been documented (Carruthers, 2008). At present, 945 738 ha of private land in the Western Cape is stocked with game; an area almost equivalent to the current Protected Area estate in the province. However, not all game farms practice biodiversity conservation and therefore not all areas contribute to the conservation estate. Still, some 10.7% (101 793 ha) of game farms in the province are included in the Stewardship Programme and therefore contribute to the conservation estate.

4. Environmental Assessment

South Africa's provincial and national legislative frameworks introduce a level of environmental oversight where habitat transformation is contemplated. Authorisation (or several authorisations) are usually required if a proponent wishes to change land use or undertake a listed activity. These include (but are not limited to):

- requirements under the National Environmental Management Act (NEMA - Act 107 of 1998) Environmental Impact Assessment (EIA) regulations,
- permissions under the Land Use Planning Ordinance (for example to subdivide or rezone land),
- applications under the Conservation of Agricultural Resources Act (Act 43 of 1983) to cultivate new land and to cultivate near water resources,
- applications for mining permits under the Minerals and Petroleum Resources Development Act (Act 28 of 2002),
- the Western Cape Land Use Planning Act (Act 3 of 2014 - which guides the development of municipal Spatial Development Frameworks), and
- the National Spatial Planning and Land Use Management Act (SPLUMA; Act 16 of 2013).

The NEMA EIA regulations, which link to the NEM:BA list of threatened ecosystems, provide the greatest amount of regulation with regard to habitat loss.

CapeNature provides comment and guidance regarding biodiversity related issues for applications to change land use or undertake a listed activity. CapeNature is a 'commenting authority'; this means that while we are not decision-makers, our input must be taken into account when making a decision. Through our commenting role we endeavour to ensure that development does not result in significant irreversible direct or indirect impacts on verified CBAs and ecological infrastructure. Where such impacts are deemed unavoidable, these impacts should be minimised and mitigated.

Between 2012 and 2017 we have provided input into more than 2 500 development applications for undertaking listed activities throughout the province (Figure 5). Sixty percent of these were EIA processes in terms of NEMA, 16% were mining authorisations, 4% rectification processes (unauthorised activities) and 22% were applications in terms of the Land Use Planning Ordinance (LUPO) (e.g. subdivisions, consent use and rezoning applications). Only 2% of the applications were submitted in terms of the Conservation of Agricultural Resources Act (CARA; Act 43 of 1983). However, it must be noted that most applications to clear natural vegetation for cultivation, also trigger an authorisation in terms of NEMA. Therefore many of the agricultural applications are counted as NEMA applications. In addition, after the commencement of the One Environmental System in 2014, many mining applications were submitted in terms of NEMA and not in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002), although the Department of Mineral Resources became the decision-makers for all mining applications. It should also be noted that most applications require commenting at more than one phase, resulting in a higher number of comments than actual applications.

Most cultivation applications (submitted in terms of CARA and NEMA) were located in the West Coast and Cape Winelands District Municipalities, with Breede Valley and Langeberg local municipalities having the highest number of applications. Most of the applications for mining and prospecting were located in the West Coast District Municipality and most of these applications were located in the Matzikama local municipality. Saldanha Bay and Swartland also have a high number of applications and decision-makers need to consider the cumulative impacts of all applications. The Karoo municipalities do not have as many applications but are facing potentially significant impacts as a result of shale gas exploration and uranium mining.

The number of proposed wind energy facilities has decreased over the last five years compared to the 2009 to 2012 period. This is most likely due to many of the more favourable sites already under application, as well as to changes and unpredictability in the purchase price of renewable energy. It is important, however, that all approved facilities remain strictly compliant with pre- and post-monitoring best practice guidelines, and the information and lessons learnt are shared with decision-makers and others in the industry. Solar energy has seen an increase in the number of applications possibly due to a decrease in the cost of the technology and the perception

that it is easier to predict and manage impacts. More monitoring of solar energy facilities is required before it can be determined whether this is actually the case. The highest number of renewable energy applications have been recorded in Matzikama, Saldanha and Laingsburg local municipalities.

Most of the applications for residential developments were received in the City of Cape Town and Overstrand municipality. Stellenbosch and Drakenstein municipalities are also experiencing high development pressure which is not surprising given the proximity to the City of Cape Town. The local municipalities of George, Mossel Bay, Knysna and Bitou provided many planning applications linked to residential developments, indicating that the pressure for residential and mixed use development in the Eden district can be expected to steadily increase.

Industrial and development pressure is unsurprisingly the highest in the City of Cape Town, followed by Saldanha Bay local municipality which is expected to become the second largest industrial and commercial centre in the Western Cape due to the development of the Industrial Development Zone (IDZ) and associated infrastructure.

An analysis of the application locations showed that a greater number of applications in CBAs were received between 2012 and 2017 than between 2009 and 2012, but it must be noted that the time period is longer and when averaged out the difference per annum is not substantial. When assessed as a percentage, the results show that approximately one third of the total number of applications were entirely or partially within a CBA. This shows a decrease from the 53% recorded for applications between 2009 and 2012 and we are of the opinion that this is at least partly due to greater awareness by landowners and developers of the importance of CBAs and greater respect of their importance by decision-makers. We must unfortunately also acknowledge that there are data gaps in recording final footprints of developments so although we have seen a decrease in the percentage of applications in CBAs, a comparison between the actual footprints that have impacted, or will impact on CBAs, is not possible at this stage. However, a minimum of 34 000 ha of land which is CBA was assessed during the last five years.

Where a development is located in or near a CBA, this represents a potential threat to biodiversity, but also a potential opportunity to improve on the management of the area. It is with these applications where CapeNature's input is most crucial.

Unfortunately, CapeNature is not always informed of the outcome of planning and mining applications which makes it difficult to track the impact of our commenting role. However, a rough and subjective measure of the degree to which biodiversity issues are addressed within the EIA process is the degree to which we are satisfied with the outcome of the process (i.e. environmental authorisation). We were not able to get a complete quantitative sample of environmental authorisation reviews for the entire province but a sub-sample combined with expert opinion from the land use unit indicates similar figures to the previous State of Biodiversity report i.e. that we have been satisfied with

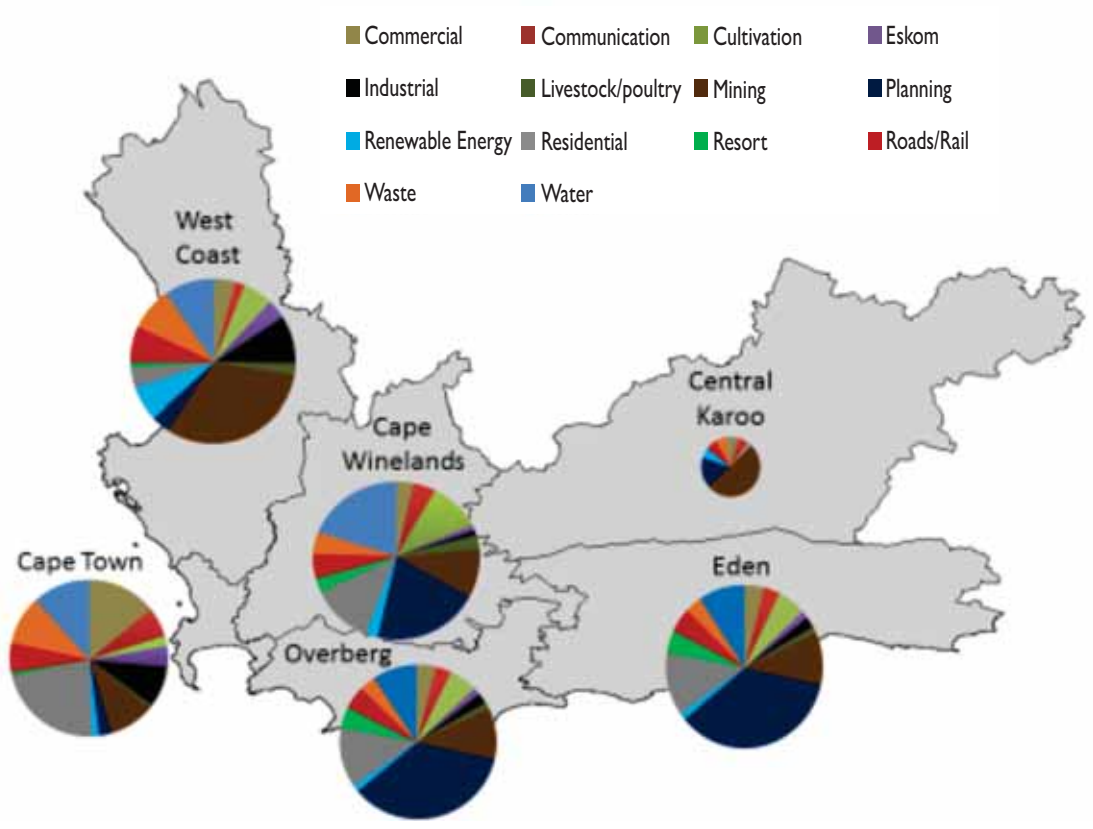

Figure 5: Type of development applications for the five District Municipalities and the City of Cape Town

approximately 75% of the environmental authorisations for applications which could potentially impact on CBAs that were concluded in the 2012 to 2017 period. We were partly satisfied with the outcome of approximately 20% which were mostly those that we believed had some important conditions lacking. Reasons for only partial satisfaction outcome could be that there was a degree of compromise required, or the implementation of mitigation measures (compliance with the conditions of authorisation) that are critical to reduce significance of the impacts of the development on biodiversity were not clearly stipulated, or only recommendations rather than conditions were issued. While we are not able to quantify the amount of habitat legally or illegally lost due to development, these figures do give us a sense of the degree to which biodiversity is protected through our oversight function.

5. Reactive Conservation through Development

As contradictory as it may sound at first, opportunities for conservation may arise through development. One of the key principles of integrated environmental management is that negative impacts on the environment must be avoided, or where they cannot be avoided, they should be minimised and remedied (according to NEMA). Conservation-worthy habitats that are excluded from development footprints (i.e. avoided) can become a valuable feature of a development and through development, resources may be unlocked for improved management of important habitat. Biodiversity offsets[8] are also considered as a form of reactive conservation. These areas may, or may not be conserved though a formal stewardship agreement. Where a stewardship agreement is included in the development proposal this is referred to as 'reactive stewardship'[9]. Through this mechanism, land that was not previously actively managed or formally secured for conservation can be conserved.

Development is seldom positive for biodiversity but the significance of many of these impacts can be reduced (minimised or mitigated) through enforceable conditions of authorisation. In theory, this introduces a level of environmental oversight that is otherwise absent. The level of conservation protection and management that arises from development set asides can vary depending on the type of development, the willingness of the landowner and the impacts on the environment. Depending on the significance of the impacts (and therefore the mitigation required), conservation measures may be either voluntary recommendations or enforced conditions of approval. The EIA process therefore requires a careful balancing of losses and gains; the aim is to reduce the negative impacts through avoiding habitat loss, but also provide an incentive to increase the conservation security of the remaining habitat (Figure 6).

Unfortunately, CapeNature's capacity to implement reactive stewardship agreements has declined over the last five years. Due to the decrease in capacity, the environmental authorisations for some applications have requested only a "farm map" in place of a stewardship agreement. A farm map is a georeferenced map which provides a clear indication of existing and approved cultivation and associated infrastructure as well as areas which should be set aside as conservation areas. It does not provide sufficient protection that we would consider it as a guaranteeing protection of conservation worthy areas, but it would hopefully provide sufficient evidence should the landowner transgress and disturb areas that were supposed to be no-go areas.

If sufficient capacity existed, ideally all areas which are required to be set aside and managed for conservation would be subjected to a stewardship review and an appropriate level of protection would be assigned. Biodiversity offsets are "conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects", so as to ensure 'no net loss' of biodiversity (Ten Kate *et al.*, 2004). In the Western Cape, offsets usually involve setting aside and formally protecting an area for biodiversity conservation. Biodiversity offsets differ to areas which are required to be set aside (as discussed above) as they usually consist of additional land, calculated at a specific ratio which does not form part of the property on which the development is proposed (DEA&DP, 2015).

Biodiversity offsets which add land to the conservation estate and provide for management of that land are currently preferred to financial offsets. Although financial offsets may be permitted in exceptional circumstances, the same process would apply where the financial offset would need to be equivalent to the cost of purchasing and managing land for conservation. Determining a suitable receiving area for the funds would also have to form part of a detailed biodiversity offset specialist study and it should be proven that the funds will be used for the acquisition and management of priority habitat thereby contributing to the expansion of the Protected Area network. While biodiversity offsets need to be agreed to by the applicant as they will be responsible for implementation, the offset can be made an enforceable condition of approval of the environmental authorisation. In other words, the offset forms a critical part of the development proposal, without which the development would not have been approved (DEA&DP, 2015). CapeNature is of the opinion that biodiversity offsets should be suspensive conditions i.e. the development should not be permitted to commence until the biodiversity offset has been secured.

Advantages of reactive stewardship include that the applicant bears the costs of the biodiversity assessments,

[8] Biodiversity offsets are conservation activities intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects. It usually involves setting aside land in a similar ecosystem elsewhere, at the cost of the developer (Maree & Vromans, 2010). Since the previous SOB report a Draft National Policy on Biodiversity Offsetting has been produced by the Department of Environmental Affairs (DEA, 2017).

[9] As opposed to proactive stewardship whereby the landowner is approached by the Biodiversity Stewardship Programme to consider a stewardship agreement independent of any development applications.

drafting of contracts and management plans, land management and auditing; and in some instances we are able to conserve priority areas which are under high threat levels.

The disadvantage of reactive stewardship is that it is opportunistic and by nature reactive, which makes planning and goal-setting difficult. The conservation areas in question are also usually smaller and more fragmented than the priority sites targeted by proactive stewardship and if not properly managed this, together with the limited resources available, could result in a diversion of resources away from more critical priorities. Over the last five years, experience has also shown that the process from when an offset is included in the environmental authorisation to when it is actually secured can be time-consuming and complicated requiring detailed input from CapeNature staff (particularly the land use and conservation planning unit, the stewardship and Protected Areas manager and the stewardship legal advisor) is required which further stretches our existing capacity.

Care must be taken to ensure that development rights are not bought; i.e. unacceptable habitat loss should not be allowed in exchange for increased security of other habitat. The impacts of development must be shown to be unavoidable before offsets are to be considered.

We only have a rough sense of the actual conservation gains made through environmental impact assessment processes. This is partly due to it being difficult to measure as conservation actions vary from case to case and can range from voluntary to compulsory. Compliance and enforcement is also not always as effective as anticipated.

Despite capacity constraints, reactive stewardship continues to be an important tool and thousands of hectares have increased conservation security through improved management as part of the mitigation requirements arising out of the impact assessment process. However, many of these agreements have yet to be concluded even though they have been required as a condition of authorisation. The land use unit is constantly being presented with proposals to conserve land as mitigation for developing another portion of land on the same property or elsewhere. As these sites are of high conservation value, the lack of capacity to include those as part of CapeNature's Stewardship Programme is a challenge that needs to be met in conjunction with our partners.

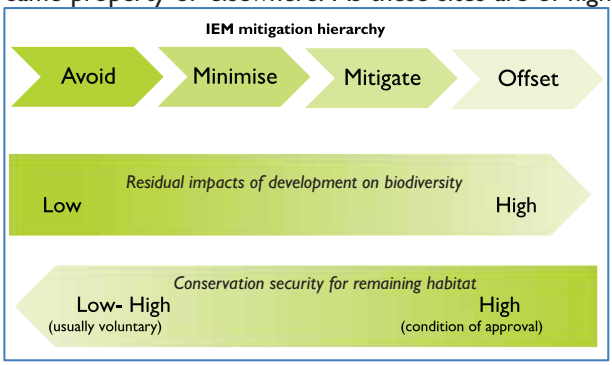

Figure 6: Mitigation hierarchy and reactive stewardship

6. Spatial Planning

Spatial planning can afford a level of protection to important biodiversity, albeit a low level of protection. The Western Cape Province and municipalities are obliged under SPLUMA and LUPA to develop maps and associated reports, termed Spatial Development Frameworks (SDFs) which indicate desired patterns of land use and provide strategic guidance for the location and nature of development and conservation. The other main spatial planning tools accommodated for by NEMA include Environmental Management Frameworks (EMF), Strategic Environmental Assessments (SEA), and Bioregional Plans.

Between 2012 and 2017, CapeNature's land use unit, together with our partners, has commented on a wide range of municipal SDFs, EMFs (see Box 1, in section 8 on habitat loss, for an example), Integrated Development Plans (IDPs), Strategic Environmental Assessments (SEAs) and other planning initiatives to ensure that biodiversity priority areas (i.e., CBAs and ESAs) are adequately considered and represented (Table 5).

As of September 2017, not all of the above has been finalised. Furthermore, not all of those which have been finalised have taken all of our comments regarding the priority biodiversity into account, implying that we are not always completely satisfied with the final outcome. Nonetheless, we are of the opinion that we are seeing continued improvement in most municipalities with regard to the uptake of biodiversity considerations in planning documents. More biodiversity mainstreaming effort is, however, required at all levels, from the consultants appointed to do the work to municipal officials and councillors.

In an assessment undertaken by DEA&DP in 2012, it was highlighted that certain municipal SDFs had not included CBA information. Intensive engagement with these municipalities was recommended over the next few years to ensure that CBAs were properly considered and aligned in future: Cederberg (2008), Bergrivier (2008), West Coast District Management Area (2007), Overstrand (2006), Swellendam (2009) and Overberg District Management Area (2001). In all of the above cases, the SDFs were either complete or in an advanced stage at the time of the (then available) CBA information being finalised and mainstreamed.

We would have liked to compare the 2012 results to updated SDFs for all of the local municipalities in the province this year. Most municipalities, however, have not yet completed SDF updates and due to capacity constraints (specifically in our biodiversity mainstreaming function), we have not had the opportunity to conduct a follow-up review. Importantly, the land use unit has had

Table 5: Spatial Planning initiatives which the CapeNature land use unit has provided input into between 2012 and 2017

DISTRICT	PLANNING INITIATIVE
City of Cape Town	▪ Greater Cape Metro Regional Spatial Implementation Framework Research Report ▪ Cape Town Municipality SDF
Cape Winelands District Municipality	▪ Drakenstein Municipality SDF: Proposed amendments ▪ Drakenstein Zoning Scheme Phase 2: Research Report ▪ Stellenbosch Municipality SDF ▪ Stellenbosch Municipality Zoning Scheme By-law ▪ Jonkershoek (suburb of Stellenbosch) SDF ▪ Klapmuts North (Drakenstein) SEA ▪ Urban Edge Amendment Application for Stellenbosch and Klapmuts ▪ Langeberg SDF ▪ Upper Breede SEA
West Coast District Municipality	▪ Cederberg Municipal SDF ▪ Saldanha Municipality SDF ▪ Saldanha Municipality EMF ▪ Swartland Municipality SDF ▪ Sandveld EMF ▪ Sandveld EMF standard
Overberg District Municipality	▪ Theewaterskloof SDF ▪ Overstrand IDP ▪ Overstrand SDF ▪ Danger Point Status Quo Report and Precinct Development Plan ▪ Cape Agulhas Municipality SDF ▪ Overstrand Municipality Amendment By-Law on Municipal Land Use Planning including Environmental Management Overlay Zones
Central Karoo District Municipality	▪ Central Karoo District Municipality SDF ▪ Beaufort West Municipality SDF ▪ Laingsburg Municipality SDF ▪ Prince Albert Municipality SDF
Eden District Municipality	▪ Eden District SDF ▪ George Municipality SDF ▪ Mossel Bay Municipality SDF ▪ Bitou Municipality SDF: Urban Edges
Provincial	▪ Western Cape State of the Environment Outlook Report ▪ Strategic Assessment for location of Wind Energy facilities in the Western Cape
National	▪ SEA for Wind and Solar Energy in South Africa ▪ SEA for Electricity Grid Infrastructure in South Africa ▪ Draft Generic Environmental Management Programme for the construction phase for electricity infrastructure

active engagement with municipalities with regard to integrating the WCBSP's priority biodiversity areas and guidelines into their SDFs, as well as providing comment on SDFs.

7. Policy and Legislation

Current biodiversity-related policy and legislation in South Africa creates a positive enabling environment for safeguarding priority areas for conservation. The strength of this legislative environment, however, lies not only in the application of these tools in land use planning and decision-making, but in the use of a common set of priority areas – so that all stakeholders on our national development path, and in all spheres of government, are working from the same 'blueprint'.

In the Western Cape, the Biodiversity Spatial Plan is the blueprint, and CapeNature is working alongside DEA&DP and other partners to ensure alignment between the desired objectives of the priority areas identified in the WCBSP and the relevant policy documents and legislation under development or review. This mainstreaming of biodiversity priorities is a core strategic objective of the Provincial Biodiversity Strategy and Action Plan (PBSAP). Through our commenting role specifically, CapeNature's land use unit has contributed to a wide range of legislative tools. By ensuring that the CBA terminology is reflected in current policy and legislation, and that the stipulated treatment of these CBAs is in line with the desired objectives of the CBAs, we are further able to support the safeguarding of the BSP Map. Together with our partners, CapeNature's land use unit has (since 2012) endeavoured to ensure the following list of policy documents and legislation (many still in draft format) adequately accommodate the WCBSP, and CBAs in particular:

- Proposed amendments to the National Environmental Management Act 2014
- National Environmental Management Laws Amendment Bill 2017
- National Biodiversity Framework
- National Land Use Classification

- National Policy on Biodiversity Offsets
- National Protected Area Expansion Strategy
- Cultural Heritage Survey Guidelines and Assessment Tool for Protected Areas
- Mining and Biodiversity Guidelines
- Western Cape Provincial Spatial Development Framework
- Western Cape Guideline on Biodiversity Offsets
- Western Cape Biodiversity Bill
- Western Cape Protected Area Expansion Strategy
- Provincial Biodiversity Strategy and Action Plan
- Rural Land Use Guidelines

Of special mention is the current opportunity provided by the Western Cape Biodiversity Bill to enhance the legal status of the WCBSP. Through the Bill we intend to empower the WCBSP as:

- A guideline that may be published in terms of Section 24J of NEMA;
- A relevant factor that must be considered in terms of Section 24O of NEMA;
- A systematic biodiversity plan that may be adopted by the competent authority as contemplated in listing notice 3 of the NEMA EIA Regulations;
- A requisite informant of EMFs, SEAs, and any tools used to supplement and/or replace the NEMA Regulations;
- A Provincial Sectoral Plan in terms of Section 26(d) of the Local Government: Municipal Systems Act (Act 32 of 2000);
- A Regional Spatial Development Framework that may be adopted in terms of Part 2 of Chapter 3 of the Western Cape LUPA; and
- The Provincial policy, plan and strategy for the purposes of SPLUMA and LUPA.

8. Habitat Loss and Biodiversity Priority Areas

The state of our priority areas for biodiversity conservation is not only informed by gains to the conservation estate, but by areas not yet lost (whether as a result of our regulatory safety net, considered forward planning, private stewardship or benign neglect), and also by the losses. While significant effort goes into preventing the loss of CBAs, the reality is that while some CBAs get protected, and others persist in an unprotected natural state, still other priority areas are being converted to alternative land uses and are thus lost to biodiversity conservation and ecosystem service delivery (see Box 1 for an example).

The loss of CBAs can be attributed to any of a suite of reasons, including:

- CBAs are only one consideration in an environmental assessment and impacts to biodiversity are often accepted due to overriding public and economic considerations;
- CBAs were not considered in the application;
- CBAs were erroneously identified and commenting and authorising bodies thus approved the application; or
- Illegal land transformation occurred, whereby the developer neglected to apply for the necessary authorisation(s).

Currently, our ability to quantify CBA loss, or the loss of natural habitat more generally, is hampered by a lack of development tracking, a lack of ground-truthing of natural remnants and their condition, and limitations related to remotely sensed information.

Box 1: Sandveld Environmental Management Framework as an example of transformation of natural habitat

In the previous State of Biodiversity Report, concerns about the extent of transformation of natural habitat for agricultural expansion in the Sandveld region of the province were highlighted (at least 9 650 ha were lost between July 2006 and December 2015). Subsequently, and in response to reports of illegal developments, the ostensibly prohibitive costs and timeframes associated with the environmental authorisation process, and growing evidence of ecological degradation and biodiversity loss, DEA&DP undertook the Sandveld EMF project in 2013, to proactively address these challenges.

As part of the EMF project, the Planning and Policy Coordination Directorate of DEA&DP investigated the magnitude of unauthorised vegetation clearance within the study domain. The investigation was conducted on the basis of concerns from steering committee members, surrounding the viability of the initiative if it would not be applicable to farmers who had contravened the National Environmental Management Act. The basis for excluding non-compliant farmers was to avoid the possibility of inadvertently legalising previous illegal activity. Officials, however, indicated that it was highly likely that the majority of farmers in the area would be non-compliant, and the initiative would therefore have limited applicability. Arising from this, the Directorate requested that CapeNature undertake an exercise to evaluate the extent of vegetation clearance that had arisen since July 2006 as a result of agricultural expansion within the study domain. At the same time, the Directorate requested a list of the environmental authorisations issued since 2006 for the municipal areas involved. After evaluating the applicability of each environmental authorisation (i.e. authorisations pertaining to the clearing of vegetation for agricultural purposes), the total area of vegetation clearance approved by DEA&DP in these authorisations was compared to the extent of vegetation clearance as provided by CapeNature. **Based on the disparity between these two figures, it was concluded that the vast majority of vegetation cleared since July 2006 for agricultural expansion within the Sandveld EMF study domain had been undertaken without the necessary environmental authorisation.**

These findings emphasise the severity of the challenge at hand, and have also given rise to a second project piloting the NEMA Section 24G process for 10 farms in the Sandveld EMF area. In addition, and parallel to the proactive EMF approach, DEA&DP has developed a compliance and enforcement strategy to reactively deal with alleged illegal commencement of land clearing.

Remote sensing information in the form of land cover data is the most common, reliable and objective means of determining the coverage of natural habitat at the provincial scale. Determining loss, however, requires land cover data generated for multiple time periods using comparable classification methods for comparable areas. Such datasets are currently unavailable, but under development.

The most recent land cover data however, acquired for the period 2013/14, classifies 65% of the province as natural, and a substantial percentage (33.5%) as degraded or transformed. CapeNature's 2014 assessment of the Western Cape Biodiversity Framework (mentioned in Section 2 above) found that 53 600 ha of vegetation and 16 800 ha of CBAs were lost to agricultural expansion alone between 2006 and 2011 – the period during which CBAs were first being mapped within the province (see Table 1). The assessment also concluded that a total of about 3 475 300 ha of CBAs were likely intact in 2011 (based on a combination of land cover and land use sources). A comparison between that same CBA footprint and the 2013/14 land cover product reveals a further 19 270 ha were lost in the intervening period (2011-2013/14). While this suggests a greater degree of CBA loss in the latter 2-3 year period than in the previous 5 year period, inconsistencies in data sources may confound the picture. Regardless, it is incontrovertible that habitat loss continues to erode our biodiversity priority areas, and greater effort is required to mainstream and safeguard the priorities identified in the 2017 WCBSP. In addition, significant effort should be made to procure the next time-step with which to compare the 2013/14 land cover information, as well as to put in place a development and environmental authorisation tracking tool to enable reporting on legal versus illegal land conversions.

What these losses mean in terms of Ecosystem Threat Status and our ability to meet national biodiversity targets is discussed in greater detail in Chapter 5 but in summary, CapeNature has determined that a total of 14 additional ecosystems qualify for national listing (as threatened) since the 2011 gazetting of threatened ecosystems.

The continued loss of natural habitat, particularly in CBAs and ESAs, undermines not only the rich natural heritage of the Western Cape, but our very livelihoods and quality of life, our water security, and our resilience in the face of a changing climate. In the words of Minister Bredell: *"We encourage all sectors to join us in ensuring our collective action brings about the attainment of the vision of the WCBSP: [that] biodiversity and ecological infrastructure are highly valued as assets, integrated into all planning spheres, and managed in a sustainable way so as to ensure the persistence of healthy, functioning and representative ecosystems and associated services which benefit all"* (in Pool-Stanvliet *et al.*, 2017).

9. Conclusion and Recommendations

As highlighted in the Western Cape Protected Area Expansion Strategy (Maree *et al.*, 2015), a two-tiered approach to biodiversity conservation within the province must be continued. The first tier is to secure the top-ranked biodiversity areas into formal Protected Areas. The current mechanism preferred by CapeNature is through the Stewardship Programme while other options could include land acquisitions through partnering with funders, land donations, or land transferals from one state entity to another. The second tier is to conserve priority areas through mainstreaming avenues such as spatial planning (e.g. zoning), land use decision-making, and relevant policies and guidelines.

The listing of the Cape Floral Region Protected Areas World Heritage Site will result in additional buffer areas being afforded increased protection. Each of CapeNature's reserve clusters, included in the World Heritage Site, should have an approved and fully operational management plan by the end of 2020, thereby assigning a higher level of protection to these existing Protected Areas. Mountain Catchment Areas (which overlap to a degree with World Heritage buffers) are another mechanism for protecting biodiversity, and mechanisms of controlling land use in MCAs are being investigated.

Protection of the marine environment usually comprises the formal declaration of Marine Protected Areas in terms of section 22A of NEM:PAA. CapeNature manages a number of MPAs as part of their nature reserve clusters.

Proactive stewardship remains of paramount importance to the protection of biodiversity mandate of CapeNature in accordance with the Protected Area Expansion Strategy. CapeNature should support the continuation of the programme in such a manner that a far larger contribution to CBA conservation can be achieved within the next five years. As CapeNature's resources are too limited to support the current models of stewardship, alternative models of Protected Area expansion must be explored in the next five years in order to secure top sites as formal Protected Areas.

If sustainable development is to be achieved, no CBA or part thereof should be impacted or disturbed in any way. If this is unavoidable, the loss of such CBA should be offset. The provincial guideline on biodiversity offsets (DEA&DP 2015), and the draft National Policy on Biodiversity Offsetting (DEA 2017) which is in the process of being finalised, is supported by CapeNature, as CBAs are considered as ideal receiving areas for biodiversity offsets. Biodiversity offsets are conservation activities intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects. CapeNature is in support of a process whereby biodiversity offsets should be added as suspensive conditions to environmental authorisations. Securing of biodiversity offsets must be undertaken within the framework of the Protected Area Expansion Strategy.

The role of CapeNature's land use unit in directing conservation and development is pivotal to preventing loss of biodiversity in the Western Cape Province. The land use unit plays a crucial supporting role to DEA&DP in screening development applications in terms of the impact of the activities on the biodiversity and ecological aspects of the receiving environment. A recognised need is to design and implement a system whereby all approved development footprints, as well as areas with improved conservation security are highly accurately spatially captured for future reference.

Input provided on behalf of CapeNature by the land use unit on strategic projects (for example, the Sandveld EMF, the Rural Land Use Guidelines, the Renewable Energy Development Zones, the Electrical Grid Infrastructure) has had a notable impact and must continue to be seen as a high priority function for CapeNature.

CapeNature, in collaboration with DEA&DP, has published the Western Cape Biodiversity Spatial Plan in 2017 (Pence, 2017; Pool-Stanvliet *et al.*, 2017). The WCBSP is a spatial tool which comprises biodiversity priority areas, accompanied by contextual information and land use guidelines that make the most recent and best quality biodiversity information available for land use and development planning, environmental assessment and regulation, and natural resource management. The BSP Map, as presented in the WCBSP Handbook, covers both the terrestrial and freshwater realms, as well as major coastal and estuarine habitats. Formal adoption of the BSP Map must be driven as stipulated by Listing Notice 3 of NEMA.

CapeNature and DEA&DP are embarking on a training programme to facilitate the mainstreaming of the WCBSP in all local authorities across the entire province. This will enable these institutions to increasingly take biodiversity concerns into account through ensuring that spatial products (SDFs, EMFs, etc.) are cognisant of the WCBSP. In addition, the WCBSP should be used in planning for public projects such as housing. More capacity building related to the implementation of the WCBSP, and using it as a key informant for deciding whether to authorise development and planning applications, will also be given to certain competent authorities such as the DMR which has only relatively recently started authorising mining related applications in terms of NEMA.

CapeNature and DEA&DP are the two mainstreaming agents for biodiversity conservation. Collectively, these two organisations will ensure that the WCBSP will be the standard reference towards achieving smart and sustainable development in the province, while at the same time ensuring the protection needs of ecosystems are met.

10. Acknowledgements

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CHAPTER 2

STATUS OF FRESHWATER ECOSYSTEMS

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CONTENTS

GROOT WINTERHOEK NATURE RESERVE

1. Introduction

The current drought conditions have highlighted once again, the importance of the conservation of freshwater ecosystems in the country and in the Western Cape Province (WCP). In fact, the presence of several mountain catchments in the province has received a lot of attention due to their strategically high water yield and their provision of good quality water. These mountain catchments, which include rivers and wetlands, in many cases, still enjoy some form of protection. However, for the lower lying areas, in general, the patterns of land use and other impacts have not changed much in the past five years, and freshwater ecosystems in these areas remain under an increasing threat.

The State of Biodiversity Report of 2012 (Turner, 2012; Gouws *et al.,* 2012) reported that the ecological health of the river systems within all four of the Western Cape Province's Water Management Areas (WMAs) had been assessed by that stage (River Health Programme, 2003, 2004, 2005, 2007, 2011). Subsequent to these assessments, comprehensive follow-up assessments were and are in the process of being conducted in the now two WMAs (Berg and Olifants-Doring WMA and the Breede and Gouritz WMA). From these follow-up assessments, any trends present in the health condition and changes in health of river systems can be analysed and reported on.

The results obtained through these and other related assessments, are also currently in the process of being incorporated into the updates of the National Freshwater Ecosystem Priority Areas (NFEPAs); (Nel *et al.*, 2011a and b). Furthermore, the Biodiversity Spatial Plans for the Western Cape have been updated recently, also incorporating new data and in some cases ground-truthed and confirmed spatial layers for conservation planning (Pool-Stanvliet *et al.*, 2017; also see Chapter 1 of this report). The Protected Areas Expansion Strategy (PAES) was also updated and more freshwater areas were included within these updated layers (Maree *et al.*, 2015).

Together with already established initiatives working in the improvement and integration of freshwater ecosystems management in the WCP (e.g. Working for Water and Working for Wetlands), several new initiatives and plans have been launched since 2012. These include the formation, activation and coordination of the Berg River Improvement Plan (BRIP) and the current formation of the Breede River Environmental Resources Protection Plan (BERRP) (Western Cape Government, 2012; Western Cape Government, in prep.). Both of these initiatives were initiated and coordinated by the Department of Environmental Affairs and Development Planning (DEA&DP), together with several other governmental sections and external stakeholders.

These initiatives allow for a more integrated way of managing freshwater ecosystems in the relevant catchments of the WCP. However, it makes a lot of sense to manage freshwater from the mountain catchments to the coast and it was with this in mind that CapeNature has put together a strategic plan for catchment management (Integrated Catchment Management Strategy; CapeNature, 2016) that is to be updated every five years. This strategy considers the management of freshwater ecosystems from the mountain catchments (including fire and alien invasive plant species) down to the lowlands (including groundwater, rivers and wetlands) and ultimately the estuaries.

2. State of Rivers

2.1. River Ecostatus Monitoring Programme

The State of Biodiversity Report of 2012 (Turner, 2012) marked the end of the contract between CapeNature and the then Department of Water Affairs and Forestry (DWAF) for the implementation of the River Health Programme (RHP) assessments. All assessments in the WCP are now conducted in-house, within the Western Cape Department of Water and Sanitations' (DWS) Resource Protection division. The report also marked the end of the first round of comprehensive surveys of the then four WMAs in the province and from here, the DWS team started with the next round of comprehensive surveys. To date an assessment of the Berg-Olifants WMA has been completed and the assessment of the Breede-Gouritz WMA is currently underway.

Several changes have also taken place with regards to the RHP and the assessments of the health of rivers within the Water Management Areas (WMAs) of the WCP in the last five years. The first of these changes was the name change from the RHP to the River Ecostatus Monitoring Programme (REMP). Also, the number of sites to be

assessed within the WMAs, has been reduced and refocussed on the Ecological Water Resource (EWR) management sites, now contained within two WMAs, namely the Breede-Gouritz WMA and the Berg-Olifants WMA. The latter includes the Doring River catchment.

The objective of the REMP is to determine the ecological state of South African rivers. This is achieved by monitoring a number of biological (macroinvertebrate; fish; riparian vegetation) and physical (habitat integrity; geomorphology) components. Each of these components has an index model designed for it, which once completed, produces an ecological category ranging from A (natural) to F (critically modified). Integration of the ecological categories of individual biological components produces the EcoStatus (also expressed on a scale from A to F), which can be considered as the integrated present ecological state (PES). The purpose of determining the EcoStatus is to gain insights and understanding into the causes and sources of deviation of the present ecological state of the biophysical components from their reference condition.

The EcoStatus of rivers in the Berg-Olifants WMA varies significantly depending on the anthropogenic activities occurring in their catchments, and whether one is referring to the main stem of the river or its more inaccessible tributaries. Generally, proximity to urban areas (in particular proximity to waste water treatment works, informal settlements and industry) results in low and very low EcoStatus. This is mainly caused by poor water quality and physical alteration of the instream and riparian habitat. In areas where the predominant land use is agriculture, the EcoStatus of rivers is slightly improved as water quality appears to be generally better than in urban areas, but high abstraction of river water does impact available habitat for instream and riparian biota and alters physico-chemical parameters of river water. The best EcoStatus occurs in the higher altitude tributaries where land gradient is not conducive to agriculture and inaccessibility means low urbanisation resulting in better water quality and limited instream and riparian habitat alteration.

The higher urbanisation of the Berg portion of the WMA results in a lower average EcoStatus of rivers within this catchment compared to rivers of the Olifants portion of the WMA. Consequently, in the Berg portion, improving the EcoStatus could best be achieved by improving the water quality of effluent inputs such as waste water treatment works, storm water runoff and industry. In the Olifants portion of the WMA the management focus should be on ensuring that environmental water requirements are met (i.e. preventing excessive abstraction). Currently, many higher altitude tributaries within the Berg-Olifants WMA are acting as important refugia for native aquatic and riparian biota. Fortunately, many of these tributaries are located within areas currently managed for conservation, but further efforts should be made to secure the conservation of those tributaries occurring on private or state land. The main threats to these tributaries (and all rivers not already impacted) is the invasion of alien vegetation and fish species.

The information gained from initiatives such as the REMP is invaluable to informing the management of freshwater ecosystems. Moreover, in order to address the threats, such as those posed by alien invasive vegetation, alien invasive fish and poor water quality, one would need a more coordinated approach to activities in the different catchments. It is with this in mind that the DEA&DP initiated the coordinated improvement plans for both the Berg and Breede River catchments.

2.2. Berg River Improvement Plan

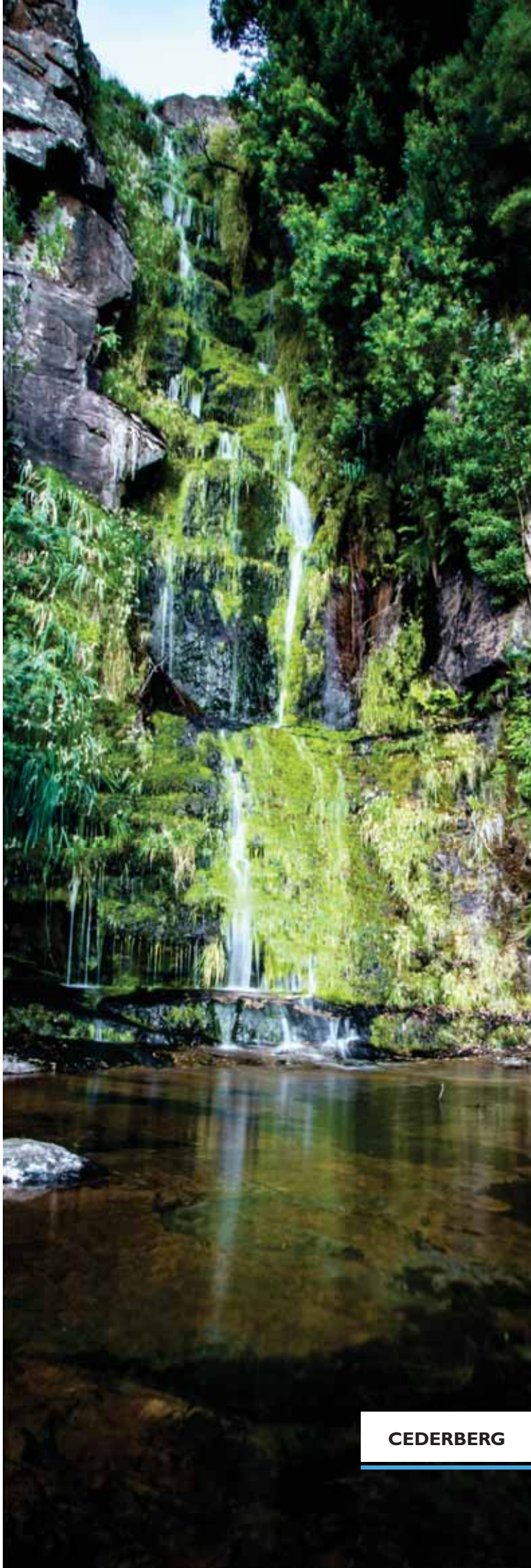
The improvement of water quality in the Berg River catchment has received much attention in the past few years, especially since the formation and application of the Berg River Improvement Plan (BRIP; Western Cape Government, 2012) as a water stewardship programme for the catchment. The plan is led by the Pollution and Chemicals Management Directorate within the DEA&DP together with several participating partners within provincial government sectors, including the DWS, the Department of Agriculture, the Department of Local Government, the Department of Human Settlements and the Department of Economic Development and Tourism (Western Cape Government, 2012). Originally, the plan consisted of six tasks, which entailed, in order, the establishment of a Berg River Water Quality monitoring program (Task 1), upgrading of waste water treatment works and training of process controllers (Task 2), upgrading informal settlements (Task 3), advocating of best practise in agricultural, industrial and domestic land-use (Task 4), rehabilitation of the riparian zone and management of the buffer zone (Task 5) and lastly, the pricing of water management in the Berg River catchment (Task 6). Subsequently, two more tasks have been added, including Task 7 on the ecological integrity of the Berg River catchment and tourism in the area as Task 8. Each of these tasks houses and allows for the coordination of several projects, including for example the Bioremediation projects within the rehabilitation task (Task 5) and the white fish reintroduction plan, within the ecological integrity task (Task 7). The BRIP task projects continue to be implemented and some are nearing their completion. Given the success and continuation of the BRIP projects, the improvement of the main-stem rivers in the other WMAs of the Western Cape Province are now being considered. In fact, the formation of the Breede River Environmental Resource Protection Plan (BERPP) has been initiated recently and is spearheaded by the DEA&DP. In the long term, it is further envisioned to formulate a plan for the Olifants-Doring River Catchment depending on resource availability for effective implementation.

2.3. Breede River Environmental Resource Protection Plan

The Breede River Environmental Resource Protection Plan (BERPP) is in the process of being finalised (Western Cape Government, in prep.). As it stands, this plan will include tasks that will relate to both the Breede and Riviersonderend Rivers. The tasks will be similar to those contained within the BRIP, but because the catchments are somewhat different in some ways, there will be dissimilarities with regards to the type of projects contained within at least some of the tasks. For the BERPP, a total of 10 tasks have been identified, with Task 3 subdivided into two parts. Again, the tasks will range, in order, from monitoring of water quality (including river health, Task 1), the improvement of performance of wastewater treatment works (Task 2), advocating best practice in land-use for urban settlements (Task 3a) and the upgrade of informal settlements (Task 3b), advocating best practice in land-use for agriculture (Task 4), the rehabilitation and management of the riparian zone (Task 5), the costing of water management in the Breede River catchment (Task 6), the protection and improvement of the ecological integrity of the rivers in the catchments (Task 7), the promotion of eco-tourism (Task 8), strengthening of environmental governance (Task 9) and lastly, the facilitation of environmental awareness and education (Task 10). Once again, several departmental stakeholders form part of the steering committee for implementation of this plan, and CapeNature will at least be involved in the protection and improvement of the ecological integrity of rivers task (Task 7) through objectives set out in the CapeNature Integrated Catchment Management Strategy (ICM; CapeNature, 2016). As was the case for the Berg River, there are already numerous projects that are active in the Breede and Riviersonderend river catchments, and the BERPP will allow for the strategic coordination of new and existing projects within the framework of each of the 10 tasks.

2.4. Resource Quality Objectives and Water Resource Classification

Despite the fact that a strategic improvement plan for the Olifants and Doring River catchments will not be formulated just yet, these catchments have received some attention with regards to the Water Resource Classification (WRC) and Resource Quality Objectives (RQOs) processes required of the DWS by the National Water Act (Act No. 36 of 1998). For this portion of the Berg-Olifants WMA, the WRC and RQO assessments where conducted separately, with the WRC analysis being completed and reported on in April 2012 ((Belcher *et al.*, 2011a and b) while the RQO's analysis was completed in 2013 (Department of Water Affairs and Sanitation, 2015). Following the publication of these analyses, CapeNature drafted a letter to the Department of Water Affairs (then the DWA) regarding the RQOs set for Freshwater Ecosystem Priority Areas (FEPAs) rivers. In line with National Freshwater Ecosystem (NFEPA) requirements and with CapeNature's mandate, the letter



requested that a 100% flow (i.e. natural flow) be allocated to these priority rivers, river sections and wetlands. These proposed natural flow levels, particularly in the mountain catchment zones, will ensure sufficient water availability for downstream areas as well as for the estuarine system. As a result, the ecological reserve for the estuaries can then also be met. It is acknowledged, however, that asking for a 100% flow in many river sections is not feasible, and flow down to 60 - 80% might be considered acceptable. Nevertheless, at least in the higher catchment areas, especially those linked to water source catchments, natural flow should be allowed.

The process for the determination of the WRC and RQOs for the Berg, Breede and Gourits river catchments was initiated in 2016 and will be completed as part of one project, by the same consultant firm (Aurecon). The points put forward in the CapeNature letter discussed above, have relevance here too. Furthermore, the categorisation of water resources according to management classes, is a 7 step process. The process takes into account the existing condition/status of a given water resource and defines the features (ecological, social and economic) that are dependent on the resource. From the resulting resource classes, the specific RQOs are set, which are either numerical or descriptive statements (or both) of conditions that should be adhered to for the protection of the receiving water resources (Aurecon, 2017). The seven steps include the following; 1) delineation of resource units and description of the status quo, 2) linking the value and condition of the water resources, 3) quantifying the ecological requirements, 4) determination of different scenarios, 5) evaluation of scenarios within the Integrated Water Resource Management (IWRM) process, 6) evaluation of scenarios with stakeholders and 7) the gazetting and class configuration. It is during the initial steps of the WRC and RQO determinations that cognisance should be taken of the protection of the strategic and priority rivers, river sections and wetlands, especially with regards to flow requirements. One potential caveat of the classification process is that when a river node is chosen within one of the integrated units of analysis, there is often not enough resolution with regards to the variation in condition of a specific river in its different sections, because not enough nodes can be assessed per river due to budget and time constraints.

For example, the upper part of a tributary river is generally in a better condition health-wise than the lower lying sections, where land use and urbanisation impacts are present. Once a node is chosen, it is often the case that it is low down in the catchment where more impacts are present. In this case the Ecostatus of that particular river is then reported as being the same low condition from its upper catchment to the lower lying areas, where that one node is located. This in turn is then likely to miss-inform the classification and RQO management principles for the upper catchments of many of the rivers. This is concerning, particularly with regards to priority rivers and those rivers coming from the important high water yield water catchments.

2.5. Water Source Areas

Water resources of specific importance, particularly in the current drought situation, are the water source areas (areas of high water yield) of the WCP, and in fact the whole of South Africa. Following on the spatial layers produced by the NFEPA project, the Worldwide Fund for Nature (WWF) South Africa, in collaboration with the Council for Scientific and Industrial Research (CSIR), recently published two reports identifying the water source areas of the country (WWF, 2013a and b). A total of seven water source areas were identified to fall within the WCP; namely the Groot Winterhoek, Table Mountain, Boland Mountains, Langeberg Mountains, Swartberg Mountains, Kougaberg Mountains and the Outeniqua Mountains. Six of these catchments were identified as strategic water source areas for the country and the province, with the Swartberg Mountains being the only catchment to not be considered of particular strategic value for the country as a whole. It is however still important as a water source catchment in the WCP.

Parts of all of the WCP water source areas are protected in some way, with most of these mountain catchments falling within either a provincial Nature Reserve (for example, Grootwinterhoek, Cederberg, Limietberg, Hottentots-Holland, Grootvadersbosch, Outeniqua and Swartberg Nature Reserves) that is managed by CapeNature, or a National Park (Table Mountain and Garden Route National Parks) that is managed by South African National Parks (SANParks). These water source areas serve as the ecological infrastructure that provides water to the engineered and built part of water-related infrastructure and water provision. Therefore the conservation and protection of these areas are extremely important, both for human use and for the preservation of the biodiverse landscapes and species contained within these catchments. It follows then that national and provincial conservation agencies, who are the custodians of large parts of the water source areas, should ensure that integrated catchment management principles are put in place in order to effectively manage these areas of high water yield. This includes the acquisition of sustainable funding for the effective management and monitoring of the water source catchment areas.

2.6. Integrated Catchment Management

Many of the threats to the Cape Floristic Region (CFR) are related to impacts on water resources. These threats are increasing and include the spread of alien and invasive species, the increasing frequency of wildfires (especially in the mountain catchments), land-use practices and destruction of habitat, over-abstraction of water and pollution of both freshwater and marine ecosystems. As CapeNature manages about six percent of the WCP, with large parts of it including the high water yielding water source catchments, a strategy was compiled to address the need for integrated management of entire catchments (CapeNature, 2016). In effect it is a way to apply management principles that speak to the catchment to coast concept and considers the integration and

improvement of the management of the terrestrial, freshwater, marine and biological resources. Ultimately, the aim is to conserve these resources, but also to allow for their sustainable utilisation.

The CapeNature Integrated Catchment Management (ICM) strategy therefore focusses on three important areas for management, namely the integration of catchment, freshwater and coastal management (CapeNature, 2016). For the mountain catchments, the management of alien invasive plants and the frequency and timing of wildfires are of particular concern, as both affects the quantity and quality of water yielded for the rest of the catchment area. In the case of freshwater ecosystems; priority rivers, wetlands and catchments (that have biodiversity and/or ecosystem pattern/process importance) have been identified through the NFEPA project (Nel *et al.*, 2011a). Of particular importance here is the determination and management of environmental flow requirements of these priority freshwater ecosystems. Therefore it is fortunate that Water Resource Classification (WRC) and Resource Quality Objectives (RQO) processes in the WCP have been completed (Olifants-Doring WMA) or is in the developmental phase (Berg and Breede-Gouritz WMA's; see discussion above). For both of these processes, CapeNature officials and other stakeholders have ensured that environmental flows for priority freshwater ecosystems and estuaries have received sufficient attention. Moreover, sufficient flows in these priority areas should also be embedded within the Catchment Management Strategies (CMS) that will guide the management activities and best practise principles applied by the relevant Catchment Management Agency (CMA). Currently the only existing CMA in the WCP is the Breede-Gouritz CMA (BGCMA; formerly the Breede-Overberg CMA or BOCMA). The processes for the formation of a Berg-Olifants CMA have been initiated by the National Department of Water Affairs in 2014, but there is still no clarity regarding the actual establishment of this CMA. However, a proto-CMA for the Berg River catchment management area based within the DWS, is currently operational and has been dealing with water management of this catchment for the past few years already.

A coordinated effort should also be made to monitor the ecological health of priority freshwater ecosystems, to inform management. The aquatic section at CapeNature's Scientific Services section has started a baseline survey process for those priorities located on or coming from CapeNature Nature Reserves, several of which house parts of the strategic water source areas in the WCP. Further monitoring of both rivers and wetlands not located on nature reserves is needed, and this can be, and to some degree is already being done in partnership with other important stakeholders, such as SANParks, DWS and DEA&DP.

Monitoring should also be conducted in priority coastal areas, like estuaries and the coastal terrestrial vegetation, which are influenced by activities in the upstream freshwater and terrestrial ecosystems. The WCP houses the three most important estuaries for conservation in South Africa (including the Knysna, Berg River and Olifants estuaries (Department of Environmental Affairs and Development Planning, 2016)). Low-lying wetlands and estuaries in particular are at risk. Also, estuaries are important as breeding grounds for numerous marine fish species, which does not only indicate an importance for biodiversity and ecological pattern and processes, but also on an economic level with regards to fish stocks and the fish-related food source. Wetlands on the other hand, provide valuable ecosystem services, which also have economic relevance. Therefore it is important that integrated catchment management is applied in the upstream areas in order to supply the lower catchment ecosystems and estuaries with good enough quality water.

3. Wetlands

For the purposes of this section, wetlands exclude marine and estuarine waters, as well as rivers, as was defined in Ollis *et al.* (2013). Furthermore, according to the National Water Act (NWA; Act 36 of 1998), wetlands are defined as:

"…land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Wetlands are considered one of the most productive ecosystems and also provide important ecosystem services in a catchment area in the form of flood attenuation, drought relief through slow release of water, water storage and soil protection, among others. Nevertheless, wetland ecosystems remain the least studied and least monitored and we are still in the early stages of measuring the wetland diversity in the WCP. An increased understanding of wetlands, particularly from a catchment context, leads to appropriate management and improves rehabilitation, stewardship and policy building towards the strategic conservation of wetlands (Nancy Job, 2017, pers. comm).

3.1. Conservation of wetlands

It was reported in the National Biodiversity Assessment (NBA; Nel and Driver, 2012), that only small percentages of the different types of wetlands were found to be under some kind of protection. In fact, only about 32% of WCP wetlands were considered to be moderately to well protected (see also Turner, 2012; Gouws *et al.*, 2012). This assessment showed that especially those freshwater ecosystems (including wetlands) found in the lowlands were not only the most threatened, but also considered the least protected. Moreover, it is on these lowlands where the seven important Ramsar sites (False Bay Nature Reserve, Bot River, De Mond, De Hoop, Verlorenvlei, Langebaan lagoon and the Wilderness lakes) of the WCP are situated (see https://www.ramsar.org/

wetland/south-africa). The False Bay Nature Reserve and Bot River are both associated to some degree to provincial nature reserves and were only recently designated as Ramsar sites; i.e. on 2 February 2015 and 31 January 2017 respectively. These sites are all considered priorities for conservation, but some are still not managed under formal protection.

It is unlikely that the situation would have changed much since the previous national and provincial assessments were done (Nel and Driver, 2012; Turner, 2012), and wetlands remain under great threat. The CSIR and SANBI are currently conducting the assessment to update the NBA, which will be published in 2018. An improved, albeit not yet complete, picture of the current general state of wetlands in the country and the WCP will be garnered from this assessment.

Moreover, wetlands cannot be considered in isolation, as they are usually connected to groundwater and/or surface water systems, depending on the wetland type. This makes it an integral part of the catchment to coast concept and ICM. In order to understand how well wetlands are protected, where the priorities are for protection, how wetlands fit into a catchment area, and how they function in it, it is important to first conduct a comprehensive inventory of the wetlands in the WCP, which will feed into future updates of the NBA. It was with this in mind that a somewhat formal wetlands inventory project was initiated in the province in 2011. The project was originally funded by the MONDI Wetlands Programme and implemented internally by CapeNature together with Working for Wetlands partners (see Turner, 2012). This work has continued and since its inception the aims have remained the same, where priority map data are still being verified (wetland Critical Biodiversity Areas and FEPAs) with the purpose to update the NFEPA wetlands layers and to improve the provincial wetland inventory. Both of these aims ultimately feed into the strategic conservation of wetlands in the WCP and into the strategic implementation framework of the CapeNature ICM strategy (CapeNature, 2016).

3.2. Wetland inventory project

During the Mondi Wetlands programme funded project wetland ground-truthing in the WCP has been done in the following areas: the Upper Breede River catchment, Rooi-Els, Bettys Bay, Kleinmond, Bot River catchment, Riviersonderend upper catchment, and several catchments in the Agulhas plain, including the Hagelkraal system and the Ratel River system. Work on the Agulhas plain has continued as part of a partnership between CapeNature, SANParks, the CSIR and previously with the Working for Wetlands programme. The work being done in CapeNature's Central Region, is a working relationship between CapeNature's Scientific Services and the Conservation Services units. The ground-truthing done by SANParks in the Bontebok National Park has also been completed (Ruth-Mary Fisher, 2017, SANParks, pers. comm.).

Ground-truthing has been conducted with a focus on the quinary catchment context, on a catchment by catchment basis. For this process, a simplified version of the WET-Health (Macfarlane et al., 2009) assessment is applied, where wetland condition is assessed by looking at the soil structure, vegetation composition, wetland extent and overall health.

Kogelberg area

The wetland ground-truthing done in the Kogelberg area (Rooi-Els to Kleinmond) started in early 2012. Through this work, some significant deviations from the NFEPA wetlands layers were identified. This included the re-classification of wetlands, where the majority of wetlands were originally mapped as channeled valley-bottom wetlands, to them actually being seep wetlands (see Figure 1a and b). The NFEPA layers also did not include the depressions located in the lower lying areas and in some cases, dams were originally mapped as wetlands. Furthermore, according to basic analyses done on these findings, 82% of the wetlands visited in the Kogelberg coast sub-catchment was still in a natural state, indicating that the sub-catchment is in an overall healthy condition, especially in the mountainous areas. The remaining wetlands are located in the lower-lying areas which are dominated by small-holdings and urban areas such as Rooi-Els, Pringle Bay and Betty's Bay. These findings were all reported on in a 3-page report card created for this sub-catchment in 2012. The updated layers were also incorporated into the updated Provincial Biodiversity Spatial Plan layers for the WCP (Pool-Stanvliet *et al.*, 2017).

Since the completion of the Mondi wetlands project, the ground-truthing in CapeNature's Central Region has expanded into the Bot River and upper Riviersonderend River catchments, as well as some focus on the Hottentots-Holland and Theewaterskloof Nature Reserves and more recently the CapeNature Stewardship sites located within these two sub-catchments. Some initial results for the Bot and Riviersonderend river catchments show that of the wetlands visited so far; 36% were still found to be in a natural or near natural condition for the Bot River system, while 64% of wetlands visited in the upper Riviersonderend River catchment were still in a near natural to natural condition. It should be noted that, for the latter catchment, most of the wetlands visited were located on Protected Area properties. The data for these sub-catchments will only be mapped, fully analysed and reported on once the ground-truthing has been completed in each one respectively.

Ratel River Catchment

The ground-truthing in the Rater River catchment resulted in significant changes to the wetland spatial layer, including the re-classification, extension and cleaning up of the floodplain wetland in the lower Ratel River, as well as the inclusion of the many depression wetlands to the southwest and additional seeps to the west and southwest of the catchment (see Figures 2a and b). In terms of changes in wetland extent, there was an increase

Figure 1a. Map depicting the NFEPA wetlands in the Rooi-Els to Kleinmond area. The colour polygons depict the following: faded orange/peach = channeled valleybottom wetland; green = un-channeled valleybottom; light blue = bench flat; darker blue = hillslope seep and yellow = estuaries.

Figure 1b. Map depicting the NFEPA wetlands in the Rooi-Els to Kleinmond area. The colour polygons depict the following: faded orange/peach = channeled valleybottom wetland; green = un-channeled valleybottom; light blue = bench flat; darker blue = hillslope seep and yellow = estuaries.

of 188.49 ha for Floodplain wetlands, a decrease of 83.42 ha for channelled Valley-Bottom wetlands and a decrease of 231.91 ha in Wetland Flats. The ground-truthing resulted in one category of Seep wetlands. Overall, 55.2 hectares of wetland not previously mapped by NFEPA was added by the ground-truthing (Fisher et al., in prep.). Approximately 38% of the wetland sites were still in a near natural or natural condition, and these were mostly located on the Agulhas National Park (ANP) protected area properties.

Since the completion of ground-truthing in the Ratel River catchment, the team also completed quinary catchments 9433 and 9434 within the Bergplaas section of ANP and moved on to the Hagelkraal River catchment, which is to be completed in 2017. The next catchment to be ground-truthed is the sub-quaternary catchments of the Nuwejaars and Heuningnes River and eventually the Kars River system. Initial results for the Hagelkraal catchment shows that about 60% of wetlands visited so far were in a near natural or natural condition. These were mostly located on the upper section of the catchment on the Waterford section of the ANP or on a private Nature Reserve and small holdings located in the lower parts of the catchment. Some work is still needed in the lower lying areas, which falls into private property. As is the case with the Bot and Riviersonderend river ground-truthing, results for the Agulhas plain catchments will be analysed and reported on as the work in each catchment is completed.

It must be noted that the wetlands in the ANP has received increased rehabilitation attention over the past decade or more through the Working for Wetlands projects. Therefore, many of the wetlands visited during the ground-truthing of the wetlands in, for example the Ratel River and upper Waterford catchments have seen some improvement because of rehabilitation efforts. It is here that the wetlands inventory project can be of specific importance, especially with regards to the identification of any future rehabilitation projects by initiatives such as Working for Wetlands, at the local, provincial or national scale.

3.3. Rehabilitation of Wetlands

During the last few years, the Working for Wetlands Programme has undergone some changes with regards to management. The programme is now housed within the Department of Environmental Affairs National Resource Management (DEA - NRM) directorate under the Environmental Programmes branch, which houses all the "Working for" programmes. Despite these changes, Working for Wetlands still functions in line with the principles of the Expanded Public Works Programme (EPWP) and continues to implement its rehabilitation and wise use projects. The overall aims/objectives of the programme still concern the protection, rehabilitation and sustainable use of wetlands, especially in areas where projects are likely to succeed in the long run.

The WCP is currently home to four official Working for Wetlands Projects. An additional two other projects are in the concept and formation phases and will be implemented in the next two to three years (Heidi Nieuwoudt, 2017, Working for Wetlands, pers. comm.). In the latest planning phases of the Western Cape Working for Wetlands Projects, the programme has changed their approach slightly and the new projects now mainly focus on wetlands that already enjoy some form of

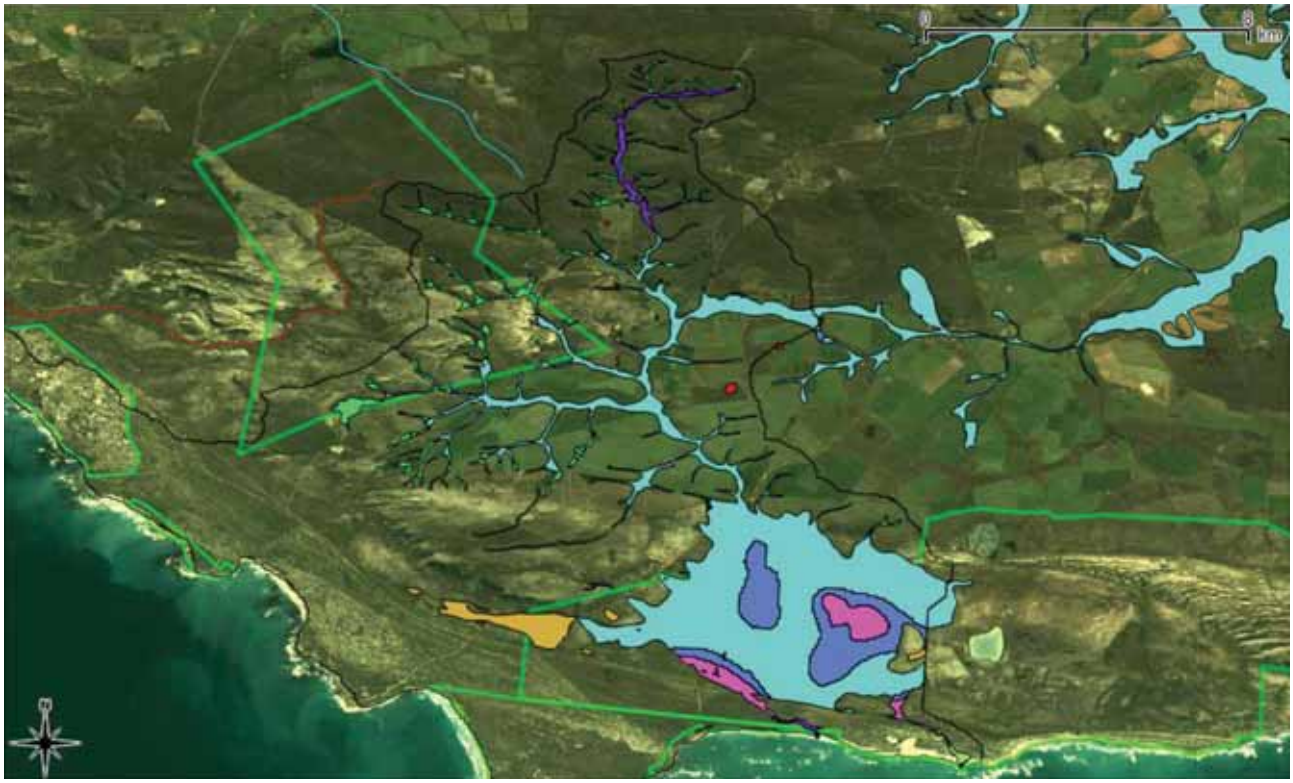


Figure 2a. Map depicting the NFEPA wetlands layer for the Ratel River catchment (black line). The polygon colours depict the following: purple = channeled valleybottom; red = depression; pink = flat; green = seep; yellow-brown = unchanneled valleybottom; blue = valleyhead seep.

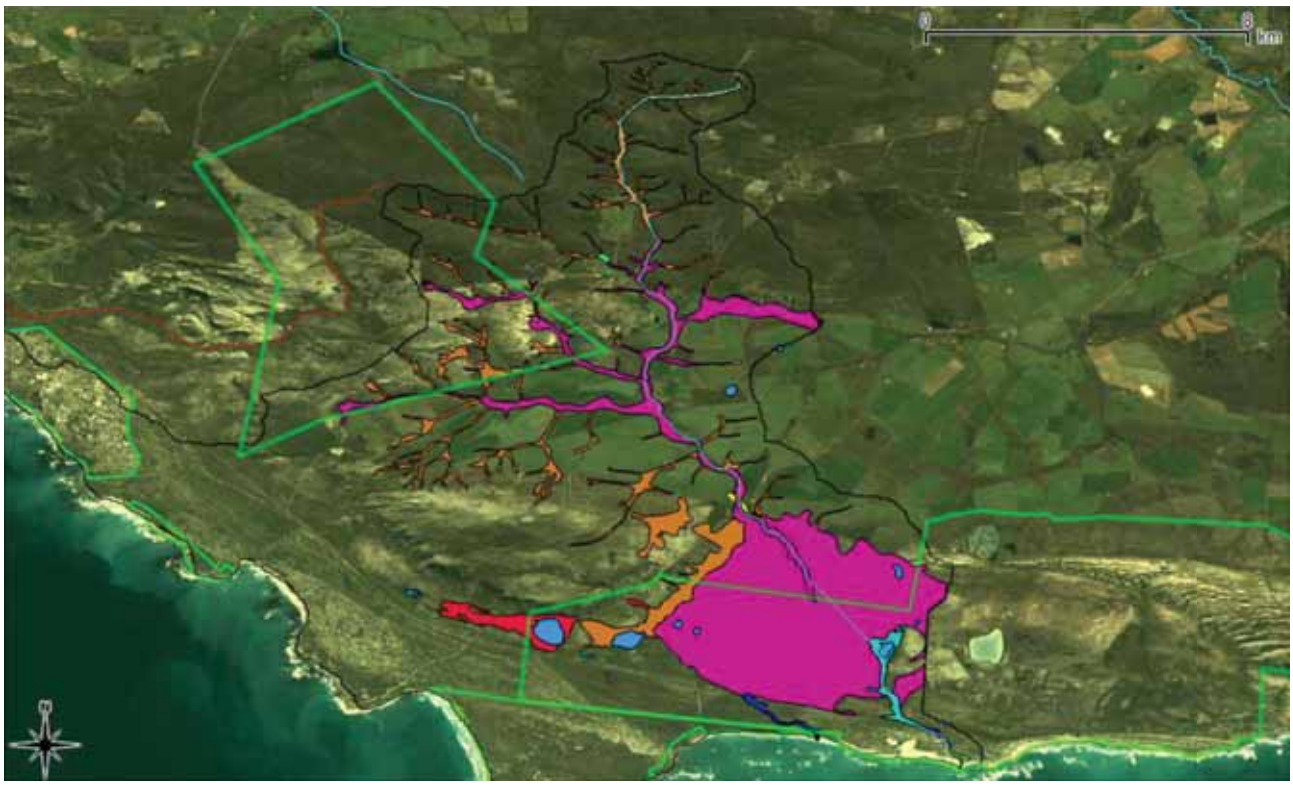


Figure 2b. Map depicting the ground-truthed wetlands layer for the Ratel River catchment (black line). The polygon colours depict the following: pink = channelled valley-bottom; bright green = dam; dark blue = channeled valleybottom; aquamarine blue = unchanneled valley-bottom; light blue = depression; green = estuary; yellow = flat; orange = seep and red = valleyhead seep. The blue line depicts the Ratel River, while the orange line depicts the Hagelkraal River.

protection. Consequently the Western Cape projects now include rehabilitation plans for wetlands located on several CapeNature Nature Reserves, including Grootwinterhoek and Rocherpan (Working for Wetlands, 2015a). During the 2015-2016 planning phase for the WCP, the available budget and planned activities for all new interventions (summarised in Table 1) were allocated for the West Coast, Agulhas, Goukou and Duiwenhoks and Peninsula projects. The budget for the WCP Working for Wetlands projects amounts to a total of R10 626 995 (see Table 3 in Working for Wetlands Programme, 2015b). All of these planned projects are to be implemented once the budgets have been finalised and all plans have been put together.

The West Coast Project

Although the West Coast project initially focussed on the Verlorenvlei catchment, its scope has expanded over the years to include the Wadrif/Langvlei, Jakkalsvlei, Grootwinterhoek Freshwater Stewardship Corridor and the Suurvlei catchment areas (Working for Wetlands Programme, 2015a). The initial focus of the projects was on the clearing of alien invasive plants and follow-up. From the recent planning phase for this project, rehabilitation plans have been put together for the following areas: Zuurvlak (G10E-01); Perdevlei (G10G-01); Grootwinterhoek (G10G-02); Krom Antonies (G30D-05); Rocherpan (G30A-01); and Suurvlei/Twee Riviere (E21H-02). (Working for Wetlands Programme, 2015a). The interventions considered for these catchments are summarised in Table 1. Since these plans have been published, those for the Zuurvlak and Suurvlei catchment have had to be revisited due to ownership disputes/issues

Figure 3. Example of a restoration action by Working for Wetlands on the upper Ratel River using geotextiles. Photo credit L. du Toit.

Table 1. The estimated budget allocations for Working for Wetland projects being implemented by Working for Wetlands and conservation agencies in the Western Cape (i.e. CapeNature or SANParks).

Project	Estimated costs of new interventions	Available budget	#Wetlands #Interventions	Activities	Implementer
West Coast	R4 687 300	R2 385 000	6* 20*	Alien Clearing, Earthworks, Concrete weir, Gabions, Bird hide, Revegetation, Geocells, ecologs, rock packs, silt fences, reed clearing	CapeNature Working for Wetlands
Duiwenhoks & Goukou	R4 953 071.14	R 2 663 780	4 12	Alien Clearing, Gabions, sandbags, concrete structures, gabion weirs	Working for Wetlands
Agulhas	R 3 256 987.31	To be confirmed	5 18	Alien clearing, Earthworks, Earth structures, gabions, concrete structures, ecologs, rock packs, sediment fences, road closures, silt fences	SANParks Working for Wetlands
Peninsula	R 2 068 125.00	To be confirmed	11 24	Gabion weirs, laddered matrass, ecologs, boardwalk, silt fences, alien clearing, revegetation, earthworks, earth berm, floating wetlands	SANParks City of Cape Town Municipality Working for Wetlands

*The number of wetland sites and interventions are likely to change for the West Coast project.

in the case of the former, and agriculturally-driven chemical pollution of the Suurvlei River in the case of the latter catchment.

The Agulhas Project

The rehabilitation project for the Agulhas area started back in 2004 and interventions were implemented in the Agulhas National Park only. More specifically, the rehabilitation interventions were implemented in the Ratel River, Hagelkraal catchments, on the Waterford property and the Toekomst, Springfield, Bergplaas, Bosheuwel and Vredehoek sections. Since 2013, the project has expanded to include catchments in the greater area of the Agulhas Plain, mainly on privately owned land, and including the Boesmans River, Hagelkraal, Upper Nuwejaars and Koue rivers, the Nuwejaars/ Upper Heuningnes rivers, the Kars River, the Poort/Kars River and the Lower Heuningnes River. The Agulhas Plain is of particular importance for plant, invertebrate, amphibian and bird diversity and some of the rivers in the catchment are considered sanctuary areas for endemic and threatened fish species (see Nel *et al.*, 2011b). The interventions planned for the Agulhas project for the 2015/16 planning cycle (for later implementation) will include the following areas: Upper Boesmans River (G40M-01 and G40M-02); Waterford (G50A-04); Upper Ratelrivier (G50A-05); Pietersielieskloof (G50B-01); Bergplaas (G50C-04) and Hangnes (G50C-06); (Working for Wetlands Programme, 2015b).

The Goukou and Duiwenhoks Project

The rehabilitation of wetlands in the Goukou and Duiwenhoks started in 2007/08 in the eastern catchment of the Duiwenhoks and the upper Goukou/Grootbosberg catchment. The western catchment of the Duiwenhoks was added later, while the upper reaches of the Goukou River and some of its tributaries have been added in the current planning cycle. For this project, the ecosystem services of these particular catchments are considered important, but they are degraded because of the land use practices in the area. Therefore the focus of rehabilitation in these catchments will be where the largest ecological returns can be gained

and where rehabilitation efforts are considered viable. The projects for the 2015/16 planning cycle will include the following areas: Duiwenhoks East (H80A-01), Grootbosberg (H90A-01), Upper Gaffie (H90A-04) and Lower Tierkloof (H90A-05) (Working for Wetlands Programme, 2015c).

The Peninsula Project

In the past, the Peninsula Project was implemented firstly by the South African National Biodiversity Institute (SANBI) and later by CapeNature. Interventions were focussed on sites in the Noordhoek area, the Kuils and Sout River catchments, the Faure, Tokai and Parklands areas, as well as some sites on City of Cape Town Municipality property (see Turner et al., 2012; Gouws *et al.*, 2012). For the more recent planning phases, where the projects are now managed by SANParks and the City of Cape Town Municipality, the following areas were included; Tygerberg Nature Reserve (G22C-03), Prinskasteel (G22D-01), Zeekoevlei Eastern Shores (G22D-07), Langvlei Canal (G22D-09), Spaanschemat (G22D-10), Westlake Conservation Centre (G22D-11), Diep River Trail (G22D-12), Kirstenhof (G22D-13), Grootboschkloof (G22D-14), Sonstraal Dam (G22E-04) and Asanda Village Park (G22K-01) (Working for Wetlands Programme, 2015 (d)).

Potential future projects

There are unofficial plans in the pipeline for new Working for Wetlands WCP projects, which will include the initial phases for wetland rehabilitation projects in the Table Mountain National Park, the upper Berg River catchment and possibly also the Riviersonderend River catchment. The latter catchment has also received increased attention outside of Working for Wetlands, through a WWF project in the upper Riviersonderend catchment. Some of these new plans should be completed by December 2017 (Heidi Nieuwoudt, 2017, Working for Wetlands, pers. comm.). These would include priority sites for both ecosystem services and for the conservation of wetland biodiversity patterns and processes.

Figure 4. Propagating restios from smoked seeds for restoration.

4. Management of Aquatic Priorities

4.1. The conservation of freshwater priorities in the Western Cape Province

In the previous State of Biodiversity Report (Turner *et al.*, 2012; Gouws *et al.*, 2012, p. 34) a list of roles and responsibilities for CapeNature were highlighted with regards to the management and conservation of freshwater ecosystems and the biodiversity they contain. Most, if not all of those roles and responsibilities have been taken up and applied by various sections within CapeNature. These responsibilities are summarised in Table 2 below.

5. Recent Publications Informing Freshwater Ecosystem Management

Throughout this chapter the function, management, rehabilitation and importance of river and wetland ecosystems have been highlighted. However, each project or initiative discussed above was initially informed and based on scientific research findings and guidelines. Below are a few examples of relevant and informative research and other publications which should be fed into conservation management and planning for aquatic ecosystems in the WCP.

Table 2. The roles and responsibilities of CapeNature in relation to managing and conserving freshwater ecosystems.

Role or Responsibility	CapeNature section involved	CapeNature actions
Commenting on development applications.	Scientific Services: - Land Use Advice - Aquatic Scientist - Aquatic Technician Conservation Services Regional Ecological Support Team (REST)	Environmental impact assessments, mining and prospecting applications, recreational fishing and aquaculture permit applications, specialist freshwater ecological input, and advising on mitigation measures and appropriate river and wetland buffers and offse t sites.
Participating in ecological reserve determination processes and the classification of water resources.	Aquatic Scientists REST Regional staff	Steering committee and stakeholder group members for the Berg, Breede and Gouritz catchments Water Resource Classification and Resource Quality Objectives projects.
Participating actively in processes led by Catchment Management Agencies (CMAs).	Aquatic Scientists REST Regional staff	Steering committee and stakeholder group members for the development of the Breede-Gouritz Catchment Management Strategy and for the formation of the Berg- Olifants-Doring CMA.
Monitoring the condition of freshwater ecosystems, especially priorities such as FEPAs.	Scientific Services: - Aquatic Scientist - Aquatic Technician REST Regional staff	Baseline surveys of FEPA fish sanctuary rivers on CapeNature Nature Reserves. Identified priority rivers per Water Management Area for monitoring (budget dependent).
Identifying FEPAs that should be included in the provincial Protected Area Expansion network	Scientific Services: - Conservation Planner - Aquatic Scientist - Aquatic Technician Regional staff Conservation Services	Incorporated additional freshwater ecosystems sites into the recent CapeNature Protected Areas Expansion Strategy (Maree *et al.*, 2015).
Ensuring that freshwater ecosystem priorities inform the development and implementation of management plans for protected areas.	Scientific Services: - Aquatic Scientist - Aquatic Technician REST Regional staff	Freshwater input into updated Protected Area Management Plans (PAMPs) for the several Nature Reserves (according to PAMP schedule).
Interacting with Working for Water, Working for Wetlands, and LandCare to direct these programmes towards rehabilitating freshwater ecosystem priority sites.	Catchment Managers Scientific Services: - Aquatic Scientist - Aquatic Technician REST Regional staff	Development of CapeNature Integrated Catchment Strategy. Stakeholder group members during planning phases of Working for Wetlands projects.
Initiating and/or participating in the development of biodiversity management plans (BMP's) for priority freshwater ecosystems and species.	Scientific Services: - Aquatic Technician - Aquatic Scientist REST Regional Staff	Development of two BMP's for fish spec ies with partners: Clanwillian Sandfish (Paxton *et al.*, 2012) and the Barrydale Redfin.(Jordaan *et al.*, 2016)
Verifying FEPAs, fish sanctuaries and free-flowing rivers.	Scientific Services: - Aquatic Scientist - Aquatic Technician	Baseline surveys of FEPA fish sanctuary rivers with partners. Field trips are budget dependent.
Filling in gaps in knowledge of freshwater ecosystems and species.	Scientific Services: - Aquatic Scientist - Aquatic Technician Conservation Services	Conducting wetland ground-truthing for the wetland verification project. Including bio-gaps fish sites (SAIAB project) into FEPA fish sanctuaries sampling for CapeNature Nature Reserves.

5.1. River Management, Rehabilitation and Flow

River management and rehabilitation

The concept of river rehabilitation, and specifically maintenance management of rivers has received increased attention in the WCP in the last few years. This is mostly due to a condition in terms of Activity 18, of Listing notice 1 (GN R. R544, 18 June 2010) of the National Environmental Management Act (NEMA, Act 107 of 1998). Activity 18 stipulates that environmental authorisations are needed before any excavation activities in a watercourse are allowed. More specifically, authorisations are required for *"the infilling or deposition of any material of more than 5 cubic metres into, or dredging, excavation, removal or moving of soil, sand, pebbles or rock of more than five cubic metres from (inter alia) a watercourse…".*

However, if the listed activities are undertaken for maintenance purposes and are managed through an approved maintenance management plan, prior authorisation is deemed unnecessary. This is only applicable to like-for-like repairs of the instream bed, river bank and infrastructure, and not to any expansion or new construction activities, which still need to go through the proper approval processes.

Some recent examples of River Maintenance Management Plans (RMMP's) with a strong catchment wide approach are those that have been and are being developed for the Upper and Central Breede River sections, several tributaries in the middle Breede sub-catchment, as well as the Upper and Middle Berg River. For these rivers, the LandCare Division of the Western Cape Department of Agriculture (WCDOA) was instrumental in the initiation and financial support of the formation of these RMMPs. The need for more comprehensive guidance with regards to what is required in these plans was quickly realised during the formation of the initial RMMPs, especially with regards to what activities are allowed in a watercourse.

Therefore, the DEA&DP initiated and is in the process of finalising a guideline document for this purpose (Department of Environmental Affairs and Developmental Planning, 2017). In addition, a comprehensive rehabilitation manual has recently been developed (Day *et al*., 2016a) which include guidelines for the activities considered within a RMMP, as well as activities such as alien vegetation clearing and the improvement of water quality, amongst others. This manual also includes a separate volume (Day *et al.*, 2016 (b)) which provides and discusses a total of 24 different river rehabilitation case studies in South Africa. Most of the case studies discussed are located within the WCP.

River FEPAs and their flows

When it comes to the management of rivers, it is important to consider activities in the entire catchment of the river, (i.e. catchment to coast, see sections earlier in document). This is especially important for rivers that are considered priorities, i.e. FEPA rivers and catchments and fish sanctuaries ((Nel *et al.,* 2011 a and b). For these rivers, flow volume, timing and frequency are of particular importance. One way of informing these variables of water flow is through the DWS Ecological Reserve determination process (where the Reserve is specified in the National Water Act, Act 36 of 1998) and the implementation thereof. However, although much work has gone into the determination methodologies, not enough has been done with regards to its implementation and operationalisation (Paxton *et al.*, 2016). In response to this and the flows needed to sustain FEPA rivers, Paxton *et al.* (2016) developed a simple tool for the monitoring of the Ecological Reserve of FEPA rivers that fall within the smaller tertiary- or quaternary catchments. This study used the Koue Bokkeveld sub-catchment as a case study, and it also aimed to establish rated cross-sections at selected flow monitoring sites for the priority rivers and their ecological support areas; to assimilate all the available latest hydrology data from the Water Resource Classification System (WRCS) and the Olifants and Doring catchments; to gather present day water use information collected by field personnel and to use this data to provide specialist inputs for river management (Paxton *et al.*, 2016).

Tools such as this can also be used to monitor aspects of hydrology, such as flow, in the smaller catchments that have gone through the WRC and RQO processes, where conditions have been set for the flow needed to sustain a specific ecosystem. Such tools can also be used to feed into the study of the effect of alien invasive trees on the flow of a river and the subsequent prioritisation of catchments and management and clearing of these species.

5.2. Conservation action: "Rondegat project invertebrates"

The management of alien plant and animal invasions have been well-documented (see for example Linder *et al.*, 2010) and the threat of invasion seems to be greatest for freshwater ecosystems and its biodiversity in particular (Dudgeon *et al.*, 2006; see also de Moor and Day, 2013). In fact, the invasion of rivers by alien fish species is considered the biggest threat to indigenous fishes and the structure of freshwater invertebrate communities (Simon and Townsend, 2003; Cox and Lima, 2006). This is of specific relevance to the CFR and the WCP, where the occurrences of endemism within not only the plants, but also the vertebrate and invertebrate animal taxa are high (Tweddle *et al.*, 2009; Linder *et al*., 2010). It is with this in mind, that CapeNature implemented the Rondegat River rehabilitation project in order to remove invasive alien fish from a section of the river to make place for the indigenous species, through the use of a piscicide (see Marr *et al.*, 2012; Jordaan *et al.*, 2012; Weyl *et al.*, 2014; Weyl *et al.*, 2016 and also see Chapter 5). The Rondegat River is the first of several rivers in the CFR to be treated with the piscicide rotenone in order to eradicate alien invasive fish species. However, rotenone does not only affect fish, but is also known to negatively affect other taxa, including aquatic invertebrates (Vinson, *et al.*, 2010;

Dalu *et al.*, 2015). It is due to this controversy that the monitoring of the collateral effects of the use of a piscicide such as rotenone to eradicate alien fishes is crucial and was applied in the case of the Rondegat River (Weyl *et al.*, 2016). To assess some of these collateral effects, pre-, during and post-treatment monitoring of aquatic invertebrates was conducted at three sites upstream of the river stretch that were treated (control site), three sites located within the treatment zone and one site below the treatment zone, for both treatment sessions of the river (see Woodford *et al.*, 2012; Woodford *et al.*, 2013). Pre-treatment sampling started in 2010 and was conducted seasonally until just before the first treatment event in February 2012. The upper (control) sites were monitored with the purpose of determining which of the invertebrate taxa were shared between the control and treatment sites, while this area was also considered to be a source of recolonisation after each of the treatments (Woodford *et al.*, 2013). Here, three sampling methods were used (i.e. kick sampling, stone sampling and drift sampling) and the effectiveness of the rapid bio-assessment method, South African Scoring System version 5 (SASS5; Dickens and Graham, 2002) in picking up the trends of change of macro-invertebrates was also assessed (Woodford *et al.*, 2013; Bellingan *et al.*, 2015).

Initial results after the first treatment showed that the species richness of invertebrates declined significantly, where a total of 18 taxa were lost out of the 85 that were identified. Of those that were lost, five were found to be endemic to the area. The mayfly Order, Ephemeroptera, was found to be the worst affected, with both density (on stones) and diversity of species showing significant declines post treatment (Woodford, *et al.*, 2013). In fact, six of the 20 mayfly species collected during pre-treatment sampling, were not collected just after the treatment event. However, at least half of all missing species were also collected at the three upper sites, meaning that recolonisation potential is high. Moreover, there seemed to be some effect from natural environmental variation, as abundances of Ephemeroptera and Trichoptera (caddisfly Order) decreased significantly from 2011 to 2012 (Woodford *et al.*, 2013). With regards to the SASS 5 method, it was found that it was adequate enough to detect impacts of rotenone on the diversity of macro-invertebrates, despite the likelihood that the method did not pick up some of the rare taxa in the pre-treatment sampling event (Woodford *et al.*, 2013; Weyl *et al.*, 2016).

Following the second treatment event, Bellingan *et al.* (2015) particularly looked at the trends observed for results obtained from the SASS 5 method, through the SASS score and the Average Score Per Taxon (ASPT) in comparison with those associated specifically with the insect Orders Ephemeroptera, Plecoptera and Trichoptera (EPT). This study also took into account the reduction of the rotenone concentrations used between the two treatments: (treatment 2012 = 50 µg l−1 (Jordaan and Weyl, 2013); treatment 2013 = 37,5 µg l−1 (Slabbert *et al.*, 2014)). This was due to the short-term, but significant decrease in macro-invertebrate abundance and diversity reported on by Woodford *et al.* (2013) following the first treatment event. In the analyses done by Bellingan *et al.* (2015), it was found that the accuracy of ASPT was a better measure of the impacts of rotenone on those taxa more sensitive to it. This was due to the changes in ASPT being correlated with the decreasing densities of the EPT insect Orders. These taxa are known to be generally sensitive to water quality changes, with especially taxa from the Ephemeroptera being very susceptible to the effects of rotenone (Vinson *et al.*, 2010; Woodford *et al.*, 2013; Dalu *et al.*, 2015).

In contrast, the EPT taxa seemed to be most affected by the higher rotenone concentration applied during the first treatment, after which they recolonised. A much lower level of impact was observed during the second treatment, where a decreased rotenone concentration was applied. These changes were also detectable in the SASS 5 results, indicating that the rapid bio-assessment method is useful for long term monitoring in general. Nevertheless, it was recommended that when wanting to investigate and monitor the specific impacts on conservation of species, a more detailed, species-specific community structure change assessment should be conducted. Other studies have come to similar conclusions (e.g. Odume *et al.*, 2015) and while it was suggested that rapid bio-assessment methods, such as SASS 5 should be applied before more in-depth studies of the health status of macroinvertebrate communities (Bellingan *et al.*, 2015; see also Ollis *et al.*, 2006), Baber-James and Pereira-da-Conceicoa (2016) found that rapid bio-monitoring should only be applied once a baseline and detailed assessment of the macro-invertebrate community has been conducted. Therefore, only once the diversity of invertebrate species and community structure are known at a particular site, more realistic conclusions can be made from any subsequent rapid bio-assessments. A checklist of criteria on when to use rapid bio-monitoring techniques versus a more detailed study was provided in their paper (see Table 2, p. 5 in Barber-James and Pereira-da-Conceicoa, 2016).

5.3. Aquatic invertebrate diversity

To gain a true understanding of the ecological health and community status of aquatic invertebrate species, it is important to conduct more in-depth studies, as proposed by Barber-James and Pereira-da-Conceicoa (2016). The current available information on these fauna in the CFR is very irregular, with some taxa being well-studied, while others have received little to no scientific attention (de Moor and Day, 2013). This is of particular concern, as the general aquatic species richness and degrees of endemism are known to be very high in the CFR, which is also considered one of the world's Freshwater Ecoregions (Thieme *et al.*, 2005). For aquatic biota of the CFR, the level of endemism reaches an average of 56% (with some variance being found between the different taxa; (see de Moor and Day, 2013 and references therein). Within this level of endemism, there is also a high level of so-called, "taxonomic disparity" (de Moor and Day, 2013), where

the genetic diversity is high within several invertebrate taxa, including amphipods, isopods, crabs, notonemourid stoneflies, teloganodid mayflies and leptocerid caddisflies (see also Dijkstra *et al.*, 2013 for global patterns). This is a pattern that is also becoming more evident for several of the indigenous fish species of the WCP.

It is with this in mind that investigations into the genetic diversity of the aquatic invertebrates of the WCP and the CFR in general should be prioritised, in order to get a better understanding of the diversity and richness of these taxa in this region and what taxa we might be losing due to climate change effects and anthropogenic impacts. Some recent studies considering phylogenetic or morphological species diversity include work in the following taxa; hydrophilid, hydraenid and dytiscid beetles (e.g. Bilton and Perkins, 2012; Bilton, 2013; Bilton, 2014; Bilton and Gentili, 2014; Bilton *et al.*, 2015), teloganodid mayflies (Barber-James and Gattolliat, 2012; Pereira-da-Conceicoa, 2016) and some work on the odonata (damselflies and dragonflies; see for example studies including WCP taxa Dijkstra *et al.*, 2013; Dijkstra *et al.*, 2014; see Chapter in this report on Arthropods). For instance, the recent work done by Pereira-da Conceicoa (2016) on the phylogenetics and historical biogeography of the teloganodid mayflies (Ephemeroptera: Teloganodidae) has expanded knowledge on the distribution ranges of several species found in the WCP and southern Cape. This study has added approximately 22 potential new species and seven genera, not previously described to the collection (see also Barber-James and Pereira-da-Conceicoa, 2016). This species diversity would not necessarily have been picked up by a rapid bio-assessment method, such as SASS 5 (Dickens and Graham, 2002).

6. Way Forward

With regards to the recommendations brought forward from the 2012 State of Biodiversity assessment, most are currently being implemented (see Table 3; also see Table 2).

For the next five years and beyond, the focus of conservation efforts for freshwater ecosystems will continue to follow those responsibilities set out in Table 2. This will be of particular relevance to those freshwater areas (surface water, groundwater and wetlands) that are considered to be priorities for aquatic biodiversity conservation as well as water provision in the WCP. Much of the work will be done in collaboration with other conservation agencies, such as SANParks and water governance agencies, such as the BGCMA, particularly with regards to the monitoring of FEPA ecosystems, the expansion of protected areas as well as informing the proper management of the freshwater ecosystems in these protected areas. This will also include the continued collaboration with SANParks, Working for Wetlands and the BGCMA with regards to the ground-truthing of the FEPA wetlands in the Agulhas Plain area (see Table 2).

Table 3. Progress of 2012 freshwater ecosystem conservation recommendations.

2012 Recommendation	2017 Response
Monitoring of macro-invertebrates in priority rivers of CN Nature Reserves.	Baseline invertebrate and fish surveys are being conducted for the priority rivers on CN Nature Reserves that have or are in the process of updating the Protected Areas Management plans.
Wetland groundtruthing and mapping of wetlands on CN Nature Reserves.	Wetland ground-truthing of FEPA wetlands continues. The mapping of wetlands on CN Nature Reserves needs to be implemented again.
Floodline management guidelines.	Many external guiding documents are available. We have a basic set of guidelines that still needs to be updated.
River Health Programme involvement.	We continue to assist the River Health (now REMP) monitoring team with surveys when required.

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DWARS RIVER, GOURITZ SYSTEM

CHAPTER 3

ESTUARIES

L. Van Niekerk[1] with input from P. De Villiers[2], A. Gordon[3], S.J. Lamberth[4], J. Adams[5], Z. Yumat[6] and A. Olds[2]

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CONTENTS

HEUNINGNES ESTUARY MOUTH AREA

Executive summary

This is the second report on estuaries in the Western Cape State of Biodiversity Report series. Estuaries form an integral part in the ecosystem connectivity between terrestrial systems, freshwater aquatic processes, and the ocean and cannot be managed in isolation. This report is based on the findings of the 2011 National Biodiversity Assessment (Van Niekerk & Turpie, 2012) with updates of the latest Department of Water and Sanitation Classification studies, DWS Ecological Water Requirement studies; and Desktop Estuary Health Assessments studies. The South African coastline is approximately 3 100 km with a total of nearly 300 functional estuaries along it length. A subset of the Western Cape data in the National Biodiversity Assessment, consisting of 56 estuaries from the Sout Estuary on the West Coast to the Bloukrans Estuary on the South East Coast was analysed in order to provide this provincial perspective. This report summarises the estuary health and management interventions in estuaries in the Western Cape Province.

In addition to the above, estuary management and estuary management plans as stipulated in the Integrated Coastal Management Act (No. 24 of 2008) and the estuarine ecological freshwater flows as stipulated in the National Water Act (No. 36 of 1998) are discussed in relation to the impact of these on estuary condition. Progress made with regards to the development and implementation of the above processes in the Western Cape Province estuaries is included in this report.

Although the states of the majority of estuarine systems in the Western Cape are good or fair, the data on current and emerging pressures highlights the need to intensify biodiversity conservation and management efforts since a high proportion of the estuaries are under pressure and formal protection levels are low.

1. Background

Estuaries link land-based systems and processes via freshwater flows, to the ocean. Actions in catchments have an impact on estuarine and marine ecosystems. In South Africa, an estuary is defined as a partially enclosed, permanent water body, either continuously or periodically open to the sea on decadal time scales, extending as far as the upper limit of tidal action or salinity penetration. This will include the floodplain for instance, which forms a crucial part of an estuary. During floods an estuary can become a river mouth with no seawater entering the formerly estuarine area. When there is little or no fluvial input, an estuary can be isolated from the sea by a sandbar and become fresh or hypersaline (Van Niekerk & Turpie, 2012).

South Africa's estuaries are defined by the "estuarine functional zone" (EFZ). The EFZ encapsulates all estuarine processes and biotic responses, following a precautionary approach, it includes:

- The maximum extent of open water area subjected to tidal effect and/or back flooding under closed mouth conditions;
- All estuarine associated habitat (sand and mudflats, rock and plant communities), including vegetation ecotones that have elements of estuarine habitat (e.g. mosaic of swamp and dune forest).
- All floodplain area as derived from the maximum extent of the following: Surveys and Mapping +5 m MSL contour; ground-truthed Lidar data; the 1:100 year floodline or mapped floods; estuarine-associated vegetation data, and the mapped historical extent.
- All islands;
- All geomorphic active zones, e.g. maximum movement of the mouth from historical imagery, adjacent dunes, lateral movement of the estuarine bed.
- All contiguous supporting freshwater ecosystems (e.g. springs and seeps) that contribute to habitat diversity in the estuary.
- Incorporates all habitat that is predominantly surrounded by estuarine habitat/processes to ensure that they are not disrupted in the future (e.g. more than 75% of feature is surrounded such as s-bends as they will erode in the future).
- Includes marinas, harbours and similar artificial habitats in or adjacent to estuaries as they are connected and can influence condition.

The South African coastline is approximately 3 100 km long with a total of nearly 300 functional estuaries along its length. For the purpose of this report a subset of 56 estuaries in the Western Cape Province, from the

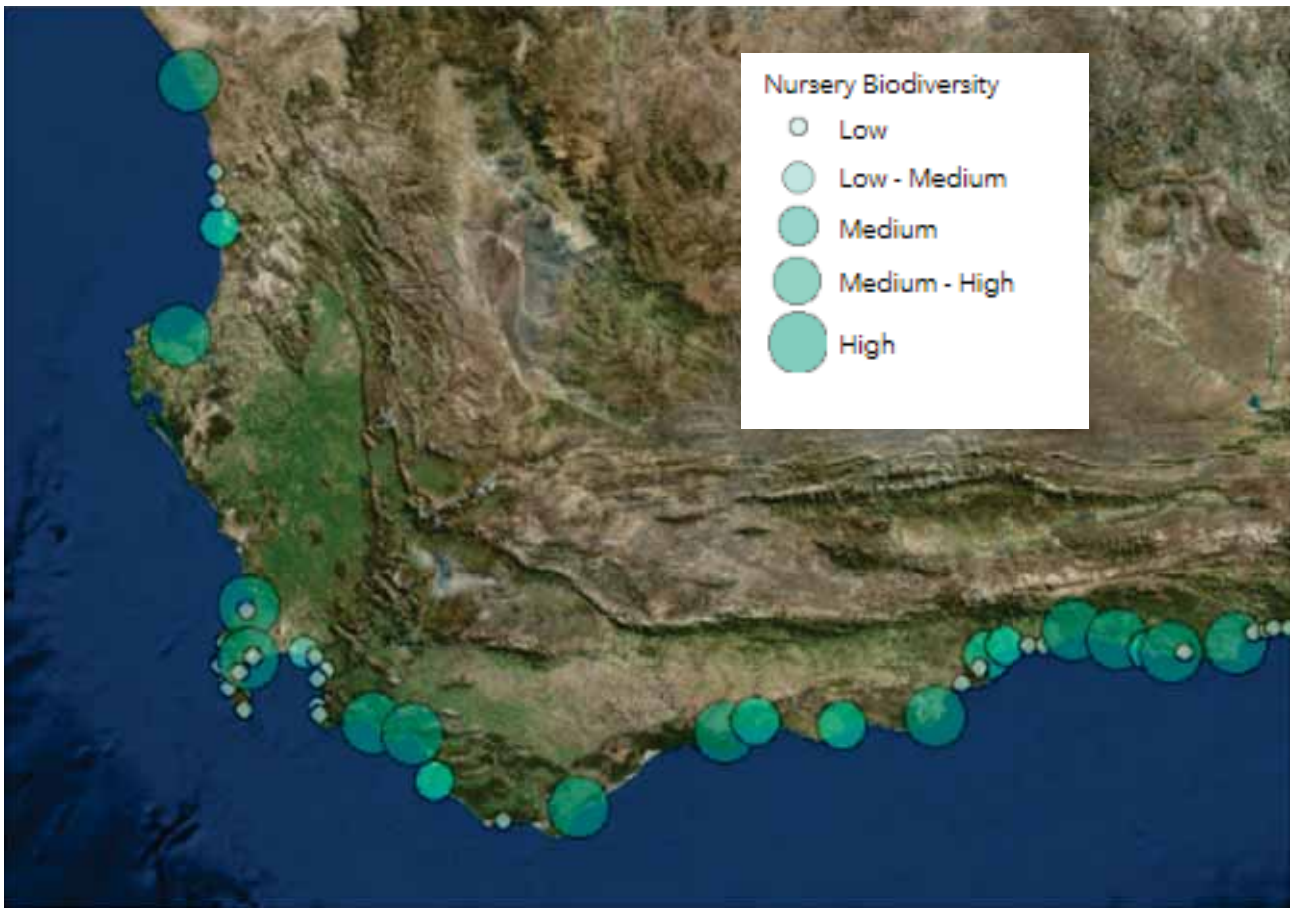


Figure 1. Important fish nurseries in the Western Cape

Olifants Estuary on the West Coast to the Bloukrans Estuary on the South East Coast were considered. Of these 23% are rated as "Highly Important" (13 estuaries) and 20% (11 estuaries) as "Important" for estuarine biodiversity (Turpie *et al.,* 2002; Turpie & Clark, 2007).

In addition to their overall biodiversity value estuaries in the Western Cape play an important role as fish nurseries contributing significantly to biodiversity, estuarine fisheries and nearshore marine fisheries (Figure 1). In total, about 23% of systems were classified as highly important nurseries (e.g. Great Berg, Olifants, Breede, Gourits estuaries), while an additional 26 % of systems (e.g. Klein Brak, Groot Brak), were deemed of medium-high or medium importance in terms of their contribution (Van Niekerk *et al.*, 2017). However, 13 estuaries in the Western Cape have experienced fish kills in the last 5 years that indicate clear signs of ecosystem stress.

2. Threats to estuaries and biodiversity

The increasing influx of people into coastal areas over the past decade has resulted in increased pressure on coastal ecosystems and resources including estuaries (Morant & Quinn, 1999). These threats may be direct in the form of development in the EFZ and the overexploitation of estuarine living resources (e.g. reeds and sedges, bait organisms, or fish) or indirect like the increased need for freshwater in the catchment. Examples of the different type of issues that threaten estuaries may be seen in Table 1. The results of an analysis of these threats for estuaries in the Western Cape can be seen in Appendix 1. The pressure rating was refined from the 2011 National Biodiversity Assessment (NBA) (Van Niekerk & Turpie, 2012) with updates of that reflected in Van Niekerk *et al.,* 2015 and Van Niekerk *et al.*, 2017.

2.1. Flow modification

The analysis of the data indicates that 25% of Western Cape Province estuaries are under very high flow modification pressure, and these include important systems such as: Jakkalsvlei, Wadrift, Rietvlei/Diep, Onrus, Uilkraals and Gourits (Figure 2A), while the important Goukou and Duiwenhoks estuaries form part of the 20% of systems under a high degree of flow modification pressure. The large permanently open estuaries such as the Berg and Olifants estuaries are included in the 23 % of systems under a moderate degree of flow modification. Only 40% of estuaries in the Western Cape are under low flow modification pressure. Examples exist in the Western Cape where a decrease in freshwater flow results from direct abstraction (e.g. Keurbooms) or dam development (e.g. Olifants, Berg and Palmiet). In the Kuils/Eerste Estuary an increase in inflow is a result of hardening of their catchments and the effluent inflow from five wastewater treatment works. The Uilkraals Estuary is an example of a permanently open estuary that has closed for the first time as a result

Table 1: Summary of threats to estuaries and biodiversity.

Threats to estuaries			
Threats	**Drivers**	**Causes/Sources**	**Consequences**
Flow modification	Increased population, increase demand for water supplies	Decreases: direct abstraction, development of large or major dams, cumulative effects of smaller dams.	Closure of mouths in estuaries that are normally open to the sea; prolonged mouth closure in temporarily open/closed estuaries; altered physical conditions, effects on biota e.g. loss of nursery function.
		Increases (in baseflows): Agricultural return flow, interbasin transfer schemes, waste water treatment works, hardening of catchment.	Prolonged mouth opening in temporarily open/closed estuaries; altered physical conditions, effects on biota, proliferation of waterborne pathogens.
Pollution	Bigger population, increased demand for water supplies	Agricultural runoff (increased nutrients, Municipal wastewater; Industrial wastewater; Stormwater runoff (including solid waste); and suspended solids, herbicides and pesticides).	Input of pollutants into estuaries, such as nutrients, microbial, heavy metals, litter; decline in water quality; impacts on estuarine biota (e.g. fish kills); and human health hazards.
Exploitation of living resources	Increased population, increased angling activities, increase demand for food supplies	Fish: Over-fishing and illegal gill netting, increased fishing demands (e.g. small scale fisheries allocation).	Recruitment failure in some fish species; direct decline of fish stocks.
		Invertebrates: Demand for bait	Impact on target and other organisms and associated habitats e.g. heavily harvested species, such as sandprawn *Callichirus kraussi*,mudprawn *Upogepia africana* and bloodworm *Arenicola loveni.*
Land-use and development	Bigger population associated with increased coastal development, poor land-use planning, poor farming practises, lack of /non adherence to set-back lines.	Inappropriate land-use and development in and around estuaries, i.e. in the estuarine functional zone.	Habitat degradation, or loss within an estuary; altered tidal flows and sediment loading; impacts on estuarine biota; loss of aesthetic value of estuary.

Emerging threats			
Aquaculture (Marine and Freshwater)	Increased population, increase demand for luxury food supplies.	Inappropriate practices in freshwater and marine aquaculture.	Increased habitat loss; increased pollution to the river and /or estuary; decline in water quality; impacts on biota e.g. spread of disease and genetic contamination.
Desalination plants	Increased population, increase demand for fresh water.	Poorly located desalination plants; discharge of (toxic) brine effluent into estuary (exacerbated by unwillingness to budget for marine outfalls and dispersers).	Increased habitat loss; disruption of salinity profile; increased pollution to the river and or estuary; decline in water quality.
Invasive alien species	Increased population, increase demand for food supplies.	Predatory fish species causing a barrier to upstream migration, habitat altering species causing changes in sediment structure and/or water clarity, loss of estuarine macrophyte habitat, invasive species as vectors of parasites and pathogens e.g. crabs as intermediate hosts of human lung fluke.	Recruitment failure, e.g. eels and freshwater mullet. Changes in community structure due to habitat changes.
Pathogens and parasites	Increase population, poorly planned waste disposal, increase demand for luxury food items produce through aquaculture, Tropical fish pet trade.	Aquaculture, including the ornamental fish trade and high fish or invertebrate densities increase the risk of outbreaks, Pollution reduces the ability of animals to resist infection.	Fish kills, recruitment failure, population crashes, human health concerns, loss of tourism income.

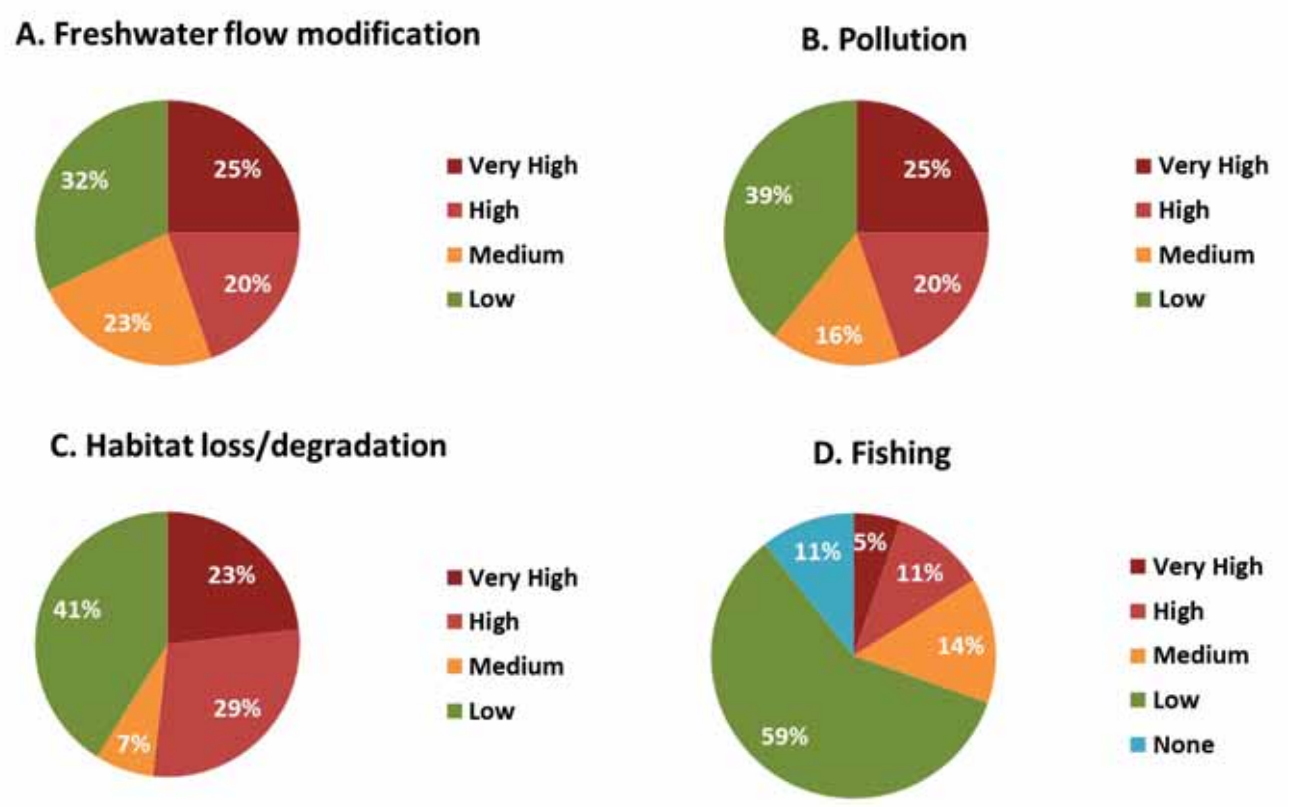


Figure 2. Pressure Data on 56 estuaries in the Western Cape showing proportions for each of A. Flow modification; B. Pollution; C. Habitat loss/degradation; and D. Fishing.

of inadequate flow allocation to maintain an open mouth condition.

2.2 Pollution

The assessment indicates that 25 % of the Western Cape's estuaries are under very high pollution pressure (Figure 2B), while an additional 20% are under high levels of pollution pressure. These include amongst others: the Olifants, Verlorenvlei, Rietvlei/Diep, Zandvlei, Klein, Bot, Onrus, Uilkraals, Breede, Groot Brak and Hartenbos estuaries. Moderately impacted estuaries comprise 16% of the total whilst 39% are under low pollution pressure. Although there are no data or comprehensive studies available on pollutant loads introduced to estuaries through agricultural sources, specific studies have shown that runoff from catchments used extensively for agriculture can contribute significantly to pollutant loading in estuaries, e.g. Olifants and Breede.

In the Western Cape about 375 200 m³ of wastewater is daily discharged into, or just above, estuaries. Numerous municipal wastewater treatments works (WWTW) discharge effluent into estuaries (Table 2). A comparison between data from 1991 and 2017 indicates that WWTW discharge volumes to estuaries have doubled over this period, reflecting the rapid population growth in coastal areas. While most of these discharges are subject to treatment (sometimes secondary or even tertiary), many of the WWTWs are malfunctioning thus causing pollution in estuaries (e.g. Eerste, Knysna and Hartenbos estuaries). Overflowing sewage pump stations are a

Table 2: Wastewater discharges into or near estuaries in the Western Cape (updated from Van Niekerk *et al.* 2017).

Estuary	Estimated flow (m^3/day)	Location	Effluent type
Olifants	418	Lutzville	WWTW
Groot Berg	130 000	Marine Product, Laaiplek	Industrial (Fish)
Rietvlei/Diep	44 000	Potsdam (Milnerton, Cape Town)	WWTW
Wildevoëlvlei	7 500	Wildevoelvlei (Kommetjie, Cape Town)	WWTW
Zeekoei	137 800	Cape Flats	WWTW
Eerste	26 400	Macassar	WWTW
Bot/Kleinmond	1 000	Hawston	WWTW
Klein	400	Standord	WWTW
Uilkraals	1000	Over flow	WWTW
Goukou	2 200	Riversdal/Stilbaai	WWTW
Hartenbos	1 0000	(Mossel Bay)	WWTW
Klein Brak	90	Friemersheim	WWTW
Gwaing	7 931	Gwaing	WWTW
Knysna	6 500	Knysna	WWTW
Piesang	50 (in season)	Plettenberg Bay	Industrial (Brine)

specific concern and regular pump failures have been recorded in systems such as the Lourens and Onrus, where sedimentation and nutrient-rich water have resulted in the proliferation of the common reed *Phragmites australis*. Another example is Wildevoëlvlei near Noordhoek, where pump failures have resulted in nutrient rich waters and the proliferation of blue green algae (*Microcystis aeruginosa*). These prolific algal blooms have resulted in the loss of pond weed in the system (competition).

In terms of industrial discharges, an emerging concern is desalination (e.g. Piesang and Knysna estuaries) that can have detrimental impacts on these sheltered and sensitive coastal environments. The Department of Environmental Affairs (DEA) operational policy for the disposal of land-derived waste water to the marine environment aims to prohibit new wastewater discharges into sensitive coastal areas such as estuaries. However, it will require a serious commitment to enforce this policy in the light of the ever-increasing demand for municipal services (e.g. wastewater facilities) and fresh water (e.g. desalination plants) in coastal areas. Planning the implementation of these policies and processes needs to be included in appropriate Estuary Management Plans (EMPs) and both Municipal and Provincial Coastal Programmes. Effluent water quality and quantity requirements need to be included in associated Reserve Determination processes as well as any Estuary Mouth Management protocol.

2.3 Land use and development

More than 50% of Western Cape estuaries exhibit very high degrees of habitat loss or degradation, with 23% of systems under very high transformation pressure and 29% under high pressure (see Figure 2C). Seven percent exhibit a moderate degree of habitat loss while a further 41 % of systems exhibit a low degree of habitat loss. Low-lying developments (e.g. Hartenbos and Klein), grazing (Olifants, Verlorenvlei), land reclamation (Eerste and Zandvlei), mining (Olifants), infrastructure developments such as roads, bridges and jetties (Klein Brak), channelisation (Sir Lowry's Pass Estuary near Gordons Bay has been reduced to a canal flowing into the sea); or the remodelling of part of an estuary for harbour or marina construction (Sand, Zandvlei, Great Berg), all result in habitat loss. Structures also interfere with flow patterns which alter available habitat. A typical example is the bridge spanning the Uilkraals Estuary where changes in flow velocity, and related sediment distribution, have led to changes in habitat and biota, e.g. bloodworm *Arenicola loveni* disappeared. In the Zandvlei Estuary, tidal flows are impaired through the build-up of sediment caused by a weir, the bridge construction, mouth stabilisation and the Da Gama Marina, which can lead to premature mouth closure. A mouth management protocol has been developed as part of the Zandvlei EMP with the aim of maximizing ecological benefits within this altered estuarine system. Other heavily impacted estuaries such as Hout Bay Estuary and Silvermine Estuary are also examples of impacted estuaries in need of formal rehabilitation plans.

2.4 Exploitation of living resources

About 1 500 tons of fish are annually caught in the estuaries of the Western Cape (Department of Agriculture, Forestry and Fisheries, unpublished data). Fishing effort is very high in five percent of the systems comprising of three estuaries under intense pressure (as shown on Figure 2D). Another 11% of the estuaries have high fishing pressure. Estuaries under moderate fishing pressure make up 14%. The majority of the estuaries (59%) have low fishing pressure and only 11% of the estuaries have no fishing pressure. All the large estuarine systems in the Western Cape are heavily overexploited, especially linefish. Fishing effort in the Olifants (sustains a legal small-scale commercial gillnet fishery), Berg and Bot systems is extremely high and requires urgent management intervention to reduce the pressure on key nursery areas and overexploited and / or collapsed stocks of estuary-associated species. Most of the catches are illegal and could be significantly reduced by dedicated compliance initiatives. Both legal and illegal effort is dominated by the use of gillnets which are not selective of target fish and therefore result in very high mortality of both juveniles and adults of prohibited bycatch species. Some form of bait collection occurs in 82% of the estuaries in the Province.

2.5 Estuary mouth manipulation

Artificial mouth management practises are recorded in 21% of the estuaries (12 systems) in the Province (Figure 3, Van Niekerk *et al.*, 2017). Five of these systems are large systems, e.g. Verlorenvlei (no longer ongoing), Bot/Kleinmond (Figure 4), Klein (Hermanus Lagoon), Heuningnes, Wilderness (Touw) and Swartvlei, whilst channelisation is observed in the Seekoei, Zandvlei and Berg. Premature breaching reduces scouring potential and causes ongoing sedimentation. This in turn leads to premature mouth closure, increased risk of flooding, higher water levels and reduced recruitment and nursery function.

Historically the mouth of the important Heuningnes estuary naturally closed during low-flow periods as a result of shifting sand, causing back-flooding to adjacent farmland. De Mond Nature Reserve (CapeNature) has an understanding with farmers to undertake artificial breaching of the mouth of the Heuningnes Estuary in emergency situations in order to prevent this back flooding. A mouth management study is currently underway to evaluate if a more natural breaching regime can be restored to this estuary.

It is essential that any form of artificial estuary mouth breaching or manipulation is carried out in a formal and well-documented manner. The need for breaching and the associated implications for the natural and social environments needs to be documented. A mouth management plan that protects the estuary ecosystem needs to be developed in association with estuary specialists, government departments and stakeholders. A final Mouth Maintenance Management Plan will need to

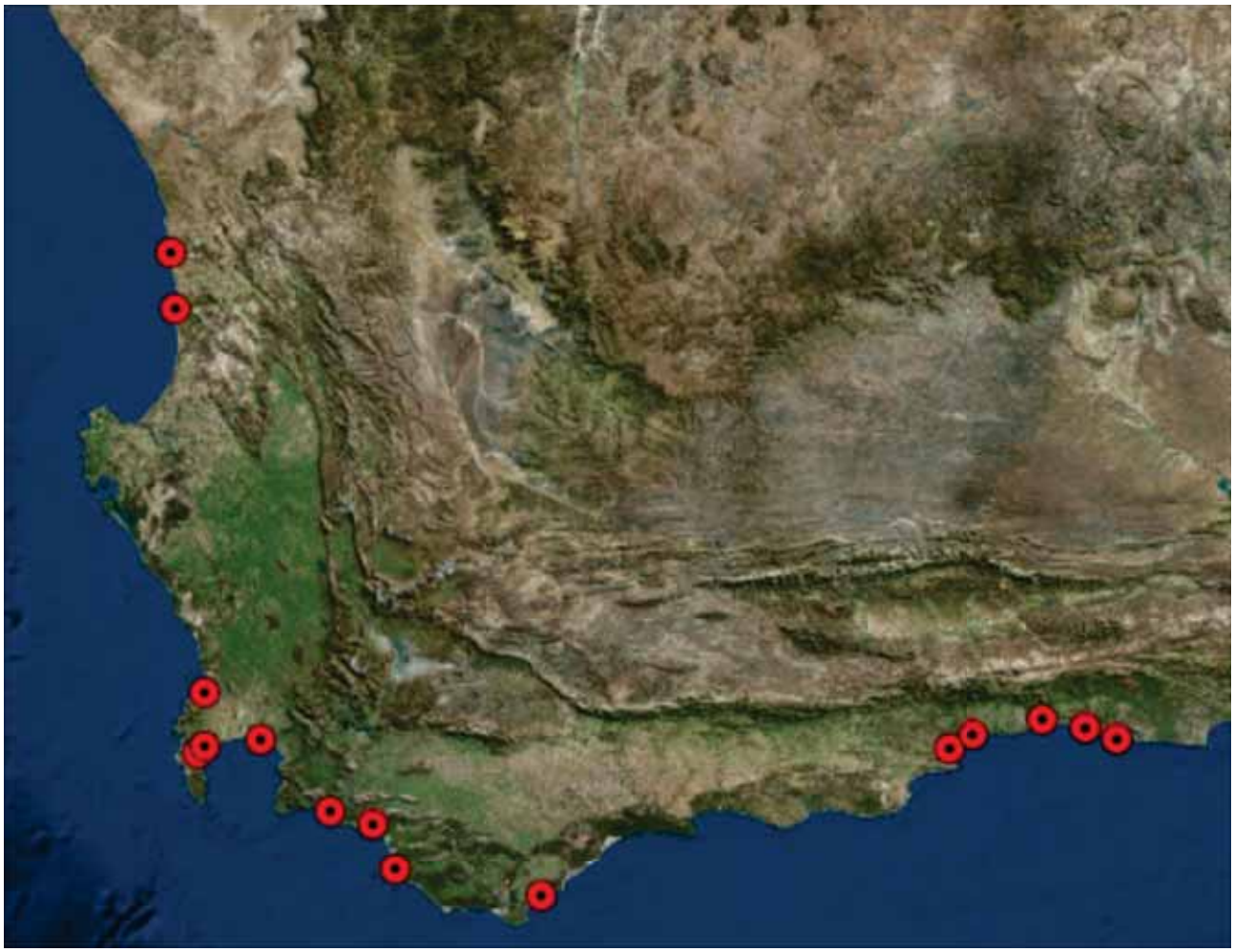


Figure 3. Estuaries subjected to mouth manipulations (artificial breaching, mouth stabilisation, channelization) (Van Niekerk *et al.,* 2017).

Figure 4. An example of the initial channel dug to artificially breach the Bot Estuary and the resultant flows within a few hours of opening demonstrating the scouring impact of the exiting water.

be submitted for approval in order to address any listed activities triggered by the breaching activity (e.g. breaching canal).

3. Estuary health status

Data on Western Cape estuaries presented in this report represents a collation of the latest Department of Water and Sanitation (DWS) Classification studies, DWS Ecological Water Requirement studies; and Desktop Estuary Health Assessments, with higher-confidence studies taking precedence over-lower confidence historical studies (van Niekerk *et al.,* 2017).

3.1 The estuarine health determination process

The health condition (also called the Present Ecological State) of an estuary is typically defined on the basis of current condition (i.e. the extent to which it differs from its reference or natural condition). Based on the above, estuary condition is described using six Present Ecological State (PES) categories, ranging from natural (A) to critically modified (F) (Table 3). The Estuarine Health Index is applied to all levels of ecological water requirement studies (comprehensive, intermediate rapid or desktop), with only the level of information supporting

the study and level of confidence varying. Scores are then weighted and aggregated so that the final score reflects the present health of the estuary as a percentage of the pristine state. Both abiotic and biotic variables are included as the relationships between the abiotic and biotic variables are often not well understood and because the biotic response to certain abiotic variables can be lagging. For comparative reasons the individual health scores were aggregated as illustrated in Table 3. In estuaries, unlike in the terrestrial environment, degradation or loss of habitat seldom means a complete loss of an estuary. This can only happen if an estuary becomes completely degraded, e.g. changed into a parking lot or golf course. In most cases, degradation means loss of processes or loss of biological functionality, e.g. the estuarine space is filled with a different salinity condition or different species composition. This loss of functionally happens on a continuum, with estuaries which retain more than 90 % of their natural processes and pattern being rated as Excellent and estuaries degraded to less of 40 % of natural functionality rated as Poor.

Table 3: Schematic illustration of the relationship between loss of ecosystem condition and functionality.

Condition	≥91%	90-75	75 - 61	60 - 41	40-21	≤20
Category	A Natural	B Largely natural with few changes	C Moderately modified	D Largely modified	E Highly degraded	F Extremely degraded
State	Excellent	Good	Fair		Poor	
Functionality	Retain Process & Pattern (representation)		Loss of Process or Pattern		No Process & Pattern	

3.2 Health status of estuaries in the Western Cape

The Present Ecological State (Estuary condition) is expressed in terms of the DWS A-F scale in Table 3. Detailed information on the health status of Western Cape estuaries is in Appendix 1.

Along the West Coast the predominantly closed estuaries tend to be in a good state while the large permanently open estuaries on average are in a fair state (Figure 5). The estuaries along the west coast were generally in a fair to poor state as a result of significant

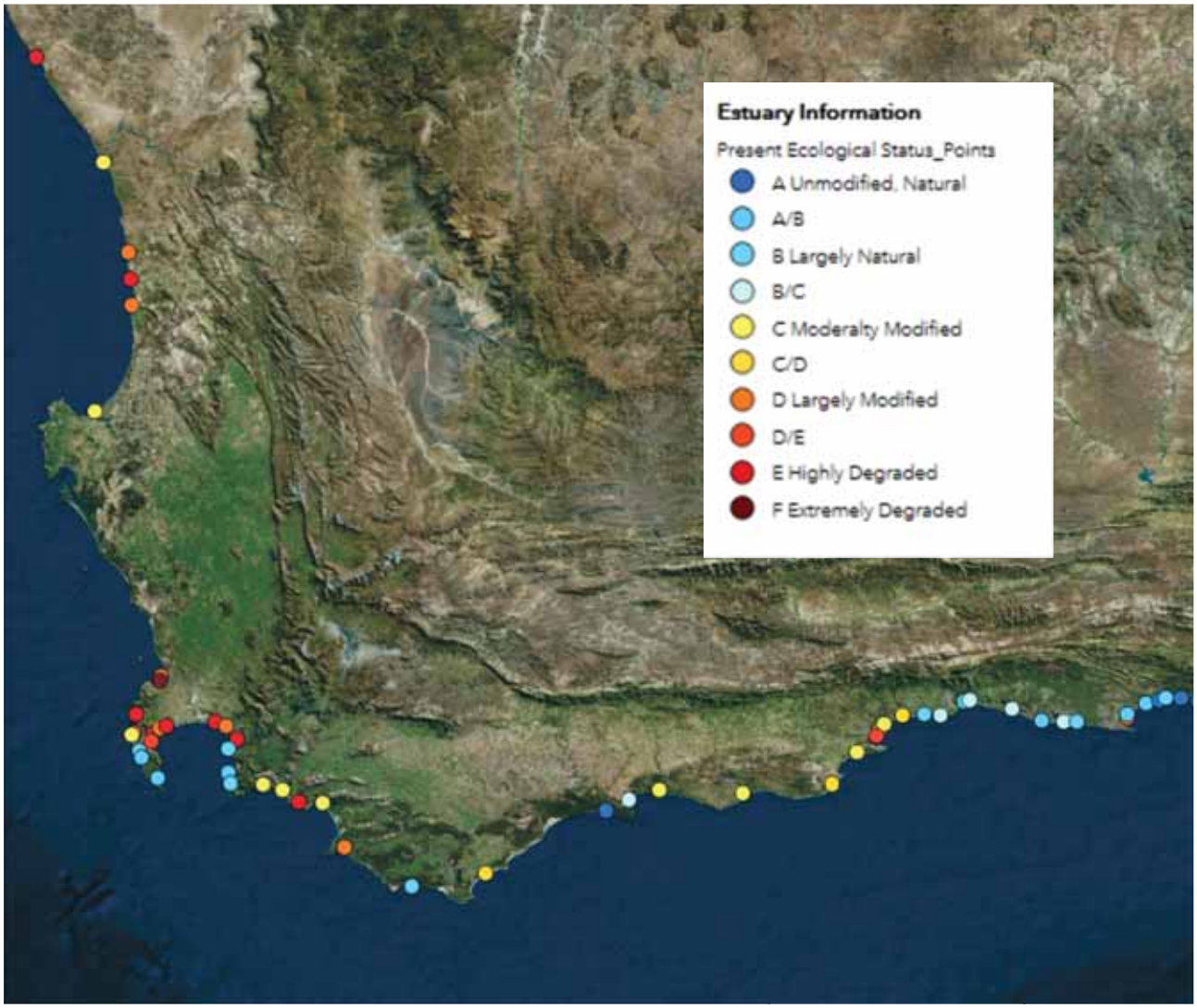
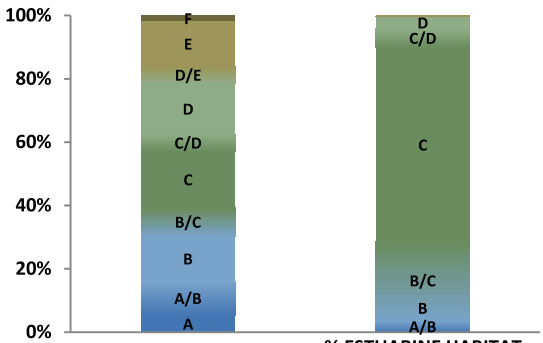


Figure 5. Estuary Health (Present Ecological Status) in the Western Cape.

flow reduction, pollution and in the case of the large systems, fishing pressure. On the other hand, the numerous small temporarily open/closed estuaries around Cape Town were generally in a poor condition. Estuaries along the south and south-east coast tend to be healthier than those in the rest of the country, with the estuaries around Mossel Bay proving to be the exception.



	% ESTUARIES (n=56)	% ESTUARINE HABITAT (20 500 ha)
F	1.8	0.0
E	14.3	0.4
D/E	5.4	0.0
D	16.1	3.6
C/D	5.4	6.1
C	17.9	61.3
B/C	8.9	24.5
B	14.3	0.5
A/B	10.7	3.5
A	5.4	0.0

Figure 6: Data for 56 estuaries in the Western Cape showing proportions of estuaries and their associated percentage habitat in an excellent (dark blue), good (light blue), fair state (shades of green) or poor state (brown)

As seen in Figure 6, only 5% of the estuaries in the Western Cape are in an excellent condition and an additional 26% in good condition, unfortunately collectively they only make up 4% of the estuarine area in the province. Most of these are relatively small systems enclosed in formal protected areas. About 48% of all Western Cape estuaries are in a fair condition, representing more than 95% of the estuarine area in the province.

Twenty-one percent of estuaries are in a non-functional poor condition but as most of these are very small systems they do not represent a large proportion of area. The systems that are in a poor condition include the Diep/Rietvlei, Elsies, Onrus and Buffels (Wes). In some estuaries recent restoration efforts to improve estuary functionality have contributed to improving system condition away from the non-functional category, e.g. improved water quality and mouth management practices by the City of Cape Town have substantially improved the nursery function of Zandvlei Estuary and enabled salt mash rehabilitation in the Gouritz Estuary.

4. Estuaries And Climate Change

South Africa's Third National Communication under the *United Nations Framework Convention on Climate Change* indicates that climate change could have significant impacts on estuary structure and functioning. Anticipated changes in precipitation and runoff will cause: (i) modifications in the extent of saline water intrusion; (ii) changes in the frequency and duration of mouth closure (iii) decreases or increases in nutrients fluxes; and (iv) changes in the magnitude and frequency of floods and related sediment deposition/erosion cycles. Increased storminess and flooding will increase the occurrence of

Figure 7. Heuningnes estuary at De Mond Nature Reserve.

disasters at a number of systems, for example, Great Brak, Wilderness and Swartvlei. Other anticipated impacts include changes in the dilution and or flushing of pollutants, rising water temperatures, and associated changes in estuarine biota.

Climate change and sea level rise will increase the pressures on management agencies to implement assisted (and often premature) estuary mouth breaching, as increasingly properties will be below the level of the sand berm near the mouth. The response of humans to sea level rise may take the form of actions destructive to estuaries, such as armouring the coastline with berms or dykes that will prevent biological systems from adjusting naturally (e.g. by inland retreat of wetlands). Climate change will therefore not only increase the risks to estuary ecosystems, but also to the human communities and associated infrastructure and property surrounding them. Estuarine management is therefore also likely to become more complex and conflicted over time.

5. Government's responses to pressures and declining estuary health in the western cape

5.1 Conservation value and status of estuaries in the WCP

The National Biodiversity Assessment 2011 (NBA) (Van Niekerk & Turpie, 2012; Turpie *et al.,* 2012) developed a biodiversity plan for estuaries of South Africa by prioritising and establishing which of them should be assigned partial or full Estuarine Protected Area status. This biodiversity plan followed a systematic approach that took pattern, process and biodiversity persistence into account. While the plan has not explicitly taken social and economic costs and benefits into consideration, it used ecosystem health as a surrogate for the former. This is because estuaries where the opportunity costs of protection are likely to be high are also likely to be heavily-utilised systems that are in a lower state of health.
The plan indicates that in the Western Cape 28 estuaries (11 require full protection and 17 require partial protection) including those already protected, would be required to meet biodiversity targets (Turpie *et al.* 2012). Two additional estuaries were subsequently also highlighted as provincial priorities, namely Noetsie (CAPE programme) and Rooiels (Kogelberg Biosphere Reserve). Fully protected estuaries are taken to be full no-take areas. Partial protection might involve zonation that includes a no-take area, or it might address other pressures with other types of action. Fully protected and partially protected estuaries can be considered Estuarine Protected Areas, whereas all other estuaries should be designated Estuarine Management Areas. All estuaries require an Estuary Management Plan (EMP) and these plans should be guided by the results of this assessment.

Over the next five years the following estuaries are being targeted by provincial authorities for formal protection: Olifants, Verlorenvlei, Berg, Bot, Klein, Heuningnes (extension), Breede, Goukou (extension), Goukamma (extension), Keurbooms (extension), Uilkraals, Palmiet and Rooiels (provincial priority). This is to be achieved through the expansion of Marine Protected Areas or Protected Areas or Stewardship programmes. While this would leave the Western Cape well short of the ultimate target of 30 estuaries under formal protection, it would provide formal protection to most of the larger systems. Smaller estuaries that fall in their entirety within one municipality can also be formally protected by local government, e.g. the City of Cape Town formally protected Zandvlei and the Diep Estuary under provincial legislation. An additional concern is that there are very few no-take estuaries in the Western Cape – measures should be explored to increase the amount of no-take areas (e.g. zonation, full closure and seasonal closures).

In addition; seven estuaries form part of Important Bird Areas sites in the Western Cape and may be seen as estuaries of relatively high conservation value: Bot/Kleinmond; Groot Berg, Heuningnes; Olifants; Rietvlei/Diep; Verlorenvlei; Wilderness Lakes. Four estuaries are declared RAMSAR sites which provides global recognition and conservation status to these systems: Heuningnes; Verlorenvlei; Wilderness and Bot estuaries.

5.2 Estuary Management Plans are needed to coordinate responses

It is important to understand that estuary ecosystem conservation and general estuary management involves the integration of the management mandates of several government departments. The Department of Water and Sanitation is responsible for the management of the freshwater resources, the Department of Agriculture, Forestry and Fisheries (DAFF) is responsible for the management of catchment land-use and marine living resources, DEA (National and Provincial) is responsible for the management of biodiversity and local government is responsible for the management of infrastructure and development around estuaries to mention but a few. In order to manage an estuary effectively the planning process needs to involve the active participation of all the appropriate government departments and the stakeholders.

The Integrated Coastal Management Act (ICMA) (No. 24 of 2008) sets the norms, standards and policies for the management, conservation and ecologically sustainable development of the coastal zone. The National Estuarine Management Protocol (NEMP) (gazetted in 2013) provides guidance on the development and implementation of the individual EMPs.

The Intergovernmental Relations Framework Act (No. 13 of 2005) provides for the ministerial political (MINMEC) and technical (MINTEC) structures that ensure policy and strategy coherence between the three spheres of government. MINMEC and MINTEC have replaced the role of the National Coastal Committee. Working Group 8 coordinates Oceans and Coastal Management in South Africa and is chaired by the Chief Director: Integrated Coastal Management of Oceans and Coast Branch of DEA. The Group is attended by key national

agencies and representatives from provincial lead agents for ICM. Working Group 8 feeds into the MINTEC and ultimately to MINMEC. The National Estuaries Management Task Group (an advisory body to Working Group 8) coordinates and fosters cooperation in estuarine management and planning at a national scale. This Task Group provides government authorities (and other key role players) with a platform to coordinate resource planning across all sectors and to optimise the use of limited estuarine resources. Similarly, the Western Cape Estuaries Programme Task Team set up to provide technical support to the Provincial Coastal Committee and Municipal Coastal Committees facilitates stronger coordination and cooperation in estuarine resource planning across estuaries in a province or in a municipal area. Estuary Advisory forums are the ideal communication hub that can be used to prioritise and integrate management actions and disseminate information at the local scale. These communication platforms may become advisory committees for the Municipal and Provincial Coastal Committees.

Advisory forums can also be used as platforms where cooperative programmes or projects can be developed with a range of partners in order to achieve specific objectives listed in the EMPs, e.g. the monitoring of water quality parameters (partnership between DWS, CapeNature and the South African Shark Conservancy aimed at monitoring the Bot and Klein estuaries).

5.3 Development and Implementation of the Western Cape Estuaries Programme

The Western Cape Estuary Management Programme forms part of the Provincial Coastal Management Programme and aligns with the National Coastal Management Programme. It focuses on the requirements of the National Estuarine Management Protocol. It is a collaborative initiative between the Western Cape: Department of Environmental Affairs and Development Planning (DEA&DP), National Department of Environmental Affairs: Oceans and Coasts Branch (DEA: O&C), CapeNature, South African National Parks, Municipalities, Non-Government Organisations and Estuary Advisory Forums and prioritise:

- Revisiting and updating 16 existing draft EMPs that were developed as part of the CAPE programme;
- Developing 17 new Priority EMPs;
- Developing 10 Mouth Management Plans;
- Provide provincial direction for the establishment and operation of estuary advisory forums;
- Ensuring that priority habitats associated with estuaries are protected through the expansion of marine protected areas and protected areas, where appropriate; and,
- Coordinating estuarine management research.

The programme also prioritises water quality improvement interventions for the Berg, Breede and Olifants estuaries through the establishment of a monitoring and reporting system. Further, establishment of learning and work creation opportunities associated with the management and monitoring of estuaries is prioritised. The programme also supports the development of coastal and estuarine setback and flood lines. These lines ultimately need to be embedded in the zonation maps within the estuary management plans.

5.4 Working together to resolve legal challenges

The judgement handed down by the Supreme Court of Appeal in the matter between David Willoughby Abbott v Overstrand Municipality and others (99/2015) [2010] ZASCA 68 (20 May 2016) ('the Abbott judgement') has resulted in disparity between the spheres of government with the interpretation and understanding of these roles and responsibilities of organs of state as prescribed by the

Figure 8. The Bot River estuary is part of an extensive wetland system near Kleinmond.

relevant statutes.

After considering both the Abbott judgement and the subsequent legal advice, the DEA&DP and DEA concur with the finding in the Abbott judgement that there are constitutional shortcomings with the assignment of powers (paragraph 5.1) under the NEMP. The court considered it to be inconsistent with section 156 (1)(b) of the Constitution as it was not provided for in legislation and it did not comply with the conditions in section 156(4) of the Constitution. There was no agreement by the municipalities, confirming that the function would most effectively be managed at local government level and that the municipalities have capacity to perform that function.

It must be noted that the 'non-assignment' of functions is in terms of the NEMP and refers to the development and implementation coordination of the EMP action plans that are assigned to the responsible management authorities. The EMP strives to converge all existing functions in estuaries to achieve the overall objective of integrated environmental management in these high use, high value environments. Local municipalities are tasked in the NEMP to oversee the overall coordination and ensure that all organs of state are fulfilling their respective functions (as per their mandate). These are the only additional functions assigned to municipalities through the NEMP. The original mandates assigned to local government in terms of the Constitution and the ICMA are still in effect.

The national and provincial government are working together to provide legal certainty with regard to the roles of local government in estuary management to reaffirm the importance of local authorities' involvement in estuary management.

5.5 Water Resource Classification and determining the Ecological Reserve

Estuaries and the associated marine environment require freshwater water flows in order to function. These flows range from flood events that scour the river channel and open the estuary mouth to dry season base flows that maintain crucial estuarine processes. These same flows also result in the functioning of the rivers and wetland systems that make up a catchment. However, a balance needs to be established between the freshwater available for human use and that which is allowed to flow down the catchment and into the ocean. Without water use in the catchment, humans and their associated agriculture and industries could not survive.

The National Water Resources Classification process (required under the National Water Act, No. 36 of 1998) gives effect to the Resource Directed Measures Strategy. Classification will ultimately set the Management Class (desired condition), the Reserve (freshwater flow requirement) and the Resource Quality Objectives for each estuary in the Western Cape. The process is currently being implemented in the Western Cape. It is hoped that the implementation of the agreed upon flow allocation aimed at achieving a target estuary condition within the existing constraints will in itself result in an improvement in the condition of those estuaries. Integral in the various flow allocations within each catchment is also those flows allocated to support the functioning of the Freshwater Ecological Priority Areas. A link between these freshwater flows needs to be made with the freshwater requirements of each estuary.

Of possible concern is that estuarine biodiversity protection targets and their associated freshwater flow requirements are simply addressed as one of many water users and as such are not clear priorities within the freshwater provisioning process. An additional concern is that the Classification process does not recognise the nearshore marine environment as a receiving environment and therefore no freshwater flow is being allocated to this critical ecosystem function. Classification and/or Reserve studies are in progress/completed the following Western Cape estuaries as listed in In Appendix B.

5.6 Living Marine Resource Management

The management and control of exploited living resources in estuaries fall primarily under the Marine Living Resources Act (MLRA) (No. 18 of 1998). The lead agent in the management and control of living resources in estuaries is DAFF. The primary purpose of the act is to protect marine living resources (including those of estuaries) through establishing sustainable limits for the exploitation of resources; declaring fisheries management areas for the management of species; approving plans for their conservation, management and development; prohibit and control destructive fishing methods and the declaration of marine protected areas (a function currently delegated to DEA). The MLRA overrides all other conflicting legislation relating to marine living resources. This resulted in some provincial and local legislation providing for the effective protection of living resources being superseded before proper protection measures were put in place under the new Act. This situation resulted in some estuaries becoming vulnerable to overexploitation.

Over the last 10 years some estuarine-dependant fish species have shown no signs of stock recovery, are at critical levels (<1% of pristine) and at risk of population, perhaps total, extinction. For example, dusky cob (*Argyrosomus japonicas*), are at less than 1% of historical spawner biomass with an effective breeding population estimated at between hundreds and a few thousand fish spanning approximately 2000 km of coastline (Mirimin *et al.*, 2015). In response to this, and the fact that more than 50% of large reproductive adults are caught at night, a ban on night fishing was introduced at the Breede Estuary to protect both adolescents and breeding adults as well as to enhance nursery function. While there was initially significant resistance (and still is in isolated instances) to this measure, it is proving successful enough that the approach will be rolled out to all estuaries in the country

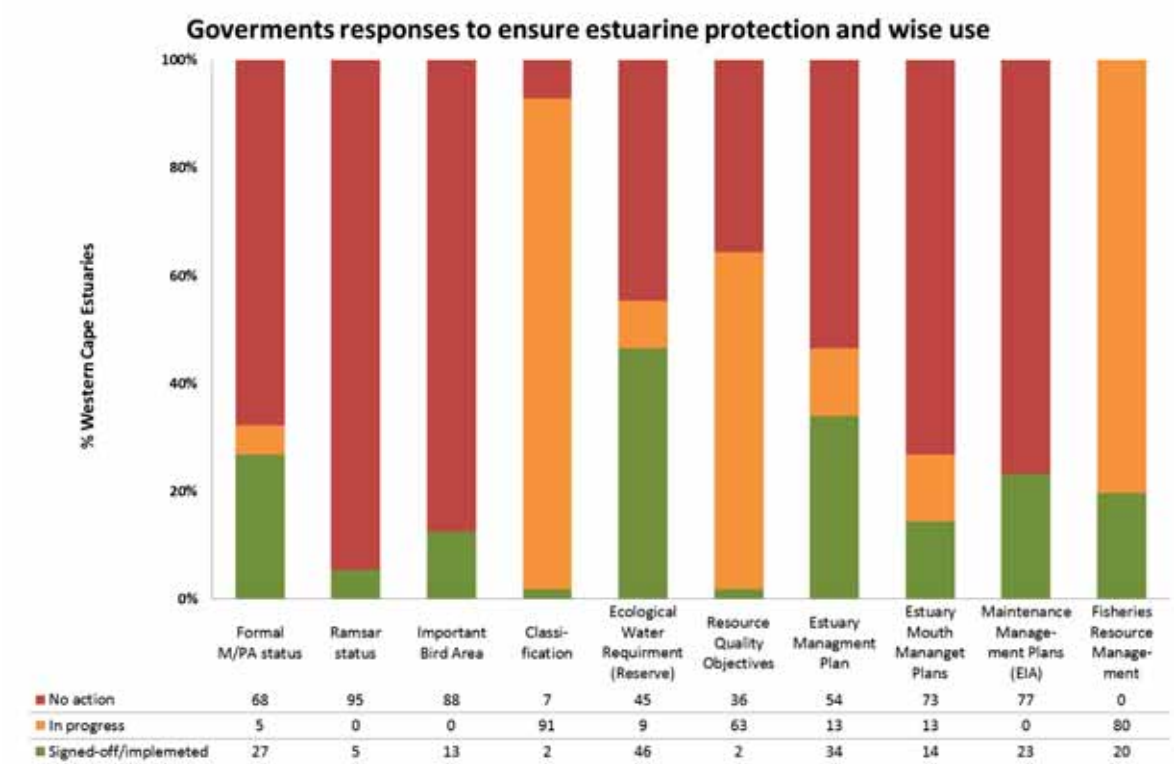


Figure 9: A summary of Western Cape Government's response to pressures on estuaries

over the next few years. In addition, no commercial linefishing is allowed in Western Cape estuaries with the exception being the Olifants Estuary that has a commercial gillnetting fishery. Commercial gillnetting was removed from the Groot Berg Estuary. No night fishing is allowed in Zandvlei (City of Cape Town). Small scale fishers in all systems are not allowed to sell their estuarine catch. There are ongoing compliance initiatives on a number of large estuaries, e.g. Great Berg (DAFF, South African Police Service & CapeNature), Goukou (CapeNature), Gouritz (CapeNature, DAFF, South African Police Service – Water Wing), Knysna (SANParks), and Keurbooms (CapeNature) (Figure 9).

5.7 What does the integrated picture look like?

Significant progress has been made in the Western Cape from a water resource and land use perspective to address pressures relating to flow reduction and habitat loss (Figure 9). Relatively little progress has been made with addressing high levels of overexploitation in Western Cape estuaries, but measures such as the ban on estuary night fishing is poised to be rolled out to other systems in the region which would significantly improve the current status quo. However, of serious concern is that there has been no movement on increasing the estuarine area under formal protection, without which it is near impossible to invoke self-compliance among the public and high levels of government cooperation.

Estuarine ecosystems are under increasing pressure from human activities, modification and degradation, and are considered amongst the most threatened ecosystems in the province. These sensitive, highly productive and diverse ecosystems are of critical importance in the provision of ecological, social and economic benefits in the Western Cape. Estuary health is identified in particular as an area of "high concern". Unless sensitive, holistic and integrated coastal management takes place, these habitats and livelihoods will be degraded and destroyed, with the very attributes that make the coastal zone attractive, being lost.

6. Conclusions and Recommendations

Estuarine ecosystems form a crucial link between catchments (including land use and water use) and the ocean. Whilst estuary condition may be evaluated for individual estuaries the broader connectivity between the land and the sea has immense value in itself and this needs to be maintained. Estuaries are extremely complex systems by virtue of the fact that actions hundreds of kilometres away in a catchment or in the ocean may have an impact on their functionality. Bearing this in mind, management needs to integrate estuary management and its associated targets into catchment management strategies and catchment management.

Classification and Ecological Water Requirement studies are good tools for achieving this. Managers will also need to be aware of broader changes in oceanic systems and species. The management of land-sea connectivity and exploitation of living resources will have an impact on estuary nursery function. Sediment and nutrient transfer between systems also plays a vital role in ecosystem maintenance and resilience. The complexity of estuary management necessitates effective planning and good communication between stakeholders. The development of EMPs and their associated Estuary Management Forums provide great tools which, in association with

supporting National, Provincial and Local legislation, can be used to effectively manage estuaries in the Western Cape. However it should be understood that the management of estuaries will always involve the integration of management mandates of National, Provincial and Local Government with the support and approval of all stakeholders. Clear estuary conservation targets need to be set for the Western Cape. While Protected Area status is important, achieving maximum functionality within existing constraints is essential.

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HEUNINGNES ESTUARY

Appendix 1: Summary of estuary condition, importance and degree of pressure on, of Western Cape estuaries, pressure levels are indicated as very high (VH), high (H), medium (M) or low (L). A Blank indicates the absence of a pressure. Species affected by fish kills are represented as fish (F), birds (B) and invertebrates (I).

Estuary key features			Estuary Condition & Importance			Pressures								
NAME	Reference MAR (m^3x10^6)	Present MAR (m^3x10^6)	National Biodiversity Importance Rating (5 =High, 3 = Average)	Biodiversity priority core set (national and/or CAPE)	Biodiversity priority core set (national and/or CAPE)	Change in flow	Pollution	Habitat loss	Mining (Diamonds, Sand)	Artificial Breaching	DAFF Fishing Effort	DAFF Fish catches(t) *	Bait collection	Fish kills linked to pollution (2000 - 2016)
Sout	1.5	1.5	Low to Average Importance		Low	M	L	H			L	0.1		
Olifants	1070.1	715	High Importance	Priority	High	M	H	H			VH	121.1	Yes	F
Jakkalsvlei	3.508	2.502	Low to Average Importance		Low	VH	H	H			L	0.1	Yes	
Wadrift	13.256	9.774	Low to Average Importance		Low	VH	H	VH			L	0.1	Yes	
Verlorenvlei	52.205	40.247	Important	Priority	Medium	VH	VH	H		Y	M	10.0		F
Groot Berg	916	520.38	High Importance	Priority	High	M	M	H			VH	511.0	Yes	F
Rietvlei/Diep	63.287	51.147	Important	Priority	High	VH	H	VH		Y	L	8.0	Yes	F
Sout (Wes)	31.108	27.521	Low to Average Importance		Low	VH	VH	VH			L	0.1		
Houtbaai	15.184	14.607	Low to Average Importance		Low	VH	VH	VH			L	0.1	Yes	
Wildevoëlvlei	2.135	1.813	High Importance		Low	VH	H	H			L	0.2	Yes	F
Bokramspruit	2.012	1.774	Low to Average Importance		Low	VH	M	L			N	0.0		
Schuster	2.574	2.485	Low to Average Importance		Low	M	L	L			N	0.0		
Krom	6.993	6.81	Low to Average Importance	Priority	Low	L	L	L			N	0.0		
Buffels Wes	0.45	0.364	Low to Average Importance		Low	L	L	L			N	0.0		
Elsies	0.594	0.534	Low to Average Importance		Low	L	M	VH			N	0.0		
Silvermine	3.754	3.56	Low to Average Importance		Low	H	H	VH		Y	L	0.1	Yes	
Sand	21.731	19.836	Important	Priority	High	M	VH	H		Y	M	20.0	Yes	F

Estuary key features			Estuary Condition & Importance			Pressures								
NAME	Reference MAR (m^3x10^6)	Present MAR (m^3x10^6)	National Biodiversity Importance Rating (5 =High, 3 = Average)	Biodiversity priority core set (national and/or CAPE)	Biodiversity priority core set (national and/or CAPE)	Change in flow	Pollution	Habitat loss	Mining (Diamonds, Sand)	Artificial Breaching	DAFF Fishing Effort	DAFF Fish catches(t) *	Bait collection	Fish kills linked to pollution (2000 - 2016)
Zeekoei	22.329	20.437	Low to Average Importance		Low	VH	VH	VH			L	0.1	Yes	
Eerste	104.595	87.087	Low to Average Importance	Priority	Medium-Low	VH	VH	VH			L	0.1	Yes	
Lourens	66.266	59.156	Low to Average Importance	Priority	Low	H	VH	H			L	0.1	Yes	F
Sir Lowry's Pass	0.14	0.145	Low to Average Importance		Low	M	VH	VH			L	0.1	Yes	F
Steenbras	33.696	26.348	Low to Average Importance		Low	VH	L	L			L	1.0	Yes	
Rooiels	8.643	8.645	Low to Average Importance		Medium	L	L	L			L	0.1	Yes	
Buffels (Oos)	9.7	9.392	Low to Average Importance		Low	M	L	L			L	0.1	Yes	
Palmiet	256.3	163.7	Important	Priority	Low	M	M	H			L	0.2	Yes	F
Bot/Kleinmond	47	87.36798	High Importance	Priority	High	M	H	L		Y	VH	70.0	Yes	
Onrus	9.558	7.335	Low to Average Importance		Low	VH	VH	VH			L	0.1	Yes	
Klein	53.41	40.88	High Importance	Priority	High	L	H	M		Y	H	80.0	Yes	F
Uilkraals	39.3	29.4	Important	Priority	Medium	VH	VH	H			M	2.1	Yes	
Ratel	4.684	4.679	Low to Average Importance	Priority	Low	L	L	L			L	0.1	Yes	
Heuningnes	41.637	36.893	High Importance	Priority	High	M	M	H		Y	M	10.0	Yes	
Klipdrifsfontein	0.24	0.233	Low to Average Importance	Priority	Low	L	L	L			N	0.0		
Breë	1785	1034	High Importance	Priority	High	M	H	L			H	80.0	Yes	
Duiwenhoks	94.19	72.344	High Importance		High-Medium	H	M	H			H	20.0	Yes	
Goukou	102.78	77.03	High Importance	Priority	High-Medium	H	M	M			H	13.0	Yes	I
Gourits	628.775	445.976	Important	Priority	High	VH	L	VH			H	20.0	Yes	
Blinde	1.249	0.876	Low to Average Importance		Low	H	VH	L			L	0.1	Yes	
Gericke	35.6	34.4	Low to Average Importance		Low	H	VH	VH			L	0.1		

Estuary key features			Estuary Condition & Importance			Pressures								
NAME	Reference MAR (m^3x10^6)	Present MAR (m^3x10^6)	National Biodiversity Importance Rating (5 =High, 3 = Average)	Biodiversity priority core set (national and/or CAPE)	Biodiversity priority core set (national and/or CAPE)	Change in flow	Pollution	Habitat loss	Mining (Diamonds, Sand)	Artificial Breaching	DAFF Fishing Effort	DAFF Fish catches(t) *	Bait collection	Fish kills linked to pollution (2000 - 2016)
Tweekuilen	0.3	0.2	Low to Average Importance		Low	H	VH	H			L	0.1		
Hartenbos	4.632	2.824	Important		Medium	M	VH	H		Y	L	2.1	Yes	F
Klein Brak	53.366	40.358	Low to Average Importance		High-Medium	H	L	H			M	10.0	Yes	
Groot Brak	36.79	16.25	Important		Medium	M	H	VH		Y	M	10.0	Yes	
Maalgate	26.64	15.984	Low to Average Importance		Low	H	L	L			L	1.0	Yes	
Gwaing	43.53	32.6475	Low to Average Importance		Low	L	H	L			L	1.0	Yes	
Kaaimans	35.73	28.783	Low to Average Importance	Priority	Low	H	L	L			L	4.0	Yes	
Wilderness	29.66	25.151	High Importance	Priority	High	L	L	L		Y	L	170.0	Yes	B
Swartvlei	83.15	56.6	High Importance	Priority	High	L	M	M		Y	L	170.0	Yes	
Goukamma	57.5	48.8	Important	Priority	Medium	L	L	L		Y	M	4.1	Yes	
Knysna	83.2	68	High Importance	Priority	High	L	L	L			H	70.4	Yes	F
Noetsie	4.363	4.362	Low to Average Importance	Priority	Low	L	L	L			L	0.2	Yes	
Piesang	5.201	3.422	Important	Priority	Medium	H	M	H			L	7.2	Yes	F
Keurbooms	232	215	High Importance	Priority	High	L	L	M			L	23.4	Yes	
Matjies	5.1	4.27	Low to Average Importance		Low	L	L	L			L	0.1	Yes	
Sout (Oos)	11.22	10.1	Low to Average Importance	Priority	Low	L	L	L			L	0.5	Yes	
Groot (Wes)	12.752	11.121	Important	Priority	Low	L	L	L			M	5.8	Yes	
Bloukrans	40.05	39.289	Low to Average Importance	Priority	Low	L	L	L			L	1.0	Yes	

- *2012 Fish catches data currently under review by DAFF*

Appendix B: Summary of Governments responses to the pressures on estuaries. Response levels are indicated as: No response (Red), Initiated a processes (Orange), Operational/signed off/implemented (Green).

NAME	District Municipality	Local Municipality	CMA	Formal M/PA status	Ramsar status	Important Bird Area	Classification	Ecological Water Requirement (Reserve)	Resource Quality Objectives	Estuary Managet Plan	Estuary Mouth Managet Plans	Maintenance Mouth Management Plan	Fisheries Resource Management
Sout	West Coast	(WCDMA01)	LOWER ORANGE	Red	Red	Red	Red	Orange	Red	Orange	Red	Red	Orange
Olifants	West Coast	Matzikama (WC011)	OLIFANTS/DOORN	Red	Red	Green	Green	Green	Red	Green	Red	Red	Orange
Jakkalsvlei	West Coast	Cederberg (WC012)	OLIFANTS/DOORN	Red	Red	Red	Red	Red	Red	Orange	Orange	Red	Orange
Wadrift	West Coast	Cederberg (WC012)	OLIFANTS/DOORN	Red	Red	Red	Red	Red	Red	Orange	Orange	Red	Orange
Verlorenvlei	West Coast	Cederberg (WC012)	OLIFANTS/DOORN	Red	Green	Green	Red	Red	Red	Green	Orange	Red	Orange
Groot Berg	West Coast	Bergrivier (WC013)	BERG	Red	Red	Green	Orange	Green	Green	Green	Red	Red	Green
Rietvlei/Diep	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Green	Orange	Orange	Orange	Green	Orange	Green	Green
Sout (Wes)	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Houtbaai	City of Cape Town	City of Cape Town (CPT)	BERG	Green	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Wildevoëlvlei	City of Cape Town	City of Cape Town (CPT)	BERG	Orange	Red	Red	Orange	Orange	Orange	Red	Red	Red	Orange
Bokramspruit	City of Cape Town	City of Cape Town (CPT)	BERG	Green	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Schuster	City of Cape Town	City of Cape Town (CPT)	BERG	Green	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Krom	City of Cape Town	City of Cape Town (CPT)	BERG	Green	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Buffels Wes	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Elsies	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Silvermine	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Red	Red	Red	Orange	Green	Orange
Sand	City of Cape Town	City of Cape Town (CPT)	BERG	Orange	Red	Red	Orange	Orange	Orange	Green	Orange	Green	Green
Zeekoei	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Orange	Orange	Red	Red	Green	Orange
Eerste	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Orange	Orange	Red	Red	Green	Orange
Lourens	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Orange	Orange	Red	Red	Red	Orange
Sir Lowry's Pass	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Red	Red	Red	Red	Red	Orange
Steenbras	City of Cape Town	City of Cape Town (CPT)	BERG	Red	Red	Red	Orange	Red	Red	Red	Red	Red	Orange

NAME	District Municipality	Local Municipality	CMA	Formal M/PA status	Ramsar status	Important Bird Area	Classification	Ecological Water Requirement (Reserve)	Resource Quality Objectives	Estuary Mananget Plan	Estuary Mouth Mananget Plans	Maintenance Mouth Management Plan	Fisheries Resource Management
Rooiels	Overberg	Overstrand (WC032)	BREEDE										
Buffels (Oos)	Overberg	Overstrand (WC032)	BREEDE										
Palmiet	Overberg	Overstrand (WC032)	BREEDE										
Bot/Kleinmond	Overberg	Overstrand (WC032)	BREEDE										
Onrus	Overberg	Overstrand (WC032)	BREEDE										
Klein	Overberg	Overstrand (WC032)	BREEDE										
Uilkraals	Overberg	Overstrand (WC032)	BREEDE										
Ratel	Overberg	Cape Agulhas (WC033)	BREEDE										
Heuningnes	Overberg	Cape Agulhas (WC033)	BREEDE										
Klipdrifsfontein	Overberg	(WCDMA03)	BREEDE										
Breë	Overberg	Swellendam (WC034)	BREEDE										
Duiwenhoks	Eden	Hessequa (WC042)	GOURITZ										
Goukou	Eden	Hessequa (WC042)	GOURITZ										
Gourits	Eden	Hessequa (WC042)	GOURITZ										
Blinde	Eden	Mossel Bay (WC043)	GOURITZ										
Gericke	Eden	Mossel Bay (WC043)	GOURITZ										
Tweekuilen	Eden	Mossel Bay (WC043)	GOURITZ										
Hartenbos	Eden	Mossel Bay (WC043)	GOURITZ										
Klein Brak	Eden	Mossel Bay (WC043)	GOURITZ										
Groot Brak	Eden	Mossel Bay (WC043)	GOURITZ										
Maalgate	Eden	Mossel Bay (WC043)	GOURITZ										
Gwaing	Eden	George (WC044)	GOURITZ										

NAME	District Municipality	Local Municipality	CMA	Formal M/PA status	Ramsar status	Important Bird Area	Classification	Ecological Water Requirement (Reserve)	Resource Quality Objectives	Estuary Mananget Plan	Estuary Mouth Mananget Plans	Maintenance Mouth Management Plan	Fisheries Resource Management
Kaaimans	Eden	George (WC044)	GOURITZ										
Wilderness	Eden	George (WC044)	GOURITZ										
Swartvlei	Eden	Knysna (WC048)	GOURITZ										
Goukamma	Eden	Knysna (WC048)	GOURITZ										
Knysna	Eden	Knysna (WC048)	GOURITZ										
Noetsie	Eden	Knysna (WC048)	GOURITZ										
Piesang	Eden	Plettenberg Bay (WC047)	GOURITZ										
Keurbooms	Eden	Plettenberg Bay (WC047)	GOURITZ										
Matjies	Eden	Plettenberg Bay (WC047)	GOURITZ										
Sout (Oos)	Eden	Plettenberg Bay (WC047)	GOURITZ										
Groot (Wes)	Eden	Plettenberg Bay (WC047)	GOURITZ										
Bloukrans	Cacadu	Plettenberg Bay (WC047)	GOURITZ										

CHAPTER 4

PLANTS AND VEGETATION

4

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Scientific Services, CapeNature

CONTENTS

Executive Summary

CapeNature has not only a national, but international responsibility in conserving two of the world's six floral kingdoms. The greatest threats to the plant taxa are permanent habitat loss (including urban expansion, infrastructure development, and agricultural expansion), invasive alien plant species and habitat degradation. No additional extinctions have been recorded since 2012, the number of species listed at Critically Endangered has declined slightly (from 333 to 330) but there are significant increases in the Endangered and Vulnerable categories (from 575 to 636 and 801 to 900 respectively). These changes are largely due to habitat loss but illegal collecting and taxonomic revisions have also affected numbers.

Altogether 14 vegetation types have deteriorated in status due to habitat transformation from a range of competing land use pressures such as agricultural and urban expansion, industrial development, mining, renewable energy installations and coastal development.

Biodiversity within large areas of CapeNature reserves is threatened by too frequent fires. A flexible and adaptive management framework is required to effectively manage indigenous vegetation under this unpredictable threat. Thresholds for potential concern using appropriate monitoring still needs to be determined for a number of protected areas.

Six reserve clusters have extensive levels of plant invasion and therefore a risk of non-optimal biodiversity restoration exists. Prioritisation of areas for clearing are clearly identified according to objective criteria. Planned clearing projects need to strictly focus on these. Improvements and expansion of biological agent releases needs to be made. Minimal resources are required for this potentially highly effective control method.

We recommend that:

- continued rolling out and awareness of planning tools are necessary to ensure we aren't losing irreplaceable habitats;
- innovative ways of meeting the plant utilisation requirements whilst conserving source populations in Protected Areas are sought;
- thresholds of potential concern need to be identified for all reserves, supported by a long term monitoring and assessment programme;
- planning of IAP clearing projects strictly focus on the areas identified as priorities;
- formulation and implementation of an adaptive management framework for monitoring the impact of IAPs on biodiversity;
- pine management tools (e.g. herbicide) should be pursued to reduce spread; and
- biodiversity restoration, although vital, can be resource intensive, but investigation to explore options is feasible over the next period.

ERICA FASCICULARIS

1. Introduction

The Western Cape Province (WCP) includes most of the Greater Cape Floristic region. This region, which previously included the Cape Floristic Region and Succulent Karoo (Born *et al.*, 2007), is acclaimed for high levels of endemism and diversity of plant species and vegetation communities (Born *et al.*, 2007). CapeNature therefore has not only a national, but international responsibility in conserving two of the world's six floral kingdoms (Cape Floral kingdom and part of the Paleotropic kingdom). The greatest threats to the plant taxa in the WCP are permanent habitat loss (including urban expansion, infrastructure development, and agricultural expansion), invasive alien plant (IAP) species, climate change and habitat degradation (such as overgrazing and inappropriate fire regimes).

The primary mechanism for protection of floral diversity, and all the ecosystem services associated with this diversity, in the WCP is through maintaining the conservation estate and expanding it through stewardship (see Chapter 2). Protected areas face fewer threats than areas undergoing urban and agricultural expansion. In addition to expansion of the protected area network, CapeNature's focus for conserving plant diversity and ecosystem integrity has been on the alleviation of these threats.

The primary threats to plants and vegetation by far, are too frequent fires and invasive alien plants. Current efforts to address these are discussed in more detail below. Keeping track of the integrity of the WCP flora and the services it provides, is vital to know when conservation actions are required. Various monitoring projects for indigenous plant threat status and population surveillance, IAP management, thresholds for potential concern (identifying and responding to inappropriate fire regimes), and over-harvesting of species are therefore also discussed.

Methods for analyses are discussed under the respective sections and use similar techniques and tools as Le Roux *et al.*, (2012). An update of the systematic account is not included in this iteration. However, no significant changes in numbers of taxa and their endemic status have been noted. Please refer to Le Roux *et al.*, (2012) for statistics relating to systematics, distribution and endemism.

2. Conservation status of plants

2.1 Species conservation status

The first comprehensive plant Red List was produced in 2009, making South Africa the first mega-diverse country to assess its entire flora (Raimondo *et al.*, 2009). Currently, the Red List is updated regularly and the list is dynamic with changes being made when new information becomes available. These updates are made by SANBI's Threatened Species Programme team in collaboration with species experts and provincial agencies such as CapeNature. As can be seen in Table 1, there are significant changes towards increased levels of threat in the categories Endangered and Vulnerable. A large contributor to this increase has been habitat loss (mainly agriculture) in new areas (this is reflected in the Table 2).

In the 2017 update, 175 Western Cape species have changed status. Factors influencing increases in threat status include taxonomic revisions, illegal collecting and habitat loss. Increased and targeted fieldwork by a range of workers now coordinated through networks such as SANBI's CREW program using the Red List as an index has also resulted in numerous taxa being "downlisted" (a decrease in threat status) as well as "uplisted" due to better field knowledge.

Table 1: Changes to the South African Red List threat status of threatened indigenous plant species in the Western Cape over the past 5 years.

IUCN Threat status	2012	2017
Extinct	21	20
Extinct in wild	3	3
Critically Endangered and Presumed extinct	37	38
Critically Endangered	296	292
Endangered	575	636
Vulnerable	801	900

Table 2. Plant Species in the Western Cape which are of Conservation Concern but not yet threatened. (These categories were not listed in the 2012 report and are included as a baseline for the next report).

Threat status	2017
Near Threatened	323
Critically Rare	110
Rare	822
Data Deficient (Insufficient Information)	216
Data Deficient (Taxonomically Problematic)	563

A future trend to watch out for is the elevation of species in the Critically Rare (110) and Rare (822) (Table 2) categories into the threatened categories. These species are either known from a single site (Critically Rare) or meet at least one of the four South African criteria for rarity (see National Red List Categories section of redlist.sanbi.org) but are not exposed to any direct and plausible threat. With the proliferation of invasive alien plants and climate change related precipitation uncertainty, areas such as nature reserves, which were previously regarded as safe, are vulnerable unless additional resources are sourced and competently disbursed.

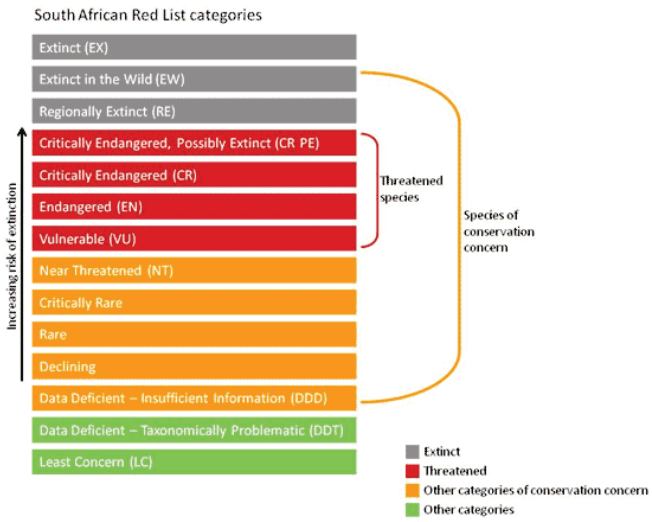

Figure 1: South African Red List categories indicating that threatened species are a subset of species that are of conservation concern. Source: SANBI Red List.

In total, there are 3 923 Species of Conservation Concern (SCC) in the Western Cape. Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD)." (SANBI 2017), see Figure 1. A full list of these species is available at http://redlist.sanbi.org/.

2.2. Vegetation conservation status

Since April 2013, CapeNature has had a conservation planner and this has enabled the organisation to have up to date conservation statuses for vegetation types. The last national update was in 2011 and according to the National Environmental Management: Biodiversity Act (No. 10 of 2004), the list must be reviewed at least every five years and this is now possible. CapeNature has thus been able to do updates in 2014 and 2016. As can be seen, rapid transformation of habitat occurred in several areas, leading to increased threat status. Results with status changes are in Table 2.

This section is to be read in conjunction with the 2012 SOB report (Le Roux *et al.* 2012), emphasis has been placed on the threatened ecosystems (Figure 2) as opposed to listing all vegetation types in the Western Cape as was done previously. Readers would notice that the figures of total hectares remaining for the various vegetation types from 2012 and 2017 do not match up. Like the Red List, the SA vegetation map is regularly updated with in-field information, improved spatial products and techniques contributing towards a more up to date understanding of the spatial extent of habitat.

Increased scrutiny of vegetation maps and detailed field observations mean that there are also new vegetation types, such as Peninsula Shale Fynbos, Nardouw Sandstone Fynbos and Citrusdal Shale Renosterveld (Dayaram *et al.*, 2016).

Interestingly, the latter two have immediately been recognised as threatened ecosystems as they occur in areas of the Western Cape where agricultural expansion in the last decade has been rapid.

Altogether 14 vegetation types have deteriorated in status due to habitat transformation (see highlighted in Table 2) from a range of competing land use pressures such as agricultural and urban expansion, industrial development, mining , renewable energy installations and coastal development (see Chapter 2).

Plate 1. Rooibos tea lands in Nardouw Sandstone Fynbos, a newly described vegetation type.

A further significant environmental quality erosion factor is the continuing problem posed by IAPs as they outcompete indigenous species, change nutrient regimes, abstract more water and provide a higher fuel load which leads to more intense fires.

As stated in Le Roux *et al.*, (2012) certain vegetation types are listed as threatened on "criteria D1 (threatened plant species associations). Ecosystems with naturally high levels of plant rarity and endemism (e.g. Kogelberg Sandstone Fynbos, Overberg Sandstone Fynbos and Peninsula Sandstone Fynbos) have now been listed as threatened, although much of their original extent remains intact." This listing is incredibly important as it highlights that the chances of locating SCC are very likely in these vegetation units.

A significant contribution towards conservation of several under-conserved threatened vegetation types* on the West Coast, has been through the multi-stakeholder Dassenberg Coastal Catchment Partnership (DCCP) which involves state agencies, NGOs and local communities. The area is notable not only for its endemic and rich flora (>300 threatened species out of >1 200 species) but also for the contribution towards regional water security and connectivity which will act as a backbone to the area's climate change resilience. The region has a high proportion of unemployed inhabitants

*Swartland Shale Renosterveld (CR), Swartland Granite Renosterveld (CR), Atlantis Sand Fynbos (CR D1), Swartland Silcrete Renosterveld (CR) and Cape Flats Dune Strandveld (EN)

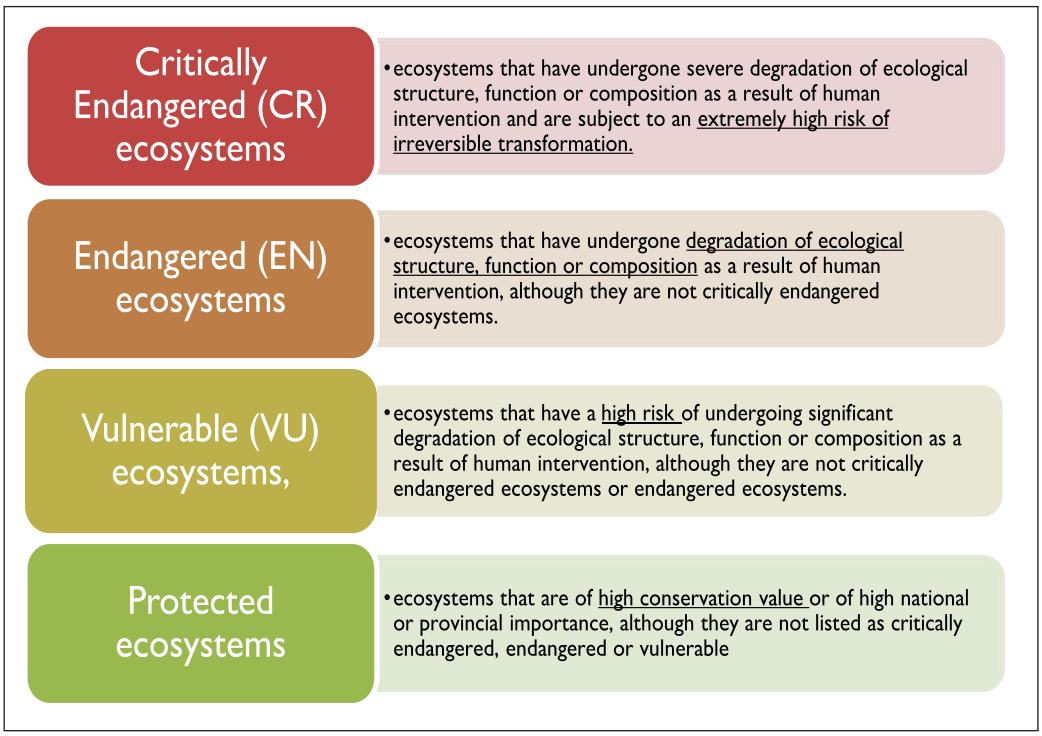

Figure 2: Definitions of threat status for ecosystems.

and there are significant socio-economic opportunities in the restoration and maintenance of the natural resources of the DCCP area. To date about 2 700 ha is being managed as Protected Areas by the City of Cape Town, with a further 7 000 ha being managed by CapeNature in the Ganzekraal/Mamre area. These areas are in various stages of declaration and there is still significant chance of consolidation towards the "Dreams for the Dassenberg" vision of a continuous conservation corridor from Riverlands Nature Reserve to the coast as envisioned in the 1995 eponymous Kilian report.

3. Threats to plant species and communities

3.1 Habitat Loss

The major driver of biodiversity loss in the Western Cape remains the permanent transformation of natural vegetation for development purposes. Please refer to Chapter 2 of this report for details of these changes.

3.2 Climate Change

Whilst mentioned in the 2012 report as a concern, recent research has been able to begin to quantify impacts at a species (White *et al*., 2016) and ecosystem level (Slingsby *et al*., 2017). The Critically Endangered Clanwilliam Ceder (*Widdringtonia cederbergensis*) has experienced a constant decline which has not been arrested by the declaration of the Cederberg Wilderness area in 1973. Increased temperatures and shorter fire return intervals associated with climate change induced precipitation variability (and subsequent drought) are the main drivers in adult tree mortality and reduced seedling recruitment and establishment (White *et al.,* 2016).

At an ecosystem level, the long term plot monitoring work at the Cape Point section of Table Mountain National Park (the initial plots laid out and recorded by Hugh Taylor in 1966, resurveyed by Sean Privett and team in 1996 and again by Slingsby *et al.,* (2010)), has produced sobering results. Weather records indicated a >1°C increase in temperatures as well as an increase in the duration of hot dry summer weather. Extended extreme summer conditions had a noticeable impact on fynbos species recruitment in the first year after fire, with a pattern of sensitive species with a low tolerance to high temperatures disappearing and being replaced by more temperature tolerant species. Additionally, the study found a lag effect attributable to previous woody IAP infestations (Slingsby *et al*., 2017). This lends urgency to CapeNature's IAP management efforts, as Cape Point has had a good track record of IAP removal and affected areas have been clear for more than 30 years.

These results are concerning for the rest of the Province, as Cape Point as a peninsula has access to the cooling effects of the Atlantic. As an example, the Swartland and Greater West Coast region have increases of mean annual temperature of 1.5-3°C predicted by the middle of the century (WCDoA and WCDEA&DP 2016). As shown by the Clanwilliam Ceder, already range-restricted species in sensitive habitats (such as high altitude wetlands) are likely to struggle under these conditions and the identification of a subset of such "indicator species" for monitoring is a priority that will be addressed in the next year. This is a bleak forecast for a region already in the grips of a historic drought. Innovation and adaptation will be required in order for livelihoods dependent on natural resources such as agriculture to persist and be successful into the future.

Table 2: A list of the threatened terrestrial ecosystems of the Western Cape and their protection levels relative to conservation targets. Changes in vegetation threat status are highlighted in yellow and new vegetation types highlighted in blue

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
Agulhas Limestone Fynbos	29438	100	29438,3	23626,59	80,3	32	39,59	VU (D1)	VU (D1)			
Agulhas Sand Fynbos	23046	100	23045,5	9169,69	39,8	32	23,66	EN	EN			
Albertinia Sand Fynbos	70770	100	70755,5	38124,23	53,9	32	20,39	VU	VU			
Atlantis Sand Fynbos	69833	100	68831,2	26556,48	38,6	30	11,56	CR (D1)	CR (D1)			
Bokkeveld Sandstone Fynbos	136140	39	44862,1	35219,12	78,5	29	3,76	VU (D1)	VU (D1)			
Boland Granite Fynbos	49906	100	52093,1	27055,32	51,9	30	88,46	VU	VU			
Breede Alluvium Fynbos	51044	100	50155,8	18402,78	36,7	30	10,61	EN	EN			
Breede Alluvium Renosterveld	49813	100	49757,2	21199,70	42,6	27	3,40	VU	EN	more threatened	VU-EN	2016
Breede Sand Fynbos	9275	100	9765,5	4529,93	46,4	30	6,17	VU	VU			
Cape Flats Dune Strandveld	42426	100	39002,7	15283,27	39,2	24	75,12	EN	EN			
Cape Flats Sand Fynbos	54584	100	55924,9	2492,57	4,5	30	5,46	CR	CR (A1 & D1)			
Cape Lowland Alluvial Vegetation	35821	100	35907,8	8136,12	22,7	31	4,94	CR	CR			
Cape Vernal Pools	20	95	19,4	6,06	31,2	24	0,00	EN	EN			
Cape Winelands Shale Fynbos	8570	100	8497,9	3983,98	46,9	30	99,11	VU	VU			

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
Cederberg Sandstone Fynbos	244854	100	251211,9	220868,57	87,9	29	200,94	VU (D1)	VU (D1)			
Central Ruens Shale Renosterveld	201063	100	201095,7	8781,38	4,4	27	0,74	CR	CR			
Ceres Shale Renosterveld	49162	100	49161,7	21561,60	43,9	27	5,22	VU	VU			
Citrusdal Shale Renosterveld		3636,6	24	872,8	0,00	new					new	
Eastern Coastal Shale Band Vegetation	7824	18	1409,1	736,37	52,3	27	161,26	VU	VU			
Eastern Little Karoo	155495	100	155495,1	120340,93	77,4	16	4,15	VU	VU			
Eastern Ruens Shale Renosterveld	276902	100	276995,4	29580,21	10,7	27	1,29	CR	CR			
Elgin Shale Fynbos	27946	100	27947,1	3226,28	11,5	30	32,51	CR	CR			
Elim Ferricrete Fynbos	66528	100	66528,4	16694,06	25,1	30	10,38	CR	CR			
Garden Route Granite Fynbos	43160	100	43045,4	9649,80	22,4	23	1,58	EN	CR	more threatened	EN-CR	2014
Garden Route Shale Fynbos	56633	93	52676,2	19865,66	37,7	23	15,73	VU	EN	more threatened	VU-EN	2016
Greyton Shale Fynbos	26884	100	26651,9	10104,70	37,9	30	22,52	EN	EN			
Groot Brak Dune Strandveld	20277	100	20060,3	9102,67	45,4	36	2,46	EN	EN			

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
Hangklip Sand Fynbos	8121	100	8689,1	3870,88	44,5	30	74,17	EN	EN			
Hawequas Sandstone Fynbos	105105	100	105052,8	100394,29	95,6	30	293,75	VU (D1)	VU (D1)			
Hopefield Sand Fynbos	179882	100	97682,8	55343,56	56,7	30	26,05	VU	VU			
Kango Limestone Renosterveld	50177	100	50177,0	39051,90	77,8	29	9,40	VU	VU			
Knysna Sand Fynbos	15370	100	15354,6	1478,52	9,6	23	14,26	CR	CR			
Kogelberg Sandstone Fynbos	91530	100	91425,9	73478,03	80,4	30	243,60	CR (D1)	CR (D1)			
Kouebokkeveld Alluvium Fynbos	18002	100	18001,7	4908,74	27,3	29	12,62	EN	CR	more threatened		
Kouebokkeveld Shale Fynbos	42791	100	42790,7	20921,33	48,9	29	59,33	VU	VU			
Lamberts Bay Strandveld	45156	100	70614,4	35218,52	49,9	24	18,15	LT	VU	more threatened		
Langkloof Shale Renosterveld	20715	72	14939,2	1783,97	11,9	29	0,00	CR	CR		LT-VU	2014
Leipoldtville Sand Fynbos	275679	100	197756,4	80838,72	40,9	29	1,61	VU	EN	more threatened		
Lourensford Alluvium Fynbos	5529	100	3547,2	137,02	3,9	30	0,80	CR	CR			
Montagu Shale Renosterveld	163657	100	160673,7	123668,67	77,0	27	28,58	VU	VU			
Mossel Bay Shale Renosterveld	79589	100	79588,8	30977,24	38,9	27	0,72	EN	EN			

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
Muscadel Riviere	42238	100	41793,4	7532,71	18,0	16	3,64	CR	EN			
Nardouw Sandstone Fynbos		36665,3	24	8799,7	0,00	new						
Overberg Sandstone Fynbos	116903	100	116853,0	95847,62	82,0	30	33,25	CR (D1)	CR (D1)			
Peninsula Granite Fynbos	8869	100	9290,1	3112,67	33,5	30	96,98	CR	CR			
Peninsula Sandstone Fynbos	23268	100	21870,1	19985,30	91,4	30	261,78	EN (D1)	EN (D1)			
Peninsula Shale Fynbos	New Vegetation Type		1263,4	558,02	44,2	24	201,30		VU	more threatened	LT-VU	2016
Peninsula Shale Renosterveld	2972	100	2418,7	242,17	10,0	26	35,48	CR	CR			
Piketberg Quartz Succulent Shrubland		282,4	26	73,4	0,00	more threatened					VU-CR	2014
Piketberg Sandstone Fynbos	46053	100	41510,4	36329,42	87,5	29	5,91	VU (D1)	VU (D1)			
Potberg Ferricrete Fynbos	4046	100	4046,1	1473,08	36,4	30	15,54	EN	EN			
Ruens Silcrete Renosterveld	20970	100	20970,3	1904,32	9,1	27	1,18	CR	CR			
Saldanha Flats Strandveld	76097	100	158617,9	54632,09	34,4	24	22,78	VU	EN	more threatened	VU-EN	2014
Saldanha Granite Strandveld	23503	100	27704,2	7564,83	27,3	24	39,46	EN	EN			

Vegetation Unit	Total ha of vegetation Unit / Threatened Ecosystem in SA 2012	% of Vegetation Unit / Threatened Ecosystem in WCP	2017 Original Extent Threatened Ecosystem in WCP	2017 ha remaining Threatened Ecosystem in WCP	2017 % remaining Threatened Ecosystem in WCP	WCP Conservation target as a %	WC_Ecosystem Protection Levels as a % of conservation target	Ecosystem threat status 2012 SOB	CapeNature Endangered Ecosystem Threat Status 2016	Change	Status Change	Year Changed
South Outeniqua Sandstone Fynbos	157386	100	157281,6	87197,11	55,4	23	159,65	LT	VU	more threatened	LT-VU	2014
Southern Cape Dune Fynbos	18644	47	8535,1	4839,01	56,7	36	130,30	LT	VU	more threatened	LT-VU	2016
Southern Cape Valley Thicket	17732	100	17730,0	10411,34	58,7	19	5,48	LT	VU	more threatened	LT-VU	2016
Swartland Alluvium Fynbos	46987	100	46541,0	12340,14	26,5	30	28,39	CR	CR			
Swartland Alluvium Renosterveld	6253	100	6309,6	2826,97	44,8	26	0,00	VU	VU			
Swartland Granite Renosterveld	94785	100	95397,0	10829,26	11,4	26	1,44	CR	CR (A1 & D1)			
Swartland Shale Renosterveld	494712	100	495223,5	31360,10	6,3	26	2,65	CR	CR (A1 & D1)			
Swartland Silcrete Renosterveld	9989	100	10124,6	658,32	6,5	26	0,78	CR	CR			
Swellendam Silcrete Fynbos	86785	100	86785,4	38023,54	43,8	30	16,01	VU	EN	more threatened	VU-EN	2016
Uniondale Shale Renosterveld	134130	53	71013,3	43172,36	60,8	29	0,49	LT	VU	more threatened	LT-VU	2014
Western Ruens Shale Renosterveld	118997	100	118997,0	7939,39	6,7	27	1,59	CR	CR			

3.3 Illegal and uncontrolled collection of material

Petersen *et al.* (2014) estimated that 279 tons of biological material are being extracted from Western Cape wild lands for traditional medicine use every year, with the majority of that figure being plant material. Unpermitted harvesting of cut flowers and valuable species such as honeybush tea are also prevalent. Additionally, threatened species are targeted by overseas collectors e.g. the 2015 arrest, sentencing and substantial fine of a Spanish couple was a high profile success for law enforcement and example of the meticulous preparation and scale of international trade in the endemic species of the Western Cape. Innovative ways of meeting these utilisation requirements whilst conserving source populations in Protected Areas are being sought.

3.4 Flawed fire regimes

By far the majority of the protected areas that CapeNature manage are located in mountain catchments where fynbos and transitional shrublands abound. As fynbos is a fire-driven ecosystem, all fynbos species are adapted to and dependent on periodic fires to maintain species richness and stimulate regeneration. Consequently, fires have a major influence on the composition of plant communities in fynbos. Variation in the intervals between successive fires, season of fires, intensity and fire size (i.e. the fire regime) can have significant influences on the species composition of fynbos (Bond, 1980, 1984; Bond *et al.,* 1984; Bond and Van Wilgen, 1996; Van Wilgen, 1981; Esler *et al.,* 2014; Kraaij and van Wilgen, 2014). Particularly, recurrent short-interval fires that occur before non-sprouting (often referred to as 'reseeders') species have matured and set seed can eliminate these species from the vegetation and cause dramatic structural changes in communities (van Wilgen, 1982; Kraaij and van Wilgen, 2014; Esler *et al.,* 2014). It has also been shown that increased fire frequency can benefit sprouting species (often referred to as 'resprouters') and that increases in resprouters lead to overall decreases in plant diversity (Vlok and Yeaton, 1999, 2000; Esler *et al.*, 2014) due to them out-competing reseeding species. Research results have suggested that when the sprouting species take over in abundance, it will have a negative impact on the water yield from the area. It is thus vital to retain tall, non-sprouting species of *Protea* and *Leucadendron* in fynbos, to keep high densities of sprouters at bay and to ensure that a high water run-off is maintained over a longer period after fire.

Figure 3 shows the areas within and adjacent to CapeNature-managed protected areas that have burnt twice (or more times) during the past 17 (indicated in blue), 12 (indicated in orange) and 7 (indicated in red) years. In the background all the recorded historic fires are mapped (in grey), indicating the 'burnable' veld. The large areas that have burnt repeatedly during these periods are alarming – particularly those that burnt twice in 12 and 7 years. The Cedarberg, Grootwinterhoek, Hexrivier, Boland Mountain, Riviersonderend and Swartberg World Heritage Site Complexes and Driftsands Nature Reserve have been subjected to such fires. Many of the areas that burnt twice during the last 12 years, had fire intervals of 5, 6, 7 or 8 years. Areas that burnt twice during the last 17 years had intervals of 9 – 13 years, and those that burnt twice during the last 7 years had intervals of (2-) 3-5 years.

An analysis of the fire regimes in fynbos protected areas of the Western Cape found that short-interval fires (≤6 years) are becoming more frequent and that there is some evidence that they are becoming larger (van Wilgen and Forsyth 2008a). In a study focussed on the fire history of the Boland area, Schutte-Vlok *et al.* (2012) found that there has been an increase in the number and sizes of fires over a 60 year period (1952-2011); that most fires were human-induced and that more than 80% of the area burnt every 10 years since 1992.

There is great concern about the ecological impacts of these repeated short interval fires. From a conservation point of view such fires are undesirable, as they may have a negative effect on populations of reseeding plant species because these species would not have adequate time to mature and set seed between fires (Van Wilgen, 2013). As the organisation mandated to promote and ensure biodiversity conservation in the Western Cape Province, CapeNature has to manage and monitor the effects of fires on biodiversity.

Efforts are underway to set the thresholds of potential concern for fire return interval for all catchment protected areas. Where they occur, slow-maturing obligate reseeding *Protea* species are used as indicator species for this purpose. Where possible, permanent *Protea* plot monitoring is being implemented to determine the juvenile periods of indicator species as a measure of minimum fire return interval. Furthermore, post-fire parent-seedling ratio monitoring of *Protea* indicator species is being done to determine the success of seedling recruitment after fire. Once thresholds of potential concern have been set, monitoring is implemented to assess whether these thresholds are being approached or exceeded. If so, management actions need to be identified and implemented to address this (Kraaij and van Wilgen, 2014).

Surveys have been undertaken in the Boland area to determine the thresholds of potential concern for fire return interval, through collection of permanent and post-fire *Protea* data. Kruger and Lamb (1978) suggested that the minimum interval between fires should be equivalent to the time needed for at least 50% of the individuals in a population of the slowest-maturing reseeding species to have flowered and set seed three times. Monitoring data collected in the Boland area show that *Protea repens* reaches the ecological threshold at year 10, based on the Kruger and Lamb (1978) rule of thumb method, while *Protea neriifolia* reaches the threshold at around 13+ years, and *Protea laurifolia* and *Protea lepidocarpodendron* at 12+ years (Schutte-Vlok *et al.,* 2012). However, for *Protea stokoei*, a slow-maturing species endemic to the Boland Area and restricted to high altitudes, the ecological threshold for fire return interval

(or fire frequency) is recommended at 17 years. This species is listed as Endangered in the Red List of South African Plants due to continuing declines in populations being recorded as a result of incorrect fire regimes, fire belt clearing and wild flower harvesting (Raimondo *et al.* 2009). Some populations of this species have been lost as a result of too frequent fires. Data collection in the Boland area is currently focussed on trying to refine the set thresholds especially in veld older than 12 years. Lack of data for this period is mainly due to the fact that there is very little veld that gets older than 9-10 years.

The map in Figure 3 clearly highlights the protected areas that need focussed action because of the occurrence of repeated short-interval fires. Predictions are that weather conditions conducive to the initiation and spread of fires will increase with global climate change (Kraaij and van Wilgen 2014). Although the adaptive management approach has been adopted in CapeNature, its implementation require a high and sustained level of support and commitment to carry out long-term monitoring and assessment programs.

Both operational and ecological thresholds need to be set to inform management. Operational thresholds investigate the proportional area occupied by different post-fire age classes, or the proportion of area burnt at different fire return intervals over the past few decades. Each age class or fire return interval class is assigned upper and lower thresholds. Exceeding these thresholds would trigger management action to bring the system back within thresholds (Kraaij and van Wilgen 2014). Ecological thresholds, as mentioned earlier, are based on data collected on selected indicator species (e.g. determining the proportion of populations that have flowered three or more seasons, proportions showing signs of senescence or trends in population size). If an ecological threshold is exceeded, steps need to be implemented to address the undesirable condition. As such, management would be adaptive because actions would be informed by new insights based on monitoring and assessment data (Kraaij and van Wilgen 2014).

3.5 Invasive Alien Plants

In the light of the serious water shortages and consequent regulatory restrictions in the Western Cape, the benefit of clearing invasive alien plants from water catchment areas is obvious. Invasive alien plants also pose the second largest threat to biodiversity in the province, after habitat destruction (Le Roux *et al.,* 2012). Information to adequately answer whether control measures are achieving progress against IAPs, is still not available for the entire province. Often progress is measured differently according to the outcomes desired. Some of these are biodiversity restoration, improved catchment water yield or simply a reduction in density and area occupied by IAPs. This further complicates the collation of data across the province. Since resources to address IAPs are limited, we discuss the prioritisation of areas to clear on reserves to achieve outcomes in terms of several criteria.

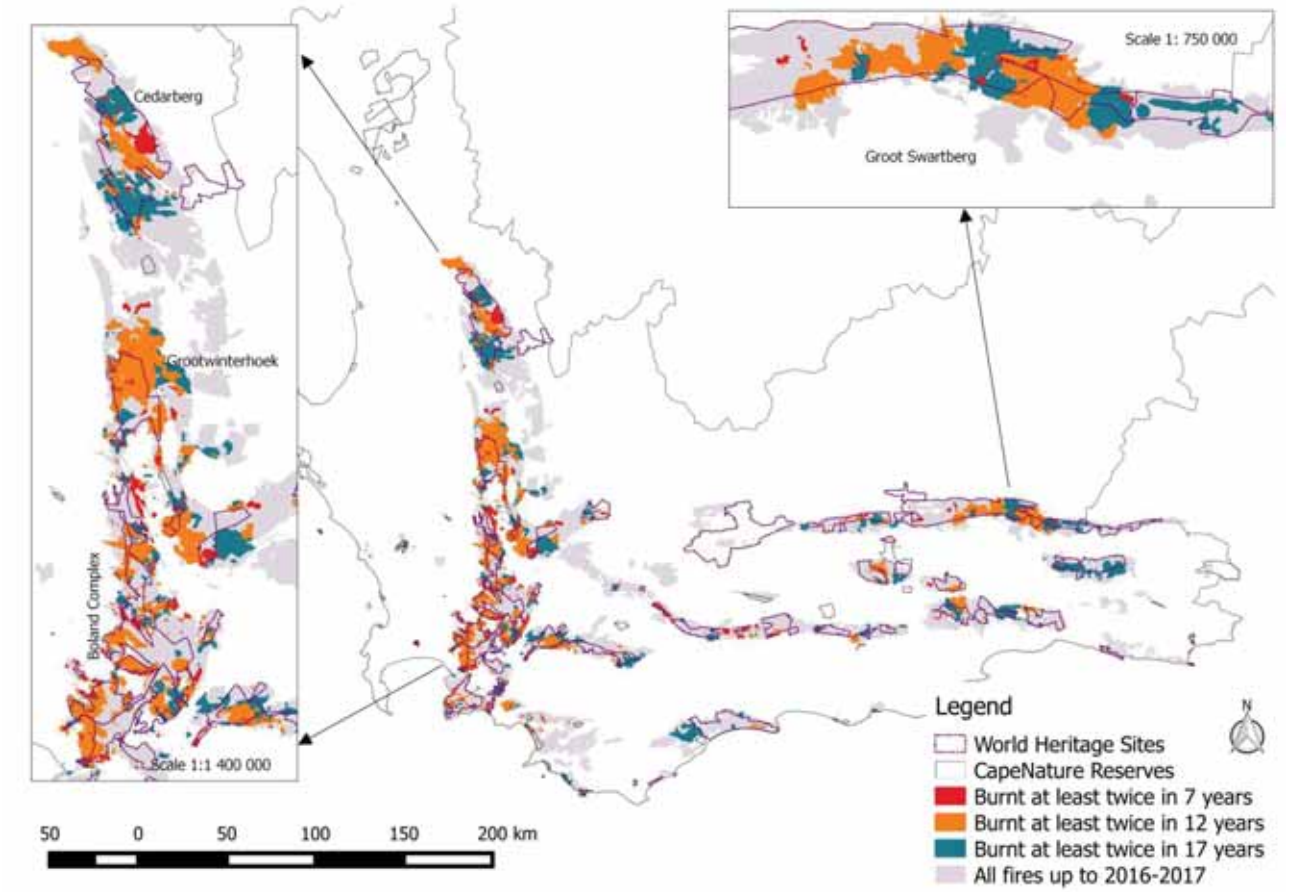

Figure 3: Areas within and adjacent to CapeNature managed World Heritage Sites and Nature Reserves that have burnt twice or more during the last 17 (in blue), 12 (in orange) and 7 (in red) years. All recorded historic fires are also shown (in grey), which indicates the 'burnable' veld.

Pines, *Acacia* and *Hakea* species are the major invaders on CapeNature reserves, but some areas have up to 27 recorded invasive species. Table 3 provides a breakdown of IAP infestation across the reserve clusters. Management of these species occurs via mechanical, chemical, biological control or a combination of these. It has often been stated that we need to take advantage of wild fires as a means to control and deplete seedbanks of invasive species, but thus far the ability to adapt within a short window period, has been mostly lacking. Strydom *et al.,* (2017) showed that for some *Acacia* spp., seed feeding biological control agents are not effective in reducing seedbanks in dense stands and recommended once again that mechanical clearing be conducted shortly after fire-stimulated recruitment events. Biocontrol is still, however, the most cost effective means of control (van Wilgen *et al.,* 2012) and while some releases of biological control agents has taken place on CapeNature reserves, monitoring of these populations and further releases need to be conducted to capitalise on the "best bang for your buck" control method. We have also requested a quantitative risk assessment of releasing a seed-feeding weevil for Mediterranean cluster pines (*Pinus pinaster*) in the WCP (see CapeNature Research Requests web page).

We are also investigating the possibility of applying highly directed streams of herbicide to the stem bark of pine trees from a helicopter which has provided a cost-effective means of controlling low density and difficult to reach pines in New Zealand (Gous *et al.*, 2014). This method requires careful evaluation of applicability in WCP conditions and research has also been requested to address this.

4. Responses to the threat of invasive alien species

4.1 Plant restoration after clearing (and secondary invasions)

Restoration of indigenous plant communities after clearing IAPs is a primary goal for CapeNature. Successful restoration in reserve clusters with extensive levels of invasion (Table 3) is particularly at risk. Fill *et al.* (2017a) found that vegetation recovery via passive restoration is not adequate to restore sites to reference diversity and canopy cover in a study in the Berg catchment where mainly pines are invasive. Galloway *et al.* (2017) showed that recovery potential was linked to the severity of the impacts caused by pines. CapeNature supports their recommendations that pine plantations be felled before it reaches 30 years old to improve native species recovery potential and ensure that indigenous seed banks are not depleted. Given these findings and the paucity of suitable long term data to monitor progress of IAP clearing in terms of desired outcomes, it is now essential that CapeNature implement monitoring and evaluation strategies and policies that would allow for adaptive management, hereby allowing for the optimisation of responses in dynamic conservation settings. The focus from here on will be on measuring the impact that IAP management has on indigenous biodiversity.

Successful indigenous vegetation recovery may be impeded by secondary plant invasions which can happen when changes in succession stage occur (e.g. fire, clearing) and invasive species are released from the competition pressures from primary invaders. Fill *et al.* (2017b) found that alien grass species invaded the cleared areas at Rondegat in the Cederberg. To maintain gains, sustained funding and the ability to adapt management decisions to treat secondary invaders, is necessary. A constraint is therefore that the national funding agency (WfW) only addresses a predetermined list of invasive species, overlooking other species. Innovative approaches will be needed to address secondary invasion as the success of clearing campaigns within current financial constraints depends on tightening the focus on certain species the focus should be on pine and hakea species (Van Wilgen *et al.* 2016).

Several lesser known invasive species have been recorded in the Western Cape recently. Vigilance and adaptive management is required to deal with these promptly when found in or near CapeNature reserves. These species are often misidentified, assumed indigenous or overlooked allowing spread and risk of primary or secondary invasion (Jacobs *et al.* 2017).

4.2 Water yield improvement

Another primary goal of IAP clearing is the improvement of catchment water yield. The Western Cape is currently experiencing its worst drought since 1904 and was declared a disaster zone in May 2017. There are high densities of invasive alien trees in the catchment area, particularly of *Pinus* spp. The impact of these invasive alien trees was reported on through a study done on the Western Cape Water Supply System (WCWSS) by Aurecon (Görgens and Howard, 2016). Theewaterskloof Dam supplies about 40% water to the City of Cape Town and many surrounding agricultural areas and smaller towns. The catchment area of the dam is a mountainous area with a very high recorded rainfall average of up to 3 000 mm per annum.

The reduction in streamflow to the Theewaterskloof Dam due to invasions were simulated and captured into the WCWSS yield model. The model was generated for various scenarios; whether clearing was done or not (Görgens and Howard, 2016). It was determined that the current invasion reduces the water supply by 38 million m^3 per annum, which is equivalent to the full capacity of the Wemmershoek Dam. Should no clearing be done, the reduction in water supply in 45 years will be 130 million m^3 per annum. This is equivalent to the full capacity of the Berg River Dam (Görgens and Howard, 2016). The WCP simply cannot afford these losses of water. Reduction of IAP density and invaded area dare iscussed below for IAPs on CapeNature reserves.

4.3 Invasive species management plans

Invasive Species Control (ISC) plans are required according to section 76 of the National Environmental: Biodiversity Act, 10 of 2004, (NEMBA), and the Alien and Invasive Species (AIS) Regulation and Lists (Oct 2014). This ISC plan must contain a status report on (i) the current measures to monitor control efforts and the eradication of invasive species, as well as (ii) indicators on measuring progress and success. CapeNature is currently formulating these plans in accordance with the legislative requirements, while at the national scale, the first status report is being compiled and should be published later this year.

NEMBA Sections 75 and 76 are very specific in terms of who must develop these Invasive Species Monitoring, Control and Eradication Plans, what the plans must include and how they should be implemented, i.e.:

4.4 Control and eradication of listed invasive species

75.

(1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.

(2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.

(3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

(4) The Minister must ensure the coordination and implementation of programmes for the prevention, control or eradication of invasive species.

(5) The Minister may establish an entity consisting of public servants to coordinate and implement programmes for the prevention, control or eradication of invasive species.

4.5 Invasive species control plans of organs of state

76.

(1) The management authority of a protected area preparing a management plan for the area in terms of the Protected Areas Act must incorporate into the management plan an invasive species control and eradication strategy.

(2) (a) All organs of state in all spheres of government must prepare an invasive species monitoring, control and eradication plan for land under their control, as part of their environmental plans in accordance with section 11 of the National Environmental Management Act. "

(b) The invasive species monitoring, control and eradication plans of municipalities must be part of their integrated development plans.

(3) The Minister may request the Institute1 to assist municipalities in performing their duties in terms of subsection (2).

(4) An invasive species monitoring, control and eradication plan must include -

(a) a detailed list and description of any listed invasive species occurring on the relevant land;

(b) a description of the parts of that land that are infested with such listed invasive species;

(c) an assessment of the extent of such infestation;

(d) a status report on the efficacy of previous control and eradication measures

(e) the current measures to monitor, control and eradicate such invasive species; and

(f) measurable indicators of progress and success, and indications of when the Control Plan is to be completed."

4.6 Prioritisation and control of Invasive Alien Plants on CapeNature reserves

The available resources to address IAPs cannot fully meet the requirements to restore all protected areas to a pristine state. Therefore funding needs to be prioritised in order to maximise beneficial ecological outcomes and efficiency in resource allocation.

Mapping of IAP and clearing are done according to reserve centres. A reserve centre often includes the adjacent mountain catchment areas. These reserve centres are divided into compartments/NBALs (Natural Biological Alien) and referred to only as compartments from here onwards. The boundaries of the compartments were established using natural features, including river streams, mountain ridges, trails, and roads. The sizes of the compartments were determined by the level of invasion. The compartments were given NBAL numbers as assigned by the Working for Water Information Management System.

For each of these compartments, baseline data was collected for the five dominant IAPs occurring in each compartment. This layer are referred to as the "IAP wall2wall map". The first map was compiled in 2010 and have been updated annually. The most recent survey done at the time of this report was in 2016 (Figure 4). The estimated percentage cover of each dominant IAP species in each compartment was captured in collaboration with experienced reserve staff, using a range of products, including high-resolution satellite imagery, aerial photography, and GoogleEarth. In some cases, where there was uncertainty about the estimates, they were verified in the field.

The IAP clearing of the compartments are prioritised using results of scientific studies and expert knowledge. A priority list of IAP species were developed during comprehensive expert workshops using decision-weighting software (Van Wilgen *et al.*, 2008b, Forsyth *et al.*, 2009). The two top species listed as priority were *Pinus* spp. and *Acacia mearnsii* (black wattle), based on the extent of invasion and impact on water resources. Even though *Hakea* spp. is also widely distributed, it received a lower priority because biological control is available for these species. For clearing prioritisation on CapeNature

Table 3: Levels of infestation of invasive alien plants (IAPs) on CapeNature Reserve clusters. Invasion level cut-offs follow Blackburn *et al.* (2014). Some taxa were not identified to species level, e.g. *Eucalyptus* sp., *Pinus* sp., *Quercus* sp. In these cases, the number of IAP species per reserve cluster may be underestimated.

Reserve cluster	IAP infestation (Condensed area (ha))	% of area infested	Invasion level	Number of IAP species
Anysberg	1754.4	2.6	Minor	18
Cederberg	1451.6	1.4	Minor	20
Dassenberg	21.7	7.8	Moderate	4
De Hoop	8216.3	25.9	Extensive	16
De Mond	0.5	0.0	Minimal	3
Driftsands	93.9	10.5	Moderate	5
Dyer Island	-	0.4	Minimal	-
Gamkaberg	169.6	0.2	Minimal	18
Ganzekraal	1213.7	19.4	Moderate	5
Genadendal (Riviersonderend)	3816.1	5.0	Minor	12
Geelkrans	504.0	40.3	Extensive	4
Goukamma	117.1	5.5	Moderate	6
Grootvadersbosch	17782.2	27.9	Extensive	11
Grootwinterhoek	449.6	0.9	Minor	15
Hottentots Holland	9716.8	27.6	Extensive	11
Jonkerhoek	4225.7	25.4	Extensive	17
Kammanassie	596.8	1.2	Minor	3
Keurbooms	1.7	0.2	Minimal	6
Kogelberg	2182.4	4.4	Minor	27
Knersvlakte	803.4	0.7	Minor	7
Limietberg	9045.1	9.6	Moderate	18
Marloth	2725.3	8.2	Moderate	10
Matjiesrivier	748.1	2.0	Minor	21
Outeniqua	8687.6	19.0	Moderate	13
Riverlands	363.9	21.2	Moderate	10
Robberg	0.4	0.3	Minimal	2
Rocherpan	0.2	0.0	Minimal	5
Swartberg	776.8	0.4	Minimal	20
Vrolijkheid	16.0	0.8	Minor	4
Waterval	6732.0	12.1	Moderate	19
Walker Bay	2171.2	34.7	Extensive	11

reserves, *Prosopis* spp. were used for reserves in drier areas, such as Anysberg and Knersvlakte. General principles of efficient clearing were also incorporated, such as clearing from sparse to dense and effectively integrating IAP clearing and fires.

The single biggest factor for CapeNature was cost of clearing, which is determined by clearing method. The following criteria are driving prioritisation once veld age maps and IAP density maps are integrated:

- Taking on areas straight after a fire while non-mechanical and non-chemical clearing methods can be used, which are cheaper,
- Clearing areas before they can set seed,
- Clear older veld where the risk of wild fires occurring is increasing.
- Different criteria were set for the different IAP species.

In addition to the densities and veld age criteria, accessibility was also considered. The accessibility directly affect the costs of clearing. Accessibility is determined by slope (the steeper the slope, the more specialised the teams must be and thus the more expensive the clearing) and the walking distance to the site. Sites within 3 km of a road were given higher priorities because that is the approximate distance the clearing teams can manage to walk in two hours with equipment in rough terrain.

The IAP clearing prioritisation maps (Figure 5) are then generated to support the compilation of annual plan of operation for clearing. These maps are generated annually using the annual updated IAP wall2wall densities map and the annual veld age map.

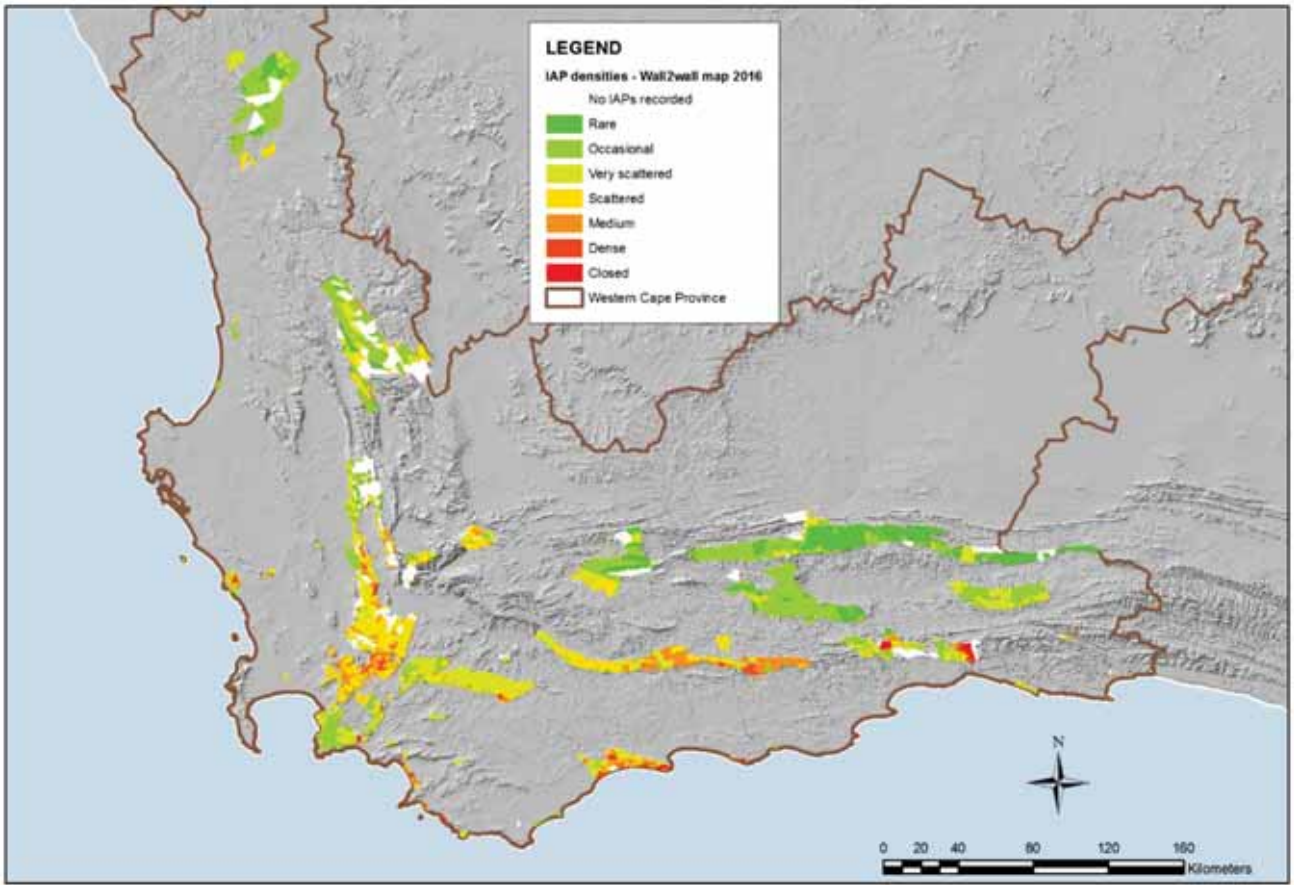

Figure 4. Invasive alien plants (IAP) densities mapped in 2016 for the land managed by CapeNature in the Western Cape Province. The densities are indicated using the seven standard categories used by Working for Water (WfW).

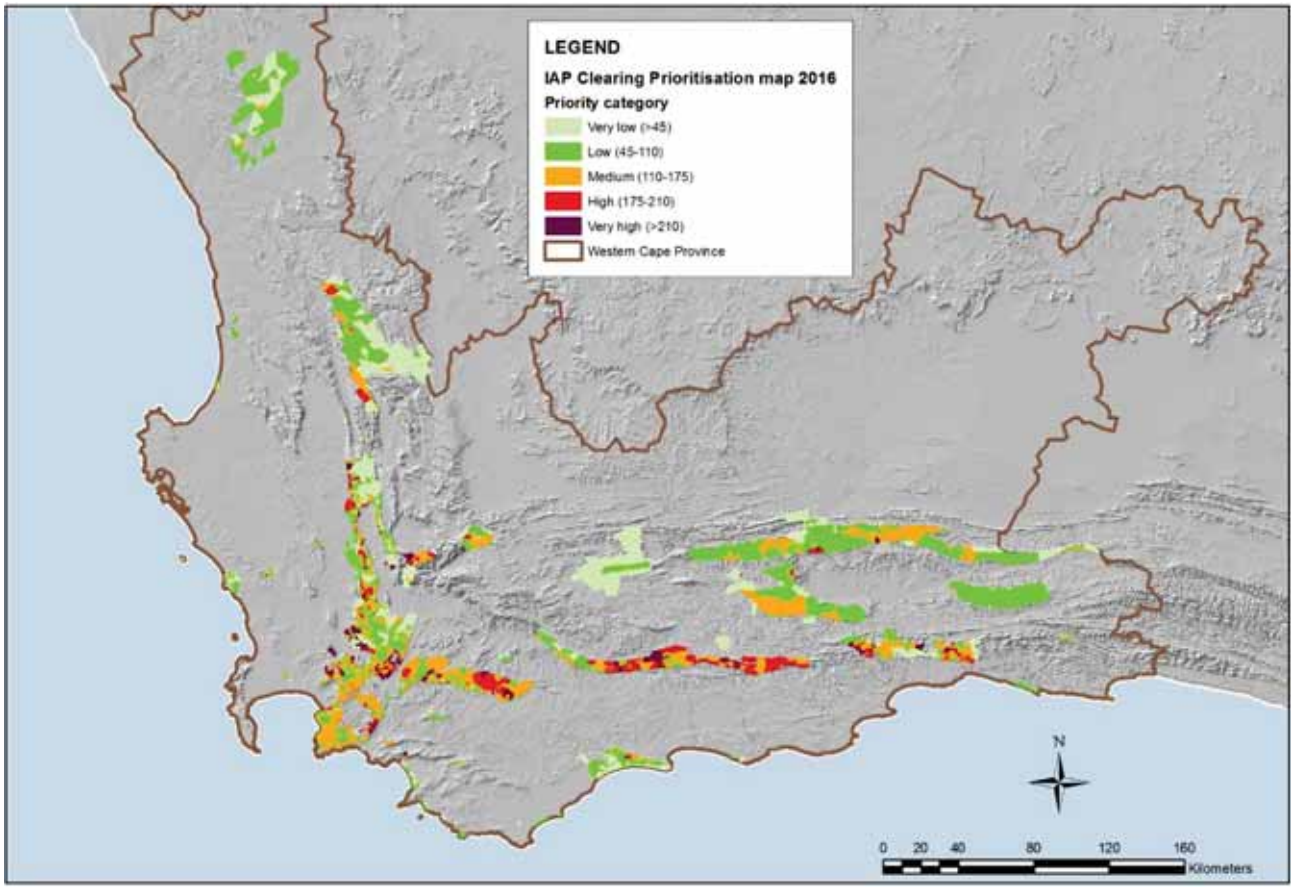

Figure 5. Invasive alien plants (IAP) clearing prioritisation map for 2016 for the land managed by CapeNature in the Western Cape. The clearing priorities are indicated using five categories. These annual IAP wall2wall maps over a period of six years can now be used to illustrate efficacy of clearing by subtracting the recorded IAP densities from each other (Figure 6). However, this analysis does not replace the need for a scientifically rigorous study on assessing the impact of IAP densities on biodiversity at a reserve level.

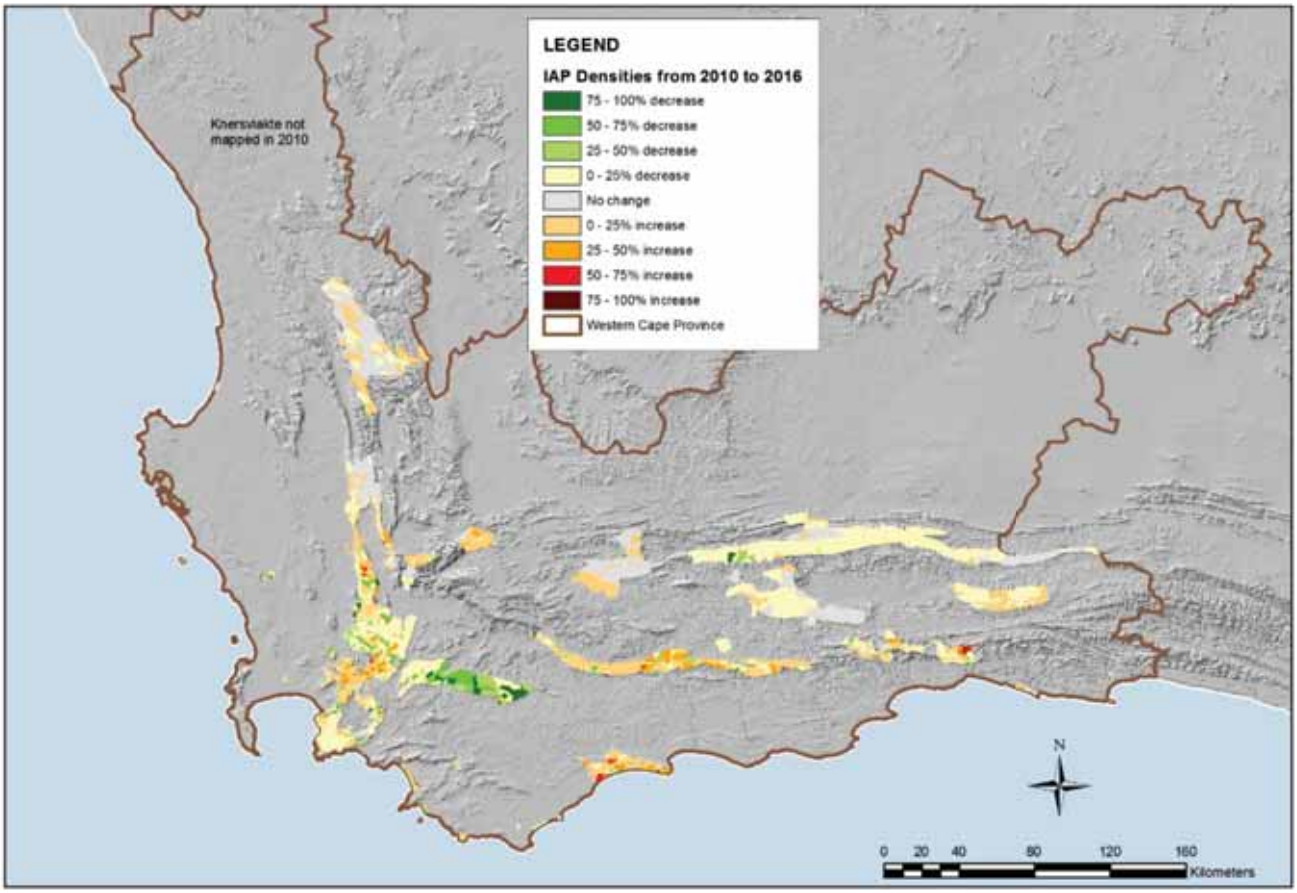

Figure 6. Areas indicating the percentage increase or decrease in invasive alien plants (IAP) densities over a seven year period for the land managed by CapeNature in the Western Cape Province. A decline in IAP densities in the Riviersonderend catchment is commended, especially as a number of these compartments were identified as priorities, while the slight increases in most of the Langeberg catchments are a concern. Changes in IAP densities may also be due to inaccuracies of density estimates. The major water catchment area for the City of Cape Town seems to indicate an increase in IAP densities, even though it has a long history of clearing. This is seriously problematic in the current drought.

4.7 Rare and Threatened Plant monitoring

Monitoring of populations of threatened plant species in the Western Cape is largely being done by plant specialists and CREW (Custodians of Rare and Endangered Wildflowers) citizen science programme that is coordinated by the Threatened Species Programme within SANBI. The local CREW group in the East Region, known as the 'Outramps', is exceptionally well organised and collaborating closely with CapeNature and SANParks. They plan their outings annually according to a 'hitlist' of species of conservation concern and aim to locate and monitor as many species on- and off-reserve areas as possible. The Outramps team consists of a variety of citizen scientists who specialise in specific plant families and are keen to share knowledge and learn from others. An important function this group and other similar CREW groups serve is knowledge exchange, specifically when local field rangers join them on field trips.

Since 2012 a total of 1 962 plant species of conservation concern have been monitored by the Outramps group. Initially the species were captured on CREW Excel data sheets, but since 2014 information and data collected during field trips are being captured on SANBI's iSpot website. About 385 of the plant species that have been recorded over the five year period were previously unknown to the Outramps team. iSpot provided a space to create project of specific topics and/or areas; the Outramps have three main projects where their site sheets are uploaded, namely inland mountains and sites (http://www.ispotnature.org/projects/outramps-crew-site-sheets-for-the-karoo-region); coast and coastal mountains – (http://www.ispotnature.org/projects/crew-site-sheets-for-the-southern-cape-coast-and-the-coastal-mountains); and all the site sheets combined – (http://www.ispotnature.org/projects/crew-species). This volunteer team is truly remarkable and an asset to CapeNature (Figure 7). They are always keen and willing to assist where and whenever possible and have in the last year expanded as far west as De Hoop Nature Reserve.

In the West Region, the 'BotAtlas' surveys are conducted in the Knersvlakte Nature Reserve to improve baseline plant data. In addition, Dr Ute Schmiedel (University of Hamburg) carries out BIOTA monitoring annually in the reserve and the local field rangers often participate in this event. Other monitoring involves tracking rehabilitation efforts of *Phragmites australis* (fluitjiesriet) at Rocherpan and Matjiesrivier Nature Reserves and the recovery of the old agricultural fields on Matjiesrivier Nature Reserve where annual seed harvesting and planting takes place. CREW monitoring is focussed mainly on specific threatened or rare species, such as *Leucadendron chamaelaea* (CR) and *Erica leucosiphon* (R) on

Grootwinterhoek Nature Reserve, *Sorocephalus imbricatus* (CR) and *Babiana odorata* (EN) on Waterval Nature Reserve, and *Marasmodes defoliata* (CR), *Disa barbata* (CR), *Skiatophytum flaccidifolium* (CR), *Serruria brownii* (EN) and *Metalasia distans* (CR) at Riverlands and Pella Nature Reserves. Demographic monitoring of *Marasmodes defoliata* is currently on hold due to potential sensitivity to trampling but the benefits of keeping an eye on this reserve endemic include being able to notice a significant decrease in a patch of plants in 2016. This is possibly due to herbivory by rodents.

The Ganzekraal staff have had regular "training visits" from the CapeNature Botanist (Rupert Koopman) in 2017 and these are opportunities to get into the Ganzekraal Reserve Conservation Area and collect baseline data. The staff also accompanied the Mamre community when collecting flowers and specimens for the 2017 Mamre Flower show and recorded localities of threatened species on the Mamre property. The Friends of the Tygerberg Hills (FOTH) CREW group, Friends of Blouberg Conservation Area and the Darling CREW group have also conducted trips to the greater DCCP area, often accompanied by Ganzekraal CA staff. FOTH are also instrumental in collecting SCC data in Stewardship sites and priority lowland vegetation remnants across the Boland, Swartland and City of Cape Town.

Further east, the Kogelberg CREW group have been operating in and around the Kogelberg Nature reserve. Members of Swellendam CREW have collected data on SCC in Marloth and Grootvadersbosch Nature Reserves. In the Central Region, *Protea holosericea* (EN) monitoring is being carried out annually and a CREW team has visited Vrolijkheid Nature Reserve during 2016 to monitor *Brunsvigia josephinae* (VU). *Protea stokoei* (EN) populations are being monitored on Hottentots Holland Nature Reserve annually. The Hottentots Holland CREW group assisted in the 2016 count of the single locality species *Leucadendron elimense* subspecies *vyeboomense* (CR).

Addressing Target 5 of the National Plant Conservation Strategy (Raimondo 2015), namely 5.1, important areas for plant diversity in South Africa identified based on botanical richness and endemism patterns and 5.2, important areas for plant diversity incorporated into biodiversity planning processes and protected area expansion strategies, a recent mapping exercise (Ebrahim & Von Staden, 2017) set out to quantify and map highly restricted plant taxa as an input to a new Landuse Screening tool.

The criteria for a highly restricted species (HRS) are those which are known from less than 50 individuals, have a Range (Extent of Occurrence) of less than 10 km^2, are known from one subpopulation or are known from one location. Nationally there are 538 HRS and 350 (65%) of those are in the Western Cape. South Africa's richest HRS area is Pilaarkop in the Riviersonderend Nature Reserve, which has 9 species (Ebrahim and Von Staden, 2017). This is also an area with a serious pine infestation and it is critical that efforts to manage this spread are improved. It is of concern that many of these sites have repeatedly been identified as priorities for species conservation but have not yet received any formal protection.

4.8 Capacity

In 2012, lack of botanical capacity was identified as an obstacle within CapeNature. Over the past 5 years the situation has worsened, with only one dedicated Botanist post in the organisation that is responsible for conserving a world-renowned flora. This capacity gap will now, however, be addressed. Another positive response in the reporting period has been the improved collaboration with partners and stakeholders in achieving conservation outputs.

Increased quality of spatial products means that priority habitats and species information is available to guide CapeNature activities, however, more specialised staff are required in order to implement the monitoring required to provide CapeNature with the baseline data required to track changes caused by threats such as climate change and water abstraction from the Table Mountain Group aquifer amongst other sources.

5. Conclusions and recommendations

The rate of loss of natural vegetation through habitat loss has not abated, as seen in Table 3 and including a significant loss of Critical Biodiversity Areas (Chapter 1). Additional extension services and improvement in the enforcement of illegal clearing contraventions is required to help slow down rates of conversion of natural areas in the Province.

Conservation of plant species and ecosystems in the WCP has largely focussed on the reduction and mitigation of the threats facing these species and ecosystems. Continued rolling out and awareness of planning tools is necessary to ensure we aren't losing irreplaceable habitats, given that some habitat loss is inevitable. Innovative ways of meeting the plant utilisation requirements whilst conserving source populations in Protected Areas are being sought. Thresholds of potential concern need to be identified for all reserves, with long term monitoring and assessment programme. Continued efforts in conjunction with partners is necessary to ensure conservation of threatened lowland species and ecosystems at DCCP area.

The improved IAP prioritisation process has enabled CapeNature to better track gains or losses against invasive species for our reserves. Thus, we recommend that planning of clearing projects strictly focus on the areas identified as priorities in that analysis. Monitoring the impact of IAPs on biodiversity within an adaptive management framework is also imperative and we recommend that this be formulated and implemented as soon as possible. Innovative pine management tools look

Figure 7: The Outramps CREW team following a field visit in burnt veld. (Photo: Di Turner).

promising and should be high on the to-do lists for the next five years. It is critical to slow the spread of pines and hereby maintain or reduce the threat to Red Listed species, especially those that are highly restricted. Biodiversity restoration, although vital, can be resource intensive, but investigation to explore options is feasible over the next period. Biological control agent releases should also be increased.

Although CapeNature is limited in our ability to alleviate climate change, the mitigation of the other threats and proper planning in conjunction with partners will go a long way to ensure conservation of our diverse and highly endemic flora.

6. Acknowledgements

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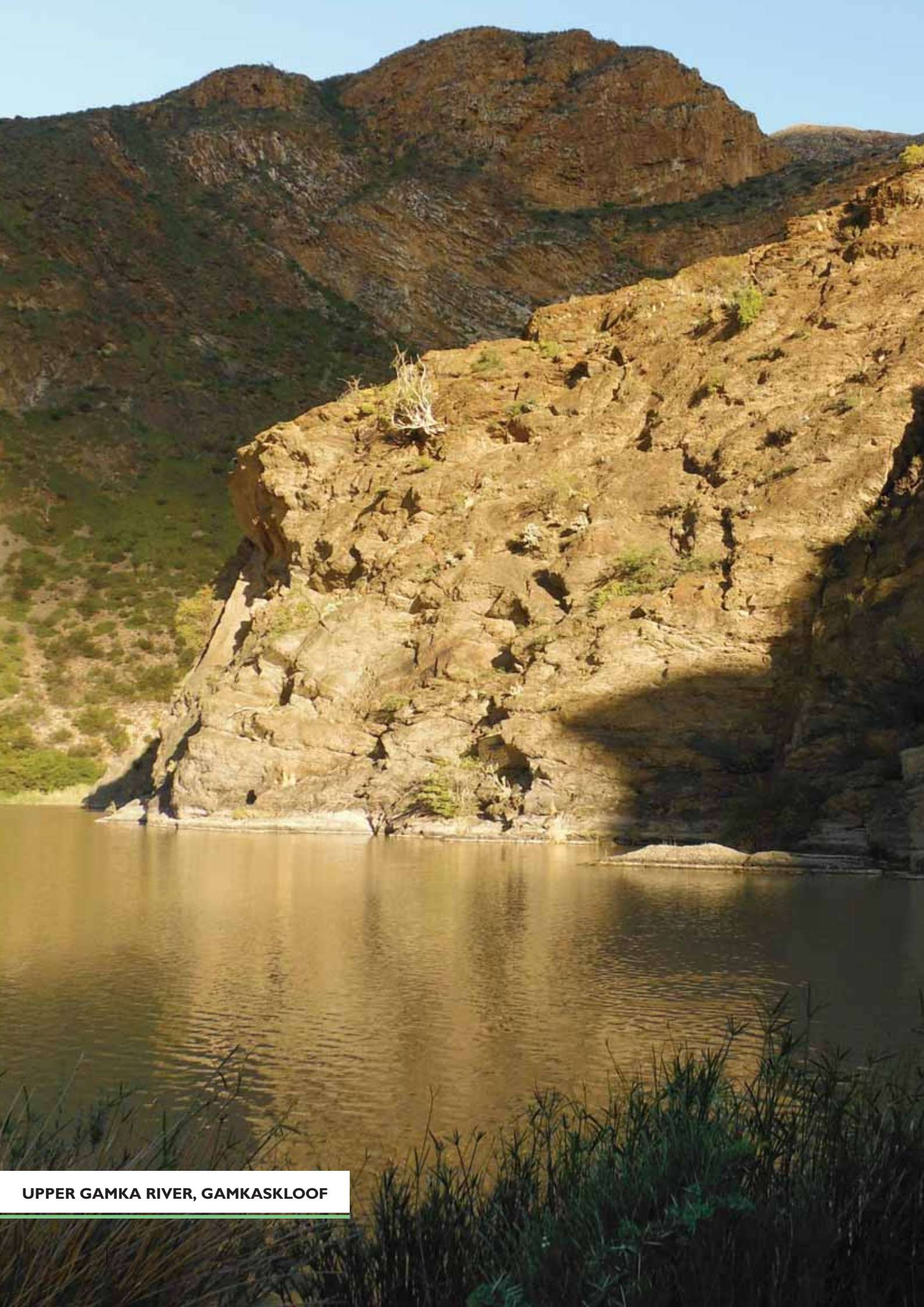
IXIA MONADELPHA



UPPER GAMKA RIVER, GAMKASKLOOF

CHAPTER 5

FRESHWATER FISHES

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Contents

BARRYDALE REDFIN

Executive summary

The Western Cape Province (WCP) is home to 19 formally described indigenous primary freshwater fish species, of which 11 are endemic. In addition, there are 18 distinct genetic lineages of fishes (17 endemic) awaiting description. Once described, these will substantially increase the indigenous freshwater fish diversity of the province. The province also has 17 invasive fish species, of which 10 are from outside South Africa, five are from outside the WCP and two are indigenous to the WCP but have extra-limital populations in the province (Clanwilliam yellowfish *Labeobarbus seeberi*, Cape kurper *Sandelia capensis*). Invasive alien species dominate all mainstem rivers, and remain the biggest threat to the indigenous fishes of the province. The conservation status of South African fishes is in the process of being reviewed and the proposed listings of fishes for 2017 are as follows for described species: two Critically Endangered (Twee River redfin '*Pseudobarbus' erubescens*, Barrydale redfin *Pseudobarbus burchelli*) and eight Endangered species. For genetically distinct lineages, the proposed listings for 2017 are two taxa that are Critically Endangered (Doring fiery redfin *Pseudobarbus* sp. "phlegethon doring", *Galaxias* sp. nov. 'slender'), six taxa that are Endangered and one that is Vulnerable. Other severe threats to these fishes are invasive alien plants (especially in riparian and floodplain areas), habitat degradation from excessive water abstraction during the dry season and river bulldozing, and poor water quality in rivers due to eutrophication and agrichemical pollution. In addition, current and future climate change effects are a significant but often overlooked threat to freshwater fish, especially given the current drought conditions in the province. During the reporting period there has been a major upsurge in research and monitoring on WCP freshwater fishes, as well as important conservation initiatives for the fishes and their habitat. The research has focused on taxonomy and systematics, distribution and conservation status, impacts of climate change, impacts of invasive species and impacts of river rehabilitation projects. The conservation initiatives include development of monitoring protocols, improved monitoring of priority areas, river rehabilitation projects and development of Biodiversity Management Plans for Species.

1. Introduction

Freshwater fish chapters have been a feature of each State of Biodiversity (SOB) report, since the first report produced by CapeNature in 2002. This is not surprising as the WCP is home to the highest concentration of endemic fishes in South Africa as well as the highest number of threatened fish species. Freshwater fish are an important component of the Western Cape's unique biodiversity as well as the ecosystem services that inland waters provide. The presence of indigenous fish species is a useful indicator of good aquatic habitat and water quality, and angling is an economically important activity in the province in terms of the recreational angling sector. In addition, freshwater fish are an important source of protein to an increasing number of subsistence fishers.

The Cape Floristic Region (CFR), contained within the Western and, to a lesser extent the Eastern and

Northern Cape provinces, is one of the six floral kingdoms of the world and recognised as a global diversity hotspot (Myers *et al.,* 2000). The geographical bounds of the CFR corresponds to the Cape Fold Ecoregion (CFE), one of the 200 aquatic ecoregions of the world (Abell *et al.,* 2008) and one of five aquatic ecoregions of Southern Africa (Skelton, 2001). The majority of the CFE has a typical Mediterranean type climate and a recent review of aquatic biodiversity of the region by de Moor and Day (2013) have highlighted why these aquatic ecosystems are so unique and sensitive compared to other biomes in South Africa. Their research showed that aquatic ecosystems of the CFE are very diverse in certain taxonomic groups (e.g. caddisflies, 119 species, 85 endemic species), have high levels of endemism across most classes and orders (e.g. 86% for primary freshwater fishes), and are extremely vulnerable to human disturbance. The reasons for this lie in the palaeohistory of the region, its unique African climate (winter rainfall dominated), the oligotrophic nature of its waters, and the major anthropogenic-induced changes that have taken place in the middle and lower reaches of most rivers (de Moor and Day, 2013). The majority of the WCP is intensively farmed and well-settled, placing huge pressure on rivers and their biota through direct water abstraction and storage, through modification of river flood-zones and banks, and through waste water releases from the high number of dysfunctional waste water treatment plants (WWF-SA, 2016). Additional threats include widespread stockings of invasive alien fishes to satisfy angling demands and inadequate management of alien invasive plants in catchments and riparian zones.

Until recently, the diversity of indigenous freshwater fishes in the WCP and CFE was low (17 and 19 species respectively, Jordaan *et al.,* 2012), but with very high levels of endemism compared to some of the other provinces in South Africa (e.g. Mpumalanga with 62 indigenous species of which 3 are endemic (Francois Roux, Mpumalanga Parks Board, pers. comm.)). Ongoing research on fish taxonomy, supported by studies on genetics and morphology, is revealing the presence of unique lineages within many described species and supports the suggestion by Linder *et al.* (2010) that the current taxonomy vastly underestimates the diversity of freshwater fishes of the CFE. Four new redfin (*Pseudobarbus*) species have been described since 2013, including the giant redfin (*Pseudobarbus skeltoni*), (Chakona and Swartz, 2013, Chakona *et al.*, 2016, Chakona and Skelton, 2017), see Plate 1. Several *Galaxias* and other redfin populations that are genetically distinct will likely be described as new species during the next SOB reporting period (2017-2022).

The numbers of invasive alien fishes in the province continue to rise, with a population of southern mouthbrooder (*Pseudocrenilabrus philander*) (Plate 2) now invasive in the Eerste-Kuils River System (Impson and Marr, unpublished data.) and there have been changes in distribution ranges of several other invasive species. Sharptooth catfish (*Clarias gariepinus*) appear to be expanding their range in the Province as a result of illegal introductions by anglers and through migration from sources of introduction.

The time period 2012 to 2017 has been productive in terms of freshwater fish research and conservation in the province. Firstly, there has been an ongoing and increased research focus on CFE fishes by several organisations, which during this reporting period has culminated in a substantial output of scientific and semi-scientific literature. The research has highlighted, amongst others, that the province and associated CFE is home to several more species than previously acknowledged, has

Plate 1: Giant redfin (*Pseudobarbus skeltoni*) photographed in the Krom River (photograph: Dean Impson).

Plate 2: The southern mouthbrooder (*Pseudocrenilabrus philander*) is a new invasive fish species in the Western Cape Province (photograph: Roger Bills, SAIAB).

confirmed that projects to rehabilitate rivers using the piscicide rotenone have been successful, and has affirmed that climate change likely pose a severe threat to several endemic fish species. Secondly, the conservation status of many species has changed due to a recent revision of the conservation status of southern African freshwater fishes by the International Union for the Conservation of Nature (IUCN). Some species (e.g. Clanwilliam redfin '*Pseudobarbus' calidus*) have been down-listed as a result of successful conservation interventions and the discovery of a number of new populations. Thirdly, the past five years has been characterised by increased partnerships and collaboration on fish conservation projects. From a conservation perspective, there has been significant progress in river rehabilitation involving the removal of invasive alien fishes from selected river reaches. The Rondegat and Thee rivers in the Cederberg are good examples of successful projects on rivers.

This chapter aims to provide an overview of the above changes and highlights progress made with the recommendations contained in the 2012 SOB Fish Chapter. The chapter concludes with recommendations for fish conservation for 2017-2022.

2. Systematic account

The systematic account of indigenous freshwater fishes has changed substantially from the previous report, with new species descriptions and identification of unique lineages, changes in species names, and the discovery of new invasive alien species. Presently, the province is home to 19 formally described indigenous freshwater fish species of which 11 are endemic. Linder *et al.* (2010) reported that the current taxonomy vastly underestimates the diversity of freshwater fishes of the CFE and thus by definition the WCP. Significant taxonomic research since 2012 has resulted in the description of four new *Pseudobarbus* species and the elucidation of several unique lineages within a number of currently described species, bringing the total number of distinguishable fish taxa (species and lineages) in the CFE up to 42 (Chakona and Skelton, 2017; Ellender *et al.,* 2017) of which 37 occur in the WCP. The majority of these new lineages await formal description but this is impeded by a lack of taxonomic and systematic capacity to describe new species (Skelton and Swartz, 2011). A summary of all known species and lineages of freshwater fishes of the WCP is presented in Table 1. It must be noted that species within the family Cyprinidae, those taxa that have historically belonged to the genus *Barbus*, have now been moved to the expanded *Pseudobarbus* genus, indicated as '*Pseudobarbus*', or to the new genus *Enteromius*, based on the work of Yang *et al.* (2015). Name changes and additions to the southern African freshwater fish fauna are summarised by Skelton (2016).

The province also has 17 invasive alien fish species comprising 10 species which have been introduced from outside the borders of South Africa (e.g. common carp (*Cyprinus carpio*), five species which are indigenous to rivers systems outside the CFE e.g. Mozambique tilapia (*Oreochromis mossambicus*), and two indigenous CFE species which have extra-limital populations within the region: Clanwilliam yellowfish (*Labeobarbus seeberi*) and Cape kurper (*Sandelia capensis*). Table 2 includes one established alien fish species, the Israeli tilapia (*Oreochromis aureus*) which has been confirmed as established in two farm dams in the Stellenbosch district, but does not appear to have become invasive (Marr *et al.*, unpublished data.) despite being introduced into these waters in the 1960s (van Schoor, 1966).

Table 1: Distribution of and main threats to indigenous freshwater fishes of the Western Cape Province. Table adapted from Ellender *et al.* (2017). Key: 0 = no dominant threat identified; 1 = alien fish; 2 = habitat destruction; 3 = pollution; 4 = utilization; 5 = genetic integrity. Species and genetic lineages endemic to the WCP are indicated with #.

Species / Lineage	Threats	Distribution
Family Anabantidae		
Sandelia capensis	1,2,5	Type locality uncertain and requires revision
Sandelia sp. "capensis Breede" #		Tributaries of the Breede, Duiwenhoks and Goukou River systems
Sandelia sp. "capensis Agulhas" #		Heuningnes, Haelkraal and Klein River systems
Sandelia sp. "capensis Klein" #		Klein River system
Sandelia sp. "capensis Koekedou" #		Titus and Koekedou tributaries of the Breede River system
Sandelia sp. "capensis Riviersonderend" #		Tributaries of the Riviersonderend River, Breede River system.
Family Austroglanididae		
Austroglanis barnardi #	1,2	Endemic to Olifants River system
Austroglanis gilli #	1,2	Endemic to Olifants River system
Family Cyprinidae		
Enteromius anoplus	0	Widely distributed throughout South Africa
Labeo seeberi	1,2	Endemic to the Olifants River system, specifically the Doring River mainstem and Oorlogskloof-Kobee River
Labeo umbratus	5	East coast rivers from Gouritz to Bushmans and the Orange-Vaal system
Labeobarbus seeberi #	1,2,4	Endemic to Olifants River system
Pseudobarbus sp. "afer Forest"	0	East coast from Klein Brak to Tsitsikamma Rivers
Pseudobarbus asper	1,2	Mainstream reaches of the Gouritz and Gamtoos system
Pseudobarbus burchelli #	1,2,3	Tradouw River, Breede River system
Pseudobarbus sp. "burchelli Breede" #	1,2	Headwater Tributaries of the Breede, Duiwenhoks and Goukou River systems
Pseudobarbus sp. "burchelli Heuningnes" #	1,2	Heuningnes River system

Species / Lineage	Threats	Distribution
Pseudobarbus burgi #	1,2,5	Endemic to the Berg River system
Pseudobarbus phlegethon #	1,2	Oudste, Thee, Noordhoeks, Boskloof and Rondegat tributaries of the Olifants River system
Pseudobarbus sp. "phlegethon Doring" #	1	Breekkrans and Driehoeks Tributaries of the Doring River, Olifants River system.
Pseudobarbus skeltoni #	1	Upper Riviersonderend and Krom River tributaries of the Breede River system
Pseudobarbus tenuis #	1,2	Headwater tributaries of the Gouritz River system
Pseudobarbus sp. "tenuis Keurbooms" #	1,2	Headwater tributaries of the Keurbooms and Bitou River systems
Pseudobarbus verloreni #	1,2	Verlorenvlei River system
'Pseudobarbus' capensis #	1,2,4,5	Endemic to the Breede and Berg River systems
'Pseudobarbus' calidus #	1,2	Endemic to the Olifants River system
'Pseudobarbus' erubescens #	1,2,3	Endemic to the Twee River catchment within the Olifants River system
'Pseudobarbus' serra #	1,2,4	Endemic to the Olifants River system
Family Galaxidae		
Galaxias zebratus #	1,2,5	Type locality uncertain and requires revision
Galaxias sp. "zebratus Breede" #		Hex, Bothaspruit and mainstem Breede River system
Galaxias sp. "zebratus Goukou" #		Goukou River system
Galaxias sp. "zebratus Heuningnes" #		Heuningnes and Ratel River systems
Galaxias sp. "zebratus Klein" #		Klein, Uilkraals and Ratel River systems
Galaxias sp. "zebratus Mollis" #		Onrus River system and Leeu River, Berg River system
Galaxias sp. "zebratus nebula" #		Widespread across CFR from Olifants River in the west to Bitou River system in the east.
Galaxias sp. "zebratus Rectognatus" #		Amandel and Du Toit's Rivers, Riviersonderend sub-catchment, Breede River
Galaxias sp. "zebratus Riviersonderend" #		Tributaries of the Riviersonderend River and in the Keurbooms River, Breede River system. Also in the Palmiet River system.
Galaxias sp. "zebratus slender" #		Uilkraals River system

Table 2: Invasive alien fish species present in the Western Cape Province, their likely introduction pathways and their distribution within the main river systems of the province (Y = present, N = absent). This list includes CFE indigenous species distributed outside their natural ranges and which now have extra-limital populations. Table adapted from Richardson *et al.* (2010) and Ellender and Weyl (2014). Data on *Sandelia capensis* from Hamman *et al.* (1984).

Family and species	Common name	Indigenous range	Introduction pathway	River system			
				Breede	Berg	Olifants / Doring	Gouritz
Family: Anabantidae							
Sandelia capensis	Cape kurper	CFE	Biological control			Y	
Family: Centrachidae							
Micropterus salmoides	Largemouth bass	North America	Angling	Y	Y	Y	Y
Micropterus dolomieu	Smallmouth bass	North America	Angling	Y	Y	Y	Y
Micropterus punctulatus	Spotted bass	North America	Angling	N	N	Y	Y
Lepomis macrochirus	Bluegill sunfish	North America	Fodder fish	Y	Y	Y	N
Family: Cichlidae							
Oreochromis mossambicus	Mozambique tilapia	Africa	Angling, Aquaculture	Y	Y	Y	Y
Oreochromis aureus	Israeli tilapia	Africa	Angling, Aquaculture	N	N*	N	N
Pseudocrenilabrus philander	Southern mouthbrooder	Africa	Aquarium hobby, fodder fish	N	N*	N	N
Tilapia sparrmanii	Banded tilapia	Africa	Fodder fish	Y	Y	Y	Y
Family: Clariidae							
Clarias gariepinus	Sharptooth catfish	Africa	Angling, Aquaculture	Y	Y	Y	Y
Family: Cyprinidae							
Cyprinus carpio	Common carp	Asia	Angling, Aquaculture	Y	Y	Y	Y
Tinca tinca	Tench	Europe	Angling, Fodder fish	Y	N	N	N
Labeobarbus aeneus	Smallmouth yellowfish	Africa	Angling	N	N	N	Y
Labeobarbus seeberi#	Clanwilliam yellowfish	CFE	Angling, conservation	N	N	Y	N
Family: Poeciliidae							
Gambusia affinis	Mosquitofish	North America	Biological control	N	Y	N	N
Family: Salmonidae							
Oncorhynchus mykiss	Rainbow trout	North America	Angling, Aquaculture	Y	Y	Y	Y
Salmo trutta	Brown trout	Europe	Angling, Aquaculture	Y	N*	Y	Y

* While these two species are not known to be present in the Berg River system, they are present in farm dams in the Eerste and Cape Flats catchments which form part of the Berg Water Management Area. *P. philander* has recently been recorded in the Bottelary River, part of the Eerste River system (Marr and Impson, unpublished data).

Species is indigenous to river system, but is invasive in at least two rivers where it has been introduced above waterfall barriers.

3. Conservation status

The most recent IUCN conservation status (Tweddle *et al.* 2009) of the indigenous fish of the WCP is presented in Table 3, along with the proposed new status as determined during a Red List Assessment workshop in 2016 and peer reviewed at the time of completing this report. There are several reasons for the changes in status of several taxa including (1) improved distribution information based on more detailed surveys of river systems e.g. Clanwilliam redfin, (2) implementation of conservation interventions which have increased the size of populations e.g. Twee River redfin *'Pseudobarbus' erubescens*, Jordaan *et al.* 2016 and (3) changes in the interpretation of the criteria (mainly relating to determining Extent of Occurrence (EOO) and Area of Occupancy (AOO), as well as defining the number of populations and locations per species).

Four species have been down-listed: Clanwilliam rock catfish (*Austroglanis gilli*) VU to NT; Clanwilliam yellowfish VU to NT, Clanwilliam redfin VU to NT and Clanwilliam sawfin (*'Pseudobarbus' serra*) EN to NT. One currently undescribed lineage, the Agulhas redfin (*Pseudobarbus sp.* "burchelli Heuningnes") has also been down-listed from CR to EN. The main reason for the down-listing is improved interpretation and subsequent application of criteria, and the discovery of new populations for a number of species. In summary, 10 of the province's 19 currently recognised species are Threatened, comprising two Critically Endangered species and eight Endangered species (Figure 1). Equally of concern is the conservation status of a number of genetically unique lineages of which two are Critically Endangered, six Endangered and one Vulnerable (Figure 1).

Table 3: Current and proposed conservation status of primary indigenous freshwater fishes and unique lineages in the Western Cape Province (from Jordaan et al. 2012, proposed 2017 status with permission of SANBI). CR = Critically Endangered, EN= Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data Deficient, NE = Not Evaluated.

Species / lineage	2012 IUCN status	Proposed 2017 IUCN status
Family: Austroglanididae		
Austroglanis barnardi	EN	EN
Austroglanis gilli	VU	NT
Family: Cyprinidae		
Enteromius anoplus	DD	DD
Labeo seeberi	EN	EN
Labeo umbratus	LC	LC
Labeobarbus seeberi	VU	NT
Pseudobarbus asper	EN	EN
Pseudobarbus burgi	EN	EN
Pseudobarbus burchelli	CR	CR
[illegible]	VU	NT
'Pseudobarbus' capensis	EN	EN
'Pseudobarbus' erubescens	CR	CR
Pseudobarbus phlegethon	EN	EN
Pseudobarbus tenuis	NT	NT
'Pseudobarbus' serra	EN	NT
Pseudobarbus skeltoni	NE	EN
Pseudobarbus sp. "burchelli Breede"	NT	NT
Pseudobarbus sp. "burchelli Heuningnes"	CR	EN
Pseudobarbus sp. "phlegethon Doring"	CR	CR
*Pseudobarbus verloreni**	EN	EN
Family: Galaxidae		
Galaxias zebratus	DD	DD
Galaxias sp. "zebratus Breede"	NE	EN
Galaxias sp. "zebratus Goukou"	NE	VU
Galaxias sp. "zebratus Heuningnes"	NE	EN
Galaxias sp. "*zebratus* Klein"	NE	EN
Galaxias sp. "zebratus Riviersonderend"	NE	EN
Galaxias sp. "zebratus slender"	NE	CR
Galaxias sp. "zebratus Verlorenvlei"	NE	EN
Family: Anabantidae		
Sandelia capensis	DD	DD

* Evaluated in 2012 as a unique lineage *Pseudobarbus* sp. "burgi Verlorenvlei"

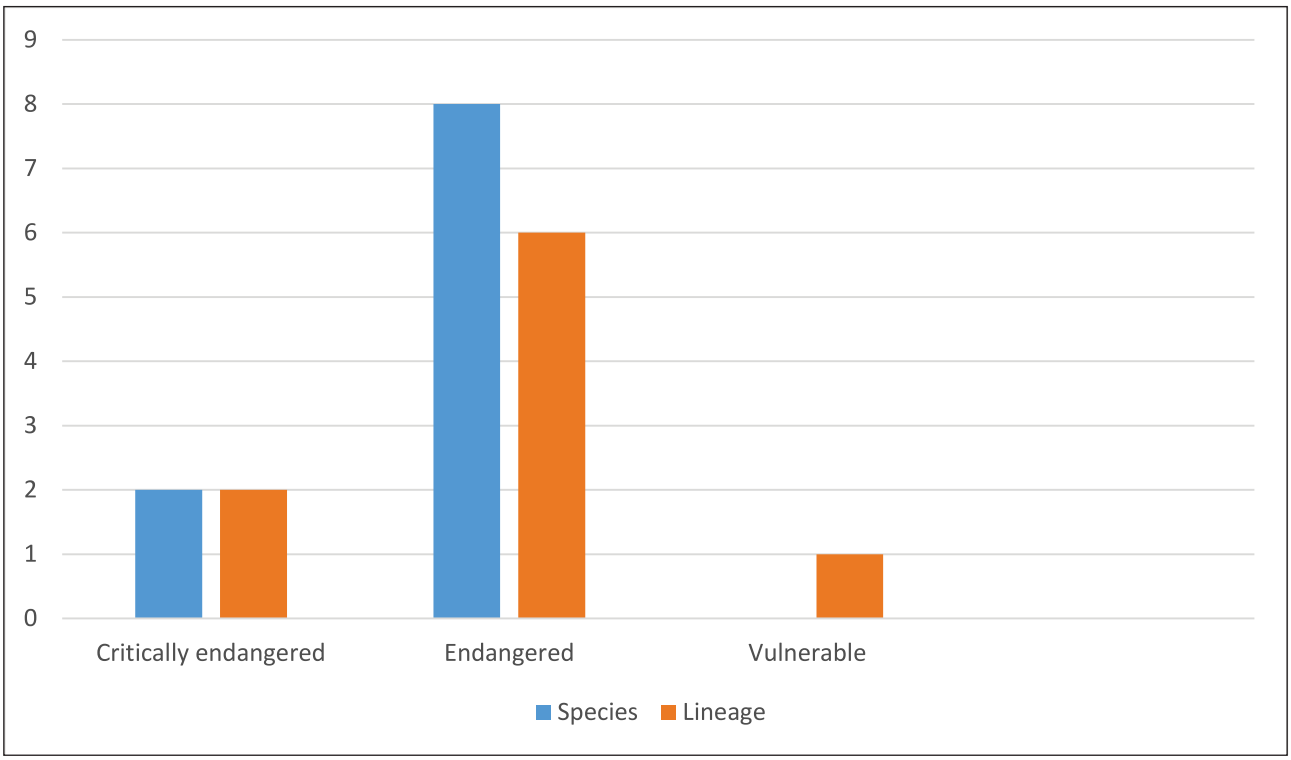

Figure 1: Number of Western Cape freshwater fish species and lineages listed as threatened (source: IUCN).

4. Species conservation plans

The national Norms and Standards for developing a Biodiversity Management Plan for Species (BMP-S) have been used to develop conservation plans for two highly threatened indigenous fishes, namely the Clanwilliam sandfish (*Labeo seeberi*) and the Barrydale redfin (*Pseudobarbus burchelli* sensu stricto). The first of these BMP-S to be published for comment was for the Clanwilliam sandfish (Paxton *et al.*, 2016) with CapeNature and the Department of Environment and Nature Conservation Northern Cape (DENC) being co-implementers as the distribution range of the species includes both the Western and Northern Cape. The second BMP-S, which will be submitted to DEA for approval in 2017, is for the Barrydale redfin which is a unique lineage within the currently described Breede River redfin (*Pseudobarbus burchelli*) Smith, 1841. This lineage is listed as Critically Endangered and is range restricted to the Tradouw River catchment near Barrydale where it is threatened by the presence of invasive alien fishes and loss of habitat from water abstraction and agricultural impacts.

4.1 Clanwilliam sandfish BMP-S

This BMP-S identified three distinct management regions within the distribution range of the species, but overarching threats identified within these three regions were fairly similar. The objectives and actions identified in the BMP-S relating to the Western Cape are summarised below along with progress on actions. Note that Actions 7-10 relate primarily to the Northern Cape but are reported on as CapeNature collaborated on implementation of these actions.

- *Action 1: Awareness and advocacy activities among conservancies and interest groups*: A significant environmental awareness project focused on the Olifants-Doring River system was implemented by the Explore for Knowledge (E4K) group. This project aims to increase awareness of the various components of aquatic ecosystems and threats to these systems and their biota. Other awareness efforts include public awareness boards produced by CapeNature's Alien Fauna Management (AFM) group to highlight the conservation status of indigenous freshwater fishes and to provide information on threats and conservation actions needed to protect these species. Engagement with the broader public on raising awareness of the highly threatened status of indigenous fishes is an ongoing activity.

- *Action 2: Initiate monitoring and research programs on the Clanwilliam sandfish:* To date no formal research has been initiated on the Clanwilliam sandfish.

- *Action 3: Annual monitoring of populations in the mainstem Doring and Biedouw Rivers:* Annual monitoring of the Clanwilliam sandfish to date has been limited to a recruiting population in the Oorlogskloof Nature Reserve on the Oorlogskloof-Kobee River. Comprehensive surveys of the mainstream Doring River were conducted in 2003, 2011 and 2013 (Paxton *et al.*, unpublished). Results indicate that the fish community of the Doring River comprises mainly alien fish species with sandfish having a severely fragmented distribution. A decrease in catch per unit effort (CPUE) for Clanwilliam sandfish and

an increase in mean size of fish caught, coupled with an absence of juvenile size classes indicate that their numbers are decreasing in the Doring River and that the persistence of the current sandfish population may be due to the population now being predominantly comprised of old, large fish which are beyond the prey size class of the predatory invasive alien species. This is evident from the size class distribution of the different species sampled during the 2013 Doring main stream survey. No indigenous fish species smaller than 400 mm (i.e. no juveniles or sub-adults) were recorded, indicating that there is no or minimal recruitment taking place.

- *Action 4: Translocate Clanwilliam sandfish populations to un-invaded or restored and secured river reaches:* An experimental translocation of young sandfish from the lower Biedouw River to a more pristine upstream section of the Biedouw River was implemented in 2014 by the Cape Critical Rivers project team of the Endangered Wildlife Trust. Around 300 juvenile sandfish were translocated from drying pools in the lower Biedouw River where they co-occurred with invasive bass (*Micropterus spp.*) and bluegill sunfish (*Lepomis macrochirus*) to habitat located upstream of a bass barrier. While no mortality was observed during the translocation, very few of the translocated fish were resampled the following year and the translocation was thus only partially successful. The middle Biedouw River has been identified as a rehabilitation priority for CapeNature with future plans to rehabilitate the riparian zone through alien plant clearing and rehabilitating instream habitat through the construction of an instream bass barrier and subsequent removal of bass and bluegill sunfish upstream of the barrier. Increasing habitat in the middle Biedouw River will hopefully allow young sandfish to grow to a larger size before entering the mainstream Doring River, thereby reducing the risk of predation by black bass.

- *Action 5: Ecological Water Releases from the Upper Doring tributaries (Groot and Leeu):* Implementing ecological water releases is the mandate of the Department of Water and Sanitation and CapeNature contributed to meeting this objective through specialist input into ecological reserve determination and classification studies. Through a partnership project with the Endangered Wildlife Trust, flow loggers have been installed in the Leeu River to provide flow information to aid in ecologically sustainable water management for the upper Doring River.

- *Action 6: Re-evaluate the conservation status of the Clanwilliam sandfish:* The conservation status of this species was evaluated in 2014 and based on the severe fragmentation of the population, small area of occupancy (AOO) and loss of the majority of its habitat to invasive fishes, it was up-listed to Critically Endangered. This assessment motivated successfully for the use of actual river areas for determining AOO instead of the 2x2 km grid overlay used conventionally for determining extent of occurrence and AOO of a species. However, during a 2016 Red List workshop its conservation status was down-listed back to Endangered. This was a result of reverting back to the conventional 2x2km grid overlay determining EOO and AOO and the discovery of a new population in the Kranskloof River, a tributary of the Doring River in the Northern Cape Province.

- *Action 7: Interpretive signage at the Nieuwoudtville Municipal Dam, Papkuilsfontein farm and Oorlogskloof Nature Reserve:* Freshwater fish awareness signage for the Olifants-Doring river system was developed with donor funding and disseminated to the Oorlogskloof Nature Reserve.

- *Action 8: Eliminate populations of mirror carp from the Kranskloof and Driefontein Dams:* A successful eradication exercise was conducted in March 2017 whereby carp were removed from Kranskloof Dam by CapeNature using the piscicide rotenone. Pre- and post-intervention monitoring was conducted by a monitoring team from the South African Institute for Aquatic Biodiversity (SAIAB).

- *Action 9: Source funding to install a stage logger and gauging plate on the Oorlogskloof River:* A formal partnership exists with the Endangered Wildlife Trust through the Cape Critical Rivers Program. Through this programme, with the assistance of SOS funding, stage loggers were installed in the Oorlogskloof River to monitor water flow and abstraction volumes.

- *Action 10: Annual monitoring of sandfish populations in the Oorlogskloof Reserve:* This action is ongoing with the aim to build up a long term dataset.

4.2 Barrydale redfin BMP-S

The draft BMP-S is in the process of being finalised for submission to DEA with CapeNature as implementing agent. Despite not being formally gazetted, a number of actions from this document have been implemented or are in the process of implementation as listed below:

- *Objective 1: To improve the conservation status of the Barrydale redfin through research and monitoring to inform conservation action:* Proposed actions from this objective will focus mainly on biological monitoring and initiating research on the species. It also includes actions such as conservation translocations and other mechanisms aimed at increasing area of occupancy and population

numbers for the species. Annual surveys have been conducted since 2012 to determine both indigenous and alien fish distributions in the catchment and this was used to inform conservation actions. Given the threats in the majority of the Tradouw catchment, a conservation translocation upstream of a waterfall in the Huis River has been proposed as a measure to increase area of occupancy in a section of river with suitable habitat which is also free of invasive fishes and not likely to be subjected to land-use impacts. The establishment of a refuge population of minnows in an off-stream dam within the Tradouw's catchment has also been included as an action in the draft BMP-S.

- *Objective 2: To prevent further habitat loss and degradation and rehabilitate habitat in key sanctuary areas:* Actions from this objective are focused around effective conservation of instream and riparian areas to ensure adequate and suitable habitat for the species. Ongoing and future actions include securing land through stewardship, alien vegetation management, effective compliance in terms of land-use applications, exploring mechanisms for environmental flow releases, improving pesticide/herbicide use patterns and partnering with relevant stakeholders (e.g. Department of Environmental Affairs and Development Planning (DEA&DP)) around developing and implementing river maintenance and management plans.

- *Objective 3: To establish and maintain partnerships and collaboration through effective communication and awareness between and among stakeholders:* Existing and proposed actions from this objective are focused around partnership development and creating environmental awareness around ecological functioning of rivers and the impacts of invasive fish and plants and the negative effects of poor land use practices such as instream bulldozing etc. A formal partnership exists with the Endangered Wildlife Trust through the Cape Critical Rivers Program. Through this program, with the assistance of Save Our Species funding, stage loggers were installed in the Huis River to monitor water flow and abstraction volumes. This information, along with a proposal for improved water use in the catchment, has been presented to Swellendam Municipality in 2016 to aid in decision support for managing surface water in the catchment and to motivate for sustainable ecological releases. Awareness materials have been developed focusing on the conservation of indigenous fishes of the Breede river system which by implication also includes the Barrydale redfin. A formal communication strategy will be developed in the first two quarters of 2017.
- *Objective 4: To mitigate the impacts of alien fish:* Proposed actions from this objective are focused around exploring mechanisms to mitigate the impacts of existing populations of invasive fishes and to prevent the establishment of new invasive fishes. Based on survey work conducted between 2012 and 2017, there is a clear understanding of fish distribution in the Tradouw River system. The redfin population is severely fragmented by the presence of invasive fishes in the central part of the catchment and the redfin has been completely displaced by invasive fishes in this area. Management interventions to remove alien fish will be complicated as a redfin population exists in the furthest downstream part of the river which will thus exclude the use of piscicides such as rotenone. Future management actions will include surveying of dams in high invasion risk areas to prevent the invasion of invasive species into the sanctuary area in the upper Huis River.

5. Controlling alien fishes in priority areas

During the past five years, CapeNature implemented river rehabilitation projects (Table 4) with funding from the national Department of Environmental Affairs: Natural Resources Management Programmes (DEA: NRMP). The projects were implemented on two priority rivers for freshwater fish conservation in the Western Cape (Figure 2). The main objective was to remove invasive fish from sections of these rivers either through manual or chemical methods and improve the riparian zones through the removal of invasive vegetation. The Rondegat River was treated with the pisicicide rotenone in 2012 and 2013 to extirpate smallmouth bass (*Micropterus dolomieu*) from 4 km of the lower river between an upstream waterfall and downstream weir. This project has been highly successful in that smallmouth bass have been successfully extirpated and threatened indigenous fish are now recolonising the river below the waterfall (Impson *et al.*, 2013, Weyl *et al.*, 2014). In addition, spotted bass *(Micropterus punctulatus)* and banded tilapia (*Tilapia sparrmanii*) were successfully eradicated from a 2-3 km section of the middle Thee River by a comprehensive netting programme from 2010-2014 (van der Walt *et al.,* unpublished data). The projects employed workers from the local communities to assist with the implementation of the projects. These projects have achieved their objectives to date and have been successful in reaching its target person days.

CapeNature also implemented two projects where invasive fish were removed from two farm dams using rotenone (Figure 2). The first dam to be treated was an off-stream dam on the Krom River in the Cederberg. In January 2017, bluegill sunfish were successfully eradicated from the dam as part of the wider Krom River catchment rehabilitation project. In March 2017, CapeNature also assisted the Northern Cape Department of Nature and Environmental Conservation to eradicate carp from the Kranskloof Dam which is close to the Oorlogskloof River, near Niewoudtville. These carp posed an invasion risk to the Oorlogskloof River which is home to one of very few

Table 4: Project progress, and task completion (in green), on priority rivers earmarked for alien fish control. Two rivers have been successfully completed (Rondegat River 2013 and Thee River 2014).

River	Fish survey	Identify barrier site	Plan for barrier	EIA for barrier	WULA submitted	WULA approved	Barrier construction	Control method
Rondegat								rotenone
Thee		n/a	n/a	n/a	n/a	n/a	n/a	manual
Noordhoek								manual
Krom								Rotenone 2018
Biedouw							2019	Rotenone 2019
Breekrans							2018	Rotenone 2020
Krom Antonies							2018	manual
Suurvlei							No longer a priority	No longer a priority

viable Clanwilliam sandfish populations. The monitoring of the treatment and dams was done by SAIAB with the assistance of honours students from Rhodes Universities Department of Ichthyology and Fisheries Science. Data collected from these two dam treatments will provide information for the legislative requirements for the registration of rotenone in South Africa for invasive fish management. CapeNature has submitted a funding proposal to DEA: NRMP to enable the rehabilitation of the Krom, Breekrans and Biedouw rivers (Figure 2) in the Cederberg region between 2017 and 2021.

6. Fish monitoring programmes

6.1 Fish monitoring on Protected Areas

A paucity of monitoring and baseline data for freshwater fish has been identified for a number of CapeNature Protected Areas for which reserve management plans have been developed. In order to address this shortcoming, surveys have been conducted on a number of nature reserves to validate historical fish distribution data and identify monitoring priorities for the future. To date, comprehensive surveys have been conducted for Anysberg Nature Reserve, Gamkaberg Nature Reserve Complex, Swartberg Nature Reserve Complex, Kammanassie Nature Reserve and the Riviersonderend Nature Reserve Complex. During these surveys, new distributions for threatened indigenous fishes have been discovered and the status of several populations of threatened indigenous fishes has been evaluated. Broadly speaking, most of the sites located in headwater

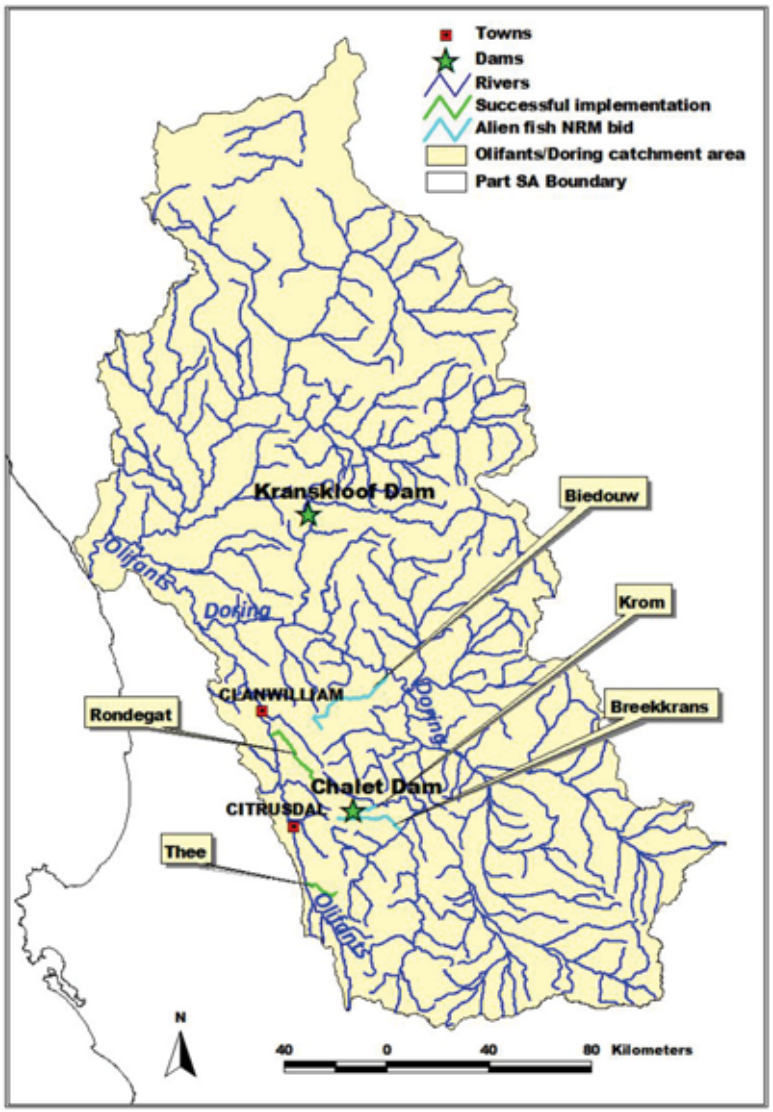

Figure 2: Rivers and dams that have been or are current priorities for invasive fish control in the Western and Northern Cape.

streams in the protected areas had secure intact populations of indigenous fishes provided that a downstream barrier to alien fish invasion is in place. The majority of lowland river sites in protected areas, however, had mostly invasive fishes present and here the reserves had limited value in terms of conserving threatened fishes. This is a particular concern in terms of lowland species such as the smallscale redfin *Pseudobarbus asper* which, as a result of its lowland habitat requirements, is extremely vulnerable to the presence of alien fishes and land-use impacts such as water abstraction and instream bulldozing, as was observed during the recent Swartberg Nature Reserve survey.

6.2 Barrydale redfin monitoring

The Barrydale redfin is a unique lineage within the currently described Breede River redfin. This lineage is listed as Critically Endangered and range restricted to the Tradouw River system. As a deliverable of the draft BMP-S, annual surveys have been conducted since 2012 to establish both indigenous and alien fish distributions in the catchment. The main conclusions from the data were as follows: The redfin has a severely fragmented distribution range within the catchment with three semi-isolated populations occurring in the upper Tradouw, Lower Tradouw and Huis Rivers. Of these three populations, the most important is arguably the one in the upper Huis River as it is not threatened by either alien fish or land-use impacts. The population is also stable in terms of numbers and consists of large mature individuals which is likely the source of recruitment downstream into the rest of the Huis River (Jordaan *et al.*, unpublished data). The other two populations are threatened by alien fish and severe agricultural impacts (upper Tradouw) and alien fish (Lower Tradouw) and monitoring data has showed very high variation in catch rates. Conservation interventions to improve the conservation status of this taxon are discussed under the management plan section and a monitoring protocol has been developed for inclusion in the eco-matrix of Grootvadersbosch Nature Reserve.

6.3 Berg River mainstream monitoring

CapeNature and the Department of Water and Sanitation undertook monitoring of the Berg River mainstem in 2014/5. Six sites were sampled with the uppermost site upstream of the Berg River Dam near Franschhoek and the lowermost site close to the ebb and flow of the estuary. Survey data provide some evidence for changes in the fish community, compared to those of Clark *et al.* (2009). Numbers of rainbow trout (*Oncorynchus mykiss*) appear to be declining in the cooler upper reaches of the river above the dam, whilst numbers of Endangered Berg River redfin (*Pseudobarbus burgi*) are increasing. Similarly, numbers of smallmouth bass and bluegill appear to be declining throughout the river, whilst sharptooth catfish numbers appear to be increasing. Extensive alien plant clearing from the riparian zone of the Berg River and planting of indigenous plants has resulted in recovery of the riparian zone - a key goal of the Berg River Improvement Plan that is being implemented by DEA&DP. This has culminated in the development of a re-introduction plan for the Berg-Breede whitefish (*'Pseudobarbus' capensis*) to the river in the near future.

6.4 Twee River redfin monitoring

The distribution ranges of threatened indigenous fish species endemic to the Twee River catchment, namely the Twee River redfin and the Twee River galaxias (an undescribed lineage within the currently described *Galaxias zebratus*) have been updated as part of a focused Twee River rehabilitation project funded by WWF-SA. Monitoring results indicated that both taxa persist as isolated populations in the Middeldeur, upper Suurvlei and Hexberg tributaries of the Twee River. Threats to these species include water abstraction, habitat degradation, agrichemical pollution as a result of intensive fruit farming in the catchment, and invasive fish species. Research within the Twee River system is ongoing to identify and quantify the environmentally relevant levels of pesticide pollution and its impact on aquatic communities. A survey of a large irrigation dam in the catchment yielded a recruiting population of several thousand Twee River redfins following an experimental introduction more than 10 years ago (Jordaan *et al.*, 2016)

7. Development of a fish monitoring protocol and sampling strategy for CapeNature

Accurate inventory of species diversity and knowledge of their ecological requirements are fundamental prerequisites for successful biodiversity conservation. Given the high number of threatened freshwater fish taxa, there is a significant requirement for monitoring of freshwater fish species to determine population trends and fine scale distributions as these will in turn provide the scientific basis for conservation interventions. While adequate distribution data exists for the majority of WCP fish species, population monitoring data is lacking for almost all species. A standardised sampling protocol has been developed to guide sampling efforts and data collection in field. The aim of this protocol is thus to provide a standardized baseline for sampling of freshwater fishes and their associated habitats and producing comparable datasets for monitoring purposes. To mitigate the shortage of capacity and to focus existing time and funding, a dedicated sampling spreadsheet has been developed for each of the water management areas to include 40-50 sampling sites per river system. These sites are a combination of nature reserve sampling sites, River Health Programme sites and sites selected in fish Critical Biodiversity Areas.

8. Current research and implications for conservation

8.1 Taxonomic studies

According to Linder *et al.* (2010), the current taxonomy vastly underestimates the diversity of freshwater fishes of the CFE and thus by definition the WCP. Significant taxonomic research since 2012 has resulted in the description of four new *Pseudobarbus* species and the elucidation of several unique lineages within a number of currently described species, bringing the total number of distinguishable fish lineages in the CFE to 42 (Ellender *et al.,* 2017). The first new redfin species to be described since the mid-1970s is the Giant redfin. This species, described from material collected in the Krom and upper Riviersonderend rivers, reaches the largest size of all *Pseudobarbus* species. It has been provisionally listed as Endangered in 2017, due to its extremely fragmented distribution range and low numbers of adult individuals (Chakona and Swartz, 2013). Subsequently, three additional species descriptions have been completed. The Verlorenvlei lineage of *P. burgi*, first identified by Skelton (1988) based on morphological characteristics, has been described as the Verlorenvlei redfin (*Pseudobarbus verloreni*) (Chakona *et. al.,* 2014). This species has known populations in the Wabooms, Krom Antonies and Kruismans tributaries of the Verlorenvlei system and is proposed for listing as Endangered.

The currently described Eastern Cape redfin *Pseudobarbus afer* has long been considered a single species with variable morphological traits between populations, but following molecular studies, four distinct lineages were identified (Swartz *et al.,* 2007, 2009). Subsequently, Chakona and Skelton (2017) redefined populations in the Baakens, Swartkops and Sundays systems as *Pseudobarbus afer* sensu stricto. The Krom lineage endemic to the Krom River system in the Eastern Cape was described as *Pseudobarbus senticeps* and the lineage restricted to the Gamtoos system as *Pseudobarbus swartzi*. The taxonomy of the remaining lineage, known as *P. afer* 'sp. Forest', which also occurs in the WCP remains unresolved at present and a phylogenetic analysis based on both morphological and molecular data indicate that it is more closely related to *Pseudobarbus phlegethon* from the Olifants River on the west coast of the WCP (Swartz *et al.*, 2009), providing evidence that phylogenetically it does not belong to the *P. afer* sensu lato complex (Chakona and Skelton, 2017). Chakona *et al.* (2013) presented evidence for three historically isolated lineages in *P. burchelli* and proposed likely mechanisms driving speciation in CFR fishes.

Cryptic diversity is not only limited to *Pseudobarbus* species and the recent work of Chakona *et al.* (2013) identified nine distinct lineages within the currently described Cape Galaxias (*Galaxias zebratus*). Geographical distribution of these lineages vary significantly, with *Galaxias* sp. 'zebratus nebula' being widespread and occurring in all river systems of the southwestern CFE. Other lineages, such as *Galaxias* sp. 'zebratus slender' and *Galaxias* sp. 'zebratus Goukou' however, are severely range restricted, occurring in the Uilkraals and Goukou catchments respectively (Chakona *et al.,* 2013). Similarly, these authors have also presented evidence for genetic structuring within Cape kurper (*Sandelia capensis*) with at least eight lineages occurring in the CFE. The geographical extent of many of these lineages are still under investigation, but some are severely range-restricted, such as *Sandelia* sp. 'capensis Klein' which is restricted to the Klein River system near Hermanus. The majority of these lineages await formal description but this is impeded by a lack of taxonomic and systematic capacity to describe new species (Skelton and Swartz, 2011). From a conservation perspective, the ongoing discovery of new lineages and species presents a challenge in terms of ensuring the long term survival in the wild of these taxa. While the biology and ecology of many known species is fairly well understood, population status and trends, as well as fine scale distribution patterns are largely lacking. This challenge is compounded by the increasing anthropogenic impacts on aquatic ecosystems and the ongoing spread of invasive fishes.

Several adjustments to the phylogeny and classification of freshwater fishes have been made since the publication of a comprehensive field guide on freshwater fishes of Southern Africa (Skelton, 2001). These changes are summarized by Skelton (2016) and, for the CFE and Western Cape, relate mainly to the Cyprinidae. The majority of cyprinids from the CFE are either tetraploid or hexaploid and based on the work of Yang *et al.* (2015), all hexaploid species were assigned to the genus *Labeobarbus*; tetraploid species from the genus *Barbus* were included in *Pseudobarbus* with the additional species designated as '*Pseudobarbus*' (e.g *Barbus calidus* = '*Pseudobarbus' calidus*) and all diploid *Barbus* species being assigned to the genus *Enteromius* (e.g *Barbus anoplus* = *Enteromius anoplus*). The names of the Clanwilliam yellowfish (previously *Labeobarbus capensis*) and the Cape whitefish (previously *Barbus andrewi*) were changed to *Labeobarbus seeberi* (Gilchrist and Thompson, 1913) and '*Pseudobarbus' capensis* (Smith, 1841) respectively. These changes were made as the type specimen on which the name *Barbus capensis* was based was re-identified as the Cape whitefish and not the Clanwilliam yellowfish as previously believed (Skelton, 2016). The name '*Pseudobarbus' capensis* (Smith, 1841) for the Cape whitefish is aligned to the work of Yang *et al.* (2015) and the name *Labeobarbus seeberi* (Gilchrist and Thompson, 1913) was resurrected as the earliest available name for the Clanwilliam yellowfish (Skelton, 2016).

8.2 Alien fish impacts and management

South Africa has a long history of alien fish introductions, primarily to enhance recreational and commercial fisheries. This has resulted in a significant reliance on alien fishes to sustain economically important activities and has led to conflict developing between economic and conservation objectives (Ellender *et al.,* 2014). Despite their economic value, invasive fish species are responsible

for significant ecological effects on recipient ecosystems and are considered the primary threat to freshwater fishes of the CFE (Tweddle *et al.*, 2009; De Moor and Day, 2013). Ellender and Weyl (2014) produced a comprehensive review of current knowledge, risk and ecological impacts associated with alien fish invasions in South Africa. It was reported that research on impacts of invasive fishes in South Africa is in its infancy, with a large taxonomic bias in research efforts (Ellender & Weyl, 2014). The majority of current research is focused on the impact of centrarchids and salmonids on indigenous biota and less than 50% of fully invasive fish species in the country had been the subject of an impact study. The relevance of this to the WCP is that despite increasing research on the impacts of global invaders such as rainbow trout and black bass, there is generally a lack of peer reviewed literature on the impacts other invasive alien fishes, both alien to South Africa (e.g. common carp, bluegill sunfish) and extra-limital (e.g. sharptooth catfish, banded tilapia). Ellender *et al.* (2015) illustrated that sharptooth catfish has the ability to invade headwater streams but their impact on these fragile ecosystems remains unstudied.

Recent research on the impacts of rainbow trout in headwater streams of the Breede River system by Shelton *et al.* (2014a) has indicated that indigenous fish density for three species was significantly reduced in the presence of trout and that trout completely displaced indigenous fish at more than 50% of the study sites. Furthermore, juvenile indigenous fish were largely absent from invaded streams but abundant in non-invaded areas, suggesting that trout impact on endemic fishes is through size-selective predation. When considering river basin scale impacts of invasive fishes, Van der Walt *et al.* (2015) conducted a comprehensive study of black bass invasion in 41 tributaries of the Olifants-Doring River system. Results indicated that more than 80% of stream habitat in the system had been invaded by black bass, resulting in the complete extirpation of small-bodied cyprinid minnows. Co-existence with larger cyprinids was only observed for individuals larger than 10 cm. The study demonstrated the critical role that instream barriers (waterfalls, weirs) play in restricting the movement of black bass and thus preventing the extinction of indigenous fishes in headwater streams. Shelton *et al.* (2014b) also highlighted the important role of instream barriers for preventing smallmouth bass invasion to the upper Witte River, a tributary of the Breede river system. Barriers on rivers are however not effective to prevent alien invasion if potential invasion sources are upstream of a barrier. This is highlighted by the collapse of a viable population of *'P'. capensis* in the upper Hex River, above a causeway barrier, once alien carp, sharptooth catfish and smallmouth bass had invaded above the barrier (Shelton *et al.,* 2017a).

Given the highly threatened status of the majority of indigenous fish, the discovery of new and potentially highly threatened lineages and the well-documented impacts of invasive alien fishes, there is a significant need for preventing new invasions and managing the impacts of invasions in priority areas. Weyl *et al.* (2015) highlighted the complexities associated with managing alien fish invasions in protected areas, once the species becomes utilized and appreciated. An example of conflicting management objectives, is the management of riverine trout populations on Limietberg Nature Reserve for sustainability (catch and release) by a local angling group, which is incompatible with conservation objectives for the newly described giant redfin. Similarly, the relatively recent introduction of carp into Groenvlei Lake in the Goukamma Nature Reserve is believed to be a result of an illegal introduction for recreational angling purposes (Weyl *et al.,* 2015).

Once established, the management of alien invasive fish is complex and few methods exist that will result in complete eradication. Rotenone, a botanical compound derived from plants in the family Leguminosae, has been successfully used for managing alien fishes for biodiversity restoration purposes. This compound exerts a toxic effect by affecting aerobic cellular respiration in gill-breathing organisms by blocking mitochondrial electron transport (Singer and Ramsay, 1994). Through the use of rotenone, smallmouth bass was removed from a 4 km stretch of the Rondegat River in the Cederberg to allow the indigenous fish community to recover (Impson *et al.,* 2013; Weyl *et al.,* 2014). The treatment was conducted according to international best practices using optimised treatment duration and rotenone concentrations (Jordaan and Weyl, 2013, Slabbert *et al.,* 2014). A detailed Water Research Commission report was produced based on the biological monitoring undertaken during the Rondegat project and this included recommendations for future interventions of this kind in South Africa (Weyl *et al.,* 2016a). CapeNature also initiated a project to rehabilitate the Krom River in the Cederberg through mechanical control of rainbow trout using nets and angling. The project was not successful despite a sustained six months of mechanical removal using a team of contractors (Shelton *et al.*, 2017b). In contrast, another project to remove smallmouth bass from a section of the Thee River, a tributary of the Olifants River, using mechanical methods (netting) appears to have been a success (van der Walt *et al.*, unpublished data).

Given the status of sharptooth catfish as a global invader (Weyl *et al.,* 2016b), their sensitivity to rotenone was experimentally investigated to evaluate the suitability of rotenone as a potential management tool (Jordaan *et al.,* 2017). Unexpected survival at high concentrations and avoidance behaviour following exposure illustrated that rotenone may not be an effective management tool for this species and that careful consideration is needed prior to the use of rotenone to manage sharptooth catfish in lotic environments. The use of rotenone as biodiversity restoration tool is somewhat controversial given the non-selective toxicity and impacts on non-target aquatic fauna (Finlayson *et al.,* 2009). Dalu *et al.* (2015) studied the effects of environmentally relevant concentrations of rotenone on various aquatic invertebrate groups and zooplankton. Results indicated that different taxonomic groups varied significantly in their response to rotenone, ranging from no effect (river crab *Potamonautes sidneyi*) to

100% mortality even at low concentrations (Ephemeropterans and zooplankton species). Invasions of instream habitats in the WCP by invasive animals are not restricted to invasive fishes, as was shown by the discovery of invasive freshwater shrimps (*Caridina africana*) in the Eerste-Kuils River System during the reporting period (Mirimin *et al.,* 2015).

8.3 Research on biology, ecology and environmental requirements of freshwater fishes

In a review of the biology and status of Cape Fold Ecoregion fishes (see Ellender *et al.,* 2017) it was reported that relatively limited peer reviewed literature exist for these species and that the majority of available research focused on taxonomy and biogeography, with studies on biology and ecology limited to selected species. The most recent ecological study on a CFE fish was done by Kadye *et al.* (2016) who investigated various ecological mechanisms to explain co-existence of the Giant redfin with its congener Breede River redfin and the anabantid Cape kurper. Results indicated that high habitat and isotope niche overlaps between the two redfins, thereby rendering niche partitioning an unlikely mechanism that drives their coexistence. Furthermore, it was reported that giant redfin has a large isotope niche width in comparison with the Breede River redfin which was reported to have a relatively small trophic niche, suggesting that its trophic niche was more conserved despite being the most abundant species at the study sites. This suggests the two redfins differed in their resource utilization patterns from a trophic niche perspective, which may help to reduce the intensity of interspecific competition. In contrast, Cape kurper was distinguished by occupying a higher trophic position and by having a trophic niche that had a low probability of overlapping onto those of redfins. Based on this, the authors inferred that trophic niche partitioning appeared to influence the coexistence between Cape kurper and redfins. In a study on environmental factors driving species distribution patterns, Chakona and Swartz (2012) identified elevation, slope, stream size, depth and water temperature as causal factors for the spatial distribution of indigenous fishes of the Breede River system and reported that species showed marked differences in their responses to these variables. Elevation and slope were of primary importance for Cape kurper, while Breede River redfin was strongly influenced by stream width and water temperature. *Galaxias sp.* 'nebula' was more sensitive to stream size and depth, and also extended into reaches at higher elevation than Cape kurper and Breede River redfin. This information is critical for the design and prioritization of conservation areas and formulating recovery programs for threatened species.

Despite these studies, the lack of information on physiology and ecological requirements of the majority of CFR fishes is a significant shortcoming which impedes the identification and implementation of effective conservation strategies, especially with regard to future impacts of projected climate change, as noted by Ellender *et al.* (2017). Within the context of climate change, reduced streamflow and increased temperatures are predicted for the CFE. The work of Beatty *et al.* (2017) provided evidence for the conservation value of artificial lentic habitats created by dams and proposed that these can act as refuges for increasingly imperilled freshwater fishes and can serve as instream barrier to prevent the upstream spread of invasive alien species in rivers. Within the CFE, the successful establishment of the Critically Endangered Twee River redfin in an off-stream dam has highlighted the role that dams can potentially play in the conservation of highly threatened species (Jordaan *et al.,* 2016). However, the long term value of this conservation intervention is dependent of the management of the dam for the long term survival of the redfin and the successful mitigation of the risks of alien fish introductions and water over-abstraction.

9. Partnerships to support fish conservation

A key contributing factor for the progress made during this reporting period has been the productive partnerships that have been maintained, improved or established. The key partnerships and the products or services delivered during the reporting period are presented in Table 5.

10. Priority rivers and conservation planning for freshwater fish

The South African National Biodiversity Institute (SANBI), in association with the Council for Scientific and Industrial Research (CSIR), SAIAB and the WRC have identified river areas which contain threatened fish species. These "fish sanctuaries" have been listed as national Freshwater Ecosystem Priority Areas (FEPAs) in maps of South Africa's priority Water Management Areas (Nel *et al.,* 2011). The WCP contains a disproportionally high number of "fish sanctuaries" because of its very high number of threatened fish species. The river system with the highest numbers of threatened fishes and priority rivers in the province is the Olifants-Doring River System. The maps show at a sub-quaternary scale where such species occur, but they do not explain why each river in the sub-quaternary is important for fish conservation and what impacts the fishes in this area. To address this limitation, CapeNature produced a report on the priority rivers for fish conservation in the Olifants-Doring River System (Impson *et al.,* 2016). This report has been developed for operational staff at CapeNature, the Department of Water and Sanitation and DEA&DP to assist land-use decision making, taking into account the needs of the threatened fish community and associated habitat. In addition, Impson and Bills (2014) developed a conservation action plan for the rock catfishes (genus *Austroglanis*) and Twee River redfin of the Cederberg region. During the next reporting period (2017-2022), similar "priority rivers for fish" reports for all major river systems in the WCP should be completed.

There are three areas of conservation planning where progress has been made in the reporting period. These include national conservation planning, provincial

Table 5: Partnership projects in fish conservation from 2012 -2017, noting key products and outcomes.

CapeNature Partner	Project	Product / Service delivered
Dept. Environmental Affairs (Natural Resources Management Programmes)	Alien fish control	NRMP provided funding throughout reporting period for project with CapeNature as implementer.
South African Institute for Aquatic Biodiversity (SAIAB)	Alien fish control	CapeNature executes projects, SAIAB leads monitoring. Scientific credibility of projects established through peer reviewed publications and presentations at national and international conferences.
SAIAB	Distribution surveys	CapeNature and SAIAB staff collaborate on field surveys. Outputs include updated distribution data for many species, collection of museum specimens and DNA samples to facilitate research.
Rhodes University, Department of Ichthyology	Alien fish control	Rhodes University Ichthyology Honours students attended a number of alien fish control projects and contributed to data collection for monitoring.
Dept. of Environmental Affairs & Development Planning (DEA&DP)	Berg River Improvement Plan	DEA&DP lead project with CapeNature leading ecological integrity task team. Proposed conservation reintroduction of Berg-Breede River whitefish into Berg River and off-stream dam.
Department of Water and Sanitation (DWS)	River Health Monitoring	DWS leads River Health Programme. CapeNature and DWS undertake joint monitoring.
Dept. Agriculture, Forestry and Fisheries (DAFF)	Notifiable disease surveillance	DAFF has national responsibility for surveillance of Epizootic Ulcerative Syndrome. CapeNature and DAFF undertake joint monitoring to detect disease.
Northern Cape Department of Environment and Nature Conservation (DENC)	Alien fish control, BMP-S, fish surveys	CapeNature collaborated with DENC to eradicate carp from a dam next to Oorlogskloof River in support of the Clanwilliam sandfish BMP-S. DENC and CapeNature collaborate on fish surveys in the Oorlogskloof-Kobee River as required by the BMP-S.
Table Mountain Fund (TMF)	Fish conservation projects	TMF provided funding through Nedbank Green Trust for rehabilitation of the Twee River catchment, with a special focus on the Twee River redfin "*Pseudobarbus" erubescens*. CapeNature implemented the project and developed a Species Conservation Plan for the redfin.
Endangered Wildlife Trust (EWT)	Fish conservation projects	EWT provides funding via the IUCN-Save our Species (SOS) initiative for Cape Critical Rivers project which is implemented by EWT and CapeNature. There is a special focus on Clanwilliam sandfish and the Barrydale redfin.
Freshwater Research Centre (FRC)	Fish conservation projects	FRC undertake research (e.g. Climate change impacts) and awareness projects on indigenous Western Cape fish. CapeNature provides active support.
Water Research Commission (WRC)	Fish research	WRC provides financial support for research on climate change, river rehabilitation and impacts of rotenone.
Cape Action for People and the Environment Invasive Alien Animal Working Group (CAPE IAA)	Alien fish management	The CAPE IAA is a working group of stakeholders involved in alien animal research and management which identify and support projects, and evaluate project progress.

conservation planning and establishment of stewardship sites which include priority rivers for fish conservation planning. From a national perspective, SANBI has initiated a new National Biodiversity Assessment (NBA) which is being undertaken by the CSIR, in association with key stakeholders including CapeNature. There is a wetland and river component to the NBA. CapeNature has highlighted the issue of inadequate capacity in government agencies (especially provincial environmental/conservation agencies) in the aquatic scientific and technical sections as a key constraint to monitoring of priority aquatic areas (Impson 2016). From a provincial perspective, there have been two main products, namely:

1) the Western Cape Protected Area Expansion Strategy and associated Conservation Action Priorities map, and

2) the Western Cape Spatial Biodiversity Plan, which includes a map of Critical Biodiversity Areas for fish and Ecological Support Areas for rivers and associated biota, and provides an accurate map of rivers which improved the spatial accuracy of the river FEPA's and river types in the province.

Table 6: Report recommendations for 2007 and 2012 and summary of progress

2007 recommendations	2012 recommendations	Progress to date
	The development of a comprehensive fish conservation plan for the WCP with clear goals and project plans.	No progress to date. This remains a priority.
Undertake biodiversity management and recovery plans for all fish species listed as Critically Endangered and Endangered	The development of conservation plans for priority fish species, focusing on top priority species, conservation actions and partnerships	A BMP-S for the Endangered Clanwilliam sandfish is in the process of being gazetted. A BMP-S for the highly threatened Barrydale redfin, a taxon currently being described, is close to completion. A Species Conservation Plan for the Twee River redfin has been completed.
Determine the biology, ecology and rehabilitation requirements of Clanwilliam sandfish *Labeo seeberi*	Determine the biology, ecology and rehabilitation requirements of Clanwilliam sandfish *Labeo seeberi*	This has been highlighted as a research priority in the BMP-S for the species but no research has been initiated to date.
Determine the biology, ecology and rehabilitation requirements of Berg-Breede whitefish *Barbus andrewi*	Determine the biology, ecology and rehabilitation requirements of Berg-Breede whitefish *Barbus andrewi*	No progress to date.
	Comprehensive surveys of all NFEPA fish conservation areas (fish sanctuaries) identified in PAMP's, with off reserve surveys if resources permit.	Extensive surveys have been conducted for Anysberg Nature Reserve, Gamkaberg Nature Reserve Complex, Swartberg Nature Reserve Complex, Kammanassie Nature Reserve and Riviersonderend Nature Reserve Complex. Comprehensive field reports have been produced following these surveys. A fine-scale survey of the Olifants-Doring River system was conducted in 2013-2014 as part of a M.Tech study (Van der Walt, 2015).
	The initiation of a study of the effects of agro-chemicals, with a focus onpesticides in critical fish conservation areas.	Two student projects have been initiated in the Twee River catchment to investigate the impacts of commercially important agrichemicals in aquatic ecosystems. The focus of one study is to determine environmentally relevant concentrations of organophosphates and link these to the ecological health of the Twee River. The 2nd study aims to investigate the impacts of pesticide pollution on biomarker responses of freshwater fishes of the Twee River system.
Determine the extent and severity of invasion of WCP rivers by sharptooth catfish	The initiation of a study to quantify the impact of sharptooth catfish on local ecosystems.	While a focused study on the impacts of catfish invasions is still lacking, some baseline monitoring has been initiated on Riviersonderend Nature Reserve. A SAIAB-led survey of the Breede River was conducted in 2016 and sharptooth catfish was collected at every site sampled with the exception of sites close to Ceres. Catfish also dominated the catch and biomass at each site below Mitchell Pass. It would appear that this species has not yet been introduced above the waterfall just downstream of Ceres. A range of size classes of catfish were captured indicating that recruitment was taking place and numerous individuals of about 1000 mm and above were captured throughout the river system (Marr *et al.*, unpublished data).
	The implementation of river rehabilitation interventions, including the management of alien fish populations.	There has been significant progress with this recommendation as highlighted in this chapter. The Rondegat project was successfully completed in 2013 using the piscicide rotenone to eradicate smallmouth bass and the Thee River project (2010-2014) was an example threatened

		indigenous fish communities. The Krom River mechanical eradication of rainbow trout (2014-2015) was not successful, but was a useful learning experience of why such control methods are often unsuccessful (Shelton et al. 2017). Two dams identified as priorities for alien fish clearing were successfully treated with rotenone in 2017. There has been substantial progress in project planning for the Biedouw, Breekkrans and Krom river rehabilitation projects.
	The drafting of best management practices for projects involving the use of piscicides.	The American Fisheries Society has Standard Operating Guidelines to guide rotenone treatments of rivers and dams. This manual will guide rotenone use in the Western Cape, and nationally, when controlled rotenone use is permitted.
Quantify the recovery of biodiversity (fish, aquatic invertebrates, and aquatic frogs) in rivers and dams after alien fishes have been eradicated.	The completion of the ecological monitoring study on the Rondegat River and publication of results in scientific and popular media.	This has been achieved with ongoing biological monitoring both pre and post rotenone treatments led by SAIAB. There has been numerous scientific publications produced as well as two dedicated WRC reports on the outcome of the project as well to guide future projects of this kind. Other outputs have been several national and international conference presentations and popular articles in local media. .
	The drafting of a policy on piscicide use and the formulating of standard operating procedures for all aspects of piscicide operations	A draft policy has been prepared (Impson and Jordaan 2016) which will be finalised prior to registration and controlled use of the piscicide CFT Legumine which contains rotenone as active ingredient.
	The drafting of a detailed communication strategy for Western Cape fishes, including products, mechanisms and platform to engage with stakeholders.	No progress with developing a strategy. However, products, mechanisms and platforms have been developed to advance fish awareness during the reporting period. These include posters on fish distribution in the four water management areas, indigenous fish displays in public aquaria (e.g. Kromrivier farm), magazine articles, scientific publications, television programmes (e.g. 50:50), and YouTube videos.

11. Recommendations for 2017-2022

The following recommendations are seen as priorities for 2017-2022:

11.1 Development of a freshwater fish conservation strategy for the WCP. This strategy should focus on endangered species and include the following:

(1) identify actions to effectively conserve such species,
(2) identify partners and potential funding sources to implement conservation actions,
(3) identify research and monitoring needs and,
(4) include a communications strategy for awareness and education purposes.

11.2. Preparation of species conservation plans for all CR species. These must focus on key populations / sub populations, key threats, key land-owners and actions needed to better conserve such fishes.

11.3 Implementation of and reporting on approved BMP-S, as well as species conservation plans.

11.4. Completion of reports on priority rivers for fish conservation in the Berg, Breede and Gouritz River Systems and dissemination of reports to key stakeholders.

11.5 Determine the biology, ecology and rehabilitation requirements of Clanwilliam sandfish. Presently this research is hampered by funding constraints which should be addressed by collaboration between CapeNature and partners to enable implementation of this research as identified in the draft BMP-S for this species.

11.6 Complete surveys of all NFEPA fish conservation areas (fish sanctuaries) identified in Protected Area Management Plans (PAMPs), with off-reserve surveys focusing on threatened species. A report should be produced by 2022 which highlights the status of species in these areas, and what actions are required to effectively conserve populations.

11.7. The initiation of a study to quantify the impact of sharptooth catfish on aquatic ecosystems of the CFE, especially mountain tributaries.

11.8. The implementation of river rehabilitation interventions, including the management of alien fish populations. This will be subject to funding from the NRMP section of DEA, and availability of resources within CapeNature.

12. Acknowledgements

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WATERFALL IN GOURITZ RIVER TRIBUTARY

CHAPTER 6

AMPHIBIANS

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Contents

Executive Summary

The Western Cape Province (WCP) now has 60 indigenous species and two extralimital (domestic exotic) species recorded within its borders producing a total of 62 species. Of the 60 indigenous species, five are Critically Endangered, four are Endangered, and six are Near Threatened. Three recently described species are Data Deficient and a further three are yet to be evaluated. There are also at least two new species in the genus *Capensibufo* still to be described and have their threat status formally evaluated. More than half (36) of the frogs are endemic to this province. The introduced guttural toad has persisted over the reporting period although its spread has been limited by active management. The painted reed frog continues to expand its range in the province. No invasive alien amphibians originating outside South Africa have become established in the WCP. The primary threats to amphibians in the WCP are habitat loss, invasive alien plant species and inappropriate fire frequencies.

1. Introduction

The 2012 State of Biodiversity report on amphibians (Turner and De Villiers, 2012) indicated that there was still taxonomic work underway in this group and there has been an increase in the number of species described in the Western Cape Province (WCP) (see Systematic section below). All of the new species described from the WCP are endemic to this province. This is reflective of the unique and rich amphibian fauna, particularly those associated with the fynbos biome. One of the features of this unique frog fauna is the small distribution range over which many of these species occur. This is of consequence both to assessing risk of extinction and for protecting these species. An update of the threat status according to IUCN criteria was conducted during the reporting period and the results and implications of these assessments are included in this chapter. Monitoring frogs continues to be an important requirement to assess state of amphibians as indicator species (and hence as an indicator of environmental health) and is also crucial for accurate threat assessments (IUCN red list).

2. Methods

Data on the distribution of amphibians was extracted from the CapeNature Biodiversity Database and iSpot. Threat status was drawn from the updated red list as published on the IUCN Red List.

For the species listed in this report the regional and global IUCN Threat statuses are identical.

Additional data on the status of frogs in the WCP were obtained from the CapeNature Long-term Frog Monitoring Project and ongoing monitoring of the Threatened species of the WCP (see Monitoring section below).

3. Systematic account

There are 62 species recorded in the province and 60 of these are indigenous to the WCP (see Table 1 and Table 3). Two species, the guttural toad (*Sclerophrys gutturalis*) and foam nest frog (*Chiromantis xerampelina*), from elsewhere in South Africa, have been recorded in the WCP (see section on invasive species below). Of particular note is that in the period since the 2012 report eight new species were described (Channing et al., 2013, Channing *et al.*, 2017, Turner & Channing, 2017). An example of one of these recently described, cryptic species is illustrated in Figure 1. For the purposes of this report only currently recognised species are considered with the exception of one additional species, *Heleophryne depressa,* which is recognised here although it still awaits formal removal from synonymy with *H. purcelli*.

Figure 1. The recently described Landdroskop mountain toadlet (*Capensibufo magistratus*).

There have been a number of name changes in the river frogs (genus *Amietia*) (Channing & Baptista, 2013, Channing *et al.*, 2016) and toads in the genus Sclerophys *(Amietophrynus*) (Ohler & Dubois, 2016) since the last report.

It is expected that a few more species in the genus *Capensibufo* will be formally described. One species, the tremolo sand frog (*Tomopterna cryptotis*), was included in the 2012 list of species indigenous to the WCP possibly in error. It is very difficult to distinguish this species from Tandy's sand frog (*T. tandyi)* on morphological grounds and the southern limit of the distribution of the tremolo sand frog which occurs to the north of the WCP is uncertain. Until its presence in the WCP can be confirmed we have removed it from the list of indigenous WCP frogs.

Table 1. Frog species indigenous to the Western Cape Province.

	Scientific Name	English Name
1	*Afrixalus knysnae*	Knysna leaf-folding frog
2	*Amietia delalandii*	Queckett's river frog
3	*Amietia fuscigula*	Cape river frog
4	*Amietia poyntoni*	Poynton's river frog
5	*Amietia vandijki*	van Dijk's river frog
6	*Arthroleptella atermina*	Riviersonderend moss frog
7	*Arthroleptella bicolor*	Bain's Kloof moss frog
8	*Arthroleptella draconella*	Drakenstein moss frog
9	*Arthroleptella drewesii*	Drewes's moss frog
10	*Arthroleptella kogelbergensis*	Kogelberg moss frog
11	*Arthroleptella landdrosia*	Landdroskop moss frog
12	*Arthroleptella lightfooti*	Cape Peninsula moss frog
13	*Arthroleptella rugosa*	rough moss frog
14	*Arthroleptella subvoce*	northern moss frog
15	*Arthroleptella villiersi*	De Villiers's moss frog
16	*Breviceps acutirostris*	strawberry rain frog
17	*Breviceps fuscus*	plain rain frog
18	*Breviceps gibbosus*	Cape rain frog
19	*Breviceps montanus*	Cape mountain rain frog
20	*Breviceps namaquensis*	Namaqua rain frog
21	*Breviceps rosei*	sand rain frog
22	*Cacosternum aggestum*	Klipheuwel dainty frog
23	*Cacosternum australis*	southern dainty frog
24	*Cacosternum boettgeri*	common dainty frog
25	*Cacosternum capense*	Cape dainty frog
26	*Cacosternum karooicum*	Karoo dainty frog
27	*Cacosternum namaquense*	Namaqua dainty frog
28	*Cacosternum nanum*	bronze dainty frog
29	*Cacosternum platys*	flat dainty frog
30	*Capensibufo deceptus*	Deception Peak mountain toadlet
31	*Capensibufo magistratus*	Landdroskop mountain toadlet
32	*Capensibufo rosei*	Rose's mountain toadlet
33	*Capensibufo selenophos*	moonlight mountain toadlet
34	*Capensibufo tradouwi*	Tradouw mountain toadlet
35	*Heleophryne depressa*	Cedarberg ghost frog
36	*Heleophryne orientalis*	eastern ghost frog
37	*Heleophryne purcelli*	Cape ghost frog
38	*Heleophryne regis*	southern ghost frog
39	*Heleophryne rosei*	Table Mountain ghost frog
40	*Hyperolius horstockii*	arum lily frog

	Scientific Name	English Name
41	*Hyperolius marmoratus*	painted reed frog
42	*Kassina senegalensis*	bubbling kassina
43	*Microbatrachella capensis*	micro frog
44	*Poyntonia paludicola*	montane marsh frog
45	*Poyntonophrynus vertebralis*	southern pigmy toad
46	*Pyxicephalus adspersus*	giant bullfrog
47	*Sclerophrys pantherina*	western leopard toad
48	*Sclerophrys pardalis*	eastern leopard toad
49	*Sclerophrys capensis*	raucous toad
50	*Semnodactylus wealii*	rattling frog
51	*Strongylopus bonaespei*	banded stream frog
52	*Strongylopus fasciatus*	striped stream frog
53	*Strongylopus grayii*	clicking stream frog
54	*Tomopterna delalandii*	Cape sand frog
55	*Tomopterna tandyi*	Tandy's sand frog
56	*Vandijkophrynus angusticeps*	Cape sand toad
57	*Vandijkophrynus gariepensis*	Karoo toad
58	*Vandijkophrynus robinsoni*	paradise toad
59	*Xenopus gilli*	Cape platanna
60	Xenopus laevis	common platanna

4. Distribution Data

The number of frog distribution records that we were able to draw on for the current report was 17 771 CapeNature curated records and an additional 4 973 records from iSpot which represents a useful increase over the 17 450 records available for the 2012 report.

5. Endemism

Sixty per cent (36 of 60) of the indigenous frogs in the WCP are endemic to the WCP. As expected, this represents an increase over the endemism as recorded in 2012 due to the addition of the recently described species.

6. Conservation Status

The numbers of amphibian species listed in the Critically Endangered (CR) category increased, the number in the Endangered (EN) category remained constant, the number of species listed as Vulnerable (VU) decreased and the number in listed as Near Threatened remained the same (Figure 2). These changes are due to improved taxonomic and distribution data (CapeNature, South African National Biodiversity Institute (SANBI), Stellenbosch University, University of the Western Cape and University of Cape Town). New to the Critically Endangered category are Rose's mountain toadlet (Capensibufo rosei) and the Northern moss frog (Arthroleptella subvoce). Three recently described species of mountain toadlets (genus *Capensibufo*) are Data Deficient and a further three recently described moss frogs (genus *Arthroleptella*) are yet to be evaluated.

Table 2. Frog species endemic to the Western Cape Province.

Scientific Name	English Name
Amietia vandijki	van Dijk's river frog
Arthroleptella atermina	Riviersonderend moss frog
Arthroleptella bicolor	Bain's Kloof moss frog
Arthroleptella draconella	Drakenstein moss frog
Arthroleptella drewesii	Drewes's moss frog
Arthroleptella kogelbergensis	Kogelberg moss frog
Arthroleptella landdrosia	Landdroskop moss frog
Arthroleptella lightfooti	Cape Peninsula moss frog
Arthroleptella rugosa	rough moss frog
Arthroleptella subvoce	northern moss frog
Arthroleptella villiersi	De Villiers's moss frog
Breviceps acutirostris	strawberry rain frog
Breviceps gibbosus	Cape rain frog
Breviceps montanus	Cape mountain rain frog
Breviceps rosei	sand rain frog
Cacosternum aggestum	Klipheuwel dainty frog
Cacosternum australis	southern dainty frog
Cacosternum capense	Cape dainty frog
Cacosternum karooicum	Karoo dainty frog
Cacosternum platys	Flat dainty frog
Capensibufo deceptus	Deception Peak mountain toadlet
Capensibufo magistratus	Landdroskop mountain toadlet
Capensibufo rosei	Rose's mountain toadlet
Capensibufo selenophos	moonlight mountain toadlet
Capensibufo tradouwi	Tradouw mountain toadlet
Heleophryne depressa	Cedarberg ghost frog
Heleophryne orientalis	eastern ghost frog
Heleophryne purcelli	Cape ghost frog
Heleophryne rosei	Table Mountain ghost frog
Hyperolius horstockii	arum lily frog
Microbatrachella capensis	micro frog
Poyntonia paludicola	montane marsh frog
Sclerophrys pantherina	western leopard toad
Strongylopus bonaespei	banded stream frog
Vandijkophrynus angusticeps	Cape sand toad
Xenopus gilli	Cape platanna

Table 3. Complete list of frog species known to occur in the Western Cape with South African and IUCN Red List status. Two species are alien to the WCP: the guttural toad (*Sclerophrys gutturalis*) and the foam nest frog (*Chiromantis xerampelina*) are marked with an *.

Taxon	English Name	Regional IUCN	Global IUCN
Afrixalus knysnae	Knysna leaf-folding frog	Endangered (B1ab+2ab)	Endangered (B1ab+2ab)
Amietia delalandii	Queckett's river frog	Least Concern	Least Concern
Amietia fuscigula	Cape river frog	Least Concern	Least Concern
Amietia poyntoni	Poynton's river frog	Least Concern	Least Concern
Amietia vandijki	van Dijk's river frog	Least Concern	Least Concern
Arthroleptella bicolor	Bain's Kloof moss frog	Least Concern	Least Concern
Arthroleptella drewesii	Drewes's moss frog	Near Threatened	Near Threatened
Arthroleptella landdrosia	Landdroskop moss frog	Near Threatened	Near Threatened
Arthroleptella lightfooti	Cape Peninsula moss frog	Near Threatened	Near Threatened
Arthroleptella rugosa	rough moss frog	Critically Endangered (B1ab+2ab)	Critically Endangered (B1ab+2ab)
Arthroleptella subvoce	northern moss frog	Critically Endangered (B1bc+2bc)	Critically Endangered (B1bc+2bc)
Arthroleptella villiersi	De Villiers's moss frog	Least Concern	Least Concern
Breviceps acutirostris	strawberry rain frog	Least Concern	Least Concern
Breviceps fuscus	plain rain frog	Least Concern	Least Concern
Breviceps gibbosus	Cape rain frog	Near Threatened	Near Threatened
Breviceps montanus	Cape mountain rain frog	Least Concern	Least Concern
Breviceps namaquensis	Namaqua rain frog	Least Concern	Least Concern
Breviceps rosei	sand rain frog	Least Concern	Least Concern
Cacosternum aggestum	Klipheuwel dainty frog	Least Concern	Least Concern
Cacosternum australis	southern dainty frog	Least Concern	Least Concern
Cacosternum boettgeri	common dainty frog	Least Concern	Least Concern
Cacosternum capense	Cape dainty frog	Near Threatened	Near Threatened
Cacosternum karooicum	Karoo dainty frog	Least Concern	Least Concern
Cacosternum namaquense	Namaqua dainty frog	Least Concern	Least Concern
Cacosternum nanum	bronze dainty frog	Least Concern	Least Concern
Cacosternum platys	Flat dainty frog	Near Threatened	Near Threatened
Capensibufo deceptus	Deception Peak mountain toadlet	Data Deficient	Data Deficient
Capensibufo magistratus	Landdroskop mountain toadlet	Data Deficient	Data Deficient
Capensibufo rosei	Rose's mountain toadlet	Critically Endangered (B1abc+2ab)	Critically Endangered (B1abc+2ab)
Capensibufo selenophos	moonlight mountain toadlet	Data Deficient	Data Deficient
Capensibufo tradouwi	Tradouw mountain toadlet	Least Concern	Least Concern
*Chiromantis xerampelina**	foam nest frog	Least Concern	Least Concern
Heleophryne depressa	NULL	NULL	Not Evaluated
Heleophryne orientalis	eastern ghost frog	Least Concern	Least Concern
Heleophryne purcelli	Cape ghost frog	Least Concern	Least Concern
Heleophryne regis	southern ghost frog	Least Concern	Least Concern
Heleophryne rosei	Table Mountain ghost frog	Critically Endangered (B1ab+2ab)	Critically Endangered (B1ab+2ab)
Hyperolius horstockii	arum lily frog	Least Concern	Least Concern
Hyperolius marmoratus	painted reed frog	Least Concern	Least Concern
Kassina senegalensis	bubbling kassina	Least Concern	Least Concern
Microbatrachella capensis	micro frog	Critically Endangered (B2ab)	Critically Endangered (B2ab)
Poyntonia paludicola	montane marsh frog	Near Threatened	Near Threatened
Poyntonophrynus vertebralis	southern pigmy toad	Least Concern	Least Concern
Pyxicephalus adspersus	African giant bullfrog	Least Concern	Least Concern
*Sclerophrys gutturalis**	guttural toad	Least Concern	Least Concern
Sclerophrys pantherina	western leopard toad	Endangered (B1ab+2ab)	Endangered (B1ab+2ab)
Sclerophrys pardalis	eastern leopard toad	Least Concern	Least Concern
Sclerophrys capensis	raucous toad	Least Concern	Least Concern
Semnodactylus wealii	rattling frog	Least Concern	Least Concern
Strongylopus bonaespei	banded stream frog	Least Concern	Least Concern
Strongylopus fasciatus	striped stream frog	Least Concern	Least Concern
Strongylopus grayii	clicking stream frog	Least Concern	Least Concern
Tomopterna delalandii	Cape sand frog	Least Concern	Least Concern
Tomopterna tandyi	Tandy's sand frog	Least Concern	Least Concern
Vandijkophrynus angusticeps	Cape sand toad	Least Concern	Least Concern
Vandijkophrynus gariepensis	Karoo toad	Least Concern	Least Concern
Vandijkophrynus robinsoni	paradise toad	NULL	Least Concern
Xenopus gilli	Cape platanna	Endangered (B1ab+2ab)	Endangered (B1ab+2ab)
Xenopus laevis	common platanna	Least Concern	Least Concern
Total: 60			

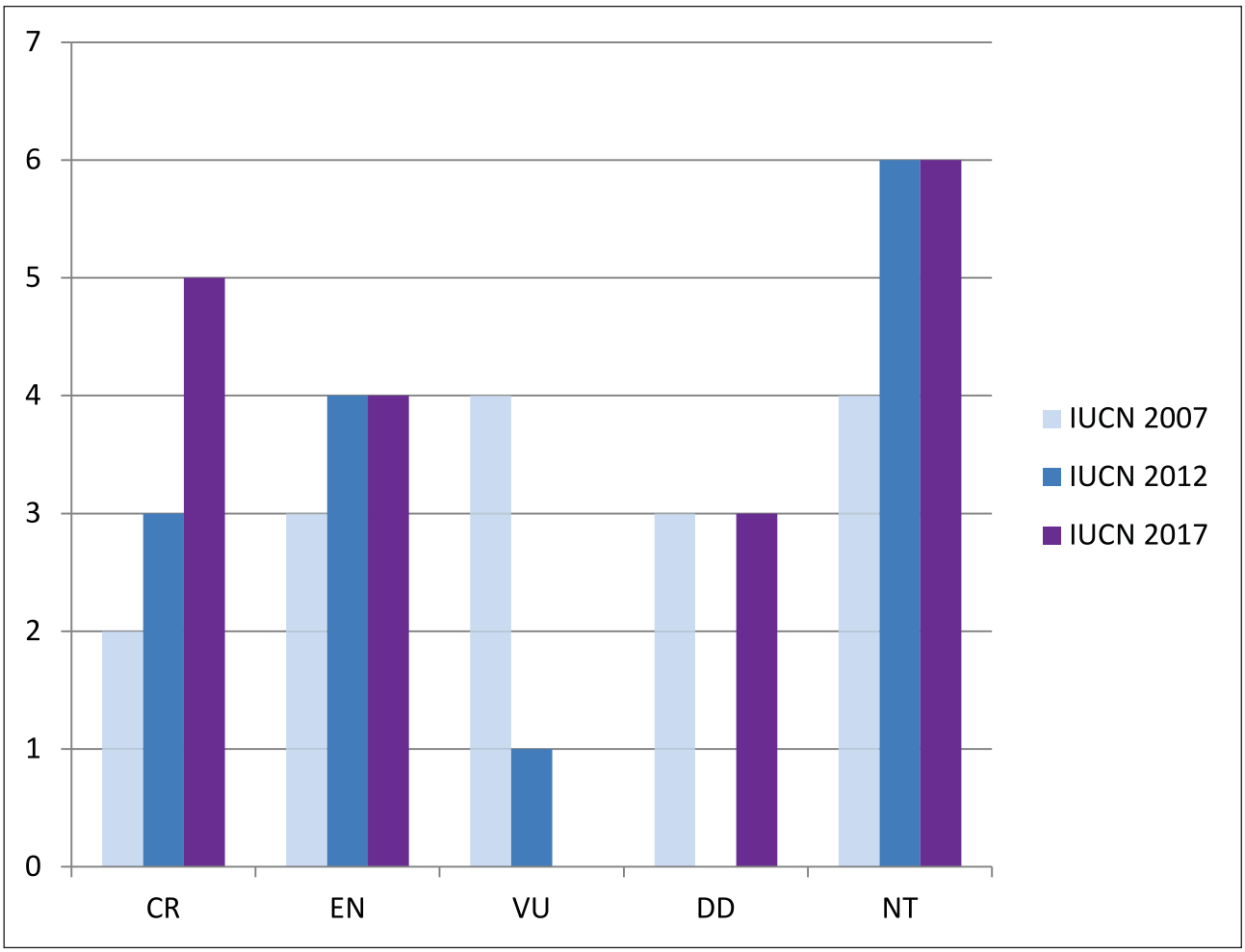

Figure 2. Summary threat status of Western Cape frogs comparing numbers of species in each IUCN threat category for 2007 to 2017.

7. Threatened species

7.1 Critically Endangered

Rough moss frog *Arthroleptella rugosa*
The rough moss frog is a highly restricted species occurring only on the Klein Swartberg Mountain near Caledon. This species is monitored as part of CapeNature's long-term frog monitoring. Monitoring over the period 2012 to date indicates that fire is the main driver of population size for this species. Fortunately it seems that there has been general recovery of the population post the 2011 fire. Regrowth of invasive alien pine trees which have been well managed in the core of the rough moss frog's habitat needs follow up. The judicial use of fire if kept away from the immediate vicinity of the seeps in which the frogs live is recommended if conducted in a safe and practical manner. Additional follow-up clearing to make sure that the pines are managed before they set seed again is an urgent requirement.

Rose's mountain toadlet *Capensibufo rosei*
Since the 2012 report there has been an important taxonomic update to the *Capensibufo rosei* group of frogs (Channing *et al.*, 2017) based on the previous work by Tolley *et al.* (2010) which indicated the presence of cryptic species. Channing *et al.* (2017) described three new species occurring on the inland mountains and confirming that *Capensibufo rosei* occurs only on the Cape Peninsula. This taxonomic work was crucially important from a conservation perspective as Cressey *et al.*, 2015 showed that there were severe declines of Rose's mountain toadlet on the Cape Peninsula. A revaluation of the threat status indicated that *Capensibufo rosei* is Critically Endangered and is restricted to only two or three remaining populations. Several of the historical populations were extirpated through development but some of the apparent local extinctions still have breeding habitat indicating a more enigmatic cause. Edwards *et al.* (2017) showed that this species is affected by the physical characters (specific thermal and depth profiles) of the breeding pools which may have important consequences for the viability of populations and implications for habitat management. Da Silva *et al.* (2016) and Da Silva and Tolley (2017) have taken a fine-scale approach to assessing genetic diversity in the remaining populations and found a dynamic situation with evidence of inbreeding and bottlenecks with both gain and loss of alleles in the two sampled populations. In conjunction with preliminary population size estimates (Becker, 2017), Da Silva & Tolley (2017) speculatively, but usefully, suggest that fires affect habitat quality. In this case fires are suggested to prevent vegetation from becoming overgrown and thus negatively affecting thermal characteristics of the breeding sites. They also suggest a similar role may be played by grazing which indicates that Rose's mountain

toadlet may be dependent on the persistence of suitable fire regimes and presence of grazing species.

Northern moss frog *Arthroleptella subvoce*
The status of this species has changed to a more threatened category since the last reporting period due to different interpretations of the criteria used to determine threat status. CapeNature monitors one of the three known populations of the northern moss frog and have data dating back to 2007. This site near Veepos in the Groot Winterhoek Nature Reserve was burnt in 2009 and 2015. In both cases the counts of calling males declined dramatically. Fire appears to be the main threat to this species at present although this is a species that requires a fire-driven habitat it does not respond well to frequent (fire return interval < 10 years) fires. Population recovery at this site has not occurred yet. Fortunately the biggest of the three populations was not exposed to the recent fires. Although this population has not been monitored due to logistical difficulties a recent ad-hoc visit to this site confirmed the persistence this population of northern moss frogs.

Table Mountain ghost frog *Heleophryne rosei*
CapeNature continues to monitor this species annually. Results indicate that, although this species occurs in a protected area and four streams continue to provide good breeding habitat, two relatively minor stream localities no longer support viable populations of this species. This frog is currently threatened by invasive alien vegetation and erosion in places, and the extent and quality of its habitat is threatened by reduced and erratic rainfall. A working group was recently formed to decide on a conservation action plan for this species.

Micro frog *Microbatrachella capensis*
The micro frog is a useful indicator of a unique and threatened ecosystem – coastal lowland blackwater wetlands – and is monitored annually by CapeNature. Monitoring results indicate that the Agulhas National Park is the stronghold of this species, in that it provides an extensive network of viable wetland breeding habitat. The second largest of the four populations is in the Kleinmond area, but more than 80% of the habitat is on unprotected private land and habitat degradation threatens some of the localities. Development pressure is an increasing threat to the two smaller populations at Betty's Bay and on the Cape Flats. All of the populations are threatened by invasive alien vegetation but this is well controlled in places, such as the Agulhas National Park and at the Cape Flats locality. A population genetics project on the micro frog has been completed and is being prepared for publication.

7.2 Endangered

Western leopard toad *Sclerophrys (Amietophrynus) pantherina*
Da Silva *et al.* (2017) found evidence of a genetic bottleneck although the results also indicate strong gene flow between sites. To conserve the remaining populations of this species it is imperative that the current genetic diversity be maintained over time, with conservation efforts focused on preserving connectivity between sites to ensure adequate gene flow between sampling sites Da Silva *et al.* (2017). A draft Biodiversity Management Plan for Species (BMP-s) has been prepared by the South African National Biodiversity Institute (SANBI), CapeNature and City of Cape Town Municipality and will be submitted to the national Department of Environmental Affairs for approval shortly (see section on BMP-s below).

Cape platanna *Xenopus gilli*
The Cape Platanna has a very limited distribution on the Cape Peninsula, Overberg and Cape Agulhas coasts where considerable historical habitat has been lost. Additional pressure on this species results from the congeneric common Platanna (*Xenopus laevis)* which preys on the Cape Platanna (Vogt *et al.,* 2017), may also outcompete it (Vogt *et al.,* 2017) and may hybridise with it (Kobel, Pasquier & Tinsley,1981; Picker, 1985, Fogell *et al.,* 2013) although this is now established to be a relatively minor threat (Furman *et al.*, 2017). Furthermore the Cape Platanna comprises two deeply divergent lineages which may warrant recognition at species level (Fogell *et al.,* 2013). There has been a very informative study on the demographics, performance and dispersal of the common Platanna (*X. laevis*) (De Villiers and Measey, In Press) and a comparison *X. gilli* (De Villiers and Measey, unpublished data.). This furthers our understanding of the competitive and predatory dynamics of these two species which in turn informs potential management responses. Importantly this work demonstrated the potential of *X. laevis* to move large distances, including overland movement at any time of year which has implications for *X. gilli* conservation. De Villiers *et al.* (2016) suggest that (a) *X. laevis* does have a negative impact on *X. gilli* through predation and/or competition, and (b) control of *X. laevis* by regular sein netting and/or trapping is a viable way to conserve *X. gilli*. Employment of these methods in the Kleinmond region is recommended. Conservation of *X. gilli* habitat is required in places and the habitat should be managed to suit *X. gilli* rather than *X. laevis* where possible i.e. shallow and/or non-permanent water bodies with access to seepages which seem to suit *X. gilli* whereas deep, permanent water bodies (typically artificial water bodies) suit *X. laevis* (Vogt *et al.,* 2017).

Knysna leaf-folding frog *Afrixalus knysnae*
A study is currently underway assessing distribution and population counts of the Knysna leaf-folding frog. Indications at this stage are that this species is still only known from very few sites and population numbers are low at most of these. On completion of this study the threat status of the Knysna leaf-folding frog should be reassessed. Any management interventions to improve the status of this species should also be trialled within an appropriate adaptive management framework.

Hewitt's ghost frog *Heleophryne hewitti*
The ghost frog occurring in the Kammanassie Mountains may be Hewitt's ghost frog. This still needs to be confirmed and a current study by Werner Conradie (Bayworld) and Michael Cunningham (University of Pretoria) should provide light on this assignment. If this is the case, the threat status of this species, currently Endangered, will need to be revised.

7.3 Near Threatened

Drewes's moss frog *Arthroleptella drewesii*
There are no monitored populations of Drewes's moss frog. Its occurrence in Protected Areas should ensure its persistence but only in the presence of effective fire and invasive alien tree species management.

Cape Peninsula moss frog *Arthroleptella lightfooti*
A considerable amount of work has been undertaken on the Cape Peninsula moss frog to estimate population sizes of this species. This uses the application of audio recordings of male advertisement calls and the application of acoustic spatially explicit capture recapture (Measey *et al.,* 2016) and an ambitious project is currently underway to estimate the population size of males for the species (and by inference the entire species population). Having this information at our disposal will make a major contribution to assessing both the threat status of this species and to direct management responses as it will allow an evaluation of the effect of invasions of exotic woody vegetation on this frog. It will also provide a pilot case for assembling similar species population estimates for other potentially threatened species which will be a major improvement over area-based threat assessments which are used for most frog species in the Province.

Landdroskop moss frog *Arthroleptella landdrosia*
The Landdroskop moss frog is monitored as part of the CapeNature long-term frog population monitoring at one site. As with other moss frog species this species seems to be severely affected by fire. Recovery of the population size after fire is very slow at the monitoring site as it is incomplete after eight years.

Montane marsh frog *Poyntonia paludicola*
The montane marsh frog occurred historically at two CapeNature long-term frog monitoring sites but has not been recorded at the one site for 18 years despite persisting at a nearby site.

Cape dainty frog *Cacosternum capense*
Very little additional information for this species has been recorded in the reporting period. It is a challenging species to monitor given its elusive nocturnal habits, short period of activity and extensive area over which it occurs.

Cape rain frog *Breviceps gibbosus*
In the reporting period there were continued ad hoc observations of this species. There is a research project currently underway to assess the conservation status of this species within the Cape Peninsula. It is negatively affected by most forms of development but has a large distribution range beyond the Cape Peninsula and occurs in several protected areas.

8. Habitat Status

Chapter 3 deals with overall health of rivers and wetlands, with a focus on rivers as there is a standardised way to monitor rivers. Most WCP frogs are not river dwellers or breeders and other wetland types are important for the survival of WCP frog species. A new wetland spatial layer created by as part of the Western Cape Province Biodiversity Spatial Plan (see Chapter 1). This is the best (most comprehensive and accurate) layer yet but still does not sufficiently represent difficult to detect wetlands obscured by vegetation. This is an important aspect to address in future landscape classifications as these wetlands represent important breeding sites and habitats for many WCP species. Refinements to species occurrence maps are required to be able to map exact areas required for tightly habitat-bound species such as many of the WCP frogs and is a challenge for the future. The current protection level assessment headed by SANBI will provide valuable insight as to how well the protected area network intersects with the distribution of WCP frogs.

9. Threats

The main threats to frogs in the WCP continue as listed in the previous report i.e. habitat loss, invasive alien plants and inappropriate fire regimes.

Habitat loss
Loss of Critical Biodiversity Areas and Ecological Support Areas (see chapter 2 and 3) and in particular those areas that incorporate wetlands, despite the availability of this vital information on environmental sensitivity (see Chapter 2) will affect frogs negatively. Habitats are not only lost to transformation but may be also be degraded by invasive alien species (IAS) and inappropriate fire regimes.

Invasive Alien Species
Direct measurements of the effects of IAS, particularly woody plants, are not readily available for the WCP. However the effects of the IAS on water regimes and water availability are well known (e.g. Le Maitre *et al.,* 2016) and can be deduced to have negative effects on most frog species which are water and/or moisture dependent.

Fire
Much of the WCP is covered in fire-driven ecosystems and it is precisely in these ecosystems that frog diversity is highest. Maintenance of suitable fire regimes is likely to be required for most of these frog species. This requires that fire neither be excluded nor be allowed to burn too frequently, the latter becoming an increasingly severe problem with human-induced ignitions that do not promote good management practices.

Emergent diseases
Constant vigilance is required to record any disease outbreak as soon as possible. These are typified by mass die-offs in the absence of extreme weather events or anthropogenic disasters such as chemical spills.

Climate change
The continued rapid pace of climate change is likely to put several WCP amphibian species at increased risk. Mokhatla *et al.,* (2015) suggest that frog species in the Cape Floristic Region have shifted their distributions since the last glacial maximum and these are predicted to further shift and shrink under future climate change scenarios. The species expected to be most vulnerable are those species living at colder and wetter spectrums of the existing climate in the Western Cape. Responses to this threat are hopefully mitigated by the WC Protected Area Expansion Plan (see Chapter 2) and human behaviour changes to reduce global warming gas emissions and water consumption.

10. Introduced Species

Guttural toad *Sclerophrys gutturalis*
Since the 2012 report, concerted action was made by the CAPE Invasive Alien Animal Working Group to control this species primarily due to the threat this species may pose to the endemic and Endangered western leopard toad which also occurs within the City of Cape Town (Measey *et al.,* 2017). A study of the guttural toad invasion in Cape Town through a multidisciplinary approach which examined the effects of life-cycle, population age structure, and dispersal within a complex urban environment developed a model that can predict the dynamics of this invasion (Vimercati *et al.*, 2017). Success of the management intervention has been mixed in that although the spread of the toad has been relatively contained the population is still thriving. Further valuable information obtained by Vimercati *et al.* (2017) indicates that management of this species needs to test focussing attention on the adult and juvenile phases of the life-cycle. These forms of management intervention require strong public support to protect the western leopard toad.

Foam nest frog *Chiromantis xerampelina*
Since the 2012 report there have been no new records of this species in the WCP. It is considered unlikely that this species would establish in this province.

Tinker reed frog *Hyperolius tuberilinguis*
There have been a couple of records of the tinker reed frog arriving in the WCP along with the fruit on which they were roosting (Measey *et al.,* 2017). There are no records as yet of this frog surviving in the wild in the WCP.

11. Monitoring

11.1 Priority species monitoring

CapeNature continues to monitor the high priority threatened frog species: Table Mountain ghost frog, micro frog, Cape platanna, western leopard toad, rough moss frog and northern moss frog. CapeNature conducts annual monitoring of the breeding activity and threats to the habitat of these species. This allows appropriate recommendations to be made to landowners and managers concerning invasive alien vegetation clearing, fire management, erosion control, development threats (in places) and general habitat degradation.

The main findings since the previous report of 2012 indicate that two of the streams in which the Table Mountain ghost frog has been recorded no longer support viable breeding habitat for this species. However there are still populations in the four other streams in which this species occurs. The Agulhas National Park is definitely the stronghold of the micro frog with extensive wetlands of prime habitat for this species but the three other isolated and smaller populations are threatened by development pressure and/or invasive alien vegetation. The western leopard toad appears to have become locally extinct in the middle part of its distribution range, extending from the Pringle Bay to Kleinmond area but is still abundant at some of the breeding sites on the Cape Peninsula and Cape Flats.

11.2 Long-term frog monitoring

CapeNature has been conducting long-term frog monitoring at two sites (Landdroskop and Swartboskloof) since 2002 and two additional sites (Veepos, Groot Winterhoek and Klein Swartberg, Caledon) since 2007 and 2012 respectively. This monitoring allows comparison of frog population numbers for the range of different species that occur at these sites to various environmental factors including climate. The data gathered thus far indicates a strong effect of fire on fynbos frog populations. These data require further analysis and publication to inform and improve the management of fynbos frog populations.

12. Legal Status

The Western Cape Nature Conservation Ordinance is still in force and protects all WCP amphibians. The WCP Biodiversity Bill is in draft form and will take all WCP frog species into consideration for provincial protection and management.

13. Biodiversity Management Plans for Species (BMP-s)

A Biodiversity Management Plan for Species (BMP-s) has been drafted for the western leopard toad and still needs to be submitted for national approval. The plan aims to control or mitigate the identified threats (most arising from the urban habitat in which the biggest remaining population resides) to ensure the persistence of the Western Leopard Toad.

The rough moss frog may also benefit from the compilation and implementation of some form of species management plan.

14. Research

Over the reporting period the Measey Lab (Stellenbosch University) and the SANBI Molecular Ecology Lab have produced numerous, high quality, conservation-relevant research publications on amphibians in the WCP. There is also a project in the pipeline by the African Amphibian Conservation Research Group (North-West University) that should be very informative. Some of the research that has not already been mentioned in specific sections above, includes work on the performance, morphology and dispersal in the context of habitat and geographic range of the southern African frog family *Pyxicephalidae*. This work has turned out to be really useful for assessing protection levels of frogs.

Research on the effects of fire and invasive alien species (plants and animals) on frogs will be most useful for informing management responses.

15. Capacity

Formally employed capacity to monitor, research and manage the conservation of frogs remains very limited in the province. There are however several students who have completed good research on frogs in the province over the past five years and the potential academic capacity has improved.

16. Conclusions and Recommendations

The most pressing concern since the 2012 report was the status of Rose's mountain toadlet which has not only experienced severe population declines but has been found to be limited to a much smaller area than previously thought. Fortunately, this species has received considerable research and conservation attention over the reporting period although its threat status is Critically Endangered.

Conservation action and research recommendations for all threatened species of frogs in the WCP are listed in Table 5.

ARTHROLEPTELLA DRACONELLA

Table 5. Recommended conservation actions for Western Cape Province frogs in order of priority.

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations	2017 action implemented	2017 recommendations
Capensibufo rosei Rose's mountain toadlet	Continue to collect new distribution data in light of systematic changes.	Several intense surveys conducted.	Negative results of surveys are alarming and urgent conservation attention needed. See details in section on this taxon above. A taxonomic follow-up on the phylogenetic work is required.	Taxonomic follow up work done and published. TMNP management is actively involved in the management of this species with SANBI.	Compile a species management plan for this species. This may be a dedicated section of the Table Mountain National Park Protected Areas Management Plan.
Arthroleptella rugosa rough moss frog	N/A	N/A	Remove invasive alien trees from the Klein Swartberg Mountain. Request construction of well-placed fire tracer belts and fire-breaks. Regular population monitoring required.	Regular population monitoring by CapeNature in place. Invasive alien trees cleared from main rough moss frog populations.	CapeNature to continue monitoring this species. It is also important to maintain control of invasive alien trees and fire regime.
Heleophryne rosei Table Mountain ghost frog	Biodiversity management plan to be written and submitted in terms of NEMBA.	Not complied. A Biodiversity management plan may not be the most appropriate solution as the management of this species should be contained in the Table Mountain National Park and Kirstenbosch National Botanic Garden Protected Area Management Plans.	Provide inputs to SANParks and Kirstenbosch National Botanic Garden to have the relevant management actions included in the TMNP and Kirstenbosch National Botanic Garden Protected Area Management Plans.	CapeNature made recommendations to the relevant management authorities, based on CapeNature's annual monitoring of this species, for inclusion in SANParks action plans and staff Annual Plans of Operation, etc. The Table Mountain Ghost Frog Working Group was formed in 2014, consisting of the main stakeholders, to review the threats to this frog and to establish an action based framework for the conservation of this species.	Continue with this process.
Sclerophrys pantherina western leopard toad	Biodiversity management plan to be compiled and submitted in terms of NEMBA.	Draft completed.	Submit draft to Minister. Continue to obtain distribution records for eastern part of range.	This has been an ongoing process which still needs to be finalized.	A final draft of the management plan is being prepared for submission to the national Department of Environmental Affairs and Tourism. Further surveys need to be done to establish the eastern limit of this toad's distribution range. Monitoring is mainly done by the Western Leopard Toad Conservation Committee.

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations	2017 action implemented	2017 recommendations
Microbatrachella capensis micro frog	Biodiversity management plan to be compiled and submitted in terms of NEMBA.	Not compiled.	Initiate a Biodiversity Management Plan in terms of NEMBA for coastal wetlands.	This plan needs to be revaluated relative to the newly released Spatial Biodiversity Plan for the WCP (see Chapter 2) and the relevant municipal Spatial Development Frameworks	CapeNature to continue monitoring the breeding activity and habitat threats at the main breeding sites of this species, and to make management recommendations to the relevant land owners and managers as needs be.
Xenopus gilli Cape platanna	Biodiversity management plan to be compiled and submitted in terms of NEMBA.	Not compiled.	As above. Also facilitate development of monitoring protocol.	Refer to the above statement for the micro frog. Population monitoring should be done in the Cape Point portion of the Table Mountain National Park by SANParks, and CapeNature has done *ad hoc* monitoring elsewhere within this frog's distribution range.	Monitoring needs to be continued. The Cape platanna benefits from the micro frog monitoring in that it is sympatric with this species through most of its area of occupancy.
Afrixalus knysnae Knysna leaf-folding frog	Collect new distribution data and start population monitoring	No new distribution data were collected.	A local 'champion' must be identified to start a systematic survey.	An MSc research project has been undertaken by a local student with the North West University and should be completed soon.	Management recommendations arising from the MSc should be put in place and the effects monitored.
Arthroleptella subvoce northern moss frog	N/A	N/A	Incorporate in long-term monitoring project.	Monitoring has been incorporated in CapeNature's long-term frog monitoring project.	CapeNature to continue monitoring this species. Annual surveillance of the largest population should be incorporated into the existing monitoring programme.
Arthroleptella landdrosia Landdros moss frog	Specific actions to be published in conservation assessment.	Conservation assessment published.	Populations monitored as part of CapeNature's Long-term Frog Monitoring Project.	This monitoring is continuing.	CapeNature to continue monitoring this species at the Landdroskop frog monitoring site (Hottentots Holland Nature Reserve).
Arthroleptella lightfooti Lightfoot's moss frog	Specific actions to be published in conservation assessment.	Conservation assessment published.	Several populations will be monitored.	An MSc study by Stellenbosch University has used acoustic Spatial Capture Recapture to obtain density estimates across their entire distribution on the Cape Peninsula.	Evaluate this method for possible roll-out to other Threatened species.

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations	2017 action implemented	2017 recommendations
Arthroleptella drewesii Drewes's moss frog	Specific actions to be published in conservation assessment.	Conservation assessment published.	Continue supporting the removal of IAS from the Klein River Mountains and the construction of well-placed fire tracer belts and fire-breaks.	Annual firebreak maintenance in place with CapeNature in cooperation with private local authorities and private land owners. IAS In maintenance phase (< 5 % invasion)	Maintain current operations.
Poyntonia paludicola montane marsh frog	Continue to collect new distribution data and continue to monitor populations.	Populations monitored as part of CapeNature's Long-term Frog Monitoring Project.	Continue to collect new distribution data and continue to monitor populations.	Some new data has been collected including a slight range expansion (A. Rebelo, Bayworld, Pers. Comm.)	CapeNature to continue monitoring this species at the Landdroskop and Swartboskloof frog monitoring sites.
Cacosternum capense Cape dainty frog	Susceptibility to agro-chemicals needs to be ascertained.	Research not conducted yet.	Project concept to be formally delivered to University of Stellenbosch.	This research project has not yet been defined.	Research request to be drafted and placed on CN research request page.
Breviceps gibbosus Cape rain frog	Identify private land with good populations and incorporate this species in management plans.	These populations not yet identified.	Re-evaluate this species for conservation action by gathering new distribution records as it may not warrant priority conservation action	Status has been revaluated and a new threat status proposed.	Continue surveillance for this species, particularly in the north of its range.

17. Acknowledgements

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CHAPTER 7

REPTILES

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CONTENTS

Executive Summary

There are 155 described reptile species and subspecies recorded to occur in the Western Cape Province (WCP). Ten of these species are alien to the Province and 22 are considered endemic to the Province. Of the 146 indigenous species eight are listed as Threatened. These are made up by one Critically Endangered, one Endangered and six Vulnerable species. A further 11 species are listed as Near Threatened and one species is still considered to be Data Deficient. There has been very little formal monitoring of reptile populations in the WCP apart from the monitoring of the Critically Endangered geometric tortoise. The reptile monitoring situation is improving with the initiation of some new projects by University of the Western Cape.

1. Introduction

The most important assessment of reptiles since the 2012 State of Biodiversity report (Turner *et al.,* 2012) has been the publication of the South African Reptile Conservation Assessment (SARCA) by Bates *et al.* (2014). This assessment has now been formalized with the IUCN RedList. There is a reassessment process currently underway and should be complete by 2018.

The National Department of Environmental Affairs (DEA) and the South African National Biodiversity Institute (SANBI) are, in collaboration with partners such as CapeNature, has developed an assessment of protection levels for a number of taxa, including reptiles. This will be a good first attempt to quantify the protection afforded to reptiles by formal conservation areas. The methods for making such assessments will however require refinement in future as reptiles may often be dependent on spatial features that are not mapped at appropriate scales or are not mapped at all. Ideally at some point adequate data will exist for the evaluation of protection levels at a provincial level in the WCP. For distribution data, there has been a major improvement in knowledge of the Karoo regions of the WCP (and the neighbouring Eastern and Northern Cape Provinces) as a result of the baseline survey work done in order to evaluate potential ecological impacts of shale gas prospecting (Karoo BioGaps Survey, SANBI). This survey has provided many new records for this historically poorly surveyed area.

There has been a major advance in in our knowledge of the Karoo regions of the WCP (and the neighbouring Eastern and Northern Cape Provinces) as a result of the baseline survey work done in order to evaluate potential ecological impacts of shale gas prospecting (Karoo BioGaps Survey, SANBI). This survey has provided many new records for this historically poorly surveyed area.

There are several productive research universities and institutes: Stellenbosch University, University of the Western Cape, and SANBI that are producing excellent research outputs that should inform conservation management of reptiles and their habitats. These are partnerships that are actively driving knowledge forward.

There has been a very important advance in the protection of WCP reptiles through securing land to protect a good population of Critically Endangered Geometric Tortoises. The development of the Biodiversity Management Plan for Species (BMP-s) for the Geometric Tortoise has unfortunately been delayed but is currently being drafted.

2. Methods

Threat status was taken from the SARCA (Bates *et al.*, 2015) which have been formalised on the IUCN RedList and readers are referred to the SARCA for further details on the threats to reptiles

Data were obtained from CapeNature's Biodiversity Database and iSpot and additionally the consolidated SARCA database and Animal Demography Unit ReptileMap were consulted. This chapter used 30 900 distribution records from the CapeNature Biodiversity Database and 2 781 iSpot records to draw distribution information.

3. Systematic Account

As in the previous report, some uncertainties persist but are being tackled e.g. see section on Cape whip snake (*Psammophis leightoni)* below (Figure 1). Among these problems are the statuses of the three described subspecies of the tent tortoises (*Psammobates tentorius*) for which recent genetic research reveals a complicated phylogenetic structure which does not exactly match the existing subspecies descriptions (Hofmeyr *et al.,* 2016). This work further indicates the possible existence of cryptic species which may increase the number of species in the WCP in future. A new species of sandveld lizard (genus *Nucras*) is in the process of being described.

An additional species of pygmy gecko, Essex's pygmy gecko (*Goggia essexi*) has recently been found to also occur in the WCP extending its known range from the Eastern Cape Province.

There has been a name change for the Swartberg leaf-toed gecko (previously *Afrogecko swartbergensis)* which has now been transferred to the genus *Ramigekko* (Heinecke *et al.,* 2014).

4. Distribution Data

Distribution data continues to improve and a major advance has been made in several parts of the Karoo as a result of the baseline data surveys required to assess the potential impact of fracking for shale gas in this area. There is still a strong dependency on occurrence data for assessing threat status for the majority of the WCP reptile species in the absence of population data. Online databases for public deposition of occurrence records is becoming a valuable additional source of distribution data.

5. Invasive Alien Species

The flowerpot snake (*Indotyphlops (Ramphotyphlops) braminus*): There has been at least one new record of this species in the reporting period. It is interesting that this globally widespread invasive snake appears to occur in low numbers in the WCP.

The tropical house gecko (*Hemidactylus mabouia*): There have been at least two new records in this reporting period but further evidence is required of establishment and breeding of this species in the province although this is likely in at least one locality (Simonstown).

There have been no new records of the red-eared slider (*Trachemys scripta*) in the WCP during the reporting period.

5.1 South African Invasive Alien Species in the WCP

The Cape dwarf gecko (*Lygodactylus capensis*) has significantly expanded its distribution since the 2012 report and is now established and breeding in numerous WCP urban areas and further spread is likely. Control of this species will be difficult and the negative effects, if any, of this species' invasion are unknown and unquantified at present.

A single record has been reported of a Nile monitor (*Varanus niloticus*) in the WCP near George. This species naturally occurs in the northern and eastern provinces of South Africa and widely elsewhere in Southern, Central and Eastern Africa. It is not known whether this species was intentionally or accidentally introduced. This species has successfully invaded parts of Florida in the USA and may well be able to expand its range within Southern Africa.

The common agama (*Agama agama*), Namibian rock agama (*Agama planiceps*), common snapping-turtle (*Chelydra serpentina*) and the corn snake (*Pantherophis guttatus*) have all been observed but are not known to have become established in the WCP. The Nile crocodile is alien to the WCP but is confined to captive facilities.

6. Endemism

Twenty-two of the 155 described reptile taxa are endemic to the Western Cape Province (Table 1).

7. Conservation Status

Eight of the species indigenous to the WCP are listed as Threatened and these are made up by one Critically Endangered, one Endangered and six Vulnerable species (the Nile crocodile which is not indigenous to the WCP is also listed as Vulnerable). A further 11 species are listed as Near Threatened. One species, the olive ridley turtle (*Lepidochelys olivacea*), is still considered to be Data Deficient (Table 2). There are no changes to the species threat categories relative to the 2012 report.

Figure 1. The cape whip snake (*Psammophis leightoni*) is a species that has lost a lot of habitat in the southwestern Cape coastal lowlands and its relationship to other whip snakes remains a topic of active research.

7.1 Critically Endangered

Geometric tortoise *Psammobates geometricus*
The geometric tortoise is now listed as Critically Endangered (Baard & Hofmeyr 2014). The previous Western Cape State of Biodiversity Report (Turner *et al.,* 2012) recommended vigorous perusal of stewardship sites to secure additional protection for this species. Fortunately the Turtle Conservation Trust was able to secure a very valuable remnant of suitable habitat for the geometric tortoise and has active management to conserve the geometric tortoise population. This is the single most important achievement in conserving this Critically Endangered species in the last 30 years. However there is still an urgent need to reduce declines in existing populations and further expand the area under protection to the point at which a sustainable population can be reasonably assured. Since the previous report (Turner *et al.,* 2012) the population monitoring protocol has been revised and improved to allow better monitoring of this species. In general, the geometric tortoise populations are slow to respond to declines and need active management intervention, especially to ensure optimal fire-return intervals. Another important contribution to conservation management of the geometric tortoise is the development of a health profile for the geometric tortoise (Hofmeyr *et al.,* 2017, Walton *et al.,* 2017). This allows assessment of the health of individual tortoises through application of a simple protocol which can facilitate critical management decisions such as whether a particular environment is providing sufficient nutrition and when tortoises undergoing care may be released into the wild.

The BMP-s for the geometric tortoise is currently still being drafted and is set to be completed in the next two years.

7.2 Endangered

Leatherback turtle *Dermochelys coriacea*
There have been regular records of this species off WCP shores and satellite tracking of several individual shows activity off the WCP coast (Nel, 2014, Nel, 2016). Research to assess the importance of the WCP coastal and marine habitat for this species is warranted as well as an assessment of the threats posed by fishing activities so that these can be mitigated in future. The South African leatherback population remains 'dangerously' low, although stable (Nel, 2016).

7.3 Vulnerable

Cape dwarf chameleon *Bradypodion pumilum*
Small numbers continue to be traded but the main concern is still habitat loss, particularly wetland associated habitat. In a study by Katz *et al.* (2013) it was reported that a population of this species remained stable for the duration of the study period. This was however dependent on the species' ability to reproduce sufficiently to offset relatively low survival rates. Measurements of physiological performance under increased ambient temperatures, as expected with climate change, indicate a general decrease in performance for the Cape dwarf chameleon (in contrast to the effects on the Namaqua dwarf chameleon *B. occidentale*) with the exception of running speed which improved (Segall *et al.*, 2013).

Table 1. Reptile species endemic to the Western Cape Province. The Knysna dwarf chameleon is included as a near endemic to the Western Cape Province.

Taxon name	English name
Acontias grayi	striped legless skink
Afroedura hawequensis	Hawequa flat gecko
Australolacerta australis	southern rock lizard
Bitis armata	southern adder
Bitis rubida	red adder
Bradypodion atromontanum	Swartberg dwarf chameleon
Bradypodion damaranum	Knysna dwarf chameleon
Bradypodion gutturale	Robertson dwarf chameleon
Bradypodion pumilum	Cape dwarf chameleon
Cordylus minor	dwarf girdled lizard
Cordylus niger	black girdled lizard
Cordylus oelofseni	Oelofsen's girdled lizard
Goggia braacki	Braack's dwarf leaf-toed gecko
Goggia microlepidota	small-scaled leaf-toed gecko
Hemicordylus capensis	graceful crag lizard
Hemicordylus nebulosus	dwarf crag lizard
Psammobates geometricus	geometric tortoise
Ramigekko swartbergensis	Swartberg African leaf-toed gecko
Scelotes bipes	silvery dwarf burrowing skink
Scelotes gronovii	Gronovi's dwarf burrowing skink
Scelotes kasneri	Kasner's dwarf burrowing skink
Scelotes montispectus	Bloubergstrand dwarf burrowing skink

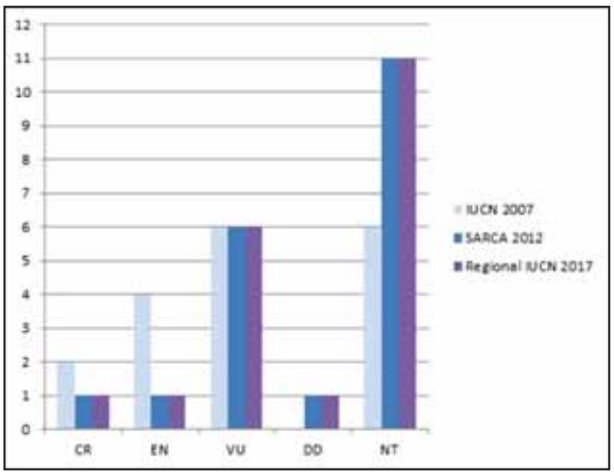

Figure 2. The number of Western Cape Province reptile species in each threat category. The SARCA 2012 statuses refer to Regional status for some species whereas the IUCN 2012 statuses refer to Global statuses.

Speckled padloper *Homopus signatus*
Research on this species in the Northern Cape indicates that populations may exhibit enigmatic declines (Loehr, 2017). A rough indication of the trends in this species may be obtained by presence absence surveys every five years.

Dwarf girdled lizard *Hemicordylus nebulosus*
No new data has been acquired in this reporting period and it is recommended that presence absence surveys,

Table 2. Threat status of Western Cape Province reptiles. The asterisk denotes differences between the Regional and Global assessments. The extralimital Nile crocodile is present in the WCP in captivity only and is excluded from the WCP species statistics.

Species	English name	Regional IUCN	Global IUCN
Psammobates geometricus	geometric tortoise	Critically Endangered (A2acde)	Critically Endangered (A2acde+4acde)
*Lepidochelys olivacea**	olive ridley turtle	Data Deficient	Vulnerable (A2bd)
*Dermochelys coriacea**	leatherback sea turtle	Endangered (D)	Vulnerable (A2bd)
*Crocodylus niloticus**	Nile crocodile	Vulnerable (A2ac)	Least Concern
Homopus signatus	speckled padloper	Vulnerable (A2acde)	Vulnerable (A2acde)
Bradypodion pumilum	Cape dwarf chameleon	Vulnerable (B1ab)	Vulnerable (B1ab)
Psammophis leightoni	fork-marked whip snake	Vulnerable (B1ab)	Vulnerable (B1ab)
Bitis armata	southern adder	Vulnerable (B1ab+2ab)	Vulnerable (B1ab+2ab)
*Caretta caretta**	loggerhead turtle	Vulnerable (D1)	Endangered (A1abd)
Hemicordylus nebulosus	dwarf crag lizard	Vulnerable (D1+2)	Vulnerable (D1+2)
Afroedura hawequensis	Hawequa flat gecko	Near Threatened	Near Threatened
*Chelonia mydas**	green turtle	Near Threatened	Endangered (A2bd)
Cordylus macropholis	large-scaled girdled lizard	Near Threatened	Near Threatened
Cordylus niger	black girdled lizard	Near Threatened	Near Threatened
Cordylus oelofseni	Oelofsen's girdled lizard	Near Threatened	Near Threatened
*Eretmochelys imbricata**	hawksbill sea turtle	Near Threatened	Critically Endangered (A2bd)
Goggia braacki	Braack's dwarf leaf-toed gecko	Near Threatened	Near Threatened
Homopus boulengeri	Karoo padloper	Near Threatened	Near Threatened
Scelotes gronovii	Gronovi's dwarf burrowing skink	Near Threatened	Near Threatened
Scelotes kasneri	Kasner's dwarf burrowing skink	Near Threatened	Near Threatened
Scelotes montispectus	Bloubergstrand dwarf burrowing skink	Near Threatened	Near Threatened

covering the extent of the area previously sampled by Costandius *et al.,* (2006) be repeated within the next five years. Ideally, this survey should be extended to cover the adjacent Kogelberg Mountains.

Cape whip snake *Psammophis leightoni*
The Maritz Lab at the University of the Western Cape and SANBI is assessing the taxonomic status of the Cape whip snake (*Psammophis leightoni*), currently listed as Vulnerable. Preliminary results have suggested that *P. leightoni* might not be as geographically restricted as previously thought. Results indicated that more widespread molecular sampling will be needed to confirm the status of this species, and thus its conservation status. The conservation status itself is under review as part of the Southern African Regional Reptile Specialist Group's work.

Southern adder *Bitis armata*
There have been few new records during the reporting period. The occurrence of this snake in several protected areas and its probable occurrence in a large new area shortly to be proclaimed as a protected area should promote persistence of this rare endemic species.

Loggerhead turtle *Caretta caretta*
There have been at least seven new records in various reptile databases the WCP since the last report. This is the most abundant species reported as stranded in the Western Cape with 230 individuals reported in 2014 and 2015 (Nel 2016). This species definitely uses WCP waters and a research project on the importance of the WCP coastal and marine habitat for this species is warranted.

The Nile crocodile (*Crocodylus niloticus)* is also listed as Vulnerable and is represented on several commercial facilities in the Province. However it is not indigenous to the Western Cape and we have excluded it from the list of Threatened WCP reptiles.

7.4 Near Threatened

Several species listed as Near Threatened occur along the west coast of the WCP: the large-scaled girdled lizard (*Cordylus macropholis*), Gronovi's dwarf legless skink (*Scelotes gronovii*), Kasner's dwarf legless skink (*Scelotes kasneri*), Table view skink (*Scelotes montispectus*); and the black girdled lizard (*Cordylus niger*) which also occurs on the Cape Peninsula. Many of these species are listed due to the ongoing land transformation (mostly housing developments but also mining) of this narrow coastal strip to which they are restricted. These species are reliant on protection in formal Protected Areas and due consideration of the remaining Critical Biodiversity Areas in this region *(*see Chapter 1*)*.

Braack's dwarf leaf-toed gecko (*Goggia braacki*)
No new records were obtained for this species in the reporting period. The species has a restricted range but a

Figure 3. The speckled padloper (*Homopus signatus*) appears to have decreasing populations and is sensitive to land use changes.

significant part of its range falls within the Karoo National Park (Branch, 2014a). Surveys to establish the full extent of its range would be most useful for this poorly known species.

Karoo padloper (*Homopus boulengeri*)
Although much of this species known distribution range falls outside the WCP, Hofmeyr and Baard (2017) report that a recent survey with a search effort of nearly 600 person-hours and covering about 20 localities yielded only three live specimens. Further field surveys and a revaluation of its conservation status based on extant distribution and population numbers are required. Predation has been implicated for the congeneric *H. signatus* (Loehr, 2017) and this should be investigated to assess extinction risk for this species.

Oelofsen's girdled lizard (*Cordylus oelofseni*)
It has been known for some time that there is significant genetic structuring across the range of this species (Daniels et al. 2004, Stanley *et al.,* 2011) and taxonomic clarity is still required.

Hawequa flat-tailed gecko (*Afroedura hawequensis*).
Few new records of this species have been recorded in the reporting period but this is not surprising at it occurs in difficult to access areas, most of which are within formally Protected Areas. Ongoing surveillance is the only managment response required for this species at present.

Green turtle (*Chelonia mydas*)
This species does not breed in the WCP but does appear to utilise WCP marine waters. There has been a call for developing a BMP-s for this species (Nel and Hughes 2014a) which may affect management practices in the Provinces.

Hawksbill turtle (*Eretmochelys imbricata*).
There were no new records for this species in the reporting period. This species is not known to breed in South Africa (Nel and Hughes, 2014b) but there are stranding records from the WCP. The value of WCP marine waters to this species remains unknown.

7.5 Data Deficient

Olive ridley turtle (*Lepidochelys olivacea*)
There have been no new records in the WCP in this reporting period. The olive ridley turtle is still considered to be Data Deficient (Table 2). There are very few records for this species in South Africa and it may even be considered a vagrant (Branch, 2014b). No specific actions are recommended for this species in the WCP.

8. Population Monitoring

The geometric tortoise is regularly monitored at four sites. Due to changing methods and data gaps over time the data presents certain challenges for robust interpretation. CapeNature is are engaging the Centre for Statistics in Ecology, the Environment and Conservation group at University of Cape Town to assist with improving monitoring design and statistical analysis. Preliminary analysis of data indicate a general negative trend in population numbers. The use of conservation detection dogs in this project has improved detection rate and efficiencies of monitoring. This bodes well for obtaining reliable population estimates which are essential for management responses, particularly for managing vegetation structure as determined by fire frequency. This method should also assist in assessing presently unsurveyed properties for the presence of geometric tortoises. It is essential that this species be

regularly monitored at all currently identified monitoring localities.

The Maritz Lab at the University of the Western Cape has been actively conducting research on snakes and snake communities within the greater Cape Town area for the last two years. Apart from the work on the Cape whip snake (see above) this research group is also conducting snake population mark-recapture at Koeberg Nature Reserve and mapping and predicting the distribution of snakes within the greater Cape Town Area.

The mark-recapture monitoring at Koeberg Nature Reserve has started to produce a valuable dataset regarding snake populations in the Western Cape, which is notably one of the only such datasets in Africa. They have captured and marked over 150 individual snakes, dominated by four species, spotted skaapsteker (*Psammophylax rhombeatus*), cross-marked whip snake (*Psammophis crucifer*), Cape whip snake (*Psammophis leightoni*), and common eggeater (*Dasypeltis scabra*). An MSc student will start to analyse this dataset in 2018.

8.1 Biodiversity management plans for species (BMP-s)

Although the geometric tortoise is highly range restricted and Critically Endangered, it occurs across a large number of different land usage types and ownerships. For these reasons it was decided that a BMP-s is the appropriate tool to direct focussed and concerted conservation action for this Critically Endangered species. An initial stakeholder meeting has been held and the BMP-s is in an early draft format.

9. Habitat Status

Reptiles in the WCP are dependent on appropriate ecosystem and habitat conservation. This bears both good and bad news for the conservation and long-term persistence of reptiles in the Province. The bad news is that there is unfortunately a continuing trend in habitat loss (see CBA loss in Chapter 1) and degradation of habitat quality. As mentioned in previous reports there is a concern that many reptile species may require large areas with good connectivity for effectively conservation of sustainable metapopulations.

Unfortunately, developed areas and infrastructure such as roads can significantly impede migration of reptile species by interfering with movement (e.g. Shine *et al.*, 2004) and directly causing mortalities (e.g. Ashley & Robinson, 1996, Row *et al.,* 2007). The good news derives from the formalised forward-planning of protected area expansion in the WCP which takes landscape-level issues such as connectivity and long-term persistence in the face of climate change into account (see sections on WCP Protected Area Expansion Strategy and WCP Biodiversity Spatial Plan in Chapter 1).

The DEA has engaged SANBI to assess protection levels for a number of South Africa's species. This process is underway and is scheduled for completion in 2018. When it is complete it will provide an initial indication of the level of protection afforded to the WCP species by formally protected areas. This process will however need some refinement as available knowledge of the actual requirements of our reptiles improve.

9.1 Threats

Ongoing loss of habitat is still the greatest threat to reptiles in the WCP and is being addressed in a landscape-level approach through CapeNature's Provincial Protected Area Expansion Strategy (see Chapter 1).

Another major concern for this group is the effects of invasive alien species. In particular the effects of changing habitat structure and shading access to suitable thermal microclimate is very important for ectotherms (e.g. Huey, 1991). A very informative assessment has been published by Schreuder & Clusella-Trullas (2016) that quantifies the negative impacts of alien invasive pines on lizard diversity and thermal habitat quality. The threat of invasive alien woody plant species must be mitigated through well designed and executed management actions (see Chapter 4).

Illegal collection for the pet trade affects several species. This threat is always difficult to quantify but seems to persist at low levels. Since 2013, there have been no significant cases involving the illegal capture and smuggling of reptile species for the pet trade. This may be as a result of successful prosecution and sentencing of perpetrators.

Global climate change is predicted to affect several reptile species (Houniet *et al.,* 2009, Segall *et al.,* 2013). This is not only through absolute temperatures or water regimes becoming unsuitable for habitation but also through sublethal affects such is decreased foraging time and impeded access to optimal microhabitats that may gradually erode population sustainability (e.g. Gibbons *et al.,* 2000, Todd *et al.,* 2010). However predicted effects of climate change are complex and require consideration of seasonal changes (Basson & Clusella-Trullas, 2015) and microhabitat (Basson *et al.,* 2016). There is a study underway which should be able to model the impacts of invasive plants and climate change on the common padloper (*Homopus areolatus*). However there is still a deficit of studies on the effects of climate change and their underlying causal mechanisms on reptiles and other vertebrates (Clusella-Trullas & Garcia, 2017). One of the few realistic ways in which we can mitigate climate change is through protecting and expanding areas that will allow access to and movement across climatic and microclimatic conditions.

The effects that climate change will have on fire regimes in the WCP is difficult to predict but we will need to be able to respond to changes that increase fire frequency. One of the ways the WCP can respond is by conducting prescribed burning where this is ecologically appropriate (i.e. when veld has not burnt for longer than the minimum fire-return threshold of potential concern) and where the

results of these interventions can be well monitored and assessed (Van Wilgen 2013).

There are few threats that apply uniquely to marine turtles. These include entrapment in fishing nets, ingestion of plastic which seems to be a growing threat and the gas and oil industry is also a potential pollution threat to this group (Nel 2016).

9.2 Emergent threats

Disease has been highlighted in previous reports as a concern, particularly novel fungal pathogens. There have been no reported outbreaks of disease epidemics in WCP reptiles but there is also no active monitoring to detect this in wild populations. Thus we are still reliant on ad hoc observations as formal monitoring for this is difficult to achieve in practice at present.

10. Public Awareness

There has been good publicity on the use of conservation detection dogs which can provide increased search efficiency for monitoring species with low detection probabilities such as the geometric tortoise.

11. Research

There have been a number of very useful studies in the reporting period that have contributed to improved understanding of reptiles and their requirements in the WCP. These studies have spanned ecological, ecophysiological, phylogenetic and taxonomic fields and have covered the following taxa: Cape legless skink (*Acontias meleagris*) (Engelbrecht *et al.*, 2013), several dwarf chameleons (*Bradypodion*) (e.g. Da Silva & Tolley, 2013, Da Silva *et al.,* 2014, Da Silva *et al.,* 2016, Dollion *et al.,* 2017), Oelofsens's girdled lizards (*Cordylus oelofseni*) Basson & Clusella-Trullas (2015) and Basson *et al.,* (2016), typical lizards (Family Lacertidae) (Edwards *et al.,* 2012, Edwards *et al.,* 2013, Tolley *et al.,* 2014, Vanhooydonck *et al.,* 2015), spotted sand lizards (*Pedioplanis lineoocellata*) (Tolley *et al.,* 2014), and puff adders (*Bitis arietans*) (Barlow *et al.,* 2013).

Additionally, research has been carried out on the Cape whip snake and species distribution models have been developed for it and its close relative the Namib whip snake (*Psammophis namibensis*) which show no spatial overlap. There are also several phylogenetic studies underway (many by the SANBI Molecular Ecology laboratory and partners) that will have consequences for species status (and names) of Western Cape reptiles including the genera *Aspidelaps* (shield-nose snakes), *Bradypodion* (dwarf chameleons), *Cordylus* (girdled lizards), *Naja (*cobras), *Nucras* (sandveld lizards*), Pachydactylus* (thick-toed geckos), *Philothamnus* (green snakes), *Psammobates* (tent tortoises), *Psammophis* (whip snakes), *Psammophylax* (skaapstekers), *Ptenopus* and *Pseudcordylus*. There are several other researchers working on WCP reptiles and ongoing projects include phylogenetic and taxonomic work on many-spotted snakes *(Amplorhinus*) (W. Conradie, Bayworld) and the gecko genera *Goggia*, *Naja, Nucras* and *Pachydactylus*. (A. Bauer, Villanova University).

Species distribution data are foundational for much research and the University of the Western Cape's Maritz Lab is also collating georeferenced distribution data for snake species in the greater Cape Town area. Thus far 1 148 georeferenced records representing 23 species have been obtained and will be shared with CapeNature.

Figure 4. Brin: a conservation detection dog gives CapeNature an edge in detecting difficult to find species. Photograph: V. Hudson.

12. Capacity

There has been no improvement in numbers of professional reptile biologists in the WCP in the reporting period but herpetological training and research at SANBI, University of the Western Cape, University of Cape Town and Stellenbosch University continues.

13. Conclusions and Recommendations

Feedback on the recommendations for reptile conservation arising from the 2007 State of Biodiversity report are listed in Table 3 below.

In summary, to improve protection of the WCP reptiles there is a need to collect information on threatened species where there are indications that populations are in new or accelerating decline. There is further need for ongoing work to resolve taxonomic problems and bolster existing protected area networks, especially where these will improve protected areas landscape connectivity. Monitoring techniques and statistical analysis of population counts (e.g. for the geometric tortoise) are being improved but need to be tested in a strategic adaptive management framework.

14. Acknowledgements

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Table 3. Progress of 2012 reptile conservation recommendations.

2007 Recommendation	2012 Response	2017
Very little is known of the size of habitat required to support viable populations of each reptile species.	We are reliant on external investigators to assess this. This remains a gap in our knowledge base.	The Focus is on the geometric tortoise but also now need to pay attention to the Karoo padloper (*Homopus boulengeri*). Generally, it will be most useful to know if certain species can be used as indicators or proxies for sufficient protection of Threatened reptiles. The Maritz Lab is collecting population data and ecological information for snakes which may inform this request.
Investigating basic systematics.	Several studies underway & several have been completed (see Research above).	More work has been completed (see Research above).
Conducting distribution and population status surveys.	More distribution records have been collected. Systematic population surveys for threatened tortoises have been undertaken.	SANBI's BioGaps project to assess baseline data for 'fracking' has yielded a lot of valuable new data. There are now several 'Citizen Science' sites which allow greater public participation in data gathering.
Researching basic habitat requirements, population biology and ecology	We are reliant on external investigators to assess this. Work has been *Bradypodion pumilum* (see Research above).	Work is being advanced on habitat associations for the geometric tortoise in collaboration with SAEON. The Maritz Lab is collecting population data and ecological information for several snake species.
Assessing whether the current and future protected area network would be adequate to protect representative samples of the reptile fauna of this region.	This can only be addressed once the basic population biology & habitat requirements are known.	Researchers at UWC are compiling snake species distribution maps which if ground-truthed and found to be reliable can be used in a revised assessment of the Protection Levels Project. There is still an underlying need to establish the environmental requirements of the most threatened reptile species.

The recommendations arising from this report are listed in Table 4 below.

Table 4. 2012 Recommendations for reptile conservation in the Western Cape Province.

2012 Recommendations	2017 Responses
Institute measures to safeguard remaining populations of geometric tortoises from fire and feral pigs.	One of the most important populations has been protected through the purchase of a key property.
Vigorously pursue stewardship arrangements with landowners that have geometric tortoise populations.	There is ongoing interaction with key landowners to register additional stewardship sites.
Actively monitor WCP reptile species in the pet trade.	Maintain database of illegal trade cases.
Broaden the effort to collect marine turtle records from WCP waters.	Liaise with Nelson Mandela Metropolitan University.
Continue to collect distribution data on all Threatened and Near Threatened WCP reptile species.	This will be ongoing.

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PSACHYDACTYLUS GEITJIE

16. Appendices

Appendix 1. List of all reptile species known to occur within the Western Cape Province. Those species alien to the WCP are marked with an asterisk. Species marked with a # require confirmation of their occurrence in the province.

Taxon name	English name	Alien
Acontias meleagris meleagris	Cape legless skink	
Afroedura hawequensis	Hawequa flat gecko	
Afrogecko porphyreus	marbled leaf-toed gecko	
Afrogecko swartbergensis	Swartberg African leaf-toed gecko	
Agama aculeata aculeata	ground agama	
Agama agama	common agama	*
Agama anchietae	Anchieta's agama	
Agama atra atra	southern rock agama	
Agama atra knobeli	southern rock agama	
Agama hispida	spiny agama	
Agama planiceps	Namibian rock agama	*
Amplorhinus multimaculatus	many-spotted snake	
Aspidelaps lubricus lubricus	coral snake	
Australolacerta australis	southern rock lizard	
Bitis arietans arietans	puff adder	
Bitis armata	southern adder	
Bitis atropos	berg adder	
Bitis caudalis	horned adder	
Bitis cornuta	many-horned adder	
Bitis rubida	red adder	
Bitis schneideri	Namaqua dwarf adder	
Bradypodion atromontanum	Swartberg dwarf chameleon	
Bradypodion damaranum	Knysna dwarf chameleon	
Bradypodion gutturale	Robertson dwarf chameleon	
Bradypodion occidentale	Namaqua dwarf chameleon	
Bradypodion pumilum	Cape dwarf chameleon	
Bradypodion ventrale	southern dwarf chameleon	
Caretta caretta	loggerhead turtle	
Causus rhombeatus	common night adder	
Chamaeleo namaquensis	Namaqua chameleon	
Chamaesaura anguina anguina	Cape grass lizard	
Chelonia mydas	green turtle	
Chelydra serpentina	common snapping turtle	*
Chersina angulata	angulate tortoise	
Chondrodactylus angulifer angulifer	giant ground gecko	
Chondrodactylus bibronii	Bibron's gecko	
Cordylosaurus subtessellatus	dwarf plated lizard	
Cordylus aridus	Dwarf Karoo girdled lizard	
Cordylus cloetei	Cloete's girdled Lizard	
Cordylus cordylus	Cape girdled lizard	
Cordylus macropholis	large-scaled girdled lizard	
Cordylus mclachlani	McLachlan's girdled lizard	
Cordylus minor	dwarf girdled lizard	
Cordylus niger	black girdled lizard	
Cordylus oelofseni	Oelofsen's girdled lizard	
Crocodylus niloticus	Nile crocodile	*
Crotaphopeltis hotamboeia	herald snake	
Dasypeltis scabra	common egg eater	
Dermochelys coriacea	leatherback sea turtle	

Taxon name	English name	Alien
Dipsina multimaculata	dwarf beaked snake	
Dispholidus typus typus	boomslang	
Duberria lutrix lutrix	common slug eater	
Elaphe guttata	corn snake	*
Eretmochelys imbricata	hawksbill sea turtle	
Gerrhosaurus flavigularis	yellow-throated plated lizard	
Gerrhosaurus typicus	Namaqua plated lizard	
Goggia braacki	Braack's pygmy gecko	
Goggia essexi	Essex's pygmy Gecko	
Goggia hewitti	Hewitt's pygmy gecko	
Goggia hexapora	Cedarberg pygmy gecko	
Goggia lineata	striped pygmy gecko	
Goggia microlepidota	small-scaled gecko	
Goggia rupicola	Namaqualand dwarf leaf-toed gecko	
Hemachatus haemachatus	rinkhals	
Hemicordylus capensis	graceful crag lizard	
Hemicordylus nebulosus	dwarf crag Lizard	
Hemicordylus robertsi	graceful crag lizard	
Hemidactylus mabouia	Moreau's tropical house gecko	*
Homopus areolatus	parrot-beaked tortoise	
Homopus boulengeri	Karoo padloper	
Homopus femoralis	greater padloper	
Homopus signatus	Namaqua speckled padloper	
Homoroselaps lacteus	spotted harlequin snake	
Karusaurus polyzonus	Karoo girdled lizard	
Lamprophis aurora	Aurora house snake	
Lamprophis capensis	Brown House Snake	
Lamprophis fiskii	Fisk's house snake	
Lamprophis fuscus	yellow-bellied house snake	
Lamprophis guttatus	spotted house snake	
Lamprophis inornatus	olive house snake	
Lepidochelys olivacea	olive ridley turtle	
Leptotyphlops nigricans	black thread snake	
Lycodonomorphus rufulus	common brown water snake	
Lycophidion capense capense	Cape wolf snake	
Lygodactylus capensis	Cape dwarf gecko	*
Meroles knoxii	Knox's desert lizard	
Meroles suborbitalis	spotted desert lizard	
Microacontias lineatus grayi	striped legless skink	
Microacontias lineatus lineatus	striped legless skink	
Microacontias litoralis	coastal legless skink	
Naja nivea	Cape cobra	
Naja nigricincta woodi	black spitting cobra	
Namazonurus peersi	Peers's girdled lizard	
Namibiana gracilior	slender thread snake	
Ninurta coeruleopunctatus	blue-spotted girdled lizard	
Nucras lalandii	Delalande's sandveld lizard	
Nucras livida	Karoo sandveld lizard	
Nucras tesselata	striped sandveld lizard	
Ouroborus cataphractus	armadillo girdled lizard	
Pachydactylus austeni	Austen's gecko	
Pachydactylus capensis	Cape gecko	
Pachydactylus formosus	southern rough gecko	

Taxon name	English name	Alien
Pachydactylus kladaroderma	Thin-skinned Thick-toed Gecko	
Pachydactylus labialis	Western Cape gecko	
Pachydactylus maculatus	spotted gecko	
Pachydactylus mariquensis mariquensis	Marico gecko	
Pachydactylus oculatus	golden spotted gecko	
Pachydactylus purcelli	western spotted gecko	
Pachydactylus serval	western spotted gecko	
Pachydactylus weberi	Weber's gecko	
Pedioplanis burchelli	Burchell's sand lizard	
Pedioplanis laticeps	Cape sand lizard	
Pedioplanis lineoocellata pulchella	spotted sand lizard	
Pedioplanis namaquensis	Namaqua sand lizard	
Pelamis platurus	Yellow -bellied Sea Snake	
Pelomedusa subrufa	marsh terrapin	
Philothamnus hoplogaster	green water snake	
Philothamnus natalensis occidentalis	eastern green snake	
Prosymna sundevallii sundevallii	Sundevall's shovel-snout	
Psammobates geometricus	geometric tortoise	
Psammobates tentorius tentorius	tent tortoise	
Psammobates tentorius trimeni	Namaqua tent tortoise	
Psammobates tentorius verroxii	Bushmanland tent tortoise	
Psammophis crucifer	cross-marked grass snake	
Psammophis leightoni	fork-marked whip snake	
Psammophis namibensis#	Namib whip snake	
Psammophis notostictus	Karoo whip snake	
Psammophylax rhombeatus rhombeatus	spotted skaapsteker	
Pseudaspis cana	mole snake	
Pseudocordylus microlepidotus microlepidotus	Cape crag lizard	
Pseudocordylus microlepidotus namaquensis	Cape crag lizard	
Ptenopus garrulus maculatus	common barking gecko	
Indotyphlops braminus	flower-pot snake	
Rhinotyphlops lalandei	Delalande's beaked blind snake	*
Scelotes bipes	silvery dwarf burrowing skink	
Scelotes caffer	Cape dwarf burrowing skink	
Scelotes gronovii	Gronovi's dwarf burrowing skink	
Scelotes kasneri	Kasner's dwarf burrowing skink	
Scelotes montispectus	Tableview dwarf burrowing skink	
Scelotes sexlineatus	striped dwarf burrowing skink	
Stigmochelys pardalis	leopard tortoise	
Telescopus beetzii	Namib tiger snake	
Tetradactylus seps	short-legged seps	
Tetradactylus tetradactylus	common long-tailed seps	
Trachemys scripta	Red-eared Slider	
Trachylepis capensis	Cape skink	*
Trachylepis homalocephala	red-sided skink	
Trachylepis occidentalis	western three-striped skink	
Trachylepis sulcata	western rock skink	
Trachylepis variegata	variegated skink	
Tropidosaura montana montana	common mountain lizard	
Typhlosaurus caecus	Cuvier's blind legless skink	
Varanus albigularis albigularis	rock monitor	
Varanus niloticus	Nile monitor	*

CHAPTER 8

AVIFAUNA

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Scientific Services, CapeNature

8

Contents

CAPE VULTURE

Executive Summary

There are 608 bird species recorded for the province including the offshore waters, with 269 species resident to the province, a number which has remained constant over the last 15 years. Only one species, the Agulhas Long-billed Lark occurs solely within the boundaries of the province. Within the Cape Floristic region however (occurring predominantly within the Western Cape, with the remainder in the Northern and Eastern Cape), there are seven endemic bird species.

The regional conservation status assessment of the birds of South Africa, Lesotho and Swaziland was published in 2015, and is an essential resource that is used to aid in avifaunal conservation planning. Populations and/or distribution ranges of five species have reduced to such an extent that they moved two categories higher on the threat status scale. Twelve new species were added to the list of threatened species. It took 15 years for the regional conservation status of birds to be reassessed. Given the nature of the threats to birds and rate of habitat change, the gap between these assessments is too long and needs to be re-addressed in future.

Of the threatened species in the province, two species are critically endangered, 11 are endangered, 15 are vulnerable and 19 species are near threatened. Threats faced by these species include habitat degradation, decreasing food supply, invasive species, disease, predation and climate change; the impact and severity of all these are likely to increase in future.

Both the composition and number (10) of alien species that have established free ranging populations in the province have remained constant over the previous reporting periods. The invasive Common Myna is expanding its range and there is a real possibility that it could move into the Western Cape. The program to remove the highly invasive House Crow from the Cape Metropolitan has been extremely successful.

SABAP2 continues to play the key role in the country and Province in terms of providing distribution and relative abundance data of all the avifaunal species. Species specific monitoring projects are run by SANParks, CapeNature and DEA, as well as by NGOs and tertiary institutions in the Province.

In terms of legislation concerning avifauna in the Province, the National Environmental Management: Biodiversity Act (Act no 10 of 2004) and the Threatened or Protected Species (TOPS) regulations promulgated in terms of the Act in 2007 are still applicable. Since the 2012 SOB report the Alien Invasive Species (AIS) regulations were gazetted in 2014, placing restrictions on the keeping and use of identified alien invasive species. The only active Biodiversity Management Plan for species (BMP-s) for birds in the Province is for the African Penguin. This BMP-s is undergoing its 5 year review and update. In terms of achieving its aim, the vision of halting the decline within two years of the BMP-s being gazetted was not reached. A critical review of actions is required, and is being undertaken by DEA. The BMP-s for the Cape Vulture and Crane species have not materialised, although a Multi-species action Plan has been compiled for African Vulture species.

Numerous public awareness campaigns occur through various marketing, advertising and awareness raising by government departments and NGOs. Research is required to assess how effective these various initiatives are in raising awareness for avifaunal conservation and changing people's behaviours to become more environmentally conscious. The publication of the revised Important Bird and Biodiversity Areas Directory for South Africa during this period has provided an updated inventory of the sites most critical to long-term bird conservation.

Conservation of the Province's avifauna is moving into an increasingly challenging phase in light of the threats they face. As capacity amongst all levels of government, NGOs and tertiary institutions becomes increasingly limited, the need and value of partnerships is progressively important.

1. Introduction

The long awaited updates to the threatened status of South African birds has been published and understandably a large portion of this chapter is dedicated to the effects of these updates. Unfortunately this assessment indicates that the threats to the avifauna have not abated, and that there are also a number of new ones. This is going to place added responsibilities on conservation authorities and non-governmental organisations that are already resource limited. Fortunately avifauna in the province and the country as a whole is supported with a huge component of citizen scientists and bird club members who have already contributed substantial resources in gathering data for various monitoring programs, and implementing small scale conservation projects. Between 2012 and 2017 this army of scientists have carried out over 17 500 surveys over nearly the entire province, as part of the 2nd South African Bird Atlas Project (SABAP2). The data emanating from this project is already proving useful in informing, amongst others, landscape conservation initiatives and mitigation of development impacts.

2. Methods

Most presence and distribution data were obtained from the CapeNature State of Biodiversity database, a list that is methodically maintained for the province by Trevor Hardaker, which includes vagrant visitors and the 2nd South African Bird Atlas Project (SABAP2). The 2015 Eskom Red data book of birds of South Africa, Lesotho and Swaziland (Taylor *et al.,* 2015) was used to obtain the regional conservation status, while the global conservation status was obtained from the International Union for Conservation of Nature (IUCN) web based database (IUCN, 2017). Nomenclature (both scientific and common names) followed that of BirdLife South Africa's latest list for southern African species (version 6 dated 22/04/2016) which is freely available from their website (https://www.birdlife.org.za/publications/checklists).

3. Systematic account

There are 608 species that have been recorded for the province including the offshore waters (Appendix 1). This is 10 species more than that reported in the 2012 SOB report. For the purposes of this report, a number of species were removed from the 2012 list due to unsubstantiated records, and confusion with species name changes due to species splits. Additional species recorded for the province during 2013-2017 were all vagrants that remained for short periods before disappearing. Most notable among these where the Rufous-tailed Scrub Robin (*Cercotrichas galactotes*), European Pied Flycatcher (*Ficedula hypoleuca*) and Black Skimmer (*Rhynchops niger*).

The majority of the species recorded for 2013-2017 were species resident to the province (269) and this number has remained constant over the last two SOB Reports (Turner, 2012, 2007). For most of the other groupings the number of species have remained more or less the same (Figure 1) and the slight changes to groups like "Southern Extremities" and "Escapee" are due to changes in distributional status as a result of better information.

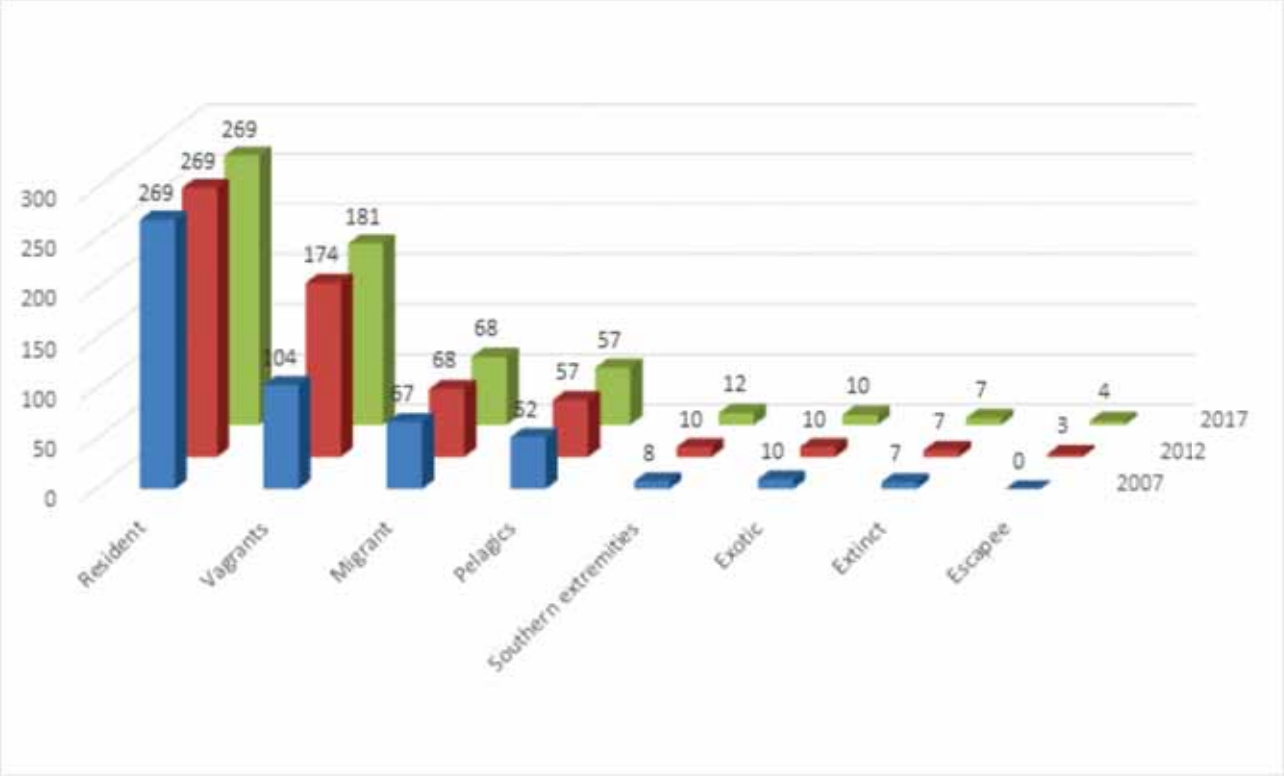

Figure 1: Comparative numbers of Western Cape bird species in each category as reported in the 2007, 2012 and 2017 SOB reports.

4. Distribution Data

Bird distribution data is recorded via SABAP2, by numerous citizen scientists throughout the province. Currently there are just over 2 200 observers registered with the project who, since 2007 when the project was initiated, have contributed over 9 million records for the entire atlas region to the project. In the SOB 2012 report the number of Atlas surveys submitted for the Western Cape was given as 14500 and the survey coverage of the province as 79% (Shaw & Waller, 2012). As of June 2017 the number of surveys is over 32 000, which effectively means that 17 500 surveys have been completed in the last five years. The area of the province covered by the survey as of June 2017 stands at 91% and it is only some of the remote areas that now need to be surveyed (http://sabap2.adu.org.za/) – see map in Figure 2, courtesy of the SABAP2 project.

5. Endemism

There are seven recognised terrestrial Zoogeographic regions in the world and South Africa falls within the Afrotropic or Ethiopian Region (Ruda *et al.*, 2013). With birds however, as with some other taxa e.g. mammals and reptiles, a sub region within the Ethiopian region is recognised and is referred to as southern Africa. This is the area south of the Cunene, Okavango and Zambezi Rivers (Hockey *et al.*, 2005) and many field guides use this zoogeographical boundary e.g. Roberts birds of southern Africa, Smithers' Land mammals of southern Africa and Branch's Field guide to the snakes and other reptiles of southern Africa. It is for this reason that the term "endemic" or "near endemic" in the majority of cases refers to those species restricted or nearly restricted to southern Africa. This report covers only the Western Cape Province and hence endemism refers to those species restricted to the province and not to the southern African sub-region.

The Agulhas Long-billed Lark is the only species of bird that occurs solely within the boundaries of the province. The species is found in the Agulhas region of the province and has adapted to the agricultural habitat and is therefore fairly common (Hockey *et al.*, 2005).

The majority of the Cape Floristic Kingdom commonly referred to as Fynbos vegetation occurs within the Western Cape Province, with the Northern and Eastern Cape provinces containing the remainder of this vegetation type. Traditionally six bird species are recognised as endemic to this vegetation type (Lee & Barnard, 2015) and can therefore be considered near-endemics with the majority of their distribution restricted to the Western Cape Province. They are the Cape Sugarbird (*Promerops cafer*), Orange-breasted Sunbird (*Nectarinia violacea*), Victorin's Scrub-warbler (*Bradypterus victorini*), Cape Rock-jumper (*Chaetops frenatus*), Cape Siskin (*Crithagra totta*) and Protea Canary (*Serinus leucopterus*). The Hottentot Buttonquail (*Turnix hottentotus*) previously treated as a conspecific of the

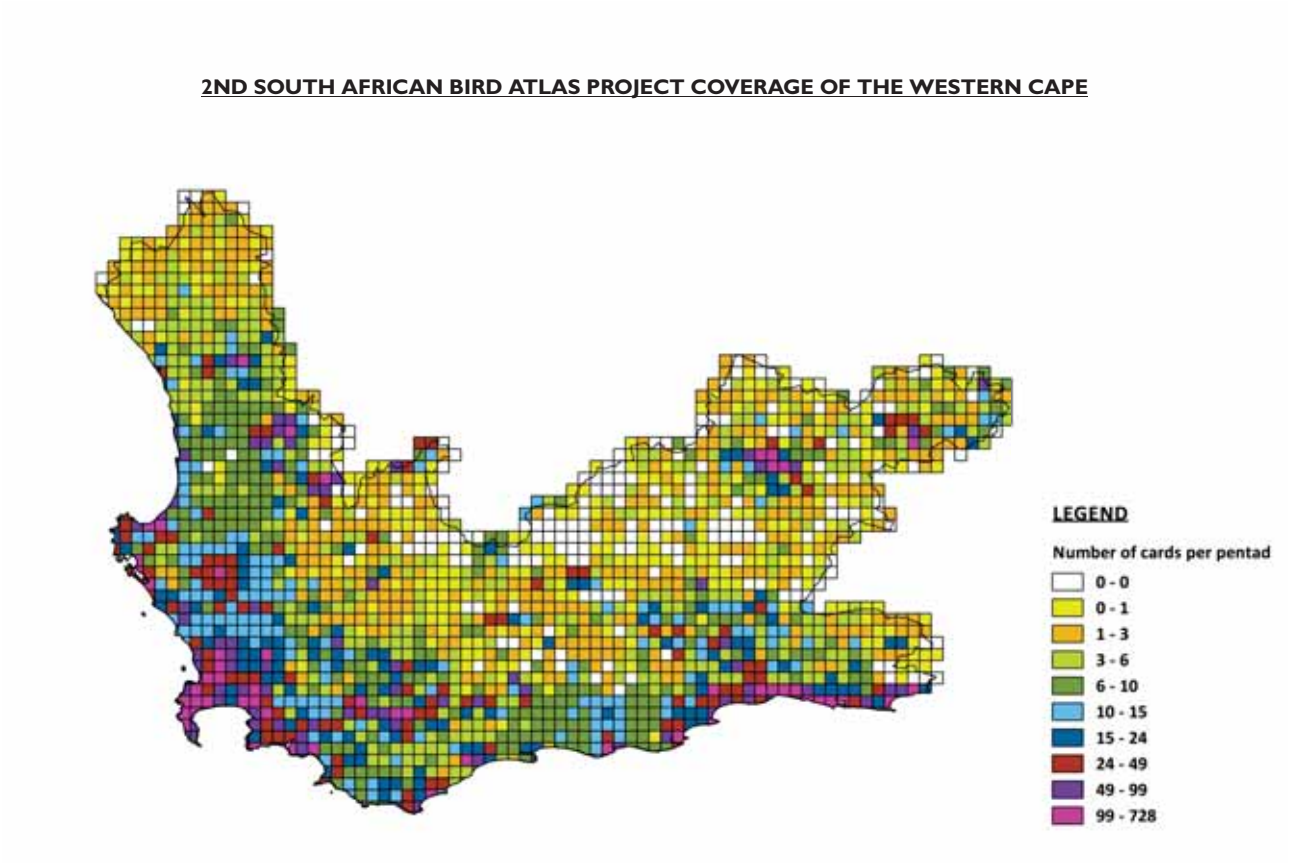

Figure 2: Map illustrating areas surveyed during the 2nd South African Bird Atlas Project as of the 8 September 2017 (Map created from data supplied by the Animal Demography Unit, University of Cape Town).

Black-rumped Buttonquail (*Turnix nanus*), can be considered as the seventh endemic Fynbos species as it only occurs within this vegetation type (Hockey *et al.,* 2005). The Hottentot Buttonquail is currently listed as Endangered (globally and nationally) owing to a small and highly fragmented population size. However, information for this species is lacking, and recent comprehensive surveys have suggested a slightly higher population size than previously thought, which may warrant down-listing to Vulnerable (Lee *et al.,* in press). The other six species are currently listed as "Least Concern" in terms of their Global Conservation status (IUCN, 2017), whereas in terms of their Regional status the Cape Rockjumper is listed as Near Threatened and the other five species as Least concern (Taylor *et al.*, 2015). Recent studies however indicate that these species have declined and that at least the Cape Rock-jumper and the Protea Seedeater need to be listed as threatened species, both regionally and globally (Lee & Barnard, 2012).

6. Conservation Status

The regional conservation status assessment of the birds of South Africa, Lesotho and Swaziland (Taylor et al., 2015) was completed since the last SOB report (Turner, 2012). The comparative statuses between the current report and the previous two reports (Shaw & Waller, 2012; Turner, 2007) is illustrated in Figure 3. The 15 year gap between the previous Red data book (Barnes, 2000) and the current one (Taylor *et al.*, 2015), is the reason why the same figures are displayed for 2007 and 2012. Populations and/or distribution ranges of five species had reduced to such an extent that they moved two categories higher on the status scale. Twelve new species were added to the list of threatened species. It is possible that the extended period between the Barnes (2000) report and the Taylor *et al.* (2015) report played a role in the number of new additions to the threat. The IUCN global threatened list however, showed that 6 new species were added between the SOB 2012 report and this 2017 report. Given the nature of the threats to birds and rate of habitat change, 15 years between assessments of threat status is too long and needs to be remedied in future.

The IUCN database was used to determine global threatened status. The global assessments correlate well with the regional assessments as the data shows that the number of threatened species (Endangered and Vulnerable) have increased with each SOB Report (Figure 4).

It must be noted that for both the regional and global status comparisons, species classified as vagrant to the province that were included in the 2012 threat status analysis were excluded as they inflated numbers in the various threat categories. This is why the 2012 figures in the above graphs differ from those presented in the 2012 report (Shaw & Waller, 2012). Furthermore the exotic species, the pelagic species and the birds that escaped from captivity were also excluded from the above analysis. The term pelagic can be ambiguous, but for this report the term is applied to those marine bird species that do not breed on the mainland or the islands offshore from the Western Cape mainland.

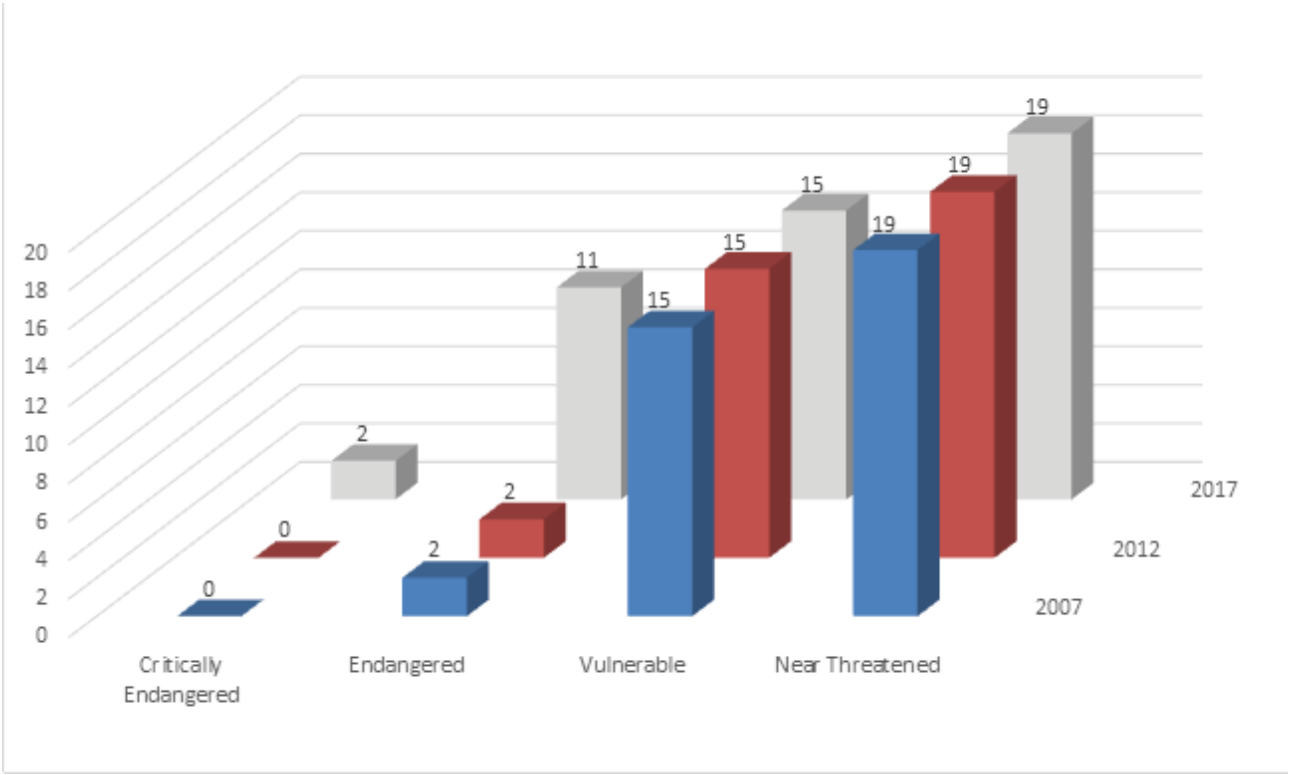

Figure 3: Number of Western Cape bird species occurring in each threat category as assessed at a regional level.

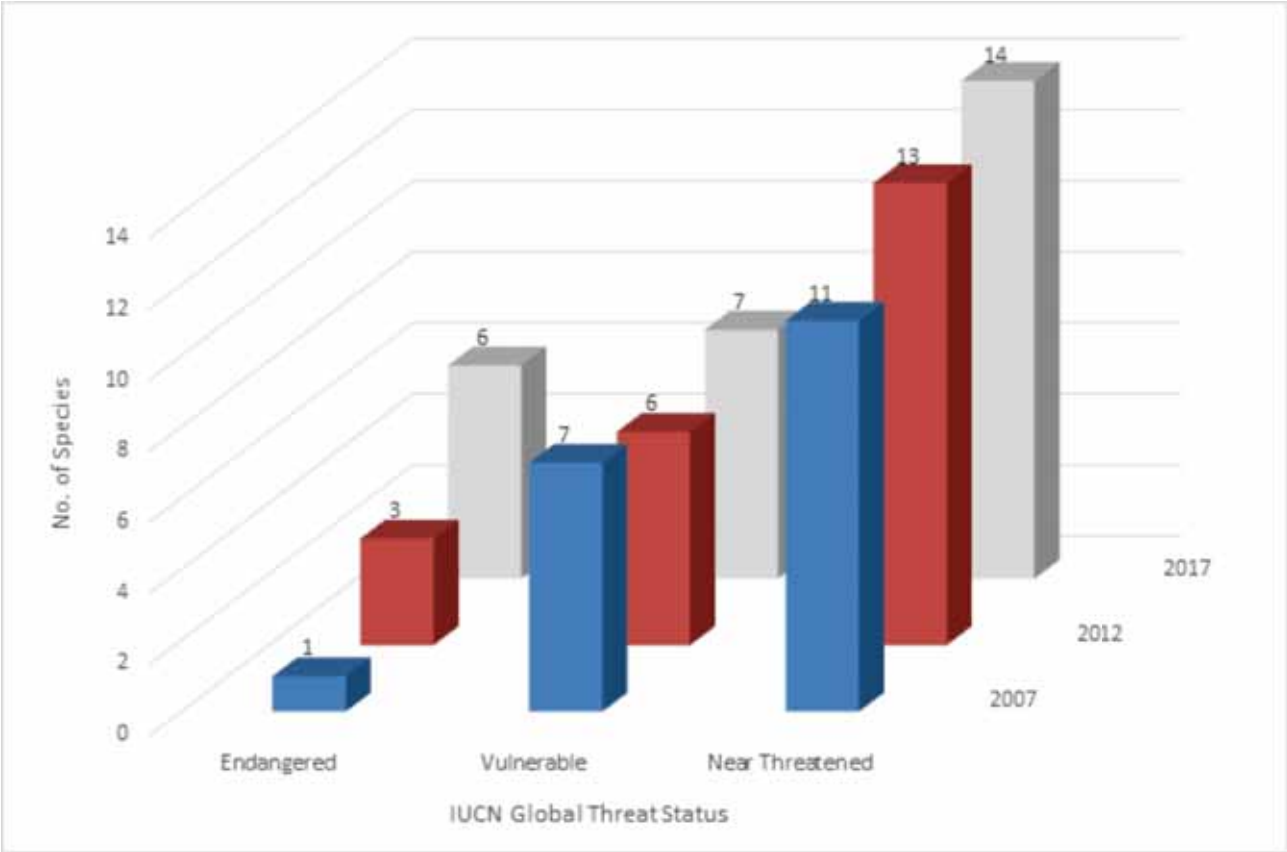

Figure 4: Number of Western Cape birds occurring in each threat category as assessed at a global level.

7. Threatened species

In this section, regionally threatened species found in the Western Cape Province are identified for the four IUCN threat categories (Critically Endangered, Endangered, Vulnerable, Near Threatened). The global status of each species is also included for completeness. Criteria used to evaluate species at a global and regional scale are standardised as per the IUCN threat criterion (IUCN, 2012). The individual species situations (e.g. population sizes and trends) at these two scales may differ however, and so their threat status may not be the same. Some species for example, may not be threatened regionally, but identified as threatened at a global scale. Only two of the Western Cape Province species listed as globally threatened, were not assigned a regional threat status. They are the Red Knot (*Calidris canutus*) and Bar-tailed Godwit (*Limosa lapponica*). Both are migratory species and both are listed as Near Threatened (IUCN, 2017).

7.1 Critically Endangered

Two species occurring in the province, the Damara Tern (*Sterna balaenarum*) and Leach's Storm Petrel (*Oceanodroma leucorhoa*) are listed as Critically Endangered (Table 1). The Damara Tern was uplisted during the 2015 conservation status assessment of birds from Endangered to Critically Endangered (Simmons, 2015).

Leach's Storm Petrel – This species breeds at islands in the North and South Atlantic as well as North Pacific oceans (Hockey *et al.*, 2005). In southern Africa, breeding has been confirmed at three locations: Jutten, Dassen and Dyer Islands (Crawford, *et al.*, 2007; Whittington *et al.*, 2008). Dassen Island currently represents the only extant breeding colony of Leach's Storm Petrel in the southern hemisphere, and this, together with its reproductive isolation from migratory non-breeding birds, warrants the regionally Critically Endangered status of this species (Taylor & Whittington, 2015). Breeding was last reported at Jutten Island in 2003 and at Dyer Island in 2005 (Crawford *et al.*, 2007; 2012), possibly due to cormorants nesting above favoured breeding sites in stone walls (Taylor & Whittington, 2015). CapeNature staff conduct surveys along the stone walls during October to February, the breeding season of Leach's Storm Petrel, to monitor for return of their breeding to Dyer Island.

Table 1: List of species classified as Critically Endangered at a regional scale. Corresponding statuses as at 2007 and 2012 SOB reports as well as the global statuses are included for comparison.

Common Name	Scientific Name	Regional Status			Global Status		
		2007	2012	2017	2007	2012	2017
Damara Tern	*Sterna balaenarum*	EN	EN	CR	NT	NT	NT
Leach's Storm Petrel	*Oceanodroma leucorhoa*	NA	NA	CR	LC	LC	VU

Damara Tern – While the species is listed as Near Threatened globally, it is listed regionally as Critically Endangered (Simmons 2015). The species is uncommon in the province although can be found along the entire coastline, with the only known extant breeding site situated in the Struisbaai area along the South Coast (Simmons, 2015). In the past, off-road vehicles travelling through the breeding area destroyed nests and created disturbance, but the banning of off-road driving on beaches has virtually eliminated this threat. Sand swamping and flooding at high tide of nests are currently the reasons for poor breeding performance (CapeNature unpubl. data).

7.2 Endangered

Species listed as endangered according to the latest regional assessment of the birds of South Africa are listed in Table 2 (Taylor *et al.*, 2015). Only one species, the Roseate Tern (*Sterna dougallii*), retained the same status as assessed in 2000 (Barnes, 2000). All the other species were uplisted to a higher threat category than what was previously assigned and in two species, the Black Harrier (*Circus maurus*) and the Cape Cormorant (*Phalacrocorax capensis*) the decline was of such a nature that they were uplisted two categories higher than previously assessed.

Roseate Tern – This species is listed globally as Least Concern, but Endangered regionally. Within the southern African region, it breeds on Bird Island and sometimes on St Croix, Algoa Bay and at Dyer Island, the only breeding locality within the Western Cape (Hagen, 2015a). The breeding population at Dyer Island has remained constant. Breeding on Dyer was first recorded in 1971, with estimates since ranging from no breeding to 20 pairs (Hagen, 2015a). More recent estimates from DEA indicate that c. 25 breeding pairs at Dyer Island in 2017 (DEA unpubl. data). During breeding, Roseate Terns are vulnerable to disturbance and do not immediately return to their nests once displaced (Underhill, 2000). As a result, eggs and chicks are vulnerable to predation by Kelp gulls (*Larus dominicanus*) and during cold, wet weather, chicks are vulnerable to hypothermia (Randall *et al.*, 1991). Dyer Island, like all other coastal offshore islands bar Robben Island, is closed to tourism. This provides these small, sensitive environments the protection they need to minimise disturbance to breeding seabirds.

African Marsh-Harrier – This species is listed globally as Least Concern, but Endangered regionally. While only 5% of the global range occurs within South Africa the area in which it occurs within this region has decreased by more than 30% (Taylor, 2015a). Loss of habitat, predominantly the degradation and loss of sensitive wetland habitats, is cited to be the reason for this decline (Taylor, 2015a). This species is monitored via the Coordinated Waterbird Count project, administered by the Animal Demography Unit, University of Cape Town. Conservation action required to improve the status of this species involves the protection and management of wetlands. For more information on the protection and management of wetlands see Chapter 2.

African Penguin – The African Penguin is endemic to the Benguela Upwelling Ecosystem, found in the coastal waters from northern Namibia to southern KwaZulu-Natal (Frost *et al.*, 1976; Shelton *et al.*, 1984). They breed at 28 localities in Namibia and South Africa (Kemper *et al.*, 2007), of which 9 islands and 2 mainland sites occur within the Western Cape Province.

Overall population trends of the African Penguin were summarised in the previous SOB report (Shaw and Waller, 2012) and in Crawford *et al.*, (2011) . The global population of African Penguins in 2011 was estimated at c. 26 000 pairs, which then was considered its lowest recorded level, with the Western Cape Province containing c. 34% of the global population (Department of Environmental Affairs & CapeNature unpubl. data). Since then, the population has continued to decline and the global population in 2016 was estimated at c. 25 000 pairs (Birdlife International, 2016), with the South African component declining by ~ 3 000 pairs during this period. As at 2016, the Western Cape contained 34 % of the global and 32% of the South African population (DEA

Table 2: List of species classified as Endangered at a regional scale. Corresponding statuses as at 2007 and 2012 SOB report as well as the global statuses are including for comparison.

Common Name	Scientific Name	Regional Status			Global Status		
		2007	2012	2017	2007	2012	2017
Roseate Tern	*Sterna dougallii*	EN	EN	EN	LC	LC	LC
African Marsh-Harrier	*Circus ranivorus*	V	V	EN	LC	LC	LC
African Penguin	*Spheniscus demersus*	V	V	EN	V	EN	EN
Bank Cormorant	*Phalacrocorax neglectus*	V	V	EN	EN	EN	EN
Cape Vulture	*Gyps coprotheres*	V	V	EN	V	V	EN
Ludwig's Bustard	*Neotis ludwigii*	V	V	EN	LC	EN	EN
Martial Eagle	*Polemaetus bellicosus*	V	V	EN	LC	NT	V
Black Harrier	*Circus maurus*	NT	NT	EN	V	V	V
Cape Cormorant	*Phalacrocorax capensis*	NT	NT	EN	NT	NT	EN
Antarctic Tern	*Sterna vittata*	LC	LC	EN	LC	LC	LC
Hottentot Buttonquail	*Turnix hottentottus*	NE	NE	EN	LC	LC	EN

unpubl. data). The species was uplifted to regionally Endangered in 2015 (Hagen, 2015b).

Threats to the African Penguin were summarised by Shaw & Waller (2012) in the African penguin Biodiversity Management Plan (Anon, 2013) and also Hagen (2015a), and are briefly alluded to in the threats section in this report. Access to sufficient food resources continues to be considered the primary driver of the ongoing decline of this species (Birdlife International, 2016).

The 2012 report summarised monitoring, research and some conservation initiatives taking place in the province. Much of this continues. Numerous publications have shown the benefit of and recommended no fishing zones around colonies (Pichegru *et al.*, 2010; Sherley *et al.*, 2015; 2017), which are range restricted when feeding. Research that looked at foraging of non-breeding penguins indicates a potential ecological trap that will have important implications for the future recovery of this species (Sherley *et al.*, 2017). The first African Penguin Biodiversity Management Plan is due for review and update in 2018, and that is further discussed in the legislative section later in this chapter.

Bank Cormorant – The Bank cormorant is near endemic to southern Africa, at breeding localities within the Benguela upwelling region off the west coast of Namibia and South Africa (Hockey *et al.*, 2005). This species is listed as globally and regionally Endangered, its regional status uplifted to a higher threat category from the previous assessment. The change in status was as a result of population declines of more than 50% over the past three generations (Cook, 2015a). Population trends for this species were reported in the 2012 SOB report (Shaw & Waller, 2012). Since then, the population has further declined and the trends are described in further detail in Crawford *et al.*, (2015). Food shortage is considered a key factor causing the decline (Crawford *et al.*, 2015), with oiling, human disturbance at nesting sites and competition for suitable nesting habitat with Cape fur seals as additional contributing factors (Cook, 2015a; Cooper, 1987; Crawford *et al.*, 1999). Additionally, breeding success of Bank cormorants is negatively impacted by environmental conditions such as large winter storms and heat waves (Sherley *et al.*, 2012). They are thus considered a species particularly vulnerable to increase in extreme climatic events as a result of climate change (Sherley *et al.*, 2012). A working group has been established to identify and facilitate the implementation of actions that are required to improve the conservation status of this species. Some of the initial priority actions that have been identified by this group include updating the population census to verify the population status; assessing the threats to this species at each Bank cormorant breeding colony; compiling a research strategy and placing artificial breeding platforms at a number of colonies and comparing the success thereof (Bank Cormorant Working Group Minutes 30 March 2017). Recently, (Sherley *et al.*, 2017) documented the benefit that small-scale, targeted MPAs (with associated monitoring and adaptive management) could have in solving localised species-specific conservation concerns such as that of Bank cormorants and Rock lobster (*Jasus lalandii*), which would be of benefit to the broader ecosystem without causing negative impacts to local fisheries.

Cape Vulture – The Cape Vulture is listed as Endangered, both on a global and regional scale (IUCN, 2017; Taylor *et al.*, 2015). The global population in 2013 was estimated at 4 700 pairs (Allan, 2015). As a breeding species it is extinct in Namibia and Zimbabwe, with a small breeding population in Botswana (Allan, 2015). South Africa thus contains > 90% of the breeding population of this species (Allan, 2015). There is only one breeding colony in the Western Cape situated in the De Hoop Nature Reserve. As indicated in the 2012 SOB Report this colony has been increasing since the mid 1980's (Shaw & Waller, 2012) and is still on the increase, currently at 100 breeding pairs (CapeNature unpubl. data). CapeNature monitors the Cape Vulture on a regular basis, and it is suspected that a change in farming practices has benefitted this population (Shaw pers. comm). From recorded incidents (CapeNature unpubl. Data) there are a number of threats, e.g., drowning in farm dams, collision with powerlines, electrocution, agrochemicals, etc. that the species is exposed to within the province. Mitigation measures are implemented as and when required in order to reduce the impacts of these threats. Collision with wind turbines is a new threat that needs to be monitored carefully. The first incidents of vultures colliding with wind turbines within South Africa was recorded in the first half of 2017. Although no operational windfarms currently occur within the foraging range of the Western Cape birds, there is one that is proposed within 40 km of the De Hoop colony, which is well within the range of a Cape Vulture's flying capabilities.

Ludwig's Bustard – The species is restricted to the arid parts of the province, and is declining due to collisions with telephone and power lines (Shaw, 2015). Jenkins *et al.,* (2011) obtained mortality rates of 0.63 birds/km/year in the Karoo resulting in an estimated 8 600 birds dying per year. Other threats to the species include, hunting, disturbance and poisoning. This species is monitored as part of the Coordinated Avifaunal Roadcount project, administered by the Animal Demography Unit, University of Cape Town. Retrofitting telephone and powerlines with mitigation devices and ensuring that the species is considered during the EIA process for new lines, are being implemented to reduce the number of mortalities.

Martial Eagle – It is estimated that there are about 800 mature birds occurring within South Africa and that the area that they occupy within the country has declined by 53.7% (Taylor, 2015b). Furthermore SABAP2 shows a decline in reporting rates for this species. Reasons for the decline include direct persecution by small stock farmers, drowning, reduction in prey, electrocution on electricity pylons and disturbance at the nest site. The large territory size required means that not even Protected Areas are a sanctuary for this species. Juvenile birds

dispersing out of Protected Areas are particularly at risk. Some mitigation measures have been developed and implemented for some of the threats such as drowning and electrocution. Given its territory size, it remains a species that is difficult to monitor in term of population trends. SABAP2 is thus a crucial tool to assist in determining changes in species distribution and reporting rates.

Black Harrier – The Black Harrier was listed as Near Threatened in 2000 (Barnes, 2000), but is now listed as Endangered (Taylor, 2015c), a jump of two threat categories. The species' favoured breeding habitat in the Western Cape is Fynbos. Curtis *et al.*(2014) found almost no nests in transformed habitat in the lowland areas of the Fynbos. The transformation of Renosterveld (a type of Fynbos vegetation) for agriculture, especially in the Overberg, is the reason for this species' population decline (Taylor, 2015c). A long term study (>10 years) under the auspices of the Percy FitzPatrick Institute, University of Cape Town is providing valuable information on the biology and ecology of the species. Furthermore the incorporation of the remaining habitat fragments under private ownership into formal stewardship agreements, by CapeNature and other Non-governmental Organisations like the Overberg Lowland Conservation Trust will ensure the future of the species.

Cape Cormorant – The Cape cormorant is a southern African endemic seabird species and has jumped two threat categories since the last assessment report, and has gone from Near Threatened in 2012 to Endangered as at the time of this SOB Report and trends of this species are reported in (Cook, 2015b; Crawford *et al.*, 2016; Crawford *et al.*, 2015). As with many of the coastal seabirds, lack of available food is considered the driver of this decline (Cook, 2015b). This food shortage has been attributed to shifting fish stocks as a result of climate change (Crawford et al., 2007; Crawford *et al.*, 2015) and to competition with commercial purse seine fisheries (Cook, 2015b). Additional threats to the species include human disturbance causing nest abandonment and subsequent predation of eggs and chicks (Cook, 2015b). Primary predators of this species include the Kelp gull (*Larus dominicanus*), Great White Pelicans (*Pelecanus onocrotalus*) and Cape fur seals (Makhado *et al.*, 2013; Voorbergen *et al.*, 2012). Outbreaks of Avian cholera (*Pasteurella multocida*) have affected some colonies, and caused the mortality of almost 10 000 adults in one outbreak (Waller & Underhill, 2007), but these large scale mortality events have fortunately not been documented since the mid-2000s.

Hottentot Buttonquail – This is a shy and elusive species and as such is very difficult to find, let alone monitor and therefore very little is known about the biology of the species. The global population is estimated at less than 1000 individuals and it is suspected that this is declining due to habitat loss and fragmentation (Peacock, 2015a). The species was not evaluated during the 2000 red data book assessment as it was considered conspecific with the more widespread Black-rumped Buttonquail (*Turnix nanus*). Dr Alan Lee of the Percy FitzPatrick Institute and Dale Wright from BirdLife South Africa have recently completed a survey across the entire suspected distribution range of the species in order to assess the status of the species. Preliminary modelling results suggest a larger population size for this species than current estimates. Once published, these data will provide valuable information on the species.

Table 3: List of species classified as Vulnerable at a regional scale. Corresponding statuses as at 2007 and 2012 as well as the global statuses are including for comparison.

Common Name	Scientific Name	Regional Status			Global Status		
		2007	2012	2017	2007	2012	2017
African Finfoot	*Podica senegalensis*	V	V	V	LC	LC	LC
African Grass-Owl	*Tyto capensis*	V	V	V	LC	LC	LC
Cape Gannet	*Morus capensis*	V	V	V	V	V	V
Denham's Bustard	*Neotis denhami*	V	V	V	NT	NT	NT
Knysna Warbler	*Bradypterus sylvaticus*	V	V	V	V	V	V
Striped Flufftail	*Sarothrura affinis*	V	V	V	LC	LC	LC
African Crowned Eagle	*Stephanoaetus coronatus*	NT	NT	V	NT	LC	LC
Black Stork	*Ciconia nigra*	NT	NT	V	LC	LC	LC
Caspian Tern	*Sterna caspia*	NT	NT	V	LC	LC	LC
Great White Pelican	*Pelecanus onocrotalus*	NT	NT	V	LC	LC	LC
Lanner Falcon	*Falco biarmicus*	NT	NT	V	LC	LC	LC
Secretarybird	*Sagittarius serpentarius*	NT	NT	V	LC	V	V
Burchell's Courser	*Cursorius rufus*	LC	LC	V	LC	LC	LC
Verreaux's Eagle	*Aquila verreauxii*	LC	LC	V	LC	LC	LC
Southern Black Korhaan	Afrotis afra	NE	NE	V	NE	NE	V

7.3 Vulnerable

Table 3 lists those species that have been assessed in the latest 2015 regional threatened status assessment and assigned a threat status of Vulnerable (Taylor *et al.,* 2015). Seven species retained the same assigned category as assessed in 2000 (Barnes, 2000), while eight species were uplisted to a higher category two of which, the Burchell's Courser and Verreaux's Eagle were uplisted two categories higher than previously assessed.

African Finfoot – This is a naturally rare and localised species occurring in the coastal region of the province, with the distribution extending not much further west than Mossel Bay (Hockey *et al.*, 2005). Threats to the species habitat, specifically reduced water flow in rivers due to afforestation, damming and water abstraction, is cited as the principle threat (Peacock, 2015).

African Grass Owl – This species is limited to a few breeding pairs in the Province in an area stretching from Knysna in the east to the Bredasdorp are in the west (Whittington-Jones & Peacock, 2015). The scarcity and crepuscular nature of the species in the region makes it difficult to determine the population size. Most of the records for this species are from ad hoc sightings and road kills (CapeNature unpubl. data). In the province, loss of habitat predominantly due to urbanisation is the largest threat facing this species. Collision with cars is frequently recorded as a cause of mortality in other parts of the species range (Whittington-Jones & Peacock, 2015). There have been a few mortalities of this nature in the Western Cape (CapeNature unpubl. data) but it is unclear what impact this is having on the local population.

Denham's Bustard – In South Africa, this species can be found from the Overberg in the Western Cape, through the Eastern Cape and KwaZulu Natal to the high lying grasslands of Mpumalanga with an outlying sub-population in the Limpopo province (Hockey *et al.*, 2005). The species is impacted upon by a wide range of threats throughout its distribution range. In the Western Cape the most serious threat to the species is collisions with powerlines (Shaw *et al.,* 2010). The transformation of large areas of natural veld to mono–culture has seemed to benefit the species (Allan, 2003) and as indicated in the 2012 SOB report, data collected through the Coordinated Avifaunal Roadcount shows an increasing population trend for the species (Shaw & Waller, 2012).

Knysna Warbler – The species is endemic to South Africa and restricted to the narrow coastal strip from near Margate in the east to Cape Town in the west, with an isolated inland population near Swellendam. Within this range the distribution is not continuous and is highly fragmented (Hockey *et al.,* 2005). Habitat destruction through the clearing of natural vegetation for housing is the main threat for this species and has resulted in the disappearance of the species in areas. This in turn has increased fragmentation which could lead to inbreeding depression (Taylor, 2015d).

Striped Flufftail – Two subspecies have been described, the nominate subspecies is endemic to South Africa and Swaziland. Within the Western Cape the species occurs mostly at high altitudes and can be found on the mountain ranges in a narrow band stretching from the province's eastern border westwards to the Cape Peninsula (Hockey *et al.*, 2005). In the province large proportions of the mountain ranges within this species distribution range are conserved either as Provincial reserves, mountain catchment areas or stewardship sites. High-frequency and high intensity fires are, however, a threat to the species. High-frequency fires tend to alter the habitat while high intensity fires result in mortalities (Peacock, 2015b).

African Crowned Eagle – In the province the species is restricted to the Afro-montane forests of the southern Cape occurring as far westward as Heidelberg (Hockey *et al.,* 2005). Unlike in other parts of its distribution where the species has adapted to alien plantations, the majority of the nests in the Province are found in the natural forests, all in large Outeniqua Yellowwood (*Podocarpus falcatus*) trees (CapeNature unpubl. data). Threats to this species include persecution and loss of habitat (Taylor, 2015b).

Black Stork – The species is uncommon in the Western Cape, occurring in small groups or as single birds (Siegfried, 1967). Hockey *et al.,* (1989) indicate that the breeding population within the south-Western Cape is small and estimate that there are less than 5 breeding pairs. There is a paucity of information in the literature on both the non-breeding and breeding populations of this species. Taylor (2015e) assessed the species based on the reduction of its Area of Occupancy from information obtained via SABAP2. Probable threats to the species include habitat degradation and collisions with powerlines and overhead cables (Taylor, 2015e)

Lanner Falcon – The species is widespread throughout the province and occurs at relatively high densities. While loss of habitat in the Grassland Biome is cited as the most important threat within South Africa, in the Western Cape secondary threats such as poisoning, persecution by pigeon fanciers and powerline collisions would be more applicable (Taylor, 2015f) and the impact thereof requires monitoring.

Secretarybird – The species occurs throughout the province (Hockey *et al.*, 2005) with higher densities recorded for the coastal plains between the mountain ranges and the coastline and around Beaufort West region (Retief, 2015). The primary threat to the species is cited as habitat loss due to agriculture and urbanisation (Retief, 2015), although they seem to have adjusted to the small grain/small stock rotational agricultural system practiced within the Western Cape, nesting on small trees in remaining natural vegetation patches and foraging in the agricultural lands (Shaw pers obs). Retief (2015) indicates other threats and those that would be of relevance to the province include powerline collisions, indiscriminate poisoning and the risk of collisions with wind turbines.

Burchell's Courser – The species occurs in the arid regions of the province and avoids the fynbos areas (Maclean and Herremans, 1997). A number of publications (Hockey *et al.*, 2005; Maclean and Herremans, 1997; Peacock, 2015c) indicate that the species has declined, both in number and range, but the cause thereof is poorly understood. Peacock (2015c) cites habitat loss, irrigation for agriculture use, pesticides and fertilizers and the possible reduction of wild grazing ungulates as probable causes for the species decline.

Verreaux's Eagle – The species occurs throughout the province, but is mainly restricted to the mountainous areas (Davies & Allan, 1997). Although large portions of these mountains are provincial nature reserves the data indicates that the Area of Occupancy for the species has declined (Taylor, 2015g). Direct persecution is the primary threat, but other threats include collisions with powerlines, depletion of its natural prey, urbanisation and drowning in farm water reservoirs. With the increase in the supply of renewable energy, a future threat that will need to be considered is the collision with the blades of wind turbines (Taylor, 2015g). Recent research has shown that this species can adapt to foraging in agricultural landscapes; however this may lead to increased persecution (Murgatroyd *et al.*, 2016).

Southern Black Korhaan – The species is endemic to South Africa and is restricted mainly to the Western and Eastern Cape, but the distribution does extend into the Northern Cape (Hockey *et al.,* 2005). The large scale removal of the natural vegetation in the wheat-land areas of the Overberg and the Swartland, including the urbanisation of the Cape Flats region has resulted in the decline of this species within the province (Hofmeyr & Taylor, 2015). Other threats include, disturbance and nest predation by corvids. Conservation actions should focus on conserving the remaining lowland fynbos and Karoo habitats which the species favours.

Cape Gannet – The Cape gannet is a southern African endemic, breeding on three islands in Namibia and three islands in South Africa, with two in the Western Cape (Kemper *et al.,* 2007a). The SOB report for 2012 reported that there were 120 000 pairs in South Africa. In 2016, c. 122 000 pairs bred in South Africa, with c. 40 000 pairs in the Western Cape (DEA unpubl. data).

Threats to this species are summarised in the 2012 SOB report (Shaw & Waller, 2012) and Hagen (2015c) and are not discussed in great detail in this report (although see later in Threats section for broad threats to seabirds). Subsequent to the 2012 SOB report, a declining trend in survival of adult Gape Gannets at Lambert's Bay over a 20 year period between 1956 and 2007 was shown (Distiller et al., 2012). This period coincided with the south eastward displacement of most spawning sardine and anchovy from the west coast of South Africa to the south coast (Coetzee *et al.*, 2008; Roy *et al.*, 2007). Furthermore, Distiller *et al.*, (2012) state that the continued use of sub-optimal conditions by the west coast colonies is an ecological trap and recommend the introduction of spatial considerations into fisheries management. As has been mentioned before in this chapter, coastal breeding seabirds are vulnerable to extreme weather/environmental conditions. In 2016, 123 Gannet fledglings and 38 adults drowned at Lambert's Bay as a result of foam washing up onto the island (CapeNature unpubl. data).

7.4 Near Threatened

The species listed in Table 4 are those that were assigned the threat status Near Threatened during the 2015 regional red list assessment (Taylor *et al.*, 2015). Two species, the Blue Crane (*Anthropoides paradiseus*) and the Kori Bustard (*Ardeotis kori*) were downlisted to a lower category as the data for the two species did not warrant retaining or uplisting the 2000 assigned status of vulnerable (Barnes, 2000). Twelve species retained the same status as assessed in 2000, while six species were uplisted due to declines in either the area of occupancy or in population size. Two of the latter species, the Eurasian Curlew and the European Roller, are undergoing declines due to threats on their northern breeding grounds and on their migration routes, while two other species, the African Rock Pipit and the Cape Rock-jumper, are predicted to undergo severe range contractions due to climate change (Taylor *et al.*, 2015). The data for the Karoo Korhaan suggests that the populations has undergone a decline, but the reasons for this decline are unclear (Peacock, 2015d), while the Maccoa Duck is suspected to have undergone a decline due to invasive vegetation encroaching onto and into suitable wetlands, variation of water levels in artificial impoundments, disturbance, pollution, draining of wetlands and improved water quality in sewage farms (Berruti *et al.*, 2007). The status of the remaining ten species listed in the table has stayed the same over the period of three assessments suggesting that the original decline in population number and/or distribution range has stabilised.

8. Threats

8.1 Habitat destruction and degradation

Evaluating the threats to birds listed in the threatened categories above it is clear that the greatest threat for the terrestrial and freshwater birds in the Western Cape is still destruction and degradation of habitats. With an increasing human population within the province it is highly likely that this threat will persist and the only intervention is mitigation. Activities (agricultural expansion, mining, etc.) that contribute to the threat may change due for e.g. to changing technologies requiring new approaches to mitigation measures. This requires monitoring, often at a landscape scale, to determine the impact of the threat and the success of the mitigation. In the majority of cases it is mostly the habitat specialists that are impacted, e.g. Black Harrier (Curtis *et al.*, 2004) whereas generalist species and/or species that can adapt to man-made habitats e.g. Pied Crow (*Corvus albus*) are increasing in numbers and expanding their distribution ranges (Londei, 2010). This is of particular concern for the

Table 4: List of species classified as Near Threatened at a regional scale. Corresponding statuses as at 2007 and 2012 as well as the global statuses are including for comparison.

Common Name	Scientific Name	Regional Status			Global Status		
		2007	2012	2017	2007	2012	2017
Blue Crane	*Anthropoides paradiseus*	V	V	NT	V	V	V
Kori Bustard	*Ardeotis kori*	V	V	NT	LC	LC	NT
Agulhas Long-billed Lark	*Certhilauda brevirostris*	NT	NT	NT	NR	NR	NE
Black-winged Lapwing	*Vanellus melanopterus*	NT	NT	NT	LC	LC	LC
Chestnut-banded Plover	*Charadrius pallidus*	NT	NT	NT	NT	NT	NT
Crowned Cormorant	*Phalacrocorax coronatus*	NT	NT	NT	NT	NT	NT
Greater Flamingo	*Phoenicopterus roseus*	NT	NT	NT	LC	LC	LC
Greater Painted-snipe	*Rostratula benghalensis*	NT	NT	NT	LC	LC	NR
Half-collared Kingfisher	*Alcedo semitorquata*	NT	NT	NT	LC	LC	LC
Knysna Woodpecker	*Campethera notate*	NT	NT	NT	NT	NT	NT
Lesser Flamingo	*Phoeniconaias minor*	NT	NT	NT	LC	LC	NT
Peregrine Falcon	*Falco peregrinus*	NT	NT	NT	LC	LC	LC
Sclater's Lark	*Spizocorys sclateri*	NT	NT	NT	NT	NT	NT
African Rock Pipit	*Anthus crenatus*	LC	LC	NT	LC	LC	LC
Cape Rock-jumper	*Chaetops frenatus*	LC	LC	NT	LC	LC	LC
Eurasian Curlew	*Numenius arquata*	LC	LC	NT	LC	NT	NT
European Roller	*Coracias garrulous*	LC	LC	NT	NT	NT	LC
Karoo Korhaan	*Eupodotis vigorsii*	LC	LC	NT	LC	LC	LC
Maccoa Duck	*Oxyura maccoa*	LC	LC	NT	NT	NT	NT

seven fynbos endemic species which may become increasingly threatened in future, due to habitat loss or degradation.

There is a need for energy for the growing population and the policy makers are looking to renewable energy to supply this demand. A number of wind and solar farms have been proposed and some are already operational. Pre-construction monitoring on these development sites have allowed for better placement and in a number of cases a reduction in the number of solar panels/turbines and as a means of mitigating the possible impacts. Post-construction monitoring has shown that a number of bird fatalities have occurred at these renewable energy farms (Ralston Paton *et al.*, 2017). This data is being assimilated and will be analysed providing a better understanding of the impacts that these technologies are having on the avifauna of the province.

In the marine environment, oiling is one of the biggest activities that contribute to a degradation of habitat and this is through both chronic and catastrophic events. The impact of oiling is two-fold. Firstly it causes direct mortality (to the adults and juveniles that are oiled, and chicks that are abandoned as a result of parents dying or being captured and sent for rehabilitation (Wolfaardt *et al.*, 2008, 2009). Secondly, it has also been shown to reduce survival and negatively impact future reproductive success of those birds that are de-oiled (Barham *et al.*, 2007). Flying seabirds such as cormorants and gannets have very low success when it comes to de-oiling, while for the African penguin, de-oiling and rehabilitation has been successful – however with some birds exhibiting the secondary effects as noted above.

Plastic pollution also degrades the marine habitat, causing entanglements of seabirds on shore and at sea.

8.2 Food supply

This threat is mostly restricted to near-shore marine birds that are dependent on shoaling fish for food. These fish have either declined or have moved further from seabirds breeding sites, thereby requiring breeding birds to forage further afield. This has decreased both breeding success and adult survival of some seabirds (e.g. Crawford *et al.*, 2015; Sherley *et al.*, 2014, 2013). Numerous publications recommend the spatial management of fisheries and the creation of no take zones around seabird breeding colonies (Crawford *et al.*, 2015; Sherley *et al.*, 2017, 2015). Recommendations have also been made that more research is conducted to investigate the extent to which food is a limiting factor around colonies for certain species and to address measures to mitigate this (Cook, 2015b).

8.3 Invasive species

Invasive species directly impact the birds of the Western Cape, through for example predation and hybridisation or indirectly by changing the habitats. Those species responsible for direct impacts are the Feral Pig (*Sus scrofa*), the Mallard (*Anas platyrhynchos*) and the House Crow (*Corvus* splendens). The latter two are discussed

further in the section below on introduced species. The impact of feral pigs on especially ground nesting birds is unknown, but there is a program within CapeNature to eradicate this species in the areas where they occur.

Species that have indirect impacts on birds mostly do so by altering the habitat and include all the alien plant species that are invading natural systems, specifically Fynbos habitats. Exotic tree plantations are excluded as they are perceived as habitat degradation. Those areas that are invaded by exotic trees benefit for example a small sub-set of forest dwelling species, whereas it is not beneficial for species that have a preference for low shrub-land or open areas. Invasive plants also contribute to increased fire frequencies and intensities which alter the fynbos plant community. Chalmandrier *et al.* (2013) showed that older stands of Fynbos contained Fynbos endemic birds, while recently burnt fynbos contained birds which were primarily associated with habitats other than fynbos.

Invasive species may also hold some benefit to indigenous avifauna. For example the invasion of the coastal near shore waters by the Mediterranean Mussel (*Mytilus gallprovnicialis*) is cited as one the reasons why the African Black Oystercatcher (*Haematopus moquini*) population has increased by 37% since 1979/1980 and where previously assessed as Near Threatened (Barnes, 2000) has been removed from the threatened bird list in the latest assessment (Taylor *et al.*, 2015).

8.4 Disease

Disease can have a significant impact, particularly in threatened populations (Friend *et al.*, 2001), and the threat of disease can increase with the level of extinction risk in a species (Heard *et al.*, 2013) and so from a conservation management point of view, it is important to be aware of disease outbreaks and their potential impact.

There are a number of avian diseases that can and do occur within the bird populations of the province and most of them only result in individual mortalities. Avian botulism, however can result in a number of deaths, and outbreaks do occur on an irregular basis at a number of the many waterbodies scattered throughout the province. The bacterium (*Clostridium botulinum*) that causes the outbreaks occurs naturally in the environment, and while infected animals can be treated at an early stage, implementation of measures to prevent the spreading of the disease once detected is the only way to mitigate the impact. Avian flu, may have an indirect impact on wild birds through its impact on the Ostrich and poultry industry. The financial loss due to import embargos and the often large scale euthanasia of contaminated birds may incite farmers to retaliate against wild birds. Depending on the methods used this retaliation could have severe localised impacts on certain bird populations.

A disease risk assessment was completed in 2016 for southern African seabird colonies (Parsons & Vanstreels, 2016). It provides details of known diseases recorded in the captive and wild environments, and lists the following as disease hazards of high concern for specific seabird groups based on the probability of occurrence and outbreak impact: Newcastle disease, Avian cholera, Avian malaria, Coccidiosis, Avian influenza, Avian botulism and Marine biotoxins.

8.5 Predation

Predation is a significant threat to a number of seabirds listed in this report. At sea, predation by Cape fur seals is a threat to African penguins, Cape Gannets and Cape and Bank Cormorants (Makhado *et al.*, 2013; Weller *et al.*, 2016). On land predation by kelp gulls (Pichegru, 2013; Weller *et al.*, 2016, 2014), Great White Pelicans (Mwema *et al.*, 2010), Pied Crows (Fincham and Lambrechts, 2014), caracals (CapeNature unpubl data, Underhill *et al.*, 2006), mongooses (CapeNature Unpubl data) and leopards (CapeNature unpubl data) have been documented. Of particular concern is caracal predation at the two mainland colonies of Stony Point and Burgher's Walk/Boulders. In almost all the cases some form of mitigation is required to reduce predation levels to acceptable levels.

8.6 Climate change and extreme climatic events

Although climate change has an impact on all the above threats it is included as a separate threat as it can have a direct impact on birds. There is evidence that at least two species of fynbos near endemics Cape Rockjumper (*Chaetops frenatus*) and Protea Seedeater (*Serinus leucopterus*) are susceptible to climate change, and have suffered range contractions due to this (Lee & Barnard, 2015). The Percy FitzPatrick Institutes "Predicting the impacts of Climate Change on Desert Birds: the "Hot Birds" Programme has undertaken a number of studies where the impact of climate change on birds is clearly shown, albeit their study site in South Africa sits in the Northern Cape Province. Some studies within this group have also focused on the physiological responses of Cape Rockjumpers and other species to increased temperatures, and these have suggested that Rockjumpers in particular exhibit a reduced capacity to respond physiologically, and show behaviours associated with cooling at lower temperatures as ecologically similar species (Milne *et al.*, 2015). In addition a camera trap study focusing on bird drinking sites revealed a strong dependence on such sites for granivores (Lee *et al.*, 2017). Predictions of increased temperatures and decreased rainfall may therefore have negative impacts on these species.

Given that most breed in low lying coastal areas, the southern African seabirds listed in this report are particularly vulnerable to climate change and environmental conditions such as extreme weather events, the frequency of which is likely to increase in future.

9. Introduced Species

Within the Western Cape Province, both the species, and number of exotic species that have established free ranging populations have stayed the same. The species are listed in Table 5.

The Common Myna was observed during the SABAP 1 project period (Craig, 1997) and it was likely an escaped cage bird. The species is however included as an exotic as it has undergone a significant range expansion towards the north, west and south (Peacock *et al.,* 2007; Underhill *et al.*, 2014) and there is a real threat that it could move into the Western Cape. The species does not pose a risk to other avifaunal species in rural and natural habitats, but may displace birds in urban environments (Hockey *et al.,* 2005).

The only colony of Chukar Partridges occurs on Robben Island. They were introduced to the island in 1964 and have remained on the island with no evidence of establishing mainland colonies. (Hockey *et al.*, 2005), despite various attempts to introduce them to several localities on the mainland.

The Common Starling, the House Sparrow and the Rock Dove occur throughout the province, but are commensurate with humans and are generally found only in towns and cities and around human dwellings (Hockey *et al.*, 2005). There is no national/provincial human wildlife mitigation programme but this is done on an ad hoc localised level where they become a nuisance.

In the province the House Crow is restricted to the Cape Metropolitan area and there is an active program to remove this highly invasive species that has established itself in numerous seaboard ports along the East Coast of Africa. The program has proved successful and numbers have been reduced substantially since its inception. The estimated population in 2009 was around 10 000 birds. The city carried out a survey in April 2016 and recorded only 273 birds and estimate that there are less than 500 birds left (City of Cape Town unpubl.data).

The Common Chaffinch was introduced ca. 1898 to Cape Town and has managed to sustain a small population in the pine plantations between Rondebosch and Tokai (Hockey *et al.,* 2005). No attempts have been made to remove the remaining population and as it has not expanded its distribution since the original introduction it is a low priority for any control program.

The Mallard is the only other species for which there is a control program albeit an informal one in most of the areas other than the Cape Metropolitan. Control is carried out by municipalities and Provincial authorities. This species occurs in a large area of the province, absent only form the drier regions, (http://sabap2.adu.org.za, 2nd June 2017) and may be found on open waters in both developed and rural areas. These populations originate from escaped/released pet birds and this is a continuous source of new infestations or re-colonisation of previously cleaned areas. The species competes for resources forcing indigenous species to look elsewhere and hybridizes readily with native waterfowl (Hockey *et al.*, 2005).

Like the Mallard the Indian Peafowl population originated from captive birds that have and are allowed to roam free creating opportunities of establishing feral populations. The distribution range of this species is expanding in the province (http://sabap2.adu.org.za, 2nd June 2017) and it is unclear what impact this invasion will have, but it does bear investigation and possible inclusion to the Alien Invasive Specie Regulations.

The Mute Swan was introduced to various localities in the province and most of these introductions resulted in an increase in populations, but were followed by a decline and have subsequently become extinct as feral

Table 5 – List of bird species exotic to the province. AIS = Alien Invasive Species listed according to the Alien Invasive Species Regulations promulgated in terms of the National Environmental Management: Biodiversity Act (No 10 of 2004). The categories refer to restricted activities as specified by the Biodiversity Act that may be permissible or prohibited dependent on the category.

Common Name	Scientific Name	AIS category
Chukar Partridge	*Alectoris chukar*	2 on mainland 1b on off-shore islands
Common Chaffinch	*Fringilla coelebs*	2
Common Myna	*Acridotheres tristis*	2
Common Starling	*Sturnus vulgaris*	3
House Crow	*Corvus splendens*	1a
House Sparrow	*Passer domesticus*	3
Indian Peafowl	*Pavo cristatus*	Not listed
Mallard Duck	*Anas platyrhynchos*	2
Mute Swan	*Cygnus olor*	Not listed
Rock Dove	*Columba livia*	3 2 for all restricted activities relating to racing and showing of pigeons.
Any hybrid between an exotic and an indigenous species		1a

populations. The odd sightings reported in SABAP2 are presumably cage birds that have escaped, and there is no evidence that any feral populations of this species occur in the Western Cape.

10. Monitoring

There are numerous avifaunal monitoring projects undertaken within the province, by a number of people and organisations. The largest project is the monitoring of distribution and relative abundance of all the avifauna species across the entire country and by implication the Province as well. This is SABAP2 which has already been mentioned above and involves the collection of presence/absence data per defined area, by birding enthusiasts commonly referred to as citizen scientists. Statistics on this project has already been described under the heading Distribution Data above

The other two national bird monitoring programs that are applicable to the Province and like SABAP2 coordinated by the Animal Demography Unit (ADU) situated in the Department of Biological Sciences at the University of Cape Town are the Coordinated Avifaunal Road Count (CAR) and Coordinated Waterbird Counts (CWAC). CAR are transect counts carried out twice a year along set routes, where mostly large terrestrial birds are counted. There are 52 routes sited in the Western Cape and these provide valuable information on species tends especially of threatened species (Young *et al.*, 2003). The CWAC survey involves counts of waterbirds on the numerous waterbodies scattered throughout the country. There are 234 sites registered for the province which are counted at least twice a year during January and July (http://cwac.adu.org.za., 27th June 2017).

Other than these projects there are a number of species specific monitoring projects that are undertaken by CapeNature, SANParks, BirdLife South Africa and the Oceans and Coasts Directorate of the Department of Environmental Affairs as well as non-governmental organisations and tertiary institutions. The majority of these monitoring programs are for species that are threatened and require monitoring to determine population trends and success of management interventions.

11. Legal Status

The National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and the Threatened or Protected Species (ToPS) regulations promulgated in terms of the Act in 2007 are still applicable. Since the 2012 SOB report the Alien Invasive Species (AIS) regulations were gazetted in 2014 placing restrictions on the keeping and use of identified alien invasive species. Those avifaunal species relevant to the province are listed in Table 5 above with the respective AIS categories. Furthermore the threatened or protected marine species regulations and the list of threatened or protected marine species which include avifaunal species was gazetted in May 2017. This legislation regulates the activities that may have an impact on the listed species.

On a provincial scale the Provincial Nature Conservation Ordinance (No. 19 of 1974) and the regulations promulgated in terms of this ordinance in 1975 is still applicable and affords protection to all South African bird species with the exception of a few species. The exceptions include species such as mousebirds, bulbuls, certain sparrows and weavers, and starlings. This ordinance is however outdated and a new Biodiversity Bill which aligns with national legislation is currently being drafted.

The National Environmental Management: Biodiversity Act (NEM:BA) makes provision for the compilation of species biodiversity management plans (BMP-s). All BMP-s have legislative actions requiring input/action by all relevant provincial conservation authorities and therefore the majority of these plans are applicable to the Western Cape Province. However in terms of conservation actions other than legal requirements the only biodiversity management plan applicable to the province is the African Penguin BMP.

The African Penguin BMP-s was gazetted shortly after the 2012 SOB report was published and is currently undergoing its 5 year review and update. The BMP-s for the African Penguin had as its Vision "To halt the decline of the African Penguin population in South Africa within two years of the implementation of the management plan and thereafter achieve a population growth which will result in a down listing of the species in terms of its status in the IUCN Red List of Threatened Species". The BMP-s has achieved pulling the stakeholders together to work toward a common goal as well as encouraging increasing collaboration. Since the BMP-s is a stakeholder participation plan, it was used by the American Association of Zoos and Aquaria (AZA) as a reference against which projects they chose to support in order to contribute to African penguin conservation through their Saving Animals From Extinction (SAFE) programme. Further details of this programme can be found on their website https://www.aza.org/SAFE-african-penguin. The Vision of the African Penguin BMP-s has not been reached however and the species continues to decline. As part of the process in compiling the second BMP-s for the African penguin, a comprehensive analyses of the achievement of the different actions listed in the current BMP-s is required, together with an assessment on their impact in terms of halting the decline. By doing this, it will be possible to determine where efforts need to be more focussed and concentrated in the next BMP-s in order to stop this species from declining further and becoming critically endangered. This review is currently being driven by the DEA. At the very least, every effort should be made to prevent the mortality and injury/oiling of adult African penguins to ensure as many breeding pairs as possible are able to breed each year. The availability of food around colonies during the breeding season and in other areas during the non-breeding season is essential for the future survival of the species.

The 2012 SOB report refers also to two other envisaged BMP-s's namely the Cape Vulture and the Crane (this includes all three South African crane species) BMP's, but unfortunately these have not materialised. The Cape Vulture is however incorporated into the Vulture Multi-species Action Plan compiled under the auspices of the Convention of Migratory Species (Bonn Convention). The plan is to submit the document to the Conference of the Parties in October 2017 in Manilla, Philippines for consideration. This plan covers all 15 species of vulture occurring throughout Africa, Europe and Asia. The Palm-nut Vulture was excluded based on it not relying entirely on scavenging and therefore not exposed to the same threats as the other species.

The Important Bird and Biodiversity Area (IBA) programme, while not affording an area any legal status does however, indicate the importance of an area to avifaunal conservation. This programme was initiated in South Africa in the late 1990's when the report entitled "The Important Bird Areas of Southern Africa" was published (Barnes, 1998). The programme, which is driven and facilitated by BirdLife South Africa, undertook a revision of each IBA between 2010 and 2014 the results of which were published in a new Directory of sites - "The Important Bird and Biodiversity Areas of South Africa" (Marnewick *et al.,* 2015). All 23 IBA's within the Western Cape were re-assessed and boundaries realigned where required. Subsequent to this review, BirdLife South Africa has initiated two large scale protected area expansion programmes, targeting the Verlorenvlei estuary, Berg River Estuary, Bot – Kleinmond Estaurine system and the Klein River Estuary, as these represent some of the only sites within the Western Cape IBA network not currently under formal protection.

The other non-legal status that can be assigned to a site, specifically one that caters for the conservation of waterfowl is a Ramsar status. This incentive is governed by the Convention of Wetlands of International Importance Especially as Waterfowl Habitat. Two new sites were submitted to the Convention for consideration and were accepted bringing the total of Ramsar sites in the province to seven. The new sites are the False Bay Park (02nd February 2015) and the Bot River Estuary (31st January 2017). The intention is to submit proposals to the convention to declare both Dassen and Dyer Islands as Ramsar sites within the foreseeable future.

12. Public Awareness

Public awareness on avifaunal conservation or the threats that they face is difficult to gauge unless a formal study is conducted to assess and quantify it.

As a taxon however, avifauna are the focus of numerous public awareness campaigns in the province with the hope that the type of concern expressed above can be changed. Provincially, we have the benefit of numerous NGOs, Bird clubs and conservation authorities involved in conservation awareness. CapeNature actively contributes to environmental awareness initiatives which helps to promote raising public awareness in terms of avifaunal conservation, both through its own awareness programmes and through working with partners. These include World Oceans Day, African penguin awareness day and National Marine Week to name a few. Every year, as part of National Marine Week, BirdLife South Africa hold an Oceans of Life festival at Simons Town where seabirds are certainly a focus. SANCCOB have an annual African penguin festival at Simons Town. In October 2016 CapeNature, in partnership with SANCCOB, held a 'Penguin Palooza' at Stony Point to raise public awareness of the Stony Point seabird colony and seabirds in general and this will become an annual event. Also in 2016, and in partnership with the Dyer Island Conservation Trust (DICT) more than 10 000 learners were involved in a colouring competition (foundation phase), writing poems and essays (for older learners) the theme of which focussed on the marine environment, which included the African penguin. The intention is to expand this project to a provincial level and reach > 100 000 learners on matters related to marine awareness, climate change, the concept of catchment to coast and some of these themes will include an avifaunal focus. Since 2011, CapeNature has supported the Two Oceans led initiative of the 'Penguin Promises Waddle for a Week,' which aims to create awareness of the plight of the African penguin.

Through their various internal environmental education programmes CapeNature staff actively engage with learners on conservation issues. Examples of these include taking learners to the Stony Point seabird colony and teaching them about marine (including seabird) conservation, giving talks at schools and teaching learners about Cape vultures at the Potberg EE centre. Focus is placed on both the African Penguin and the Cape Vulture through eco-tourism activities, inviting the public to visit the special places where these birds occur in their natural environment through marketing and advertising initiatives.

CapeNature has contributed to numerous bird related media initiatives through participating in documentaries (various international documentaries, 50/50, the Red List), contributing to and writing newspaper articles, giving radio interviews and engaging the public through our various online platforms to promote public awareness and engagement. Research is required to assess how effective these various initiatives are in raising awareness for avifaunal conservation and changing people's behaviours to become more environmentally conscious.

BirdLife South Africa has also recently published a Habitat Management Guidelines booklet for the fynbos endemic bird species. This booklet is available for download from their website and is intended to encourage best practice in terms of managing habitat for the Fynbos endemic birds, and raising awareness of these species amongst landowners, farmers and the general public.

13. Research

There are five tertiary institutions situated within the Province, four (University of Cape Town, University of the Western Cape, University of Stellenbosch, and the Cape Peninsula University of Technology) are located within the Cape Peninsula and one (satellite campus of the Nelson Mandela Metropolitan University) situated in George. All these institutions have departments that are dedicated to conservation issues and often have avifauna related projects, while the University of Cape Town has two institutes (Percy FitzPatrick Institute for African Ornithology and the Animal Demography Unit) where the majority of the focus is on avifauna research. Some NGOs are also actively involved in avifaunal research, with research projects registered with CapeNature, and include BirdLife South Africa, SANCCOB and Nature's Valley Trust. The Department of Environmental Affairs and CapeNature are also actively engaged in research within the Province.

A permit from CapeNature is required for any research on biodiversity within the province. CapeNature has a database that tracks the research permits issued by the organisation. From 2012 to 2016, 692 research permits were issued, 77 of which (11%) were avifaunal focussed.

While facilitating research within the province, CapeNature scientists also actively source research partnerships to conduct research required to inform management decision making. Of the 77 avifaunal research projects CapeNature Scientists were involved in 5 of these projects, which include amongst others research into Blue Crane movements, African Penguin foraging ecology, African Penguin parasitology, Cape Cormorant foraging ecology and the impact of disturbance on African Penguins. During this period CapeNature Scientists also supervised/co-supervised 4 thesis concerning avifaunal research

14. Capacity

The limited resources within all levels of government, the Non-government Organisations and tertiary institutions involved in conservation work has already been alluded to in this chapter. Avifaunal conservation in South Africa is in the fortunate position that there is a huge component of citizen scientists that collect and submit data according to set protocols to a number of projects. For example there are 2279 observers listed for SABAP2 who contribute or have contributed survey data to this project (http://sabap2.adu.org.za, 27th June 2017). Furthermore there are numerous bird clubs scattered throughout the province, the members of which regularly report on unusual sightings either via their email list servers, websites and/or newsletters or via SABAP2. These clubs also undertake small scale conservation projects focused on their local avifauna or sites.

As mentioned under the previous section there are five tertiary institutions situated within the Province, and there is a wealth of student resources from these institutions that can be utilised to carry out research within the province.

The contribution that official rehabilitation centres contribute toward seabird conservation in the Province is acknowledged. For the period 2012 – 2016, the following numbers of threatened seabirds have been admitted alive to these centres: ~10 125 African penguins, ~1 310 Cape Cormorants, ~835 Cape Gannets and ~ 36 Bank Cormorants.

15. Conclusions and Recommendations

It is clear that the environment is facing and will continue to face challenges due to an increasing human population and the demands they place on the environment. The increase in the number of bird species that are now included in the list of threatened species since the last assessment attests to this. The fact that some species were up listed by two categories indicates how quickly some of the declines have occurred.

The reality of renewable energy in the form of both solar and wind farms have been realised and there are a number of these farms in operation with more in the developmental phase. While collisions have been recorded on a number of the windfarms it remains unclear what the magnitude of these incidents are. Further it is unclear what impacts solar farms will have and data emanating from the required post–construction monitoring for both types of renewable energy will need to be assessed at a much larger scale than the individual wind/solar farm. The collaboration of the individual developers of these farms is crucial in this process.

Inroads have been made since the last SOB report regarding the impacts of climate change on avifaunal taxa. Most notably is the work done by the Percy FitzPatrick Institute's collaborative "Hot Birds Project" and the work done on some of the fynbos endemic species. The challenge for conservation practitioners will be how to ensure species survival and ecosystem functioning in future, in light of increasingly fragmented landscapes and an increasingly warmer and drier environment as a result of climate change. Expanding the network of government protected areas and biodiversity stewardship sites in critical habitat corridors may provide species with potential to adapt to climate change is one method that is currently being pursued in the conservation field to mitigate the impacts of climate change.

Sustainable long term monitoring is key to determine changes in the ecosystems especially those changes that have a long duration. This means that it is critical that government at its various levels, tertiary institutions and NGOs maintain the long term monitoring datasets that they are responsible for. Tracking of individuals improves our understanding of bird ecology and their response to climate and environmental fluctuations, and it's essential that these projects continue in order to improve our understanding of how birds use the landscape in light of the pressures they face. The use of citizen scientists and

bird club members in the collection of the distribution and species richness data as part of SABAP2 will become an increasingly crucial contribution to the understanding of how species are utilising the landscape. The facilitation and collation of this data is important and long term solutions to address this issue needs to be addressed.

Seabirds can be viewed as indicators of ecosystem health (Boersma, 2008). Ten out of the 28 species listed in this report (excluding the near threatened category) are sea or coastal shorebirds. Additionally, of the 10 seabirds endemic to southern Africa, half are threatened according to the red list categories. Much of the decline of these species has been attributed to food availability and the challenge in future is going to be how to ensure sufficient food for these species.

As conservation planning moves forward, it is likely that Biodiversity Management Plans will become an increasingly used tool. This tool is however administratively heavy, and careful consideration needs to be given in terms of selecting BMPs going forward. Benefits of single species, versus multiple species or ecosystem management plans need to be considered where the addressing of threats can have positive impacts for multiple species.

Table 6 lists the recommendations made in the avifaunal chapters of previous State of Biodiversity Reports and the achievements made in fulfilling these recommendations.

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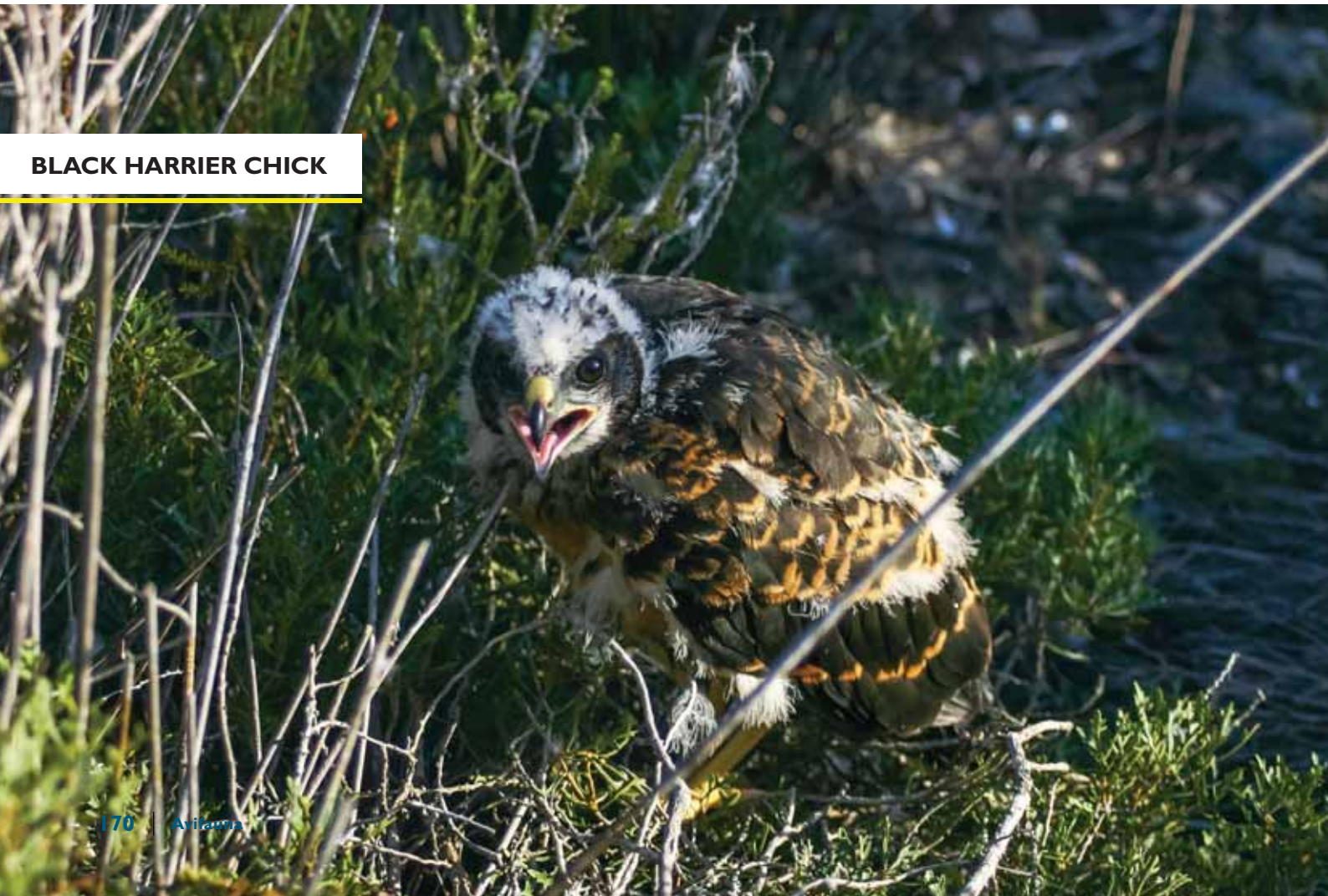

BLACK HARRIER CHICK

Table 6: Recommended conservation actions for Western Cape Province birds.

2000 Recommendations	2007 Recommendations	2012 Recommendations	Achievements
Mitigating powerline mortalities	Mitigation measures for anthropogenic impacts		This is an ongoing issue that requires often a very good understanding of the biology of the species involved and innovative thinking. In most cases the issue is only noted once the problem arises and in most cases involves the death or maiming of birds. The placement of bird scaring devices must become mandatory on all new powerline infrastructure.
Misuse of agrochemicals			There is a large agricultural sector within the Western Cape and large sections of the province is subject to one or other agricultural activity. While the use of Agrochemicals is governed very strictly according to legislation, there have been cases in the past where the misuse thereof has had an impact on wildlife and vigilance is required to prevent this from happening in the future. No known deliberate poisoning within the Western Cape has been reported since the 2000 SOB report.
Species on agricultural lands require innovative ideas to protect them			This is an ongoing issue and usually reactive. Many issues have been addressed, but as new farming methods are employed new threats arise and need to be addressed. The production of habitat management guidelines for the Fynbos endemic bird species provides some recommendations for actions on agricultural land.
Human/bird interactions	Damage causing animals – Human bird interactions – short term solutions no long term solutions		This is an ongoing issue and usually reactive. Many issues have been addressed, but as the human population increases and the increase of man-made habitats occur new issues arise that need to be addressed.
Forum to facilitate communication between conservationists, researches and bird enthusiast			A Western Cape Bird Forum has been established as a means of communicating between the various bird clubs in the Province and various conservation agencies involved in bird conservation. Invites have been extended to researchers and conservationists to sit in on Forum meeting and currently there are a number of researchers and conservationists that attend Forum meetings

2000 Recommendations	2007 Recommendations	2012 Recommendations	Achievements
	Information dissemination		This is an ongoing process and can be both reactive and proactive. It is often difficult to assess the success or quantify the efforts of initiatives specifically aimed at avifauna conservation. The various institutions, governmental and non-governmental realise the importance of informing the public and decision makers and regularly disseminate information via signage, brochures, internet and media releases.
		Regional threat status requires completion	The 2015 Red Data Book has subsequently been completed.
		IBA's re -evaluated and boundaries adjusted	This has been completed by BirdLife South Africa in conjunction with numerous partners and the report is available (Marnewick *et al.*, 2015)
		Revised conservation prioritisation of the Western cape Birds	This has not been completed – The late publication of the red data book delayed this process.
		African Penguin BMP-s gazetted	The BMP-s was gazetted shortly after the publication of the 2012 SOB report and is currently being implemented. Currently up for review/rewrite in 2018.
		Crane BMP	Unfortunately despite initial workshops to get this BMP-s compiled no further progress was made.
		Cape Vulture BMP	A number of attempts have been made to compile a BMP-s, but due to a number of issues this process has been/is being delayed.
		Knysna Warbler monitoring	No progress has been made.
		Coastal Bird monitoring	A monitoring protocol has been developed to standardise methods of monitoring along the coastline of the province.
		Windfarms	A number of windfarms have been constructed and are operational. Through monitoring according to guidelines (REF) a number of issues have been highlighted and these are being addressed through guidelines (Vulture/Verreaux's eagle) and mitigation measures.

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MALE SOUTHERN BLACK KORHAAN

18. Appendices

Appendix 1: List of bird species that occur or occurred in the Western Cape.

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Blue Waxbill	*Uraeginthus angolensis*	Escape	Least Concern	Least Concern
Livingstone's Turaco	*Tauraco livingstonii*	Escape	Least Concern	Least Concern
Long-tailed Paradise-Whydah	*Vidua paradisaea*	Escape	Least Concern	Least Concern
Purple Indigobird	*Vidua purpurascens*	Escape	Least Concern	Least Concern
African Scops-Owl	*Otus senegalensis*	Extinct	Least Concern	Least Concern
Bearded Vulture	*Gypaetus barbatus*	Extinct	Critically Endangered	Near Threatened
Cape Parrot	*Poicephalus robustus*	Extinct	Endangered	Least Concern
Egyptian Vulture	*Neophron percnopterus*	Extinct	Regionally Extinct	Endangered
Lappet-faced Vulture	*Torgus tracheliotos*	Extinct	Endangered	Endangered
Southern Bald Ibis	*Geronticus calvus*	Extinct	Vulnerable	Vulnerable
Wattled Crane	*Bugeranus carunculatus*	Extinct	Critically Endangered	Vulnerable
Chukar Partridge	*Alectoris chukar*	Exotic	Not Evaluated	Least Concern
Common Chaffinch	*Fringilla coelebs*	Exotic	Not Evaluated	Least Concern
Common Myna	*Acridotheres tristis*	Exotic	Not Evaluated	Least Concern
Common Starling	*Sturnus vulgaris*	Exotic	Not Evaluated	Least Concern
House Crow	*Corvus splendens*	Exotic	Not Evaluated	Least Concern
House Sparrow	*Passer domesticus*	Exotic	Not Evaluated	Least Concern
Indian Peafowl	*Pavo cristatus*	Exotic	Not Evaluated	Least Concern
Mallard Duck	*Anas platyrhynchos*	Exotic	Not Evaluated	Least Concern
Mute Swan	*Cygnus olor*	Exotic	Not Evaluated	Least Concern
Rock Dove	*Columba livia*	Exotic	Not Evaluated	Least Concern
African Black Swift	*Apus barbatus*	Migratory	Least Concern	Least Concern
African Emerald Cuckoo	*Chrysococcyx cupreus*	Migratory	Least Concern	Least Concern
African Reed-Warbler	*Acrocephalus baeticatus*	Migratory	Not Evaluated	Not Evaluated
Alpine Swift	*Tachymarptis melba*	Migratory	Least Concern	Least Concern
Antarctic Tern	*Sterna vittata*	Migratory	Endangered	Least Concern
Arctic Tern	*Sterna paradisaea*	Migratory	Least Concern	Least Concern
Banded Martin	*Riparia cincta*	Migratory	Least Concern	Least Concern
Barn Swallow	*Hirundo rustica*	Migratory	Least Concern	Least Concern
Bar-tailed Godwit	*Limosa lapponica*	Migratory	Least Concern	Near Threatened
Black Cuckoo	*Cuculus clamosus*	Migratory	Least Concern	Least Concern
Black Cuckooshrike	*Campephaga flava*	Migratory	Least Concern	Least Concern
Black Kite	*Milvus migrans*	Migratory	Least Concern	Least Concern
Black Saw-wing	*Psalidoprocne pristoptera*	Migratory	Least Concern	Least Concern
Black-tailed Godwit	*Limosa limosa*	Migratory	Least Concern	Least Concern
Booted Eagle	*Hieraaetus pennatus*	Migratory	Least Concern	Least Concern
Brown-throated Martin	*Riparia paludicola*	Migratory	Least Concern	Least Concern
Common Buzzard	*Buteo buteo*	Migratory	Least Concern	Least Concern
Common Greenshank	*Tringa nebularia*	Migratory	Least Concern	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Common House-Martin	*Delichon urbicum*	Migratory	Least Concern	Least Concern
Common Quail	*Coturnix coturnix*	Migratory	Least Concern	Least Concern
Common Redshank	*Tringa totanus*	Migratory	Least Concern	Least Concern
Common Ringed Plover	*Charadrius hiaticula*	Migratory	Least Concern	Least Concern
Common Sandpiper	*Actitis hypoleucos*	Migratory	Least Concern	Least Concern
Common Swift	*Apus apus*	Migratory	Least Concern	Least Concern
Common Tern	*Sterna hirundo*	Migratory	Least Concern	Least Concern
Common Whimbrel	*Numenius phaeopus*	Migratory	Least Concern	Least Concern
Curlew Sandpiper	*Calidris ferruginea*	Migratory	Least Concern	Least Concern
Damara Tern	*Sterna balaenarum*	Migratory	Critically Endangered	Near Threatened
Diderick Cuckoo	*Chrysococcyx c aprius*	Migratory	Least Concern	Least Concern
Eurasian Curlew	*Numenius arquata*	Migratory	Near Threatened	Near Threatened
Eurasian Golden Oriole	*Oriolus oriolus*	Migratory	Least Concern	Least Concern
Eurasian Hobby	*Falco subbuteo*	Migratory	Least Concern	Least Concern
European Bee-eater	*Merops apiaster*	Migratory	Least Concern	Least Concern
European Honey-Buzzard	*Pernis apivorus*	Migratory	Least Concern	Least Concern
European Roller	*Coracias garrulus*	Migratory	Near Threatened	Least Concern
Great Spotted Cuckoo	*Clamator glandarius*	Migratory	Least Concern	Least Concern
Greater Sand Plover	*Charadrius leschenaultii*	Migratory	Least Concern	Least Concern
Greater Striped Swallow	*Cecropis cucullata*	Migratory	Least Concern	Least Concern
Grey Plover	*Pluvialis squatarola*	Migratory	Least Concern	Least Concern
Horus Swift	*Apus horus*	Migratory	Least Concern	Least Concern
Jacobin Cuckoo	*Clamator jacobinus*	Migratory	Least Concern	Least Concern
Klaas's Cuckoo	*Chrysococcyx klaas*	Migratory	Least Concern	Least Concern
Lesser Flamingo	*Phoeniconaias minor*	Migratory	Near Threatened	Near Threatened
Lesser Kestrel	*Falco naumanni*	Migratory	Least Concern	Least Concern
Little Stint	*Calidris minuta*	Migratory	Least Concern	Least Concern
Little Tern	*Sterna albifrons*	Migratory	Least Concern	Least Concern
Marsh Sandpiper	*Tringa stagnatilis*	Migratory	Least Concern	Least Concern
Osprey	*Pandion haliaetus*	Migratory	Least Concern	Least Concern
Pearl-breasted Swallow	*Hirundo dimidiata*	Migratory	Least Concern	Least Concern
Red Knot	*Calidris canutus*	Migratory	Least Concern	Near Threatened
Red-chested Cuckoo	*Cuculus solitarius*	Migratory	Least Concern	Least Concern
Ruddy Turnstone	*Arenaria interpres*	Migratory	Least Concern	Least Concern
Ruff	*Philomachus pugnax*	Migratory	Least Concern	Least Concern
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	Migratory	Least Concern	Least Concern
Sabine's Gull	*Xema sabini*	Migratory	Least Concern	Least Concern
Sand Martin	*Riparia riparia*	Migratory	Least Concern	Least Concern
Sanderling	*Calidris alba*	Migratory	Least Concern	Least Concern
Sandwich Tern	*Thalasseus sandvicensis*	Migratory	Least Concern	Least Concern
Spotted Flycatcher	*Muscicapa striata*	Migratory	Least Concern	Least Concern
Terek Sandpiper	*Xenus cinereus*	Migratory	Not Evaluated	Least Concern
Whiskered Tern	*Chlidonias hybrida*	Migratory	Least Concern	Least Concern
White Stork	*Ciconia ciconia*	Migratory	Least Concern	Least Concern
White-rumped Swift	*Apus caffer*	Migratory	Least Concern	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
White-throated Swallow	*Hirundo albigularis*	Migratory	Least Concern	Least Concern
White-winged Tern	*Chlidonias leucopterus*	Migratory	Least Concern	Least Concern
Willow Warbler	*Phylloscopus trochilus*	Migratory	Least Concern	Least Concern
Wood Sandpiper	*Tringa glareola*	Migratory	Least Concern	Least Concern
Yellow-billed Kite	*Milvus aegyptius*	Migratory	Not Evaluated	Least Concern
Antarctic Petrel	*Thalassoica antarctica*	Pelagic	Not Evaluated	Least Concern
Antarctic Prion	*Pachyptila desolata*	Pelagic	Least Concern	Least Concern
Atlantic Petrel	*Pterodroma incerta*	Pelagic	Least Concern	Endangered
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	Pelagic	Endangered	Endangered
Balearic Shearwater	*Puffinus mauretanicus*	Pelagic	Not Evaluated	Critically Endangered
Black-bellied Storm-Petrel	*Fregetta tropica*	Pelagic	Near Threatened	Least Concern
Black-browed Albatross	*Thalassarche melanophris*	Pelagic	Endangered	Near Threatened
Blue Petrel	*Halobaena caerulea*	Pelagic	Near Threatened	Near Threatened
Broad-billed Prion	*Pachyptila vittata*	Pelagic	Least Concern	Least Concern
Buller's Albatross	*Thalassarche bulleri*	Pelagic	Least Concern	Near Threatened
Bulwer's Petrel	*Bulweria bulwerii*	Pelagic	Not Evaluated	Least Concern
Chatham Albatross	*Thalassarche eremita*	Pelagic	Not Evaluated	Vulnerable
Cory's Shearwater	*Calonectris diomedea*	Pelagic	Least Concern	Least Concern
European Storm-Petrel	*Hydrobates pelagicus*	Pelagic	Not Evaluated	Least Concern
Fairy Prion	*Pachyptila turtur*	Pelagic	Near Threatened	Least Concern
Flesh-footed Shearwater	*Puffinus carneipes*	Pelagic	Least Concern	Least Concern
Great Shearwater	*Puffinus gravis*	Pelagic	Not Evaluated	Least Concern
Greater Frigatebird	*Fregata minor*	Pelagic	Not Evaluated	Least Concern
Great-winged Petrel	*Pterodroma macroptera*	Pelagic	Near Threatened	Least Concern
Grey Petrel	*Procellaria cinerea*	Pelagic	Vulnerable	Near Threatened
Grey-backed Storm Petrel	*Garrodia nereis*	Pelagic	Near Threatened	Least Concern
Grey-headed Albatross	*Thalassarche chrysostoma*	Pelagic	Endangered	Endangered
Indian Yellow-nosed Albatross	*Thalassarche carteri*	Pelagic	Endangered	Endangered
Kerguelen Petrel	*Lugensa brevirostris*	Pelagic	Near Threatened	Least Concern
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Pelagic	Critically Endangered	Least Concern
Light-mantled Albatross	*Phoebetria palpebrata*	Pelagic	Near Threatened	Near Threatened
Little Shearwater	*Puffinus assimilis*	Pelagic	Least Concern	Least Concern
Long-tailed Jaeger	*Stercorarius longicaudus*	Pelagic	Not Evaluated	Least Concern
Manx Shearwater	*Puffinus puffinus*	Pelagic	Least Concern	Least Concern
Northern Giant-Petrel	*Macronectes halli*	Pelagic	Near Threatened	Least Concern
Northern Royal Albatros	*Diomedea sanfordi*	Pelagic	Endangered	Endangered
Parasitic Jaeger	*Stercorarius parasiticus*	Pelagic	Least Concern	Least Concern
Pintado Petrel	*Daption capense*	Pelagic	Least Concern	Least Concern
Pomarine Jaeger	*Stercorarius pomarinus*	Pelagic	Least Concern	Least Concern
Red-tailed Tropicbird	*Phaethon rubricauda*	Pelagic	Least Concern	Least Concern
Salvin's Albatross	*Thalassarche salvini*	Pelagic	Least Concern	Vulnerable
Salvin's Prion	*Pachyptila salvini*	Pelagic	Near Threatened	Least Concern
Shy Albatross	*Thalassarche cauta*	Pelagic	Near Threatened	Near Threatened
Slender-billed Prion	*Pachyptila belcheri*	Pelagic	Not Evaluated	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Soft-plumaged Petrel	*Pterodroma mollis*	Pelagic	Near Threatened	Least Concern
Sooty Albatross	*Phoebetria fusca*	Pelagic	Endangered	Endangered
Sooty Shearwater	*Puffinus griseus*	Pelagic	Near Threatened	Near Threatened
South Polar Skua	*Catharacta maccormicki*	Pelagic	Least Concern	Least Concern
Southern Fulmar	*Fulmarus glacialoides*	Pelagic	Least Concern	Least Concern
Southern Giant-Petrel	*Macronectes giganteus*	Pelagic	Near Threatened	Least Concern
Southern Royal Albatross	*Diomedea epomophora*	Pelagic	Vulnerable	Vulnerable
Spectacled Petrel	*Procellaria conspicillata*	Pelagic	Vulnerable	Vulnerable
Streaked Shearwater	*Calonectris leucomelas*	Pelagic	Not Evaluated	Near Threatened
Subantarctic Skua	*Catharacta antarctica*	Pelagic	Least Concern	Least Concern
Tristan Albatross	*Diomedea dabbenena*	Pelagic	Critically Endangered	Critically Endangered
Wandering Albatross	*Diomedea exulans*	Pelagic	Vulnerable	Vulnerable
Wedge-tailed Shearwater	*Puffinus pacificus*	Pelagic	Not Evaluated	Least Concern
White-bellied Storm-Petrel	*Fregetta grallaria*	Pelagic	Least Concern	Least Concern
White-chinned Petrel	*Procellaria aequinoctialis*	Pelagic	Vulnerable	Vulnerable
White-faced Storm-Petrel	*Pelagodroma marina*	Pelagic	Not Evaluated	Least Concern
White-headed Petrel	*Pterodroma lessonii*	Pelagic	Least Concern	Least Concern
Wilson's Storm-Petrel	*Oceanites oceanicus*	Pelagic	Least Concern	Least Concern
Acacia Pied Barbet	*Tricholaema leucomelas*	Resident	Least Concern	Least Concern
African Black Duck	*Anas sparsa*	Resident	Least Concern	Least Concern
African Black Oystercatcher	*Haematopus moquini*	Resident	Least Concern	Near Threatened
African Crowned Eagle	*Stephanoaetus coronatus*	Resident	Vulnerable	Near Threatened
African Darter	*Anhinga rufa*	Resident	Least Concern	Least Concern
African Dusky Flycatcher	*Muscicapa adusta*	Resident	Least Concern	Least Concern
African Finfoot	*Podica senegalensis*	Resident	Vulnerable	Least Concern
African Fish-Eagle	*Haliaeetus vocifer*	Resident	Least Concern	Least Concern
African Goshawk	*Accipiter tachiro*	Resident	Least Concern	Least Concern
African Grass-Owl	*Tyto capensis*	Resident	Vulnerable	Least Concern
African Harrier-Hawk	*Polyboroides typus*	Resident	Least Concern	Least Concern
African Hoopoe	*Upupa africana*	Resident	Least Concern	Least Concern
African Marsh-Harrier	*Circus ranivorus*	Resident	Endangered	Least Concern
African Olive-Pigeon	*Columba arquatrix*	Resident	Least Concern	Least Concern
African Paradise-Flycatcher	*Terpsiphone viridis*	Resident	Least Concern	Least Concern
African Penguin	*Spheniscus demersus*	Resident	Endangered	Endangered
African Pipit	*Anthus cinnamomeus*	Resident	Least Concern	Least Concern
African Quail-finch	*Ortygospiza fusocrissa*	Resident	Least Concern	Least Concern
African Rail	*Rallus caerulescens*	Resident	Least Concern	Least Concern
African Red-eyed Bulbul	*Pycnonotus nigricans*	Resident	Least Concern	Least Concern
African Rock Pipit	*Anthus crenatus*	Resident	Near Threatened	Least Concern
African Sacred Ibis	*Threskiornis aethiopicus*	Resident	Least Concern	Least Concern
African Snipe	*Gallinago nigripennis*	Resident	Least Concern	Least Concern
African Spoonbill	*Platalea alba*	Resident	Least Concern	Least Concern
African Stonechat	*Saxicola torquatus*	Resident	Least Concern	Least Concern
African Swamphen	*Porphyrio madagascariensis*	Resident	Least Concern	Least Concern
African Wood-Owl	*Strix woodfordii*	Resident	Least Concern	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Agulhas Long-billed Lark	*Certhilauda brevirostris*	Resident	Near Threatened	Not Evaluated
Amethyst Sunbird	*Chalcomitra amethystina*	Resident	Least Concern	Least Concern
Anteating Chat	*Myrmecocichla formicivora*	Resident	Least Concern	Least Concern
Baillon's Crake	*Porzana pusilla*	Resident	Least Concern	Least Concern
Bank Cormorant	*Phalacrocorax neglectus*	Resident	Endangered	Endangered
Barn Owl	*Tyto alba*	Resident	Least Concern	Least Concern
Bar-throated Apalis	*Apalis thoracica*	Resident	Least Concern	Least Concern
Black Crake	*Amaurornis flavirostris*	Resident	Least Concern	Least Concern
Black Harrier	*Circus maurus*	Resident	Endangered	Vulnerable
Black Sparrowhawk	*Accipiter melanoleucus*	Resident	Least Concern	Least Concern
Black Stork	*Ciconia nigra*	Resident	Vulnerable	Least Concern
Black-backed Puffback	*Dryoscopus cubla*	Resident	Least Concern	Least Concern
Black-bellied Starling	*Lamprotornis corruscus*	Resident	Least Concern	Least Concern
Black-headed Canary	*Serinus alario*	Resident	Least Concern	Least Concern
Black-headed Heron	*Ardea melanocephala*	Resident	Least Concern	Least Concern
Black-headed Oriole	*Oriolus larvatus*	Resident	Least Concern	Least Concern
Black-necked Grebe	*Podiceps nigricollis*	Resident	Least Concern	Least Concern
Black-shouldered Kite	*Elanus caeruleus*	Resident	Least Concern	Least Concern
Blacksmith Lapwing	*Vanellus armatus*	Resident	Least Concern	Least Concern
Black-winged Lapwing	*Vanellus melanopterus*	Resident	Near Threatened	Least Concern
Black-winged Stilt	*Himantopus himantopus*	Resident	Least Concern	Least Concern
Blue Crane	*Anthropoides paradiseus*	Resident	Near Threatened	Vulnerable
Blue-mantled Crested-Flycatcher	*Trochocercus cyanomelas*	Resident	Least Concern	Least Concern
Bokmakierie	*Telophorus zeylonus*	Resident	Least Concern	Least Concern
Brimstone Canary	*Crithagra sulphuratus*	Resident	Least Concern	Least Concern
Brown-backed Honeybird	*Prodotiscus regulus*	Resident	Least Concern	Least Concern
Brown-hooded Kingfisher	*Halcyon albiventris*	Resident	Least Concern	Least Concern
Buff-spotted Flufftail	*Sarothrura elegans*	Resident	Least Concern	Least Concern
Burchell's Coucal	*Centropus burchellii*	Resident	Not Evaluated	Not Evaluated
Burchell's Courser	*Cursorius rufus*	Resident	Vulnerable	Least Concern
Cape Batis	*Batis capensis*	Resident	Least Concern	Least Concern
Cape Bulbul	*Pycnonotus capensis*	Resident	Least Concern	Least Concern
Cape Bunting	*Emberiza capensis*	Resident	Least Concern	Least Concern
Cape Canary	*Serinus canicollis*	Resident	Least Concern	Least Concern
Cape Clapper Lark	*Mirafra apiata*	Resident	Least Concern	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Resident	Endangered	Endangered
Cape Crow	*Corvus capensis*	Resident	Least Concern	Least Concern
Cape Eagle-Owl	*Bubo capensis*	Resident	Least Concern	Least Concern
Cape Gannet	*Morus capensis*	Resident	Vulnerable	Vulnerable
Cape Glossy Starling	*Lamprotornis nitens*	Resident	Least Concern	Least Concern
Cape Grassbird	*Sphenoeacus afer*	Resident	Least Concern	Least Concern
Cape Long-billed Lark	*Certhilauda curvirostris*	Resident	Least Concern	Least Concern
Cape Longclaw	*Macronyx capensis*	Resident	Least Concern	Least Concern
Cape Penduline-Tit	*Anthoscopus minutus*	Resident	Least Concern	Least Concern
Cape Robin-Chat	*Cossypha caffra*	Resident	Least Concern	Least Concern

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Cape Rock-jumper	*Chaetops frenatus*	Resident	Near Threatened	Least Concern
Cape Rock-Thrush	*Monticola rupestris*	Resident	Least Concern	Least Concern
Cape Shoveler	*Anas smithii*	Resident	Least Concern	Least Concern
Cape Siskin	*Crithagra totta*	Resident	Least Concern	Least Concern
Cape Sparrow	*Passer melanurus*	Resident	Least Concern	Least Concern
Cape Spurfowl	*Pternistis capensis*	Resident	Least Concern	Least Concern
Cape Sugarbird	*Promerops cafer*	Resident	Least Concern	Least Concern
Cape Teal	*Anas capensis*	Resident	Least Concern	Least Concern
Cape Turtle-Dove	*Streptopelia capicola*	Resident	Least Concern	Least Concern
Cape Vulture	*Gyps coprotheres*	Resident	Endangered	Endangered
Cape Wagtail	*Motacilla capensis*	Resident	Least Concern	Least Concern
Cape Weaver	*Ploceus capensis*	Resident	Least Concern	Least Concern
Cape White-eye	*Zosterops virens*	Resident	Not Evaluated	Not Evaluated
Capped Wheatear	*Oenanthe pileata*	Resident	Least Concern	Least Concern
Cardinal Woodpecker	*Dendropicos fuscescens*	Resident	Least Concern	Least Concern
Caspian Tern	*Sterna caspia*	Resident	Vulnerable	Least Concern
Cattle Egret	*Bubulcus ibis*	Resident	Least Concern	Least Concern
Chat Flycatcher	*Bradornis infuscatus*	Resident	Least Concern	Least Concern
Chestnut-banded Plover	*Charadrius pallidus*	Resident	Near Threatened	Near Threatened
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*	Resident	Least Concern	Least Concern
Chorister Robin-Chat	*Cossypha dichroa*	Resident	Least Concern	Least Concern
Cinnamon-breasted Warbler	*Euryptila subcinnamomea*	Resident	Least Concern	Least Concern
Cloud Cisticola	*Cisticola textrix*	Resident	Least Concern	Least Concern
Collared Sunbird	*Hedydipna collaris*	Resident	Least Concern	Least Concern
Common Fiscal	*Lanius collaris*	Resident	Least Concern	Least Concern
Common Moorhen	*Gallinula chloropus*	Resident	Least Concern	Least Concern
Common Ostrich	*Struthio camelus*	Resident	Least Concern	Least Concern
Common Waxbill	*Estrilda astrild*	Resident	Least Concern	Least Concern
Crowned Cormorant	*Phalacrocorax coronatus*	Resident	Near Threatened	Near Threatened
Crowned Lapwing	*Vanellus coronatus*	Resident	Least Concern	Least Concern
Denham's Bustard	*Neotis denhami*	Resident	Vulnerable	Near Threatened
Double-banded Courser	*Rhinoptilus africanus*	Resident	Least Concern	Least Concern
Dusky Sunbird	*Cinnyris fuscus*	Resident	Least Concern	Least Concern
Egyptian Goose	*Alopochen aegyptiacus*	Resident	Least Concern	Least Concern
Fairy Flycatcher	*Stenostira scita*	Resident	Least Concern	Least Concern
Familiar Chat	*Cercomela familiaris*	Resident	Least Concern	Least Concern
Fiery-necked Nightjar	*Caprimulgus pectoralis*	Resident	Least Concern	Least Concern
Fiscal Flycatcher	*Sigelus silens*	Resident	Least Concern	Least Concern
Forest Buzzard	*Buteo trizonatus*	Resident	Least Concern	Least Concern
Forest Canary	*Crithagra scotops*	Resident	Least Concern	Least Concern
Fork-tailed Drongo	*Dicrurus adsimilis*	Resident	Least Concern	Least Concern
Freckled Nightjar	*Caprimulgus tristigma*	Resident	Least Concern	Least Concern
Gabar Goshawk	*Melierax gabar*	Resident	Least Concern	Least Concern
Giant Kingfisher	*Megaceryle maxima*	Resident	Least Concern	Least Concern
Glossy Ibis	*Plegadis falcinellus*	Resident	Least Concern	Least Concern

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Great Crested Grebe	*Podiceps cristatus*	Resident	Least Concern	Least Concern
Great Egret	*Egretta alba*	Resident	Least Concern	Least Concern
Great White Pelican	*Pelecanus onocrotalus*	Resident	Vulnerable	Least Concern
Greater Double-collared Sunbird	*Cinnyris afer*	Resident	Least Concern	Least Concern
Greater Flamingo	*Phoenicopterus roseus*	Resident	Near Threatened	Least Concern
Greater Honeyguide	*Indicator indicator*	Resident	Least Concern	Least Concern
Greater Kestrel	*Falco rupicoloides*	Resident	Least Concern	Least Concern
Greater Painted-snipe	*Rostratula benghalensis*	Resident	Near Threatened	Least Concern
Green Wood-Hoopoe	*Phoeniculus purpureus*	Resident	Least Concern	Least Concern
Green-backed Camaroptera	*Camaroptera brachyura*	Resident	Least Concern	Least Concern
Grey Cuckooshrike	*Coracina caesia*	Resident	Least Concern	Least Concern
Grey Heron	*Ardea cinerea*	Resident	Least Concern	Least Concern
Grey Tit	*Parus afer*	Resident	Least Concern	Least Concern
Grey-backed Cisticola	*Cisticola subruficapilla*	Resident	Least Concern	Least Concern
Grey-backed Sparrowlark	*Eremopterix verticalis*	Resident	Least Concern	Least Concern
Grey-headed Gull	*Chroicocephalus cirrocephalus*	Resident	Least Concern	Least Concern
Grey-winged Francolin	*Scleroptila africanus*	Resident	Least Concern	Least Concern
Ground Woodpecker	*Geocolaptes olivaceus*	Resident	Least Concern	Least Concern
Hadeda Ibis	*Bostrychia hagedash*	Resident	Least Concern	Least Concern
Half-collared Kingfisher	*Alcedo semitorquata*	Resident	Near Threatened	Least Concern
Hamerkop	*Scopus umbretta*	Resident	Least Concern	Least Concern
Hartlaub's Gull	*Chroicocephalus hartlaubii*	Resident	Least Concern	Least Concern
Helmeted Guineafowl	*Numida meleagris*	Resident	Least Concern	Least Concern
Hottentot Buttonquail	*Turnix hottentottus*	Resident	Endangered	Endangered
Hottentot Teal	*Anas hottentota*	Resident	Least Concern	Least Concern
Jackal Buzzard	*Buteo rufofuscus*	Resident	Least Concern	Least Concern
Karoo Chat	*Cercomela schlegelii*	Resident	Least Concern	Least Concern
Karoo Eremomela	*Eremomela gregalis*	Resident	Least Concern	Least Concern
Karoo Korhaan	*Eupodotis vigorsii*	Resident	Near Threatened	Least Concern
Karoo Lark	*Calendulauda albescens*	Resident	Least Concern	Least Concern
Karoo Long-billed Lark	*Certhilauda subcoronata*	Resident	Least Concern	Least Concern
Karoo Prinia	*Prinia maculosa*	Resident	Least Concern	Least Concern
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	Resident	Least Concern	Least Concern
Karoo Thrush	*Turdus smithi*	Resident	Not Evaluated	Not Evaluated
Kelp Gull	*Larus dominicanus*	Resident	Least Concern	Least Concern
Kittlitz's Plover	*Charadrius pecuarius*	Resident	Least Concern	Least Concern
Knysna Turaco	*Tauraco corythaix*	Resident	Least Concern	Least Concern
Knysna Warbler	*Bradypterus sylvaticus*	Resident	Vulnerable	Vulnerable
Knysna Woodpecker	*Campethera notata*	Resident	Near Threatened	Near Threatened
Lanner Falcon	*Falco biarmicus*	Resident	Vulnerable	Least Concern
Large-billed Lark	*Galerida magnirostris*	Resident	Least Concern	Least Concern
Lark-like Bunting	*Emberiza impetuani*	Resident	Least Concern	Least Concern
Laughing Dove	*Streptopelia senegalensis*	Resident	Least Concern	Least Concern
Layard's Tit-Babbler	*Sylvia layardi*	Resident	Least Concern	Least Concern
Lemon Dove	*Columba larvata*	Resident	Least Concern	Least Concern

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Lesser Honeyguide	*Indicator minor*	Resident	Least Concern	Least Concern
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	Resident	Least Concern	Least Concern
Levaillant's Cisticola	*Cisticola tinniens*	Resident	Least Concern	Least Concern
Little Bittern	*Ixobrychus minutus*	Resident	Least Concern	Least Concern
Little Egret	*Egretta garzetta*	Resident	Least Concern	Least Concern
Little Grebe	*Tachybaptus ruficollis*	Resident	Least Concern	Least Concern
Little Rush-Warbler	*Bradypterus baboecala*	Resident	Least Concern	Least Concern
Little Sparrowhawk	*Accipiter minullus*	Resident	Least Concern	Least Concern
Little Swift	*Apus affinis*	Resident	Least Concern	Least Concern
Long-billed Crombec	*Sylvietta rufescens*	Resident	Least Concern	Least Concern
Long-billed Pipit	*Anthus similis*	Resident	Least Concern	Least Concern
Ludwig's Bustard	*Neotis ludwigii*	Resident	Endangered	Endangered
Maccoa Duck	*Oxyura maccoa*	Resident	Near Threatened	Near Threatened
Malachite Kingfisher	*Alcedo cristata*	Resident	Least Concern	Least Concern
Malachite Sunbird	*Nectarinia famosa*	Resident	Least Concern	Least Concern
Marsh Owl	*Asio capensis*	Resident	Least Concern	Least Concern
Martial Eagle	*Polemaetus bellicosus*	Resident	Endangered	Vulnerable
Mountain Wheatear	*Oenanthe monticola*	Resident	Least Concern	Least Concern
Namaqua Dove	*Oena capensis*	Resident	Least Concern	Least Concern
Namaqua Sandgrouse	*Pterocles namaqua*	Resident	Least Concern	Least Concern
Namaqua Warbler	*Phragmacia substriata*	Resident	Least Concern	Least Concern
Narina Trogon	*Apaloderma narina*	Resident	Least Concern	Least Concern
Neddicky	*Cisticola fulvicapilla*	Resident	Least Concern	Least Concern
Olive Bush-Shrike	*Chlorophoneus olivaceus*	Resident	Least Concern	Least Concern
Olive Thrush	*Turdus olivaceus*	Resident	Least Concern	Least Concern
Olive Woodpecker	*Dendropicos griseocephalus*	Resident	Least Concern	Least Concern
Orange River White-eye	*Zosterops pallidus*	Resident	Least Concern	Least Concern
Orange-breasted Sunbird	*Anthobaphes violacea*	Resident	Least Concern	Least Concern
Pale Chanting Goshawk	*Melierax canorus*	Resident	Least Concern	Least Concern
Pale-winged Starling	*Onychognathus nabouroup*	Resident	Least Concern	Least Concern
Peregrine Falcon	*Falco peregrinus*	Resident	Near Threatened	Least Concern
Pied Avocet	*Recurvirostra avosetta*	Resident	Least Concern	Least Concern
Pied Crow	*Corvus albus*	Resident	Least Concern	Least Concern
Pied Kingfisher	*Ceryle rudis*	Resident	Least Concern	Least Concern
Pied Starling	*Lamprotornis bicolor*	Resident	Least Concern	Least Concern
Pin-tailed Whydah	*Vidua macroura*	Resident	Least Concern	Least Concern
Plain-backed Pipit	*Anthus leucophrys*	Resident	Least Concern	Least Concern
Pririt Batis	*Batis pririt*	Resident	Least Concern	Least Concern
Protea Seedeater	*Crithagra leucopterus*	Resident	Least Concern	Least Concern
Purple Heron	*Ardea purpurea*	Resident	Least Concern	Least Concern
Red-billed Teal	*Anas erythrorhyncha*	Resident	Least Concern	Least Concern
Red-capped Lark	*Calandrella cinerea*	Resident	Least Concern	Least Concern
Red-chested Flufftail	*Sarothrura rufa*	Resident	Least Concern	Least Concern
Red-eyed Dove	*Streptopelia semitorquata*	Resident	Least Concern	Least Concern
Red-faced Mousebird	*Urocolius indicus*	Resident	Least Concern	Least Concern

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Red-knobbed Coot	*Fulica cristata*	Resident	Least Concern	Least Concern
Red-necked Spurfowl	*Pternistis afer*	Resident	Least Concern	Least Concern
Red-winged Francolin	*Scleroptila levaillantii*	Resident	Least Concern	Least Concern
Red-winged Starling	*Onychognathus morio*	Resident	Least Concern	Least Concern
Reed Cormorant	*Phalacrocorax africanus*	Resident	Least Concern	Least Concern
Rock Kestrel	*Falco rupicolus*	Resident	Least Concern	Least Concern
Rock Martin	*Hirundo fuligula*	Resident	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Resident	Endangered	Least Concern
Rufous-chested Sparrowhawk	*Accipiter rufiventris*	Resident	Least Concern	Least Concern
Rufous-eared Warbler	*Malcorus pectoralis*	Resident	Least Concern	Least Concern
Scaly-feathered Finch	*Sporopipes squamifrons*	Resident	Least Concern	Least Concern
Scaly-throated Honeyguide	*Indicator variegatus*	Resident	Least Concern	Least Concern
Sclater's Lark	*Spizocorys sclateri*	Resident	Near Threatened	Near Threatened
Secretarybird	*Sagittarius serpentarius*	Resident	Vulnerable	Vulnerable
Sentinel Rock-Thrush	*Monticola explorator*	Resident	Least Concern	Least Concern
Short-toed Rock-Thrush	*Monticola brevipes*	Resident	Least Concern	Least Concern
Sickle-winged Chat	*Cercomela sinuata*	Resident	Least Concern	Least Concern
Sombre Greenbul	*Andropadus importunus*	Resident	Least Concern	Least Concern
South African Shelduck	*Tadorna cana*	Resident	Least Concern	Least Concern
Southern Black Korhaan	*Afrotis afra*	Resident	Vulnerable	Vulnerable
Southern Boubou	*Laniarius ferrugineus*	Resident	Least Concern	Least Concern
Southern Double-collared Sunbird	*Cinnyris chalybeus*	Resident	Least Concern	Least Concern
Southern Grey-headed Sparrow	*Passer diffusus*	Resident	Least Concern	Least Concern
Southern Masked-Weaver	*Ploceus velatus*	Resident	Least Concern	Least Concern
Southern Pochard	*Netta erythrophthalma*	Resident	Least Concern	Least Concern
Southern Red Bishop	*Euplectes orix*	Resident	Least Concern	Least Concern
Southern Tchagra	*Tchagra tchagra*	Resident	Least Concern	Least Concern
Speckled Mousebird	*Colius striatus*	Resident	Least Concern	Least Concern
Speckled Pigeon	*Columba guinea*	Resident	Least Concern	Least Concern
Spike-heeled Lark	*Chersomanes albofasciata*	Resident	Least Concern	Least Concern
Spotted Eagle-Owl	*Bubo africanus*	Resident	Least Concern	Least Concern
Spotted Thick-knee	*Burhinus capensis*	Resident	Least Concern	Least Concern
Spur-winged Goose	*Plectropterus gambensis*	Resident	Least Concern	Least Concern
Streaky-headed Seedeater	*Crithagra gularis*	Resident	Least Concern	Least Concern
Striped Flufftail	*Sarothrura affinis*	Resident	Vulnerable	Least Concern
Swee Waxbill	*Coccopygia melanotis*	Resident	Least Concern	Least Concern
Swift Tern	*Thalasseus bergii*	Resident	Least Concern	Least Concern
Tambourine Dove	*Turtur tympanistria*	Resident	Least Concern	Least Concern
Terrestrial Brownbul	*Phyllastrephus terrestris*	Resident	Least Concern	Least Concern
Three-banded Plover	*Charadrius tricollaris*	Resident	Least Concern	Least Concern
Tractrac Chat	*Cercomela tractrac*	Resident	Least Concern	Least Concern
Verreaux's Eagle	*Aquila verreauxii*	Resident	Vulnerable	Least Concern
Verreaux's Eagle-Owl	*Bubo lacteus*	Resident	Least Concern	Least Concern
Victorin's Warbler	*Cryptillas victorini*	Resident	Least Concern	Least Concern
Wailing Cisticola	*Cisticola lais*	Resident	Least Concern	Least Concern

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Water Thick-knee	*Burhinus vermiculatus*	Resident	Least Concern	Least Concern
Wattled Starling	*Creatophora cinerea*	Resident	Least Concern	Least Concern
White-backed Duck	*Thalassornis leuconotus*	Resident	Least Concern	Least Concern
White-backed Mousebird	*Colius colius*	Resident	Least Concern	Least Concern
White-breasted Cormorant	*Phalacrocorax lucidus*	Resident	Least Concern	Least Concern
White-faced Duck	*Dendrocygna viduata*	Resident	Least Concern	Least Concern
White-fronted Plover	*Charadrius marginatus*	Resident	Least Concern	Least Concern
White-necked Raven	*Corvus albicollis*	Resident	Least Concern	Least Concern
White-starred Robin	*Pogonocichla stellata*	Resident	Least Concern	Least Concern
White-throated Canary	*Crithagra albogularis*	Resident	Least Concern	Least Concern
Yellow Bishop	*Euplectes capensis*	Resident	Least Concern	Least Concern
Yellow Canary	*Crithagra flaviventris*	Resident	Least Concern	Least Concern
Yellow-bellied Eremomela	*Eremomela icteropygialis*	Resident	Least Concern	Least Concern
Yellow-billed Duck	*Anas undulata*	Resident	Least Concern	Least Concern
Yellow-billed Egret	*Egretta intermedia*	Resident	Least Concern	Least Concern
Yellow-throated Woodland-Warbler	*Phylloscopus ruficapilla*	Resident	Least Concern	Least Concern
Zitting Cisticola	*Cisticola juncidis*	Resident	Least Concern	Least Concern
Black-collared Barbet	*Lybius torquatus*	Southern Extremity	Least Concern	Least Concern
Black-eared Sparrowlark	*Eremopterix australis*	Southern Extremity	Least Concern	Least Concern
Dark-backed Weaver	*Ploceus bicolor*	Southern Extremity	Least Concern	Least Concern
Desert Cisticola	*Cisticola aridulus*	Southern Extremity	Least Concern	Least Concern
Eastern Long-billed Lark	*Certhilauda semitorquata*	Southern Extremity	Least Concern	Least Concern
Golden-breasted Bunting	*Emberiza flaviventris*	Southern Extremity	Least Concern	Least Concern
Grey Sunbird	*Cyanomitra veroxii*	Southern Extremity	Least Concern	Least Concern
Kori Bustard	*Ardeotis kori*	Southern Extremity	Near Threatened	Near Threatened
Northern Black Korhaan	*Afrotis afraoides*	Southern Extremity	Least Concern	Not Evaluated
Red-billed Firefinch	*Lagonosticta senegala*	Southern Extremity	Least Concern	Least Concern
Red-billed Quelea	*Quelea quelea*	Southern Extremity	Least Concern	Least Concern
Sabota Lark	*Calendulauda sabota*	Southern Extremity	Least Concern	Least Concern
Abdim's Stork	*Ciconia abdimii*	Vagrant	Near Threatened	Least Concern
African Crake	*Crecopsis egregia*	Vagrant	Least Concern	Least Concern
African Cuckoo	*Cuculus gularis*	Vagrant	Least Concern	Least Concern
African Cuckoo Hawk	*Aviceda cuculoides*	Vagrant	Least Concern	Least Concern
African Firefinch	*Lagonosticta rubricata*	Vagrant	Least Concern	Least Concern
African Golden Oriole	*Oriolus auratus*	Vagrant	Least Concern	Least Concern
African Hobby	*Falco cuvierii*	Vagrant	Least Concern	Least Concern
African Jacana	*Actophilornis africanus*	Vagrant	Least Concern	Least Concern
African Openbill	*Anastomus lamelligerus*	Vagrant	Least Concern	Least Concern
African Palm-Swift	*Cypsiurus parvus*	Vagrant	Least Concern	Least Concern

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African Pied Wagtail	*Motacilla aguimp*	Vagrant	Least Concern	Least Concern
African Pitta	*Pitta angolensis*	Vagrant	Not Evaluated	Least Concern
African Pygmy Kingfisher	*Ispidina picta*	Vagrant	Least Concern	Least Concern
Allen's Gallinule	*Porphyrio alleni*	Vagrant	Least Concern	Least Concern
American Golden Plover	*Pluvialis dominica*	Vagrant	Not Evaluated	Least Concern
American Purple Gallinule	*Porphyrio martinicus*	Vagrant	Least Concern	Least Concern
Amsterdam Albatross	*Diomedea amsterdamensis*	Vagrant	Not Evaluated	Critically Endangered
Amur Falcon	*Falco amurensis*	Vagrant	Least Concern	Least Concern
Australian Gannet	*Morus serrator*	Vagrant	Not Evaluated	Least Concern
Baird's Sandpiper	*Calidris bairdii*	Vagrant	Not Evaluated	Least Concern
Bateleur	*Terathopius ecaudatus*	Vagrant	Endangered	Near Threatened
Black Heron	*Egretta ardesiaca*	Vagrant	Least Concern	Least Concern
Black Skimmer	*Rynchops niger*	Vagrant	Not Evaluated	Least Concern
Black Tern	*Chlidonias niger*	Vagrant	Least Concern	Least Concern
Black-chested Prinia	*Prinia flavicans*	Vagrant	Least Concern	Least Concern
Black-chested Snake-Eagle	*Circaetus pectoralis*	Vagrant	Least Concern	Least Concern
Black-crowned Night-Heron	*Nycticorax nycticorax*	Vagrant	Least Concern	Least Concern
Black-headed Gull	*Chroicocephalus ridibundus*	Vagrant	Least Concern	Least Concern
Black-legged Kittiwake	*Rissa tridactyla*	Vagrant	Least Concern	Least Concern
Black-throated Canary	*Crithagra atrogularis*	Vagrant	Least Concern	Least Concern
Black-winged Pratincole	*Glareola nordmanni*	Vagrant	Near Threatened	Near Threatened
Blue-cheeked Bee-eater	*Merops persicus*	Vagrant	Least Concern	Least Concern
Bridled Tern	*Onychoprion anaethetus*	Vagrant	Not Evaluated	Least Concern
Broad-billed Sandpiper	*Limicola falcinellus*	Vagrant	Least Concern	Least Concern
Bronze-winged Courser	*Rhinoptilus chalcopterus*	Vagrant	Least Concern	Least Concern
Brown Booby	*Sula leucogaster*	Vagrant	Not Evaluated	Least Concern
Brown Noddy	*Anous stolidus*	Vagrant	Not Evaluated	Least Concern
Brown Snake-Eagle	*Circaetus cinereus*	Vagrant	Least Concern	Least Concern
Buff-breasted Sandpiper	*Tryngites subruficollis*	Vagrant	Least Concern	Near Threatened
Buffy Pipit	*Anthus vaalensis*	Vagrant	Least Concern	Least Concern
Bush Blackcap	*Sylvia nigricapillus*	Vagrant	Vulnerable	Near Threatened
Caspian Plover	*Charadrius asiaticus*	Vagrant	Least Concern	Least Concern
Cinnamon-breasted Bunting	*Emberiza tahapisi*	Vagrant	Least Concern	Least Concern
Citrine Wagtail	*Motacilla citreola*	Vagrant	Not Evaluated	Least Concern
Collared Pratincole	*Glareola pratincola*	Vagrant	Near Threatened	Least Concern
Comb Duck	*Sarkidiornis melanotos*	Vagrant	Least Concern	Least Concern
Common Buttonquail	*Turnix sylvaticus*	Vagrant	Endangered	Least Concern
Common Cuckoo	*Cuculus canorus*	Vagrant	Least Concern	Least Concern
Common Scimitarbill	*Rhinopomastus cyanomelas*	Vagrant	Least Concern	Least Concern
Corn Crake	*Crex crex*	Vagrant	Least Concern	Least Concern
Crab Plover	*Dromas ardeola*	Vagrant	Least Concern	Least Concern
Crested Barbet	*Trachyphonus vaillantii*	Vagrant	Least Concern	Least Concern
Crowned Hornbill	*Tockus alboterminatus*	Vagrant	Least Concern	Least Concern
Dark-capped Bulbul	*Pycnonotus tricolor*	Vagrant	Least Concern	Least Concern
Drakensberg Rock-jumper	*Chaetops aurantius*	Vagrant	Least Concern	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Dunlin	*Calidris alpina*	Vagrant	Least Concern	Least Concern
Dusky Indigobird	*Vidua funerea*	Vagrant	Least Concern	Least Concern
Dwarf Bittern	*Ixobrychus sturmii*	Vagrant	Least Concern	Least Concern
Eastern Clapper Lark	*Mirafra fasciolata*	Vagrant	Least Concern	Least Concern
Elegant Tern	*Sterna elegans*	Vagrant	Not Evaluated	Near Threatened
Eleonora's Falcon	*Falco eleonorae*	Vagrant	Not Evaluated	Least Concern
Emerald-spotted Wood-Dove	*Turtur chalcospilos*	Vagrant	Least Concern	Least Concern
Eurasian Bittern	*Botaurus stellaris*	Vagrant	Least Concern	Least Concern
Eurasian Oystercatcher	*Haematopus ostralegus*	Vagrant	Least Concern	Least Concern
European Nightjar	*Caprimulgus europaeus*	Vagrant	Least Concern	Least Concern
European Pied Flycatcher	*Ficedula hypoleuca*	Vagrant	Not Evaluated	Least Concern
Franklin's Gull	*Larus pipixcan*	Vagrant	Least Concern	Least Concern
Fulvous Duck	*Dendrocygna bicolor*	Vagrant	Least Concern	Least Concern
Garden Warbler	*Sylvia borin*	Vagrant	Not Evaluated	Least Concern
Garganey	*Anas querquedula*	Vagrant	Not Evaluated	Least Concern
Gentoo Penguin	*Pygoscelis papua*	Vagrant	Endangered	Near Threatened
Goliath Heron	*Ardea goliath*	Vagrant	Least Concern	Least Concern
Great Knot	*Calidris tenuirostris*	Vagrant	Not Evaluated	Endangered
Great Reed-Warbler	*Acrocephalus arundinaceus*	Vagrant	Not Evaluated	Least Concern
Greater Sheathbill	*Chionis albus*	Vagrant	Not Evaluated	Least Concern
Greater Yellowlegs	*Tringa melanoleuca*	Vagrant	Not Evaluated	Least Concern
Green Sandpiper	*Tringa ochropus*	Vagrant	Least Concern	Least Concern
Green-backed Heron	*Butorides striata*	Vagrant	Least Concern	Least Concern
Grey Crowned Crane	*Balearica regulorum*	Vagrant	Endangered	Endangered
Grey Wagtail	*Motacilla cinerea*	Vagrant	Not Evaluated	Least Concern
Grey-backed Camaroptera	*Camaroptera brevicaudata*	Vagrant	Least Concern	Not Evaluated
Grey-headed Kingfisher	*Halcyon leucocephala*	Vagrant	Least Concern	Least Concern
Groundscraper Thrush	*Turdus litsitsirupa*	Vagrant	Least Concern	Least Concern
Gull-billed Tern	*Gelochelidon nilotica*	Vagrant	Not Evaluated	Least Concern
Harlequin Quail	*Coturnix delegorguei*	Vagrant	Least Concern	Least Concern
Hudsonian Godwit	*Limosa haemastica*	Vagrant	Not Evaluated	Least Concern
Icterine Warbler	*Hippolais icterina*	Vagrant	Least Concern	Least Concern
King Penguin	*Aptenodytes patagonicus*	Vagrant	Near Threatened	Least Concern
Laysan Albatross	*Phoebastria immutabilis*	Vagrant	Not Evaluated	Near Threatened
Lazy Cisticola	*Cisticola aberrans*	Vagrant	Least Concern	Least Concern
Lesser Crested Tern	*Thalasseus bengalensis*	Vagrant	Not Evaluated	Least Concern
Lesser Grey Shrike	*Lanius minor*	Vagrant	Least Concern	Least Concern
Lesser Moorhen	*Paragallinula angulata*	Vagrant	Least Concern	Least Concern
Lesser Sand Plover	*Charadrius mongolus*	Vagrant	Least Concern	Least Concern
Lesser Spotted Eagle	*Clanga pomarina*	Vagrant	Not Evaluated	Least Concern
Lesser Striped Swallow	*Cecropis abyssinica*	Vagrant	Least Concern	Least Concern
Lesser Yellowlegs	*Tringa flavipes*	Vagrant	Not Evaluated	Least Concern
Lilac-breasted Roller	*Coracias caudatus*	Vagrant	Least Concern	Least Concern
Little Bee-eater	*Merops pusillus*	Vagrant	Least Concern	Least Concern
Little Blue Heron	*Egretta caerulea*	Vagrant	Not Evaluated	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Little Crake	*Porzana parva*	Vagrant	Least Concern	Least Concern
Long-crested Eagle	*Lophaetus occipitalis*	Vagrant	Least Concern	Least Concern
Macaroni Penguin	*Eudyptes chrysolophus*	Vagrant	Vulnerable	Vulnerable
Madagascar Bee-eater	*Merops supercilliosus*	Vagrant	Not Evaluated	Least Concern
Magellanic Penguin	*Spheniscus magellanicus*	Vagrant	Not Evaluated	Near Threatened
Mangrove Kingfisher	*Halcyon senegaloides*	Vagrant	Endangered	Least Concern
Marabou Stork	*Leptoptilos crumeniferus*	Vagrant	Near Threatened	Least Concern
Marsh Warbler	*Acrocephalus palustris*	Vagrant	Least Concern	Least Concern
Matsudaira's Storm Petrel	*Oceanodroma matsudairae*	Vagrant	Not Evaluated	Vulnerable
Mocking Cliff-Chat	*Thamnolaea cinnamomeiventris*	Vagrant	Least Concern	Least Concern
Montagu's Harrier	*Circus pygargus*	Vagrant	Least Concern	Least Concern
Northern Rockhopper Penguin	*Eudyptes moseleyi*	Vagrant	Least Concern	Endangered
Northern Shoveller	*Anas clypeata*	Vagrant	Not Evaluated	Least Concern
Pacific Golden Plover	*Pluvialis fulva*	Vagrant	Not Evaluated	Least Concern
Pallid Harrier	*Circus macrourus*	Vagrant	Near Threatened	Near Threatened
Pallid Swift	*Apus pallidus*	Vagrant	Least Concern	Least Concern
Palm-nut Vulture	*Gypohierax angolensis*	Vagrant	Least Concern	Least Concern
Pearl-spotted Owlet	*Glaucidium perlatum*	Vagrant	Least Concern	Least Concern
Pectoral Sandpiper	*Calidris melanotos*	Vagrant	Not Evaluated	Least Concern
Pel's Fishing-Owl	*Scotopelia peli*	Vagrant	Endangered	Least Concern
Pink-backed Pelican	*Pelecanus rufescens*	Vagrant	Vulnerable	Least Concern
Pink-billed Lark	*Spizocorys conirostris*	Vagrant	Least Concern	Least Concern
Red Lark	*Calendulauda burra*	Vagrant	Vulnerable	Vulnerable
Red Phalarope	*Phalaropus fulicaria*	Vagrant	Least Concern	Least Concern
Red-backed Shrike	*Lanius collurio*	Vagrant	Least Concern	Least Concern
Red-billed Oxpecker	*Buphagus eryth rorhynchus*	Vagrant	Least Concern	Least Concern
Red-billed Tropicbird	*Phaethon aethereus*	Vagrant	Not Evaluated	Least Concern
Red-footed Booby	*Sula sula*	Vagrant	Not Evaluated	Least Concern
Red-footed Falcon	*Falco vespertinus*	Vagrant	Near Threatened	Least Concern
Red-fronted Tinkerbird	*Pogoniulus pusillus*	Vagrant	Least Concern	Least Concern
Red-headed Finch	*Amadina erythrocephala*	Vagrant	Least Concern	Least Concern
Red-necked Buzzard	*Buteo auguralis*	Vagrant	Not Evaluated	Least Concern
Red-necked Phalarope	*Phalaropus lobatus*	Vagrant	Least Concern	Least Concern
Red-necked Stint	*Calidris ruficollis*	Vagrant	Least Concern	Near Threatened
Red-rumped Swallow	*Hirundo daurica*	Vagrant	Least Concern	Least Concern
Red-throated Wryneck	*Jynx ruficollis*	Vagrant	Least Concern	Least Concern
Rufous-tailed Scrub Robin	*Cercotrichas galactotes*	Vagrant	Not Evaluated	Least Concern
Scopoli's Shearwater	*Calonectris diomedia*	Vagrant	Not Evaluated	Least Concern
Sedge Warbler	*Acrocephalus schoenobaenus*	Vagrant	Least Concern	Least Concern
Shaft-tailed Whydah	*Vidua regia*	Vagrant	Least Concern	Least Concern
Snowy Egret	*Egretta thula*	Vagrant	Not Evaluated	Least Concern
Sooty Falcon	*Falco concolor*	Vagrant	Near Threatened	Near Threatened
Sooty Tern	*Onychoprion fuscatus*	Vagrant	Not Evaluated	Least Concern
South African Cliff-Swallow	*Petrochelidon spilodera*	Vagrant	Least Concern	Least Concern
Southern Black Tit	*Parus niger*	Vagrant	Least Concern	Least Concern

English Name	Scientific Name	Western Cape Status	South African Conservation Status	IUCN Conservation Status
Southern Carmine Bee-eater	*Merops nubicoides*	Vagrant	Least Concern	Least Concern
Southern Yellow-billed Hornbill	*Tockus leucomelas*	Vagrant	Least Concern	Least Concern
Spectacled Weaver	*Ploceus ocularis*	Vagrant	Least Concern	Least Concern
Spotted Crake	*Porzana porzana*	Vagrant	Least Concern	Least Concern
Squacco Heron	*Ardeola ralloides*	Vagrant	Least Concern	Least Concern
Steppe Eagle	*Aquila nipalensis*	Vagrant	Least Concern	Endangered
Subantarctic Shearwater	*Puffinis elegans*	Vagrant	Not Evaluated	Least Concern
Swallow-tailed Bee-eater	*Merops hirundineus*	Vagrant	Least Concern	Least Concern
Tawny Eagle	*Aquila rapax*	Vagrant	Endangered	Least Concern
Tawny-flanked Prinia	*Prinia subflava*	Vagrant	Least Concern	Least Concern
Temminck's Courser	*Cursorius temminckii*	Vagrant	Least Concern	Least Concern
Temminck's Stint	*Calidris temminckii*	Vagrant	Not Evaluated	Least Concern
Thick-billed Weaver	*Amblyospiza albifrons*	Vagrant	Least Concern	Least Concern
Tree Pipit	*Anthus trivalis*	Vagrant	Not Evaluated	Least Concern
Village Indigobird	*Vidua chalybeata*	Vagrant	Least Concern	Least Concern
Violet-backed Starling	*Cinnyricinclus leucogaster*	Vagrant	Least Concern	Least Concern
Wahlberg's Eagle	*Hieraaetus wahlbergi*	Vagrant	Least Concern	Least Concern
Western Marsh Harrier	*Circus aeruginosus*	Vagrant	Not Evaluated	Least Concern
Western Reef Heron	*Egretta gularis*	Vagrant	Not Evaluated	Least Concern
Western Yellow Wagtail	*Motacilla flava*	Vagrant	Least Concern	Least Concern
White-backed Night-Heron	*Gorsachius leuconotus*	Vagrant	Vulnerable	Least Concern
White-backed Vulture	*Gyps africanus*	Vagrant	Critically Endangered	Critically Endangered
White-browed Coucal	*Centropus superciliosus*	Vagrant	Least Concern	Least Concern
White-browed Scrub-Robin	*Cercotrichas leucophrys*	Vagrant	Least Concern	Least Concern
White-fronted Bee-eater	*Merops bullockoides*	Vagrant	Least Concern	Least Concern
White-rumped Sandpiper	*Calidris fuscicollis*	Vagrant	Not Evaluated	Least Concern
White-tailed Tropicbird	*Phaethon lepturus*	Vagrant	Least Concern	Least Concern
White-throated Bee-eater	*Merops albicollis*	Vagrant	Least Concern	Least Concern
White-winged Widowbird	*Euplectes albonotatus*	Vagrant	Least Concern	Least Concern
Wilson's Phalarope	*Steganopus tricolor*	Vagrant	Least Concern	Least Concern
Wing-snapping Cisticola	*Cisticola ayresii*	Vagrant	Least Concern	Least Concern
Woolly-necked Stork	*Ciconia episcopus*	Vagrant	Least Concern	Least Concern
Yellow-billed Stork	*Mycteria ibis*	Vagrant	Endangered	Least Concern
Yellow-crowned Bishop	*Euplectes afer*	Vagrant	Least Concern	Least Concern
Yellow-fronted Canary	*Crithagra mozambicus*	Vagrant	Least Concern	Least Concern
Yellow-throated Petronia	*Gymnoris superciliaris*	Vagrant	Least Concern	Least Concern

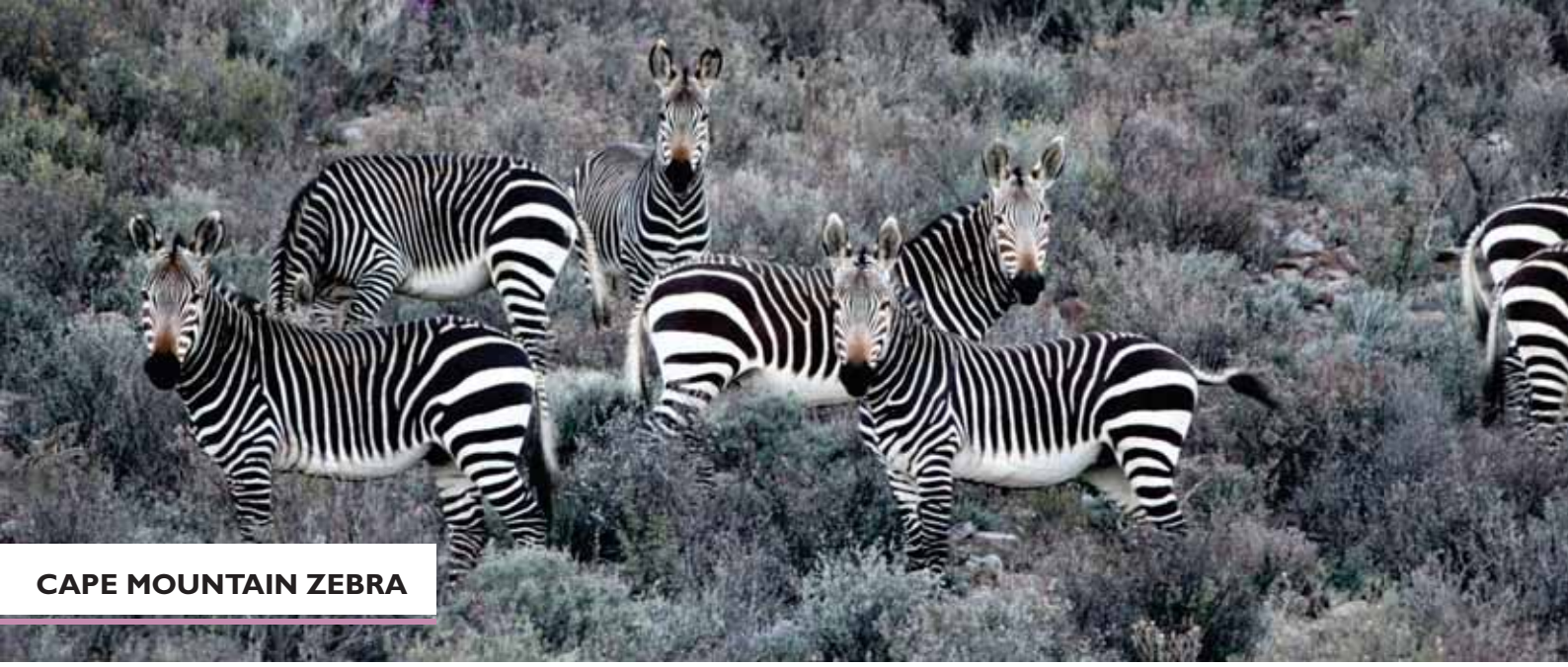
CHAPTER 9

MAMMALS

C. Birss

Scientific Services, CapeNature

CONTENTS



CAPE MOUNTAIN ZEBRA

Executive Summary

The Western Cape Province (WCP) has 176 described mammal taxa (species and subspecies). Of these, four are extinct, 24 are listed as Threatened and 13 are listed as Near Threatened in the 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (Child *et al*., 2012). Three are Critically Endangered, eight are Endangered, 13 are Vulnerable to extinction. Eight of nine taxa are extant and endemic to the Western Cape Province while 10 are near endemic and some taxa are considered locally Extinct in the Wild. Of the extant mammal species of the Western Cape, 19 species have a weakened conservation status. Nine of these are endemic to South Africa.

The conservation status of Cape mountain zebra (*Equus zebra zebra*) has strengthened to Least Concern but conservation dependent and it was down listed from CITES Appendix I to Appendix II following a proposal by South Africa during the Convention of Parties(COP) in 2017. The collaborative inter-agency Draft Biodiversity Management Plan for Cape Mountain Zebra in South Africa was finalized in 2016 and was submitted during COP17 to support the application to down list.

The recent red list assessments highlighted the lack of good quality population trend data available for a number of species occurring on protected areas throughout the region, as is also evident for population trend data for the small and medium sized antelope species occurring on CapeNature protected areas.

The conservation status of bontebok (*Damaliscus pygargus pygargus*) has remained unchanged and it is still red listed as Vulnerable. The CapeNature Bontebok Conservation Translocation and Utilization Policy was finalized in 2014 and incorporates the establishment of genetic hybrid thresholds to inform regulatory measures to address the threats of hybridization with blesbok (*Damaliscus pygargus phillipsi*). An inter-agency Draft Biodiversity Management Plan for Bontebok in South Africa was also compiled in 2016.

CapeNature relies extensively on partnerships and collaborations in the policy and research spheres to engage on mammalians priorities for the Western Cape Province to extend and augments its capacity.

The "Conclusions and Recommendations" of this chapter provides updates and highlights for mammal species prioritized for conservation action during the previous review (2007 to 2012): The riverine rabbit (*Bunolagus monticularis*) benefited from improved knowledge related to distribution and species' range, although the species is still Critically Endangered and the Western Cape Game Distribution Database was established to enable monitoring of the extent of game ranching in the Western Cape as well as to provide additional information for future conservation assessment of species occurring on private land. This database also accommodates distribution data for alien and invasive species.

This review period experienced a significant decline in recorded distribution data for mammal species in the Western Cape, and some critical data gaps are identified in the "Updates on recommended actions for other 2012 priority mammal species".

Changes in the threatened statuses of mammalian species, performance against the previous recommendations and the distribution status of prioritized mammal species informs the setting of priorities for the next review period.

1. Introduction

The IUCN Red List, established in 1963 provides an indication of the likelihood of a species becoming extinct in their natural wild habitats: threatened species are those which face a high risk of extinction in the near future and are categorised as Critically Endangered, Endangered or Vulnerable (SANBI, 2013; IUCN, 2008). The Endangered Wildlife Trust (EWT) and the South African National Biodiversity Institute (SANBI) in collaboration with the IUCN Species Survival Commission (SSC), provincial and national conservation

agencies, universities and museums produced the 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (Child *et al.* 2016). A total of 331 species, subspecies or subpopulations were assessed for this region, including 173 of the 176 species of mammals which are indigenous to the Western Cape Province (EWT 2016). A complete list of mammal species for the Western Cape is included as Appendix 1.

Species accounts and conservation assessments are intended to inform conservation policy and management, necessitating period review of the distribution and abundance of species as well as their persistence in light of threats which may impact them. These periodic reviews may occur at global, regional and local scales at which appropriate policy and management measures need to be developed to mitigate against persistent threats at the appropriate scale. Thus the context of this review is primarily at a provincial (local) scale and where appropriate relates the regional and global scales.

2. Methods and Results

Species conservation statuses were updated using the individual Red List Assessments of the 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (Child *et al.* 2016).

Taxonomic changes including reclassification or changes in distribution ranges were incorporated in the CapeNature Biodiversity Database and are discussed in the "Systematic Account" section.

Changes in conservation statuses were assessed to inform reprioritisation of mammal species for the Western Cape Province for the next five years. An account of these changes are discussed in the "Conservation Status" section. Species accounts and conservation assessments are intended to inform appropriate policy and management interventions.

Distribution ranges for mammalian taxa were re-assessed to inform the determination of endemism status which is discussed in the "Endemism" section.

Mammal distribution records lodged for this review period, 2012 to 2016, were extracted from the CapeNature Biodiversity Database, evaluated and assessed in terms of the recommendations made in in the previous Western Cape State of Biodiversity Report. Progress and further recommendations are reflected in the "Conclusions and Recommendations" section.

3. Systematic Account

The CapeNature Biodiversity Database currently holds a total of 61 291 mammal distribution records. A total of 8 402 of these records consists of data for this review period (being 2012 to 2016). Distribution records for the previous review period (being 2007 to 2011) consisted of 15 917 records. Distribution records for the 2002 to 2006 review period consisted of 9 224 records.

A total of 2 995 distribution records in addition to the 8 402 records for the current (2012 to 2016) review period are derived specifically from the Western Cape Game Distribution Database (WC GDDB).

3.1 Taxonomic changes

Taxonomic revisions have resulted in the following renaming of mammal species indigenous to the Western Cape:

- Cape grey mongoose: *Galerella pulverulenta pulverulenta* to *Herpestes pulverulentus* (Do Linh San *et al.*, 2016)
- Robert's vlei rat: *Otomyse saundersiae* to *Otomys karoensis* (Taylor *et al.*, 2016)
- Indo-pacific humpback dolphin *Sousa chinensis to* Indian Ocean humpback dolphin *Sousa plumbea* (Plön *et al.*, 2016).
- Bushbuck: *Tragelaphus scriptus sylvaticus* to southern buschbuck, *Tragelaphus sylvaticus* (Downs *et al.*, 2016).

Updated distribution data and identification have resulted in the following reclassification of species listed as indigenous to the Western Cape:

- Database records for long-eared bats, *Laephotis wintoni,* to be substituted with *Laephotis namibensis* (Jacobs *et al.*, 2016);
- Database records for long-fingered bats, *Miniopterus schreibersii* to be substituted with *Miniopterus natalensis* (MacEwan *et al.*, 2016);
- Database records for the finless porpoise, *Neophocaena phocaenoides* to be removed as they appear to be based on an erroneous type locality for the species which is restricted to the Indo-pacific region (Wang & Reeves 2012);
- Database records for leopard, *Panthera pardus* to be substituted with *Panthera pardus pardus* (Swanepoel *et al.*, 2016; Dutta *et al.*, 2013)
- Database records for mountain reedbuck, *Redunca fulvorufula* to be substituted with *Redunca fulvorufula fulvorufula*, the near endemic southern mountain reedbuck subspecies (Taylor *et al.*, 2016);
- Include black wildebeest, *Connochaetes gnou* (Vrahimis *et al.*, 2016; Birss *et al.*, 2015), and
- Include the Cape ground squirrel, *Xerus inausris* (Waterman *et al.*, 2016).

4. Conservation Status

Of the 176 mammal taxa (including subspecies) which are indigenous to the Western Cape Province, four are extinct (the blue antelope, *Hippotragus leucophaeus* the Cape warthog, *Phacocheorus aethiopicus aethiopicus*, the Cape lion, *Panthera leo melanochaitus* and the quagga, *Equus quagga quagga*), (EWT, 2016).

Of the 172 extant mammal species indigenous to the

Western Cape, 24 (14 %) are Threatened: three Critically Endangered, eight are Endangered and 13 are Vulnerable. Thus 14 % of the mammal species in the Western Cape are Threatened. Of the remaining taxa, 13 are Near Threatened, 12 are Data Deficient, one which was not evaluated and 122 are known not to be threatened (Least Concern), as illustrated in Figure 1 and listed in Table 1. From a country-wide perspective, 17 % of the Southern African mammal species which were assessed, are threatened (EWT, 2016).

Of the extant mammal species indigenous to the Western Cape, 40 species are indicated to have an improved conservation status, 117 species are indicated to have remained unchanged, but 19 species are indicated to have a weakened conservation status. Of these 19 species, nine are endemic to South Africa. Only two of the non-endemic species are not oceanic species, namely the near-endemic mountain reedbuck (*Redunca fulvorufula fulvorufula*), which weakened from Least Concern to Endangered due to an estimated 61 % decline in 32 protected areas across its range (Taylor *et al.*, 2016), and the Namib long-eared bat (*Leaphotis namibensis*) which was not previously evaluated but weakened from Least Concern to Vulnerable, compared to its global Red List assessment in 2008 (Jacobs *et al.*, 2016).

The Southern African endemic species which have a weakened conservation status include grey rhebok (*Pelea capreolus*), changed from Least Concern to Near Threatened due to an estimated decline of 20 % in 13 protected areas across its range (Taylor *et al.*, 2016); Duthie's golden mole (*Chlorotalpa duthieae*), Least Concern to Vulnerable due to its limited area of occupancy and lack of protected habitat across its range (Bronner & Bennet, 2016); the spectacled dormouse (*Graphiurus ocularis*), Least Concern to Near Threatened due to the reduction in the area of occupancy, increased habitat fragmentation and a significant drop in reporting frequency which may be an artefact of decreased

Table 1: Mammal species indigenous to the Western Cape which are Threatened or Near Threatened.

Common Name	Taxon Name	2016 Regional IUCN Assessments
CRITICALLY ENDANGERED		
Riverine rabbit	*Bunolagus monticularis*	Critically Endangered C2a(i)
Antarctic true blue whale	*Balaenoptera musculus intermedia*	Critically Endangered A1abd
Boosmansbos long-tailed forest shrew	*Myosorex longicaudatus boosmani*	Critically Endangered B1ab(ii,iii)+2ab(ii,iii)
ENDANGERED		
Van Zyl's golden mole	*Cryptochloris zyli*	Endangered B1ab(iii)+2ab(iii)
African wild dog	*Lycaon pictus*	Endangered D
Sei whale	*Balaenoptera borealis*	Endangered A1d
Southern Hemisphere fin whale	*Balaenoptera physalus*	Endangered A1d
Mountain reedbuck	*Redunca fulvorufula fulvorufula*	Endangered A2b
Indian hump-backed dolphin	*Sousa plumbea*	Endangered A4cd; B1ab(iii,v)
Long-tailed forest shrew	*Myosorex longicaudatus*	Endangered B1ab(ii,iii)+2ab(ii,iii)
Southwestern black rhinoceros	*Diceros bicornis bicornis*	Endangered D
VULNERABLE		
Bryde's whale	*Balaenoptera edeni*	Vulnerable
Sperm whale	*Physeter macrocephalus*	Vulnerable A1d
Grant's golden mole	*Eremitalpa granti granti*	Vulnerable B1ab(iii)+B2ab(iii)
Bontebok	*Damaliscus pygargus pygargus*	Vulnerable B2ab(ii)+D1
Cheetah	*Acinonyx jubatus*	Vulnerable C2a(i)+D1
Cape Marsh Rat	*Dasymys capensis*	Vulnerable B1ab(ii,iii,iv)+B2ab(ii,iii,iv)
Duthie's golden mole	*Chlorotalpa duthieae*	Vulnerable B1ab(iii)+2ab(iii)
Blue duiker	*Philantomba monticola monticola*	Vulnerable B2ab(ii,iii,v)+C2a(i)
Leopard	*Panthera pardus*	Vulnerable C1
Black-footed cat	*Felis nigripes*	Vulnerable C2a(i)
White-tailed mouse	*Mystromys albicaudatus*	Vulnerable C2a(i)
Humpback whale	*Megaptera novaeangliae*	Vulnerable D1
Namib long-eared bat	*Laephotis namibensis*	Vulnerable D1
NEAR THREATENED		
Grey rhebok	*Pelea capreolus*	Near Threatened A2b
Southern elephant seal	*Mirounga leonina*	Near Threatened A2b
Spectacled dormouse	*Graphiurus ocularis*	Near Threatened A2bc
Laminate vlei rat	*Otomys laminatus*	Near Threatened B2ab(i,ii,iii,iv)+C1+C2a(i)
Serval	*Leptailurus serval serval*	Near Threatened B2ab(ii,iii,iv,v)+C2a(i)
Fynbos golden mole	*Amblysomus corriae*	Near Threatened B2ab(iii)
Indian Ocean bottlenosed dolphin	*Tursiops aduncus*	Near Threatened B2ab(iii,v)
Littledale's whistling rat	*Parotomys littledalei*	Near Threatened B2b(iii,iv),c(iii)
African striped weasel	*Poecilogale albinucha*	Near Threatened C1
African clawless otter	*Aonyx capensis*	Near Threatened C2a(i)
Brown hyaena	*Parahyaena brunnea*	Near Threatened C2a(i)+D1
Spotted hyaena	*Crocuta crocuta*	Near Threatened C2a(ii)

observation effort (Wilson *et al.*, 2016); the laminate vlei rat (*Otomys laminatus*), Least Concern to Near Threatened due to decreased area of occupancy and habitat loss (Taylor *et al.*, 2016); the Indian Ocean bottlenose dolphin (*Tursiops aduncus* Ifafa-False Bay subpopulation) was not previously evaluated, however new information supports the assessment at subpopulation level pending the outcome of further genetic analyses (Cockcroft *et al.*, 2016). The subpopulation is considered Near Threatened due to an ongoing declining population trend and habitat degradation; the long-tailed forest shrew (*Myosorex longicaudatus*), changed from Least Concern to Endangered due to reduced and fragmented habitat and decreased area of occupancy. The Boosman's long-tailed forest shrew (*Myosorex longicaudatus boosmani*), which was not previously evaluated is considered Critically Endangered due to a severely limited area of occupancy and the projected impact of climate change (Baxter *et al.*, 2016); the Cape marsh rat (*Dasymys capensis*), has been evaluated to full species status based on cranial morphology and its isolated distribution. It is considered Vulnerable due to its restricted area of occupancy, declining populations due to habitat degradation and loss (Pillay *et al.*, 2016); South African endemic species which were not previously evaluated which are now threatened are the Karoo rock sengi (*Elephantulus pilicaudus*), was only described in 2008, based on molecular genetics and is known only from 5 locations without actual abundance or density data and is thus considered Data Deficient (Rathbun and Smit-Robinson 2016).

5. Legal Status

5.1 International Legislation: CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was drafted as a result of a resolution adopted in 1963 at a meeting of the members of the IUCN (The World Conservation Union) and is an international agreement between governments aimed at ensuring that international trade in specimens of wild animals and plants do not threaten their survival. States or countries which have agreed to be bound by the Convention are known as Parties. CITES is legally binding on Parties but CITES does not replace national legislation, however, CITES does provide a framework for the development of national legislation to ensure that CITES is implemented at a national level (CITES COP17).

Species may be listed on three CITES Appendices in accordance with the degree of protection required. Appendix I and II lists species which are globally threatened with extinction for which trade needs to be strictly controlled or regulated. Appendix III species are those species for which protection in at least one country requires control of trade.

Of the 172 extant mammal species indigenous to the Western Cape Province, 16 are listed as Appendix I and 42 are listed as Appendix II. Whales and dolphins constitute the majority of CITES listed species: 13 on Appendix I and 27 on Appendix II. Of the terrestrial species, cheetah, leopard, black-footed cat are listed on Appendix I, requiring very strict trade control measures.

Cape mountain zebra was down listed from Appendix I to Appendix II following a proposal by South Africa at the 2016 Conference of Parties. The down listing is subject to the implementation of a Biodiversity Management Plan including the development and implementation of cautionary hunting quotas based on population simulation models (CITES COP17).

Bontebok, blue duiker, hippopotamus, African clawless otter, caracal, African wild cat, serval, lion, vervet monkey, chacma baboon, African elephant and four species of seals are also listed on Appendix II.

Honey badger and aardwolf are listed on Appendix III for Botswana.

5.2 National Legislation

The **National Environmental Management: Biodiversity Act**, No. 10 of 2004 (NEM: BA) provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act of 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matter connected therewith. **The Threatened or Protected Species (ToPS) Regulations** provide the regulations in terms of section 97 of the NEM: BA.

Of the 172 extant mammal species indigenous to the Western Cape Province, only the riverine rabbit is listed as Critically Endangered in the ToPS; African wild dog, Cape mountain zebra and south-western black rhinoceros are listed as Endangered; cheetah, leopard, bontebok, blue duiker and lion are listed as Vulnerable; black wildebeest, black-footed cat, spotted hyaena, brown hyaena, Cape fox, African clawless otter, serval, African elephant and honey badger are listed as Protected. Species listed in the ToPS are listed in relation to the threats posed by the listed restricted activities:

i. hunting, catching, capturing or killing any living specimen of a listed threatened or protected species by any means, method or device whatsoever, including searching, pursuing, driving, lying in wait, luring, alluring, discharging a missile or injuring with intent to hunt, catch, capture or kill any such specimen;
ii. gathering, collecting or plucking any specimen of a listed threatened or protected species;
iii. picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed threatened or protected species;

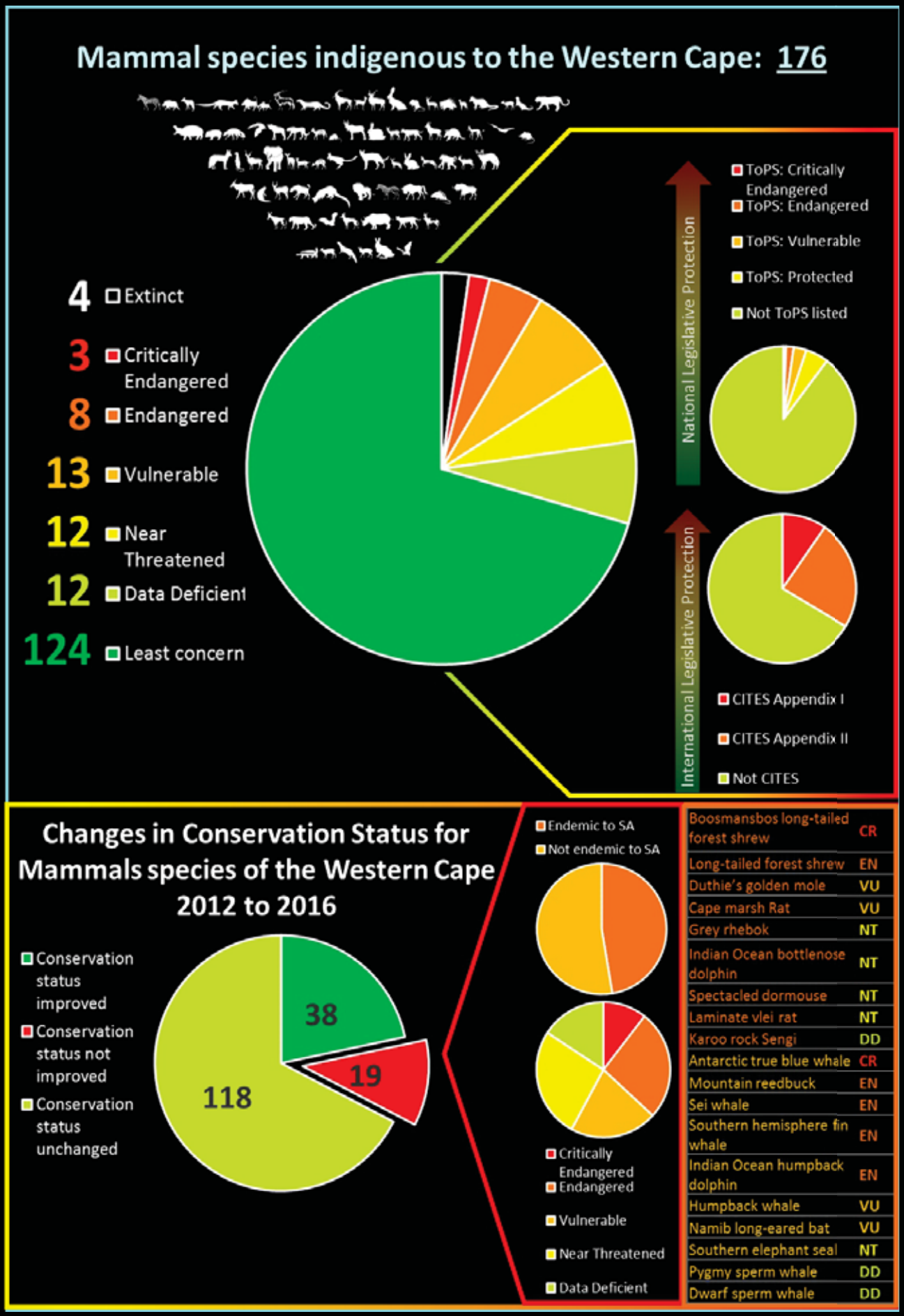


Figure 1: Infographic representation of the conservation and legal statuses of the mammal species indigenous to the Western Cape Province

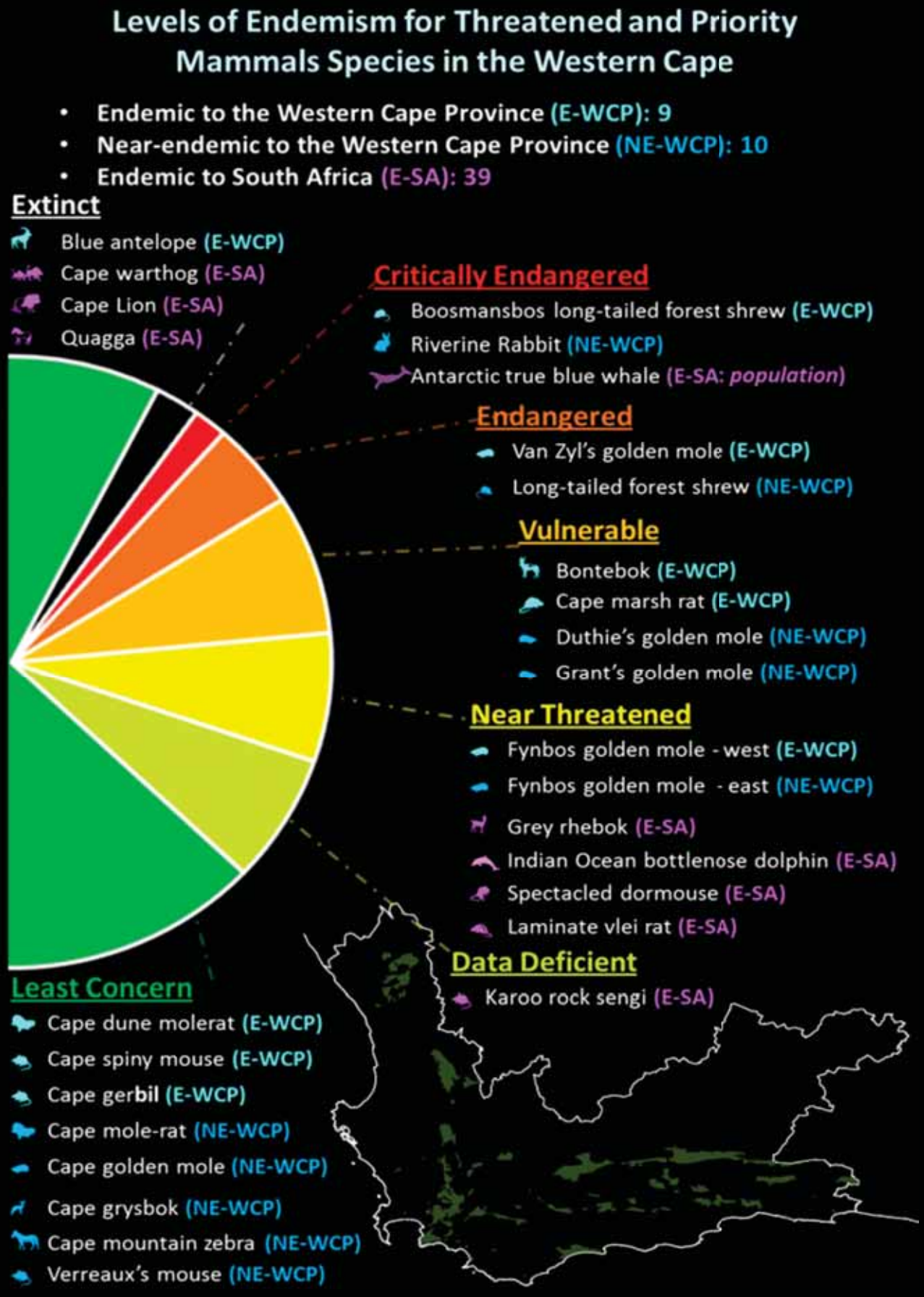


Figure 2: Infographic representation of the mammal species endemic and near-endemic to the Western Cape Province (E = Endemic; NE = Near-endemic).

iv. importing into the Republic, including introducing from the sea, any specimen of a listed threatened or protected species;
v. exporting from the Republic, including re-exporting from the Republic, any specimen of a listed threatened or protected species;
vi. having in possession or exercising physical control over any specimen of a listed threatened or protected species;
vii. growing, breeding or in any other way propagating any specimen of a listed threatened or protected species, or causing it to multiply;
viii. conveying, moving or otherwise translocating any specimen of a listed threatened or protected species;
ix. selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any way acquiring or disposing of any specimen of a listed threatened or protected species; or
x. any other prescribed activity which involves a specimen of a listed threatened or protected species.

5.3 Provincial Legislation

The **Nature and Environmental Conservation Ordinance, No. 19 of 1974** as amended by the Western Cape Nature Conservation Laws Amendment Act, No. 3 of 2000 provides laws relating to nature and environmental conservation and provides for matters incidental thereto.

Of the 172 extant mammal species indigenous to the Western Cape Province, Cheetah, South-western black rhinoceros, Cape mountain zebra and riverine rabbit are listed on Schedule 1: Endangered Wild Animals; Elephant shrews, Shrews, bats, lion, leopard, black-footed cat, serval, aardwolf, brown hyaena, honey badger, Cape fox, bat-eared fox, African striped weasel, African elephant, aardvark, hippopotamus, klipspringer, common duiker, blue duiker, steenbok, Cape grysbok, grey rhebok, kudu, bushbuck, mountain reedbuck, springbok, gemsbok, Cape eland, African buffalo, black wildebeest and bontebok are listed on Schedule 2: Protected Wild Animals.

6. Endemism

Table 2 lists the levels of endemism for the Western Cape mammal species: Nine species of mammals, eight of which are extant, are endemic to the Western Cape and another ten species are near endemic: (near endemic species are either species endemic to the Cape Floristic Region or species that have a distribution range which is primarily in the Western Cape but extends marginally into the Northern Cape and/or Eastern Cape provinces.). Refer to Figure 2 for a schematic representation of endemism in relation to conservation status.

Common Name	Taxon Name
ENDEMIC TO THE WESTERN CAPE	
Fynbos golden mole (west)	*Amblysomus corriae devilliersi*
Van Zyl's golden mole	*Cryptochloris zyli*
Bontebok	*Damaliscus pygargus pygargus*
Blue antelope	*Hippotragus leucophaeus*
Boosmansbos long-tailed forest shrew	*Myosorex longicaudatus boosmani*
Cape spiny mouse	*Acomys subspinosus*
Cape dune molerat	*Bathyergus suillus*
Cape marsh rat	*Dasymys capensis*
Cape gerbil	*Gerbilliscus afra*
NEAR-ENDEMIC TO THE WESTERN CAPE	
Fynbos golden mole (east)	*Amblysomus corriae corriae*
Duthie's golden mole	*Chlorotalpa duthieae*
Cape golden mole	*Chrysochloris asiatica*
Grant's golden mole	*Eremitalpa granti granti*
Cape grysbok	*Raphicerus melanotis*
Long-tailed forest shrew	*Myosorex longicaudatus*
Riverine rabbit	*Bunolagus monticularis*
Cape mountain zebra	*Equus zebra zebra*
Cape molerat	*Georychus capensis*
Verreaux's mouse	*Myomyscus verreauxii*

Table 2: Endemism of Western Cape mammal species.

7. Monitoring

The recent regional red list assessments highlighted the lack of good quality data for monitoring the trends of particularly the eco-typical game species on protected areas to inform the assessment of population performances. In the case of species such as mountain reedbuck and grey rhebok, it is strongly recommended that more suitable survey and monitoring methodologies need to be implemented for obtaining more reliable population numbers for protected areas.

Mountain reedbuck is near-endemic to South Africa is estimated to have suffered a population decline of 61% in the protected areas throughout its range and is now red listed as Endangered where it was previously listed as Least Concern (Taylor *et al.*, 2016). Mountain reedbuck is expected to occur on four (of 68 connected) CapeNature protected areas but has only been confirmed on one and no population trend data is available.

Grey rhebok is endemic to South Africa and has experienced a 20% population decline in the protected areas throughout its range and is now red listed as Near Threatened where it was previously listed as Least Concern (Taylor *et al.*, 2016). Grey rhebok is expected to occur on 57 (of 68 connected) Cape Nature Protected Areas and has only been confirmed on 22 with no population trend data.

Cape grysbok is near-endemic to the Western Cape Province is considered well represented in protected areas throughout its range, but estimates of population sizes are scarce and outdated, highlighting the need for more robust estimates of subpopulation sizes from sites throughout their range (Palmer *et al.*, 2016).

Cape grysbok is expected to occur on 60 (of 68 connected) Cape Nature Protected Areas and has only been confirmed on 19 with no population trend data.

Registers for monitoring populations of game species on CapeNature reserves have been implemented. These register will monitor population trends for priority game species, occurrence of alien or invasive ungulate species as well as persistence of eco-typical game species. A total of 68 Nature Reserve registers have been established for CapeNature managed nature reserves, (Priority game species are those mammalian game species which are indigenous to the Western Cape).

Cape mountain zebra occur on four CapeNature protected areas: De Hoop, Anysberg, Kammanassie and Gamkaberg Nature Reserves. Population estimate data for these subpopulation are reported but in the absence of having conducted precise censuses, population growth rates can currently only be inferred by calculating natality and mortality rates. Figure 3 below illustrates the subpopulation trends for Cape mountain zebra on CapeNature protected area in terms of what is projected (based on average growth rates derived from recorded natality data) compared to the subpopulations numbers reported. Overall low population growth rates are concerning for the Gamkaberg, Kammanassie and Anysberg Nature Reserves. For De Hoop Nature Reserve, observed natality projects an expected growth rate of approximately 10% however, reported population numbers to not increase correspondingly.

8. Public Awareness

Public awareness of the complexity of conservation legislation, mandates, intentions and priorities are essential to ensure that informed public members participate in stakeholder engagement and commenting processes towards addressing the array of conservation related issues which are provided for in legislative review and policy formulation. The principles of adaptive governance as outlined by Novellie *et al.* (2017), highlight the principle of "collaboration and information sharing between resources users, scientists and policy makers, facilitating the joint setting of the desired state (outcomes) and collective goals." Both the Cape mountain zebra and bontebok BMP and CITES non-detriment finding (NDF) pursued extensive stakeholder engagement processes which embraced multi-agency, multi-stakeholder and multi-disciplinary participation aimed at the dissemination of updated relevant information related to the threats faced by these species.

9. Research

Historically bontebok and blesbok had non-overlapping ranges but translocations to wildlife farms and reserves outside their natural distribution ranges (NDR) have brought the two sub-species in artificial, secondary contact which resulted in documented hybridisation events (Van Wyk *et al.*, 2016). Due to some shortfalls in characterising hybrids based on only morphological characteristics, a more accurate DNA test using a model-based Bayesian approach was developed that could be used to identify non-admixed individuals and hybrids (Van Wyk *et al.*, 2016). This Research was led by the National Zoological Gardens of South Africa in collaboration with the University of the Free State, the University of Ferrara (Italy), the Morton Arboretum (USA), the University of Tennessee (USA), the Cardiff University (UK), CapeNature and the University of Johannesburg in order to support the 2014 CapeNature Bontebok Translocation and Utilization Policy.

Cape mountain zebra was listed under Appendix I of the CITES. In identifying stakeholder interests during both the BMP and NDF developments, the private sector indicated that the establishment of a hunting quota for exports would increase incentives for landowners to invest in Cape mountain zebra. The NDF for Cape mountain zebra which was issued in 2014 by the Scientific Authority of South Africa, indicated that local and

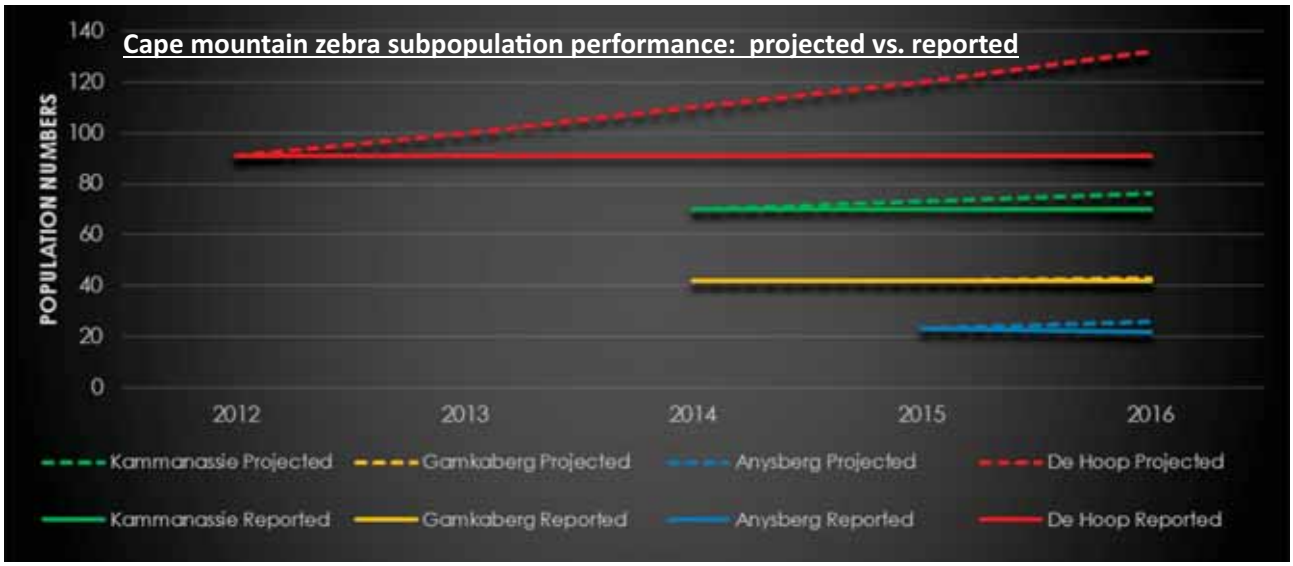


Figure 3: Projected subpopulation growth rates for Cape mountain zebra on CapeNature Protected Areas compared to reported subpopulation numbers.

international trade in live animals and the export of hunting trophies poses a moderate to high risk for maintaining Cape mountain zebra. This evaluation was largely attributed to the absence of a management plan addressing the impacts and risks of hunting and export against conservation and rebuilding targets based on a quantitative resource assessment. These are now being addressed in the Draft BMP for Cape mountain zebra through providing for the development of appropriate tools for evaluating the effect of a hunting quota. A Cape mountain zebra off-take simulator which allows forecasting of stochastic population trajectories under different selective off-take options for any specified initial population size was developed by the South African National Biodiversity Institute and the University of Cape Town in collaboration with the Nelson Mandela University and CapeNature (Winker *et al.*, 2016; Birss *et al.*, 2016).

Provincial conservation agency scientists assisted the National Department of Environmental Affairs to develop scientifically defensible natural distribution range maps for selected game species to support the following processes (Birss *et al.*, 2015):

1. Red Listing processes: The IUCN Red Listing process generally requires consideration of numerical status within natural (indigenous) distribution range.
2. Conservation targets for species recovery programmes and conservation planning: Setting conservation targets for spatial planning requires an understanding of the original distribution range as targets are often based on conserving/maintaining a certain percentage of the original population or habitat e.g. 20% of the original extent.
3. Legislation implementation: Provincial legislation (in some instances) and national regulations prescribe different regulatory approaches within and outside natural distribution ranges, based on the assumption that, all else being equal, there is less risk to biodiversity (habitat) in environments that evolved with that form of herbivory than in those where herbivory would/may constitute a novel form of disturbance. NEMBA defines an indigenous species translocated outside of its indigenous range as alien. However, while these maps are tools to assist with implementing legislation, the primary purpose is to represent the natural distribution range of mammal species, and discretion must be exercised in using these products given the limitations. The authors and their institutions are indemnified against any damages resulting from the use of these products.
4. Species management: An understanding of past distribution will assist with genetic management (and hence translocation guidelines) as this will indicate where gene flow was likely and where not. This allows for the natural process of gene flow (and hence speciation) to be replicated through management of translocation.
5. Protected area management: Protected areas are supposed to be stocked with species natural to that area, other than for specific species conservation objectives. The natural distribution range maps will provide one tool for assessing what species should be present in a protected area.
6. Text and reference books: Many books do not distinguish between natural and introduced range of species; these maps will allow for the distinction to be made.
7. Environmental and Climate change: Maps will allow assessment of changes over time in response to climate and other environmental changes.

10. Capacity

Monitoring and reporting on population performance for priority species which occur on CapeNature nature reserves is required for Cape mountain zebra (4 subpopulations) and bontebok (2 subpopulations) as these data relate to reporting requirements for both BMPs and CITES NDFs.

Both the Cape mountain zebra and the bontebok BMP identify specific research and scientific decision support for the implementation of actions as identified in the BMP development processes.

Changes in conservation statuses and concerns about data quality to confirm persistence of eco-typical species, populations of mountain reedbuck, grey rhebok, klipspringer, steenbok, Cape grysbok, common duiker, bushbuck and blue duiker, requires the monitoring of population trends of these species to inform the next red list assessment.

Within CapeNature, mammalian scientific decision support must be provided for regulations pertaining to the Western Cape Nature Conservation Ordinance, CITES, Alien and Invasive Species Regulations and the Threatened or Protected Species Regulations.

It is essential to maintain collaborations and partnerships with research and other institutions for the benefit of gaining and developing scientific knowledge and expertise to inform conservation management and regulation towards desired conservation outcomes for mammal species. To this end, CapeNature works closely with the following institutions to achieve these outcomes: The Research and Scientific Services Section of the National Zoological Gardens of South Africa; the University of the Free State; the University of Cape Town; the University of Ferrara (Italy), the University of Tennessee (USA), the Cardiff University (UK), the University of Johannesburg; the South African National Biodiversity Institute; the University of Pretoria; the University of the Western Cape, University of Manchester (UK) and the IUCN SSC Conservation Genetics Specialist Group.

It is also essential to maintain and develop scientific skills and ability within CapeNature. Participation in national and international scientific fora yield much needed opportunities for the development and growth of scientific skills in CapeNature. During this review period, the mammal priorities of CapeNature were engaged at international conferences through the following presentations:

Birss C, Kotze A. 2016. Formulating National Biodiversity Management Policy and integrating adaptive governance for Cape mountain zebra conservation in South Africa. Oral presentation at the 3rd African Congress for Conservation Biology. 4 – 8 September 2016. El Jadida, Morocco.

Birss, C. 2013. Conservation Genetics in South Africa: Policy and Management Implications for Bontebok. Oral presentation at GONGRESS SA: International Conservation Genetics Workshop 20-21 November 2013, National Zoological Gardens of South Africa, Pretoria.

Dalton, D., Kotze, A., Grobler, P., Janse van Vuuren, B., Birss, C., Roelofste, M., Russo, I., Bruford, M. and Hoban, S. 2015. Oral presentation at the 27th International Congress for Conservation Biology/4th European Congress for Conservation Biology, 2 – 6 August, Montpellier, France. (Presented by D Dalton).

Van Wyk, A., Grobler, P., Birss, C. and Kotze, A. 2015. Management Responses to Hybridisation: the South African Perspective. Oral presentation at the 27th International Congress for Conservation Biology / 4th European Congress for Conservation Biology, 2 – 6 August, Montpellier, France. (Presented by A van Wyk).

During this review period, the mammal priorities of CapeNature were engaged at national and local symposia or conferences through the following presentations:

Birss C, Rushworth I, Collins N, Peinke D, Buijs D. 2016. Mapping mammal distribution ranges in South Africa: A biodiversity economy game. Oral presentation at the Symposium for Contemporary Conservation Practice, 31 October - 4 November 2015, Howick, KwaZulu-Natal.

Birss C, Hayward N. Challenges for conserving a fragmented Cape mountain zebra population in South Africa. Oral presentation at the Symposium for Contemporary Conservation Practice, 31 October - 4 November 2015, Howick, KwaZulu-Natal.

Birss C. 2013. Bontebok: An Overview of Bontebok Distribution in the Western Cape, Genetic Tools and Conservation Genetics for the development of a BMP-s. Oral presentation at the Bontebok BMP-s Workshop, 28 November 2013, Tokai, Cape Town. (Included: Genetic Certification of Pure Bontebok, Dalton, D. and Kotze, A.; GONGRESS Tools; Modelling the genetic impacts of selective / intensive breeding, Grobler, P.J., Department of Genetics, University of the Free State).

Birss C. and Buijs D. 2013. Evaluating the Mapping of Natural Distributional Ranges for Eco-typical Species for the National Norms and Standards. Oral presentation at the Southern African Wildlife Management Association Symposium 15-19 September 2012, Skukuza, Kruger National Park, Limpopo.

Buijs D and Birss C. 2013. Mapping Natural Distribution Ranges of Herbivores. Oral presentation by Daan Buijs at the Southern African Wildlife Management Association Symposium 15-19 September 2012, Skukuza, Kruger National Park, Limpopo.

Birss C. 2012. Considering Principles for the Conservation of "Ecotypes" Identified in the Translocation Norms and Standards Process. Oral presentation at the National Translocation Task Team Workshop 19 – 21 June 2012, Pretoria.

Collaboration and research partnership during this review period resulted in a number of publications and reports which have been included in the Introduction of this report.

11. Conclusions and Recommendations: Priority Species

This section focused on updates to recommendations made during the previous review for prioritized species or species groups.

11.1 Updates conservation actions recommended for priority mammal species

The **riverine rabbit** (*Bunolagus monticularis*), near endemic to the Western Cape, and endemic to the central Karoo, for which the Western Cape population has been identified as an Evolutionary Significant Unit (ESU), is listed as Critically Endangered. It is primarily threatened by habitat destruction through cultivation and extensive livestock grazing; predation by domestic dogs; road kills and lack of general awareness and knowledge of the species. Other potential threats would include inbreeding depression due to low population numbers, catastrophic events such as flooding, fire, disease and effects of global climate change. The Endangered Wildlife Trust (EWT) has established a Riverine Rabbit Working Group within the Drylands Conservation Program to coordinate riverine rabbit conservation, maintain and facilitate close relationships with landowners, relevant authorities, research institutions, and to ensure the survival of the riverine rabbit and its habitat. Kai Collins, in collaboration with the EWT Riverine Rabbit Working Group members, analysed historical survey data to derive an improved assessment of the population status and distribution (Collins and du Toit, 2016). The findings were published in the African Journal of Ecology and

indicate that the species is distributed over an area of approximately 55,000 km2 whilst only occupying an area of approximately 2,940 km2. The total population size is only estimated between 157 to 207 mature individuals in 12 subpopulations divided into two distinct populations: 3 subpopulations in the southern population and 9 subpopulations in the northern population (Collins & du Toit 2016; Collins *et al.* 2016).

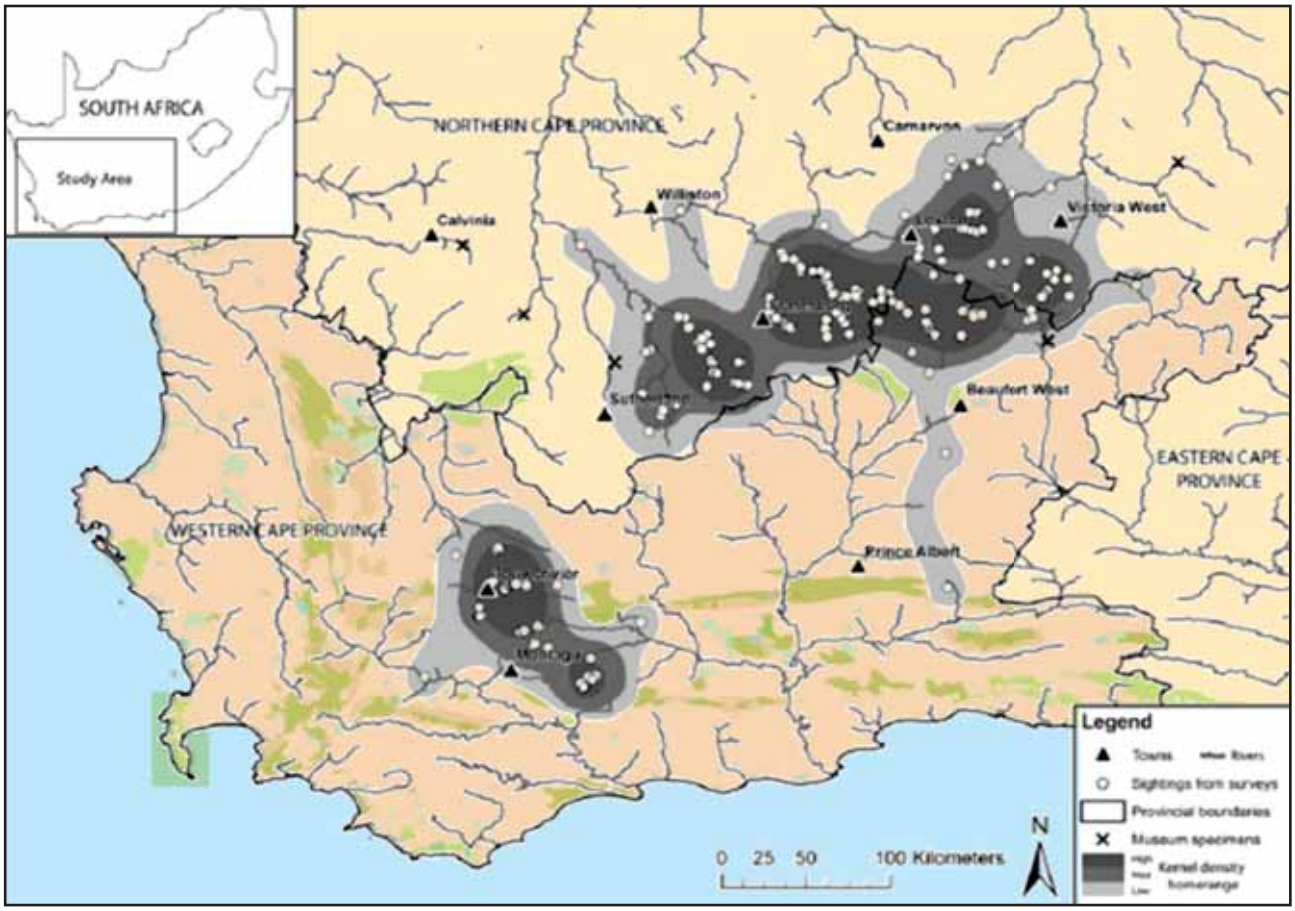


Figure 4: Kernel density estimates indicating approximate core distribution range for riverine rabbits resulting from the study by Collins and Du Toit (2016).

Bunolagus monticularis **Riverine rabbit**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions; Facilitate further genetic research on ESUs and develop conservation action plans accordingly; Participate in Riverine Rabbit Working Group, Asses private land conservation initiatives towards conservation of the riverine rabbit: Sanbona, Kromrivier, Sakrivier.	**2012 Actions Implemented** Distribution data informed determination of core distribution range and population densities. Distribution data confirms presence in Anysberg Nature Reserve and Sanbona Wildlife Reserve (Stewardship Site). Genetic research underway but not concluded.
2017 Conclusion and Recommendations This species requires continued systematic monitoring for improved subpopulation estimates and trends as well as genetic analyses and possible taxonomic revision. Further opportunities for the expansion of protected habitat should be investigated.	

Cape mountain zebra (*Equus zebra zebra*) is a subspecies endemic to the fynbos, grassland and karoo habitats of the Western and Eastern Cape provinces which marginally into the Northern Cape Province (Figure 4). Major threats include a loss of genetic diversity through inbreeding and genetic drift, hybridisation with Hartmann's mountain zebra and plains zebra, a shortage of large areas of suitable habitat, and the absence of a metapopulation management strategy (Hrabar *et al.*, 2016).

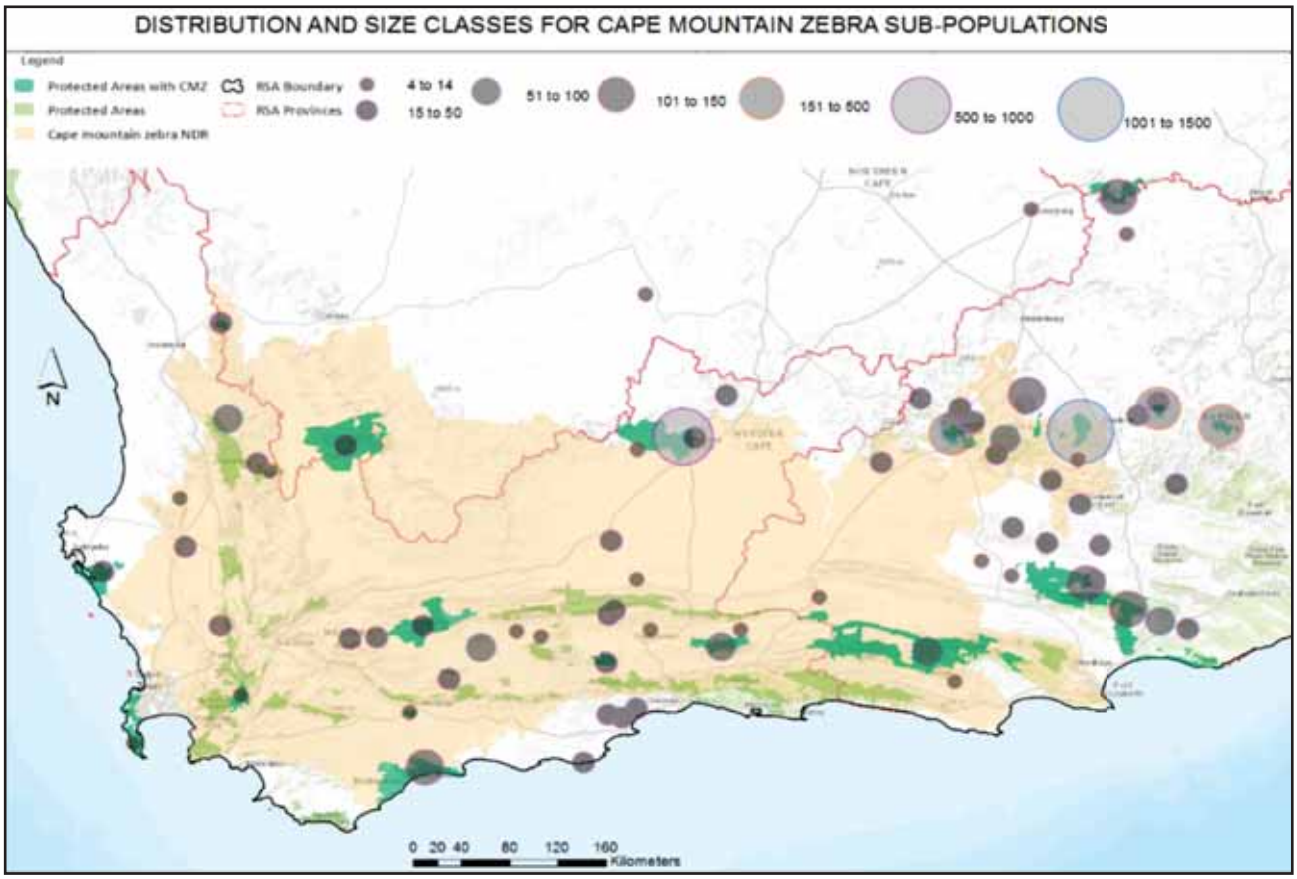


Figure 5: Distribution and size classes of Cape mountain zebra subpopulations (Birss *et al.*, 2016. The Draft Biodiversity Management Plan for Cape mountain zebra in South Africa).

Equus zebra zebra **Cape mountain zebra**	
2012 Recommendations Develop BMP-s for CMZ.	**2012 Actions Implemented** CapeNature and South African National Parks initiated and jointly developed a Biodiversity Management Plan (BMP) in collaboration with the conservation agencies from the Eastern Cape, Northern Cape and the Free State as well as the National Zoological Gardens of South Africa. The draft BMP was gazetted for public comment on 2 December 2016 in Gazette No. 404644 in terms of Section 43(3) read with Section 100 of the NEM: BA following extensive stakeholder consultation.

2017 Conclusion and Recommendations

CapeNature has been identified as the lead agent for the implementation of the Cape mountain zebra BMP and it is expected to be gazetted for implementation in 2018.

The vision of the Cape mountain zebra BMP 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 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 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 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.
4. To ensure effective communication, collaboration and coordination between stakeholders and the public for Cape mountain zebra conservation.

The BMP for Cape mountain zebra 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 genetic diversity for future evolutionary change.
3. Ensure all individuals show reproductive success 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.

The BMP contains a reporting and monitoring framework wherein the required actions to achieve the stated objectives within the 5 year timeframe, were identified throughout the development of the BMP, with responsibilities of the le ad and implementing agencies assigned.

Bontebok (*Damaliscus pygargus pygargus*), is subspecies endemic to the East Coast Renosterveld bioregion within the Cape Floristic Region (CFR) of the Western Cape and has been widely introduced outside of its historical range (Figure 6). The major threats to bontebok are the uncertainty around the number of hybrids within the existing population, lack of habitat availability within its natural range (thus limiting population expansion), and the lack of a metapopulation plan to sustain genetic diversity (Radloff *et al.* 2016).

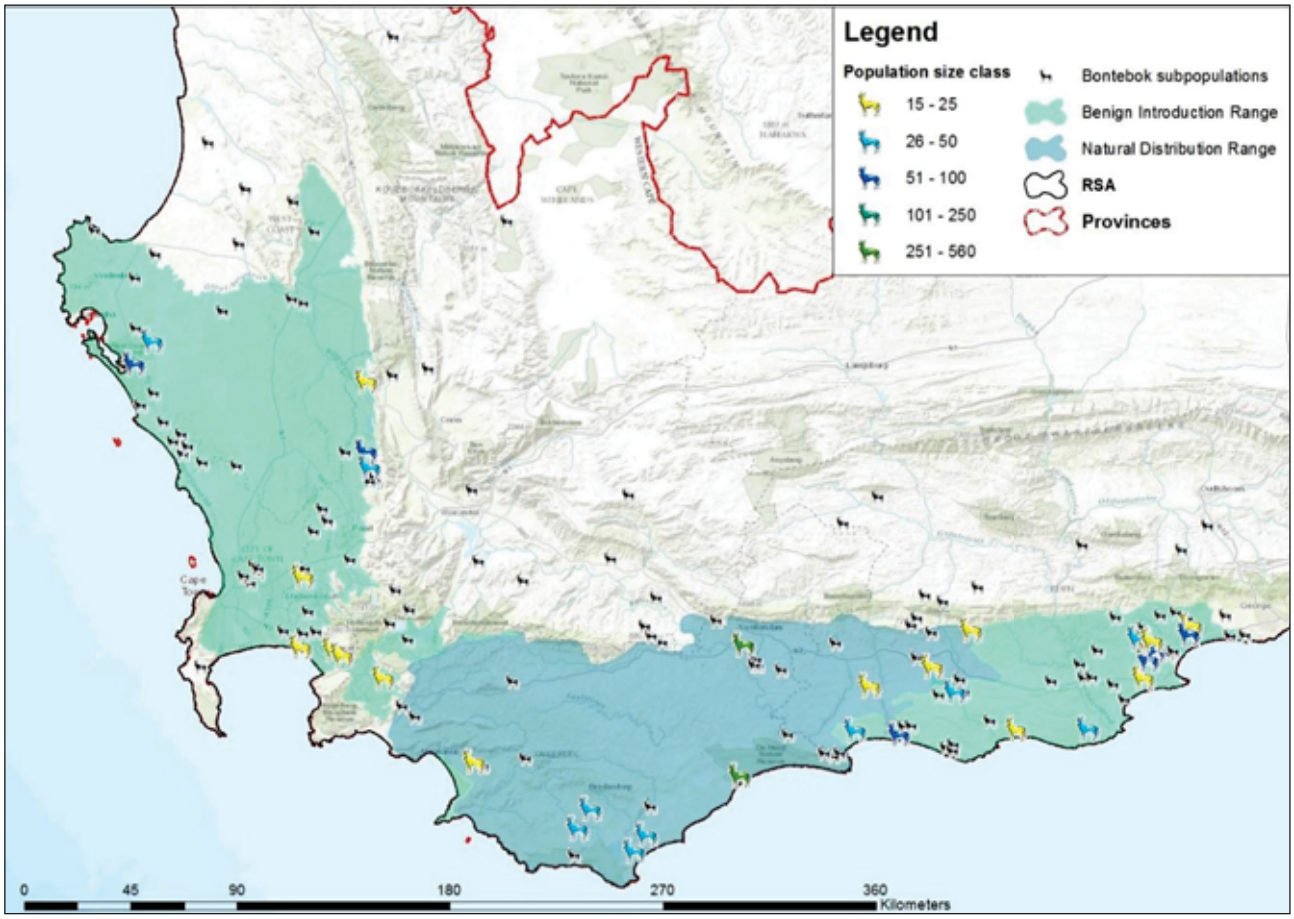


Figure 6: Distribution and size classes of bontebok subpopulations in the Western Cape (Cowell and Birss 2017). The Draft Biodiversity Management Plan for bontebok in South Africa).

Damaliscus pygargus pygargus **Bontebok**	
2012 Recommendations Develop meta-population management strategy and implement genetic testing, develop policy, test all CapeNature bontebok.	**2012 Actions Implemented** SANParks, CapeNature and the National Department of Environmental Affairs jointly developed the Biodiversity Management Plan for Bontebok.
2017 Conclusion and Recommendations The Biodiversity Management Plan for bontebok in South Africa defines the desired state as follows: "The conservation of a secure and well managed bontebok population." This desired state is aimed at creating a long term vision for successful conservation of this species and this is to be achieved by a set of associated objectives: 1. To conserve the genetic integrity and diversity of bontebok; 2. To prevent further habitat loss and habitat degradation , and establish and maintain historic habitat connectivity; 3. To establish and maintain effective communication and awareness between and among stakeholders; and 4. To investigate and conduct research aimed at supporting adaptive management and the implementation of bontebok conservation. CapeNature has been proposed as the lead implementing agency for this BMP, which also contains a reporting and monitoring framework wherein the required actions to achieve the stated objectives within the 5 year timeframe, were identified throughout the development of the BMP, with responsibilities of the lead and implementing agencies assigned.	

11.2 Updates on recommended actions for mammalian game species

The Western Cape Game Translocation and Utilization Policy (GTUP), implemented in 2011, in a bid to support the game farming economy in the WCP, provides for the extra-limital introduction of game species (outside their natural distribution range) as well as the regulatory parameters for the sustainable use of game species in the province. The policy aims:

- to consolidate all existing policies into one policy for use on a corporate basis, and to clarify the various related processes and other responsibilities regarding game management;
- to confirm CapeNature's legal mandate to administer the subject matter of the policy;
- to formulate guidelines against which applications to translocate game into, from and within the WCP must be considered (which guidelines are subservient to any relevant national laws, acts and regulations);
- to protect the biodiversity of the WCP against the unforeseen and foreseen impacts (such as genetic interference) which may result from the import and translocation of game species;
- to ensure that extra-limital game species pose no, or as little risk as possible, to the receiving environment;
- to mitigate and reduce any impact posed by extra-limital game species to the unique environment of

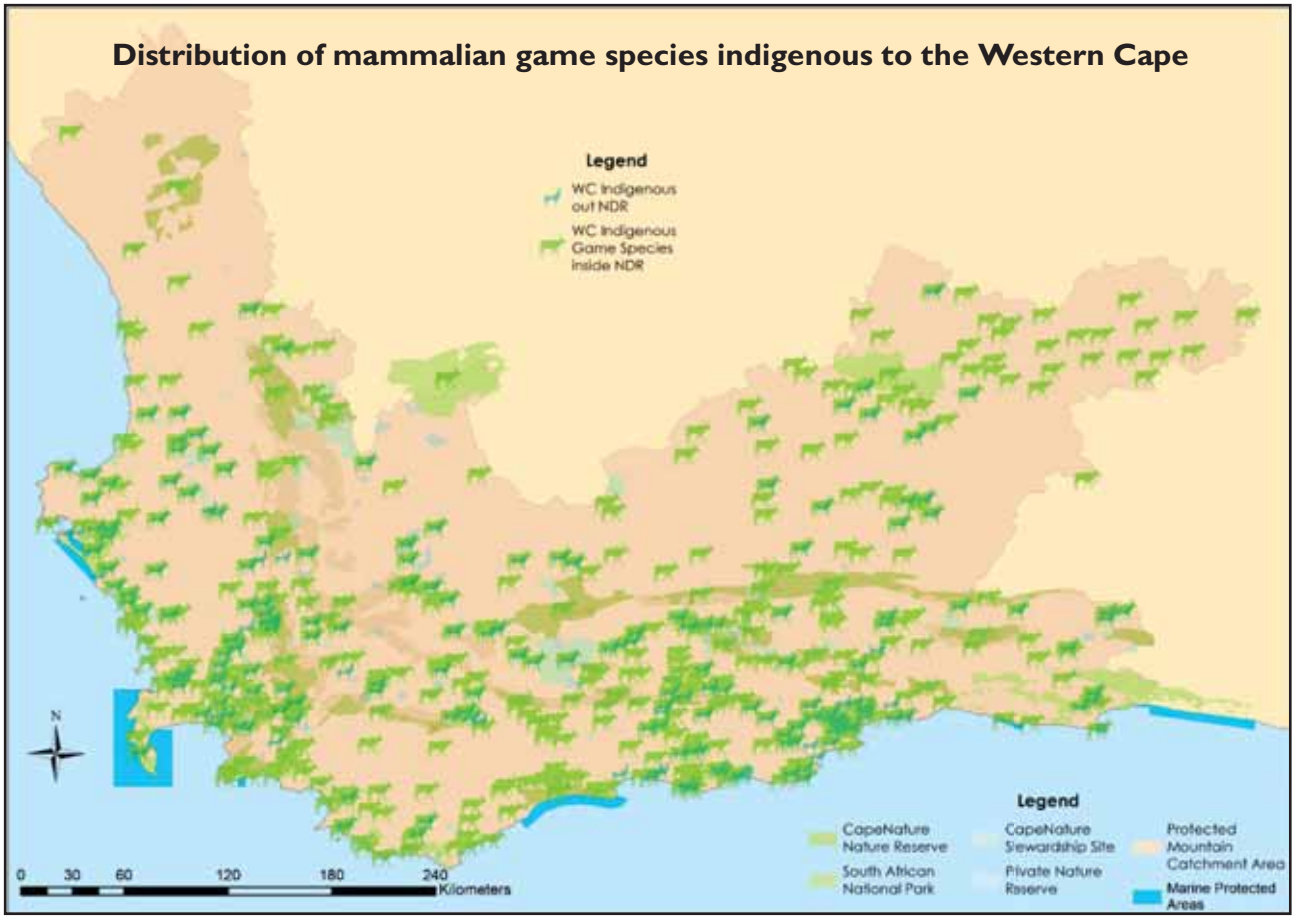


Figure 7: Distribution of mammalian game species indigenous to the Western Cape

Game Species Indigenous to the Western Cape	
Bontebok *(Damaliscus pygargus pygargus)*, **Cape mountain zebra** *(Equus zebra zebra)*, **red hartebeest** (*Alcelaphus buselaphus caama*), **south-western black rhinoceros** (*Diceros bicornis bicornis* – data not displayed), **springbok** (*Antidorcas marsupialis*), **hippopotamus** (*Hippopotamus amphibius*), **African elephant** (*Loxodonta africana*), **southern savanna buffalo** (*Syncerus caffer caffer*), **gemsbok** *(Oryx gazella gazella)*, **eland** (*Taurotragus oryx oryx*), **black wildebeest** (*Connochaetes gnou*) and **greater kudu** (*Tragelaphus strepsiceros strepsiceros*).	
2012 Recommendations Develop and monitor the implementation of the GTUP and game management plans.	**2012 Actions Implemented** The Western Cape Game Distribution Database (WC GDDB) was developed and deployed throughout the regions. This database is populated by conservation officials, GIS technicians and ecological coordinators with data on the distribution of game species in the province. Figure 7 illustrates the wide distribution of game species indigenous the Western Cape on private and state owned land. This information will assist in determining the conservation status of these species as well as to evaluate the private sector investment in these species.
2017 Conclusion and Recommendations The successful deployment of the WC GDDB is ascribed to the commitment and contribution of CapeNature conservation officials, GIS technicians and ecological coordinators. The initial volume of data required consistent and systematic processing to which updates can be made on an annual basis. (Acknowledgments to Marius Wheeler, Sheila Henning).	

the WCP;
- to collate information relating to the implementation of this policy and utilise this information to improve this policy and decision-making;
- to introduce and implement the principles of "polluter pays" and "duty of care" with respect to habitat management as it relates to the translocation of game species;
- to prevent the establishment of any alien, hybridised or invasive game species in the WCP.

As already mentioned in the section on Monitoring, monitoring and confirmation of the persistence of populations of eco-typical game species require the development of robust survey and monitoring methodologies to be implemented for obtaining more reliable population numbers for protected areas. It is also essential to obtain data for these species on private land to assess the performance and connectivity of populations on protected areas and to assist in the provision of scientific decision support to evaluate applications for hunting and translocation of these species.

Table 3: Number of CapeNature Protected Areas on which eco-typical game species are confirmed compared to the total number of Protected Areas where the species should be present.

	Mountain reedbuck	Blue duiker	Bushbuck	Cape grysbok	Common duiker	Grey rhebok	Klipspringer	Steenbok
Number of CapeNature Protected Areas with Confirmed Occurrence of the species	1	0	7	19	25	22	23	17
Total Number of CapeNature Protected Areas within the Natural Distribution Range of the Species	4	6	29	60	65	57	52	41

Eco-typical Game Species Indigenous to the Western Cape

Mountain reedbuck (*Redunca fulvorufula fulvorufula*), **klipspringer** (*Oreotragus oreotragus oreotragus*), **steenbok** (*Raphicerus campestris*), **Cape grysbok** (*Raphicerus melanotis*), **grey rhebok** (*Pelea capreolus*), **common duiker** (*Sylvicapra grimmia grimmia*), **blue duiker** (*Philantomba monticola monticola*) and **bushbuck** (*Tragelaphus sylvaticus*)

2012 Recommendations	**2012 Actions Implemented**
Ensure CAPMap updates for priority mammal species distributions; Conduct evaluation and research on ecotypes and ESUs – coordinate evaluation for DEA of 12 national species.	Standard operating guideline for evaluation of hunting and translocation of eco-typical species developed and implemented. Nature Reserve Game Registers implemented.

2017 Conclusion and Recommendations

The development of a standard operating guideline to be implemented by conservation services officials enable a consistent and standardised approach to ensuring that any and all proposed off-takes are sustainable and that threats and risks to the persistence of these species, are effectively mitigated. (Acknowledgement to Michael Hanson).

The development and implementation of register for recording and monitoring trends of eco-typical species on CapeNature nature reserves is dependent on the contributions of nature reserve officials, ecological coordinators and technical scientific contributions. The initial volume of data required consistent and systematic processing to which updates can be made on an annual basis. Refer to Table 3 for an account of confirmed occurrence compared to expected occurrence of these species on CapeNature Protected Areas (Acknowledgments to Alexis Olds).

11.3 Update on recommended actions for introduced species

The GTUP further promotes the compilation of game management plans with the purposes:

- to facilitate the translocation of certain game species indigenous to South Africa, including certain extra-limital game species into and within the WCP;
- to facilitate the translocation of game between farms with management plans;
- to adhere to the provisions of the Game Translocation and Utilization Policy (GTUP) for the WCP;
- to acknowledge the intention (and opportunities) of the game farmer.

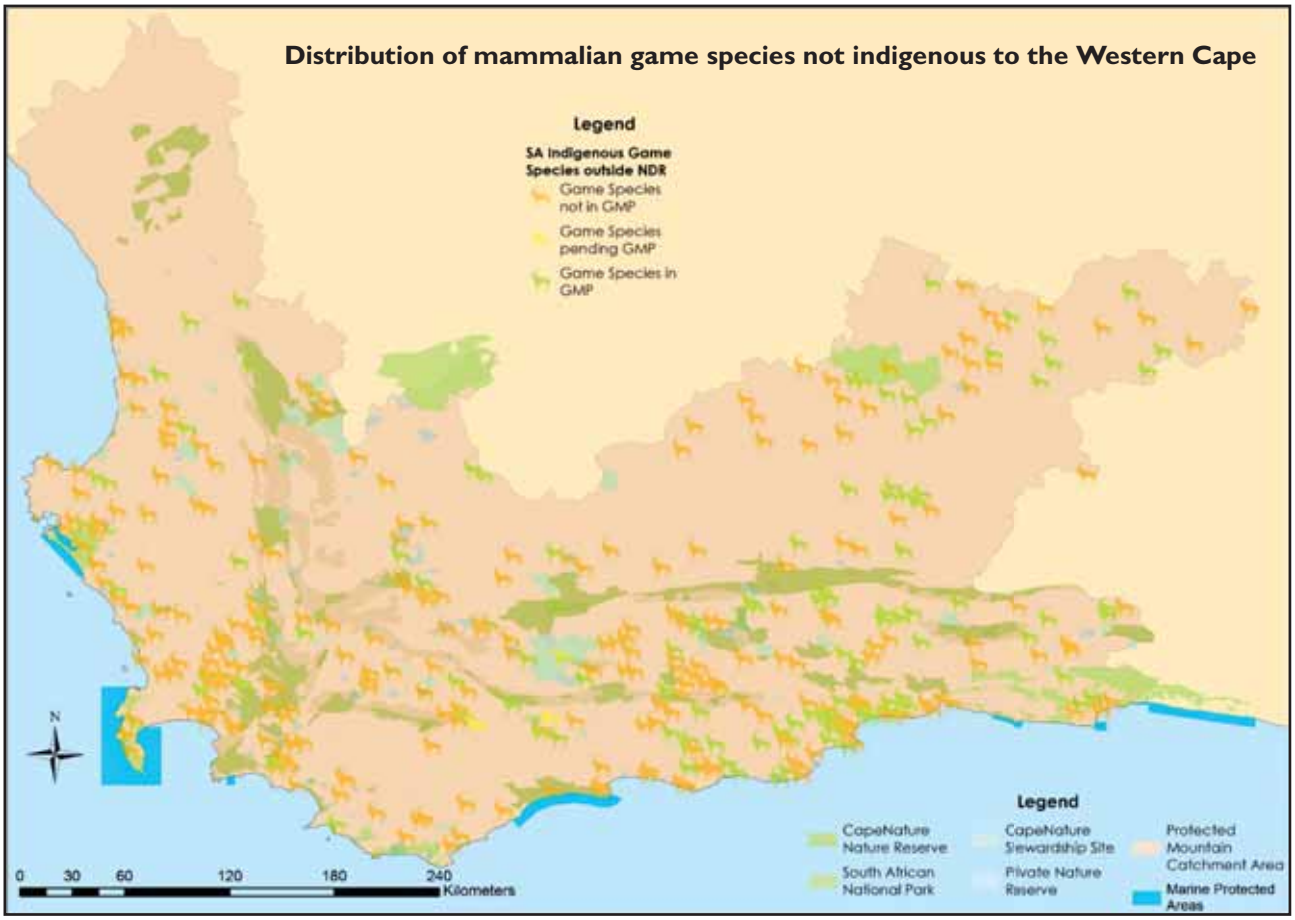


Figure 8: Distribution of mammalian game species not indigenous to the Western Cape indicating which introductions are associated with approved Game Management Plans (GMP).

Game Species Extra-limital to the Western Cape **Blue wildebeest** (*Connochaetes taurinus taurinus*), **blesbok** *(Damaliscus pygargus phillipsi)*, **south-eastern black rhinoceros** (*Diceros bicornis minor* – data not displayed), **Hartmann's mountain zebra** *(Equus zebra hartmannae)*, **roan antelope** **(***Hippotragus equinus equnius*), **sable antelope** (*Hippotragus niger niger*), **reedbuck** (*Redunca arundinum arundinum*), **waterbuck** (*Kobus ellipsiprymnus ellipsiprymnus*), **giraffe** (*Giraffa Camelopardalis giraffa*), **white rhinoceros** (*Ceratotherium simum simum* – data no displayed) and **plains zebra** *(Equus quagga burchelli)*	
2012 Recommendations Develop and monitor the implementation of the GTUP and game management plans.	**2012 Actions Implemented** The WC GDDB enables the monitoring of introductions of game species which are not indigenous to the Western Cape and to track whether these introductions are associated with approved management plans as provided in the GTUP as illustrated in Figure 8.
2017 Conclusion and Recommendations The successful deployment of the WC GDDB is ascribed to the commitment and contribution of CapeNature conservation officials, GIS technicians and ecological coordinators. The initial volume of data required consistent and systematic processing to which updates can be made on an annual basis. (Acknowledgments to Marius Wheeler, Shiela Henning).	

11.4 Update on recommended actions for alien game species

Impala *(Aepyceros melampus melampus)*, **nyala** *(Tragelaphus angassii)*, **tsessebe** *(Damaliscus lunatus lunatus)*, **common warthog** *(Phacochoerus africanus sundevallii)* **and red lechwe** *(Kobus leche leche)* are mammalian game species which are indigenous to southern Africa but considered as alien game species in the Western Cape Province. Deliberate introductions into the Western Cape Province are not supported, however, under the auspices of the IUCN, provision is made for the consideration and evaluation of deliberate introductions of these species which provide clear and well-defined benefits, under intensive risk management conditions in relation to that which may be provided by native and near-native species which are already available to for private sector investment.

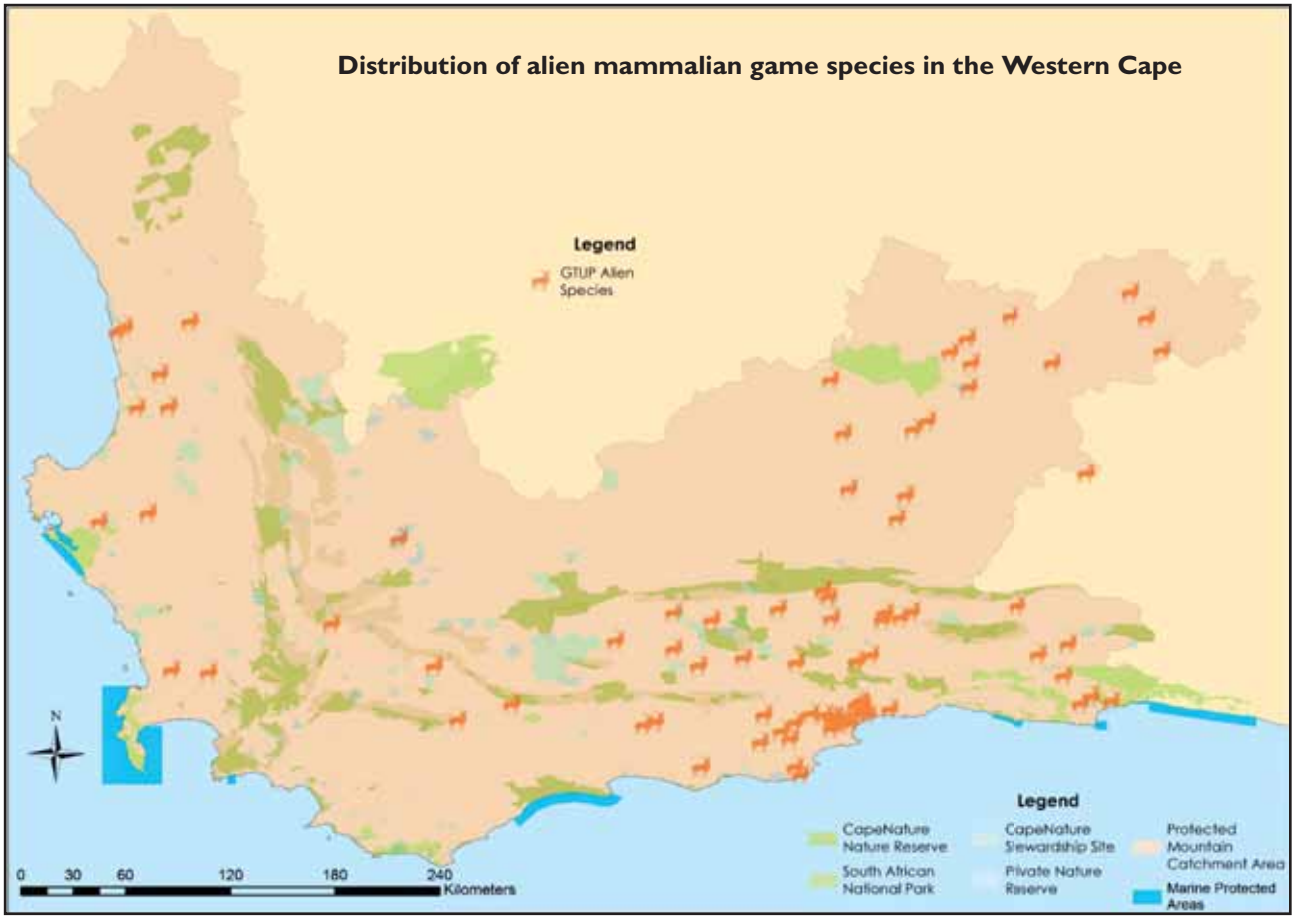


Figure 9: Distribution of alien mammalian game species in the Western Cape Province.

Alien Game Species (GTUP) **Impala** *(Aepyceros melampus melampus)*, **nyala** *(Tragelaphus angassii)*, **tsessebe** *(Damaliscus lunatus lunatus)*, **common warthog** *(Phacochoerus africanus sundevallii) and* **red lechwe** *(Kobus leche leche)*	
2012 Recommendations	**2012 Actions Implemented**
Collect distribution data for alien game species in the Western Cape Province; Assess and evaluate applications for introduction of non-indigenous mammals into the WCP.	The WC GDDB enables the monitoring of occurrence and introductions of alien game species and to track whether these introductions are associated risk assessments and management as provided in the GTUP as illustrated in Figure 9.
2017 Conclusion and Recommendations	
The successful deployment of the WC GDDB is ascribed to the commitment and contribution of CapeNature conservation officials, GIS technicians and ecological coordinators. The initial volume of data required consistent and systematic processing to which updates can be made on an annual basis. (Acknowledgments to Marius Wheeler, Shiela Henning).	

11.5 Invasive Alien Species

Unfortunately, numerous introductions of **fallow deer** into South Africa and the WCP have resulted in well-established populations where they are known to breed and spread freely and are infamously difficult to control. Growing evidence suggests that fallow deer have expanded into the sensitive habitats of the Karoo.

Feral pigs, listed in "100 of the World's Worst Invasive Alien Species - A selection from the Global Invasive Species Database" are escaped or released domestic animals. Based on a risk rating or on land that is of the highest conservation status (i.e. Renosterveld or Geometric Tortoise breeding areas), intense and sustained management, utilising a combination of the control methods to maximum effectiveness, is recommended. (Hignett, 2006).

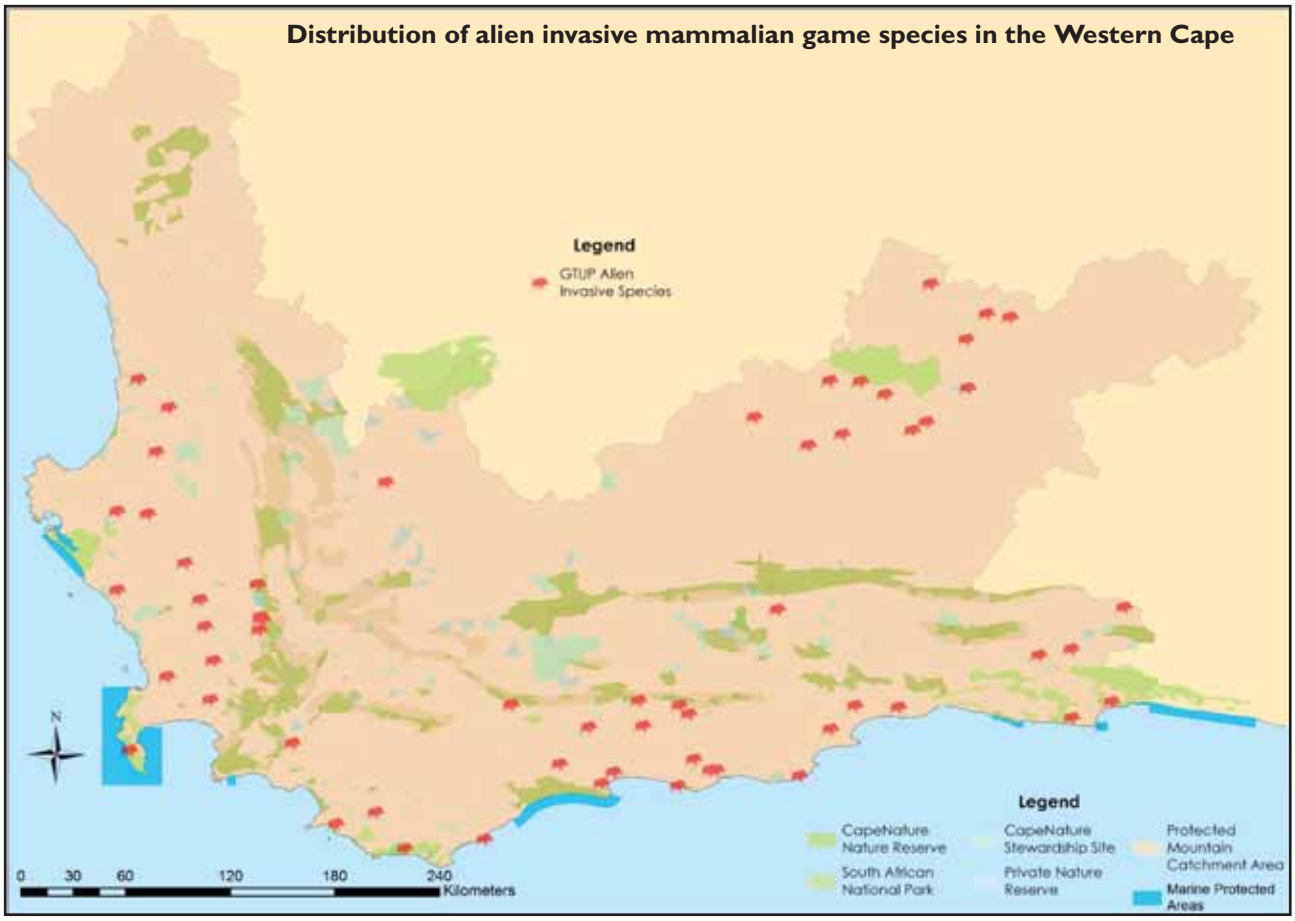


Figure 10: Distribution of alien invasive mammalian game species in the Western Cape Province.

Alien Invasive Game Species **Fallow deer** *(Dama dama)*, **Himalayan tahr** *(Hemitragus jemlahicus)*, **sambar deer** *(Rusa unicolor)*, and **feral pigs** *(Sus scrofa domestica)*	
2012 Recommendations	**2012 Actions Implemented**
Refine and prioritise actions plans for AIS strategy for invasive mammal species: collect distribution data	The WC GDDB enables the monitoring of occurrences of alien invasive game species which will inform the development of control and eradication measures for these species, particularly on protected areas.
2017 Conclusion and Recommendations	
Control and eradication strategies to be developed and implemented with monitoring of outcomes.	

11.6 Updates on recommended actions for other 2012 priority mammal species

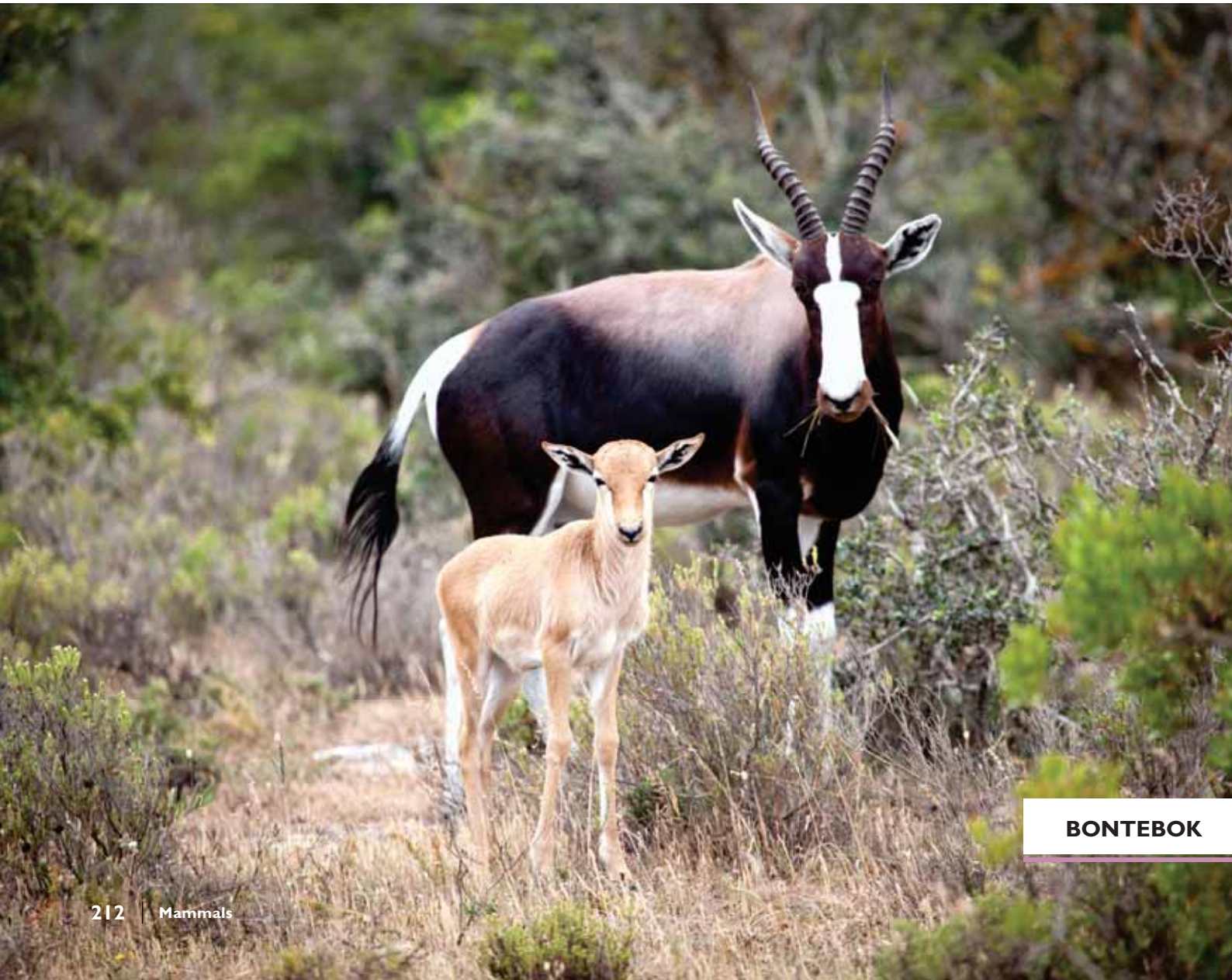
Cryptochloris zyli **Van Zyl's golden mole**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions; Monitor land transformation as a surrogate for habitat status at fine scale.	**2012 Actions Implemented** No distribution data was collected during this review period.
2017 Conclusion and Recommendations Persistence of populations to be confirmed. The range of Van Zyl's golden mole is suspected to be more widespread than previously recognised but further field studies are required to discover other potential subpopulations (Bronner and Asher, 2016).	
Mystromys albicaudatus **White-tailed mouse**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions; Develop monitoring protocol to assess persistence of populations.	**2012 Actions Implemented** No distribution data was collected during this review period.
2017 Conclusion and Recommendations Persistence of populations to be confirmed. *Ad hoc* surveys to be conducted on protected areas. The white-tailed mouse has a widespread but patchy and fragmented distribution across South Africa. It appears to have a preference for microhabitats wit hin vegetation types and transitory habitats post fires. They are very rare and have very low trapping records. Further field surveys are needed to estimate population size and trends more accurately (Avenant *et al.,* 2016).	
Eremitalpa granti **Grant's golden mole**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions; Develop monitoring protocol to assess persistence of populations.	**2012 Actions Implemented** Distribution data were collected at Langebaan.
2017 Conclusion and Recommendations Persistence of populations to be confirmed. Grant's golden mole is known from at least five locations along the West Coast in the Western and Northern Cape Provinces but is suspected to be more widespread (Maree and Bronner, 2016).	
Parahyaena brunnea **Brown hyaena**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions;	**2012 Actions Implemented** Distribution data were collected region between Laingsburg, Robertson, Barrydale and Ladismith.
2017 Conclusion and Recommendations *Ad hoc* collection of distribution data.	
Acinonyx jubatus **Cheetah**	
2012 Recommendations Assess potential for introductions in accordance with national cheetah conservation priorities.	**2012 Actions Implemented** EWT metapopulation strategy
2017 Conclusion and Recommendations Engage with the EWT on the implementation of the metapopulation strategy and evaluate proposal for reintroduction into the Western Cape Province.	
Panthera pardus **Leopard**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions;	**2012 Actions Implemented** The Cape Leopard Trust contributed substantial distribution data for the Boland mountain region and the Cederberg. Additional distribution data were collected in the Anysberg, Goukamma, Gamkaberg, Grootvadersbosch, Garcia, Grootwinterhoek, Hottentots-Holland, Jonkershoek, Marloth and Waterval Nature Reserves.
2017 Conclusion and Recommendations Facilitate continued research by the Cape Leopard Trust.	
Mellivora capensis **Honey badger**	
2012 Recommendations Collect distribution data and initiate the collection of genetic material for taxonomic assessment.	**2012 Actions Implemented** The Cape Leopard Trust contributed substantial distribution data for the Boland mountain region and the Cederberg. Additional distribution data were collected in the Overberg, Riviersonderend, Goukamma, Gamkaberg, Kogelberg, Grootvadersbosch, Marloth and De Mond Nature Reserves.
2017 Conclusion and Recommendations Collect *ad hoc* distribution data. The honey badger has reportedly expanded its range and there is no evidence to suggest that the population is experiencing an overall decline, however localised persecution may still result in localised declines (Begg *et al.,* 2016).	

Aonyx capensis **Cape clawless otter**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions; Collaborate and facilitate collaboration on research projects: faecal DNA collection, spatial ecology and pollution burdens.	**2012 Actions Implemented** Distribution data were collected in the Waterval, Robberg, Marloth, Keurbooms, Kogelberg, Hottentots-Holland, Jonkershoek, Matjiesrivies, Goukamma and Jonkershoek Nature Reserves, and at Betty's Bay Marine Protected Area, Perdebergrivier, Sanbona Wildlife Reserve, Ceres and the Botrivier Lagoon.
2017 Conclusion and Recommendations Facilitate continued research. Cape clawless otters exhibit a reduction in abundance associated with riparian habitat transformation, pollution and disturbance. Contemporary density estimates are required from across the species' range to calculate overall population size more accurately and the establishment of long-term monitoring sites will enable estimation of population trends in different regions (Okes *et al.,* 2016).	
Poecilogale albinucha **African striped weasel**	
2012 Recommendations Ensure CAPMap updates for priority mammal species distributions; Assess range expansion.	**2012 Actions Implemented** Distribution data were collected in the Helderberg, Tygerberg, Cederberg and Riviersonderend Nature Reserves as well as in Stellenbosch, Robertson, Somerset West and Vanrhynsdorp,
2017 Conclusion and Recommendations *Ad hoc* collection of distribution data. The African striped weasel can only persist in habitats with adequate prey since it has a very high metabolic rate. African weasel numbers are reported to have declined in the rest of South Africa but presence data despite inconsistent reporting frequencies, indicate an increase in numbers in the Western Cape Province. Further studies and field surveys to determine the current area of occupancy, densities and home range sizes are recommended (Child *et al.,* 2016).	

11.7 Update on recommended actions for marine and coastal mammal species

Sousa plumbea **Indian Ocean humpback dolphin**	
2012 Recommendations Collect survey data from coastal protected areas and MPAs to inform MPA and coastal protected area management.	**2012 Actions Implemented** Distribution data were collected at Robberg and Marine Protected Areas and the Keurbooms River Nature Reserve.
2017 Conclusion and Recommendations This species ranges along the southern and eastern coastline of South Africa in shallow waters, thus the majority of the population occurs within 2 kilometres of the coastline, which makes them susceptible to human activities in both the terrestrial and marine environments. Subpopulation estimates are low and habitats appear discontinuous along the coast resulting in fragmented subpopulations. A national coordinated monitoring programme is recommend to detect future changes in population size (Plön S *et al.,* 2016).	
Baleaenoptera musculus intermedia **Antarctic true blue whale**	
2012 Recommendations Collect distribution information in MPAs.	**2012 Actions Implemented** No distribution data was collected during this review period.
2017 Conclusion and Recommendations Blue Whales are highly migratory and wide-ranging with no barriers to dispersal. The population is currently increasing but at a slow rate relative to other whales that have become protected in the same period. Continued monitoring of population recovery and mitigation of potential noise pollution are recommended, (Findlay and Child, 2016).	
Tursiops aduncus **Indian Ocean bottlenose dolphin**	
2012 Recommendations Collect distribution information in MPAs.	**2012 Actions Implemented** Distribution data were collected at Robberg Marine Protected Area.
2017 Conclusion and Recommendations Migratory stock, moving between Plettenberg Bay and Durban, is assessed separately to the resident stock of the nearshore waters from Kosi Bay to Mossel Bay due to significant differentiation of mtDNA haplotypes between Eastern Cape and KwaZulu-Natal individuals. This species only occurs within 10 kilometres of the shoreline with the majority of the population occurring within 2 kilometres of the coastline. It is recommended that basic ecological and distributional data need to be collected for all subpopulations (Cockcroft *et al.,* 2016).	
Physeter macrocephalus **Sperm whale**	
2012 Recommendations Collect distribution information in MPAs.	**2012 Actions Implemented** No distribution data was collected during this review period
2017 Conclusion and Recommendations The sperm whale population is considered to be recovering although the commercial whaling industry reduced the global abundance significantly and may have resulted in a skewed sex ration in the assessment region. Sperm whales are highly migratory and wide-ranging with no barriers to dispersal. Abundance and population trend data is required (Elwyn *et al.,* 2016).	

Mirounga leonina **Southern elephant seal**	
2012 Recommendations Collect distribution information in MPAs.	**2012 Actions Implemented** Distribution data were collected along the Hermanus coast.
2017 Conclusion and Recommendations The population of southern elephant seals have increased and its global range is continuous with adequate connectivity, (De Bruyn *et al.,* 2016).	
Balaenoptera edeni **Bryde's whale**	
2012 Recommendations Collect distribution information in MPAs.	**2012 Actions Implemented** Distribution data were collected in the Goukamma Marine Protected Area.
2017 Conclusion and Recommendations The population of Bryde's whales is estimated at fewer than 1,000 mature individuals and is not considered to be migratory wi th no apparent barriers to dispersal. Taxonomic resolution and current estimates of populati on size and trends are required (Penry *et al.,* 2016).	
Oryctolagus cuniculus **European rabbit**	
2012 Recommendations Refine and prioritise actions plans for AIS strategy for invasive mammal species.	**2012 Actions Implemented** Initial assessment of European rabbits on Dassen Island to inform the development of a control and eradication strategy.
2017 Conclusion and Recommendations The **European rabbit** is also listed as one of the world's worst alien invasive species by the IUCN's ISSG, are regarded by some, along with the common rat, as being one of the world's five worst alien invasive species. Feral populations of rabbits have a devastating impact on any natural environment in that they compete with indigenous wildlife, damage vegetation and degrade th e land. This species has been listed in the Alien and Invasive Species Regulations for coastal island and an eradication strategy needs to be developed.	



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11.8 Selecting Mammal Priorities for 2017 to 2021

Species listed in Table 4 have been identified as priority species on which to focus actions for the next review period (2017 to 2021). Prioritisation considers the natural distribution ranges of mammalian taxa: indigenous to South Africa or Western Cape; endemic to South Africa or Western Cape; conservation status; the trend in conservation status and any implications of its legal status.

Fulfilling the data requirements for the Mammalian taxa portfolio relies on the contribution of conservation officials throughout the Western Cape.

The recent Regional Red List review indicates that there have been no net conservation gains for mammalian taxa over the last 10 years, and even though it may appear that there are proportionally fewer threatened species, these changes are non-genuine due to improved knowledge. It is concerning that the genuine changes detected have resulted in listing weakened conservation statuses (Child *et al.*, 2016; EWT).

12. Acknowledgements

Deon Hignett, Lauren Waller and Natalie Hayward are thanked for having read and reviewed the drafts of this chapter and for having provided constructive inputs and recommendations.

Table 4: List of Priority Mammal Species for 2017 to 2021

Common Name	Taxon Name	Priority Actions for 2017 to 2021
Riverine rabbit	*Bunolagus monticularis*	Collect distribution data; develop robust population monitoring methods.
Cape mountain zebra	*Equus zebra zebra*	As identified in the BMP; maintain registers on nature reserves.
Bontebok	*Damaliscus pygargus pygargus*	As identified in the BMP; maintain registers on nature reserves.
Grey rhebok	*Pelea capreolus*	Collect distribution and population data; develop robust population monitoring methods; maintain registers on nature reserves.
Mountain reedbuck	*Redunca fulvorufula fulvorufula*	Collect distribution and population data; develop robust population monitoring methods; maintain registers on nature reserves.
Blue duiker	*Philantomba monticola monticola*	Collect distribution and population data; develop robust population monitoring methods; maintain registers on nature reserves.
Eco-typical game species: Cape grysbok Steenbok Bushbuck Common duiker Klipspringer	 *Raphicerus melanotis* *Raphicerus campestris* *Tragelaphus sylvaticus* *Sylvicapra grimmia grimmia* *Oreotragus oreotragus oreotragus*	Collect distribution and population data; maintain registers on nature reserves.
Leopard	*Panthera pardus*	Collect distribution and population data.
Black-footed cat	*Felis nigripes*	Collect distribution data.
Boosmansbos long-tailed forest shrew	*Myosorex longicaudatus boosmani*	Collect distribution data.
Long-tailed forest shrew	*Myosorex longicaudatus*	Collect distribution data.
Duthie's golden mole	*Chlorotalpa duthieae*	Collect distribution data.
Van Zyl's golden mole	*Cryptochloris zyli*	Collect distribution data.
Grant's golden mole	*Eremitalpa granti granti*	Collect distribution data.
White-tailed mouse	*Mystromys albicaudatus*	Collect distribution data.
Spectacled dormouse	*Graphiurus ocularis*	Collect distribution data.
Cape Marsh Rat	*Dasymys capensis*	Collect distribution data.
Laminate vlei rat	*Otomys laminatus*	Collect distribution data.
Namib long-eared bat	*Laephotis namibensis*	Collect distribution data.
Indian Ocean humpback dolphin	*Sousa plumbea*	Collect distribution data.
Indian Ocean bottlenose dolphin	*Tursiops aduncus*	Collect distribution data.
Bryde's whale	*Balaenoptera edeni*	Collect distribution data.
Humpback whale	*Megaptera novaeangliae*	Collect distribution data.
Game Species: Game species indigenous to the WCP Game species extra-limital to the WCP Game species alien to the WCP Alien and invasive game species	*(as listed in GTUP)*	Collect distribution and population data; maintain registers on nature reserves.

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14. Appendix 1: List of mammal taxa known to occur in the Western Cape with Regional (Red List of Mammals of South Africa, Lesotho and Swaziland) and global (IUCN) threat assessment categories.

Common Name	Taxon Name	South African Endemic	Western Cape Endemic	2016 Regional IUCN Assessment	IUCN Global IUCN Assessment, Year
Golden moles					
Fynbos golden mole	*Amblysomus corriae*	Yes		Near Threatened B2ab(iii)	Near Threatened, 2015
Fynbos golden mole (east)	*Amblysomus corriae corriae*	Yes	Near	Not Evaluated	Not Evaluated
Fynbos golden mole (west)	*Amblysomus corriae devilliersi*	Yes	Yes	Not Evaluated	Not Evaluated
Hottentot golden mole	*Amblysomus hottentotus*	Yes		Least Concern	Least Concern, 2015
Duthie's golden mole	*Chlorotalpa duthieae*	Yes	Near	Vulnerable B1ab(iii)+2ab(iii)	Vulnerable , 2015
Sclater's golden mole	*Chlorotalpa sclateri*	No		Least Concern	Least Concern, 2015
Cape golden mole	*Chrysochloris asiatica*	Yes	Near	Least Concern	Least Concern, 2015
Van Zyl's golden mole	*Cryptochloris zyli*	Yes	Yes	Endangered B1ab(iii)+2ab(iii)	Endangered , 2015
Grant's golden mole	*Eremitalpa granti granti*	Yes	Near	Vulnerable B1ab(iii)+B2ab(iii)	Least Concern, 2015
Even-toed ungulates					
Red hartebeest	*Alcelaphus buselaphus caama*	No		Least Concern	Least Concern, 2016
Springbok	*Antidorcas marsupialis*	No		Least Concern	Least Concern, 2008
Black wildebeest	*Connochaetes gnou*	No		Least Concern	Least Concern, 2008
Bontebok	*Damaliscus pygargus pygargus*	Yes	Yes	Vulnerable B2ab(ii)+D1	Near Threatened, 2008
Hippopotamus	*Hippopotamus amphibius capensis*	No		Least Concern	Vulnerable , 2008
Blue antelope	*Hippotragus leucophaeus*	Yes	Yes	Extinct	Extinct
Klipspringer	*Oreotragus oreotragus oreotragus*	No		Least Concern	Least Concern, 2016
Gemsbok	*Oryx gazella gazella*	No		Least Concern	Least Concern, 2016
Grey rhebok	*Pelea capreolus*	Yes		Near Threatened A2b	Least Concern, 2008
Cape warthog	*Phacochoerus aethiopicus aethiopicus*	Yes		Extinct	Not Evaluated
Blue duiker	*Philantomba monticola monticola*	No		Vulnerable B2ab(ii,iii,v)+C2a(i)	Least Concern, 2016
Bushpig ssp. koiropotamus	*Potamochoerus larvatus koiropotamus*	No		Least Concern	Least Concern, 2016

Steenbok	*Raphicerus campestris*	No		Least Concern	Least Concern, 2016
Cape grysbok	*Raphicerus melanotis*	Yes	Near	Least Concern	Least Concern, 2008
Mountain reedbuck	*Redunca fulvorufula fulvorufula*	No		Endangered A2b	Least Concern, 2008
Common duiker	*Sylvicapra grimmia grimmia*	No		Least Concern	Least Concern, 2016
Southern savannah buffalo	*Syncerus caffer caffer*	No		Least Concern	Least Concern, 2008
Eland (Cape)	*Tragelaphus oryx oyx*	No		Least Concern	Least Concern, 2008
Greater kudu	*Tragelaphus strepsiceros strepsiceros*	No		Least Concern	Least Concern, 2008
Southern bushbuck	*Tragelaphus sylvaticus*	No		Least Concern	Least Concern, 2008
Carnivores					
Cheetah	*Acinonyx jubatus*	No		Vulnerable C2a(i)+D1	Vulnerable, 2015
African clawless otter	*Aonyx capensis*	No		Near Threatened C2a(i)	Near Threatened, 2015
Antarctic fur seal	*Arctocephalus gazella*	No		Least Concern	Least Concern, 2016
Cape fur seal	*Arctocephalus pusillus pussilus*	No		Least Concern	Least Concern, 2015
Subantarctic fur seal	*Arctocephalus tropicalis*	No		Least Concern	Least Concern, 2015
Water mongoose	*Atilax paludinosus*	No		Least Concern	Least Concern, 2015
Black-backed jackal	*Canis mesomelas*	No		Least Concern	Least Concern, 2014
Caracal	*Caracal caracal*	No		Least Concern	Least Concern, 2016
Spotted hyaena	*Crocuta crocuta*	No		Near Threatened C2a(ii)	Least Concern, 2015
Yellow mongoose	*Cynictis penicillata*	No		Least Concern	Least Concern, 2015
Black-footed cat	*Felis nigripes*	No		Vulnerable C2a(i)	Vulnerable, 2016
African wild Cat	*Felis silvestris*	No		Least Concern	Least Concern, 2015
Small-spotted genet	*Genetta genetta*	No		Least Concern	Least Concern, 2015
Cape genet	*Genetta tigrina*	No		Least Concern	Least Concern, 2015
Large grey mongoose	*Herpestes ichneumon*	No		Least Concern	Least Concern, 2016
Cape grey mongoose	*Herpestes pulverulentus*	Near		Least Concern	Least Concern, 2015

Leopard seal	*Hydrurga leptonyx*	No		Not Evaluated	Least Concern, 2015
Striped polecat	*Ictonyx striatus*	No		Least Concern	Least Concern, 2015
Serval	*Leptailurus serval serval*	No		Near Threatened B2ab(ii,iii,iv,v)+C2a(i)	Least Concern, 2015
African wild dog	*Lycaon pictus*	No		Endangered D	Endangered, 2012
Honey badger	*Mellivora capensis*	No		Least Concern	Least Concern, 2016
Southern elephant seal	*Mirounga leonina*	No		Near Threatened A2b	Least Concern, 2015
Bat-eared fox	*Otocyon megalotis*	No		Least Concern	Least Concern, 2014
Lion	*Panthera leo*	No		Least Concern	Vulnerable, 2016
Cape lion	*Panthera leo melanochaitus*	Yes		Extinct	Not Evaluated
Leopard	*Panthera pardus*	No		Vulnerable C1	Vulnerable, 2016
Brown hyaena	*Parahyaena brunnea*	No		Near Threatened C2a(i)+D1	Near Threatened, 2015
African striped weasel	*Poecilogale albinucha*	No		Near Threatened C1	Least Concern, 2015
Aardwolf	*Proteles cristatus*	No		Least Concern	Least Concern, 2015
Suricate	*Suricata suricatta*	No		Least Concern	Least Concern, 2015
Cape fox	*Vulpes chama*	No		Least Concern	Least Concern, 2014
Whales and dolphins					
Dwarf minke whale	*Balaenoptera acutorostrata subsp.*	No		Least Concern	Least Concern, 2008
Antarctic minke whale	*Balaenoptera bonaerensis*	No		Least Concern	Data Deficient, 2008
Sei whale	*Balaenoptera borealis*	No		Endangered A1d	Endangered , 2008
Bryde's whale	*Balaenoptera edeni*	No		Vulnerable	Data Deficient, 2008
Pygmy blue whale	*Balaenoptera musculus brevicauda*	No		Data Deficient	Data Deficient, 1996
Antarctic true blue whale	*Balaenoptera musculus intermedia*	No		Critically Endangered A1abd	Critically Endangered , 2008
Southern Hemisphere fin whale	*Balaenoptera physalus*	No		Endangered A1d	Endangered, 2013
Arnoux's beaked whale	*Berardius arnuxii*	No		Data Deficient	Data Deficient, 2008
Pygmy right whale	*Caperea marginata*	No		Least Concern	Data Deficient, 2008

Heaviside's dolphin	*Cephalorhynchus heavisidii*	Near		Least Concern	Data Deficient, 2013
Long-beaked common dolphin	*Delphinus capensis*	No		Least Concern	Data Deficient, 2008
Short-beaked common dolphin	*Delphinus delphis*	No		Least Concern	Least Concern, 2008
Southern right whale	*Eubalaena australis*	No		Least Concern	Least Concern, 2013
Pygmy killer whale	*Feresa attenuata*	No		Least Concern	Data Deficient, 2008
Short-finned pilot whale	*Globicephala macrorhynchus*	No		Least Concern	Data Deficient, 2011
Southern long-finned pilot whale	*Globicephala melas edwardii*	No		Least Concern	Data Deficient, 2008
Risso's dolphin	*Grampus griseus*	No		Least Concern	Least Concern, 2012
Southern bottlenose whale	*Hyperoodon planifrons*	No		Least Concern	Least Concern, 2008
Longman's beaked whale	*Indopacetus pacificus*	No		Data Deficient	Least Concern, 2015
Pygmy sperm whale	*Kogia breviceps*	No		Data Deficient	Data Deficient, 2012
Dwarf sperm whale	*Kogia sima*	No		Data Deficient	Data Deficient, 2012
Dusky dolphin	*Lagenorhynchus obscurus*	No		Least Concern	Data Deficient, 2008
Humpback whale	*Megaptera novaeangliae*	No		Vulnerable D1	Not Evaluated, 2008
Blainville's beaked whale	*Mesoplodon densirostris*	No		Data Deficient	Data Deficient, 2008
Gray's beaked whale	*Mesoplodon grayi*	No		Data Deficient	Data Deficient, 2008
Hector's beaked whale	*Mesoplodon hectori*	No		Data Deficient	Data Deficient, 2008
Layard's beaked whale	*Mesoplodon layardii*	No		Data Deficient	Data Deficient, 2008
True's beaked whale	*Mesoplodon mirus*	No		Data Deficient	Data Deficient, 2008
Killer whale	*Orcinus orca*	No		Least Concern	Data Deficient, 2013
Melon-headed whale	*Peponocephala electra*	No		Least Concern	Least Concern, 2008
Sperm whale	*Physeter macrocephalus*	No		Vulnerable A1d	Vulnerable , 2008
False killer whale	*Pseudorca crassidens*	No		Least Concern	Data Deficient, 2008
Indian Ocean humpback dolphin	*Sousa plumbea*	No		Endangered A4cd; B1ab(iii,v)	Near Threatened, 2008
Pantropical spotted dolphin	*Stenella attenuata*	No		Least Concern	Least Concern, 2012

Striped dolphin	*Stenella coeruleoalba*	No		Least Concern	Least Concern, 2008
Spinner dolphin	*Stenella longirostris*	No		Least Concern	Data Deficient, 2012
Indian Ocean bottlenose dolphin	*Tursiops aduncus*	Yes		Near Threatened B2ab(iii,v)	Not Evaluated
Common bottlenose dolphin	*Tursiops truncatus*	No		Least Concern	Least Concern, 2012
Cuvier's beaked whale	*Ziphius cavirostris*	No		Data Deficient	Least Concern, 2008
Bats					
Lesueur's wing-gland bat	*Cistugo lesueuri*	No		Least Concern	Least Concern, 2008
Wahlberg's epauletted fruit bat	*Epomophorus wahlbergi*	No		Least Concern	Least Concern, 2016
Long-tailed serotine bat	*Eptesicus hottentotus*	No		Least Concern	Least Concern, 2008
Lesser woolly bat	*Kerivoula lanosa*	No		Least Concern	Least Concern, 2008
Namib long-eared bat	*Laephotis namibensis*	No		Vulnerable D1	Least Concern, 2008
Lesser long-fingered bat	*Miniopterus fraterculus*	No		Least Concern	Least Concern, 2008
Natal long-fingered bat	*Miniopterus natalensis*	No		Least Concern	Least Concern, 2008
Temminck's hairy bat	*Myotis tricolor*	No		Least Concern	Least Concern, 2008
Cape serotine bat	*Neoromicia capensis*	No		Least Concern	Least Concern, 2008
Egyptian slit-faced bat	*Nycteris thebaica*	No		Least Concern	Least Concern, 2008
Cape horseshoe bat	*Rhinolophus capensis*	Yes		Least Concern	Least Concern, 2008
Geoffroy's horseshoe bat	*Rhinolophus clivosus*	No		Least Concern	Least Concern, 2008
Egyptian fruit bat	*Rousettus aegyptiacus*	No		Least Concern	Least Concern, 2016
Flat-headed free-tailed bat	*Sauromys petrophilus*	No		Least Concern	Least Concern, 2008
Egyptian free-tailed bat	*Tadarida aegyptiaca*	No		Least Concern	Least Concern, 2008
Mauritian tomb bat	*Taphozo us mauritianus*	No		Least Concern	Least Concern, 2008
Shrews					
Reddish-grey musk shrew	*Crocidura cyanea*	No		Least Concern	Least Concern, 2008
Greater red musk shrew	*Crocidura flavescens*	No		Least Concern	Least Concern, 2016

Tiny musk shrew	*Crocidura fuscomurina*	No		Least Concern	Least Concern, 2008
Lesser grey-brown musk shrew	*Crocidura silacea*	No		Least Concern	Least Concern, 2008
Long-tailed forest shrew	*Myosorex longicaudatus*	Yes	Near	Endangered B1ab(ii,iii)+2ab(ii,iii)	Vulnerable, 2008
Boosmansbos long-tailed forest shrew	*Myosorex longicaudatus boosmani*	Yes	Yes	Critically Endangered B1ab(ii,iii)+2ab(ii,iii)	Not Evaluated
Forest shrew	*Myosorex varius*	No		Least Concern	Least Concern, 2008
Least dwarf shrew	*Suncus infinitesimus*	No		Least Concern	Least Concern, 2008
Lesser dwarf shrew	*Suncus varilla*	No		Least Concern	Least Concern, 2008
Hyraxes					
Rock hyrax	*Procavia capensis*	No		Least Concern	Least Concern, 2015
Hares and rabbits					
Riverine rabbit	*Bunolagus monticularis*	Yes	Near	Critically Endangered C2a(i)	Critically Endangered , 2008
Cape hare	*Lepus capensis*	No		Least Concern	Least Concern, 2008
Scrub hare	*Lepus saxatilis*	Yes		Least Concern	Least Concern, 2008
Hewitt's red rock rabbit	*Pronolagus saundersiae*	No		Least Concern	Least Concern, 2008
Sengis					
Cape rock Sengi	*Elephantulus edwardii*	Yes		Least Concern	Least Concern, 2015
Karoo rock Sengi	*Elephantulus pilicaudus*	Yes		Data Deficient	Data Deficient, 2015
Western rock Sengi	*Elephantulus rupestris*	No		Least Concern	Least Concern, 2015
Karoo Round-eared Sengi	*Macroscelides proboscideus*	No		Least Concern	Least Concern, 2015
Odd-toed ungulates					
South-western black rhinoceros	*Diceros bicornis bicornis*	No		Endangered D	Vulnerable , 2011
Quagga	*Equus quagga quagga*	Yes		Extinct	Extinct
Cape mountain zebra	*Equus zebra zebra*	Yes	Near	Least Concern	Vulnerable, 2008

Primates					
Vervet monkey	*Chlorocebus pygerythrus*	No		Least Concern	Least Concern, 2008
Chacma baboon	*Papio ursinus*	No		Least Concern	Least Concern, 2008
Elephants					
African elephant	*Loxodonta africana*	No		Least Concern	Vulnerable, 2008
Rodents					
Cape spiny mouse	*Acomys subspinosus*	Yes	Yes	Least Concern	Least Concern, 2016
Cape dune molerat	*Bathyergus suillus*	Yes	Yes	Least Concern	Least Concern, 2016
Common molerat	*Cryptomys hottentotus*	Yes		Least Concern	Least Concern, 2008
Cape marsh rat	*Dasymys capensis*	Yes	Yes	Vulnerable B1ab(ii,iii,iv)+B2ab(ii,iii,iv)	Not Evaluated, 2008
Grey climbing mouse	*Dendromus melanotis*	No		Least Concern	Least Concern, 2008
Brants' climbing mouse	*Dendromus mesomelas*	No		Least Concern	Least Concern, 2008
Chestnut climbing mouse	*Dendromus mystacalis*	No		Least Concern	Least Concern, 2008
Short-tailed gerbil	*Desmodillus auricularis*	No		Least Concern	Least Concern, 2008
Cape molerat	*Georychus capensis*	Yes	Near	Least Concern	Least Concern, 2016
Cape gerbil	*Gerbilliscus afra*	Yes	Yes	Least Concern	Least Concern, 2016
Hairy-footed gerbil	*Gerbilliscus paeba*	No		Least Concern	Least Concern, 2008
Woodland mouse	*Grammomys dolichurus*	No		Least Concern	Least Concern, 2008
Woodland dormouse	*Graphiurus murinus*	No		Least Concern	Least Concern, 2008
Spectacled dormouse	*Graphiurus ocularis*	Yes		Near Threatened A2bc	Least Concern, 2008
Cape porcupine	*Hystrix africaeaustralis*	No		Least Concern	Least Concern, 2008
Large-eared mouse	*Malacothrix typica*	No		Least Concern	Least Concern, 2008
Multimammate mouse	*Mastomys coucha*	No		Least Concern	Least Concern, 2016
Natal multimammate mouse	*Mastomys natalensis*	No		Least Concern	Least Concern, 2008
Grant's rock mouse	*Micaelamys granti*	Yes		Least Concern	Least Concern, 2008

Namaqua rock mouse	*Micaelamys namaquensis*	No		Least Concern	Least Concern, 2008
Pygmy mouse	*Mus minutoides*	No		Least Concern	Least Concern, 2008
Verreaux's mouse	*Myomyscus verreauxii*	Yes	Near	Least Concern	Least Concern, 2016
White-tailed mouse	*Mystromys albicaudatus*	No		Vulnerable C2a(i)	Endangered, 2008
Vlei Rat (Fynbos type)	*Otomys irroratus*	Yes		Least Concern	Least Concern, 2008
Robert's vlei rat	*Otomys karoensis*	Yes		Least Concern	Not Evaluated
Laminate vlei rat	*Otomys laminatus*	Yes		Near Threatened B2ab(i,ii,iii,iv)+C1+C2a(i)	Least Concern, 2008
Karoo bush rat	*Otomys unisulcatus*	Yes		Least Concern	Least Concern, 2008
Brants's whistling rat	*Parotomys brantsii*	Near		Least Concern	Least Concern, 2008
Littledale's whistling rat	*Parotomys littledalei*	No		Near Threatened B2b(iii,iv),c(iii)	Least Concern, 2008
Springhare	*Pedetes capensis*	No		Least Concern	Least Concern, 2008
Barbour's rock mouse	*Petromyscus barbouri*	Yes		Least Concern	Least Concern, 2016
Pygmy rock mouse	*Petromyscus collinus*	No		Least Concern	Least Concern, 2008
Karoo four-striped grass mouse	*Rhabdomys intermedius*	Yes		Least Concern	Not Evaluated
Striped mouse	*Rhabdomys pumilio*	Yes		Least Concern	Least Concern, 2008
Pouched mouse	*Saccostomus campestris*	No		Least Concern	Least Concern, 2008
Krebs' fat mouse	*Steatomys krebsii*	No		Least Concern	Least Concern, 2008
Cape ground squirrel	*Xerus inausris*	No		Least Concern	Least Concern, 2008
Aardvark					
Aardvark	*Orycteropus afer*	No		Least Concern	Least Concern, 2015

CHAPTER 10

ARTHROPODS

10

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CONTENTS

DRAGONFLY

Photo Credit: Terence Bellingan

1. Introduction

Invertebrates are a vital component of terrestrial ecosystems and constitute more than 80% of all animal diversity, yet they are grossly under-represented in studies of African diversity. Site biodiversity estimates that do not consider invertebrates not only omit the greatest components of what they are attempting to measure, but also ignore groups that are very significant contributors to terrestrial ecosystem processes. To be able to manage and conserve this critical faunal component, and to understand the role that invertebrates play in the environment, it is crucial to first determine the baseline taxonomic knowledge through biodiversity inventories and the subsequent systematic investigation of the collected material. Biodiversity inventories are thus essential to identify key areas for conservation and to monitor the effects of threats, and are considered good investments by conservationists.

Recently, insect conservation has assumed considerable importance as awareness of the vital roles they play in ecosystems increases (McGeoch 2002, Samways *et al.* 2010, 2012). Progress in this field has been made through various initiatives at species and landscape level (Samways *et al.,* 2012). Within the last five years, several projects investigating invertebrate species richness patterns have been initiated. One such study is being piloted by the Iziko South African Museum and focussed on the inventorying of insect species richness and abundance in the Fynbos, Forest, Thicket, Nama Karoo and Succulent Karoo Biomes in the Western Cape Province. They aim to assess the comparative insect species richness between the different vegetation types, including an assessment of the spatial and temporal parameters affecting insect species richness between and within each vegetation type. In addition, this study will address description of new species and genera as part of systematic revisions based on specimens sampled during this study and will assess the evolutionary relationships through phylogenetic analyses using both morphological and molecular characteristics.

Another study, headed by the South African National Biodiversity Institute, focusses on filling biodiversity information gaps to support decision making in the Karoo, specifically linked to the Shale Gas Exploration Strategic Environmental Assessment (SGE SEA). This study mainly focusses on the Odonata, Hymenoptera, Orthoptera and Arachnida and aims to collect baseline biodiversity data, produce comprehensive high quality occurrence data, to assess the threat status of the species to identify those of conservation concern and to identify core areas and habitats for the species of conservation concern occurring within the Karoo. This study will also assess functional diversity of the four taxa to be used as a baseline for monitoring ecosystem services and function.

This is the second time that Arthropods are covered in the State of Biodiversity Report. The insect species richness of the Western Cape has not yet been adequately established. This chapter thus covers only a few groups of relatively well known groups of Arthropods for the Western Cape, focussing mainly on the conservation status of the three taxa for which Red Listing has been done. The coverage in the State of Biodiversity Report will be expanded as our knowledge of Arthropods expands and our capacity in CapeNature grows.

2. Levels of Endemism

Given our incomplete knowledge of the arthropod diversity in the Western Cape, it is very difficult to establish endemism of the group. Considering the high levels of plant endemism in the Cape Floristic Region (Goldblatt, 1978), similar levels of insect endemism might be expected. Co-evolution between flowering plants and some specialist pollinators such as bees and pollinating flies (Tabanidae and Nemestrinidae) has led to endemism in the Fynbos and Succulent Karoo biomes, and some of these species are thus restricted to relatively small areas. Approximately 27% of bee species is endemic to the area (Kuhlmann, 2009).

The Western Cape Neuroptera fauna (insect orders Neuroptera and Megaloptera) is unique, with very high levels of endemicity. These insects are extremely vulnerable, with some species highly endangered owing to human activities (urbanization, agriculture) and require special protection. To date 156 species in 79 genera comprising 12 families have been recorded from the Western Cape. Of these, 38 species are endemic. In addition there are at least 20 species of Myrmeleontidae and 10 Nemopteridae that are awaiting formal description, before incorporation into the database of Neuropterida.

Endemism is most pronounced amongst flightless taxa. Flightless species are locally scarce and difficult to collect and their restricted distributions and inability to disperse make them vulnerable to extinction. For example, each of the 17 species of the wingless stag beetle genus *Colophon* of the Lucanidae (Fig. 1) is restricted to a single mountain peak in the Western Cape. Fourteen of these species have been Red Listed (see Table 1). In addition, Southern Africa is home to 14 species of small, flightless keratin-feeding beetles that belong to the genus *Trox* (Trogidae). These endemic, flightless species have restricted distributions and four species are endemic to the Western Cape, namely *Trox horridus* (west coast species), *T. aculeatus* (possibly extinct), *T. nasutus* (restricted to the Cape peninsula) and *T. capensis* (a Cape montane and forest species). Even though some of the species' distribution areas fall within areas and habitats that are under some form of protection, large areas have either been severely transformed in the past or are still under threat from encroaching human land uses. Continued sampling of known and new areas and habitats will allow the delineation of species boundaries. A better understanding of their distributions will allow us to provide recommendations on the conservation management of the species if necessary.

The grasshopper family Lentulidae is also wingless, and has high levels of endemism. Moreover, Picker and Samways (1996) identified several endemic species on the Cape Peninsula, most of these being non-insect invertebrates or wingless insects. This pattern strongly suggests that mobility is a key factor in endemicity in the area.

Table 1. *Colophon* species status in the Western Cape Province, South Africa. All of these species are endemic to the Western Cape. The IUCN status is according to Bellamy and Endrody-Younga (1996) and needs updating.

Species	IUCN Status	Red List Criteria
Colophon barnardi	EN	B1+2e
Colophon berrisfordi	CR	B1+2e
Colophon cameroni	VU	B1+2e
Colophon cassoni	CR	B1+2e
Colophon eastmani	EN	B1+2e
Colophon endrodyi	Not listed	-
Colophon haughtoni	EN	B1+2e
Colophon izardi	NT	
Colophon kawaii	Not listed	-
Colophon montisatris	CR	B1+2e
Colophon neli	VU	B1+2e
Colophon oweni	Not listed	-
Colophon primosi	CT	B1+2e
Colophon stokoei	VU	B1+2e
Colophon thunbergi	EN	B1+2e
Colophon westwoodi	VU	B1+2e
Colophon whitei	EN	B1+2e

3. Conservation Status

Assessing the conservation status of species has become critical in monitoring trends in biodiversity conservation at both national and global levels (Zamin *et al.*, 2009). It is also a powerful tool for conservation because threatened species are identified using internationally accepted criteria and through a standardised process, and can therefore direct research and monitoring attention towards priority species (New, 2009). However, large data sets that provide an understanding of distributions and changes in these are required for species Red Listing. For many species the data required for such assessments are simply not available.

Due to the wide interest in certain charismatic groups Red Listing of insects in South Africa has been undertaken by expert groups (Samways, 2002). Recent Listings include the Lepidoptera, Odonata and Arachnida. The updated conservation assessment of the butterflies of South Africa, Lesotho and Swaziland was published in 2013, followed by that of the dragonflies and damselflies in 2016. The conservation assessment of the Arachnida has started in 2013 and is still underway, aiming to be finalised in 2017.

3.1 Lepidoptera – Butterflies and moths

Butterflies belong to one of the most diverse and charismatic insect orders and the butterfly fauna of South Africa has thus been well studied over many years. The group is taxonomically well known, with a few minor issues unresolved. In addition, the distribution of species

Figure 1: A *Colophon* beetle. Photo credit: A. Loots.

is also relatively well studied, thanks to the combined efforts of professional lepidopterists and the members of the Lepidopterist Society of Southern Africa. It is thus not surprizing that butterflies form the bulk of the species on the Red Data List for insects. The butterflies of South Africa were recently assessed according to the latest IUCN criteria (IUCN 2001) as part of the South African Butterfly Conservation Assessment (SABCA) project (Mecenero *et al.,* 2013).

One species, *Lepidochrysops methymna dicksoni* (Dickson's monkey blue), is classified as extinct (Table 1). This species used to occur only on the Tygerberg Hills near CapeTown on Swartland Shale Renosterveld and Swartland Silcrete Renosterveld (Mecenero *et al.*, 2013). This species has not been recorded for over 45 years with habitat destruction being the probable cause of its extinction (Mecenero *et al.*, 2013). Moreover, all species that are Red Listed are threatened by habitat destruction due to developments, habitat degradation due to invasive alien plants and too-frequent fires (Mecenero *et al.*, 2013). For most species of conservation concern management plans are required, which must include alien vegetation clearing and fire management plans (Mecenero *et al.*, 2013).

Currently, two species are classified as Critically Endangered Possibly Extinct, namely *Stygionympha dicksoni* (Dickson's hillside brown) and *Trimenia malagrida malagrida* (scarce mountain copper) (Table 1). *S. dicksoni* occurs on the low hills south of Darling and near Malmesbury, and used to occur at Tygerberg Hills. This species is restricted to Swartland Granite Renosterveld and Hopefield Sand Fynbos, but due to its habitat being lost to agriculture and ongoing habitat degradation due to alien invasive plants, has not been recorded since 1985 (Mecenero *et al.*, 2013). *T. m. malagrida* is restricted to the western slopes of Table Mountain between Llandudno and Lion's Head on rocky, west-facing slopes in more open vegetation associated with periodic fires (Mecenero *et al.*, 2013). Even though this species was placed on the list of protected wild animals of the former Cape Province in 1976 (Ordinance 19 of 1974, amendment of Schedule 2 in 1976), and was assumed to be protected in the Table Mountain Nature Reserve, the last subpopulation of this species might have been destroyed during the mid-1990s during too-frequent, alien invasive plant-enhanced fires, and has not been seen since (Mecenero *et al.*, 2013).

Eight butterfly species are classified as Critically Endangered, seven species as Endangered and five species as Vulnerable (see Table 2, Mecenero *et al.* 2013). All of these species are endemic to the Western Cape. The Critically Endangered Brenton Blue Butterfly (*Orachrysops niobe*) (Fig. 2) is protected on the Brenton Blue Butterfly Reserve (BBBR). This reserve was proclaimed in July 2003 after a major campaign by the Lepidopterists' Society of Africa and several other NGOs (see Steenkamp and Stein 1999). The BBBR is managed by a management committee established by the Brenton Blue Trust with representatives from all stakeholders and chaired by CapeNature. A management plan at this site has been established and is continuously refined by research, and regular monitoring of the habitat and

population levels is undertaken. Population numbers have been declining over the last few years. This has particularly been true the last year due to poor host plant quality because of dry conditions and high temperatures (Dave Edge, 2017, pers. comm). Attempts have been made to reintroduce this species at the Nature's Valley fynbos reserve, but due to the host plant's poor condition in this area and the absence of the larvae's host ant, *Camponotus baynei*, it was not successful (Edge *et al.*, 2008).

a)

b)

Figure 2. The Brenton Blue butterfly, Orachrysops niobe. a. Male (photo credit: A. Coetzer), and b. female (photo credit: J. Bode).

The Barber's Cape Flats Ranger (*Kedestes barberae bunta*) is currently known to occur only at Strandfontein on the Cape Peninsula and faces extinction if no action is taken soon. Virtually no suitable host plant has been available to this species at Strandfontein due to too- frequent fires (Mecenero *et al.*, 2013). The host plant of this butterfly (cottonwool grass, *Imperata cylindrica*) occurs on Rondevlei Nature Reserve (a municipal reserve) and the Driftsands Nature Reserve (CapeNature Reserve) and investigations are underway to determine the suitability of these sites for the butterfly and to determine whether the species occur there.

There are a further 38 species of Lepidoptera that are endemic to the Western Cape but classified as Least Concern (Mecenero *et al.*, 2013). However, species that are classified as Least Concern may still perform unique functions. One such example is *Aeropetes tulbaghia* (Table Mountain beauty), which is the only known pollinator of several plants with red flowers, including the red Disa orchid *Disa uniflora* (Marloth, 1895, Johanson & Bond, 1992). Mecenero and others (2013) argued that, in the South African context, it is not just the threatened taxa that are of importance, but also those taxa that are intrinsically rare or localised but not currently threatened. Conservationists should be made aware of these taxa so that future threats can be identified timeously and the species monitored for change. They assigned Conservation status to butterfly species that were classified as Least Concern during Red Listing but has local rarity (Mecenero *et al.*, 2013). These species were either classified as Extremely Rare (known from only one site) or Rare. Rare species were further classified as Rare – Restricted range (those with a range less than 500 km^2), Rare – Habitat specialist (species restricted to a specific micro-habitat) or Rare – Low density (species with small subpopulations or single individuals scattered over a wide area). Table 3 gives the classification of the Western Cape species that are classified as Least Concern with local rarity. Twenty eight of these 36 species are endemic to the Western Cape.

3.2 Odonata - Dragonflies and damselflies

for the Odonata include Samways (2006), Samways and Grant (2006), and Suhling *et al.,* (2009). All South African odonate species have now been updated and national as well as global statuses applied (Samways & Simaika, 2016). A freshwater health index (the Dragonfly Biotic Index) has also been developed which places great emphasis on these irreplaceable endemics, and is particularly useful for assessing the level of threat to the local dragonfly fauna as well as its recovery when these threats are lifted (Samways & Simaika, 2016). By far the biggest threat to Western Cape dragonflies is invasive alien trees. Removal of these trees has resulted in substantial recovery of these irreplaceable dragonfly species, as well as that of other endemic invertebrates, especially in low-elevation mountain rivers.

Recent work on some of the Western Cape odonate lineages has indicated that they are ancient. Species in the genus Syncordulia (Corduliidae or Emeralds) for example, diverged some 60 million years ago. These species, along with several others, currently survive in small populations and are more resilient than expected, recovering quickly when invasive alien trees are removed. Invasive alien trees shade out the sunny habitat that the dragonflies require for all their life activities.

There are three species of dragonfly of conservation concern in the Western Cape (Table 4). Orthetrum rubens (EN), a highly threatened and restricted species that is only known from the mountains of the Western Cape, was discovered in the early part of the last century on Table Mountain but has not been seen there since, nor in Du Toits Kloof where it was present in the mid-1970s. It has now been rediscovered near Victoria Peak in the Hottentots-Holland Mountains, and since 2016 is the only known extant population. Another species, Spesbona angusta (EN) (Figure 3) was originally only

Table 2. Conservation status of butterfly species in the Western Cape (Mecenero *et al.*, 2013). All species listed in the table are endemic to the Western Cape.

Species	Common name	IUCN Status	Distribution and conservation issues
Hesperiidae			
Kedestes barberae bunta	Barber's Cape flats ranger	CR B1ab(i,ii,iii)+2ab(i,ii,iii); C2b	At one small area near Strandfontein, in Cape Flats Dune Strandveld and Southern Cape Dune Fynbos.
Kedestes lenis lenis	Valse Bay unique ranger	EN B1ab(i,ii,iii,iv,v)	Two subpopulations occur on protected areas (Zandvlei & Rondevlei MNR). Urgent surveys required around Worcester to determine if it still exists there.
Kedestes niveostriga schloszi	Greyton dark ranger	EN B1ab(ii,iii,v)+2ab(ii,iii,v)	
Nymphalidae			
Stygionympha dicksoni	Dickson's hillside brown	CR PE B2ab(i,ii,iii,iv,v)	Currently known only from a single population from one locality, near the town of Darling, in the Swartland of the Western Cape . Not seen since 1985.
Lycaenidae			
Aloeides carolynnae aurata	De Hoop copper	NT D2	De Hoop NRC. Locate additional populations. Presumed larval ant associations.
Aloeides carolynnae carolynnae	Carolynn's copper	EN B1ab(i,iii,iv,v)	Currently known from one small site, Control measures *Hakea sericea* and no further upslope extension of vineyards.
Aloeides egerides	Red Hill copper	VU B1ab(ii,iii)	Effective fire and invasive alien plant management.
Aloeides lutescens	Worcester copper	EN B1ab(ii,iii,iv)	Find additional subpopulations.
Aloeides pallida littoralis	Knysna giant copper	DD (Taxonomic uncertainty)	Detailed taxonomic study needed.
Aloeides thyra orientis	Brenton copper	EN B1ab(ii,iii,iv,v)	Research needed on life history and associations with ants. Maintain habitats at current localities in suitable conditions for host plants and host ants.
Aloeides trimeni southeyae	Trimen's copper	EN B1ab(ii,iii,iv,v)	Autoecological study to determine life history and whether there is an associated host plant and ant.
Chrysoritis brooksi tearei	Brook's opal	VU B1ab(ii,iii)	Monitoring of subpopulations and habitat quality to inform management actions.
Chrysoritis dicksoni	Dickson's strandveld copper	CR B1ab(ii,iii,v)	Single subpopulation north of Witsand on the south coast. An extensive research program has been launched by the Lepidopterists' Society of Africa.
Chrysoritis thysbe mithras	Brenton opal	DD (Taxonomic uncertainty)	Research into life history and ecology needed.
Chrysoritis thysbe schloszae	Schlosz's opal	CR C2a(i)	Near Moorreesburg.
Chrysortis rileyi	Riley's opal	CRB1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)	Restricted to the Brandvlei Dam area.
Lepidochrysops littoralis	Coastal blue	NT B1ab(ii,iii,iv,v)	De Mond NR to Mossel Bay. Include this species in impact assessments for coastal developments.

Species	Common name	IUCN Status	Distribution and conservation issues
Lepidochrysops methymna dicksoni	Dickson's monkey blue	EX	Used to occur only on the Tygerberg Hills near CapeTown on Swartland Shale Renosterveld and Swartland Silcrete Renosterveld.
Orachrysops niobe	Brenton Blue	CR B1ab(iii)+2ab(iii)	Brenton Peninsula at Knysna. Protected in the Brenton Blue Butterfly Reserve.
Thestor barbatus	Bearded skollie	DD (Insufficient information)	
Thestor brachycerus brachycerus	Seaside skolly	CR B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v)	Knysna. Research program into the life history and ecology initiated.
Thestor claassensi	Claassen's skollie	VU B1ab(iii)	Secure known colonies close to Still Bay before they are lost to development.
Thestor dicksoni malagas	Atlantic skollie	VU D2	Langebaan area. Further exploration required of the area.
Thestor dicksoni warreni	Dickson's skollie	DD (Insufficient information)	Found at a single location near Graafwater.
Thestor kaplani	Kaplan's skollie	EN B1ab(iii)	Surveys and monitoring of the two subpopulations near Greyton.
Trimenia malagrida malagrida	Scarce mountain copper (berg-silwerkolkopertjie)	CR PE 1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)	Systematic searches required on the western slopes of Table Mountain between Lion's Head and Llandudno.
Trimenia malagrida paarlensis	Scarce mountain copper (Paarlse berg-silwerkolkopertjie)	CR B1ab(ii,iii)	Only found on Paarl and Paardeberg mountains, which are part of a nature conservancy. Population monitoring, synecological and autoecological studies needed.
Trimenia wallengrenii gonnemoi	Wallengen's silver - spotted copper (Piketberg Fynbos-silwerkolkopertjie)	VU D2	Piketberg mountain. No further plantation forestry allowed and other agricultural development should be carefully considered.
Trimenia wallengrenii wallengrenii	Wallengren's Silver - spotted Copper (Fynbos-silwerkolkopertjie)	CR B1ab(i,ii,iii,iv,v)	Near summits on western slopes of low hills of Swarland Granite Fynbos at altitude of 350 – 450m. Only two subpopulations left between Darling and Mamre. Urgent monitoring and research into ecological requirements are needed to avoid extinction.

known from a female specimen collected at Ceres in the 1920s. It was thereafter not observed until 2003 when it was rediscovered in a wetland at the base of Franschhoek Pass (on the Villiersdorp side). It is one of South Africa's rarest damselflies, having only been recorded from two localities at an elevation of approximately 400 m above sea level in the Western Cape (Samways & Simaika, 2016). This species displays an unusual (to date globally unique) phenomenon of showing rapid reversible color change in both sexes that is linked to reproductive enhancement, competitive advantage and thermoregulation (Deacon & Samways, 2016a). This species is also very unusual in its ecology, aspects of behavior and larval morphology (Deacon & Samways, 2016b). A conservation plan has been developed with two viable options to ensure the conservation of the species (Deacon & Samways in press). The first option is to improve the current habitat condition by increasing water supply of the pools, physically deepening the pools and increasing the density of the pools. The second option is to translocate a part of the current population to a suitable area in the Cederberg where similar species assemblages exist as at the current site.

The third species of conservation concern is *Proischnura polychromatica* (EN). This species was last seen in the

Table 3. Conservation status of butterfly species in the Western Cape that were classified as Least Concern during Red Listing but are locally rare (Mecenero *et al.*, 2013). Extremely Rare: known from only one site; Rare – Restricted range: Range less than 500 km²; Rare – Habitat specialist: restricted to micro-habitat; Rare – Low density: small subpopulations or single individuals scattered over a wide area.

Species	Common name	Province	Distribution
Extremely Rare			
Nymphalidae			
Charaxes xiphares occidentalis	Western forest-king charaxes	WC	Grootvadersbos, Swellendam. Southern Afrotemperate Forest.
Lycaenidae			
Aloeides pallida jonathani	Kammanassie giant copper	WC	Southern side of the Kammanassie mountain range near Uniondale.
Chrysoritis adonis aridimontis	Adonis opal	WC	Elandsberg mountains north of the Swartberg, near Ladysmith. Matjiesfontain Quartzite Fynbos.
Chrysoritis daphne	Daphne's opal	WC	Kammanassie mountains near Uniondale. South Kammanassie Sandstone Fynbos.
Rare – Low density			
Hesperiidae			
Tsitana dicksoni	Dickson's sylph	WC & EC	Inland areas from Franschhoek to Baviaanskloof, widespread on the Langeberg and its foothills.
Lycaenidae			
Aloeides caledoni	Caledon copper	WC & EC	Sporadically from Caledon to Nieu-Bethesda.
Rare – Habitat specialists			
Nymphalidae			
Pseudonympha southeyi kamiesbergensis	Southey's brown	WC & NC	Gifberg to Kammiesberg mountain range. Restricted to Namaqualand Klipkoppe Shrubland, Namaqualand Granite Renosterveld and Vanrhynsdorp Shale Renosterveld.
Lycaenidae			
Chrysoritis irene	Irene's opal	WC	Du Toit's Kloof Pass, Steep, rocky south - to southwest-facing mountain slopes, frequenting exclusively the bases of large cliffs.
Chrysoritis swanepoeli hyperion	Hyperion opal	WC	Swartberg mountain range to Kammanassie mountain range. Occuring in steep, rocky gullies.
Chrysoritis swanepoeli swanepoeli	Swanepoel's opal	WC	Swartberg mountain range, Huis River Pass and Gamkaberg NRC. Low-lying (800 – 900m) rocky kloofs at the foot of mountains with steep dry gullies and river beds.
Chrysoritis uranus schoemani	Uranus opal	WC	Cederberg to Gifberg mountains; Rocky ridges near the summits of high mountains in Bokkeveld Sandstone Fynbos.
Lepidochrysops pringlei	Pringle's blue	WC & EC	Swartberg mountain range to Willowmore. Rocky ridges on the upper slopes of mountains in North Swartberg Sandstone Fynbos.
Thestor strutti	Strutt's skollie	WC	Rocky areas in fynbos at the foot of mountain peaks, between Franschhoek and Wolseley.
Rare - Restricted range			
Nymphalidae			
Serradinga kammanassiensis	Kammanassie widow	WC	South-eastern portion of the Kammanassie mountains near Uniondale. High-altitude fynbos (1100 – 1600m) on steep slopes, in valeys and along river courses. North and South Kammanassie Sandstone Fynbos.
Torynesis mintha piquetbergensis	Piquetberg widow	WC	Moreesburg to Piketberg along upper slopes of wartland Shale Renosterveld hills.

Species	Common name	Province	Distribution
Lycaenidae			
Aloeides monticola	Cederberg copper	WC	In the Cederberg at high altitudes in Cederberg Sandstone Fynbos.
Aloeides pallida juno	Tsitsikamma giant copper	WC & EC	Plettenberg Bay to Kareedouw in Eastern Fynbos-Renosterveld.
Chrysoritis adonis adonis	Adonis opal	WC	Northern slopes of the Gydo mountains and adjacent ranges near Ceres. Winterhoek Sandstone Fynbos.
Chrysoritis beaufortia charlesi	Beaufort opal	WC & NC	Sneeukrans area of the Roggeveld escarpment near Sutherland in Roggeveld Shale Renosterveld.
Chrysoritis pyramus pyramus	Pyramus opal	WC	Swartberg mountain range above 1500m in North Swartberg Sandstone Fynbos.
Chrysoritis nigricans rubrescens	Dark opal	WC	Gamkaberg NRC in North Swartberg Sandstone Fynbos.
Lepidochrysops gydoae	Gydo blue	WC	In the mountains around Ceres, on the higher slopes in mountain fynbos.
Lepidochrysops oreas oreas	Peninsula blue	WC	Restricted to the Cape Peninsula.
Lepidochrysops outeniqua	Outeniqua blue	WC & EC	Outeniqua and Kouga mountains.
Lepidochrysops quickelbergei	Quickelberge's blue	WC	On the north-facing slopes of the Groot Winterhoek mountains to Gydoberg and Waboomberg north of Ceres on Winterhoek Sandstone Fynbos.
Orachrysops brinkmani	Brinkman's blue	WC	On the Southern side of the Kammanassie mountain range in South Kammanassie Sandstone Fynbos.
Thestor pictus	Langeberg skollie	WC	From Barrydale to Riversdale along the Langeberg mountains in South Langeberg Sandstone Fynbos.
Thestor rooibergensis	Rooiberg skollie	WC	In the Rooiberg near Ladysmith in South Rooiberg Sandstone Fynbos.
Thestor yildizae	Peninsula skollie	WC	Restricted to the Cape Peninsula.
Trimenia argyroplaga cardouwae	Large silver-spotted copper	WC	In the mountains near Porterville, including the Groot Winterhoek mountains, in Winterhoek Sandstone Fynbos.
Trimenia malagrida maryae	Scarce mountain copper (Suid-Kaapse berg-silwerkolkopertjie)	WC	From De Hoop NRC to Vermaaklikheid in Agulhas Limestone Fynbos, De Hoop Limestone Fynbos and Canca Limestone Fynbos.
Rare - Habitat specialists and Restricted range Hisperidae			
Kedestes sarahae	Cederberg ranger	WC	Known only from its type locality in the Cederberg NRC in montane fynbos, in patches of *Merxmuellera* grass at altitudes around 950 m.
Lycaenidae			
Chrysoritis blencathrae	Waaihoek opal	WC	Only on the highest peaks in the Waaihoek Mountain near Worcester.
Chrysoritis endymion	Endymion opal	WC	Du Toit's Kloof Pass to Riviersonderent mountains above 1200m.
Lepidochrysops balli	Ball's blue	WC	Restricted to the southern slopes of the Kammanassie mountains and the Aasvoëlsberg near Willowmore at an altitude of 1300 m.
Rare – Habitat specialists and Low density Lycaenidae			
Lepidochrysops bacchus	Wineland blue	WC & EC	Occurs in Fynbos and Albany Thicket localities that receive between 500 mm and 750 mm rainfall per annum.

early 1960s at Franschhoek. It was rediscovered in 2003 in the same locality as *Spesbona angusta* and has since also been found near Ceres. Both these last species were only known from sites where invasive alien trees had been removed. *Syncordulia legator* (VU), a rare and localized Western Cape endemic with few scattered records from Clanwilliam, Du Toits Kloof, the Palmiet River, Jonkershoek and Franschhoek at an elevation between 350 and 800 m was also recorded at the same site. Therefore, Deacon and Samways (in press) argued that the conservation plan they developed for Spesbona. angusta will serve as an umbrella plan for *P. polychromatica* and *Syncordulia. legator*.

Other species in the area which have a global Red List status are *Syncordulia gracilis* (VU), *S. venator* (VU) and *S. serendipator* (VU) (Table 3), all of which are threatened by invasive alien trees as are most of the Western Cape freshwater biota. *Syncordulia venator* is a Western Cape endemic that is only found at 300 – 1300 m elevation. *S. serendipator* (VU) only have a few scattered records from the Western Cape, including Riebeeck Kasteel, Bainskloof and Jonkershoek and only occur above 350 m elevation.

Invasive alien Rainbow trout have been found not to be a threat to odonate larvae in the Breede River system, although they are to the local Redfin (Shelton *et al.,* 2015a, b, 2016, in press). The local odonate fauna shows a newly-discovered attribute: the adults can select in-water conditions, which appears to have been honed over considerable time (Kietzka *et al.,* 2017). Artificial ponds increase the area of occupancy of many dragonfly species, including Cape Floristic Region endemics, improving their resilience to landscape change (Simaika *et al.,* 2016).

3.3 Arachnida - Spiders and mites

The South African National Survey of Arachnida (SANSA) was initiated in 1997 (Dippenaar-Schoeman *et al.* 2015). It is an umbrella project that is implemented at a national level in collaboration with researchers and institutions countrywide dedicated to document and unify information on arachnids in South Africa. The information gathered is organised in a relational database collating all available data from surveys and published data involving 11 institutions.

Although spiders constitute an abundant and successful group of invertebrates in South Africa, they are still poorly sampled in some areas. SANSA is providing essential information needed to address issues concerning the conservation and sustainable use of the arachnid fauna (Dippenaar-Schoeman *et al*., 2013; Dippenaar-Schoeman *et al*., 2015). The rationale for SANSA is primarily to gather baseline information for conservation assessments. Presently a Red listing projects is underway to evaluate all the South African species (Lyle & Dippenaar-Schoeman, 2015). This project was initiated in 2013 and is planned to be completed before the end of 2017.

The SANSA database contains a wealth of information on spider diversity including data on each province. A total of 11 842 records from 307 sites were recorded in the Western Cape up to 2017. Data on spider species richness for the Western Cape was obtained from existing data sets for the province compiled from the first Spider Atlas of South Africa (Dippenaar-Schoeman *et al.*, 2010) and further additional surveys. Data from the SANSA database is available in three formats: information

Table 4. Species and their National Red List categories and criteria (Samways & Simaika 2016).

Scientific Name	Common Name	National Red List Category	National Red List Criteria
Platycnemididae (Featherlegs and Threadtails)			
Spesbona angusta	Spesbona/Ceres Streamjack	EN	A2c; B1ab(i,ii,iii)+2ab(i,ii,iii)
Coenagrionidae (Pond damsels)			
Proischnura polychromatica	Mauve Bluet	EN	B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)
Corduliidae (Emeralds)			
Syncordulia legator	Gilded Presba	VU	B2ab(i,ii,iii), D2
Syncordulia gracilis	Yellow Presba	VU	B2ab(i,ii,iii), D2
Syncordulia venator	Mahogany Presba	VU	B2ab(i,ii,iii), D2
Syncordulia serendipator	Rustic Presba	VU	B2ab(i,ii,iii), D2
Libellulidae (Skimmers)			
Orthetrum rubens	Elusive Skimmer	EN	B2ab(i,ii,iii), D2

on all the preserved specimens housed in several natural history collections worldwide and published in the primary literature; primary data of specimens housed in the National Collection of Arachnida (NCA) at the ARC-Plant Protection Research Institute (PPRI), Pretoria as well as a digital photographic database containing images of species recorded by the public. These digital data are available online (google SANSA virtual Museum). Also included are published and unpublished MSc and PhD theses and longer-term surveys that were undertaken in the Western Cape.

The 230 Western Cape sample sites represent different areas such as different protected areas, forest stations, research farms, farms and urban areas. The areas most intensively sampled in the province are centred on Cape Town, the Cape winelands and the Cederberg Mountains, as well as several reserves and national parks. Public participating in SANSA in the Western Cape resulted in good data sets from Gouritzmond (Borrelfontein), Hermanus, Oudtshoorn and Worcester. In Table 5 the different protected areas sampled are listed indicating who had undertaken the survey with references of the results that have been published.

Presently 71 spider families, 471 genera and 2 240 species are known from South Africa, representing approximately 4.8% of the world spider species. From the Western Cape a total of 965 species represented by 365 genera and 66 families have been recorded (Table 5). Of the 965 species, 361 species are endemic to the Western Cape (37.4%), with 119 species only known from their type locality (Table 5).

The three families with the greatest diversity were Salticidae, Gnaphosidae and Thomisidae (Table 5). The Salticidae had the most species (113 species of which 41 species (36%) were endemic), followed by the Gnaphosidae (104 species of which 24 species (23%) are endemic) and Thomisidae (72 species of which only seven species (9.9%) are endemic). Ten families are represented by single species.

Owing to the unresolved taxonomy of some families (e.g. Dictynidae, Linyphiidae Theridiosomatidae, Theridiidae), a portion of the species collected cannot be accurately identified to species level or are undescribed and the diversity indicated here represents only a portion of the actual species present. In addition, 30 species of the families Ammoxenidae, Gallieniellidae, Hahniidae, Salticidae, Tetragnathidae and Zodariidae are recognized as new species. Most of these species are already described with results in press or form part of revisions to be published soon.

a)

b)

c)

Figure 3: *Spesbona angusta* (EN), a species that displays an unusual and globally unique phenomenon of rapid reversible colour change in both sexes. A) Female, b) male, c) larvae. Photo credits: C. Deacon.

Table 5. Areas sampled in the Western Cape with indication of type of survey, number sampled and references of the results.

Protected area	#Records	Survey type	Reference
Protected Areas			
Aardvark Nature Reserve	>50	SANSA survey (ARC)	Lyle 2014
Anysberg Nature Reserve	>150	SANSA survey (UFS)	Lyle 2014
De Hoop Nature Reserve	>400	SANSA survey (UFS)	Haddad & Dippenaar-Schoeman 2009
Fernkloof Nature Reserve	>100	SANSA Public surveys	Hamilton-Atwell 2010
Gamkaberg Nature Reserve	>100	PA survey	Dippenaar-Schoeman & Goemas 2008
Gondwana Game Reserve	>50	SANSA (PA surveys)	Not published
Goukamma Nature Reserve	>50	SANSA (PA surveys)	Dippenaar-Schoeman *et al.* 2008
Jonkershoek Nature Reserve	>50	SANSA (PA surveys)	Dippenaar-Schoeman & Le Roux 2016
Keurbooms Nature Reserve	>50	PA survey	Dippenaar-Schoeman *et al.* 2008
Lily Vlei Nature Reserve	>50	PA survey	Dippenaar-Schoeman *et al.* 2008
Marloth Nature Reserve,	>50	PA survey	Not published
Outeniqua Nature Reserve	>50	PA survey	Dippenaar-Schoeman *et al.* 2008
Swartberg Nature Reserve	>300	PA surveys	Dippenaar-Schoeman *et al.* 2005
Steenbokkie Nature Reserve	>30	UOFS Student survey	Not published
Witteberg Nature Reserve	>80	UOFS Student survey	Not published
National Parks			
Bontebok National Park	>200	SANSA (PA surveys)	Swart *et al.* 2017
Karoo National Park	>250	SANSA (PA surveys)	Dippenaar-Schoeman *et al.* 1999
Table Mountain National Park	>300	SANSA (PA surveys); US students surveys	Uys 2008. Pryke & Samways 2008, 2010, 2012
Tsitsikamma National Park	>50	PA surveys	Not published
Forest Stations			
Diepwalle Forest Station	>100	NCA survey	Not published
Groeneweide Forest Station	>150	PA reserve	Not published
Groenkop	>50	PA reserve	Not published
Grootvadersbosch	>50	NCA survey	Not published
Knysna	>50	PA reserve; US student surveys	Not published
Lebanon Forest Station	>50	PA reserve	Not published
Saasveld Forest Station	>50	PA reserve	Not published
Heritage Sites			
Robben Island	>250	US student survey; UCT student survey	Steenkamp 2015; Mukherjee *et al.* 2010
National Gardens			
Kirstenbosch National Botanical Garden	>100	US student surveys; PA surveys	Tucker 1920; Le Roux & Dippenaar-Schoeman 2016; Uys 2008; Pryke & Samways 2009
Wilderness Areas			
Cederberg Wilderness area	>5000	CIB surveys	Foord & Dippenaar-Schoeman 2016
Biosphere Reserves			
Kogelberg Biosphere Reserve	>80	PA reserve	Dippenaar-Schoeman 2008b
Caves			
Table Mountain caves	>50	Student surveys; literature surveys	Sharratt, *et al.* 2000; Dippenaar-Schoeman & Myburg 2009
Agro-ecosystems			
Pasture	>100	ARC survey (Welgevallen)	Not published
Protea (commercial)	>100	ARC surveys; US student survey	Coetzee *et al.* 1990; Visser *et al.* 1999; Sasa 2008
Vineyards	>300	ARC Survey; US student surveys	Halleen & Dippenaar-Schoeman 2013; Gaigher 2008; Gaigher & Samways 2010, 2014; Gaigher *et al.* 2016
Student Projects			
Brand-se-Baai	>50	Student surveys	Lyons 2008
Cape Town	>900	US Student surveys	Magoba & Samways 2012
Jakobsbaai, Saldanha Bay	>50	US Student surveys	

Protected area	#Records	Survey type	Reference
Other			
Beaufort West farms	>400	ERA survey	Jacobs 2008
Borrelfontein, Gouritz Mouth	>200	SANSA Public surveys	Dippenaar-Schoeman, 2008c
Cape Peninsula		Literature survey	Picker & Samways 1996
Ceres (Touwsriver)	>200	NCA survey	Not published
Hermanus	>200	SANSA Public surveys	Hamilton-Atwell 2014
Heuweltjie, Prince Albert	>300	By catch surveys	Dean 1988; Dean & Milton 1995.
Matjiesfontein	>120	UFS student surveys	Not published
Oudtshoorn	>100	SANSA Public surveys	Dippenaar-Schoeman 2008a
Rawsonville	>200	ARC survey	Halleen & Dippenaar-Schoeman 2013
Stellenbosch	>350	ARC survey	Not published
Swellendam	>50	SANSA Public surveys	Not published
Worcester	>100	SANSA Public surveys	Dippenaar-Schoeman 2008a

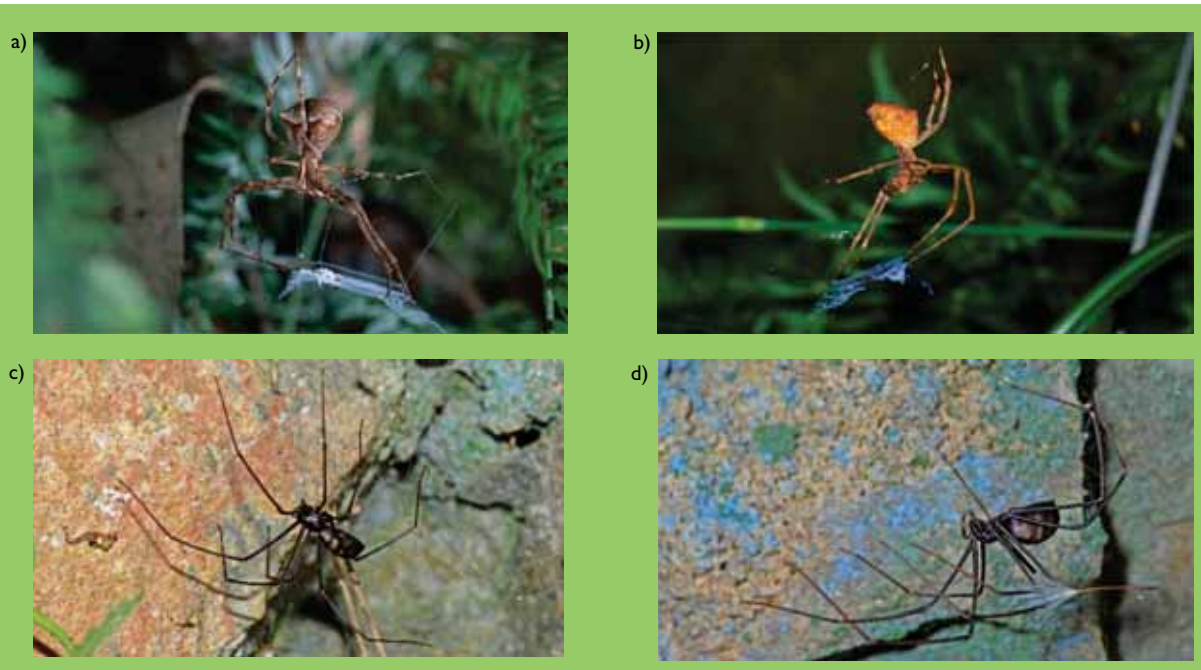

Figure 4. Two spider species that are endemic to the Western Cape. a) and b) *Menneus capensis* and c) and d) *Drymusa capensis*. Photo credits: N. Larson.

4. Long-term Monitoring: The Coast To Karoo Transect

The Coast to Karoo Transect was a long-term study of species richness and abundance variation in ants, ground beetles and tiger beetles, initiated in 2002, as part of a Ph.D. study in the Greater Cederberg Biodiversity Corridor (Botes 2006, Botes *et al.*, 2006a, b). This study was the first of its kind in South Africa and the Western Cape and was also replicated in Sani Pass and in Limpopo and was run by the DST-NRF Centre of Excellence for Invasion Biology (C·I·B) at the University of Stellenbosch. The transect runs across an altitudinal transect covering the major vegetation types on both aspects of the Cederberg, encompassing the full range of vegetation. The transect ranged from sea level at Lambert's Bay, to Sneeukop (1926 m a.s.l.), and down the eastern slopes to Wupperthal (approximately 500 m a.s.l.).

Sampling of the ground-dwelling fauna took place from 2002 to 2012. A total of 135 ant species belonging to 19 Families and 29 genera were collected across the altitudinal gradient. The collection of ground surface temperature readings is still being conducted.

Furthermore, the C·I·B initiated a project that contributes to the two key objectives of the Convention on Biological Diversity, namely "identification and monitoring" and "public education and awareness". The limbovane Outreach Project was initiated with the objectives to provide long-term data on ant diversity and environmental factors that are associated with different species (e.g. vegetation data, climate data, levels of disturbance), and to educate Grade 10 Life Science learners and educators about local biodiversity, biodiversity science, biodiversity loss and the impact of human activity on biodiversity. The project thus combines inventorying and monitoring of local biodiversity with outreach efforts aimed at educating the public about biodiversity.

Table 6. The total number of families, genera and species recorded from the Western Cape Province showing the number of endemic species (END) for each family.

Family	Genera	Species	Endemic
Agelenidae	6	13	9
Amaurobiidae	4	7	5
Ammoxenidae	2	15	10
Anapidae	3	3	2
Anyphaenidae	1	1	0
Araneidae	35	65	8
Caponiidae	2	8	4
Chummidae	1	1	0
Clubionidae	2	8	4
Corinnidae	7	10	1
Ctenidae	1	2	1
Ctenizidae	1	9	7
Cyatholipidae	5	10	7
Cyrtaucheniidae	2	5	3
Deinopidae	2	3	1
Desidae	1	1	0
Dictynidae	4	4	2
Dipluridae	1	1	0
Drymusidae	1	4	4
Dysderidae	1	1	0
Eresidae	5	14	3
Eutichuridae	3	14	3
Filistatidae	1	1	0
Gallieniellidae	1	5	4
Gnaphosidae	29	104	24
Hahniidae	1	7	2
Hersiliidae	3	7	0
Idiopidae	3	5	1
Linyphiidae	19	24	9
Liocranidae	3	6	5
Lycosidae	18	46	14
Migidae	1	11	8
Mimetidae	2	3	0
Miturgidae	2	2	1
Mysmenidae	1	1	1
Nemesiidae	4	28	23
Nephilidae	2	2	0
Nesticidae	1	1	0
Oecobiidae	2	2	1
Oonopidae	8	10	4
Orsolobidae	2	3	3
Oxyopidae	3	18	5
Palpimanidae	2	4	1
Penestomidae	1	4	1
Philodromidae	6	16	3
Pholcidae	3	13	7
Phrurolithidae	1	1	1
Phyxelididae	5	6	5
Pisauridae	5	11	1
Prodidomidae	5	13	3
Salticidae	40	115	41
Scytodidae	1	13	6
Segestriidae	1	6	3
Selenopidae	1	21	8
Sicariidae	2	3	0
Sparassidae	6	21	8
Tetragnathidae	5	17	4
Theraphosidae	5	19	13
Theridiidae	13	36	16
Theridiosomatidae	1	1	1
Thomisidae	25	72	7
Trachelidae	7	20	9
Trochanteriidae	1	6	2
Uloboridae	3	6	1
Zodariidae	20	45	32
Zoropsidae	2	13	9
Total	**357**	**965**	**361**

The project established a monitoring programme across the Cape Floristic Region including different vegetation types. The project covers 39 study sites located in both pristine and transformed areas (Figure 5). Transformed sites are located on or near the school grounds of secondary schools. Pristine sites are situated in national parks and in nature reserves with a few on private farms and private nature reserves.

Between 2006 and 2014, the monitoring component of the project has collected 305 987 individuals belonging to 35 genera (219 species) over all 39 monitoring sites. Local richness of ants in the Fynbos and Succulent Karoo biomes was shown not to be exceptional but follows expectations based on global ant diversity-energy and ant diversity–climate relationships (Braschler *et al.,* 2012). This is in contrast to the exceptionally high plant diversity of the region and the factors contributing to the richness of the flora thus did not have the same effect on all diversity. However, in common with other regions with a Mediterranean climate ant diversity in the Western Cape is still very high. Ant species with large body size are more likely to be missing in sites with strong human impact, which would affect which types of seeds get dispersed (Braschler *et al.,* 2012). However, some important native seed dispersers can reach high densities in heavily disturbed sites even with the presence of the invasive Argentine ant (Braschler *et al.*, 2010).

Data replicated both over time and large spatial scales on invertebrates is rare and the limbovane dataset thus offers a great opportunity to researchers. Furthermore, material is made available for the description of new species by collaborators (Mbanyana and Robertson,

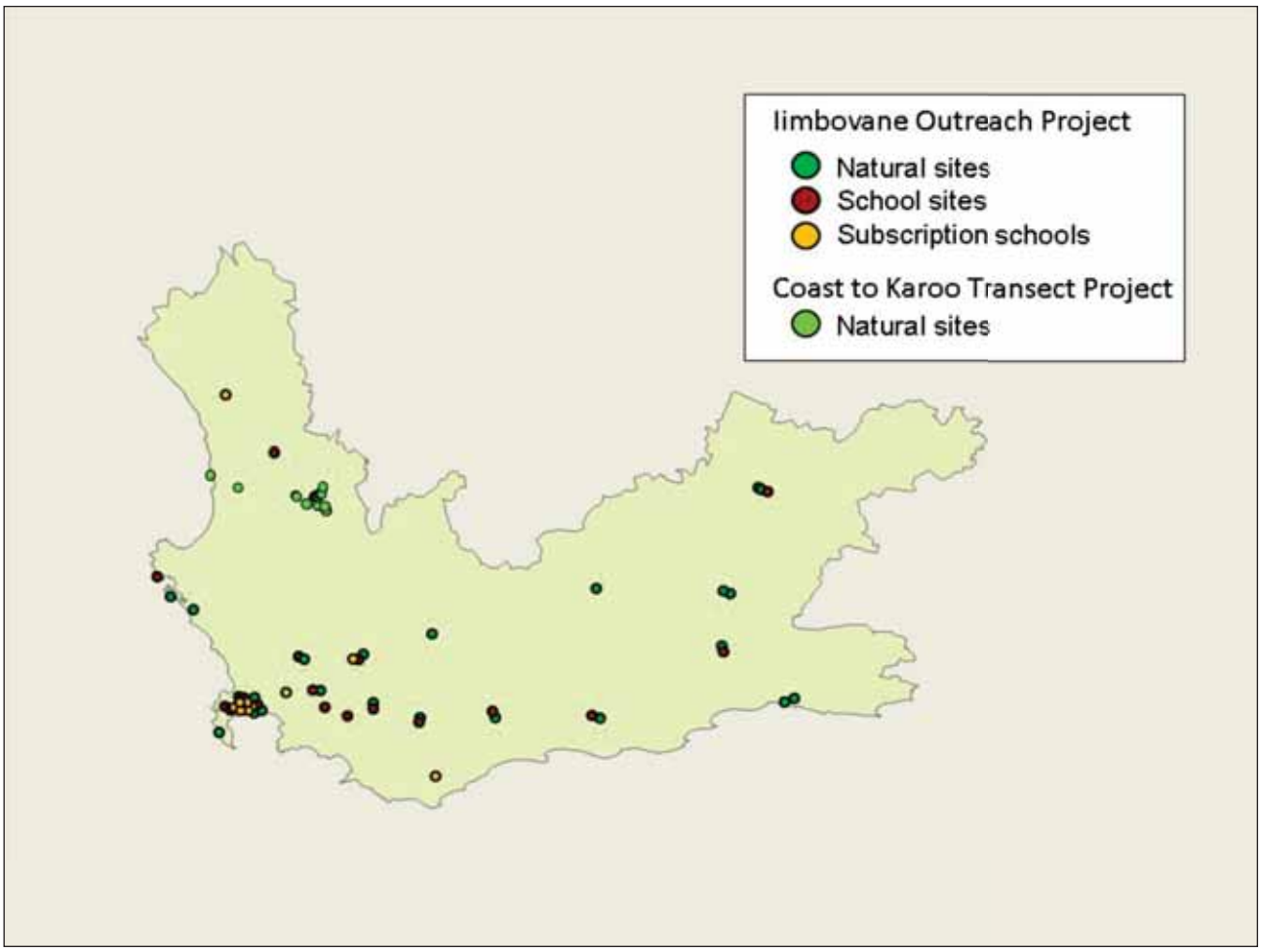

Figure 5. The study sites of the Iimbovane Outreach Project are distributed over the Western Cape Province, representing major vegetation types.

(2008) on the genus *Nesomyrmex*, an ongoing study by Mbanyana, Robertson and le Roux on the genus *Tetramorium*, and work by the same group on the genus *Ocymyrmex*). DNA barcodes for most species examined are deposited in the searchable online BOLD database (www.boldsystems.org) of the International Barcode of Life Initiative, which are freely accessible to South African researchers or conservation professionals as a new identification tool. All records include high quality photographs and coordinates and other information for the sites.

5. Threats

5.1 Invasive and alien species

Alien and invasive arthropod species cover most insect orders, arachnids and other non-insect arthropods (Picker & Griffiths, 2011). Several of these species were introduced deliberately (e.g. as biological control agents) while many invasive invertebrate species are still introduced by accident and may have dire consequences if left unmanaged.

Biological Control agents

The considerable biodiversity of the Cape Floristic Region is threatened by alien plant invasions, which are rapidly increasing in extent and severity. Invasions by alien tree species in particular have caused large scale ecosystem degradation and has exacerbated habitat loss due to human activities (Cowling & Richardson, 1995; Le Maitre *et al.*, 2000; De Lange & Van Wilgen, 2010; Moran & Hoffmann, 2012).

Biological control was hailed as a cost-effective and successful method of control when used as part of an integrated alien clearing plan (Van Wilgen *et al.*, 2013). This method is an important approach for dealing with invasive alien plants where prevention and eradication are no longer options for management and other means of control are too expensive or ineffective (Van Wilgen *et al.*, 2013). Biological control has been implemented in South Africa for more than 100 years and has been DEA: NRMP-funded since 1997 (Van Wilgen *et al.*, 2012). Since 1970, twelve invasive alien tree species have been subjected to this control method. These are: eight *Acacia* species (*Acacia longifolia*, *A. mearnsii*, *A. melanoxylon*, *A. pycnantha*, *A. saligna*, *A. decurrens*, *A. podalyriifolia* and *A. dealbata*) and *Paraserianthes lophantha* (Mimosaceae), *Hakea sericea* (Proteaceae), and *Leptospermum laevigatum* (Myrtaceae)

(all from Australia) and *Sesbania punicea* (Fabaceae) from South America. Nineteen species of biological control agents have been released on these invasive alien plant species, of which nine are weevil species (eight Coleoptera: Curculionidae and one Brentidae), a seed-feeding moth (Lepidoptera: Carposinidae), two bud-gallers (Hymenoptera: Pteromalidae), two flower-gallers (Diptera: Cecidomyiidae) and a gall-forming rust fungus (Uredinales: Pileolariaceae) (Moran & Hoffmann, 2012). These biological control agents primarily reduce seed production, and some can cause die-back of their host plants.

Fifty six percent of invasive alien plants in South Africa are under good biocontrol. Of the 48 invasive alien plant species on which biological control agents have established, ten species are under complete control (21%) and 18 species are under substantial control (38%) (Klein, 2011). However, 14 of the 48 species are under negligible control (29%) whereas the status of five species (10%) are still unknown (Klein, 2011). Invasive pines which are one of the primary invasive alien plants in the Western Cape have not yet been subject to any biocontrol.

By 1998 biocontrol had reduced management costs by 20% and it has the potential to further reduce the costs by 40% (van Wilgen *et al.* 2004, de Lange & van Wilgen, 2010). It has been proposed in the National Strategy on Dealing with Biological Invasions in South Africa (2014) that the research capacity must be doubled over the next 10 years through long-term training through universities, short-term training through courses and internships and by collaboration with experts in the field. The implementation capacity must be doubled over the next 5 years through pre- and post-release monitoring, mass-rearing and field collections. Furthermore, invasive alien plant biocontrol must be integrated into management programmes for invasive alien plants, the potential of biocontrol of emerging weeds must be included in the National strategy and the NEMBA status of invasive alien plants under complete or substantial biocontrol must be changed (Zachariades *et al.*, 2016).

5.3 Vespula germanica

An example of an invasive invertebrate species that were introduced by accident and may have dire consequences if left unmanaged is the European or German wasp, *Vespula germanica* (Fig. 6a). This species is native to Europe, North Africa and temperate parts of Asia but has, in recent times, also become established in parts of New Zealand, Australia, Chile, Argentina and North America. The arrival of this alien wasp in these parts of the world has in all cases been entirely accidental and a result of inter-continental transport of air cargo. Wherever they have become established the wasps have been regarded as pests, and in certain countries as a major threat to both the ecology and to commercial enterprises (Tribe & Richardson, 1994). This is particularly so in south-east Australia, Tasmania, and New Zealand, parts of the United Kingdom, and north-east USA, where this species is the major wasp pest.

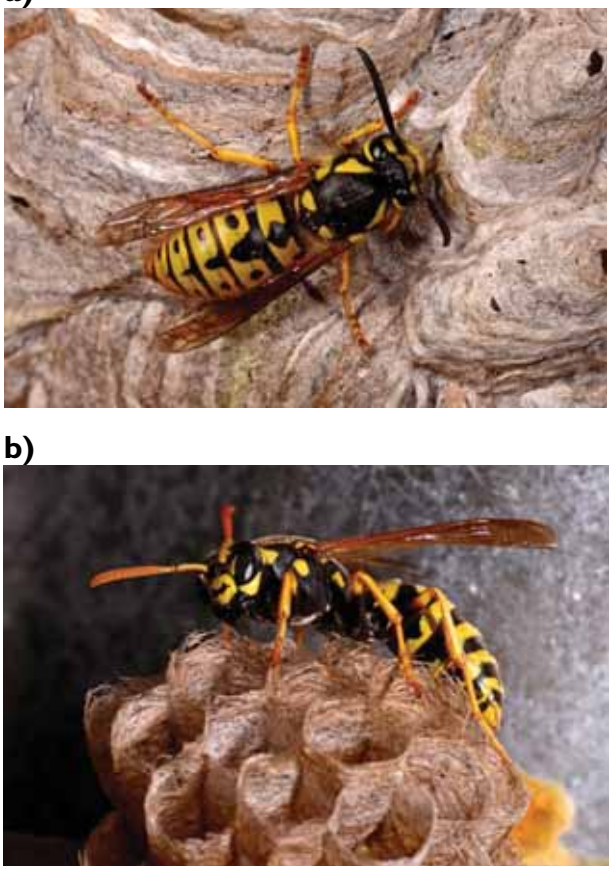

Figure 6. The two invasive wasps. a) *Vespula germanica* and b) *Polistes dominulus*. Picture credits: S. van Noort (Iziko Museums).

Vespula germanica was initially recorded in South Africa in Kirstenbosch in 1974 (Whitehead & Prins, 1975). It is suspected that the first V. germanica specimen arrived in the Western Cape Peninsula via intercontinental transport of air cargo (Whitehead & Prins, 1975; Tribe & Richardson, 1994). Population expansion of V. germanica has been uncharacteristically slow in the Western Cape compared to other countries where dispersal rates have been documented. The wasp is still confined to a relatively small area within the Western Cape, which now include on the fringes: Ceres, Wellington, Grabouw, Somerset West, Franschhoek and Constantia (Veldtman *et al.,* 2012; Haupt, 2014) (Figure 7). *V. germanica* populations have been found in both undisturbed natural vegetation (Richardson *et al.,* 1992) and in highly disturbed areas, but it is suspected to thrive in the latter (Mooney & Hobbs, 2000) due to increased food availability. During the early 2000s, the large size of excavated nests in the Somerset West area suggested that *V. germanica* overwinters in South Africa (Allsopp, 2014, PPRI, pers. comm.). Due to the lack of monitoring records in the timeframe between the first documented case of *V. germanica* in South Africa and the latest research conducted by Haupt (2014), it is impossible to construct successive snapshots of population spread. What can be concluded, is that *V. germanica* has spread in the past 50 years, albeit slowly, and concern remains for potential expansion beyond current distribution, where ecological factors are more favourable (Tribe & Richardson, 1994). Tribe and Richardson (1994) and Spradbery and Maywald

(1992) have indicated that ecoclimatic conditions for V. germanica are more suitable along the southern Cape coastal belt and the eastern escarpment, up toward the eastern half of sub-Saharan Africa. Once the wasp becomes established in these regions, rapid dispersal can be expected (Goodisman *et al.,* 2001).

Current findings indicate that *V. germanic*a nests are found almost exclusively next to permanent rivers. Given its distribution in the Western Cape, this includes all permanent river tributaries of the Berg and Breede rivers, along which this wasps seems to be spreading slowly above and below stream where suitable foraging areas are in close proximity. In the odd exception where a nest is found away from a river or permanent water resource, there is always freshwater in close proximity and alternative forage available such as grape and other fruit waste. This means that the area in which *V. germanica* currently occurs is much smaller than previously estimated, likely due to the current drought conditions experienced.

In New Zealand these wasps have been shown to be a threat to the indigenous fauna (Fordham, 1991; Moller *et al*., 1991) with which they compete for the same food, and on which they prey. Harris (1991) showed that the prey utilization by *V. germanica* in parts of New Zealand was similar to that of the entire insectivorous bird fauna and displayed considerable dietary overlap. He calculated that carbohydrate intake by these wasps was as high as 343 l/ha per season. Beggs (2001) reported that wasp densities in preferred habitat could be as high as 34 per hectare and that the wasps consumed over 90% of available honey-dew, thereby competing with indigenous birds and insects. He concluded that competition with *V. germanica* could eradicate whole populations of invertebrates.

The larvae of *V. germanica* require fresh protein (mainly in the form of soft-bodied insects), while the adults require a sugar source for energy and wood to make the paper nest. Wasps prey primarily on spiders, caterpillars, ants, flies and bees (Beggs, 2001), but will consume any available protein, even killing newly-hatched birds (Spradbery, 1988). Few studies have been undertaken in other ecological biomes where *V. germanica* has become established, but the massive nests and huge populations of over-wintering wasps in the southern hemisphere pose an obvious threat to biodiversity. When abundant, European wasps destroy practically all other insect life and even nestling birds (Spradbery, 1988). Competition for nectar alone could have a major effect on the indigenous fauna, and the out–competing of native pollinators (including native wasps that also need soft-bodied insects) could interfere with seed formation and the gene flow of indigenous plants. The harvesting of insect prey by the wasps will also serve to reduce the numbers of indigenous pollinators, and hence also impact on pollination and biodiversity.

In South Africa, however, *V. germanica* is currently not abundant and is unlikely to have such severe impacts as seen in New Zealand. Habitat suitability is much lower where the wasp currently occurs in South Africa compared to New Zealand, and the absence of similar honey dew resources explain why wasp abundance is low. Given *V. germanica*'s current distribution and low nest density, it is unlikely that this species has more than a negligible impact on South Africa's invertebrate and insectivore biodiversity. Further studies will have to be conducted to determine whether this prediction is true.

Figure 7. Present distribution of *V. germanica* in the Western Cape, South Africa based on nests found between 2013 and 2016.

Figure 8: Current estimated distribution range of *Polistes dominula* in the Western Cape based on field observations, reports form the public and observations on the species habitat selection.

5.4 Polistes dominula

A second species, the European paper wasp, *Polistes dominula* (Fig. 6b) is a new arrival (post 2005, see Eardley *et al.*, 2009) but seems to already occupy a similar range to *V. germanica*, despite the latter having arrived 35 years earlier. The workers of both species look very similar in colour and size but *P. dominula* constructs comparatively small nests, which differ from *V. germanica* in that these are above ground (typically under the outer roof margin of houses and other structures in suburban settings). The invasion pattern of *P. dominula* is thus potentially very different, being a much more recent establishment and fast-spreading, theoretically having different biodiversity impacts than *V. germanica*.

The European paper wasp, *P dominula* is a relatively recent arrival in South Africa but has rapidly spread from its points of introduction. *Polistes dominula* was discovered in 2008 in Brakenfell in the Cape Metro of the Western Cape (Eardley *et al.*, 2009). Subsequently no further attention was given to this species. In 2011 this species started to be commonly observed in Kuilsrivier and Stellenbosch, being added to the SANBI Invasive Wasp Project research effort that previously focused only on *V. germanica* (Veldtman *et al.*, 2012) (Fig. 8). Further spread of the wasp to Paarl, Wellington, Franschhoek and Grabouw was recorded by Benadé *et al.*, (2014). Currently the wasp is arguably the most common insect seen in peri-urban areas and now also is found in bordering farming areas.

This wasp species is not normally aggressive to humans but can sting when the nest is accidentally disturbed, with large nests showing increased aggression. When the temperature is high (30°C+) wasps become very active, and are more likely to be encountered by people, increasing the chance of getting stung.

There is substantial scientific knowledge of the ecology of this species to understand its invasion pattern and asses the possibility of systematically exterminating it from South Africa. Findings show that wasp densities are highest in peri-urban and agricultural areas, intermediate on natural fringes and very low inside natural areas. There is also no evidence of the invasive species impacting on native paper wasps (*Polistes* and other paper wasp genera). The high abundance in human modified habitats is likely due to increased prey density of cosmopolitan and exotic species. Research thus suggests *P. dominula*'s impact as an invasive species is largely confined to human modified landscapes. The wasp is thus less of a threat to biodiversity than it is to human health, urban quality of live and agricultural labour practices.

6. Recommendations

As signatories to the Convention on Biodiversity, South Africa is required to develop a strategic plan for the conservation and sustainable utilization of this heritage. The convention also has two key objectives, which are the "identification and monitoring" of biological diversity and "public education and awareness" (articles 7 and 13).

In the State of Biodiversity report of 2008 – 2012, the recommendation was made that the *first step in understanding what we are dealing with would be to compile a co-ordinated inventory for arthropod species for the Western Cape, which must include information on endemism and*

threat status of species. Given the Iziko South African Museum Invertebrate Inventory Project and the BioGaps project run by the South African National Biodiversity Institute in the Karoo, in addition to the three Red Listings of invertebrate groups, it is safe to say that a step is taken in the right direction to increase our knowledge with regards to what to protect and how to do it. Some protection might be provided to certain arthropod groups in protected areas such as CapeNature reserves given the fact that there are correlations between insect species richness and biomes in the Western Cape (e.g. Procheş & Cowling, 2006, 2007; Procheş *et al*., 2009). Therefore, the argument can be made that the attention and protection that the area receives in terms of its floral diversity might provide some protection for its insect diversity (Samways *et al.,* 2012).

Given the capacity constraints and priorities in CapeNature, we are heavily reliant on partnerships with tertiary institutions and National initiatives. In particular, specialist studies and monitoring can provide us with much needed information to help us get a handle on invasive species and any special species that may not be protected by the normal means.

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DRAGONFLY

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