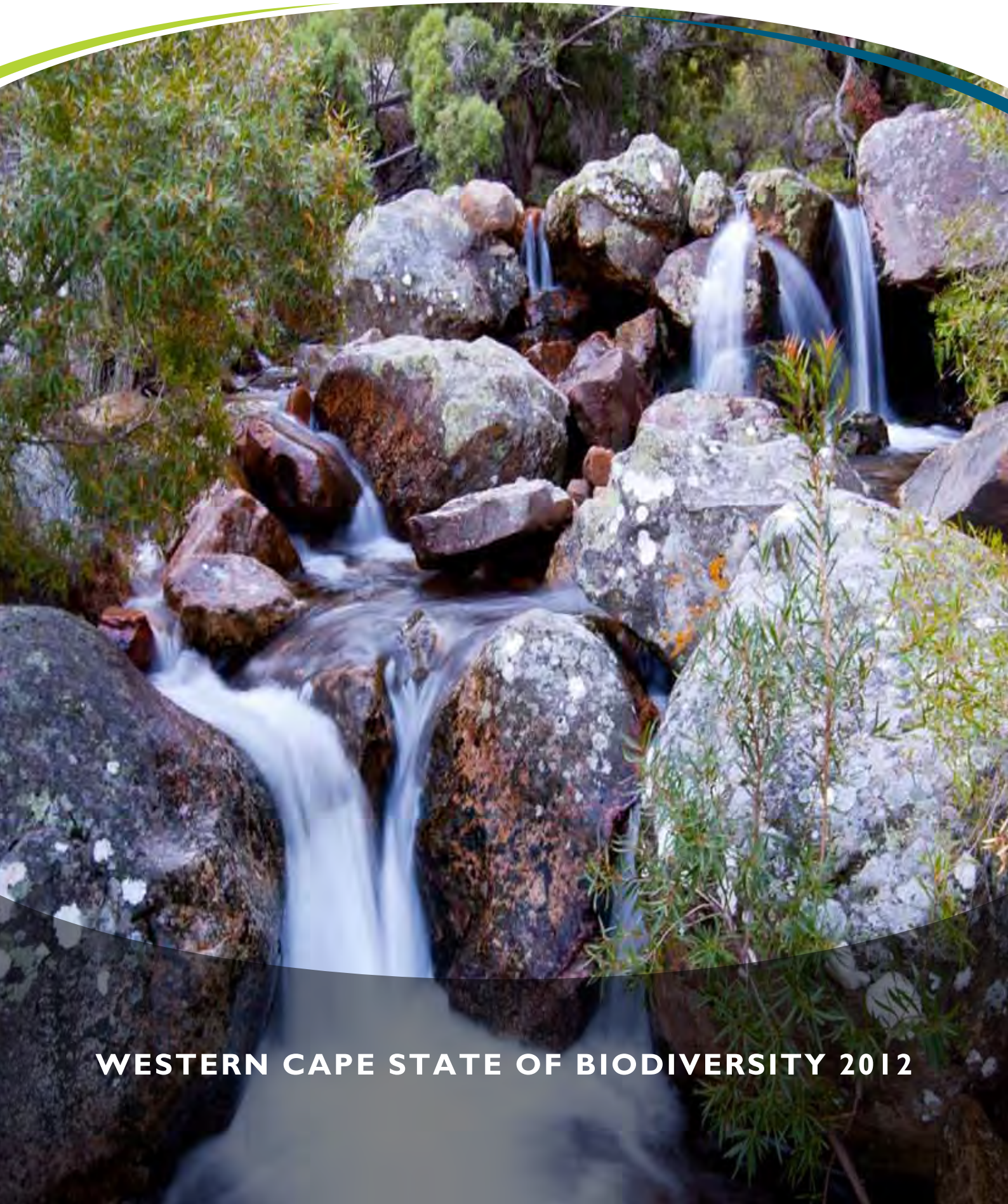
CapeNature

Conserve - Explore - Experience



WESTERN CAPE STATE OF BIODIVERSITY 2012

CEDERBERG NATURE RESERVE

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AFRICAN BLACK OYSTERCATCHERS

Introduction

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Biodiversity

Biodiversity is a broad concept that incorporates all the variation that is present in life, from the genetic differences between individuals to the differences between biomes such as forest and succulent Karoo. The intrinsic value of this biodiversity is substantial but there is much more value apart from the intrinsic value. This variation houses and facilitates a multitude of ecosystem services such as the provision of clean water, pollination, flood attenuation, provision of oxygen and many others that sustain life on this planet. Healthy ecosystems underpin many aspects of human well-being (Millennium Ecosystem Assessment, 2005). It is important for this understanding, that the natural environment is critical for human survival and well-being, to gain greater awareness. This is required to move away from the erroneous but persistent view that conservation and human well-being are alternative choices.

Biodiversity reaches extraordinary heights in the Western Cape Province (WCP) primarily due to the more than 13,000 plant species of the Cape Floristic Region (CFR) which is almost completely contained within the WCP borders. New plant and animal species continue to be described in the WCP and there is a growing recognition that there is more animal diversity represented in the province than previously thought (see chapters 4, 5 and 8). The very high levels of diversity are thought to have arisen due to the long evolutionary history of the WCP and the topographical and edaphic (soil) diversity of the province (e.g. Cowling *et al.* 2009, Linder *et al.* 2010). This, coupled with the relatively stable climatic conditions, has allowed local populations of plants and animals to diversify and persist through evolutionary time leading to the current situation where there are many species distributed across the province's varied landscapes. As a result of this mode of evolution, many of these species have small and restricted ranges which has led to the province having very high numbers of endemic species. These species are dependent on this province's conservation bodies for their conservation. Another effect of this evolutionary pattern is that many of these species are likely to be adapted to local environmental conditions and this may occur at very fine spatial scales so that the number, and extent, of suitable habitats may be very limited which limits management options. This may have knock-on management effects such as when animals or plants are moved from one area to another, the chances are good in the WCP that this may interfere with the results of many (often in the order of millions or tens of millions) years of evolution.

Biodiversity is in constant flux and as custodians of a remarkable wealth of biodiversity in the WCP, it is incumbent upon CapeNature to take stock of the current status, compare changes over time to assess trends and plan actions to address upcoming conservation challenges.

Changes in the state of biodiversity must be evaluated against a backdrop of an expanding human populace: the percentage increase in the WCP population between 2001 and 2007 was proportionately the largest in South Africa at 16.7% (Statistics SA 2007) and the population has continued to grow as the WCP share of the country's population rose from 10.2% in 2007 to 10.45% in 2011 (Statistics SA 2011) with justifiable

expectations of an improved standard of living which create additional economic demands. In addition there are large-scale changes in the biophysical realm such as anthropogenic climate change (IPCC 2007) which will impact on where, how and to what degree conservation measures are effective in the long term (see DEA&DP 2008). All these changes make maintaining biodiversity and ecosystem functioning an increasingly complex and challenging task.

CapeNature has produced State of Biodiversity Reports and we compile these reports in response to:

A. Legislative context: South Africa has a well-developed suite of environmental legislation that entrenches environmental protection and wise stewardship from the Constitution of the Republic of South Africa (section 24 of the Bill of Rights) through national legislation – National Environmental Act (NEMA) and the Biodiversity Act (NEMBA) to Provincial legislation – the Western Cape Nature Conservation Board Ordinance. The NEMBA requires reporting on the state of biodiversity at a national level. Provincial level reporting should facilitate the national reporting. In line with the national legislation, CapeNature, as the agency responsible for biodiversity conservation in the Western Cape Province, is developing a provincial Biodiversity Bill that will implement biodiversity monitoring at a provincial level. This will also align with the country's obligation under Articles 6 and 7 of the Convention on Biological Diversity (CBD).

The Department of Environmental Affairs and Tourism compiled a National Biodiversity Strategy and Action Plan (NBSAP) for South Africa to guide implementation of the CBD (DEAT 2005). The WCP State of Biodiversity Report specifically addresses indicators listed under Strategic Objective 2.5 although it touches on several other objectives (e.g. 2.2., 3.3, 5.2).

The South African Department of Environmental Affairs has set 12 outcomes as a key focus of work between 2010 and 2014 (DEA undated). Of direct relevance to the conservation of biodiversity is Outcome 10: that environmental assets and natural resources are protected and continually enhanced. Within Outcome 10, outputs 1: enhanced quality and quantity of water resources, 3: sustainable environmental management and 4: protected biodiversity are addressed in chapters 2, 3 and 1 respectively. The WCP's Strategic Objective 7: Mainstreaming sustainability and optimising resource-use efficiency is addressed in chapter 1.

B. To provide an opportunity to assess trends in the conservation status of the WCP species and the associated conservation management; and

C. To set recommendations for future research and conservation action.

Status quo

The target agreed by the world's governments in 2002, "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth" has not been met (Secretariat of the Convention on Biological Diversity, 2010). Unfortunately the levels of threat and loss are not abating. In the 2005 Millenium Ecosystem Assessment (MEA) it was stated that "Most of the direct drivers of biodiversity loss are projected to either remain constant or to increase in the near future" (Millennium Ecosystem Assessment, 2005). Five years later it was stated in the Global Biodiversity Outlook 3 that "The five principal pressures directly driving biodiversity loss (habitat change, overexploitation, pollution, invasive alien species and climate change) are either constant or increasing in intensity"
(Secretariat of the Convention on Biological Diversity, 2010).

Within South Africa, the situation is mixed: some progress has been made with establishment of a suite of bioregional programmes with a strong focus on the ecosystem approach and on mainstreaming, development of tools for mainstreaming biodiversity in land-use planning and environmental assessment; business and biodiversity initiatives with key production sectors; establishment of stewardship programmes to secure protected area expansion on private land; and most recently the implementation of fiscal incentives to support conservation on private land (South Africa's Fourth National Report to the Convention on Biological Diversity, 2009). However, there are also indications that the status of threatened species is declining and biodiversity and ecosystem health continues to decline as key drivers of change (land-use change, climate change and alien invasive species) show no sign of decreasing (South Africa's Fourth National Report to the Convention on Biological Diversity, 2009). The same report also lists human capacity is a key constraint, and shortfalls in financial resources present a challenge (South Africa's Fourth National Report to the Convention on Biological Diversity, 2009). The challenge of capacity is now being dealt with by GreenMatter – a biodiversity sector skills capacity enhancement programme.
(see http://www.greenmatter.co.za/).

Major threats

Invasive alien species

Invasive alien species may cause myriad problems for the natural environment and society alike. The effects caused by invasive alien plant species are reviewed by Le Maitre *et al.* (2011). Although much attention has been and continues to be devoted to invasive alien plant species, there are some intense pressures developing from the impact of invasive alien animals. Invasive alien plants remain an extensive problem in the WCP despite a massive effort from CapeNature and Working for Water (see chapter 10). The extent and intensity of the problem is represented at a quarter degree scale in Le Maitre *et al*'s 2011 Figure 14.1 which clearly shows the large number of invasive alien plant species in the WCP. The suite of IAS is also growing and presenting new challenges (see Chapter 10). Responses to this situation will require an expansion of the tools and spatial scale of the operations we employ to tackle this problem.

CapeNature is most concerned with those species that negatively affect ecosystems e.g. less available water, more intense fires, competitive exclusion of indigenous species, and those species that spread most rapidly. This ranking allows CapeNature to prioritise the areas for clearing. The worst of these aliens are cluster pines (*Pinus pinaster*), silky hakeas (*Hakea sericea*) in the mountainous areas, various Australian acacias in the lowlands and black wattles (*Acacia mearnsii*) along river courses (although none of these species are limited to these habitats). The planting of pines has a long history in South Africa and it is argued that the negative impact of the vast area invaded by pines (2.9 million Ha) may exceed the positive impact commercial pine plantations (660 thousand Ha) provide

in this area (Van Wilgen & Richardson 2012). This problem is particularly acute in the WCP where the direct effects of pines such as water use, competition for light and nutrients are exacerbated by wildfires which lead to much hotter fires due to increased fuel loads leading to increased damage which may even extend to the underlying soil. Wildfires in invaded areas are very difficult to control and may run into formal plantations. It is necessary that the forestry industry continue to adopt practices and cultivars that minimise the risk of further invasions. The enormity of the problem requires that CapeNature pursue a greater role for biocontrol to boost clearing effectiveness in the rugged mountains of the WCP where standard clearing methods are less effective. This approach is in line with recommendations by Moran *et al.* (2005), Van Wilgen & De Lange (2011) and Van Wilgen & Richardson (2012).

Land use change

Conversion of the natural environment to human-made landscapes remains a major and on-going threat to biodiversity and ecosystem functioning. The challenge here is to incorporate conservation issues in land-use planning and to design and construct more environmentally-friendly developments e.g. that are energy efficient and sensibly sited in the environment. The most sensible way of not losing further land for supporting biodiversity and ecosystem functioning is to use available knowledge to map which areas are the most important for conservation. This is done in a way (systematic conservation planning) in which the least amount of land required to meet the biodiversity targets is identified. If these conservation planning products (maps and supporting documentation) are incorporated into Spatial Development Frameworks then future developments can be planned to avoid these areas and so not foreclose our opportunities for the maintenance of future life support systems.

Mapping habitat changes and ecosystem loss is a continual challenge. CapeNature maps land use changes for approved development applications but this is not a comprehensive assessment of habitat loss (see Chapter 1).

Emerging threats

The above-mentioned threats are well known and affect many species and ecosystems worldwide. However, there are less well known threats and some of these may become major threats in the future. One of these threats that may affect all kinds of organisms (humans included), is the threat of new diseases. With the ever-increasing rate and reach of human transport, many species are intentionally or inadvertently carried to places outside of their historic ranges and diseases may thus reach novel hosts. This may have devastating consequences in cases where the disease is lethal and the new host does not develop resistance in time. An acute example of this is the effect of the chytrid fungus on Central American Frogs (see Chapter 5).

Biodiversity and ecological process monitoring

Monitoring is an essential part of the process of adaptive management. Biological systems are very dynamic by nature and thus require constant monitoring. CapeNature and its many partners all contribute to biological monitoring but the spatially heterogeneous nature of the CFR makes monitoring challenging and ideally every natural habitat should be monitored. Although by no means comprehensive, CapeNature carries out a number of different biodiversity and ecological process monitoring programmes.

Priority species

Due to the large number of species within the WCP, CapeNature focuses its monitoring efforts on endemic, threatened, keystone and alien invasive species. Collectively these species are referred to as "Priority Species". However, the remaining species are not ignored and distribution data is recorded for all indigenous species.

CapeNature carries out three main types of monitoring for Priority Species to get measures of diversity, distribution and abundance. Measures of diversity are primarily driven by taxonomic inventories. This is dependent on the availability of good taxonomies and the ability of field workers and scientists to correctly identify the taxa in the province. Since the last WCP State of Biodiversity Report in 2007 there have been incremental improvements in taxonomy and systematics. Taxonomy underlies our biodiversity inventory and contributes to our understanding of evolutionary pressures which in turn allows modern threats to be evaluated in context. Taxonomic expertise has been identified as a research gap nationally (Driver *et al.* 2011). The WCP is fortunate to have reasonable access to a wide range of taxonomists but the full suite of biodiversity is far from covered and the decline in expertise in this field is apparent in this province too.

Distribution is of course also dependent, like much of conservation biology, on good taxonomies and accurate identification. It is also dependent on repeated and wide-scale observational data. This is something which has advanced dramatically with the recent increase in the number of atlas projects. These atlas projects make extensive use of public participation and observations. Examples of this approach are represented by South African Bird Atlas Project 2, South African Reptile Conservation Assessment, South African Butterfly Conservation Assessment and the South African National Survey of Arachnida.

Communities and ecosystems

Equally as important as individual distribution is the mapping of biotic communities. Given the vast numbers of species in the province and the lack of comprehensive data on all of them, it makes very good sense to use communities as surrogates for conservation targets (see Chapters 1 and 10). Unfortunately our ability to correctly classify biotic communities, delineate them and then, crucially, map their changes over time has also been identified as a research gap (Driver *et al.* 2011).

For a few priority species, proper management relies on abundance estimates. Having good abundance estimates allows one to assess population trends and the effects of management interventions or other factors. An example of this kind of the monitoring is that of the Cape Vultures as presented in Chapter 7.

Conservation status

Both species and communities can be classified according to the levels of threat they are exposed to. CapeNature actively participated in the formal assessments and the distribution data that we collect is a primary informant in many assessments (see Chapter 1).

Ecosystem processes

Fire is a major driver of fynbos ecosystems and so all fires on nature reserves, and most in adjacent natural vegetation, are recorded and mapped. This allows quantification of the extent and frequency of fires. The resultant veld age is a primary informant of reserve management. A summary map of these fires can be found on the BGIS website. (www.bgis.sanbi.org) CapeNature continues its involvement in the River Health Programme despite no longer being the implementing agent in the WCP. CapeNature is also actively involved in assessing the NFEPA wetland mapping and classifications. Outputs from these programmes are presented in Chapter 2.

CapeNature is involved in some freshwater, estuarine and marine monitoring programmes and try to align our efforts with national monitoring programmes. Formalised monitoring programmes are being developed at pilot sites.

Weather

Although not strictly speaking a biodiversity or ecosystem function measure, weather plays a role in many biological processes. CapeNature and other research institutions frequently require weather information to assess its affects. Of the various measures of weather, temperature and rainfall are particularly important environmental factors for many natural processes. These are measured over the long-term and are important to provide a direct indication of climate change. Although this is crucial data, the number and distribution of high quality weather stations with modern and efficient data capture and transmission is not ideal. This impinges on the ability of climate researchers to build realistic models of current and future climate. The foreknowledge of climate change is an essential first step in mitigating and adapting to this change before it is too late or too expensive to modify our actions. CapeNature is working with SAEON, the Agricultural Research Centre working on fire and the University of Cape Town to address this shortfall.

Implementation

To keep monitoring programmes up and running and providing a useful management function, requires planning and implementation. The CapeNature Regional Ecological Support Team (REST) facilitates the integration of biodiversity science with conservation management. This team ensures that: 1) biodiversity monitoring programmes are operational (that the observations are being done and in accordance with the standardised monitoring protocols); 2) that the data from these projects is quality-checked and safely housed and 3) that this information is processed and fed back into conservation management action. This is achieved by creating a schedule (ecological matrix) of all monitoring activities that need to be carried out for each reserve (or conservation services area). Feedback to the management staff is facilitated by the local presence of ecological coordinators and a set of regular meetings of the REST to respond to the problems and challenges that inevitably arise. It is crucial that this kind of solution be in place to allow CapeNature to prioritise and plan its work based on up to date and reliable information.

This report continues CapeNature's Western Cape Province State of Biodiversity Report series that began in 2002 and is repeated every five years.

The report aims to provide summary statistics and lists for the WCP on:

- the number of different species that occur in the province (this is limited to the groups for which we have sufficient data and is by no means comprehensive);
- the number of species endemic to the province;
- the numbers of species in each of the IUCN threat categories;
- the primary threats to biodiversity and ecosystem functioning; and
- the extent of Protected Areas and the degree of protection conferred.

These are covered in separate chapters on birds, mammals, reptiles, amphibians, fish, arthropods, plants, freshwater ecosystems, biodiversity protection and mainstreaming.

The report also aims to discusses current and recommended conservation initiatives and actions to address these threats to biodiversity and ecosystem functioning. The WCP State of Biodiversity Reports should, over time, allow a certain degree of assessment of whether we are responding to this challenge effectively.

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CHAPTER 1

PROTECTED AREAS AND BIODIVERSITY MAINSTREAMING

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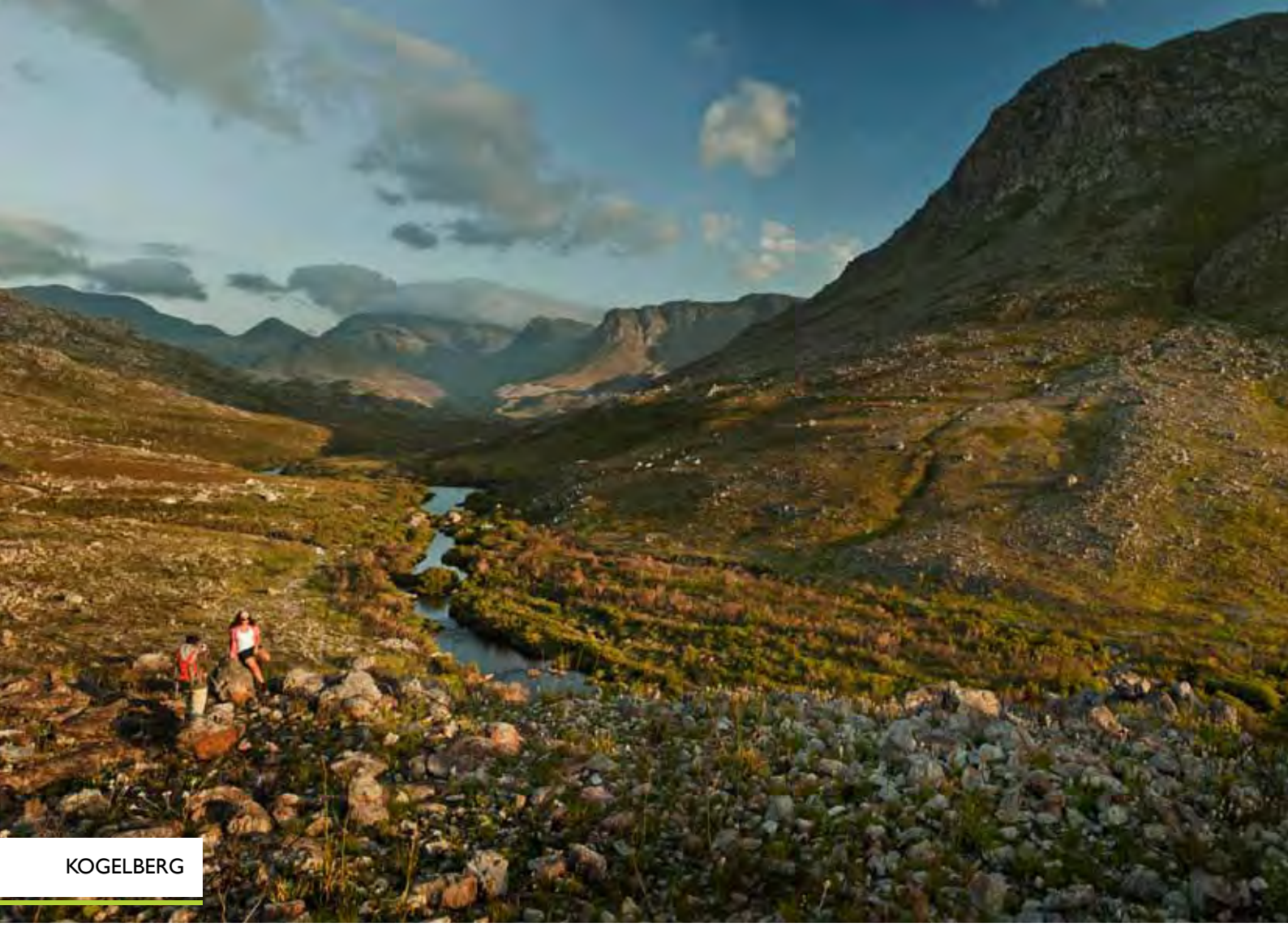
CONTENTS



KOGELBERG

Executive Summary

As habitat loss remains the biggest threat to the biodiversity of the Western Cape, our most challenging goal is to ensure that development and conservation happens in the appropriate places in the landscape.

Critical Biodiversity Areas (CBA) Maps identify areas that should be conserved and areas where development can take place without compromising biodiversity. These CBA Maps are 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 CBA Maps 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 these various mechanisms to providing a level of safeguarding to the province's CBAs. The main mechanisms which are looked at include formal Protected Area proclamation, the establishment of stewardship agreements or conservancies and input into environmental assessment, spatial planning and business and biodiversity initiatives.

Considering the seemingly short period of time since the completion of the CBA Maps, the quantification or qualification of our mainstreaming successes or failures at this stage could be considered immature. In such instances, it becomes vital for this chapter to form a baseline study which, for comparative reasons, can be replicated by the time of the next State of the Biodiversity Report, 2017 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 a Protected Area. In the Western Cape, this traditional form of biodiversity conservation is supported by the National Environmental Management: Protected Areas Act (NEMPAA) (Act No. 57 of 2003), Marine Living Resources Act (Act No. 18 of 1998) and the Western Cape Nature Conservation Board Act (Act No. 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 and Margules, 2000). Internationally, their importance has been recognised by the Convention on Biological Diversity and by the creation of intergovernmental funding agencies such as the Global Environmental Facility (Lovejoy, 2006). Nationally and provincially their importance has recently been

supported through the establishment of a National Protected Area Expansion Strategy (NPAES) (SANBI & DEAT, 2008) and the CapeNature Protected Areas and Expansion Strategy 2010 (Purnell *et al.* 2010).

The establishment of Protected Areas alone are, however, not adequate for biodiversity conservation (Cowling *et al.* 2003) 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.

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, 2004).

The mainstreaming of biodiversity consideration came about as a response to Article 6 (b) and 10 (a) of the Convention on Biological Diversity (CBD) which reads 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 reduced risk, 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 some degree of safeguarding.

Biodiversity mainstreaming was not reported on in the previous State of Biodiversity Report. Although it was taking place in an ad hoc manner, there was no formal programme prior to 2007, which is why the equivalent chapter in the previous report only highlighted the contribution of formal Protected Areas to biodiversity conservation.

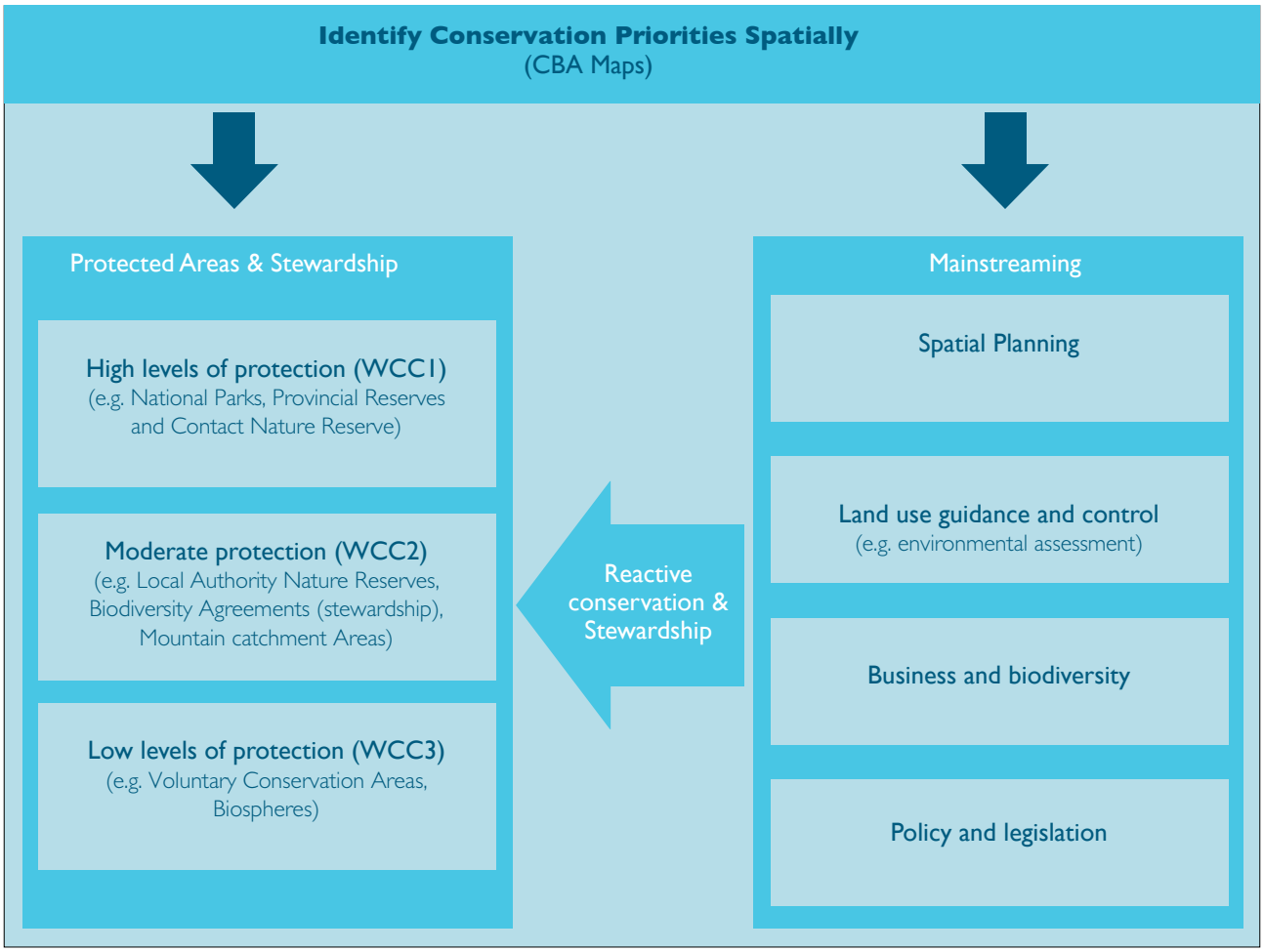


Figure 1: Strategies to reduce habitat loss and aid biodiversity conservation.

Since 2007, 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 three main biodiversity mainstreaming avenues, namely a) environmental assessment and land-use decision-making, b) spatial land-use planning and c) agricultural business and biodiversity initiatives.

We have aimed to quantify our impacts on biodiversity conservation achieved through both formal Protected Area expansion as well as these three mainstreaming avenues. Where data exists for 2007, we have also tried to compare the statistics. Furthermore, where there is currently insufficient data for the province, we have tried to produce the data for a pilot area only with the ultimate aim to roll out the assessment by the next State of Biodiversity Report.

2. Identifying biodiversity worthy of conservation

Biodiversity is the diversity of all living things. It includes both the patterns associated with nature, as well as those processes required in order to ensure the sustained persistence of those patterns. Biodiversity is not considered equal throughout the landscape and identifying those areas best suited for conservation is a vital step in achieving your conservation goals. Furthermore, as biodiversity conservation exists in a competitive world where economic development in the form of agriculture, mining, settlement, etc. is often weighted higher and seen as divorced from biodiversity conservation, it becomes even more important to prioritise where in the landscape we work.

Since 2007, CapeNature together with our partners have developed a full set of spatial products for our province highlighting our priorities within the province. For the vast majority of the province, these priority areas have been determined through a science known as systematic biodiversity (or conservation) planning where the principle aim is to identify areas for conservation action (Cowling *et al.* 1999). These areas have been referred to as Critical Biodiversity Areas (CBAs) and their safeguarding is critical in order to meet our national biodiversity targets. (See figure 2 for map of CBAs.)

Biodiversity conservation underpins sustainable development. For this reason, we have identified areas which are critical for conservation (CBAs) and the maintenance of some ecosystem services, as well as areas which are best suited for development (Other Natural Areas).

3. Establishment of formal Protected Areas

The existence and continued establishment of formal Protected Areas remains the cornerstone of the province's conservation efforts. 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 expansion of our network remains vital. In response to the National Protected Area Expansion Strategy (NPAES) (SANBI & DEAT, 2008) which calls on provinces to develop implementation plans in support of the NPAES and in support of provincial conservation efforts and priorities, CapeNature produced its own strategy in 2010. This strategy, known as the Protected Area Expansion Strategy and Implementation Plan, identifies areas of importance to be targeted for Protected Area expansion and also concentrates on a broad suite of possible mechanisms to be adopted in order to achieve our goals. The spatial product guiding CapeNature's strategy is also

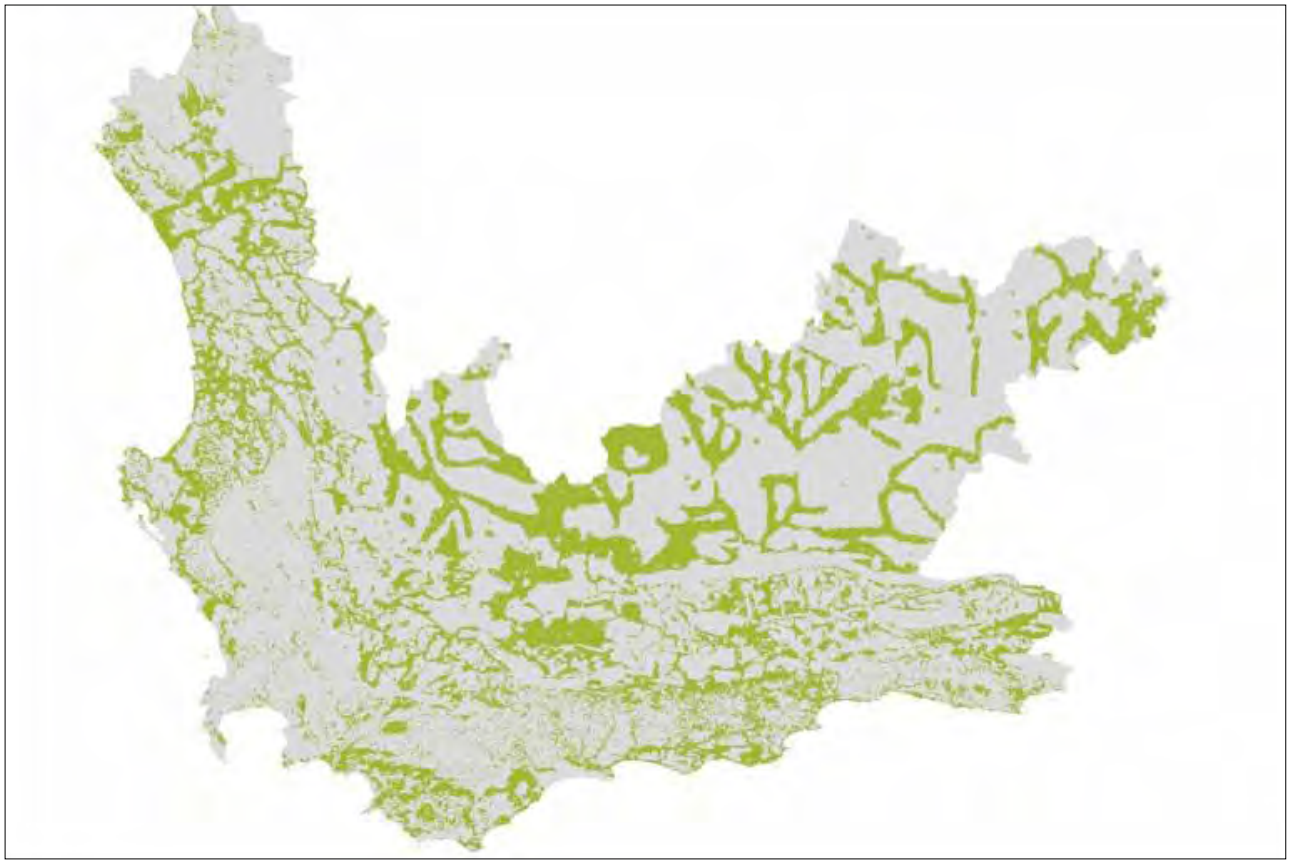


Figure 2: Map of Critical Biodiversity Areas of the Western Cape Province.

based on the CBA Maps thereby ensuring that all provincial conservation efforts are concentrated in the same areas.

3.1 Classification of Protected Areas

The classification system defined in the 2007 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 sub-categories. This 2012 report once again makes use of this system with the only additional sub-categories being those of the Biodiversity Stewardship Programme[1], namely: Contract Nature Reserves, Protected Environments, Biodiversity Agreements and Voluntary Conservation Areas. Furthermore, the Protected Area sub-category of "South African Natural Heritage Site" no longer exists and has therefore been removed from this classification system. The resultant WCCCs are thus as follows:

Table 1: Western Cape conservation 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 with *some* legislative security	Protected Areas with *little or no* legislative security
• National Parks • World Heritage Sites • Wilderness Areas • Provincial Nature Reserves • State Forest Nature Reserves • Marine Protected Areas • Island Nature Reserves • Contract Nature Reserves • Protected Environments	• Local Authority Nature Reserves • Mountain Catchments Areas • Private Nature Reserves • Biodiversity Agreements	• Voluntary Conservation Areas • Biosphere Reserves • Conservancies

[1]See section 4 below for more details on the Biodiversity Stewardship Programme

3.2 Status of the Protected Areas

Western Cape Conservation Category 1: In 2007, 1 105 817 ha of the WCP was classified as WCCC1. Since then, an additional 97 315 ha have been added to the WCCC1 amounting to a total of 1 203 132 ha (8.71% of the province). The National Protected Areas Expansion Strategy of 2008 sets a target of 13% of the province by 2028. This 13% is, however, to be comprised of all formally recognised Protected Areas which includes Mountain Catchment Areas (which we have classified as WCCC2).

The increase in the WCCC1 estate is mostly attributed to the additional 35 221 ha secured by CapeNature as Contract Nature Reserves through the Stewardship Programme as well as the expansion of the Knersvlakte Provincial Nature Reserve by 45 513 ha. An additional 12 793 ha were also secured through SANParks' expansion plans which resulted in the growth of the Garden Route, Tankwa, Agulhas, West Coast, Table Mountain and Bontebok National Parks. It is important to keep in mind that a Protected Area may fit into more than one sub-category which is why amendments to sub-category totals will not always correspond to amendments to the overall WCCC.

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

In addition to the expansion of the WCCC1 estate, it is also important to bring about better 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 has included 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. This exercise, which is in compliance with the National Environment: Protected Areas Act No. 57 of 2003, resulted in the drafting and submission for approval of management plans for nine of its reserve clusters; namely Kogelberg, Dassen Island, Dyer Island, Kammanassie, Cederberg, Keurbooms River, Robberg, Limietberg and Vrolijkheid. CapeNature hopes to draft the remaining 23 management plans by March 2015 to ensure that each of its reserves has an approved management plan and is thus afforded the same level of protection.

Furthermore, CapeNature has also submitted a serial nomination to UNESCO for consideration for an additional 441 119 ha of World Heritage Sites in the Western Cape and 293 606 ha in the Eastern Cape. Neither of these two mechanisms (drafting of PA management plans or declaration of World Heritage Sites) will expand the WCCC1 estate as they are already formally 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.

At the time of Critical Biodiversity Areas Maps production, all existing Protected Areas falling within WCCC1 were considered safe. The identification of Critical Biodiversity Areas within these Protected Areas did therefore not take place and only Protected Areas declared post-2007 could contribute towards CBA safeguarding. The result is that the WCCC1 has a very low contribution of only 28 283 ha (i.e. 2.35% of WCCC1) towards the safeguarding of the province's CBAs.

The expansion of these areas in the future should however be heavily directly by the location of the CBAs and in time, their contribution towards CBA safeguarding is expected to increase drastically. This is especially true for the sub-categories of Contract Nature Reserves and Protected Environments.

Western Cape Conservation Category 2: The contribution of WCCC2 to the province's Protected Area estate appears to have decreased from 751 916 ha to 744 181 ha.

There have been no changes to the Local Authority Nature Reserves, Mountain Catchment Areas or Private Nature Reserve sub-categories since 2007. The South African Natural Heritage Sites sub-category however no longer exists and has resulted in a total loss of 31 551 ha in the WCCC2 category.

Once again, CapeNature's Biodiversity Stewardship Programme is accountable for the addition of 13 992 ha in the Biodiversity Agreement sub-category.

In order to afford the WCCC2 areas better protection it is suggested that CapeNature undertake an audit of all Private Nature Reserves falling into priority expansion areas to determine proclamation status and whether their status should be converted to a Contract Nature Reserve (WCCC1). It is also suggested that CapeNature evaluate and consider the declaration of additional Mountain Catchment Areas and investigate the promulgation of regulations and assignment of management authorities for all Mountain Catchment Areas in order to afford these areas a higher level of safeguarding.

With regards to the marine environment, an alternative to the establishment of MPAs (WCCC1) 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 and Johnson, 2012). Once endorsed by the Convention for Biological Diversity, these areas will most likely be categorised as WCCC2.

WCCC2 offers 242 041 ha (i.e. 32.67% of WCCC2) of CBAs a medium level of protection. This far higher contribution towards CBA safeguarding when compared to that of WCCC1 is attributed to the fact that for most of the province, WCCC2 areas were not considered 'safe' (i.e. were not considered to have strong legislative security) when assigning CBAs to the landscape. In actual fact, where possible, the software was programmed to favour the selection of CBAs within these areas as a means to minimise conflict throughout the remaining landscape.

Western Cape Conservation Category 3: Approximately 1 623 479 ha of land within the province has been classified as WCCC3. This represents a slight increase from the 2007 amount of 1 598 200 ha which can be attributed to the increase in all three of the sub-categories.

The Biosphere Reserve estate has increased from 498 330 ha in 2007 to 820 349 ha in 2012. This is due to the establishment of the new Cape Winelands Biosphere Reserve of 322 019 ha which was designated in 2007. Although much of this area 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. A nomination for an additional 264 ha for the establishment of the Gouritz Biosphere Reserve also awaits approval from UNESCO.

Approximately 29.07% (472 008 ha) of WCCC3 is comprised of CBAs. For most of the province, the location of existing WCCC3 areas had no bearing on the CBA configuration. Although offering a very low level of protection to the CBAs, this WCCC3, nonetheless, has the highest contribution to hectares of CBAs being afforded some level of safeguarding.

The 2002 statistics were extracted directly from the 2007 State of the Biodiversity Report. The 2007 statistics have, however, been recalculated in order to allow for appropriate comparisons between 2007 and 2012. This recalculation included the addition of the hectares secured through the stewardship programme (in 2007 they were reported on in a separate table) as well as the consideration of overlap areas which were not accounted for in the 2007 report.

Table 2: A comparison between 2002, 2007 and 2012 of Western Cape Conservation Categories and Protected Area types. Green shading represents actual expansion on the ground while slight changes in white blocks are attributed to boundary corrections or GIS analysis only. The dark green block (South African Natural Heritage Sites) no longer exists. The most notable success stories are those of the Provincial Nature Reserves, SA National Parks, Contract Nature Reserves, Biodiversity Agreements and Biosphere Reserves. Categories indicated by an *are stewardship categories. The amounts reflected in the 'Total' rows are not simply the sums of the individual sub-categories as many of the sub-categories will overlap with each other and should therefore not be double counted.

Category	Sub-category	2002 ha	2007 ha	2012 ha	CBA ha	% of category therefore CBA
Western Cape Conservation Category 1	Wilderness Area	131 540	130 570	130 470	65	0.05%
	SA National Park	156 923	290 631	303 424	9 590	3.16%
	Provincial Nature Reserve	152 794	189 474	234 987	5 616	2.39%
	State Forest Nature Reserve	408 597	408 906	409 033	664	0.16%
	Marine Protected Area	41 784	68 338	72 092	NA	NA
	Island Reserve	296	296	302	NA	NA
	World Heritage Sites	unknown	392 710	392 694	33.12	0.01%
	Contract Nature Reserves*	NA	17 602	52 824	12 348	23.38%
TOTAL WCCC1		891 935	1 105 817	1 203 132	28 283	2.35%
Western Cape Conservation Category 2	Local Authority Nature Reserve	25 580	26 654	32 533	2 162	6.65%
	Mountain Catchment Area	558 962	589 493	575 873	155 626	27.02%
	Private Nature Reserve	122 824	139 465	145 789	80 982	55.55%
	South African Natural Heritage Sites	31 954	31 551	0	NA	NA
	Biodiversity Agreement *	NA	960	14 959	7 083 ha	47.35%
TOTAL WCCC2		739 320	751 916	744 181	242 041	32.67%
Western Cape Conservation Category 3	Biosphere Reserves	320 186	498 330	820 349	193 787	23.62%
	Conservancies	1 186 216	641 086.34	897 181	300 084	33.45%
	Voluntary Conservation Area *	NA	19 097.04	22 348	11 185	50.05%
TOTAL WCCC3		1 506 402	1 598 200	1 623 479	472 008	29.07%

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. CapeNature undertakes to support this management by providing advice, management plans and assistance in planning invasive alien species clearing and fire management schedules. 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 eco-tourism or green labelling of agricultural produce (e.g. Business and Biodiversity Initiatives[2]).

These agreements may take the form of one of four sub-categories each with a different level of obligation and protection offered:

1. Contract Nature Reserves are Protected Areas with legally recognised contracts aimed at protecting biodiversity in the long term.
2. Protected Environments are the most flexible of the formally recognised Protected Areas with legally recognised contracts.
3. Biodiversity Agreements are negotiated contracts between CapeNature and a landowner for conserving biodiversity in the medium term.
4. Conservation Areas are informal, flexible options for landowners and communities who want to conserve biodiversity on their land.

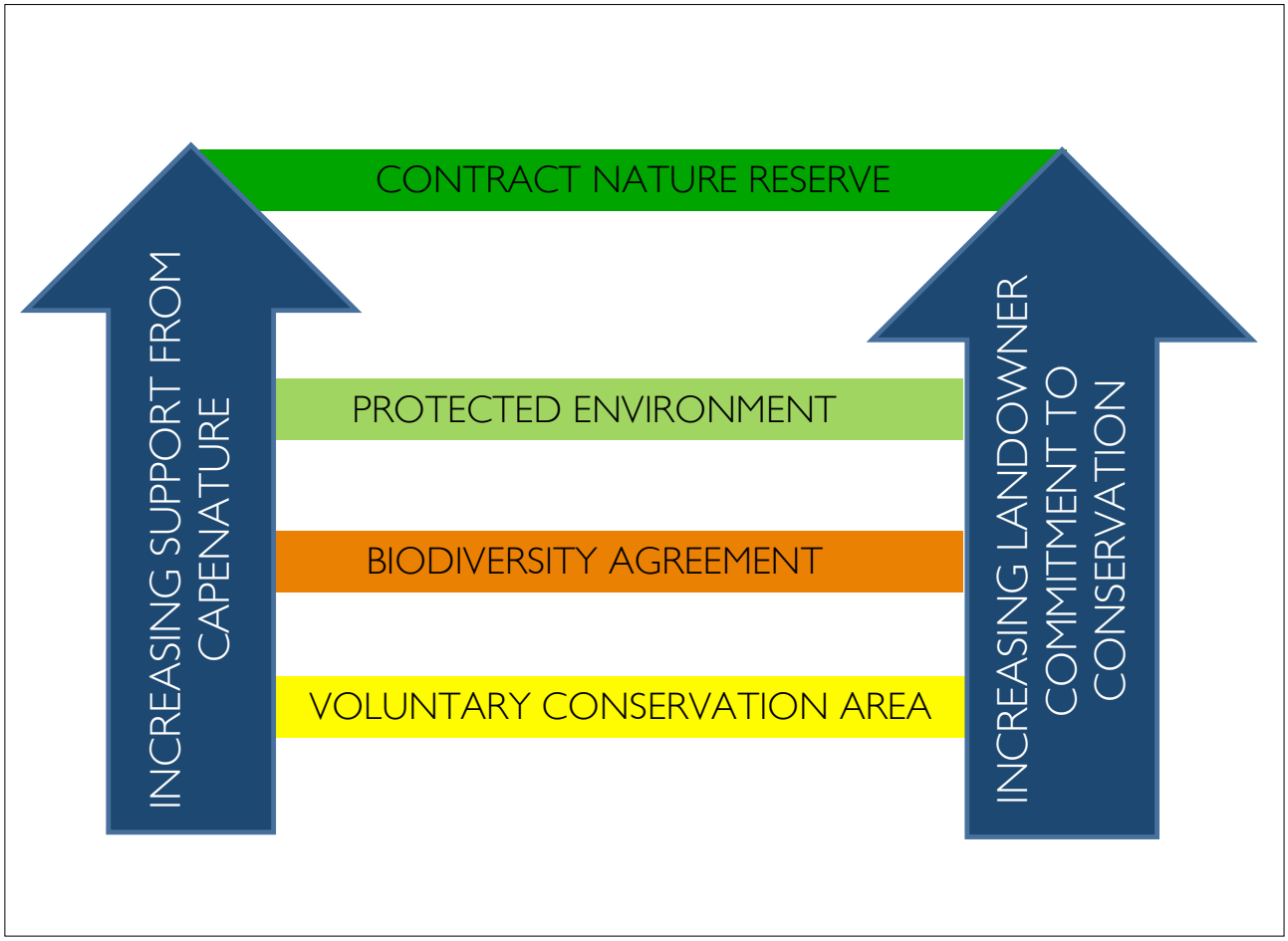


Figure 3: Biodiversity Stewardship Programme sub-categories.

Due to limited resources available to the stewardship programme, only the top priorities can be targeted for Stewardship. These priorities are identified in CapeNature's Protected Areas Expansion and Implementation Strategy of 2010 which highlights a subset of the province's CBAs. According to this strategy, the aim for 2015 is to secure an additional 79 100 ha in the province through stewardship agreements between land owners and either CapeNature or other conservation agencies.

[2]See section 8 for more information on the Business and Biodiversity Initiatives

Table 3: Number and sizes of properties in each of the Biodiversity Stewardship Programme sub-categories

	Number 2007	Number 2012	Hectares 2007	Hectares 2012	ha CBAs 2012	% of which is CBA
Contract Nature Reserve	14	46	17 602	52 824	12 348	23.38%
Biodiversity Agreement	5	30	960	14 959	7 083	47.35%
Voluntary Conservation Area	29	29	19 097.04	22 348	11 185	50.05%
Total	48	105	625 685	90 130	30 616	34%

Currently, the Contract Nature Reserves are conserving 12 348 ha (0.32%) of the province's CBAs. Although this stewardship option represents the highest degree of legal safeguarding available to privately-owned land, the fact that only 23.38% of the land within these Contract Nature Reserves is a CBA is of concern. This is due to a large portion of these Contract Nature Reserves declared or negotiated before the identification of the CBAs and it highlights the benefit of CBA maps in helping direct our efforts where we need them most. Approximately 47.35% of the Biodiversity Agreements are comprised of CBAs which implies a better positioning of this stewardship category. Unfortunately, a lower level of protection is however assigned to these CBAs. Voluntary Conservation Areas (excluding conservancies) offer a low level of protection to 11 185 ha of CBAs. Approximately 50% of these areas are however CBAs.

The amount of energy invested by CapeNature into these stewardship agreements should correspond directly with the contribution to the long term protection of CBAs. The low proportion CBAs in all sub-categories of Stewardship is disappointing, but not surprising given that CBAs were not available in the early days of the programme. The use of the CBA Maps as a key informant should result in a dramatic rise in these figures for the next reporting period.

5. Environmental Assessment

The Western Cape Provincial and National legislative framework introduces 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. These include requirements under the Environmental Authorisations in terms of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) regulations, permissions under the Land Use Planning Ordinance (for example to subdivide or rezone land applications to cultivate new land and mining permits. The NEMA EIA regulations, which link to the National Environmental Management Biodiversity Act (NEMBA) list of threatened ecosystems, provide the greatest amount of oversight for habitat loss.

CapeNature provides comment and guidance regarding biodiversity related issues for applications to change land use. 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 direct or indirect impacts on verified CBAs. Where such impacts are deemed unavoidable, these impacts should be minimised and/or mitigated.

Since 2009[3] we have provided input into more than 1700 applications to change land use throughout the province (an average of approximately 550 per year). Sixty four percent of these were Environmental Authorisation processes, 12% were mining, 4% rectification processes (unauthorised activities) and 19% were applications in terms of the Land Use Planning Ordinance (LUPO) (e.g. subdivisions and rezoning). Only 2% (33 applications) were for cultivation. A total of 761 174[4] ha was assessed for some type of land use change.

Most cultivation applications were located in the West Coast and Cape Winelands District Municipalities, with the Matzikama Local Municipality most affected. Similarly most of the applications for mining and prospecting were located in the West Coast District Municipality and once again, most of these applications were located in the Matzikama Local Municipality thereby necessitating the need for proactive engagement with the municipal and provincial officials involved in planning and decision-making in this municipality.

The number of renewable energy facilities (i.e. solar and wind farms) proposed has increased dramatically over the past few years and if not carefully located and planned for could represent a new threat to biodiversity. CapeNature has commented on close to 100 proposed wind farms and solar plants in the last few years. Most of these facilities have been proposed in the West Coast District Municipality (Saldanha Bay being most affected), followed by the Overberg and Central Karoo District Municipalities.

Most of the applications for housing and mixed use were located in the Eden District Municipality, with the remainder being fairly evenly spread through the remaining District Municipalities (excluding the Central Karoo). Not surprising most of the industrial development was proposed in the City of Cape Town (followed by the Overberg).

A broad analysis of the type of habitat where development is proposed reveals that 8% of the applications CapeNature reviewed contained primarily pristine habitat. Thirty one percent were in habitat that was completely transformed and therefore unlikely to have significant impacts on biodiversity pattern (although ecological processes may still be of concern). Fifty three percent were located in Critical Biodiversity Areas or contained some CBAs (i.e. mixed with Other Natural or No Natural Remaining Areas).

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 these applications where CapeNature's input is critical.

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

[3]The new land use data base came into effect in 2009. Before this time, our comments were captured in such a manner which does not allow for easy interrogation or manipulation.

[4]This figure is not necessarily the development footprint, but is the area that was considered and broadly assessed in the application. For example, the area assessed in prospecting and wind farm applications is usually quite large, but the actual footprint is usually small.

the degree to which we are satisfied with the outcome of the process (i.e. environmental authorisation). Of the 106 applications which could potentially impact on CBAs that were concluded in the 2009-2012 period, CapeNature was satisfied with the outcome of 64%. We were only partly satisfied with the outcome of 32%. 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) may be critical to reduce significance of the impacts of the development on biodiversity. 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.

6. 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 (National Environmental Management Act, Act No. 107 of 1998). 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[5] 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'[6] . Through this mechanism, land that was not previously actively managed or formally secured for conservation can be conserved.

Unfortunately, development itself is almost never positive for the environment, 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 land set aside 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.

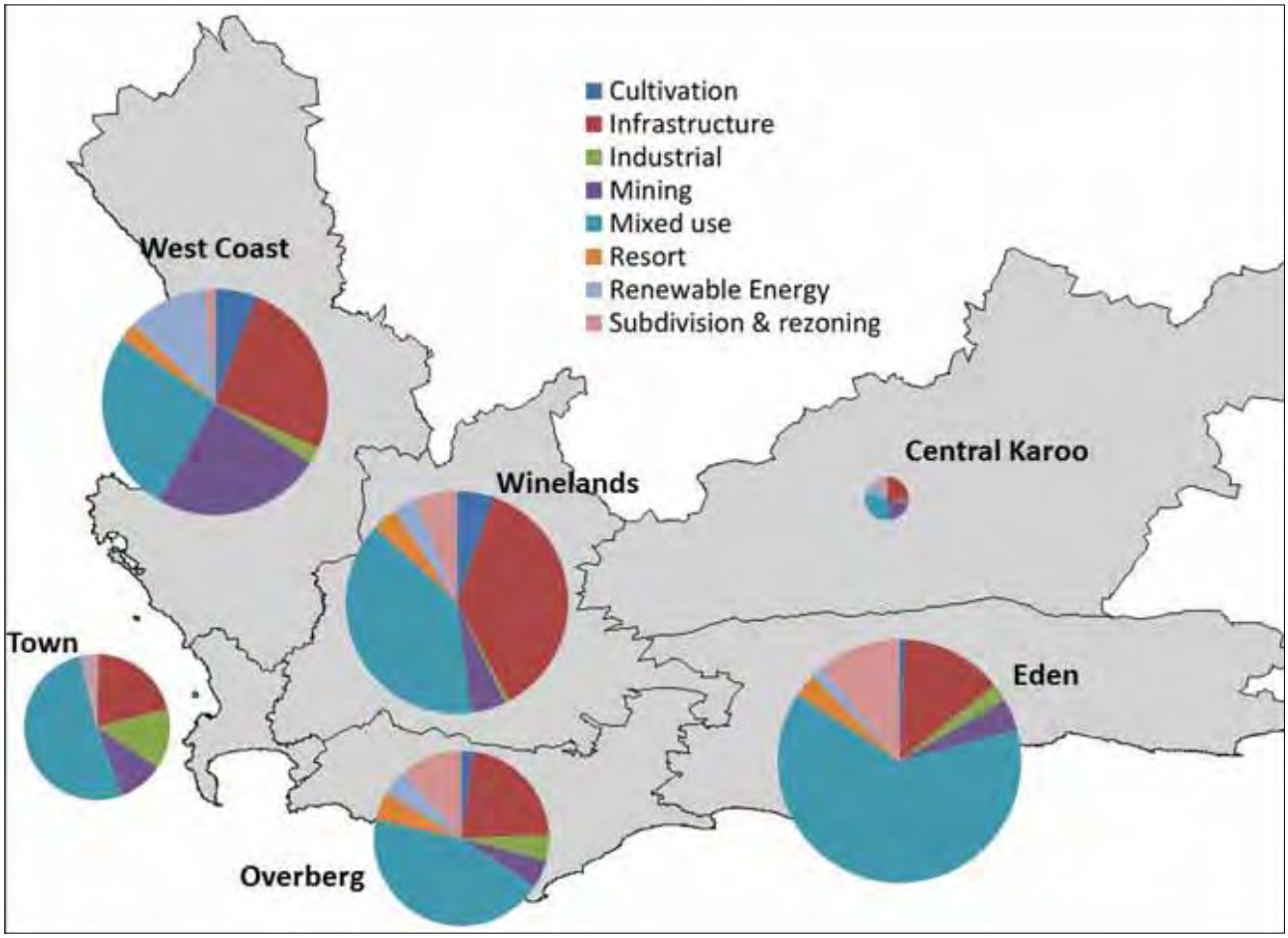


Figure 4: Type of development applications for the five District Municipalities and the City of Cape Town

[5] 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 and Vromans, 2010).

[6] 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.

Conditions of authorisation that simply require an area to be set aside and managed for conservation only really offer short term security. If required, for example as mitigation or to offset residual negative impacts, habitat can be secured through title deed restrictions and stewardship agreements.

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, although biodiversity offset can be in the form of monetary compensation, where the funds are to be used for the acquisition and management of priority habitat thereby contributing to the expansion of the Protected Area network (Department of Environmental Affairs and Development Planning, 2011.) While biodiversity offsets are voluntary in the sense that the applicant needs to agree to it, an 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, 2011).

The normal approach to conservation stewardship is proactive, where the highest priority sites for conservation are identified and the landowners are approached to negotiate a stewardship contract. In order to harness and formalise opportunities for conservation that arise through development applications discussed above, Reactive Stewardship has arisen as a complementary approach to proactive stewardship.

The benefit of Protected Area expansion through development applications (i.e. reactive stewardship) is that it allows for an increase in the Protected Area network with a far smaller resource investment by CapeNature than proactive stewardship. These efficiencies are as a result of: 1) a shorter and simpler stewardship negotiation process; 2) the applicant boring the costs of the biodiversity assessments, drafting of contracts and management plans, land management and auditing; and 3) the affording of formal protection to those priority biodiversity areas which face the highest threat levels.

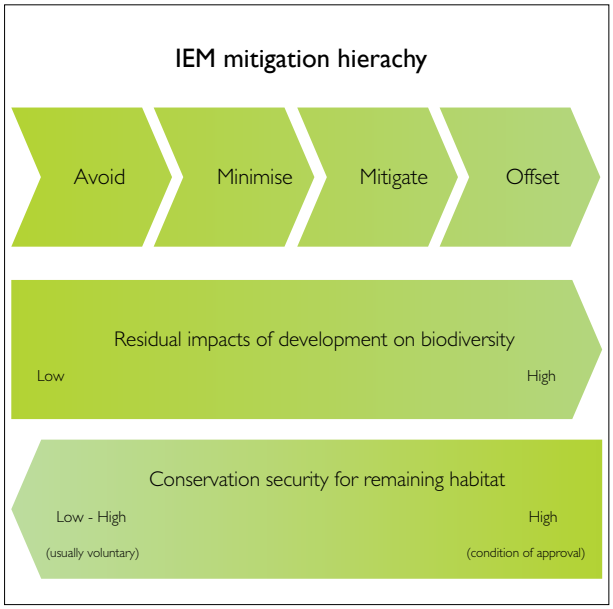


Figure 5: Mitigation hierachy and Reactive Stewardship

An example of reactive conservation in Action

Shaw's Pass is a Critical Biodiversity Area that has long been recognised as an important area for biodiversity conservation. It is a core area of floral diversity with an exceptionally high number of endemic plant species (there are more than 35 plant species of conservation concern in the area).

An Environmental Impact Assessment (EIA) process was conducted for the upgrade of the Hemel-en-Aarde Road, which included the realignment of the road in the area of Shaw's Pass. This realignment was required as the existing layout was unsafe. However, the assessment revealed that the realignment would impact on at least 1 ha of unique and irreplaceable habitat, including populations of critically rare plants. CapeNature objected to these impacts as they would be irreversible and of a very high negative significance.

After lengthy negotiations with the Department of Transport and Public Works, a biodiversity offset was agreed to which would see at least 30 ha of the remaining habitat secured and managed for conservation. Invasive alien plants pose the most significant threat to this habitat and importantly the offset included an amount of R7.5 million which will be administered by CapeNature and used for the management of the offset area and surrounding habitat into perpetuity. While the actual area of habitat to be conserved is relatively small, it is hoped to be a catalyst for further conservation initiatives in the area. Furthermore, this example also represents a precedent whereby the financial burden of land management, which is usually assigned to CapeNature and therefore limits the potential of reactive stewardship, is now transferred to the developers.

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 availed to CapeNature, could result in a diversion of resources away from more critical priorities.

Care must be taken to ensure that development rights are not bought; that is, 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. Further, the use of Biodiversity Offsets is in infancy and implementation is often complicated and time-consuming. Financial offsets, often the most attractive offset model for developers, could prove to be an effective means to expand the Protected Areas network. As previously suggested by CapeNature's Protected Areas Expansion and Implementation Strategy, 2010, the investigation into the establishment of an offset fund and the implications of this, needs to be prioritised. At this stage, we only have a very rough sense of the actual conservation gains made through environmental impact assessment processes. This is partly as it is 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 what it should be.

Reactive stewardship sites represent the most secure end of the scale of conservation gains linked to development. At this stage very few reactive stewardship agreements have been concluded although several are in process and/or required as a condition of approval.

Table 4: Spatial Planning initiatives which the CapeNature land-advice unit has provided input into since 2007.

DISTRICT	PLANNING INITIATIVE
City of Cape Town	• City of Cape Town SDF • City of Cape Town Bioregional Plan
Cape Winelands District Municipality	• Cape Winelands SDF • Cape Winelands (eastern section) status quo report • Cape Winelands Strategic Environmental Assessment Strategy Report • Cape Winelands Biosphere Reserve SDF • Witzenberg SDF • Breede Valley SDF • Langeberg SDF • Breede River Winelands Integrated Zoning Scheme • Breede River Winelands Urban Edges • Drakenstein EMF • Drakenstein Municipality proposed ecological corridors • Drakenstein Municipality draft Ecosystem by-law • Stellenbosch Municipality draft Structure Plan
West Coast District Municipality	• West Coast District Area Based Plan • West Coast Strategic Development plan • Saldanha Bay SDF • Greater Saldanha Bay Environmental Management Framework • Bergrivier SDF • Matzikama SDF • Swartland SDF
Overberg District Municipality	• Cape Agulhas SDF • Theewaterskloof SDF • Swellendam SDF • Overstrand Sectoral Plan • Kogelberg Biosphere SDF
Central Karoo District Municipality	• Laingsburg SDF • Central Karoo Environmental Management Plan
Eden District Municipality	• Hessequa SDF • Mossel Bay SDF • Bitou SDF • Keurbooms and Environs Local Area Spatial Plan • Garden Route Environmental Management Framework
Provincial:	• Strategic Assessment for location of Wind Energy facilities in the Western Cape
National:	• Agricultural Zoning Project

This low number is partly due to the new nature of this model and the length of time it takes to conclude the environmental authorisation process and subsequent agreements, but is also indicative of CapeNature's lack of capacity to harness all stewardship opportunities presented to us.

Our estimates are that thousands of ha of CBAs should have increased conservation security and/or improved management as a result of environmental impact assessment processes. These are often relatively small areas (on average less than 300 ha), which usually face a high degree of threat and would otherwise be difficult and expensive to manage.

7. Spatial Planning

Spatial planning can in many ways afford a level of protection to important biodiversity, albeit a low level of protection. The most prevalent of such tools is the municipal Spatial Development Framework (SDF) which according to the Municipal Systems Act (Act No. 32 of 2000) should spatially delineate those areas within both local and district municipalities where certain development types should be encouraged or discouraged. Other main spatial tools accommodated for by the NEMA includes Environmental Management Frameworks (EMF) and Bioregional Plans.

Since 2007, the CapeNature land advice unit, together with our partners, has been commenting on the municipal SDFs, EMFs, (featured in table 4) and other planning initiatives to ensure that the CBAs are adequately considered and represented.

Case studies of municipal SDFs and CBA alignment

Cape Agulhas SDF: Much of remaining inland habitat in the Cape Agulhas Municipality is threatened, while most of the coast has been identified as a CBA due to its importance as a coastal corridor. Due to the perceived conservative nature of the CBA Map in this specific area, the municipality was hesitant to assign the appropriate Spatial Planning Category to CBAs as the resultant map would leave little area available to development. This is an example of where, together with our partners, extra resources need to be invested in understanding, verifying and communicating the importance of ecological process areas. Similarly, resources need to be invested in surveying remnants of threatened habitats in and around towns to confirm their conservation value. Once the CBA Map of this municipal area has been better ground-truthed, we expect that the municipality would be more willing to accommodate the CBAs appropriately.

Theewaterskloof SDF: In Theewaterskloof Municipality much of the remaining natural land has been assigned threatened status due to the expected occurrence of threatened and rare plant species associated with these underlying vegetation types. The result is that large tracts of land have been assigned CBA status in the CBA Maps. Once again the municipality was hesitant to assign the appropriate Spatial Planning Category to CBAs due to the perceived conservative nature of the CBA maps. While resources were not available to conduct detailed botanical assessments of all areas of potential conflict a novel approach was adopted whereby experts from CapeNature and a botanist familiar with the area were brought in to highlight areas of known sensitivity and those that were unlikely to be of conservation concern.

Information from CREW (Custodians of Rare and Endangered Wildflowers) was a valuable resource here and extra resources need to be invested into verifying the underlying threat status of ecosystems by undertaking rare and threatened plant species surveys in those areas where development conflicts are bound to arise. Once the CBA Map of this municipal area has been better ground-truthed, we suspect that the municipality would be more willing to accommodate the CBAs appropriately.

As of April 2012, not all of the above had 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 feel that all of these spatial planning products, represent an improvement of its predecessor (albeit a small improvement in some cases) in terms of conserving priority biodiversity areas and should therefore be qualified and quantified as a very low level of conservation success.

In a recent assessment undertaken by DEA&DP, it was highlighted that the following municipal SDFs do not include the CBA information. Intensive engagement with these municipalities is therefore required over the next few years to ensure that the CBAs are properly considered and aligned: Cederberg (2008), Bergrivier (2008), West Coast District Management Areas (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 CBAs being finalised and mainstreamed.

Recognition for this achievement must be shared with SANBI and DEA&DP Spatial Planning Directorate who over the years have provided a dedicated function of biodiversity mainstreaming into the various spatial planning initiatives. Although being carried out in recent years in an ad hoc manner by CapeNature, since August 2011 the organisation has obtained dedicated capacity to comment on forward-planning initiatives and in future we hope to engage more proactively with the municipalities. DEA&DP have also identified the gap municipalities where biodiversity has not been adequately considered and through partnering with these municipalities, we aim to add Oudtshoorn, Kannaland and Beaufort West municipalities to the above table by 2017.

8. Business and Biodiversity Initiatives

As the agricultural industries of the Western Cape Province are the most obvious threat to biodiversity (Raimondo *et al.* 2009) and thus also to our CBAs, it is vital to engage with these industries to incentivise sustainable development and biodiversity conservation.

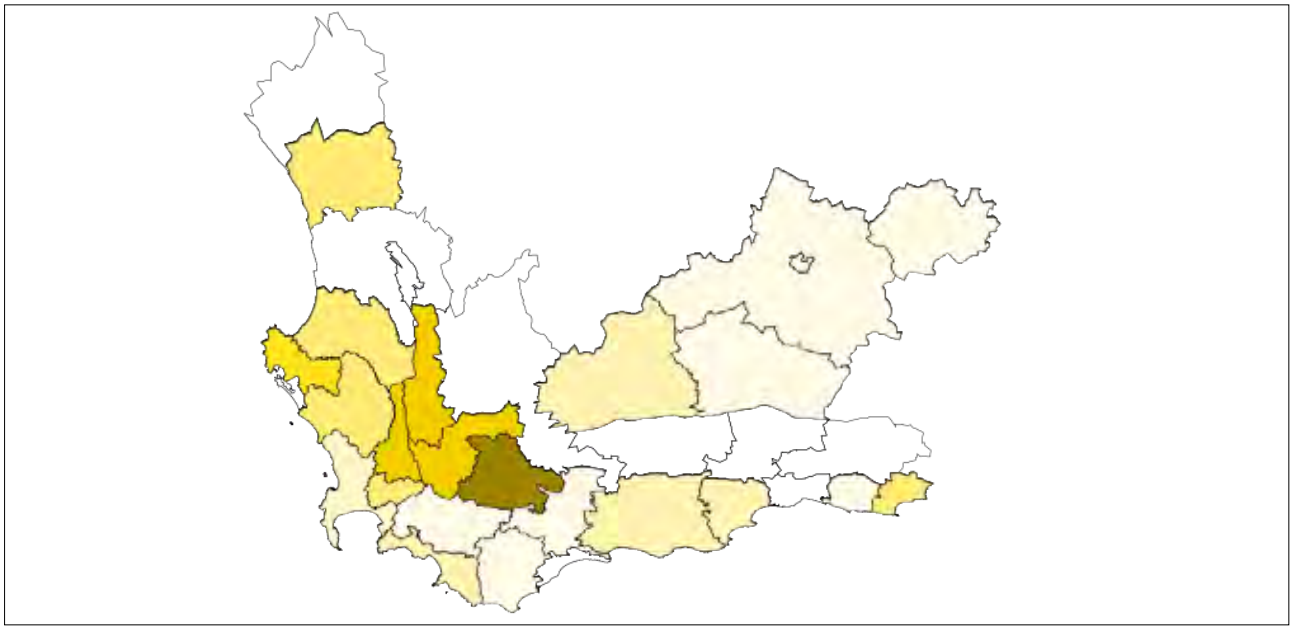


Figure 6: Map of spatial planning initiatives commented on by CapeNature land-advice unit since 2007. A darker colour indicates a higher number of engagements while colourless municipalities are those areas where there have been no formal engagements with regard to formal municipal spatial planning initiatives.

There are four main Business and Biodiversity Initiatives (BBIs) of relevance in the Cape Floristic Region, namely the wild-flower, ostrich, harvesting, potato, rooibos and wine initiatives. These initiatives, which were all founded between 2004 and 2007 aim to build a business case for sustainability and biodiversity conservation in farming and sustainable flower harvesting (Hawkins, 2010). The assumption is that once a farmer has signed up to be a member of a BBI, the land which is managed by him/her will be better managed and the biodiversity represented by that land under less threat. As of December 2010, there were 280 BBI members across the province which amounted to a total of 412 000 ha of land (Pence, 2011). Thirty one per cent of this, i.e. 27 292 ha are CBAs. The ultimate aim of the Green Choice Alliance was to have 80 000 ha of CBAs under better land management attributed to the BBI membership status.

In a recent Green Choice study undertaken by Pence (2011), it is highlighted that membership of a BBI alone is not adequate in conserving biodiversity. This is validated by the level of transformation of CBAs despite being contained within BBI membership farms. The resulting recommendation is that Green Choice and the BBIs should leverage greater conservation commitment from their existing members for priority biodiversity areas. The study has not disproven the above-mentioned assumption that land contained in a BBI membership is better managed and therefore under less threat (as the study did not compare results to a control group which would be required in order to disprove this assumption), but rather that the level of safeguarding afforded to the biodiversity captured through BBI membership is in fact very low.

9. Policy and Legislation

By ensuring that the CBA terminology is reflected in current policy and legislation, and that the stipulated treatment of these CBAs in these policies and legislation is in line with the desired objectives of the CBAs, we are further able to support the safeguarding of the CBA Maps. Together with our partners and through our commenting role, CapeNature Land-advice unit has also contributed to ensuring that the following list of policy documents and legislation (many still in draft format) have accommodated the CBAs correctly:

- DEA's Mining and Biodiversity Guidelines (draft)
- NEMA EIA Regulations, especially Listing Notice 3
- DEA&DP's Basic Assessment Template
- DEA&DP's Rural Development (Eco-housing) Guidelines
- WCPSDF Rural Land-use and Management Guidelines (draft since 2009)
- Guidelines for Publishing of Bioregional Plans
- WC Biodiversity Bill
- WC Biodiversity Policy
- WC Land-use Bill
- Provincial Spatial Plan
- Drakenstein Ecosystems By-law
- Overstrand Coastal Setback Lines
- National SDF Guidelines
- National Spatial Planning and Land Use Management Bill
- DEA Protected Area Expansion Strategy
- CapeNature's Protected Area Expansion and Implementation Strategy

Of special mention is the success we have had in having CBAs reflected in Listing Notice 3 of NEMA, which allows for province-specific descriptions of the sensitive receiving environments.

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As a result of our engagement, Listing Notice 3 stipulates the extraordinary treatment of CBAs recognised 'in bioregional plans' or in 'systematic biodiversity plans adopted by the competent authority'. There are currently no plans to publish the CBA Maps as Bioregional Plans (other than that of the City of Cape Town) which will imply that this clause will not be activated in the near future. CapeNature has however embarked upon having its CBA Maps 'adopted' by DEA&DP and hopes to have achieved that for most of the provinces CBA Maps within the immediate future.

10. Summary of Biodiversity Conservation Mechanisms

CapeNature's biodiversity conservation efforts since 2007 have been grouped into three broad categories. The first group which offers a high level of protection is comprised of WCCC1 Protected Areas only. The second group is believed to offer a medium level of protection and is comprised of WCCC2 Protected Areas as well as those areas which have been set aside as a result of the environmental assessment process. The third category is comprised of WCCC3 areas, the farms of Business and Biodiversity Initiative members and those areas addressed through spatial planning initiatives.

11. Impacts of legal and illegal land transformation

The state of our priority biodiversity is however not only informed by the gains but also by the losses. While every effort is being made to prevent the loss of CBAs, the reality is that while some CBAs are being protected, areas classified as CBA are also being lost. This loss of CBA can happen due to a suite of reasons:

Table 5: Summary statistics of all biodiversity conservation mechanisms including both the expansion of the Protected Area Network and the dominant mainstreaming mechanisms implemented by CapeNature since 2007. The percentage of the province which has been assigned WCCC1 status is based on terrestrial hectares only (i.e. Total of WCCC1 minus that of the Marine Protected Areas).

	Form of Biodiversity Conservation	Hectares	% of province (total 12 953 256 ha)	CBA ha	Contribution to CBAs (total 3 825 056 ha)
High Level of Safeguarding	WCCC1	1 203 132	8.7%	28 313.11	0.74%
Medium Level of Safe-guarding	WCCC2	744 181	5.74%	242 040.78	6.33%
	Reactive Stewardship	Unknown but estimated to be a few thousand	Unknown	Unknown but estimated to be a few thousand	Unknown
Low Level of Safeguarding	WCCC3	1 623 479	12.53%	472 007.89	12.34%
	Spatial Planning	8 992 076	69.48%		
	Business and Biodiversity	412 010	3.18%	127 292	3.41%
	Reactive conservation	761 174	5.87%	371 000	9.70%

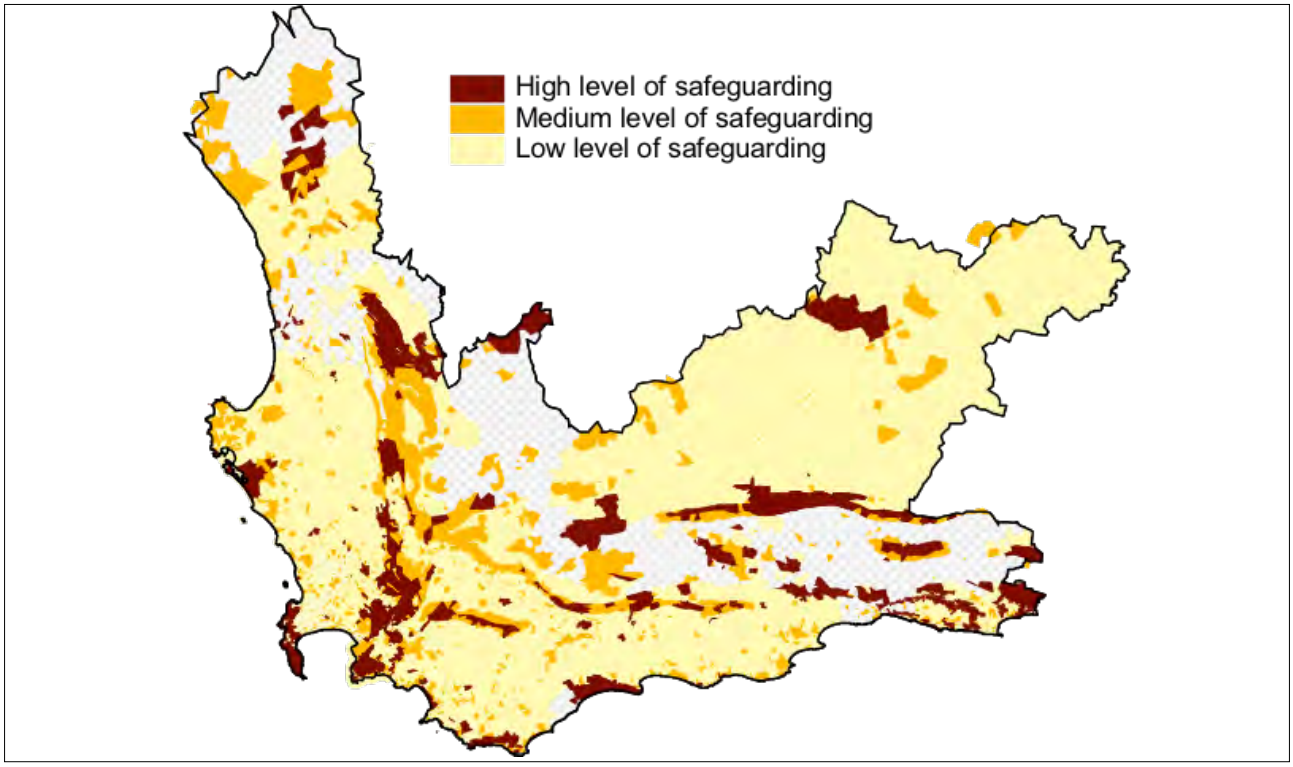

Figure 7: Composite map indicating the levels of safeguarding which have been afforded to the Western Cape Province through both formal protection and biodiversity mainstreaming mechanisms. High levels are comprised of formal WCCC1 areas only. Medium levels are comprised of WCCC2 areas only and Low levels of protection are comprised of WCC3 areas, Business and Biodiversity Initiatives Member Farms and areas covered through formal spatial planning initiatives.

- CBAs were erroneously identified in which case commenting and authorising bodies approved the transformation of CBAs;
- CBAs were not considered in the application;
- CBAs are only one consideration in environmental assessment and biodiversity is often over-shadowed by its economic and social counterparts; and
- Illegal land transformation whereby the developer has not applied for necessary authorisations continue to occur unpenalised.

Currently, the only manner in which this can be quantified is by undertaking land cover analysis which is an incredibly resource-intensive exercise when considering the scale and accuracy required. This option is also the only way in which the illegal transformations can be mapped and measured.

For this report, the losses have not been quantified. It is however hoped that by 2017, we will be able to provide some quantitative indication on the amount of CBAs lost.

In 2011, SANBI undertook a study for the Sandveld area to map all land transformed between the years 2006 and 2010. The total transformation amounted to 9 470 ha. Approximately 30% of this (2 807 ha) was CBAs. Although this represents a terrible loss for biodiversity, it occurred before the CBA Maps for the area were being mainstreamed and therefore should not be viewed as a failure of our mainstreaming function.

Of this 9 470 ha of land which was transformed, only 21% (1 970 ha) was transformed post implementation of the CBA Maps between the years of 2007 and 2010. It is not yet understood what the main driving force behind this reduction is but it is likely to include the active mainstreaming activities carried out in this area (although economic and other reasons will most likely also feature). Of this 1 970 ha, 620 ha (once again approximately 30%) were CBAs. The fact that the contribution of CBAs to the loss of land has not decreased, and has in fact increased slightly, should be viewed as a partial failure of priority biodiversity conservation in this area. What is not known at this stage is whether or not this transformation was legal or illegal and further studies which are to be undertaken by DEA&DP will hopefully provide more insight as to whether our commenting function has failed biodiversity or whether illegal activities are failing biodiversity. Note: what is also not properly understood is the degree of error of the original land cover maps which informed the CBA Maps. It is likely, that a considerable percentage of the land which was considered not transformed was in fact transformed at the time of the mapping and should therefore not have been assigned CBA status. We can however assume that this percentage error will remain consistent.

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12. Conclusion and Recommendations

- As highlighted through the CapeNature Protected Area Expansion and Implementation Strategy, a two-tiered approach to biodiversity conservation within the province must be continued. The first tier will invest energy into securing the top ranked biodiversity areas into formal Protected Areas. The current preferred mechanism for this in CapeNature is through the Stewardship programme while other options could include land acquisitions through partnering with funders, land donations, or land transformations from one state body to another. The second tier is to cover land through mainstreaming avenues such as spatial planning, land-use decision and business/market angles through CapeNature's land advice unit.
- Proactive Stewardship remains paramount to the overarching conservation of biodiversity for this organisation. 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. If the current models of Stewardship are considered too resource intense for the organisation, then alternative models of PA expansion must be explored in order to secure top sites as formal Protected Areas.
- The location of Stewardship sites should also become heavily informed by the location of CBAs. This is especially true for the top category of Contract Nature Reserve which are currently 23.38% CBAs.
- By 2017, each of CapeNature's reserve clusters should have an approved and fully operational management plan thereby assigning a higher level of protection to these existing Protected Areas.
- Consider a nomination of marine Ecologically or Biologically Significant Areas (EBSAs) as an alternative to formal MPA declaration to protecting the marine environment.
- The role of reactive stewardship must be better understood and a sustainable method of implementing it must be devised. There are great opportunities for biodiversity conservation through this avenue, however due to limited resources and unpredictability of the demand, there is an impediment to expanding this mechanism.
- CapeNature must continue to work closely with existing and new possible partners to make sure that any biodiversity conservation which is happening within the province, is prioritised within our priority areas. At this stage these main partners include SANBI, DEA&DP and TMF/WWF however this is likely to stay dynamic and change regularly.
- CapeNature's mandated commenting role on all land-use applications within the province is currently being addressed by only three officials. Although these officials are meeting their obligations, there is room to improve as the current staff are not always able to undertake site assessments or to stay up-to-date on the latest science. The role that these staff play in directing conservation and development is pivotal to preventing loss of biodiversity in the WCP.
- CapeNature is to drive DEA&DP's formal adoption of the provinces CBA Maps as is stipulated by Listing Notice 3 of NEMA.
- Options for establishing an offset fund and the implications of this need to be investigated further as was supported by the recommendations of CapeNature's Protected Areas Expansion and Implementation Strategy, 2010.

- The spatial informants which are used to guide biodiversity conservation in the landscape must remain up-to-date and together with our partners we should consider investing resources in ground-truthing the maps and conducting detailed surveys in areas of potential conflict (e.g. in and around towns). It is suggested that they are updated at least every five years. This role currently lies with CapeNature, but once again, partnering up with key partners could result in a lowering of the input required from CapeNature. By 2017, there will be a provincial-wide systematic conservation plan (CBA Map) based on updated information.
- Further mainstreaming of biodiversity conservation through initiatives such as spatial planning, business and biodiversity, and targeting of specific industries such as finance and insurance, needs to remain a priority for CapeNature's land advice unit. Once again, the bulk of this can be undertaken through partnerships, but the CapeNature presence and support in these initiatives must be maintained.
- As the two mainstreaming agents for biodiversity conservation are DEA&DP and CapeNature, capacity building within these two organisations to understand and apply these products must continue and all resource planning and management carried out by these organisation must be focussed on priority areas.
- Ensure that the entire province has taken biodiversity concerns into account through ensuring that spatial plans developed are cognisant of the CBAs.
- Set up of a system whereby all approved development footprints as well as areas with improved conservation security are spatially captured.

13. Acknowledgements

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CHAPTER 2

FRESHWATER ECOSYSTEMS

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RATELS RIVER POOL

Executive Summary

The conservation of the freshwater ecosystems of the Western Cape Province (WCP) has come under increased scrutiny over the past few decades. These systems are under a great deal of pressure in the landscape. As a result, several initiatives have been started to manage our freshwater ecosystems. These include the River Health Programme (RHP), Working for Water, Working for Wetlands and the National Freshwater Ecosystem Priority Areas (NFEPA) project.

The Breede Water Management Area (WMA), which includes the Breede River and Riviersonderend River catchments, was the last of the four WCP WMA's to be surveyed comprehensively. Here it was found that in general, for all RHP indices, the upper catchments of the Breede River and the upper tributaries were still in a good condition, with the main channel being in a fair condition. The largest impacts were those related to agricultural land use. The central Breede River catchment and associated tributaries were mostly found to be in a fair condition overall, were agricultural activities and alien vegetation encroachment continues to be major impacts. The Riviersonderend River catchment (including tributaries) was also found to be in a fair state overall, and here modifications to flow, alien vegetation and invasive alien fish posed major threats to the ecosystem and health of the rivers. Similarly, the lower catchment of the Breede River and its associated tributaries were largely found to be in a fair state, with the upper reaches of a few of the tributaries still being in a good condition. Major impacts though, include agricultural land use practices and alien vegetation encroachment.

Through their work, Working for Water has over the years assisted with the improvement of water volume and removal of alien vegetation from prioritised catchments within CapeNature Nature Reserves as well as areas outside the boundaries of nature reserves. CapeNature projects include those in the Hottentots Holland, Limietberg, Swartberg and Goukamma catchments. These projects in general focus on entire river catchments, which also include wetlands.

The state of the wetlands of the WCP has only recently started being investigated in more detail and compared to rivers there is limited information on the condition of the wetlands in general. Through mostly desktop studies, which were augmented by expert knowledge, the NFEPA projects data showed that only 13% of the wetlands in the province are in a natural condition, with 34% being moderately modified and the rest (53%) being heavily or critically modified. To get a clearer indication of true wetland condition, CapeNature has started to ground-truth the wetlands found in Critical Biodiversity Areas (CBAs). The aim here is to verify priority map data (wetland CBAs and FEPAs) and improve the provincial wetland inventory, which will in turn inform the strategic conservation of WCP wetlands.

The wetland verification process as well as the NFEPA project will also inform the prioritisation process for the Working for Wetland project. This project adds to the processes of conservation, rehabilitation and also the sustainable use of wetlands. Here, wetland priorities for rehabilitation are chosen and focussed on, with the projects in the WCP being in the following areas; West Coast, Duiwenhoks, Peninsula and Agulhas. These systems need various interventions, which could include alien vegetation clearing, earthworks, gabion construction and the re-vegetation of cleared areas.

The NFEPA project products highlight important freshwater priorities nationally, while also providing ways to strategically manage the protection of these areas in the WCP. Through the NFEPA process, Freshwater Ecosystem Priority Areas (FEPAs) were identified and mapped and through this a desktop inventory, with regards to the state of these aquatic ecosystems, could also be conducted. Four major findings were:

- rivers and wetlands are highly threatened;
- tributaries are generally in a better condition than the main channel;
- FEPAs only contribute 20% of total river length in the WCP;
- by protecting only 17% of FEPAs, all WCP endangered (including critically endangered) fish species could be protected.

With all these kind of projects, it is important to consider the science that informs them. To better understand the observed patterns and to inform the proper management of freshwater ecosystem priorities, a strong scientific base is necessary.

Introduction

Due to the semi-arid nature of the South African and Western Cape Province (WCP) landscape, conservation of freshwater ecosystems has become more and more important. The Western Cape Province is fortunate to still have some near-pristine mountain streams and upper foothill rivers, many of them found in CapeNature Nature Reserves. The wetlands found in these mountain catchments are generally also found to be in good condition. However, too many of the lower lying ecosystems have been altered to a completely degraded state, often resulting in impoverished water quantity and quality.

Following on the work done for the River Health Programme, (RHP), driven by a partnership between the Department of Water Affairs (DWA; regional) and CapeNature (CN), the ecological health of the river systems within all four of the Western Cape Province's Water Management Areas (WMAs) have now been assessed (SOB, 2007; River Health Programme, 2011). The Breede WMA was the last of the four to be surveyed comprehensively. The results obtained in these assessments, together with input from experts and research findings were also incorporated into the most recent conservation planning tools (e.g. National Freshwater Ecosystem Priority Areas; NFEPAs).

Furthermore, several initiatives have been launched in the past five years focussed on more coordinated management of our freshwater ecosystems. Numerous relevant stakeholders were involved in the development of guidelines for the management of rivers, wetlands and estuaries. Concepts such as environmental flow requirements (King & Brown, 2006), sustainable water use, Freshwater Ecosystem Priorities (FEPAs; Nel *et al.* 2011) and Aquatic Critical Biodiversity Areas (CBAs; Pence, 2008) have received a great deal of attention. The results and maps for the latter two projects have, and will, continue to play, important roles in identifying freshwater ecosystem priority areas for management and conservation. It follows then that all these tools in effect informs the improved planning and management of important aquatic ecosystems for the conservation of the biodiversity associated with them.

In fact, as freshwater ecosystems have not received as much attention as the conservation of important terrestrial ecosystems, it has become increasingly important to consider aquatic ecosystems in conservation planning. Here the management of water flow required for freshwater ecosystem function, maintenance downstream of storage dams (environmental flow; e.g. King & Brown, 2006), the sustainable use of water in both the urban and agricultural spheres (e.g. Shand & Pullen, 2009) and improved incorporation of freshwater priority areas for conservation into biodiversity/ecosystem planning have played an integral part in getting freshwater ecosystems "on the map".

State of Rivers

1. River Health Programme, Breede WMA

As discussed in the SOB report of 2007, the aim of the River Health Programme (RHP) is to assess the ecological health of rivers by using several relevant biological indicators. These indicators include the South African Scoring System for macro-invertebrates version 5 (SASS5), Fish Assemblage Index (FAII), riparian vegetation, geomorphology, water quality and the Index of Habitat Integrity (IHI).

Comprehensive surveys of the Berg, Olifants/Doring and Gouritz WMAs and the Overberg catchment were completed and reported on prior to 2007 (River Health Programme, 2011). According to the ecological data of these assessments, very few rivers in these catchments were in a natural or good condition. Here, it was generally found that the good to natural sites were the tributaries of mainstem rivers. It was found to be much the same for the Breede WMA; the last of the four WMAs to be surveyed.

Methods

The assessments for the Breede WMA included only the Breede and Riviersonderend river catchments. The Overberg rivers form part of the Breede WMA, but were assessed separately from the Breede and Riviersonderend catchments. A total of 52 sites were surveyed for the Breede WMA (see Figure 1).

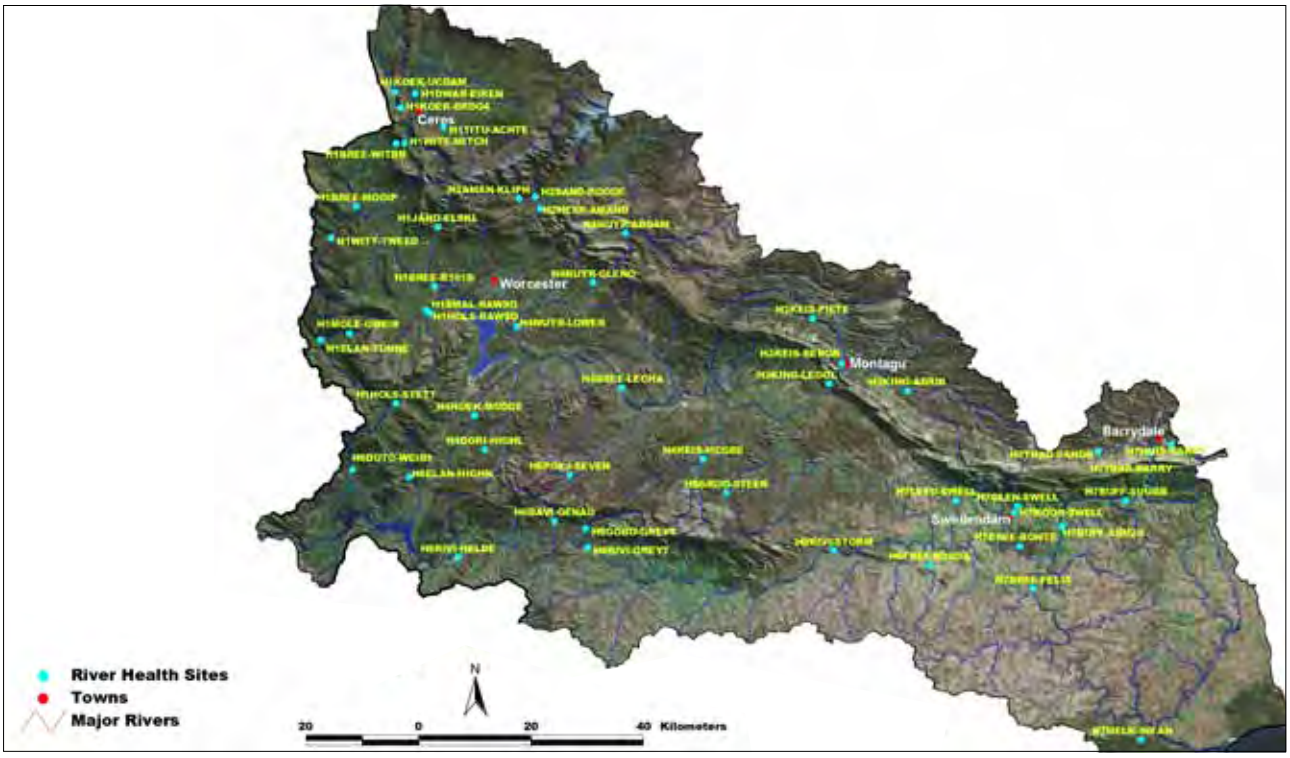

Figure 1. The study area and the sites on the rivers sampled in the Breede WMA.

As was done for the SOB 2007 report, the results from the State of River (SOR) and Technical Report for all the sites of the Breede WMA were imported into a Microsoft Excel spreadsheet. Descriptive statistical analyses were conducted for the following:

- Overall condition for each of the indices in the four sub-catchments of the Breede WMA. The number of sites within each health class was determined and then reflected as a percentage for each health class per index per sub-catchment (see Figures 2 - 6).

The same limitations mentioned in the SOB 2007 report (SOB, 2007, p165) would apply here.

Results

a. Macro-Invertebrates (SASS5)

The SASS results for the four sub-catchments are shown in Figure 2. From these analyses, it is clear that the majority of sites sampled in all areas of the Breede WMA are only in a fair condition. Moreover, it is important to note that for the whole of this WMA; only some tributaries of the Upper Breede were found to be in a natural state (15.8%). However, some good condition sites still exist in all sub-catchments (Upper Breede = 36.8%; Central Breede = 7.1%; Riviersonderend = 22.2; Lower Breede = 9.1%). It is therefore important to protect as many of these natural to good condition sites in order to ensure the continued existence of the pollutant sensitive macro-invertebrate species which forms a fundamental part of a functioning river ecosystem.

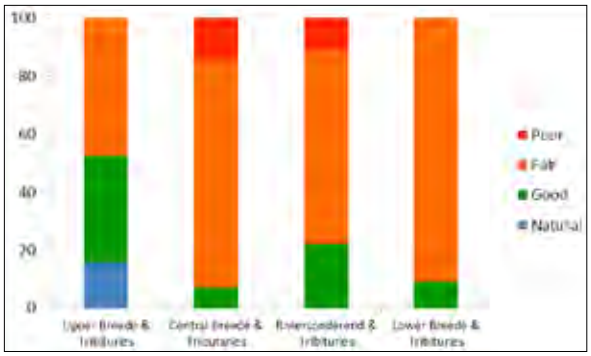

Figure 2. SASS score percentages for rivers in the Breede WMA.

b. Fish

The Fish Assemblage Index results for the four sub-catchments of the Breede WMA are shown in Figure 3. Natural condition sites for fish assemblages were only found in the tributaries of the Upper Breede (2.6% of sites), with some good condition sites being found in all sub-catchments (Upper Breede = 26.3%; Central Breede = 14.3%; Riviersonderend = 25%; Lower Breede = 36.4%). Alien fish invasion seems to be rife in all areas, with indigenous fish species often being completely replaced by alien species. This is reflected in the number of sites found to be in a poor condition with regards to fish (Upper Breede = 48.8%; Central Breede = 64.3%; Riviersonderend = 50%; Lower Breede = 27.3%).

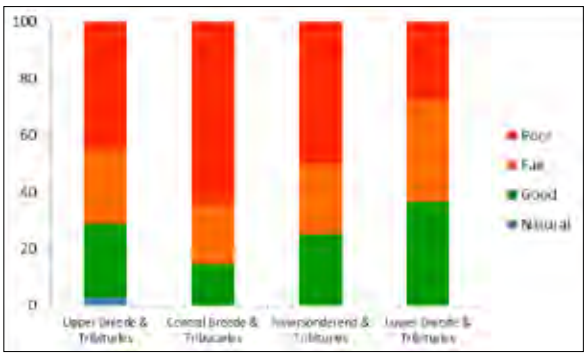

Figure 3. Fish assemblage health percentages for rivers in the Breede WMA.

c. Riparian Vegetation

The riparian vegetation index (VEGRAI; Kleynhans *et al.* 2007) results for the four sub-catchments are shown in Figure 4. Once again, it is worrying to note how few sites in the Breede WMA are in natural or good condition. Many sites were found to be in a fair condition (Upper Breede = 52.6%; Central Breede = 42.9%; Riviersonderend = 77.8%; Lower Breede = 81.8%). The high percentage of sites in a poor condition is largely due to invasion by alien plants and removal of indigenous plants to make way for agricultural land use.

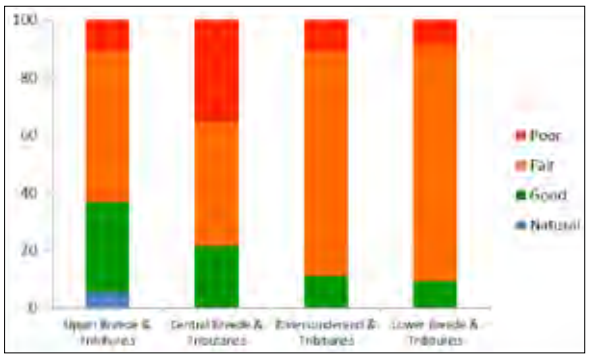

Figure 4. Riparian vegetation health percentages for rivers in the Breede WMA.

d. Geomorphology

Results for the geomorphological health data are shown in Figure 5. Natural condition sites were only found in the Upper and Central Breede sub-catchments (Upper Breede = 10.5%; Central Breede = 3.6%), while good condition sites were found in all four sub-catchments (Upper Breede = 47.4%; Central Breede = 14.3%; Riviersonderend = 22.2%; Lower Breede = 36.4%). As was found for the other catchments assessed in the SOB 2007 report (SOB, 2007), many of the sites that were assessed were disturbed to some degree (fair to poor condition). This was generally because of the invasion by alien plants as well as agricultural and other land use within the 1 in 100 year flood zone of the river systems.

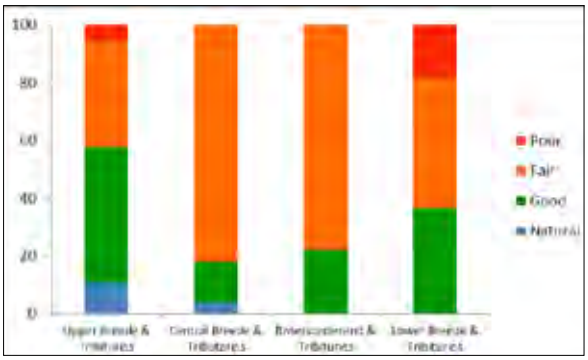

Figure 5. Geomorphology health percentages for rivers in the Breede WMA.

Table 1. Results achieved by the WfW Programme, through DWA and CapeNature projects, over the last five years (2007 – 2012). Person days refer to the number of days each contracted employee worked. Initial HA's refers to the number of hectares cleared of aliens for the first time; Follow up HA's refers to the number of hectares cleared on follow up clearing done on a previously cleared site. See also Chapter 10.

	BUDGET	HA's	PERSONDAYS	NO. OF CONTRACTS	INITIAL HA's	FOLLOW UP HA's
DWA IAs	R123,92 million	356,624	729,890	4158	104,928	253,705
CN	R63,84 million	585,313	392,701	2375	149,861	433,443
TOTALS	R187,76 million	941,937	1,122,591	6533	254,789	687,148

e. Habitat Integrity

The ecological integrity scores were assessed separately for the instream and riparian habitats. Results are shown in Figure 6(a) and 6(b) respectively. Similar to some of the other indices discussed above, natural sites for both the instream and riparian zone integrity scores were only present in tributaries of the Upper Breede sub-catchment (instream = 10.5%; riparian = 15.8%). As would be expected, a higher number of poor condition riparian zones (Upper Breede = 26.3%; Central Breede = 28.6%; Riviersonderend = 22.2%; Lower Breede = 45.5%) was found in all four sub-catchments when compared to poor integrity instream habitats (Upper Breede = 5.3%; Central Breede = 14.3%). The instream habitat (Upper Breede = 47.4%; Central Breede = 50%; Riviersonderend = 22.2%; Lower Breede = 54.5%) for a larger percentage of sites in all sub-catchments was also found to be in a good condition when compared to the riparian habitat (Upper Breede = 26.3%; Central Breede = 14.3%; Riviersonderend = 11.1%; Lower Breede = 18.2%). This is largely due to agricultural land use practices which often extend into and/or replaces the riparian areas next to the rivers. Another significant impact on the riparian zone is the invasion by alien vegetation.

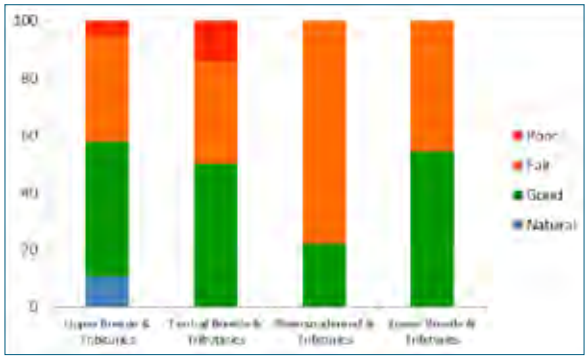

Figure 6 (a). Integrity percentages of the instream habitat conditions for rivers in the Breede WMA.

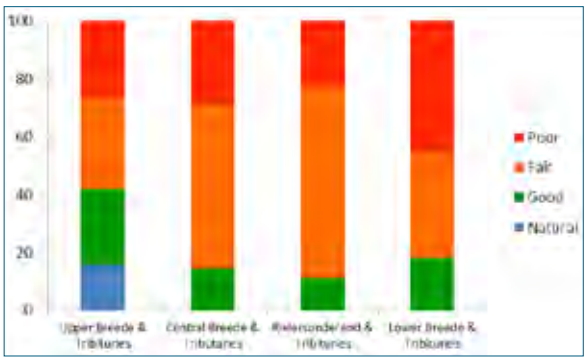

Figure 6 (b). Integrity percentages of the riparian habitat conditions for rivers in the Breede WMA.

These and other results obtained from the RHP work in the different WMAs of the WCP are ultimately used to inform decision makers on the management and health/condition of the rivers in the different catchments. This in turn, also serves as a "whistle-blower" of sorts with regards to threatened aquatic ecosystems, the degradation of rivers and the presence of alien invasive plant species.

Table 2. A list of Working for Water projects currently being implemented throughout the Western Cape. This list excludes the SANParks in the region.

DWA Project Name	Other Projects
WC Asbos_TCTA	CN Cape Flats
WC Asbos_HAT	CN Helderberg
WC Asbos_DWAF	CN Hottentots Holland
WC Berg River	CN Limietberg
WC Berg River Arbor	CN Riverlands
WC Protea	CN Steenbras
WC Hermanus_Onrus	CN Upper Palmiet
WC Kleinriver	CN Voelvlei
WC Worcester	CN Waterval
WC Breede River	CN Botrivier
WC Kwaggaskloof	CN Ceres
WC Buffeljags	CN De Hoop
WC Duivenhoks	CN Elandskloof
WC Buffeljags Rehab	CN Genadendal
WC Beaufort Wes	CN Marloth
WC Leeu Gamka	CN Walker Bay
WC Uniondale	CN Gamkaberg
WC Brandwacht	CN Grootvadersbos
WC Groot Brak	CN Goukamma
WC Karatara	CN Kammanasie
WC Knysna	CN Outeniqua
WC George	CN Swartberg
WC Citrusdal	
WC Klipwerf	
WC Rondekop	
WC Gannabos	
WC Calvinia	
WC AQUATIC WEEDS	
WC BIOLOGICAL CONTROL	

2. Working for Water

Derek Malan

The Working for Water Programme (WfW) was initiated in October 1995 with the aim of securing the water resources and improving the biodiversity of the country through the creation of sustainable job opportunities (also see Chapter 10). The Programme in the Western Cape utilises the services of ten implementing agents to undertake the control of invasive alien plants (IAPs). The agents range from organisations such as CapeNature to municipalities to a Water Users Association.

In 2008 WfW decided to establish areas of priority for the control of IAPs. The CSIR was appointed to investigate and produce a report which would guide the programme as to where it should clear first in the future. The prioritisation process compared the importance of the primary water catchments within the Fynbos biome in relation to each other.

The most important criteria for the Fynbos biome was found to be the impact on ecosystem services (55%) and biodiversity (32%) whilst the taxa with the highest impact were found to be *Acacia cyclops* (Rooikrans), *Acacia longifolia* (Long leave wattle) and *Acacia mearnsii* (Black wattle). The Analytical Hierarchy Programme (AHP) was used to compare all the criteria and the results showed that the Berg and Breede River catchments are of the highest importance for clearing in the Fynbos biome.

Thereafter, the priority of the quaternary catchments within each Water Management Area (WMA) was determined, utilising the same processes used by the CSIR to determine the priority of the biomes. A series of expert workshops were held to determine the criteria against which the catchments would be compared. It was decided to use the same priority list for the taxa in the WCP as for the Fynbos biome as both show similar degrees of invasion (see Appendix A for a list of the priority quaternary catchments per primary catchment).

Several projects are currently being implemented throughout the Western Cape. A list of these projects, excluding those in the National Parks (SANParks) is listed in Table 2.

The control of invasive alien plants has resulted in improved water security and enhancement of the biodiversity of the region. Research has shown that by clearing the riparian zone of a river, approximately 50% of the run-off can be returned to the river (See Chapter 10).

Although the WfW project only focusses on river catchment areas, there are many wetland areas that are also of importance. An understanding of the state of wetlands in the WCP, and in fact in the country, is still a relatively young field of study. However, several projects have been initiated in furthering knowledge on wetland ecosystems (with one such example being discussed below); and the Working for Wetlands project was established in response to the degradation of numerous wetland systems in the country (see Working for Wetlands section below).

Wetlands

3. State of Wetlands

Nancy Job

Wetlands, as discussed in this section, are understood to exclude marine waters, estuaries (aquatic ecosystems with an existing permanent or periodic connection to the sea) and river channels (aquatic ecosystems with flowing water concentrated within a distinct channel, either permanently or periodically), as defined in the Classification System for Wetlands and Aquatic Ecosystems in South Africa User Manual: Inland Systems (Ollis *et al.* in press).

Wetlands meet the following definition; "*….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*" (National Water Act; Act No. 36 of 1998; hereafter referred to as NWA).

State of wetlands

Wetlands have been mapped for approximately 300 000 hectares or just over 1% of the WCP.

A method for the desktop assessment of wetland condition, developed and led by the Council of Scientific and Industrial Research (CSIR), has been applied both to wetlands of the C.A.P.E. Fine-Scale Planning project within the Western Cape and the National Freshwater Ecosystem Priority Areas (NFEPA). The method makes use of available land cover data, which has broadly grouped land cover classes into "natural", "degraded" and "transformed". The percentage "natural" land falling within a mapped wetland is calculated, as well as within areas of 50, 100 and 500 meters surrounding the wetland (Nel *et al.* 2011).

Although the C.A.P.E. Fine-Scale Planning project covers a significant area of the province (approximately two thirds), the NFEPA data has been drawn upon for the results reported in Figure 7, as it systematically covers the entire province. According to the NFEPA data, 13% of Western Cape wetlands are in an AB or intact condition, 34% are in a C or moderately modified condition, and the remaining 53% are in a D, E, F or Z

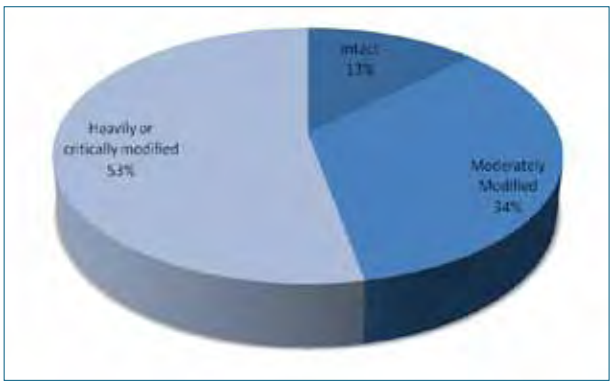

Figure 7. State of wetlands in the Western Cape Province.

condition, meaning they are heavily or critically modified. Even though all wetlands meeting the NWA definition should be afforded legal protection in South Africa under the National Water Act (36 of 1998), Conservation of Agricultural Resource Areas Act (43 of 1983; hereafter referred to as CARA), and Listed Activities associated with the National Environmental Management Act Environmental Impact Assessment 2010 regulations, approximately 87% of our Western Cape wetlands are categorised in a moderate to heavily modified condition, and wetlands continue to be lost or impacted through development, drainage, cultivation, human-induced erosion or invasive alien plants.

Representation of wetland biodiversity

We are still in the early stages of quantifying the full diversity of our wetlands in the WCP and how biodiversity is distributed within them. This is a challenge throughout South Africa and is an important component of our aquatic conservation planning, which sets targets to conserve a representative sample of biodiversity pattern (e.g. wetland types) as well as the processes that enable biodiversity to persist. Part of the challenge is to decide on the best approach for categorising wetlands to reflect the change in biodiversity across the province, because the drivers of wetland diversity operate at multiple spatial levels, from broad-level regional patterns through to fine-scale habitat structure, chemistry and insect assemblage differences. There is no single approach that captures all this as yet, although it is likely that a hierarchical classification system will be required. A further challenge is that we currently know very little about the spatial and temporal variation in species composition of most of our wetlands.

For the C.A.P.E. Fine-Scale Planning Project, botanists preparing vegetation maps recorded observations of wetland diversity, describing more than 30 wetland types, and this informed the final set of wetland types for the project (Helme, 2007a; Helme, 2007b; Helme & Koopman, 2007; Vlok, 2009). However, many more wetlands were mapped through desktop mapping for this project than were described by the botanists. To overcome this, the terrestrial vegetation types within which the wetlands were embedded were applied to all wetlands of the Fine-Scale Planning Project, as the vegetation types provide a comprehensive spatial coverage. Each vegetation type is well-documented, and could also be linked to the Vegetation types of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006). Combining the botanist observations of wetlands on-the-ground, with climate, geology, soils and other contextual information drawn from the comprehensive vegetation type coverage led to an outcome of 45 wetland types within the C.A.P.E. Fine-Scale Planning Project.

In comparison, the NFEPA map, identifies 37 regional wetland types in the WCP. According to Mucina and Rutherford (2006), five wetland types occur within the Fynbos Biome (Cape Lowland Freshwater Wetlands, Cape Vernal Pools, Fynbos Riparian Vegetation, Cape Lowland Alluvial Vegetation and Cape Inland Salt Pans), and several more within the Succulent Karoo Biome. Euston-Brown (2007) found that in the Agulhas Plain alone at least 12 wetland types can be distinguished: Berzelia Riparian Wetland, Elim Riparian Wetland, Palmiet Riparian Wetland, Restio Bog, Black Acidic Vlei, Lime Vlei, Muddy Vlei, Salt Pan, Restioid Wetland, Sarcocornia Wetland, Short Reed Wetland, Tall Reed Wetland. According to initial findings of the National Wetland Vegetation Database project, Seiben (unpublished), at least seven broad wetland types may be found within the Western Cape, with more than 35 sub-types. These types are not all confined to the Western Cape, some have characteristics in common with wetlands found across South Africa.

The accuracy of drawing from terrestrial vegetation information to group wetlands remains to be interrogated by field and academic studies, but it is a useful way to begin to indicate potential wetland biodiversity groupings. It is essential to gather on-the-ground data to contribute to the initial framework.

Western Cape wetland diversity

Without yet being able to definitively and comprehensively list all the wetland types of the WCP, we do know they are extremely diverse. They vary greatly in geographic location, water source and permanence, and chemical properties. Wetland water chemistry in the WCP can range from fresh to saline and from acidic to basic. Some wetlands hold water for only a few weeks in the year (temporary wetlands) while others are always wet (permanent wetlands). Many wetlands receive their water inputs from groundwater, while others are totally dependent on precipitation and hillslope through-flow or overland flow. A common mistake is to think that wetlands occur only where water is visible at the surface. In fact, many WCP wetlands have soils that are saturated for many months of the year but there is never standing water to be seen at the ground surface.

Wetlands within sandstone fynbos vegetation are often found to have "peaty" soils and tannin-stained waters. Wetlands on mountains and slopes throughout the region, including Cape Point through Rooi-Els to Kleinmond coastal areas (at the base of mountainous slopes), and into the Grootwinterhoek and other mountain ranges, often have sandy soils with a very high carbon content, although mostly less than 15% organic carbon (the cutoff of peat soils according to the Soil Classification Working Group [1991]). Wetlands in the Southern Cape, from the Agulhas Plain through to George and Tsitsikamma, however, are sometimes rich in peat soils, with an organic carbon content of more than 40% at times. Some peat basins have been found to be as much as seven or eight metres deep, with one exceptional wetland near Knysna (Vankervelsvlei) where the peat is known to be more than twelve metres deep. Most of these peat systems are dominated by palmiet (*Prionium serratum*) vegetation, as well as a diversity of restio and bulb species. Palmiet is able to withstand high flows and is an exceptionally valuable plant in this regard, preventing soils from being washed downstream during floods. Once the peat vegetation is cleared, the organic matter can dry out and the soils subside, often with catastrophic consequences, including deep gully erosion, loss of land and damage to infrastructure from flooding.

The Agulhas Plain has an especially rich and large network of important wetlands, including the second largest coastal lake in South Africa: Soetendalsvlei, and two Ramsar sites, De Mond Estuary and De Hoop Vlei. Within the Agulhas Plain, the great variability of soils and geology, salinity range and flow regimes creates a diverse assemblage of wetland ecosystems from highly acidic black water rivers to basic limestone pools, and fresh water peat bogs to hypersaline isolated pans (Euston-Brown, 2007; Jones *et al.* 2000). The dense concentration of pans along the Agulhas coastal plain also extends through the Riversdale coastal plain (Vlok, 2009).

Wetlands are more sparsely distributed along the semi-arid west coast and inland of the Cape Fold Mountains, with a high concentration of pans, now mostly embedded within a matrix of agricultural lands. Most are seasonal or temporarily wet, often "perched" on top of dense clays, which is impervious to water, thereby not allowing surface water to filter down to the water table. These wetlands are easily overlooked during cultivation. Surprisingly, some wetlands in this dry region once supported sandy peat soils (semi-permanently wet, groundwater-fed systems). The integrity of many of these wetlands was lost to fires within the peat (sometimes burning for a year or more without being extinguished) as the water table drops and the

normally saturated soil remains dry. The remaining wetlands of this type require careful management of water abstraction and fire. Seasonal wetlands along the West Coast of significant importance for waterfowl include Rocherpan, Verlorenvlei, Wadrif Pan and Lamberts Bay.

The WCP supports five Ramsar sites. Two of these fall within CapeNature Provincial Nature Reserves; De Mond and De Hoop. The third, Verlorenvlei, is located on private land, although CapeNature is involved in stewardship and rehabilitation initiatives in the area. The other two Ramsar sites are Langebaan lagoon and the Wilderness lakes.

Mondi Wetlands Programme Wetland Critical Biodiversity Areas ground-truthing and inventory project

CapeNature is currently undertaking extensive ground-truthing of the wetland inventory for the province, starting with key Critical Biodiversity Areas. This is a cross-cutting project involving staff across multiple CapeNature functions and regions, together with the NGO Mondi Wetlands Programme and Working for Wetlands.

A strong wetland inventory, and the process itself of developing and ground-truthing an inventory, has many benefits, including deepening our understanding of the range of wetland types present across the province, how they function, their extent and loss. Deepened understanding leads directly to more appropriate management guidance and strengthens our rehabilitation, stewardship, policy and action, with the ultimate goal of strategic conservation of the wetlands of the Western Cape.

This project comprises the initial steps towards a wetland inventory of high confidence for the province. To achieve a highly accurate inventory for the entire province will ultimately involve multiple partnerships and a long term commitment over many years. The project sets protocols in place for managing the data and for capturing information in a consistent manner.

Inventory and protocols -This project is focused on ground-truthing wetland CBAs in select areas and will develop protocols for consistent data collection, and formalise a centralised home for the province's spatial wetland inventory.

Spatial boundary -The project will build on the existing Western Cape wetland spatial layer (including consideration of any discrepancies between the CBA wetland and NFEPA layers). Fieldwork will draw on the general principles of wetland delineation outlined in the Department of Water Affairs (DWA) delineation manual (2005), including documenting evidence of wetland soils, wetland hydrology and plants adapted to seasonal or permanent wetness. For each CBA wetland visited the following question will be answered: Is it correctly mapped as wetland and is the boundary adequately accurate?

Regional wetland type - As introduced above, we are in the early stages of describing the diversity of wetland types within the province. Fortunately, the national Wetland Vegetation Database project, led by Dr Erwin Seiben of the University of the Free State, is currently underway so that, wherever possible, detailed vegetation plots for the national database can be located within ground-truthing areas and links made to the national research on wetland types from a vegetation structure and community perspective. A key feature of this project is also that it draws in the range of expertise from across the WCP. The project is investing much time in learning on the ground and incorporating local knowledge. The focus is on time spent making direct observations in the field, discussing and synthesizing these observations as a group. The more wetlands we observe, the more we will notice defining characteristics (e.g. plants and soils) which will allow grouping wetlands according to these characteristics. This will allow us to get to know the area and wetlands better, contribute to future studies, and inform wetland conservation planning and management planning. The diversity of people in the groups and their various jobs/skills/experience allows for much learning through debate and the sharing of expertise and views. Everyone is building knowledge through this project, including competence in wetland-related skills, and crucially much of the learning is being captured in the wetland inventory.

Condition -The existing biodiversity conservation planning products provide a categorisation of the condition of a wetland based on the land cover within and surrounding the wetland. This ground-truthing project will actually visit the wetland and apply a rapid wetland condition assessment, based on methods outlined in WET-Health, MacFarlane, *et al.* (2008). This includes estimating change from the historical natural condition of hydrology and vegetation. Understanding gained from visiting and assessing multiple wetlands in an area can contribute to understanding the most pertinent management issues and improve confidence in local management advice, which can then be incorporated into guidelines relevant to an entire region. Lessons learned in this project should be incorporated into future conservation planning protocols.

Catchment approach -The ground-truthing project also aims to consolidate information about the characteristics of wetlands/wetland types and key impacts over the sub-catchment. In this way comparisons can be made between catchments, relationships within catchments better understood, and criteria developed for prioritising existing CBA wetlands within a sub-catchment, and flagging those that offer opportunities for protection or restoration. The province has many aquatic priority areas, thus this project is laying the groundwork for partnerships and projects that can contribute to building a reliable wetland inventory for the Western Cape. This project will also help retain links with research projects and encourage partnerships and collaboration across academic institutes, government departments and agricultural sectors.

4. Working for Wetlands

Heidi Nieuwoudt

Wetlands play an important part for freshwater ecosystem functioning and human health. Despite this, many wetlands found within the WCP and in fact, in the whole of South Africa, have been degraded or destroyed by anthropogenic impacts (see also "State of Wetlands" section). The Working for Wetlands project was launched in response to the resultant need to rehabilitate degraded and maintain healthy wetlands.

Working for Wetlands is a Government Programme managed by the South African National Biodiversity Institute (SANBI) on behalf of the Departments of Environmental Affairs, Water Affairs and Agriculture, Forestry and Fisheries. In line with the principles of the Expanded Public Works Programme – of which Working for Wetlands is part – the programme uses an approach to the implementation of its rehabilitation and wise use projects that maximises employment creation, supports small businesses, and transfers relevant and marketable skills to its beneficiaries.

Working for Wetlands contributes to the protection, rehabilitation and sustainable use of wetlands in South Africa.

Table 3. The budget allocations for Working for Wetland projects being implemented by CapeNature.

Project	Budget	Nu/Wetlands Nu/ Interventions	Personday Delivery	Jobs created	Activities
West Coast	R7 824 668.00	6 33	26 515	54 /annum	Alien Clearing, Earthworks, Gabions, Birdhide, Revegetation, Geocells
Duiwenhoks	R 5 707 575.00	2 7	21 681	37 /annum	Alien Clearing, Gabions
Peninsula	R1515 378.00*1	23*2 96*2	7 173*1	47 /annum	Nursery, Alien Clearing, Revegetation, Gabions, Earthworks
Agulhas	R 7 826 213.90	14 88	40 129	73 /annum	Alien clearing, Revegetation, Earthworks, Earth structures, gabions, concrete structures, ecologs

These activities are informed by national policies and commitment to international agreements such as the Ramsar Convention on Wetlands.

Planning methods follow a phased approach by a team consisting of a wetland ecologist, an engineer, an Environmental Practitioner, the Working for Wetland Provincial Coordinator and affected parties. Planning and Assessments are informed by the verification and description on overall health of the wetland by using WET-Health, Macfarlane *et al.* (2008) as well as a description of the hydro-geomorphic setting of the wetland according to Kotze *et al.* (2006). Impacts and threats are identified and rehabilitation objectives are set accordingly.

The WCP is home to four Working for Wetlands Projects, three of which are implemented by CapeNature. The approach of linking wetland conservation to sustainable economic development is directly in line with CapeNature's vision to create a Biodiversity economy. These projects also provide a forum from which many wetland management topics can be aired. Each of the four Western Cape projects forms part of larger initiatives driven by national and other provincial conservation agencies. The Western Cape Working for Wetlands Projects received an annual budget of R 7 024 176.00 in 2011/12. Seventy-five percent was allocated to Projects being implemented by CapeNature and is summarised in Table 3 according to figures from year 2006 to 2012.

The West Coast Project initially only focused on Verlorenvlei but aims to address more wetlands on the West Coast as it falls directly into the management area of the Greater Cederberg Biodiversity and Groot Winterhoek Freshwater Corridors (see also Chapter 1). The West Coast Project is integrated into local conservation goals and objectives and strong partnerships are formed with local government and private Landowners. The West Coast Project received the second runner up Award for the National Best Project Award for year 2010/11.

Since its inception in 2006 the Project cleared 1 282 ha of alien vegetation in the Verlorenvlei catchment. Verlorenvlei, a Ramsar Wetland of international importance, is under threat from over-abstraction of ground water and unsustainable agricultural practices. The threat is increased by the approval of prospecting rights for the mining of tungsten in the Krom Antonies Valley -the main stem for surface water supply to Verlorenvlei. Verlorenvlei is one of the largest Estuarine wetlands along the West Coast (areal extent of water body ~ 1 500 ha) and plays a vital role as nursery areas for mullet fish species.

Verlorenvlei is an important feeding ground for the White Pelican (*Pelecanus onocrotalus*). The endangered Verlorenvlei redfin (*Pseudobarbus sp. "burgi Verlorenvlei"*) is endemic to the Verlorenvlei catchment and the protection of this species' habitat through rehabilitation is very important. Other interventions include stabilisation of small erosion gullies, revegetation and restorative earthworks.

There is also an intervention planned to construct concrete weirs in the Olifants river upper catchment to prevent invasive alien fish species to move upstream into habitat occupied by indigenous fish (see Chapter 4).

The Duiwenhoks and Goukou Project support the protection of ecological services provided by the Palmiet (*Prionium serratum*) dominated valley bottom wetlands in the Goukou and Duiwenhoks river systems. These wetlands are under pressure from erratic rainfall patterns and poorly managed landuse activities. The upper and mid Goukou wetlands cover approximately 500 Ha and has peat layers of up to 8m (this peat is estimated to form at a rate of 7 mm per annum and thus the peat is calculated to be 8 000 years old (CSIR, 2006). The protection of these wetlands should take very high priority as they assist flood attenuation, water purification and storage. According to maps produced by the National Freshwater Ecosystem Priority Areas project, they are ranked as Category C wetlands, which are regarded as wetlands in slightly modified state. Critical Biodiversity Areas Maps indicate these wetland areas as Alluvium Fynbos which receives a very low level of protection yet they are regarded as critically endangered. The efforts of Working for Wetlands and CapeNature in these catchments will contribute to the protection and wise use of water resources and biodiversity in the Goukou catchment.

The Duiwenhoks River has two sections: an eastern and a western branch. CapeNature and Working for Wetlands implements rehabilitation in the eastern branch while Landcare implements rehabilitation of wetlands and river banks in the western branch. Together with the Working for Water Duiwenhoks Project, the three programmes aim to maximise rehabilitation efforts in this heavily degraded catchment. Approximately 95% of the valley bottom wetland in the western branch of the Duiwenhoks River has been lost while the eastern branch has large erosion gullies threatening the integrity of the upper intact wetlands. To remedy this erosion, CapeNature, in partnership with Working for Wetlands and LandCare, has undertaken one of the largest gabion constructions in the history of Working for Wetlands. The gabion design will assist rehydration of the peat and revegetation with Palmiet and other wetland plants and removal of alien vegetation in the catchment

*1. Refers to year 2011-12 budget only. Previous years was under SANBI implementation
*2. Refers to all wetlands under rehabilitation since 2004 under SANBI Implementation

by WfW. They will also assist rehydration of the peat. The rehydration of the peat will assist in effective water storage as 1m³ of peat can store up to 800l of water (Ramsar Committee, 2005).

This intervention is still in progress yet the project was recognised nationally for the outstanding work delivered for the implementation year of 2009/10 by winning the Best Project Award. The project received a second award when they were selected as the first runner up in the 2010/11 year for their continued efforts in the rehabilitation of wetlands, job creation and awareness-raising in the Duiwenhoks and Goukou catchments. Once the Duiwenhoks head-cuts has been stabilised the Project will move most of its focus to the invasive alien species eradication in the Goukou catchment.

The Peninsula Project has been rehabilitating wetlands since 2004 with the South African National Biodiversity Institute (SANBI) as implementer. Implementation of this Project was handed to CapeNature at the end of 2011. The Project sites are situated in Noordhoek, Kuils River, Sout River, Faure, Tokai, Parklands and other areas on City of CapeTown property. The wetlands identified for rehabilitation are important for maintaining the ecology and biodiversity of the area, or is systems that is important for flood and sediment attenuation. This offers protection of wetlands and watercourses downstream. Priotisation of wetlands was guided by the City of CapeTown's Wetland Map under the umbrella of the City of Cape Town BioNet (Biodiversity Network). According to the Wetland Map report for the Cape Metro area, 4 500 wetlands covering 8 875 ha were mapped.

The Wetlands and Rivers of the Cape Peninsula are under tremendous pressure from urbanisation and the important role played by these systems as buffers and corridors has been either transformed or completely lost. Illegal dumping on the Cape Flats is a rising concern while pollution and aqatic weeds threatens remaining wetland systems' integrity. The Agulhas Project domain falls within the Agulhas plains – a lowland fynbos and renosterveld area with a high diversity in habitat types, red data plant species, wetland ecosystems and local endemics -hence there is no other area in the Cape Floristic Region able to compare to the Agulhas plain. Unique wetland types occur on the Agulhas plain due to its low gradient which includes the second largest lacustrine wetland, Soetendalsvlei, in the country. Threats are dominated by unsustainable and poor Landuse activities along with invasive plant species encroaching on the landscape.

The initial focus of the Working for Wetlands Agulhas Project was on wetlands within the Agulhas National Parks' boundaries. The project area has since been extended onto other important wetlands on the Agulhas Plain as the Agulhas Biodiversity Initiative (ABI), Cape Action for People and the Environment (C.A.P.E) became active in the area and the importance of collectively looking at rehabilitation and protection of wetlands became apparent.

The Project identified interventions at De Mond, a Ramsar wetland of international importance, to protect the salt marshes and will continue to address drainage lines and erosion within wetlands on the Agulhas Plain. The nature of the Agulhas plain lends itself to lower impact interventions consisting out of soft structures, for example; rock packing, eco logs, earth structures, re-vegetation with limited hard structures. Great success has been achieved by plugging agricultural drainage lines and

Wetlands in the Peninsula secure habitat for rare and endangered species in a landscape under urban pressure. The Western Cape Leopard Toad uses sections of the Noordhoek wetlands for breeding which is one of the areas being rehabilitated by the Peninsula Project.

Illegal dumping on Cape Flats Photo: H. Nieuwoudt

Removal of Parrots feather, *Myriophyllum aquaticum*, from Die Oog Wetland in Bergvliet area, Cape Peninsula. Photo: H. Nieuwoudt

facilitating water movement. Due to the severe infestation of alien vegetation, a direct threat to wetlands, a large area in the Ratelrivier area has been marked for clearing.

The Working for Wetlands Programme will continue to ensure effective and sustainable wetland rehabilitation by basing its activities on key interlinked concepts:

Criteria used for identifying FEPAs

- Representing ecosystem types for rivers and wetlands,
- Representing threatened fish species and associated migration corridors,
- Representing free-flowing rivers,
- Selecting priority estuaries identified in the National Biodiversity Assessment 2011 (Van Niekerk & Turpie, 2011),
- Maintaining water supply areas in sub-quaternary catchments with high water yield and high groundwater recharge,
- Identifying connected systems wherever possible,
- Preferentially choosing river and wetland FEPAs that overlapped with:
  - Any free-flowing river,
  - Priority estuaries identified in the National Biodiversity Assessment 2011,
  - Existing protected areas and DEA's focus areas for protected area expansion (Government, 2010),
  - Threatened frogs,
  - Wetland-dependent birds.

- Wetland protection, wise use and rehabilitation
- Skills and capacity development
- Cooperative governance and partnerships
- Research and knowledge sharing. e.g. technical advice to landowners and other
- Communication, education and public awareness.

Aquatic Priorities

5. National Freshwater Priority Areas (NFEPA)

Jeanne Nel

Both the Working for Water and Working for Wetlands programmes, as well as the wetland CBA's discussed above also fed into the development of the National Freshwater Ecosystem Priority Areas (NFEPA) project. The NFEPA project was a three-year partnership between South African National Biodiversity Institute (SANBI), CSIR, Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The NFEPA project aimed to:

1. Identify Freshwater Ecosystem Priority Areas (hereaf ter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free- flowing rivers.

The first aim used systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. The second aim was divided into a national and sub-national component. The national component sought alignment between the Department of Water Affairs and Department of Environmental Affairs with regard to policy mechanisms and tools for managing and conserving freshwater ecosystems. The sub-national component used three case study areas (one in the Breede-Overberg CMA of the Western Cape) to explore how NFEPA products should be implemented to influence land and water resource decision making processes at a sub-national level.

NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas (FEPAs). These were determined through a process of systematic biodiversity planning and involved collaboration of over 100 freshwater researchers and practitioners.
FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (Box 1). A range of different products were produced including maps, guidelines for use of these maps, and GIS shapefiles (see Figure 8).

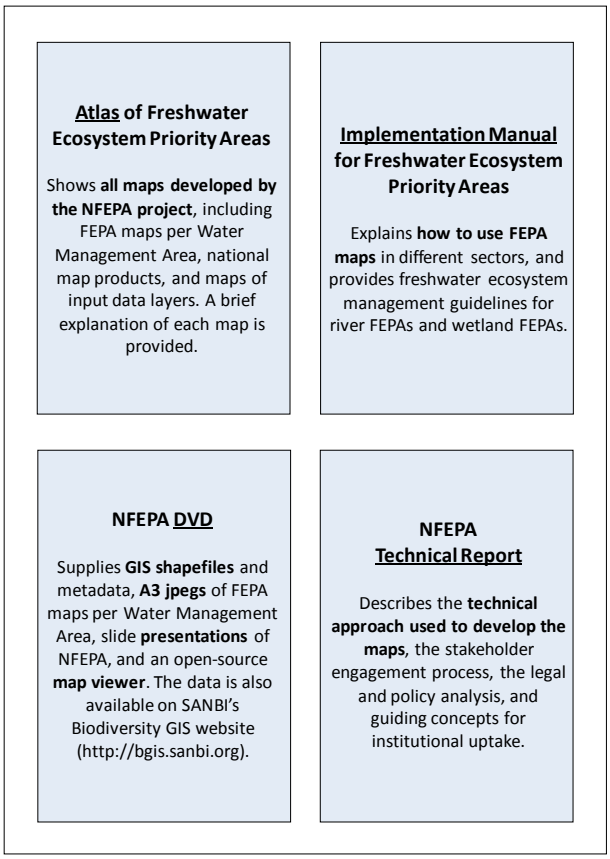

Figure 8. NFEPA products at a glance. All products are available on the SANBI Biodiversity GIS website (http://bgis.sanbi.org).

FEPA maps and supporting information form part of a comprehensive approach to sustainable and equitable development of South Africa's scarce water resources. They provide a single, nationally consistent information source for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes. For integrated water resource management, the maps provide guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA (Act No. 36 of 1998; RSA, 1998a). FEPA maps are therefore directly applicable to the National Water Act, feeding into Catchment Management Strategies, classification of water resources, reserve determination, and the setting and monitoring of resource quality objectives. FEPA maps are also directly relevant to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004; RSA, 2004) (hereafter referred to as NEMBA), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act. FEPA maps support the implementation of the National Environmental Management: Protected Areas Act (Act No. 57

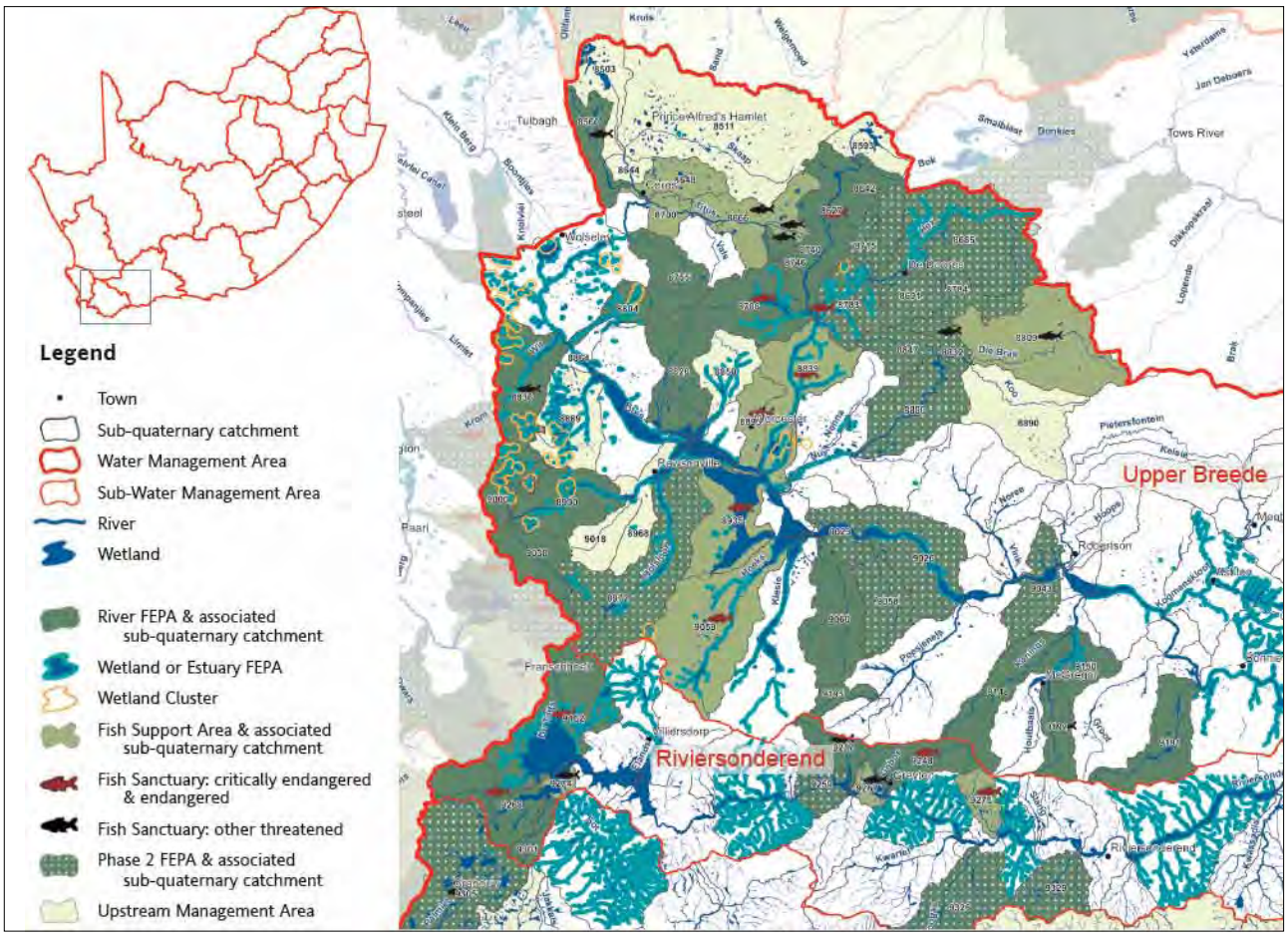

Figure 9. Example of a FEPA map for a zoomed in portion of the Breede Water Management Area.

of 2003; RSA, 2003) (hereafter referred to as NEMPAA) by informing the expansion of the protected area network. They also inform a variety of other policies and legislation that affect the management and conservation of freshwater ecosystems, including at the municipal level.

FEPA maps show various different categories, each with different management implications. The categories include river FEPAs and associated sub-quaternary catchments, wetland FEPAs, wetland clusters, Fish Support Areas and associated sub-quaternary catchments, fish sanctuaries, phase 2 FEPAs and associated sub-quaternary catchments, and Upstream Management Areas. Each of these categories is explained in the NFEPA Atlas (Nel *et al.* 2011), or the NFEPA Implementation Manual (Driver *et al.* 2011) both of which are available on the SANBI Biodiversity GIS website (http://bgis.sanbi.org). FEPA maps in pdf format are also available on BGIS. An example of a FEPA map and FEPA map legend is shown in Figure 9.

Roles and responsibilities of CapeNature in securing FEPAs

Clarifying the roles and responsibilities for managing and conserving freshwater ecosystems is important because of this is a shared mandate between the water and biodiversity sectors. Both the National Water Act and the Biodiversity Act provide explicit mechanisms for protection and conservation of freshwater ecosystems. The roles and responsibilities of CapeNature in relation to managing and conserving freshwater ecosystems include:

- Commenting on development applications, including environmental impact assessments, mining and prospecting applications, and recreational fishing and aquaculture permit applications. This includes providing specialist freshwater ecological input, and advising on mitigation measures and appropriate river and wetland buffers.
- Participating actively in DWA-led reserve determination processes and the classification of water resources, to ensure that freshwater ecosystem priorities and their freshwater requirements are taken into consideration.
- Participating actively in processes led by Catchment Management Agencies, including the development of Catchment Management Strategies. Provincial conservation authorities should play a leading role in providing a regional freshwater ecological perspective as well as technical advice and input on the incorporation of FEPA maps into the work of Catchment Management Agencies.
- Monitoring the condition of freshwater ecosystems, with a particular focus on regular monitoring of FEPAs.
- Identifying FEPAs that should be included in the consolidation and expansion of the provincial protected area network, including through biodiversity stewardship programmes.
- Ensuring that freshwater ecosystem priorities inform the development and implementation of management plans for protected areas.
- Interacting with Working for Water, Working for Wetlands, and LandCare to direct these programmes towards rehabilitating freshwater ecosystem priority sites.
- Initiating and/or participating in the development of biodiversity management plans in terms of the Biodiversity Act, for priority freshwater ecosystems and species.
- Verifying FEPAs, fish sanctuaries and free-flowing rivers that occur in the relevant province, and confirming their status (for example, ground-truthing their ecosystem type and condition).

- Filling in gaps in knowledge of freshwater ecosystems and species, for example:
  - Mapping wetlands that have not yet been included in the national wetland map, and contributing these to the national wetland inventory co-ordinated by SANBI (freshwater@sanbi.org.za),
  - Properly surveying the distribution of threatened fish populations.

Provincial conservation authorities play a particularly pivotal role in implementing and monitoring freshwater ecosystem priorities, as they have the primary function responsibility for ecosystem management and conservation. Most provincial conservation authorities have very little human resource or financial capacity to fulfil their roles and responsibilities in relation to freshwater ecosystems. Provincial conservation authorities ideally require at least six to eight aquatic scientists and technicians, with expertise in limnology, hydrology, fish biology, aquatic invertebrate biology, aquatic plant biology and other aspects of aquatic ecology, in order to play an effective role in managing and conserving freshwater ecosystems.

Key findings

River and wetland ecosystems are highly threatened

- This assessment found that respectively 45% and 71% of our river and wetland ecosystem types in the Western Cape are threatened (critically endangered, endangered or vulnerable), compared to 51% and 65% nationally (see also "State of Wetlands" section 3).
- Lowland river ecosystem types and floodplain wetlands are the most threatened river and wetland ecosystem types. This is particularly concerning, as they are also the least protected of the river and wetland ecosystem types.
- Threatened ecosystem distribution patterns coincide with areas of intense land-use pressure, with these pressures accumulating from source to sea.
- Wetland and river ecosystems are as threatened, or more threatened, than their marine and terrestrial counterparts (47% and 51% of marine and terrestrial ecosystem types are threatened respectively), but less threatened than estuary ecosystems (82% threatened).
- A worsening trend in river condition (from River Health data) indicates that threat levels are unlikely to improve without concerted effort to manage these ecosystems more effectively (Strydom *et al.* 2006).

Tributaries are in a better condition than main rivers

- Using 1500 000 rivers, only 17% of mainstem length is in good condition (A or B ecological category), compared to 58% of the tributary length.
- Tributaries offer refuge for many freshwater biota and hold good conservation potential. They sustain working rivers by providing natural flow and sediment pulses.
- Mainstems may still need to be managed in a state that supports connectivity between tributaries, particularly if they have been selected as an Upstream Management Area on the NFEPA maps.

Freshwater Ecosystem Priority Areas comprise only 20% of river length in Western Cape

- FEPAs maps show strategic spatial priorities for conserving freshwater ecosystems and supporting sustainable use of water resources. The river length required for conserving freshwater ecosystems is in line with the national cross-sectoral aspiration to maintain at least 20% of freshwater ecosystems in a natural or good condition (Roux *et al.* 2006).
- FEPAs need to be managed in a good condition to conserve and manage freshwater ecosystems, and protect water resources for human use. FEPAs, therefore, should be supported by good planning, decision making and management so that human use does not impact on ecosystem condition.

By protecting only 17% of our river length in the Western Cape we could protect all our fish on the brink of extinction

- Fish sanctuaries have been selected to conserve our threatened freshwater fish species. Many of these coincide with FEPAs.
- Fish sanctuaries also perform the function of conserving all the widespread and common species.
- Fish sanctuaries do not need to be in an A or B ecological condition, but each (or groups of them) require management plans to manage issues that impact on the persistence of the fish species it supports.

- Control of invasive alien fish species is a critical issue. Although some of the worst invasive alien fish are also economically valuable (for aquaculture and recreational angling), with careful planning it is possible to support their associated economies and conserve indigenous fish species (also see Chapter 4).
- Maps showing permitting zones for invasive alien fish that have been drafted for the Biodiversity Act should be used in conjunction with NFEPA maps to plan control operations and assessing license applications to stock invasive alien fishes. This is already being piloted by CapeNature in the Western Cape.

Current Research

Throughout this chapter the importance of freshwater ecosystems and their functioning has been highlighted. However, each project or initiative discussed above was initially informed and based on scientific research findings on the different topics. Below are two examples of informative research which should be fed into conservation management and planning for aquatic ecosystems in the WCP.

6. Water temperature in aquatic ecosystems

Helen Dallas, Nick Rivers-Moore & Vere Ross-Gillespie

Water temperature is recognised as an important abiotic driver of aquatic ecosystems, and understanding the role that temperature plays in driving ecosystem change is important if effective management of thermal stress on aquatic ecosystems is to be achieved. A recent research project that focused on the collection of baseline water temperature data in rivers in the Western and Eastern Cape (Figure 10) has been completed (Dallas *et al.* In press). The aims of the research were to develop a generic water temperature model for South Africa; to develop an understanding of the response of aquatic organisms to water temperature regimes in South African rivers; to identify a suite of suitable aquatic macroinvertebrates for use as bio-indicators of thermal change; to develop preliminary guidelines for the water temperature component of the Ecological Reserve; and to develop scenarios of the potential biotic responses to changes in water temperature regimes as a result of climate and hydrological changes.

Studies from this research showed that water temperature regimes have a measurable impact on aquatic macroinvertebrate life histories, and life cycle cues. Through a combination of field surveys and laboratory experiments, it was shown that life histories of three target macroinvertebrate species showed differing degrees of flexibility in life history responses - from subtle changes in the timing of emergence and egg hatching to more extreme differences involving the production of additional generations within a year given differing environmental conditions.

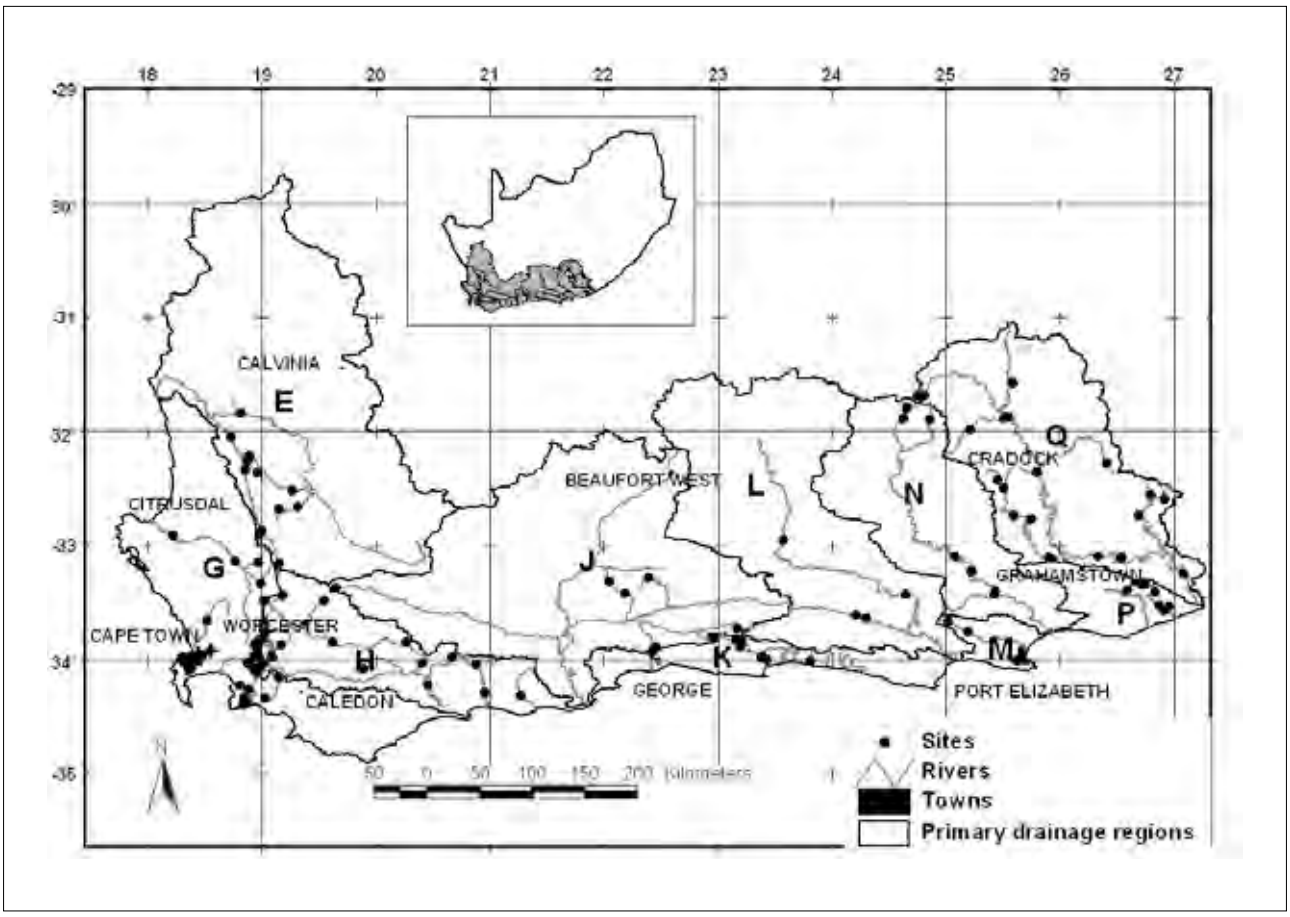

Figure 10. Sites in the Western and Eastern Cape where water temperature data loggers were installed.

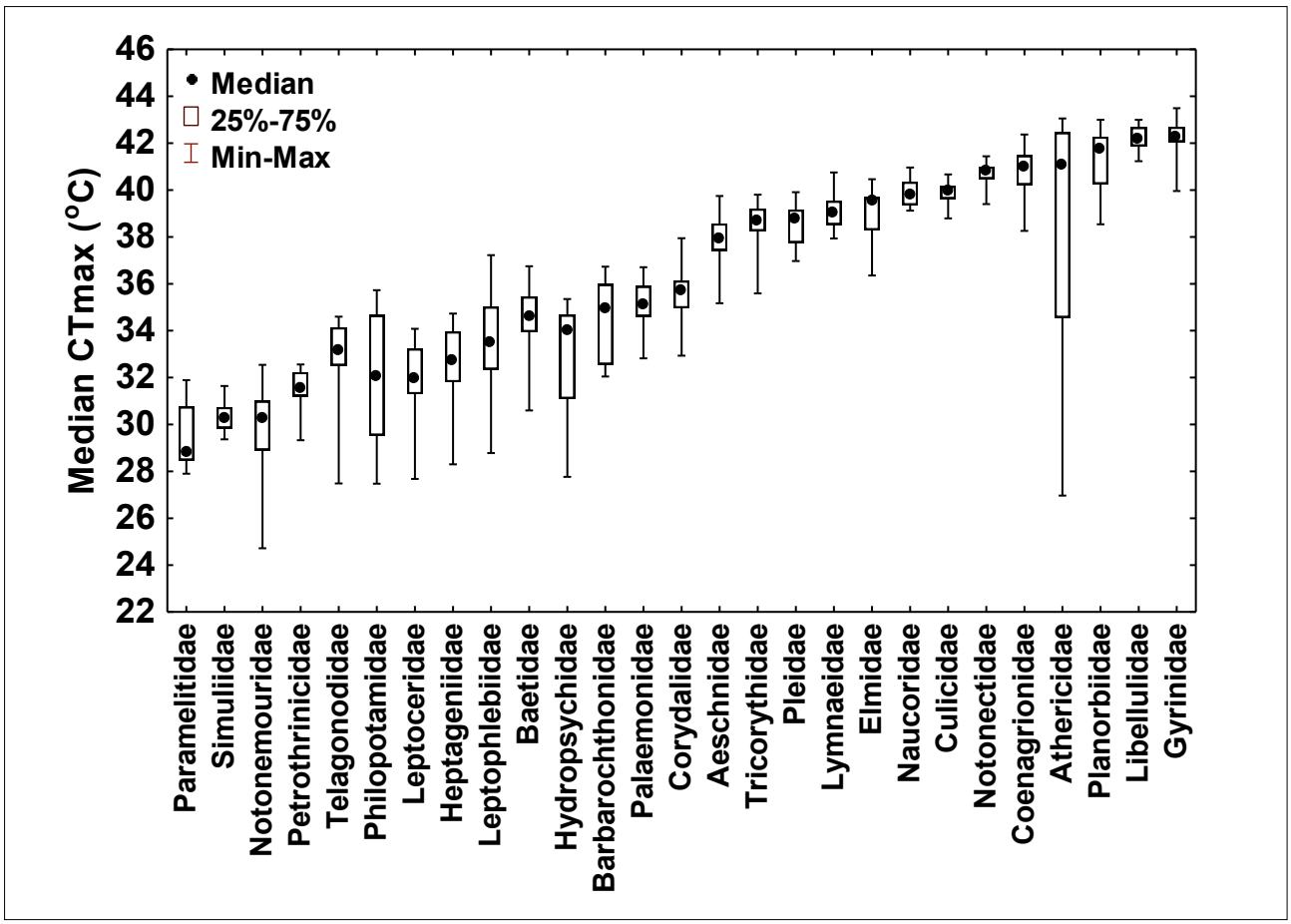

Figure 11. Median CTmax, 25th and 75th percentile and minimum and maximum values (oC) for each macroinvertebrate family tested. Families are arranged from lowest to highest median CTmax. All test organisms were acclimated to 17°C.

These responses were primarily related to water temperature and flow. A number of laboratory experiments of short (Critical Thermal Maxima, CTM) and long (96h-LT50) duration led to the identification of a suite of macroinvertebrate taxa that were thermally sensitive (Figure 11). These taxa have potential for use as bio-indicators of thermal change.

Thermal stress is taxon-dependent, and specialist taxa were typically more sensitive to thermal stress than more generalist species. Laboratory data on thermal tolerances such as incipient lethal limits may be used to generate biological temperature thresholds. These may then be used in, for example, the thermal component of the Ecological Reserve, to assess flow reduction and climate change impacts on biota and to determine the of exceedance of these biological temperature thresholds. Understanding the predictability or cyclical constancy of water temperatures is an important predictive tool in relating biotic responses to abiotic change. Cold-adapted specialist aquatic macroinvertebrates which breed only once a year (which are usually of high conservation importance) are most vulnerable to small increases in water temperatures. Under conditions of increased water temperatures, aquatic macroinvertebrate communities could become increasingly dominated by warm water, widespread generalist species. The results of studies such as this are important in informing the proper management of FEPAs, particularly those found on our CN Nature Reserves. By continued conservation of our more pristine, often priority freshwater ecosystems, the survival of more diverse macroinvertebrate communities in a changing climate should be insured. Therefore the understanding of spatio-temporal thermal patterns in the Eastern and Western Cape provinces requires a multi-scale approach and should form an integral part in planning and management of priority areas.

7. "The diversity of aquatic insects in the Tsitsikamma region, with implications for aquatic ecosystem conservation."

Data shown in this section was gained from the studies done by Terence Bellingan for his MSc. Although Mr. Bellingan's work considered the whole of the Tsitsikamma region, data from the rivers found within the Western Cape Province borders only, were considered here. These rivers include sites on the Matjies, Buffels, Salt, Groot (western) and Bobbejaans Rivers.

The aim of this study was to gain further insight into the diversity and abundances of aquatic invertebrate species, the similarity/difference and uniqueness of the river systems in question and how much of the similarity of taxa between sites/rivers can be explained by abiotic and biotic variables.

Previous studies in the Tsitsikamma area have shown that the rivers in this region have rather high species diversity, with numerous new, previously undescribed species being found (Barber-James, 2000; de Moor & Barber-James, 2001; de Moor *et al.* 2004). This study was no different, with several new species being collected for the invertebrate families collected, i.e. a further two mayfly species, 18 dragonfly species, three species of stoneflies, two species of dobsonflies, 21 species of caddisfly and eight blackfly species (see Appendix C; Bellingan, 2010). Clear patterns were found to exist in species assemblages, largely driven by water chemistry variances between sites.

Here water chemistry was found to be influenced by both anthropogenic and natural impacts. In fact, the flood event of November 2007 could also have reset the river systems, whereby species assemblage patterns could also be a reflection of a "recovery phase" river rather than a completely natural system (Bellingan, 2010; Gasith & Resh, 1999; Death, 2010).

Due to the high species diversity and high level of endemism of these species of the upper, more pristine sections of the Groot (western), Bobbejaans and Salt Rivers, it is suggested that special measures be taken to conserve these areas (Bellingan, 2010).

Way Forward

Nature Reserve monitoring

The monitoring of macro-invertebrates at sites on selected priority rivers in CN Nature Reserves have been and will continue to be incorporated into the ecological matrix planning of the relevant reserves.

Wetland ground-truthing and wetland mapping on reserves

As discussed in the "State of Wetlands" section above, training processes were started in 2011 by Nancy Job as part of the Mondi Wetlands Project to ground-truth and verify CBA wetlands. This training is aimed at CN staff, particularly conservation services and stewardship staff who regularly have to deal with land use issues in what have been mapped as important aquatic (and terrestrial) areas outside of nature reserves. The training will continue in 2012 and aims to capacitate CN staff with delineating wetlands and determining wetland condition. The long term goal is to verify a representative suite of CBAs in the different regions, whereby the FSP CBA maps can be updated in the next five years and to capacitate staff to continue with the mapping process.

As the FSP programme did not consider digitising wetland systems in CN nature reserves, the mapping of wetlands on the relevant nature reserves will be undertaken by CN staff by incorporating this task into the ecological matrix planning for these reserves. In fact, a pilot process has been initiated in the Groot Winterhoek Nature Reserve. The wetland mapping process will ultimately be incorporated into the Protected Area Management Plans for the nature reserves.

Flood line and river management guidelines

With the increase in the frequency of extreme events (such as big floods) and continued encroachment into riparian zones, it has become increasingly important to determine flood lines and develop best practice principals for land use and development in these lines . CapeNature's Marine Protected Areas, Islands and Estuaries Programme is driving a process to assemble guidelines for the sustainable management of river flood-lines. This project involves input from a number of important stakeholders, including from the Department of Water Affairs (DWA), the Department of Environmental Affairs and Development Planning (DEA&DP), Working for Water, Working for Wetlands, District Municipalities, SANParks and private consultants. The aim is to formulate two sets of guidelines, one being an over reaching, more strategic document, and the other being more focussed on actual implementation on the ground. The latter will also serve as a guide to the preparation of river management plans for river catchments and sub-catchments.

The River Health Programme

Since the conclusion of the RHP contract between CN and DWA in March 2010, CN no longer implements the biomonitoring for the RHP in the WCP. However, the aquatic section at CN Scientific Services continues to guide and provide input into the programme in the province. CapeNature will therefore also continue to support the follow up monitoring in the four WMAs and ensure that the findings of these monitoring events be incorporated into the management of aquatic ecosystems.

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Appendix A.
List of Priority Quaternary Catchments per Primary Catchment for the Western Cape Province, determined by the CSIR for the Working for Water programme. Primary catchments in the Western Cape include the Olifants/Doring, Berg, Breede and Gouritz WMA's.

Quaternary Catchments	Location	WfW Project
BERG G1		
G10B	Wemmershoek	Yes
G10G	24 Rivers	No
G22A	Cape Point	Yes SANParks
G22F	Jonkershoek	New – Fire
G10A	Asbos	Yes
BERG G2		
G40A	Steenbras	Yes
G50K	de Hoop	Yes
G40B	Betty's Bay	Yes
G40D	Kogelberg	Yes
G40C	Palmiet River (Grabouw)	Yes Partial CN
BREEDE		
H10E	Limietberg (Bainskloof)	Yes Partial CN
H60B	Theewaterskloof	Yes Partial CN
H60A	Theewaterskloof	Yes Partial CN
H10D	Waaihoek berg-Michells Peak	Yes Partial CN
H10K	Stettynskloof	Yes Partial CN
GARDEN ROUTE		
K60D	Palmiet River (Keurbooms)	Yes – SANParks
K70B	Bloukrans River	Yes Partial SANParks
K30D	Touw River (Wilderness)	Yes Partial SANParks
K30C	Kaaimans River (George)	No
K60B	Keurbooms River	No
GOURITZ		
J25A	Die Hel (Gamkapoort)	No
J12A	Verkeerdevlei Catchment	No
J22J	Leeugamka Dam Catchment	Yes
J33B	Stompdrift Dam Catchment	Yes Partial CN
J12G	Anysberg	No
OLIFANTS/DOORN		
E10H	Jan Dissels River	No
E21K	Dwars River (Cederberg)	No
E24A	Wupperthal (Cederberg)	No
E10A	Agter Witzenberg	Yes
E10C	Olifants River (Visgat)	Yes

Appendix B.
The threat status and level of protection of wetland types in the Western Cape Province (Nel and Driver, 2012), where CR = critically endangered; EN = endangered; LT = least threatened.

Wetland Type	Threat Status	Protection Level
Eastern Fynbos-Renosterveld Conglomerate Fynbos_Channelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Conglomerate Fynbos_Depression	CR	Not protected
Eastern Fynbos-Renosterveld Conglomerate Fynbos_Flat	CR	Not protected
Eastern Fynbos-Renosterveld Conglomerate Fynbos_Seep	CR	Not protected
Eastern Fynbos-Renosterveld Conglomerate Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Channelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Depression	CR	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Flat	CR	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Floodplain wetland	CR	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Seep	EN	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Granite Fynbos_Valleyhead seep	CR	Not protected
Eastern Fynbos-Renosterveld Quartzite Fynbos_Channelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Quartzite Fynbos_Depression	LT	Not protected
Eastern Fynbos-Renosterveld Quartzite Fynbos_Flat	CR	Not protected
Eastern Fynbos-Renosterveld Quartzite Fynbos_Seep	CR	Not protected
Eastern Fynbos-Renosterveld Quartzite Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Sand Fynbos_Channelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Sand Fynbos_Flat	CR	Not protected
Eastern Fynbos-Renosterveld Sand Fynbos_Floodplain wetland	CR	Not protected
Eastern Fynbos-Renosterveld Sand Fynbos_Seep	CR	Not protected
Eastern Fynbos-Renosterveld Sand Fynbos_Unchannelled valley-bottom wetland	LT	Poorly protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Channelled valley-bottom wetland	EN	Poorly protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Depression	EN	Poorly protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Flat	LT	Well protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Floodplain wetland	LT	Well protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Seep	LT	Well protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Unchannelled valley-bottom wetland	CR	Poorly protected
Eastern Fynbos-Renosterveld Sandstone Fynbos_Valleyhead seep	CR	Not protected
Eastern Fynbos-Renosterveld Shale Band Vegetation_Channelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Band Vegetation_Depression	LT	Not protected
Eastern Fynbos-Renosterveld Shale Band Vegetation_Flat	CR	Not protected
Eastern Fynbos-Renosterveld Shale Band Vegetation_Seep	CR	Not protected
Eastern Fynbos-Renosterveld Shale Band Vegetation_Unchannelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Band Vegetation_Valleyhead seep	CR	Not protected
Eastern Fynbos-Renosterveld Shale Fynbos_Channelled valley-bottom wetland	CR	Poorly protected
Eastern Fynbos-Renosterveld Shale Fynbos_Depression	LT	Not protected
Eastern Fynbos-Renosterveld Shale Fynbos_Flat	CR	Poorly protected
Eastern Fynbos-Renosterveld Shale Fynbos_Floodplain wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Fynbos_Seep	LT	Moderately protected
Eastern Fynbos-Renosterveld Shale Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Fynbos_Valleyhead seep	CR	Not protected
Eastern Fynbos-Renosterveld Shale Renosterveld_Channelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Renosterveld_Depression	CR	Not protected

Wetland Type	Threat Status	Protection Level
Eastern Fynbos-Renosterveld Shale Renosterveld_Flat	EN	Not protected
Eastern Fynbos-Renosterveld Shale Renosterveld_Floodplain wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Renosterveld_Seep	CR	Not protected
Eastern Fynbos-Renosterveld Shale Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
Eastern Fynbos-Renosterveld Shale Renosterveld_Valleyhead seep	EN	Not protected
Karoo Dolerite Renosterveld_Channelled valley-bottom wetland	LT	Not protected
Karoo Dolerite Renosterveld_Flat	LT	Not protected
Karoo Dolerite Renosterveld_Seep	LT	Not protected
Karoo Dolerite Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
Karoo Dolerite Renosterveld_Valleyhead seep	LT	Not protected
Karoo Shale Renosterveld_Channelled valley-bottom wetland	LT	Poorly protected
Karoo Shale Renosterveld_Depression	LT	Not protected
Karoo Shale Renosterveld_Flat	LT	Not protected
Karoo Shale Renosterveld_Seep	LT	Not protected
Karoo Shale Renosterveld_Unchannelled valley-bottom wetland	EN	Not protected
Karoo Shale Renosterveld_Valleyhead seep	LT	Not protected
Knersvlakte (Skk)_Channelled valley-bottom wetland	LT	Moderately protected
Knersvlakte (Skk)_Depression	EN	Not protected
Knersvlakte (Skk)_Flat	LT	Poorly protected
Knersvlakte (Skk)_Floodplain wetland	CR	Not protected
Knersvlakte (Skk)_Seep	VU	Not protected
Knersvlakte (Skk)_Unchannelled valley-bottom wetland	VU	Poorly protected
Knersvlakte (Skk)_Valleyhead seep	LT	Moderately protected
Lower Nama Karoo_Channelled valley-bottom wetland	CR	Not protected
Lower Nama Karoo_Depression	LT	Not protected
Lower Nama Karoo_Flat	EN	Not protected
Lower Nama Karoo_Floodplain wetland	LT	Not protected
Lower Nama Karoo_Seep	CR	Not protected
Lower Nama Karoo_Unchannelled valley-bottom wetland	CR	Poorly protected
Lower Nama Karoo_Valleyhead seep	CR	Not protected
Nama Karoo Bushmanland_Channelled valley-bottom wetland	LT	Not protected
Nama Karoo Bushmanland_Depression	LT	Not protected
Nama Karoo Bushmanland_Flat	LT	Not protected
Nama Karoo Bushmanland_Floodplain wetland	LT	Not protected
Nama Karoo Bushmanland_Seep	LT	Not protected
Nama Karoo Bushmanland_Unchannelled valley-bottom wetland	LT	Not protected
Nama Karoo Bushmanland_Valleyhead seep	LT	Not protected
Namaqualand Cape Shrublands Granite Fynbos_Flat	LT	Not protected
Namaqualand Cape Shrublands Granite Fynbos_Seep	LT	Not protected
Namaqualand Cape Shrublands Granite Renosterveld_Channelled valley-bottom wetland	LT	Not protected
Namaqualand Cape Shrublands Granite Renosterveld_Flat	LT	Not protected
Namaqualand Cape Shrublands Granite Renosterveld_Seep	LT	Not protected
Namaqualand Cape Shrublands Quartzite Fynbos_Flat	CR	Not protected
Namaqualand Hardeveld (Skn)_Channelled valley-bottom wetland	LT	Moderately protected

Wetland Type	Threat Status	Protection Level
Namaqualand Hardeveld (Skn)_Depression	LT	Not protected
Namaqualand Hardeveld (Skn)_Flat	LT	Not protected
Namaqualand Hardeveld (Skn)_Floodplain wetland	LT	Not protected
Namaqualand Hardeveld (Skn)_Seep	LT	Not protected
Namaqualand Hardeveld (Skn)_Unchannelled valley-bottom wetland	LT	Not protected
Namaqualand Hardeveld (Skn)_Valleyhead seep	LT	Moderately protected
Namaqualand Sandveld (Sks)_Channelled valley-bottom wetland	LT	Not protected
Namaqualand Sandveld (Sks)_Depression	LT	Not protected
Namaqualand Sandveld (Sks)_Flat	LT	Poorly protected
Namaqualand Sandveld (Sks)_Floodplain wetland	LT	Not protected
Namaqualand Sandveld (Sks)_Seep	LT	Poorly protected
Namaqualand Sandveld (Sks)_Unchannelled valley-bottom wetland	EN	Not protected
Namaqualand Sandveld (Sks)_Valleyhead seep	LT	Poorly protected
Northwest Alluvium Fynbos_Channelled valley-bottom wetland	CR	Not protected
Northwest Alluvium Fynbos_Flat	CR	Not protected
Northwest Alluvium Fynbos_Floodplain wetland	CR	Not protected
Northwest Alluvium Fynbos_Seep	CR	Not protected
Northwest Alluvium Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Northwest Alluvium Fynbos_Valleyhead seep	LT	Not protected
Northwest Quartzite Fynbos_Channelled valley-bottom wetland	EN	Not protected
Northwest Quartzite Fynbos_Depression	LT	Poorly protected
Northwest Quartzite Fynbos_Flat	CR	Not protected
Northwest Quartzite Fynbos_Seep	CR	Not protected
Northwest Quartzite Fynbos_Unchannelled valley-bottom wetland	VU	Not protected
Northwest Sand Fynbos_Channelled valley-bottom wetland	CR	Not protected
Northwest Sand Fynbos_Depression	CR	Not protected
Northwest Sand Fynbos_Flat	EN	Not protected
Northwest Sand Fynbos_Floodplain wetland	CR	Not protected
Northwest Sand Fynbos_Seep	CR	Not protected
Northwest Sand Fynbos_Unchannelled valley-bottom wetland	EN	Not protected
Northwest Sand Fynbos_Valleyhead seep	EN	Not protected
Northwest Sandstone Fynbos_Channelled valley-bottom wetland	LT	Moderately protected
Northwest Sandstone Fynbos_Depression	CR	Not protected
Northwest Sandstone Fynbos_Flat	LT	Moderately protected
Northwest Sandstone Fynbos_Seep	LT	Moderately protected
Northwest Sandstone Fynbos_Unchannelled valley-bottom wetland	EN	Poorly protected
Northwest Sandstone Fynbos_Valleyhead seep	EN	Poorly protected
Northwest Shale Band Vegetation_Channelled valley-bottom wetland	CR	Not protected
Northwest Shale Band Vegetation_Flat	LT	Well protected
Northwest Shale Band Vegetation_Seep	EN	Not protected
Northwest Shale Band Vegetation_Unchannelled valley-bottom wetland	LT	Well protected
Northwest Shale Fynbos_Channelled valley-bottom wetland	CR	Not protected
Northwest Shale Fynbos_Flat	CR	Not protected

Wetland Type	Threat Status	Protection Level
Northwest Shale Fynbos_Seep	CR	Not protected
Northwest Shale Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Northwest Shale Fynbos_Valleyhead seep	CR	Not protected
Rainshadow Valley Karoo (Skv)_Channelled valley-bottom wetland	CR	Not protected
Rainshadow Valley Karoo (Skv)_Depression	LT	Well protected
Rainshadow Valley Karoo (Skv)_Flat	EN	Not protected
Rainshadow Valley Karoo (Skv)_Floodplain wetland	CR	Not protected
Rainshadow Valley Karoo (Skv)_Seep	EN	Moderately protected
Rainshadow Valley Karoo (Skv)_Unchannelled valley-bottom wetland	CR	Poorly protected
Rainshadow Valley Karoo (Skv)_Valleyhead seep	EN	Not protected
Richtersveld (Skr)_Depression	LT	Well protected
Richtersveld (Skr)_Flat	LT	Not protected
Richtersveld (Skr)_Floodplain wetland	LT	Not protected
Richtersveld (Skr)_Seep	CR	Not protected
Richtersveld (Skr)_Unchannelled valley-bottom wetland	CR	Not protected
South Coast Limestone Fynbos_Channelled valley-bottom wetland	EN	Poorly protected
South Coast Limestone Fynbos_Depression	LT	Moderately protected
South Coast Limestone Fynbos_Flat	LT	Poorly protected
South Coast Limestone Fynbos_Floodplain wetland	LT	Not protected
South Coast Limestone Fynbos_Seep	LT	Moderately protected
South Coast Limestone Fynbos_Unchannelled valley-bottom wetland	LT	Well protected
South Coast Limestone Fynbos_Valleyhead seep	LT	Moderately protected
South Coast Sand Fynbos_Channelled valley-bottom wetland	EN	Not protected
South Coast Sand Fynbos_Depression	EN	Well protected
South Coast Sand Fynbos_Flat	LT	Not protected
South Coast Sand Fynbos_Seep	CR	Not protected
South Coast Sand Fynbos_Unchannelled valley-bottom wetland	CR	Poorly protected
South Coast Sand Fynbos_Valleyhead seep	CR	Not protected
South Strandveld Sand Fynbos_Channelled valley-bottom wetland	LT	Not protected
South Strandveld Sand Fynbos_Depression	LT	Not protected
South Strandveld Sand Fynbos_Flat	LT	Well protected
South Strandveld Sand Fynbos_Floodplain wetland	EN	Poorly protected
South Strandveld Sand Fynbos_Seep	LT	Not protected
South Strandveld Sand Fynbos_Unchannelled valley-bottom wetland	LT	Well protected
South Strandveld Sand Fynbos_Valleyhead seep	CR	Not protected
South Strandveld Western Strandveld_Channelled valley-bottom wetland	EN	Not protected
South Strandveld Western Strandveld_Depression	LT	Moderately protected
South Strandveld Western Strandveld_Flat	EN	Poorly protected
South Strandveld Western Strandveld_Floodplain wetland	EN	Moderately protected
South Strandveld Western Strandveld_Seep	LT	Moderately protected

Wetland Type	Threat Status	Protection Level
South Strandveld Western Strandveld_Unchannelled valley-bottom wetland	LT	Poorly protected
South Strandveld Western Strandveld_Valleyhead seep	LT	Well protected
Southern Sandstone Fynbos_Channelled valley-bottom wetland	LT	Well protected
Southern Sandstone Fynbos_Depression	LT	Not protected
Southern Sandstone Fynbos_Flat	LT	Well protected
Southern Sandstone Fynbos_Seep	LT	Well protected
Southern Sandstone Fynbos_Unchannelled valley-bottom wetland	VU	Well protected
Southern Sandstone Fynbos_Valleyhead seep	VU	Not protected
Southern Shale Band Vegetation_Channelled valley-bottom wetland	CR	Moderately protected
Southern Shale Band Vegetation_Depression	CR	Not protected
Southern Shale Band Vegetation_Flat	LT	Well protected
Southern Shale Band Vegetation_Seep	LT	Well protected
Southern Shale Band Vegetation_Unchannelled valley-bottom wetland	LT	Not protected
Southern Shale Fynbos_Channelled valley-bottom wetland	CR	Not protected
Southern Shale Fynbos_Flat	CR	Not protected
Southern Shale Fynbos_Seep	CR	Not protected
Southern Shale Fynbos_Unchannelled valley-bottom wetland	VU	Not protected
Southern Silcrete Fynbos_Channelled valley-bottom wetland	CR	Poorly protected
Southern Silcrete Fynbos_Depression	CR	Not protected
Southern Silcrete Fynbos_Flat	LT	Well protected
Southern Silcrete Fynbos_Seep	LT	Well protected
Southern Silcrete Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Southern Silcrete Fynbos_Valleyhead seep	LT	Well protected
Southwest Alluvium Fynbos_Channelled valley-bottom wetland	EN	Moderately protected
Southwest Alluvium Fynbos_Depression	CR	Not protected
Southwest Alluvium Fynbos_Flat	CR	Poorly protected
Southwest Alluvium Fynbos_Seep	EN	Well protected
Southwest Alluvium Fynbos_Unchannelled valley-bottom wetland	CR	Poorly protected
Southwest Alluvium Fynbos_Valleyhead seep	CR	Not protected
Southwest Ferricrete Fynbos_Channelled valley-bottom wetland	CR	Not protected
Southwest Ferricrete Fynbos_Depression	EN	Well protected
Southwest Ferricrete Fynbos_Flat	LT	Moderately protected
Southwest Ferricrete Fynbos_Floodplain wetland	CR	Not protected
Southwest Ferricrete Fynbos_Seep	EN	Poorly protected
Southwest Ferricrete Fynbos_Unchannelled valley-bottom wetland	EN	Well protected
Southwest Ferricrete Fynbos_Valleyhead seep	EN	Well protected
Southwest Granite Fynbos_Channelled valley-bottom wetland	CR	Moderately protected
Southwest Granite Fynbos_Depression	CR	Not protected
Southwest Granite Fynbos_Flat	CR	Not protected
Southwest Granite Fynbos_Floodplain wetland	CR	Not protected
Southwest Granite Fynbos_Seep	CR	Not protected
Southwest Granite Fynbos_Unchannelled valley-bottom wetland	CR	Poorly protected
Southwest Granite Fynbos_Valleyhead seep	CR	Not protected

Wetland Type	Threat Status	Protection Level
Southwest Quartzite Fynbos_Channelled valley-bottom wetland	CR	Not protected
Southwest Quartzite Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Southwest Sand Fynbos_Channelled valley-bottom wetland	CR	Poorly protected
Southwest Sand Fynbos_Depression	VU	Not protected
Southwest Sand Fynbos_Flat	CR	Moderately protected
Southwest Sand Fynbos_Floodplain wetland	CR	Not protected
Southwest Sand Fynbos_Seep	EN	Poorly protected
Southwest Sand Fynbos_Unchannelled valley-bottom wetland	CR	Poorly protected
Southwest Sand Fynbos_Valleyhead seep	CR	Poorly protected
Southwest Sandstone Fynbos_Channelled valley-bottom wetland	CR	Moderately protected
Southwest Sandstone Fynbos_Depression	LT	Well protected
Southwest Sandstone Fynbos_Flat	LT	Well protected
Southwest Sandstone Fynbos_Floodplain wetland	CR	Not protected
Southwest Sandstone Fynbos_Seep	LT	Moderately protected
Southwest Sandstone Fynbos_Unchannelled valley-bottom wetland	VU	Well protected
Southwest Sandstone Fynbos_Valleyhead seep	CR	Poorly protected
Southwest Shale Band Vegetation_Channelled valley-bottom wetland	LT	Well protected
Southwest Shale Band Vegetation_Flat	LT	Well protected
Southwest Shale Band Vegetation_Seep	LT	Well protected
Southwest Shale Band Vegetation_Unchannelled valley-bottom wetland	CR	Not protected
Southwest Shale Fynbos_Channelled valley-bottom wetland	CR	Poorly protected
Southwest Shale Fynbos_Flat	CR	Poorly protected
Southwest Shale Fynbos_Seep	LT	Well protected
Southwest Shale Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Southwest Shale Fynbos_Valleyhead seep	CR	Not protected
Soutwest Sand Fynbos_Unchannelled valley-bottom wetland	LT	Not protected
Trans-Escarpment Succulent Karoo (Skt)_Channelled valley-bottom wetland	LT	Not protected
Trans-Escarpment Succulent Karoo (Skt)_Depression	LT	Not protected
Trans-Escarpment Succulent Karoo (Skt)_Flat	LT	Not protected
Trans-Escarpment Succulent Karoo (Skt)_Seep	VU	Not protected
Trans-Escarpment Succulent Karoo (Skt)_Unchannelled valley-bottom wetland	LT	Not protected
Trans-Escarpment Succulent Karoo (Skt)_Valleyhead seep	LT	Not protected
Upper Nama Karoo_Channelled valley-bottom wetland	EN	Not protected
Upper Nama Karoo_Depression	LT	Not protected
Upper Nama Karoo_Flat	VU	Not protected
Upper Nama Karoo_Floodplain wetland	VU	Not protected
Upper Nama Karoo_Seep	CR	Not protected
Upper Nama Karoo_Unchannelled valley-bottom wetland	VU	Not protected
Upper Nama Karoo_Valleyhead seep	VU	Not protected
West Coast Alluvium Renosterveld_Channelled valley-bottom wetland	CR	Not protected
West Coast Alluvium Renosterveld_Flat	CR	Not protected
West Coast Alluvium Renosterveld_Floodplain wetland	CR	Not protected
West Coast Alluvium Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected

Wetland Type	Threat Status	Protection Level
West Coast Alluvium Renosterveld_Valleyhead seep	CR	Not protected
West Coast Granite Renosterveld_Channelled valley-bottom wetland	CR	Not protected
West Coast Granite Renosterveld_Depression	CR	Not protected
West Coast Granite Renosterveld_Flat	CR	Not protected
West Coast Granite Renosterveld_Floodplain wetland	CR	Not protected
West Coast Granite Renosterveld_Seep	CR	Not protected
West Coast Granite Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
West Coast Granite Renosterveld_Valleyhead seep	CR	Not protected
West Coast Shale Renosterveld_Channelled valley-bottom wetland	CR	Not protected
West Coast Shale Renosterveld_Depression	CR	Not protected
West Coast Shale Renosterveld_Flat	CR	Not protected
West Coast Shale Renosterveld_Floodplain wetland	CR	Not protected
West Coast Shale Renosterveld_Seep	CR	Not protected
West Coast Shale Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
West Coast Shale Renosterveld_Valleyhead seep	CR	Not protected
West Coast Silcrete Renosterveld_Channelled valley-bottom wetland	CR	Not protected
West Coast Silcrete Renosterveld_Depression	CR	Not protected
West Coast Silcrete Renosterveld_Flat	CR	Not protected
West Coast Silcrete Renosterveld_Seep	CR	Not protected
West Coast Silcrete Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
West Coast Silcrete Renosterveld_Valleyhead seep	CR	Not protected
Western Fynbos-Renosterveld Conglomerate Fynbos_Channelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Conglomerate Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Limestone Renosterveld_Channelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Limestone Renosterveld_Flat	CR	Not protected
Western Fynbos-Renosterveld Limestone Renosterveld_Seep	CR	Not protected
Western Fynbos-Renosterveld Limestone Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Quartzite Fynbos_Channelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Quartzite Fynbos_Flat	CR	Not protected
Western Fynbos-Renosterveld Quartzite Fynbos_Seep	VU	Not protected
Western Fynbos-Renosterveld Quartzite Fynbos_Unchannelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Sandstone Fynbos_Channelled valley-bottom wetland	LT	Well protected
Western Fynbos-Renosterveld Sandstone Fynbos_Flat	CR	Not protected
Western Fynbos-Renosterveld Sandstone Fynbos_Seep	EN	Well protected
Western Fynbos-Renosterveld Sandstone Fynbos_Unchannelled valley-bottom wetland	CR	Poorly protected
Western Fynbos-Renosterveld Sandstone Fynbos_Valleyhead seep	CR	Not protected
Western Fynbos-Renosterveld Shale Band Vegetation_Flat	LT	Well protected
Western Fynbos-Renosterveld Shale Band Vegetation_Unchannelled valley-bottom wetland	LT	Well protected
Western Fynbos-Renosterveld Shale Fynbos_Channelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Shale Fynbos_Flat	CR	Not protected
Western Fynbos-Renosterveld Shale Fynbos_Seep	CR	Not protected
Western Fynbos-Renosterveld Shale Fynbos_Unchannelled valley-bottom wetland	VU	Not protected
Western Fynbos-Renosterveld Shale Renosterveld_Channelled valley-bottom wetland	CR	Moderately protected
Western Fynbos-Renosterveld Shale Renosterveld_Depression	CR	Not protected

Wetland Type	Threat Status	Protection Level
Western Fynbos-Renosterveld Shale Renosterveld_Flat	CR	Moderately protected
Western Fynbos-Renosterveld Shale Renosterveld_Floodplain wetland	CR	Not protected
Western Fynbos-Renosterveld Shale Renosterveld_Seep	VU	Not protected
Western Fynbos-Renosterveld Shale Renosterveld_Unchannelled valley-bottom wetland	CR	Not protected
Western Fynbos-Renosterveld Shale Renosterveld_Valleyhead seep	CR	Moderately protected
Western Strandveld_Channelled valley-bottom wetland	CR	Moderately protected
Western Strandveld_Depression	EN	Poorly protected
Western Strandveld_Flat	CR	Not protected
Western Strandveld_Floodplain wetland	EN	Well protected
Western Strandveld_Seep	CR	Not protected
Western Strandveld_Unchannelled valley-bottom wetland	LT	Moderately protected
Western Strandveld_Valleyhead seep	LT	Not protected

Appendix C.
Species list and abundances for invertebrate families caught during four sampling events on the Matjies (upper), Buffels (upper and lower), Salt (upper and lower), Groot (upper and lower) and Bobbejaans (upper) Rivers. South-Western Cape endemic*, R.S.A. endemic** and Afrotropical***.

Order	Family	Taxon	U. Matjies	L. Buffels	U. Buffels	U. Salt	L. Salt	L. Groot (W)	U. Groot (W)	U. Bobbe-jaans
Ephemeroptera	Baetidae	*Afroptilum sudafricanum****	28	49	53		7			
		*Baetis harrisoni****	4	4	11	4	11	5	1	10
		*Bugillesia sp.**				1				
		*Cheleocloeon excisum***	22							
		*Cloeodes sp.**				217	1	13	34	14
		*Pseudocloeon vino-sum****	1			789	53	8	104	208
		*Cloeon sp.***	1	4	2					
	Caenidae	*Caenis capensis***	50	466	27			1		
	Heptageniidae	*Afronurus peringueyi****						4		1
	Leptophlebiidae	*Aprionyx sp.***				11		1	2	10
		*Aprionyx rubicundus***							3	
		*Castanophlebia calida***			1	137		7	109	29
		*Choroterpes nigriscens***	48	36	55		1			
		*Adenophlebia auricu-lata***	48	36	55		1			
	Teloganodidae	*Ephemerellina barnardi**								7
		*Lestagella penicillata***				89	1	13	20	1
		*Genus sp TSR151A**				43				3
		*Genus sp TSR472K**						1	1	
		*Nadinetella sp. TSR173E**				1		1		13
		*Nadinetella sp. TSR378K**				1				
Odonata	Aeshnidae	*Aeshna minuscula****						1		
		*Aeshna subpupillata****			1					
		*Anax speratus****								1
	Corduliidae	*Syncordulia gracillis****					1			
	Coenagrionidae	*Ceriagrion glabrum****	3	3	3	4		1		
		*Ishnura senegalensis****						8		
		*Pseuagrion furcigerum**				8	8	14	12	19
		*Pseuagrion hageni hageni***		3	3		5	9		
		*Pseudagrion kersteni****				1				
	Libellulidae	*Crocothemis ery-traea****				1				
		*Crocothemis sanguinolenta****								2

Order	Family	Taxon	U. Matjies	L. Buffels	U. Buffels	U. Salt	L. Salt	L. Groot (W)	U. Groot (W)	U. Bobbe-jaans
		*Othetrum julia capi-cola****	1	1	3	5	6	16		2
		*Sympetrum fonscolombii****						13		
		*Trithemis arteriosa****				1	3	4		2
		*Trithemis furva****		1	1			8		
		*Trithemis stictica****			2			11		1
	Platycnemididae	*Allocnemis leucosticta***	20	15	6	12	7	8	6	3
	Protoneuridae	*Elattoneura frenulata**						3	1	2
	Synlestidae	*Chlorolestes conspicuus**				4			5	3
		*Chlorolestes tessellatus***	7	8	6		6			
		*Chlorolestes umbratus***				8	10	7	3	22
		*Ecchlorolestes nyl-ephtha**		1		19		4	4	
Plecoptera	Notonemouridae	*Aphanicerca capensis form O**				2				
		*Aphanicerca capensis form P**							2	4
		Aphanicerca sp				55	6		60	
		*Aphanicercella cas-sida***						10		
		*Aphanicercella bifur-cata***		3		3		8	6	1
		Aphanicercellasp	8	12	1	10		4		9
		*Aphanicercopsis outeni-quae**						2	5	1
		Aphanicercopsis sp	27	13	12	266	1	3	25	3
Megaloptera	Corydalidae	*Chloroniella peringueyi**				2		1	2	2
		*Platychauliodes sp1 **	1	6	3	11		4	3	3
		*Platychauliodes woodi**	4	6	4	3	1		9	6
		*Taeniochauliodes ochra-ceopennis***				5		6	1	6
Trichoptera (larvae)	Glossosomatidae	*Agapetus murinus**				31			110	6
	Hydroptilidae	*Orthotrichia barnardi***		1						
	Philopotamidae	*Dolophilodes urceolus**				18			1	
		*Chimarra sp.***	73	49	62	60	65	11	51	5
	Hydropsychidae	*Cheumatopsyche afra****			6					
		*Cheumatopsyche TSR136E**	90	123	67		60			
		*Sciadorus obtusus**				214			15	3
		*Macrostemum capense**				214			15	3
	Ecnomidae	*Ecnomus sp.*	1			1				
		*Parecnomina sp.**				5			2	4

Order	Family	Taxon	U. Matjies	L. Buffels	U. Buffels	U. Salt	L. Salt	L. Groot (W)	U. Groot (W)	U. Bobbe-jaans
	Pisuliidae	*Dyschimus sp.***				4		1		
	Leptoceridae	*Ahripsodes prionii**				4	1	1	4	8
		*Ahripsodes harrisoni***						10		35
		*Ahripsodes schoeno-bates**						1		
		*Ahripsodes bergensis**				42	60	183	2	12
		Oecetis sp				42	8	21	11	5
		*Leptecho twisted case sp.**						1		1
	Barbarochthoni-dae	*Barbarochthon brun-neum**				63	1	143	58	222
	Petrothrincidae	*Petrothrincus demoori**				10		1	3	1
	Sericostomatida	*Petroplax sp.**				1				2
Trichoptera (adult)	Glossosomatidae	*Agapetus murinus**				2			8	1
	Hydroptilidae	*Hydroptila cruciata****	1	6	12		11	5	3	1
		*Orthotrichia barnardi***		1						5
		*Orthotrichia SCR164A**								1
		*Oxyethira velocipes***		15	22	5	49	9		4
	Philopotamidae	*Chimarra ambulans***		1	3	27	153	6	242	620
		*Chimarra cereris****								1
		*Chimarra georgensis***			1					
		*Dolophilodes urceolus**				19	1	2	38	23
	Hydropsychidae	*Cheumatopsyche afra****	3	9			21	1		
		*Cheumatopsyche TSR539K**	4	17	34		83			
		*Sciadorus obtusus**				2				1
	Ecnomidae	*Ecnomus appidanus***						1		3
		*Ecnomus similis****	15	67	22	12	1	21	9	13
		*Parecnomina resima**				13			34	29
		*Parecnomina TSR545E**								1
	Dipseudopsidae	*Dipseudopsis capen-sis****					1			
	Pisuliidae	*Dyschimus collyrifer**				5			19	9
		*Dyschimus SCR248F**				7				
	Leptoceridae	*Ahripsodes bergensis**	5	12	11	420	10236	1160	621	524
		*Ahripsodes harrisoni****	1	12	7					
		*Ahripsodes oryx**							29	1
		*Ahripsodes prionii**		3		8		9	6	

Order	Family	Taxon	U. Matjies	L. Buffels	U. Buffels	U. Salt	L. Salt	L. Groot (W)	U. Groot (W)	U. Bobbe-jaans
		*Ahripsodes scramasax**				1				
		*Ahripsodes spatula**								22
		*Ahripsodes TSR472C**				1		6		3
		*Leptecho TSR491i**								1
		*Leptecho SCR258K**						4		
		*Leptecho SCR265K**		2		75			727	442
		*Oecetis modesta***	2	4	12	5	18	4		4
		*Oecetis SCR164N**		3		1		1	2	1
		*Oecetis TSR513B**	5					2		
		*Oecetis TSR547L**		1	2					
	Barbarochthoni-dae	*Barbarochthon brunneum**								1
	Petrothrincidae	*Petrothrincus demoori**							6	3
	Sericostomatida	*Petroplax prionii**							4	
		*Petroplax SCR213F**								9
		*Petroplax TSR447**						1		
Simuliidae	Simuliidae	*Simulium dentulo-sum****			97					
		*Simulium hessei**				1				1
		*Simulium impukane****	46	89	121		8	6		
		*Simulium medusaeforme****					4	186	1	
		*Simulium merops***	8			126	232		33	18
		*Simulium nigritarse****				1	2			
		*Simulium rutherfoordi****	89	112	432		27	1		
		*Simulium vorax****		4	257	255			10	21

CHAPTER 3

ESTUARINE ECOSYSTEMS

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CONTENTS

DE MOND: LIESEL KERSHOFF

Executive Summary

This is the first report on estuaries in the CapeNature state of biodiversity reporting process. Of importance is the fact that estuaries form an integral part in the ecosystem connectivity between terrestrial systems and processes, catchments and the ocean and should not be managed in isolation. Estuary management requires an integrated effort form all relevant authorities. This report is based on data obtained from the National Biodiversity Assessment 2011(NBA): Estuary component (refer to NBA for methods). The South African coastline is approximately 3 100km with a total of 300 functional estuaries along it length. A subset of the Western Cape data in the NBA, consisting of 53 estuaries from the Olifants Estuary on the West Coast to the Bloukrans Estuary on the South East Coast were analysed in order to provide this provincial perspective. This report summarises the ecosystem threat status, ecosystem protection status, and biodiversity conservation and management interventions in estuaries in the WCP.

In addition to the above, estuary management and estuary management plans as stipulated in the Integrated Coastal Management Act (24 of 2008) and the estuarine ecological freshwater flows as stipulated in the National Water Act (36 of 1998) are discussed in relation to the impact of these of estuary condition. Progress made with regards to the development and implementation of the above processes in the WCP estuaries is included in this report.

Although the state of the majority of estuarine systems in the Western Cape is good or fair , the overall data highlights the need to intensify biodiversity conservation and management efforts since a high proportion of the estuaries are critically endangered and protection levels are low.

Background

An estuary forms the link between a catchment and the ocean. Actions in the catchment have an impact on the estuary and the ocean. 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 definition is being reviewed with the aim of including the estuarine functional zone. 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, or when there is little or no fluvial input. An estuary can be isolated from the sea by a sandbar and become a lagoon or lake which may become fresh or hypersaline.

Estuary Management Plans, a requirement of the Integrated Coastal Management Act (2008), are effective tools that can be used to integrate the ecological, social and economic drivers in at each estuary. The successful implementation of these estuary management plans will undoubtedly result in improved estuary management and associated condition. Linking estuary management to catchment management is also essential. An estuary requires specific freshwater flows in order to maintain ecological processes. Determining and implementing Ecological Reserves and forming partnerships with Catchment Management Agencies are essential.

The South African coastline is approximately 3100 km long with a total of 300 functional estuaries along its length. For the purpose of this report a subset of 53 estuaries occurring in the Western Cape Province (WCP), from the Olifants Estuary on the West Coast to the Bloukrans Estuary on the South East Coast were considered.

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 major dam, cumulative effects of smaller dams.	Closure of mouth 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: Interbasin transfer schemes, waste water treatment works, hardening of catchment.	Prolonged mouth opening in temporarily open/closed estuaries; altered physical conditions, effects on biota.
Pollution	Increased population, increase demand for water supplies	Municipal wastewater; Industrial wastewater; Stormwater runoff (including solid waste); and Agricultural runoff (increased nutrients, 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	In fish: Increased population, increase demand for food supplies.	Over-fishing and illegal gill netting, increased fishing demands.	Recruitment failure in some fish species; direct decline of fish stocks.
	In invertebrates: Increased angling activities.	Demand for fishing bait.	Impact on target and other organisms and associated habitats e.g. heavily harvested species, such as *Callianassa kraussi* and *Upogepia africana*.
Land-use and development	Increased population, increase with increased coastal development.	Inappropriate land-use and development in and around an estuary, 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.
Estuary mouth manipulation	Increased public pressure to avert negative impacts such as loss to property.	Inappropriate development in the estuarine functional zone, Prolonged mouth closure linked to reduction in flow, increased back-flooding on low-lying developments.	Artificial breaching, channelisation, diversion of mouth direction; Change in the type of estuary, e.g. from temporarily open to permanently open; impacts on physical parameters and biota.
Emerging threats			
Aquaculture and Mariculture	Increased population, increase demand for food supplies.	Inappropriate practices in freshwater aquaculture and marine aquaculture or mariculture.	Increased habitat loss; increased pollution to the river and or estuary; decline in water quality; impacts on biota e.g. spread of disease.

Threats to estuaries			
Threats	Drivers	Causes/Sources	Consequences
Desalination plants	Increased population, increase demand for water supplies.	Poorly located desalination plants; discharge of brine.	Increased habitat loss; 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 casing a barrier to upstream migration, habitat altering species causing changes in sediment structure and/or water clarity.	Recruitment failure, e.g. eels and freshwater mullet. Changes in community structure due to habitat changes.

Threats to estuaries and biodiversity

The influx of people into coastal areas has been on the rise over the past decade which has resulted in increases in pressure on coastal ecosystems and resources including estuaries (Morant & Quinn 1999). These threats may be direct in the form of development in the estuarine floodplain and the overharvesting of estuarine fish or indirect like the increased need for freshwater from dams 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 may be seen in Appendix 1.

Flow modification

The analysis of the data indicates that nine percent of WCP estuaries are under significant flow modification pressure, and these include: Jakkalsvlei, Wadrift, Sout (Wes), Steenbras and Onrus (Figure 1A). The large permanently open estuaries such as the Berg and Olifants estuaries are part of the 42% under moderate degree of flow modification. Over half of the estuaries (49%) are under low flow modification. 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).

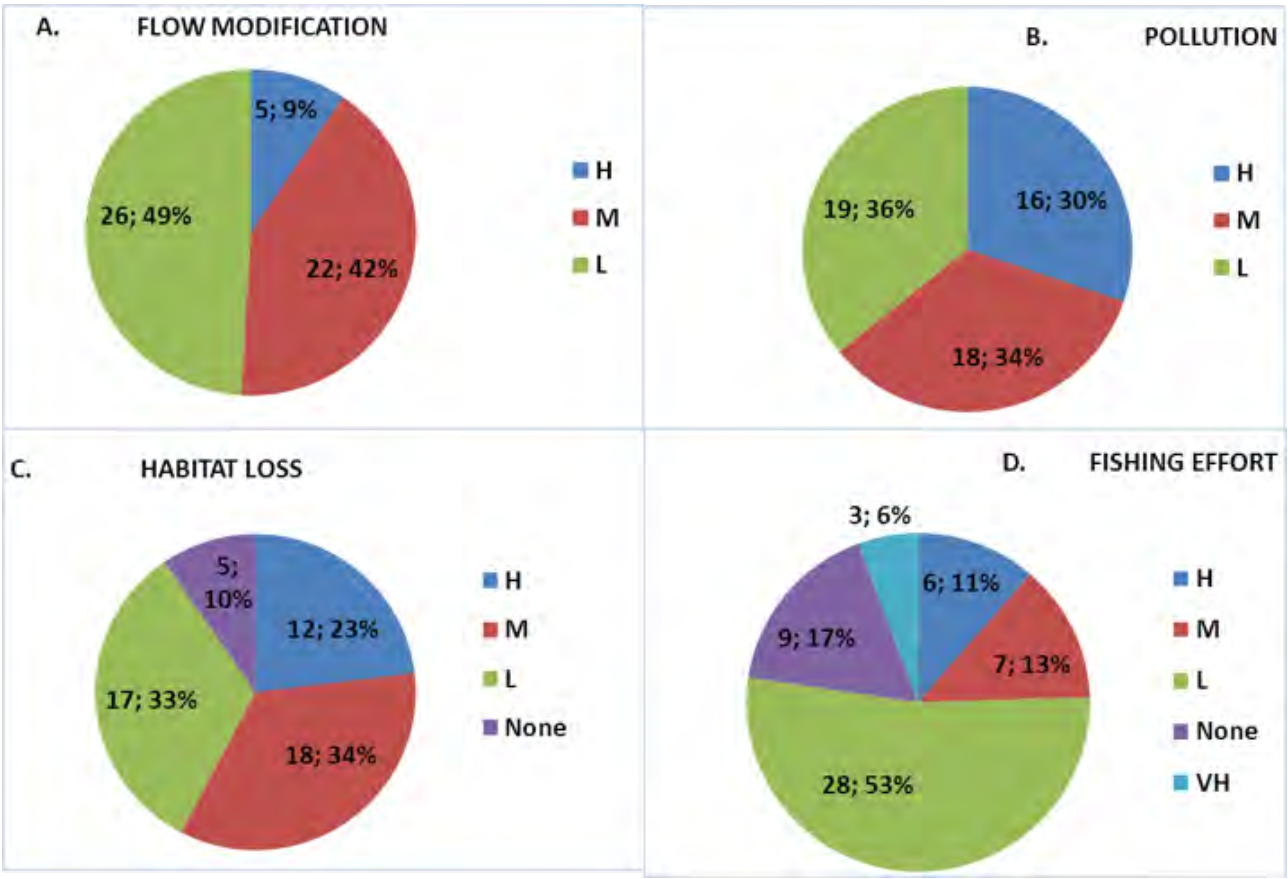

Figure 1: Data for 53 estuaries in the Western Cape showing proportions for each of A. Flow modification; B. Pollution; C. Habitat loss; and D. Fishing effort (VH-Very high, H-High, M-moderate, L-low, None).

Figure 2. Mouth of the Kaaimans Estuary near Wilderness and George.

In the Kuils/Eerste estuary an increase in the inflow is a result of the hardening of catchments and the effluent inflow from five wastewater treatment works. Figure 2 shows the mouth of the Kaaimans estuary with sediment accumulating near the mouth as a result of altered flows from the catchment and flow restrictions caused by the bridge structure.

Pollution

The results of the assessment indicate that 30% of the Western Cape's estuaries are under significant high pollution pressure (Figure 1B). These include amongst others: the Groot Berg, Rietvlei and Onrus which have numerous developments on their catchments. Moderately impacted estuaries comprise 34% of the total whilst 36% 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. Numerous municipal wastewater treatments works (WWTW) discharge effluent into estuaries (Table 2). A comparison between data from 1991 and 2004 indicates that WWTW discharge volumes to estuaries have almost doubled over this period, reflecting the rapid population growth in coastal areas (DEAT 2008). 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 Estuary). Overflowing sewage pump stations are a specific concern and regular pump failures have been recorded in systems such as the Lourens and Onrus. In terms of industrial discharges, an emerging concern is the disposal of brine (e.g. Piesang and Knysna estuaries) that can have detrimental impacts on these sheltered and sensitive coastal environments.

The Department of Water Affairs' operational policy for the disposal of land-derived waste water to the marine environment aims to prohibit (L. van Niekerk, pers. comm) new wastewater discharges into sensitive coastal areas such as estuaries (DWAF 2004). This policy is in the process of being incorporated in procedures being developed for the National Environmental Management Act: Integrated Coastal Management Act (2008) for the Department of Environmental Affairs. However, it will require a serious commitment from both departments 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 need to be included in appropriate Estuary Management Plans 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.

Table 2: Direct wastewater discharges into estuaries in the Western Cape (updated from DEAT, 2008).

Estuary (location)	Effluent type	Estimated flow (m^3/day)
Berg (Marine Product, Laaiplek)	Industrial (Fish)	130 000
Rietvlei/Diep (Milnerton, Cape Town)	WWTW	44 126
Wildevoëlvlei (Kommetjie, Cape Town)	WWTW	11 577
Eerste (Macassar, Cape Town)	WWTW	54 494
Hartenbos (Mossel Bay)	WWTW	6 471
Knysna (Knysna)	WWTW	3 955
Piesang	Industrial (Brine)	50*

Figure 3. Dried algal mats on the salt marsh at the Uilkraals Estuary. Photo Prof. J. Adams.

Figure 4. Development in close proximity to the Bot Estuary results in freshwater and fertiliser run-off which encourages reed growth. Photo Prof. J. Adams.

Land use and development

Data presented in Figure 1C indicates that in the Western Cape 23% of estuaries exhibit high degrees of habitat loss. Most of these systems are located in development zones with high population densities such as Rietvlei, Sout and Houtbaai estuaries. Thirty four percent exhibit a moderate degree of habitat loss while a further 33% of the systems exhibit a low degree of habitat loss. Only 10% of the systems have been recorded to have no habitat loss. Low-lying developments e.g. in the Bot estuary (Figure 4), land reclamation, mining, infrastructure developments such as roads, bridges and jetties; or the remodelling of part of an estuary for harbour or marina construction, all result in habitat loss. In addition to this, there are 12 proclaimed fishing harbours located mainly along the southern and Western Cape coast, one of which is in an estuary, the Groot Berg. Structures also interfere with flow patterns which alters available habitat. A typical example is the bridge spanning the Uilkraals Estuary where changes in flow velocity, and related sediment distribution, have led to possible changes in habitat and biota. It is notable that since the construction of a bridge over the Uilkraals Estuary the bloodworm *Arenicola loveni* has disappeared from the estuary upstream of the bridge and the algal growth in this area has also been affected (Figure 3). In the Zandvlei estuary, tidal flows are impaired through the build-up of sediment caused by a weir, the bridge construction and mouth stabilisation, which can lead to premature mouth closure. A mouth management protocol has been developed as part of the Zandvlei Estuary Management Plan with the aim of maximising ecological benefits within this altered estuarine system.

Exploitation of living resources

Some form of bait collection occurs in 87% of the estuaries in the Province. Results as shown on Figure 1D indicates that fishing effort is very high in six percent of the systems comprising of three estuaries under intense pressure. Another 11% of the estuaries have high fishing pressure. Estuaries under moderate fishing pressure make up 13%. The majority of the estuaries (53%) have low fishing pressure and only 17% of the estuaries have no fishing pressure. All the large estuarine systems in South Africa are heavily overexploited, especially in terms of their linefish, and this includes a few Western Cape examples. Fishing effort in the Olifants, Berg and Bot systems is extremely high and requires urgent management interventions to reduce the pressure on key nursery areas and 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 cheaply available and efficient but also the most damaging in terms of selectivity and very high mortality of both juveniles and adults of prohibited bycatch species.

Estuary mouth manipulation

Artificial mouth management practises are recorded in 23% of the estuaries in the Province. Five of these systems are large systems, e.g. Verlorenvlei, Bot/Kleinmond, Klein (Hermanus Lagoon), Heuningnes, Wilderness (Touw) and Swartvlei, whilst channelisation is observed in the Seekoei, Zandvlei and Berg. For example, historically the mouth of the Heuningnes estuary naturally closed during low flow periods as a result of shifting sand and caused back-flooding to adjacent farmland. CapeNature manages the De Mond Nature Reserve and has an agreement with farmers to undertake artificial breaching of the mouth of the Heuningnes estuary in order to prevent this back flooding. An Estuary Reserve Determination process will be carried out shortly. This will address flow and flooding scenarios.

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 the breaching and the associated implications for the natural and social environments need to be documented in the estuary management plan. A mouth management protocol needs to be developed in association with estuary specialists, Government Departments and stakeholders. This approved protocol can then be submitted to the Department of Environmental Affairs for approval. A Management Authority responsible for the mouth breaching process needs to be clearly identified and any risks need to be addressed. A Disaster Management Plan needs to be developed to address these risks. Early warning systems need to be identified and included in all communications with stakeholders.

Estuary health status

The data on Western Cape estuaries presented in this report is extracted from the National Estuarine Health Assessment which was a desktop procedure during which a national team of 13 regional specialists, covering the full suite of disciplines, evaluated estuary health based on the general (desktop-derived) characteristics of the estuaries. The method used was a standardised approach developed for determining the ecological water requirements of South Africa's estuaries which has been applied to about 30 systems along the coast. All the specialists that contributed to the assessment were familiar with the Estuarine Health Index from previous DWA studies.

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 fact that the physical conditions in estuarine systems are more dynamic than those of other aquatic ecosystems means that severe degradation of an estuary may involve a shift from a dynamic to a more stable, or unidirectional, system. This means that the loss of dynamic function per se is an important indication of declining estuarine health (DWAF 2008). Thus, in an estuarine health assessment, measures of these different states need to be sufficiently robust so that different practitioners/disciplines will arrive at the same categorisation.

Table 3. Ecological Management Categories (DWAF 2008).

Health Condition	Description
A	Unmodified, natural.
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions and processes are essentially unchanged.
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions and processes are still predominantly unchanged.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions and processes have occurred.
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions and processes are extensive.
F	Critically/Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions and processes have been destroyed and the changes are irreversible.

The Estuarine Health Index was calculated through consideration of the following components (DWAF 2008):

A. Abiotic	B. Biotic
1. Hydrology (% change in MAR)	5. Microalgae
2. Hydrodynamics and mouth condition	6. Macrophytes
3. Water chemistry (salinity and combined score for other variables)	7. Invertebrates
4. Sediment processes	8. Fish
	9. Birds

The assessment was undertaken by a multidisciplinary group of estuarine scientists (the chapter authors) in a workshop setting, based on their collective understanding of the likely impacts affecting each system. Expert knowledge and available information were all used to build up a "picture" of the probable pristine state of each estuary and the changes under current conditions. The Estuarine Health Index is applied to all levels of ecological water requirement studies (comprehensive, intermediate or rapid), with only the level of information supporting the study and level of confidence varying. For each variable the conditions are estimated as a percentage (0 – 100%) of the pristine health. Scores are then weighted and aggregated (the rules are provided in Table 3 and Table 4) 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.

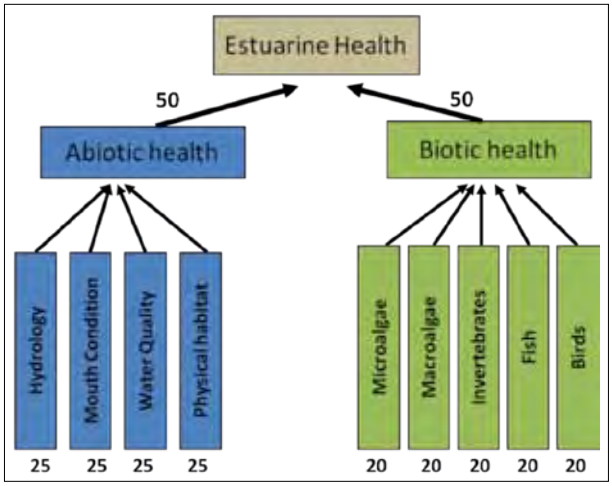

Figure 5: Components and weightings of the Estuarine Health Index (DWAF 2008).

Table 4. Calculation of the Estuarine Health Score (DWAF 2008).

No.	Variable	Example Score	Weight
Abiotic (habitat) variables			
1	Hydrology	41	25
2	Hydrodynamics and mouth condition	80	25
3	Water quality	59	25
4	Physical habitat	80	25
A. Habitat health score = weighted mean		65	50
Biotic variables			
1	Macrophytes	60	20
2	Microalgae	60	20
3	Invertebrates	70	20
4	Fish	60	20
5	Birds	90	20
B. Biological health score = weighted mean		70	50
ESTUARINE HEALTH SCORE = weighted mean of A & B		67.5	

For comparative reasons (with previous assessments) the individual health scores were aggregated as illustrated in Table 5. 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 5. 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	

Health status of estuaries in the Western Cape

Data on health status of Western Cape estuaries in presented on 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 were in a fair state. The numerous small temporarily open/closed estuaries around Cape Town were generally in a poor state. The National Health Assessment once again confirmed that estuaries along the south and south-east coast tend to be healthier than those in the rest of the country. Figure 6A shows that only 11% of the estuaries are in an excellent condition, and the Krom, Keurbooms and Sout (Oos) are three of the six examples. A 30% are in a good condition whilst 40% forms the bulk of estuaries that are in a fair condition. A total of 10 systems are in a poor condition and this constitutes 19% of the total in the Province. The systems that are in a poor condition include the Diep, Elsies, Onrus and Buffels (Wes). In some estuaries restoration of ecosystem form efforts to improve estuary condition e.g. salt marsh rehabilitation at Gouritz estuary (Figure 7).

The total estuarine area of the estuaries considered for the Province is 18 560 ha. The data on estuary health condition was expressed per unit area (Figure 6B). The six estuaries in excellent condition translated to 4% of the total estuarine area whilst estuaries in a good condition made up 22%. A bulk of the estuarine area totalling 13 380 ha constituted 72% and corresponded to fair condition and estuaries in a poor condition are 2%. According to Figure 6C, a large proportion of the estuarine area, 70% is corresponds to estuaries that are not protected, whilst only the remaining 30% are protected, occurring in some protected area. Consequently, over 71% of the total area comprises of estuaries that are critically endangered and 29% that are endangered (Figure 6D). Only a mere 35.95 ha is least threatened and is less than 1% of the total estuarine area in Western Cape.

Conservation value and status of estuaries in the WCP
The following estuaries form part of Important Bird Areas (IBA) sites in the Western Cape and may be seen as estuaries of relatively high conservation value:

1. Bot/Kleinmond
2. Groot Berg
3. Heuningnes
4. Olifants
5. Rietvlei/Diep
6. Verlorenvlei
7. Wilderness

In the Western Cape the following estuaries are listed as RAMSAR sites which provides global recognition and conservation status to these estuaries:

1. Heuningnes
2. Verlorenvlei
3. Wilderness

Figure 7: Salt marsh rehabilitation at the Gouritz Estuary

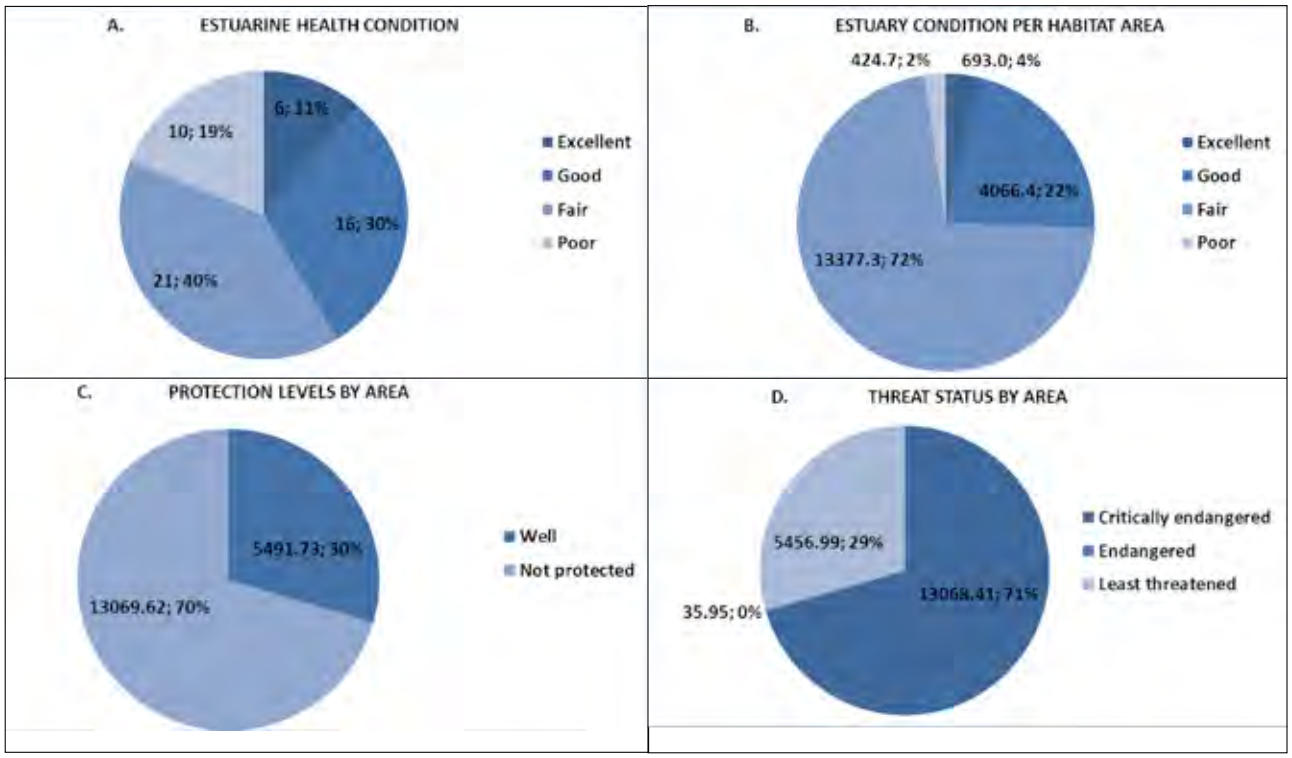

Figure 6: Data for 53 estuaries in the Western Cape showing proportions for each of A. Estuarine Health condition; B. Estuarine Health condition per habitat area; C. Protection levels by area; D. Threat status.

Estuary Management Plans

The Integrated Coastal Management (Act 24 of 2008) (NEM:ICMA) deals with setting norms, standards and policies for management, conservation and ecologically sustainable development of the countries coastal zone. In accordance to Chapter 4 of the Act, the need for a National Estuarine Management Protocol and the need to develop individual estuary management plans for estuaries in the country are provided for in Sections 33 and 34 respectively. The draft National Estuarine Management Protocol provides guidance with regards to the development and implementation of the individual estuary management plans. The management of estuaries is embedded in the management of the Municipal and Provincial Coastal Committees legislated for by the Act. The Department of Environmental Affairs is a lead agent for the Act whilst CapeNature is responsible for coordination of all estuary management planning processes.

It is important to understand that estuary management involves the integration of the management mandates of several Government Departments. The Department of Water Affairs is responsible for the management of the freshwater resources, the Department of Agriculture, Forestry and Fisheries is responsible for the management of catchment land-use and marine living resources, the Department of Environmental Affairs (National and Provincial) is responsible for the management of biodiversity and Local Government is responsible for the management of infrastructure and development around estuaries. In order to manage an estuary effectively the planning process needs to involve the active participation of all the appropriate Government Departments and the local stakeholders. An advisory forum is the ideal communication hub that can be used to prioritise and integrate management actions and disseminate information. Estuary Management Forums may become advisory committees for the Municipal and Provincial Coastal Committees. Working Group Eight (Oceans and Coasts) will function as a National Coastal Committee. The need for estuary management plans and the need for effective estuary management are included in the Municipal and Provincial Coastal Programmes. Coastal setback lines also need to be identified by the Province. Estuaries are included in this process and the setback lines need to be embedded in the zonation maps within the estuary management plans.

Currently, estuary management plans are in the process of being developed for 16 estuaries, forming 30% of the total number of estuaries in the Western Cape. Draft Estuary Management Plans exist for 15 of the 16 estuaries. While 11 EMPs have been reviewed only six have been reviewed taking the draft National Estuarine Management Protocol into consideration. Table 6 summarises the progress of each of the estuary management plans.

Table 6: Summary on the progress of each of the estuary management plans in the Western Cape (Source: Mr. P. de Villiers).

Estuary	Status
Olifants	Plan and an interim forum established to include fisher community
Groot Berg	Plan and forum established
Verlorenvlei	Plan and forum established
Diep (Rietvlei)	Plan and forum established
Sand (Zandvlei)	Plan and forum established
Bot	Plan and forum established
Klein	Plan and forum established
Uilkraals	Plan completed and forum to be established in 2012
Heuningnes	Plan and forum established
Breede	Plan and forum established
Goukou	Plan and forum will be finalised in 2012
Gouritz	Plan and forum established
Klein Brak	Plan and forum will be finalised in 2012
Groot Brak	Plan and forum will be finalised in 2012
Knysna	Plan incorporated into PA plan, and PA forum exists but not fully integrated into broader government structures
Keurbooms	Plan and forum established

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 sea. Without water use in the catchment, humans and their associated agriculture and industries could not survive.

A scientific process has been established and is entrenched in the National Water Act (36 of 1998). The Reserve Determination process and the associated catchment Classification process are aimed at calculating different water use scenarios while still allowing for environmental flows and basic human use. It is important that the Reserve process is implemented in all catchments (including estuaries, wetlands and underground water). The implementation of the agreed upon Reserve aimed at achieving a target estuary condition within the existing constraints will in itself result in an improvement in the condition of those estuaries.

It is imperative that the Reserve is determined and implemented for priority estuaries. It is also imperative that the models used to determine the estuarine Reserve and those used to determine the freshwater/catchment Reserve are calibrated with each other. In essence the system needs to be managed from catchment to coast.

Reserve Determination processes have been completed for the WCP estuaries as listed in Table 7 below (Gouritz WMA initiated in 2012; Heuningnes to be initiated in 2012).

Table 7. Reserve determination processes for WCP estuaries.

Estuary	Date	Environmental water requirement level
Breede	2004	Intermediate
Olifants	2006	Comprehensive
Matjies	2007	Intermediate
Sout	2007	Intermediate
Goukamma	2008	Rapid
Groot Brak	2008	Intermediate
Keurbooms	2008	Rapid
Knysna	2008	Intermediate
Noetsie, Gwaing Maalgate and Kaaimans	2008	Unofficial pilot test desktop
Swartvlei	2008	Rapid
Groot Berg	2010	Comprehensive
Palmiet	2010	Rapid
Bot	2011	Rapid
Uilkraals	2012	Rapid

Conclusions and recommendations

Estuaries form a crucial link between a catchment and the ocean. While 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. The Reserve Determination and Implementation process is a good tool for achieving this. Managers will also need to be aware of broader changes in oceanic systems and species. The management of estuary dependant marine fish stocks and the survival of spawn will have an impact on the nursery function of an estuary, i.e. if there is minimal spawning success at sea there will be minimal recruitment into the estuaries. The complexity of estuary management necessitates effective planning and good communication between stakeholders. The development of estuary management plans 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. The National Estuarine Management Protocol will provide guidance as to which Department will need to become the lead agent for each estuary. 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.

References

The data used in this report was extracted from[1]:

[1]Van Niekerk, L. & Turpie, J. K. 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 3: Estuary Component. CSIR Report Number CSIR/NRE/ECOS/ER/2011/0045/B. Council for Scientific and Industrial Research. Stellenbosch.

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NATURES VALLEY ESTUARY

Appendix 1:
Desktop Health Assessment for Western Cape estuaries, with individual ecological components graded from Excellent (dark blue), good (blue), fair (green) to poor (brown). A Provisional Present Ecological Status is also provided. Pressure levels are indicated as very high (VH), high (H), medium (M) or low (L). A Blank indicates the absence of a pressure.

			Pressures								Health Condition										
NAME	Change in flow	Polution	Habitat loss	Mining	Artificial Breaching	Fishing Effort(	Fishing Effort(Catches in tones)	Bait collection	Hydrology	Hydrodynamics	Water Quality	Physical habitat	Habitat State	Microalgae	Macrophytes	Invertebrates	Fish Final	Birds	Biological State	Estuary Health State (Mean)	Ecological Category
Olifants	M	M	M			VH	121.1	Y													C
Jakkalsvlei	H	M	L			L	0.1	Y													D
Wadrift	H	M	H			L	0.1	Y													E
Verlorenvlei	M	M	M		Y	M	10.0	Y													D
Groot Berg	M	H	M			VH	511.0	Y													D
Rietvlei/Diep	M	H	H		Y	L	0.1	Y													E
Sout (Wes)	H	H	H			L	0.1														F
Houtbaai	L	H	H			L	1.0	Y													E
Wildevoëlvlei	M	H	M			L	0.0	Y													D
Bokramspruit	L	H	L				0.0														C
Schuster	L	L	L				0.0														A
Krom	L	L	L				0.0														A
Buffels Wes	L	H	H				0.0														F
Elsies	L	H	H			L	0.1														E
Silvermine	L	H	H		Y	L	20.0	Y													D
Sand	M	H	M		Y	M	0.1	Y													D
Zeekoei	M	H	H			L	0.1	Y													E
Eerste	M	H	H			L	0.1	Y													E
Lourens	L	H	M			L	0.1	Y													C
Sir Lowry's Pass	M	H	H			L	1.0	Y													E
Steenbras	H	L				L	0.1	Y													B
Rooiels	L	L	L			L	0.1	Y													B
Buffels (Oos)	L	L	L			L	0.2	Y													B
Palmiet	M	L	M			L	70.0	Y													C
Bot/Kleinmond	M	M	M		Y	VH	0.1	Y													C
Onrus	H	H	H			L	80.0	Y													E
Klein	M	M	M		Y	H	2.1	Y													C
Uilkraals	M	M	M			M	0.1	Y													D
Ratel	M	M	L			L	10.0	Y													C
Heuningnes	M	M	M		Y	M	0.0	Y													D
Klipdrifsfontein	L	L					80.0														A
Breëde	M	L	L			H	20.0	Y													B
Duiwenhoks	M	L	L			H	13.0	Y													B
Goukou (Kaffirkui	M	M	M			H	20.0	Y													C
Gouritz	M	M	M			H	0.1	Y													C
Blinde	L	M	L			L	2.1	Y													B
Hartenbos	M	H	M		Y	L	10.0	Y													D
Klein Brak	L	M	M			M	0.0	Y													C
Groot Brak	M	M	H		Y	M	1.0	Y													D

NAME			Pressures								Health Condition										
	Change in flow	Polution	Habitat loss	Mining	Artificial Breaching	Fishing Effort(	Fishing Effort(Catches in tones)	Bait collection	Hydrology	Hydrodynamics	Water Quality	Physical habitat	Habitat State	Microalgae	Macrophytes	Invertebrates	Fish Final	Birds	Biological State	Estuary Health State (Mean)	Ecological Category
Maalgate	L	L				L	1.0	Y													B
Gwaing	L	M	L			L	0.0	Y													B
Kaaimans	L	L	L				0.0	Y													B
Wilderness (Touws)	L	M	M		Y		0.0	Y													B
Swartvlei	L	L	M		Y		4.1	Y													B
Goukamma	L	L	L		Y	M	70.4	Y													B
Knysna	L	M	L			H	0.2	Y													B
Noetsie	L	L	L			L	0.1	Y													B
Piesang	L	M	M			L	10.0	Y													C
Keurbooms	L	L	L			L	0.1	Y													A
Matjies	L	L	L			L	0.5	Y													B
Sout (Oos)	L	L				L	2.9	Y													A
Groot (Wes)	M	L	L			L	1.0	Y													B
Bloukrans	L	L				L	0.2	Y													A

CHAPTER 4

FRESHWATER FISHES

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BERG RIVER REDFIN: R. VAN DER WALT

Executive Summary

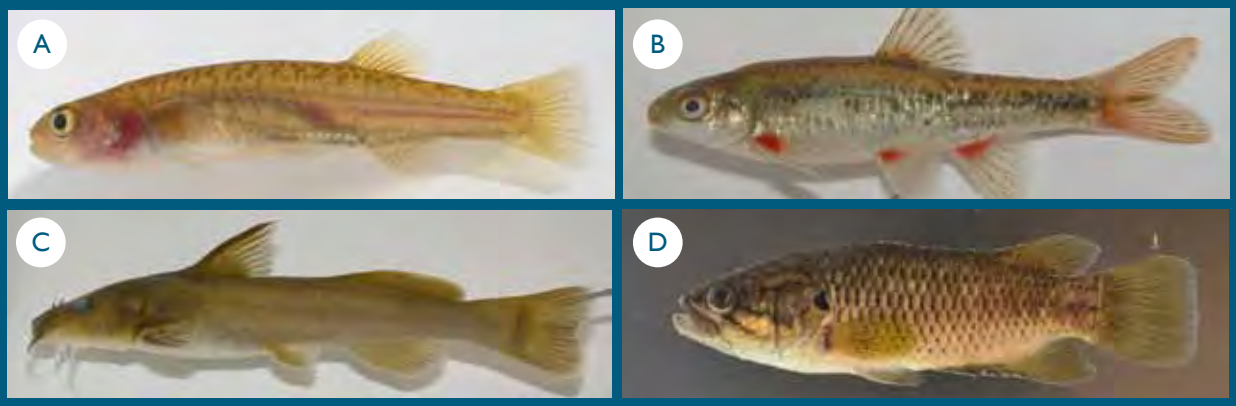
The Western Cape Province (WCP) has 17 currently described indigenous freshwater fish species and genetic research has provided evidence for another eight undescribed *Pseudobarbus* species of which six occur in the WCP. Several of the undescribed species have highly restricted geographic ranges. The conservation status of all South African freshwater fish species was reviewed in the 2009 IUCN Red List report on the status and distribution of freshwater biodiversity in Southern Africa. This report listed 16 WCP species as Threatened, making the freshwater fish the most threatened group of vertebrates in the province. Of these, four species are listed as Critically Endangered, nine as Endangered and three as Vulnerable. Two species near endemic to the Western Cape, the Cape kurper (*Sandelia capensis*) and Cape galaxias (*Galaxias zebratus*) were listed as Data Deficient as there is evidence that they are both species complexes. The primary threats to the indigenous fishes of the Western Cape remain the presence of invasive alien species, habitat degradation and destruction due to unsound land use practices and water over-abstraction. The discovery of unique and undescribed lineages within the WCP has highlighted the threat of genetic contamination between these unique lineages. Ongoing genetic research is revealing further diversity and presents more evidence that the current taxonomy vastly underestimates the diversity of freshwater fishes of the WCP as well as the greater Cape Floristic Region. In the past five years (2007-2012), a number of critical conservation initiatives including stewardship, species-specific management plans and alien fish management interventions have been initiated in priority areas and focus on priority species. These initiatives are in alignment with new legislative developments such as the Norms and Standards for species management plans, and incorporate new conservation planning products such as the National Freshwater Ecosystem Priority Areas project.

1. Introduction

The objective of this chapter is to provide feedback on the progress made with recommendations of the 2007 State of Biodiversity Report and to provide an overview of recent research results as well as conservation initiatives relevant to indigenous fish conservation and management in the Western Cape Province (WCP). The WCP is home to a diverse and unique freshwater fish fauna (Skelton 1983) and contains the highest number of endemic and threatened freshwater fish species in South Africa (Tweddle *et al.* 2009). Each of the four major river systems in the Western Cape has a unique fish community made up of species from three families of freshwater fish, namely the Cyprinidae, Galaxidae and Anabantidae. The Olifants-Doring River system is particularly diverse and also contains species of the family Austroglanididae.

The Olifants-Doring river system is an endemic fish hotspot as indicated in Figure 1 with 10 indigenous species of which eight are endemic and threatened (Skelton *et al.* 1995). Speciation patterns within the indigenous fishes, especially the redfins (family Cyprinidae), contributes to understanding the river drainage evolution of the CFR and strongly reflects past connectivity of the river basins of the area (Swartz *et al.* 2008).

Indigenous fishes of the Western Cape Province



Representative species from the four families of indigenous freshwater fishes of the Cape Floristic Region. A: Family Galaxidae showing a Cape galaxias (*Galaxias sp.*) collected from the Noordhoeks River, a tributary of the Olifants River; B: Family Cyprinidae showing a Fiery redfin (*Pseudobarbus phlegethon*) collected from the Thee river, Cederberg; C: Family Austroglanididae showing a Clanwilliam rock catfish (*Austroglanis gilli*) collected from the Noordhoeks River and D: Family Anabantidae showing a Cape kurper (*Sandelia capensis*). (Photos © Roger Bills, SAIAB)

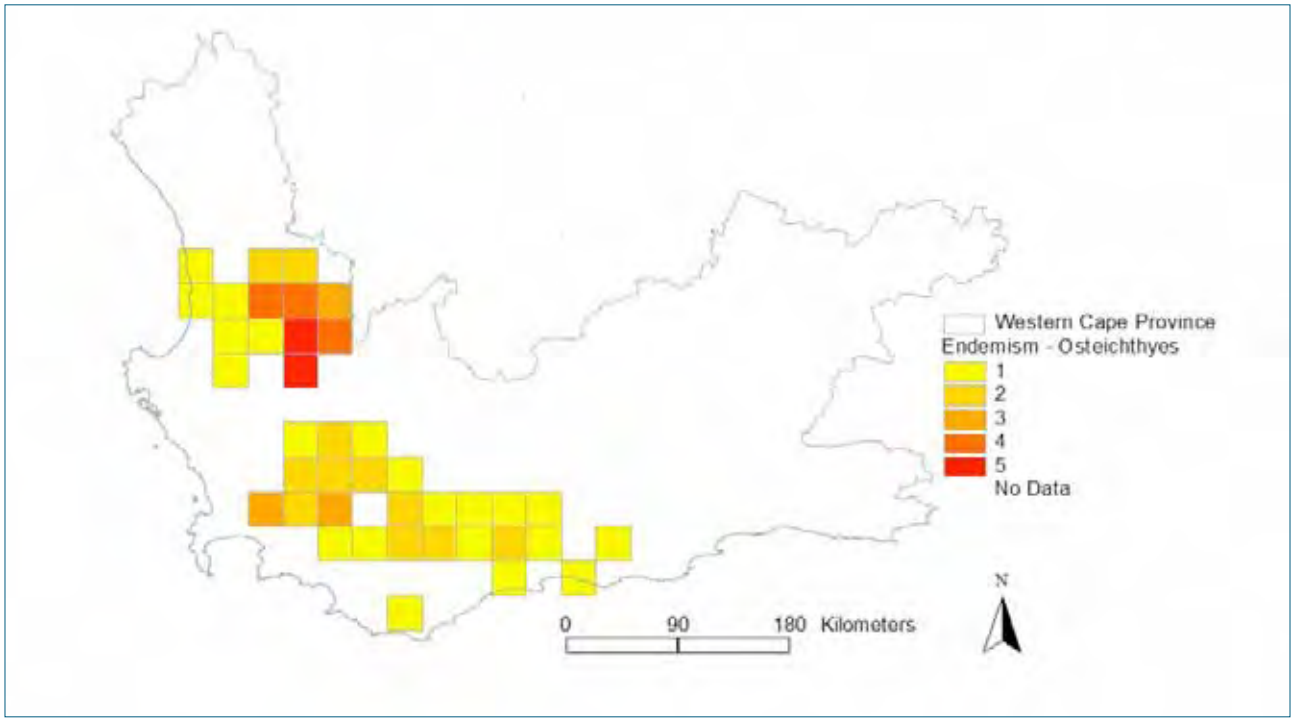


Figure 1: Map showing freshwater fish endemism for each quarter degree in the Western Cape Province.

During the period from 2007 to 2012, several advances were made in the field of freshwater fish research, mainly related to phylogenetics and taxonomy of indigenous species and the impacts of invasive alien fishes on indigenous fishes and their associated ecosystems. A major development was the reassessment of the conservation status with the 2009 IUCN Red List report on the status and distribution of freshwater biodiversity in Southern Africa (Darwall *et al.* 2009). This publication presented the updated conservation status of the 17 currently described freshwater fish species of the Western Cape Province as well as a further six unique redfin (*Pseudobarbus)* lineages. Along with the development of new biodiversity legislation and conservation planning products, this contributed to the commencement of new initiatives aimed at the conservation of indigenous fish and their associated ecosystems.

The WCP has a Mediterranean climate with typically dry and hot summers which are often characterised by severe utilisation pressure on water resources, often to the detriment of the environment. This is not unique to the Western Cape and is characteristic of many arid and semi-arid areas of the world (Collares-Pereira and Cowx, 2004). An increasing demand for water as a result of rapidly expanding residential and agricultural development often results in unsustainable water abstraction in many areas. While environmental flow reserves have been determined for many river systems, this is not always efficiently enforced. Water over-abstraction often results in a number of tributaries running dry during summer months which causes the loss of entire ecosystems, many of which are of critical importance for the conservation of indigenous fish species. With a steadily increasing human population and predicted changes in rainfall patterns as a result of global climate change, the conservation of aquatic ecosystems will become an even bigger

challenge and ever-more dependent on an integrated approach to water use. Managing and conserving water resources in the country and especially in the WCP requires managing shared responsibilities, while integrating local priorities and national needs across watersheds is critical to maintain the integrity of catchment resources and their associated ecosystems.

2. Systematic account

Accurate inventory of species diversity and knowledge of their ecological requirements are fundamental prerequisites for successful biodiversity conservation. Historically the Western Cape had 18 indigenous freshwater fish species, eight of which are endemic to the Province. This number is now 17 as the Eastern Cape redfin (*Pseudobarbus afer*) is now restricted to the Eastern Cape Province. When considering the whole Cape Floristic Region (CFR), the species richness increases to 19 species of which 16 are endemic (Impson *et al.* 1999). The geomorphological and climatic complexity of the CFR and the association with the Cape Fold Mountain belt with its numerous isolated river systems likely favoured speciation and have contributed to the historical isolation and differentiation of unique lineages (Skelton, 1994; Skelton and Swartz, 2011). The freshwater fish fauna of the CFR and by definition also the WCP consists of four families and recent research has presented evidence for unique lineages in each of these families as presented in Table 1.

Table 1: The four families of freshwater fish in the Western Cape Province and the number of unique lineages presently known within currently described species. Most but not all of these lineages occur within the Western Cape Province. N = number of identified lineages. Table adapted from Skelton and Swartz, 2011.

Family	Species	N
Austroglanididae	*Austroglanis gilli*	2
Anabantidae	*Sandelia capensis*	3
Galaxiidae	*Galaxias zebratus*	14
Cyprinidae	*Barbus anoplus*	7
	Pseudobarbus afer	4
	Pseudobarbus burchelli	4
	Pseudobarbus burgi	2
	Pseudobarbus tenuis	2
	Pseudobarbus phlegethon	2

The work of Swartz (2005) and Swartz *et al.* (2008, 2009) reported unique lineages in all Pseudobarbus species in the CFR with the exception of *P. asper* and these unique lineages are currently undergoing taxonomic revision. Six of these unique lineages occur in river systems within the WCP which increases the number of indigenous species to 23. Numbers of endemic and threatened taxa continue to increase as a result of ongoing morphological and genetic studies and confirms the suggestion by Linder *et al.* (2010) that the current taxonomy vastly underestimates the diversity of freshwater fishes of the CFR and thus by definition the WCP.

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Table 2: Current conservation status of the 17 described freshwater fishes of the Western Cape Province and a further 6 undescribed Pseudobarbus species included in the latest IUCN assessment (Tweddle *et al.* 2009). Key: CR = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data deficient. * = Species endemic to the WCP

Species: Scientific and common names (ESU's in brackets)	Distribution range	Conservation status
Family: Austroglanididae		
**Austroglanis barnardi* Barnards rock catlet	Olifants River System	EN
**Austroglanis gilli* Clanwilliam rock catlet	Olifants River System	VU
Family: Cyprinidae		
* *Barbus andrewi* Whitefish	Berg & Breede River systems	EN
Barbus anoplus Chubbyhead barb	Gourits & Orange River System	DD
* *Barbus calidus* Clanwilliam redfin	Olifants River System	VU
* *Barbus erubescens* Twee River redfin	Olifants River System	CR
Barbus serra Sawfin	Olifants River System	EN
* *Pseudobarbus sp.* "afer Forest" (Forest redfin)	Coastal rivers of southern Cape	NT
Pseudobarbus asper Small-scale redfin	Gourits and Gamtoos River System	EN
* *Pseudobarbus burchelli* Barrydale redfin	Tradouw river of Breede System	CR
* *Pseudobarbus sp.* "burchelli Breede" (Breede River redfin)	Breede River system	NT
* *Pseudobarbus sp.* "burchelli Heuningnes (Heuningnes redfin)	Heuningnes River System	CR
* *Pseudobarbus burgi* Berg River redfin	Berg River System	EN
* *Pseudobarbus sp.* "burgi Verlorenvlei" (Verlorenvlei redfin)	Verlorenvlei River System	EN
* *Pseudobarbus phlegethon* Fiery redfin	Olifants River System	EN
* *Pseudobarbus sp.* "phlegethon Doring" (Doring River redfin)	Olifants River System	CR
* *Pseudobarbus tenuis* Slender redfin	Gourits River System	NT
* *Pseudobarbus sp.* "tenuis Keurbooms" (Keurbooms redfin)	Keurbooms River System	EN
Labeo seeberi Clanwilliam sandfish	Olifants River System	EN
Labeo umbratus Moggel	Gourits, Olifants, Sundays systems	LC
Labeobarbus capensis Clanwilliam yellowfish	Olifants River System	VU
Family: Galaxiidae		
Galaxias zebratus Cape Galaxias	Widespread in CFR	DD
Family: Anabantidae		
Sandelia capensis Cape kurper	Widespread in CFR	DD

3. Conservation status

The most recent IUCN conservation status (Tweddle *et al.* 2009) of the indigenous fish of the WCP is presented in Table 2 and Figure 2, followed by a brief overview of the distribution ranges of the currently undescribed Pseudobarbus species occurring in the WCP.

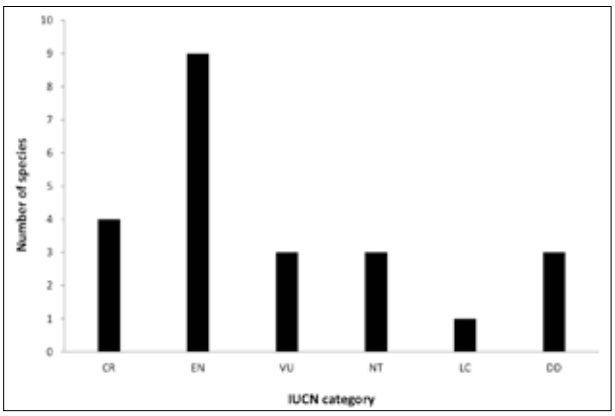

Figure 2: Conservation status of the indigenous freshwater fishes of the Western Cape Province. Key: CR = Critically Endangered, E = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, DD = Data deficient.

A comparison to the previous assessment from 1996 was not made for the following reasons: (1) the previous assessment included incorrect interpretations of certain criteria, (2) it did not include the new undescribed *Pseudobarbus* lineages, (3) the criteria and their application has changed since the last assessment and (4) there has been an increase in knowledge on species distributions across the province which thus provided for more comprehensive data for the assessment (Impson, 2007). The conservation status presented in this report corresponds to the proposed conservation status presented in the 2007 report.

Distribution ranges of currently undescribed and threatened Pseudobarbus species occurring in the WCP.

The following five unique lineages have all been identified as requiring urgent conservation intervention due to their restricted ranges, relatively small population size and the combination of the threats facing them (E. Swartz; SAIAB, pers. comm). While being currently undescribed, the Forest redfin (*Pseudobarbus sp. "afer forest"*) was not included here as it is listed as Near Threatened in the latest IUCN assessment and thus of lower concern than the species listed below.

i) Pseudobarbus burchelli Smith, 1841

The Barrydale redfin is restricted to the Tradouw River catchment which forms part of the lower Breede River system.

It is a unique lineage of the species currently described as the Breede River redfin (Swartz, 2005). The main reasons for its listing as Critically Endangered are the limited range of the species, habitat destruction, agrichemical pollution and the impact of alien fishes, mainly largemouth bass (*Micropterus salmoides*) and banded tilapia (*Tilapia sparrmanii*).

ii) Pseudobarbus sp. (burchelli Heuningnes)
The Heuningnes redfin, listed as Critically Endangered has been identified as a unique sister lineage to the Barrydale and Breede lineages of the Burchell's redfin species complex (Swartz, 2005). This species occurs in the upper Heuningnes and Kars Rivers on the Agulhas Plain where it is threatened by the presence of alien fish and habitat destruction (Russel and Impson, 2006).

iii) Pseudobarbus sp. (phlegethon Doring)
The Doring redfin is a sister lineage to the currently described Fiery redfin (*Pseudobarbus phlegethon*). This lineage has a known distribution range limited to the Breekkrans and Driehoeks Rivers in the Olifants-Doring River system and is presently listed as Critically Endangered (Tweddle *et al.* 2009). While the Breekkrans River is largely free of anthropogenic impacts and provides pristine habitat, the Doring redfin is threatened by the presence of invasive alien fish species, mainly smallmouth bass (*Micropterus dolomieu*) through most of its range (Bills, 1999; Swartz *et al.* 2004).

iv) Pseudobarbus sp. (tenuis Keurbooms)
The currently described slender redfin (*P. tenuis*) is known to occur in the Gouritz and Keurbooms systems of the Southern Cape (Skelton, 2001). The Keurbooms redfin is a unique lineage to this species and is known to occur in the Kransbos, Diep and Langbos Rivers associated with the Keurbooms River system (Swartz, 2005). This species is listed as Endangered due to the presence of alien species, habitat destruction and water over-abstraction in the upper Keurbooms River (Tweddle *et al.* 2009).

v) Pseudobarbus sp. (burgi Verlorenvlei)
Bloomer and Impson (2000) presented evidence for the Verlorenvlei redfin being a unique lineage of the Berg River redfin (*P. burgi*). Its distribution includes the Verlorenvlei River mainly below the Het Kruis Bridge and this species is presently listed as Endangered due to threats from alien invasive fish species and habitat destruction due to anthropogenic activities (Tweddle *et al.* 2009).

4. Threats to the indigenous fish of the Western Cape Province

The natural distribution ranges of most indigenous species have contracted considerably as a result of a number of threats which are listed below. These factors impact negatively on the overall health of riverine ecosystems and detrimentally affect the survival of indigenous fish populations and associated aquatic biota.

a) Physical threats

i) Impacts on water quality and water quantity
Both water quality and quantity in all major river systems in the Western Cape Province are under threat from over utilisation. Increased water usage and pollution from towns and cities are threatening aquatic ecosystems in urban areas while at the same time contributing to deteriorating water quality in main stream rivers. The alteration of hydrological regimes, mainly through construction of dams and abstraction can impact on water quality parameters and instream habitat quality (Nel *et al.* 2011). This can in turn affect the ability of resident species to survive within the river and these changes can fundamentally alter the ecological functioning of the system. Many mountain tributaries and smaller lowland rivers, which are often hotspots for conservation of indigenous fish species, are threatened by water over-abstraction for irrigation purposes which often results in a loss of critical habitats during summer months. This situation is often exacerbated by groundwater abstraction which in turn

Anthropogenic impacts on riverine ecosystems of the Western Cape Province

A: Bulldozing of the active channel of the Koornlands River in Swellendam resulting in increased sediment loads and siltation downstream;
B: Severe water pollution in the Kingna River, Montagu which is likely a result of agrichemical pollution and poorly functioning sewage works;
C: Residential development in the riparian zone of the Gobos River in the town of Greyton;
D: Littering and water pollution in the lower section of the Eerste River at Faure. All these activites have severe existing or potential impact on the health of the riverine ecosystem, including the indigenous and endangered freshwater fish.

(Photos © MS Jordaan).

influences surface water resources. Many rivers in agricultural areas are also subject to agrichemical pollution, mainly herbicides and pesticides which may detrimentally affect indigenous fish species and their associated ecosystems (Marriot, 1998; Bills, 1999; Jordaan, 2010).

ii) Loss of habitat through environmentally unsound land use practices

The habitats of many indigenous species are threatened by unsound land use practices such as residential and agricultural development within the 1/100 or even 1/10 year flood line. Development in these areas increase the risk of flood damage during periods of high rainfall which in turn necessitates the repair of flood damage which often involves bulldozing of the active channel of the river and destabilisation of the river banks. In turn this leads to silting up of instream pools and sedimentation of cobble habitat which are often critical for successful feeding and spawning of some indigenous species (Whitehead, 2007). Additionally, Woodford *et al.* (2005) proposed that there may be a synergistic effect between the loss of benthic cover as a result of sedimentation and predation pressure from alien predators, resulting in the extirpation of benthic species. Evidence for this was presented by Bills (1999) who found that the Clanwilliam rock catfish and its close relative the spotted rock catfish could co-exist with smallmouth bass *(Micropterus dolomieu)* in rivers with complex rocky substrates, but not in sandier rivers, and surmised that sedimentation increased the predatory impact of *M. dolomieu* on these species.

b) Biological threats

i) Alien invasive fish species

Alien invasive fish species are considered the primary threat to the survival of the indigenous fish of the WCP (Skelton, 1983; Impson and Hamman, 2000; Impson *et al.* 2002; Tweddle *et al.* 2009). These species affect indigenous fishes through predation, habitat alteration, competition for resources, the introduction of diseases and the disruption of ecological processes (Skelton, 1987, De Moor and Bruton, 1988). The primary impact is predation on smaller species and on juveniles of larger species and this has resulted in the extirpation of many indigenous species from main stream rivers and tributaries (Cambray, 2003; Swartz *et al.* 2004; Woodford *et al.* 2005). While being of current research interest, the initial impacts of alien invasive fishes on indigenous fish assemblages in the CFR was poorly recorded and not studied in great detail. This is because most of the impacts occurred before the negative ecological effects of these species were known and before conservation of the indigenous species was considered a priority (Marr *et al.* 2012). At present, the main stream fish fauna of the all four river systems in the WCP is dominated by alien invasive species with very few indigenous species remaining. Almost all viable populations of indigenous species are now limited to upper reached of tributaries above waterfalls and other barriers where alien species cannot invade (Skelton, 2001). Local examples are the Witte River in Bainskloof (Breede River system) and the Rondegat River in the Cederberg (Olifants-Doring River system).

The WCP has a long history of introduction of non-native fish species and is, along with South Africa as a whole, considered an alien fish invasion hotspot (Leprieur *et al.* 2008). Initial introductions of bass (*Micropterus spp.*) and trout (*Oncorhynchus mykiss* and *Salmo trutta*) species occurred in the late 19th and early 20th century and were primarily for angling as the indigenous fishes are mostly smaller species not suitable for angling purposes (De Moor and Bruton 1988). Additional pathways for introductions of alien species are summarised by Weyl (2011) and include escapes from aquaculture facilities (e.g. common carp *Cyprinus carpio* and the tilapias *Oreochromis mossambicus* and *O. niloticus*), biological control (e.g. grass carp *Ctenopharyngodon idella* and mosquitofish *Gambusia affinis*), ornamental fish trade (e.g. guppies *Poecilia reticulata* and swordtails *Xiphophorus helleri*) and inter basin transfers (e.g. sharptooth catfish *Clarias gariepinus* and smallmouth yellowfish *Labeobarbus aeneus*). While inter basin transfers are less relevant to the Western Cape, they have been illustrated to be important invasion pathways in the rest of South Africa (Laurenson *et al.* 1989; Weyl *et al.* 2009).

There is strong evidence that the alien species with the most severe impacts in the CFR is smallmouth bass (Tweddle *et al.* 2009), although there are many other invasive species that prey on and compete with indigenous fishes (De Moor and Bruton, 1988). A number of these alien species, including common carp, largemouth bass and rainbow trout are listed as being among the world's 100 worst invasive species (Lowe *et al.* 2000). The impact of sharptooth catfish, a relatively new invader to the WCP, has not yet been quantified but there is strong evidence that their impact will be as severe as or potentially worse than smallmouth bass (Cambray, 2003a; Clark *et al.* 2009; Jordaan and Impson, unpublished data). The successful invasion of the sharptooth catfish into all four major river systems of the WCP was confirmed in 2012 with the collection of a specimen of this species in the lower Rondegat River near Clanwilliam and another from near the town of Citrusdal in the Olifants River catchment. Prior to this, sharptooth catfish has been known to occur in all three other major river systems of the Western Cape. Recent surveys have provided evidence that they dominate the fish fauna of the main stream Berg and Breede River systems and are also abundant in the Gouritz River system (RHP reports, 2007, 2011; Clark *et al.* 2009). Sharptooth catfish are indigenous to the rivers of woodland-savanna zones of the Afrotropical regions of Africa where it occurs from the Nile to as far south as the Orange River system and the Umtamvuna river system in South Africa (Skelton, 2001). Their invasive success and associated impacts on indigenous fish fauna can be attributed to a range of factors, including their ability to survive in and adapt to a range of environmental conditions, their ability to survive desiccation, their omnivorous feeding habits, high fecundity and fast growth rate.

While the presence of invasive alien species remains the primary threat to the indigenous fish of the WCP, the management of these species is challenging for a number of reasons. These include their importance as aquaculture and angling species, a lack of knowledge of the threat of these species to indigenous fishes and the extreme difficulty of managing an alien species once it has established in a natural environment (Cucherousset and Olden, 2011; Van Rensburg *et al.* 2011). In many cases, indigenous fishes are also considered of marginal importance (Cowx, 2002) and alien species are better known due to their established economic value as angling and aquaculture species (Cambray, 2003b). The alien invasive species currently present in the major river systems of the Western Cape Province are presented in Table 3.

Table 3: Alien invasive 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 excludes CFR indigenous species distributed outside their natural ranges and which now have extralimital populations. Table adapted from Richardson *et al.* (2010).

				River system			
Family and species	Common name	Native range	Introduction pathway	Breede	Berg	Olifants/ Doring	Gouritz
Family: Centarchidae							
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 niloticus	Nile tilapia	Africa	Angling, Aquaculture	N	N	N	N
Oreochromis aureus	Israeli tilapia	Africa	Angling, Aquaculture	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, IBT	N	N	N	Y
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 the species is not known to be present in the Berg River, they are likely present in farm dams in the Eerste and Cape Flats catchments which form part of the Berg WMA.

ii) Alien invasive vegetation

Alien invasive vegetation is considered to be one of the major threats to biodiversity in the Western Cape and riparian ecosystems are particularly susceptible to invasion by a number of alien species (Le Maitre *et al.* 2000; Richardson and van Wilgen, 2004, Richardson *et al.* 2007). While the riparian zone only occupies a small area in relation to the greater catchment, it has a strong influence on the surrounding landscape, including the instream environment (Reinecke *et al.* 2007). Bank vegetation affects the flow patterns of the river and provides shelter and habitat for aquatic species, as well as supplying leaves and other organic material which sustain aquatic food webs. Furthermore, the riparian zone acts as a buffer against agrichemicals and other matter that may enter the river from the terrestrial environment (Reinecke *et al.* 2007). The primary invasive alien plants affecting riparian zones in the Western Cape are *Acacia spp.*, *Eucalyptus spp.* and *Populus spp.* The effects of invasive riparian plants on instream aquatic communities were studied by (Lowe *et al.* 2008) who reported significant differences in invertebrate communities associated with certain substrate types at sites invaded sites when compared to uninvaded sites. This was attributed to an increase in leaf litter and sedimentation observed at the invaded sites. The latter study also showed an interaction between the presence of alien invasive plants and alien invasive fish when considering the impacts on aquatic invertebrates. No literature was found quantifying the effects of alien invasive vegetation on the indigenous fishes of the WCP.

iii) Diseases and parasites

Parasites and pathogens are part of all ecological systems and in most cases disease outbreaks are associated with suboptimal environmental conditions and various factors that either compromise the host or make conditions more favourable for the pathogen. In the WCP there have been no major disease threats to indigenous freshwater fish species to date and the occurrence of parasites has primarily been associated with areas where water quality and quantity had been affected. The positive identification in 2011 of Epizootic Ulcerative Syndrome (EUS) in dams in the Western Cape Province poses a significant risk to indigenous species as the pathogen is not host-specific and is known to affect a number of fish species (FAO, 2009). This disease was diagnosed by scientists from the Department of Agriculture, Forestry and Fisheries (DAFF) following reports of diseased fish in dams in the Palmiet and Eerste River systems (K. Christison (DAFF), pers. comm.). Epizootic Ulcerative Syndrome is caused by the oomycete fungus *Aphanomyces invadans* and can affect wild and farmed freshwater and estuarine finfish. Typical symptoms include pinpoint red spots, haemorrhagic spots, localised swelling, skin erosion

Biological threats to the indigenous fish of the Western Cape Province

A: Alien plan invasion, mainly wattle, on the banks of the upper and middle sections of the Riviersonderend River; B: A Sharptooth catfish showing lesions typically associated with Epizootic Ulcerative Syndrome (EUS); C: A healthy specimen of the sharptooth catfish collected from the Breede River. This species is one of the more recent and serious invaders in the aquatic ecosystems of the Cape Floristic Region; D: A smallmouth bass from the Witte River. This species have a wide distribution range in the CFR due to its popularity as an angling species but is has proven deleterious effects on aquatic ecosystems and indigenous fishes in particular.

(Photos © MS Jordaan, K Christison (DAFF), D Woodford (SAIAB)).

and ulceration exposing the underlying musculature. Infection occurs when motile spores of the fungi penetrate the skin and germinate, forming hyphae which in turn penetrate into surrounding skin and deeply into the underlying muscle tissues causing extensive ulceration and tissue destruction. Epizootic Ulcerative Syndrome is an OIE notifiable disease which has a high mortality rate as most infected fish die during an outbreak (FAO, 2009).

The control of EUS in natural systems such as rivers is impossible and once it has established in a natural water body, it cannot be eradicated (FAO, 2009). The occurrence of this disease within the river systems of the WCP has severe implications for conservation, angling, aquaculture and research. The susceptibility of the indigenous fish species of the WCP is not known, but several African barb species have been proven to be susceptible and therefore is can be safely assumed that local species may also be at risk (K. Christison (DAFF), pers. comm.) Therefore it is critical to inform the wider public of the risks that EUS poses in terms of freshwater fish conservation and utilisation. It is critical that no live fish may be moved from river systems or dams where the disease is known to be present to prevent contamination of new areas. Furthermore, it is essential that all equipment used for transporting or sampling fish is sterilised after use to prevent the accidental transfer of this pathogen between sampling sites or catchments.

5. Current research and the implications for fish biodiversity conservation

i) Research on genetics and species diversity of indigenous fish: Following a comprehensive assessment by (Darwall *et al.* 2011) of the conservation status of all major elements of freshwater biodiversity in Africa, including freshwater fishes, it was concluded that there is a rich diversity present in all groups and many species are largely endemic and incompletely described (Skelton and Swartz, 2011). For the Southern African region of the assessment, it was evident that new species were discovered at a vastly greater rate than at which these species could be formally described (Tweddle *et al.* 2009) and that this was partly the result of major advances in molecular research. The first South African species on which a DNA sequencing study was initiated was the Cape galaxias. The research yielded evidence that this CFR endemic is a species complex consisting of four divergent lineages (Waters and Cambray, 1997). Additional studies by van Niekerk (2004) and Wishart *et al.* (2006) identified four additional lineages while further ongoing studies are suggesting that there may be many more (Skelton and Swartz, 2011).

The number of *Pseudobarbus* redfin species in the CFR was originally believed to be six species (Skelton 1988), but subsequent genetic studies have presented evidence for the existence of at least 14 historically isolated lineages, most of which occur in the WCP (Bloomer and Impson, 2000; Swartz *et al.* 2004, 2008, 2009; Swartz, 2005.). Recent research conducted at SAIAB has revealed two distinct lineages in the spotted rock catfish (Skelton and Swartz, 2011), while the Cape kurper also appears to be a species complex (Roos, 2004) with a number of species present in the WCP. Recent comprehensive surveys by members of the South African Institute for Aquatic Biodiversity (SAIAB) identified additional unique lineages within native fishes from the Breede and associated river systems. The studies documented and mapped the distribution ranges of at least nine deeply divergent lineages of the Cape galaxias, a fourth unique lineage of the Breede River redfin and at least two deeply divergent lineages of the Cape kurper (Chakona, unpublished data). Some of the lineages were already known (Roos, 2004; van Niekerk, 2004; Swartz, 2005), but these have been mapped much more accurately now. The future of many of these lineages is uncertain because they have highly restricted geographic ranges and are often restricted to lower reaches of mountain tributaries which expose them to multiple anthropogenic threats listed in the previous section. The length and linear nature of rivers makes them difficult to conserve at a catchment level and many middle and lower reaches of rivers are poorly conserved at present (Davies and O' Keeffe, 1993; Impson *et al.* 2002). For example, the situation is particularly dire for the unique Heuningnes redfin and Heuningnes galaxias of the lowland Agulhas plain where there are few in-stream physical barriers to prevent invasion of introduced fish predators and competitors. The work of Russel and Impson (2006) reported the presence of four alien invasive species (largemouth bass, spotted bass, bluegill sunfish and common carp) in the river systems of the Agulhas plain and attributed the absence of indigenous species to loss of habitat and the impacts of these alien species, especially spotted bass.

From a conservation management perspective, the potential for recovery of most indigenous species is high, provided that their critical habitats are restored and protected. Immediate conservation efforts should aim to halt range expansion of alien species though eradication (where feasible) and building of in-stream physical barriers to prevent further invasion of tributaries (Moyle and Sato, 1991; Impson *et al.* 2002). However, the location of barriers needs to be carefully chosen to ensure that protected river sections encompass optimal habitats for all indigenous fishes. There is also a need to rehabilitate degraded habitats and to restore ecological flows in many rivers. These measures will inevitably lead to the recovery and expansion of indigenous fish through natural recruitment and dispersal from upstream refugia. For this to be achieved participation by all stakeholders is imperative and there is a need for conservation authorities to establish stewardship agreements in critical freshwater fish conservation areas. Stocking of indigenous fish species should not be approved without scientific input from species specialists and conservation authorities, because the indigenous populations could suffer a loss of local genetic adaptations through hybridisation.

ii) Research on the biology and ecology of indigenous fish
The research of Chakona *et al.* (2011) has documented a case of amphibious capabilities in an African galaxiid. This lineage of the species currently described as *Galaxias zebratus* appears to be the most common and widespread primary freshwater fish in the CFR as well as in the WCP as its range extends from the Olifants River on the west coast to the Bitou River in the eastern parts of the WCP. Given the abilities of this species to survive out of water for a prolonged period of time, it is critical that researchers should ensure that sampling gear are cleaned and dried to prevent inadvertent translocations of this species beyond its natural range.

A study on the reproductive and feeding biology of the fiery redfin in the Noordhoeks River in the Cederberg was done by Whitehead *et al.* (2007). The authors presented evidence that this species is likely a carnivorous cyprinid species feeding mostly on aquatic invertebrates and to a lesser extent on filamentous algae. Gonadal histology suggests that this species spawns in spring. In a similar study by Marriot (1998), some aspects of the ecology of the Twee River redfin was investigated and evidence was presented that this species also spawns in spring to early summer and that it mainly feeds on aquatic invertebrates and algal material. The conservation implications of ecological research becomes apparent when considering that water abstraction and agricultural activities in these and similar rivers likely decrease available spawning habitat and upstream agricultural activities such as bulldozing cause siltation which in turn may affect the invertebrate communities on which the fish feed.

A comprehensive study on the biology, ecology and environmental requirements of the Clanwilliam yellowfish and Clanwilliam sawfin in the Driehoeks River system was conducted by Paxton and King (2009). The study included determining the abundance and distribution of these species, identifying and describing critical habitats for spawning and feeding, determining age-length relationships and determining the time of spawning and spawning cues. The biological information was linked to environmental variables such as temperature and flow rate and this highlighted the need to integrate water allocations and flood releases with flow requirements of the species in question. The effects of river fragmentation by dam and weir construction include disruption of migration patterns critical to normal spawning behaviour and the prevention of normal dispersal of eggs, larvae and juveniles and highlighted the need for fish migration facilities for existing and proposed instream structures (Paxton, 2004; Paxton and King, 2009).

iii) Research relating to the impacts of invasive alien fish species
The work of Olds *et al.* (2011) reported on a comprehensive fish survey of the Wilderness Lakes system and the presence of mosquitofish and Mozambique tilapia was confirmed. The presence of largemouth bass was not recorded during the survey, despite historical records for the presence of this species in the lakes. The survey also reported the presence of a new invader, the common carp in the Langvlei section of the lake system. This is a cause for concern as the common carp is listed as one of the world's worst invasive species (Lowe *et al.* 2000). There is also limited knowledge of the impacts of this species, and the other invasive species present in the Wilderness lakes systems, in estuarine ecosystems in South Africa. Weyl and Lewis (2006) and Wasserman *et al.* (2011) illustrated that largemouth bass prey opportunistically on juvenile estuarine species such as Cape moonies (*Monodactylus falciformes*) as well as mullet species such as flathead mullet (*Mugil cephalus*) and freshwater mullet (*Myxis capensis*), illustrating that the presence of alien invasive species in freshwater systems also affects estuarine species and environments.

The impact of the various bass species has been relatively well researched in the river systems of the WCP. The study of Paxton *et al.* (2002) on the Olifants-Doring river system illustrated that the presence of smallmouth bass and bluegill sunfish caused a significant decline in the numbers of Clanwilliam sawfin, Clanwilliam sandfish and Clanwilliam yellowfish in this system. These results were confirmed by recent (2011) surveys conducted as part of a conservation plan for the Clanwilliam sandfish. The deleterious impacts of the various bass species in tributaries have also been researched. The work of Woodford *et al.* (2005) on the Rondegat River illustrated that smallmouth bass was responsible for the loss of four of the five indigenous fish species in this river below a waterfall barrier in the river. Shelton (2003) and Shelton *et al.* (2008) presented evidence that the presence of largemouth bass can influence abundance and habitat selection of Cape galaxias in Cape mountain streams with galaxias selecting deeper and faster flowing habitats in the presence of bass. In the Berg and Breede rivers, the presence of bass is associated with the disappearance of several endemic cyprinid species such as the Berg Breede River whitefish (Christie, 2002, Clark *et al.* 2009). Current research on the impacts of invasive fishes includes a PhD study by Jeremy Shelton on the impact of rainbow and brown trout in the south Western Cape region. This study aims to quantify the impact of these two species in the rivers of the WCP and will help to guide the future management of these fishes. For another PhD study, Sean Marr focused on the management of invasive alien fishes in the CFR which included recommendations for improving conservation efforts focused on indigenous fishes.

Two of the indigenous species of the WCP, the Clanwilliam yellowfish and the Cape kurper have been translocated outside their natural distribution ranges and now occur as extralimital populations in the Twee River catchment in the Cederberg (Marriot, 1998). While the Clanwilliam yellowfish is endemic to the Olifants-Doring system, they do not naturally occur in the Twee catchment and were translocated for conservation purposes in the 1980s (Impson *et al.* 2007). The Cape kurper, indigenous to the Berg, Breede and Gouritz River systems was illegally introduced into a farm dam in the Suurvlei River

catchment from where they invaded the Twee River catchment (Hamman *et al.* 1984). The Twee River catchment is home to the Critically Endangered Twee River redfin (Skelton, 1974) which is considered to be one of the most threatened species in the WCP (Impson *et al.* 2007). Five alien species, including the two species indigenous to the WCP have invaded this catchment and is one of the many threats affecting the Twee River redfin (Marriot, 1998, Impson *et al.* 2007, Marr *et al.* 2009). It was reported by Marriot (1998) that of the alien species present, the Cape kurper has established the largest population and this was confirmed by Marr *et al.* (2009). The latter study also confirmed that while the distribution range of the Twee River redfin has not changed since Marriot's 1998 survey, the fish had become less abundant and more localised. This is as a result of the presence of alien fish and other threats including negative impacts on habitat caused by unsustainable land use practices and the use of agrichemicals, mainly pesticides (Davies, 2007). The impacts of pesticides on aquatic invertebrates in rivers of the WCP have been studied (Schulz and Liess, 1999), but a study quantifying the impacts of commercially important pesticides on the indigenous fish of the WCP requires urgent attention. Bruton (1995) stated that while many threatened fish species may be able to withstand the effects of habitat degradation and pollution, the added impact of introduced fishes may result in a potentially lethal combination leading to the extirpation of threatened species.

6. Conservation initiatives and actions

CapeNature has several conservation initiatives underway to address the threats to the WCP freshwater fishes and to improve their chances of long-term survival in the wild. Apart from the overarching mandate of CapeNature to conserve biodiversity in the WCP, the National Environment Management Act (Act No. 107 of 1998) places a legal obligation on conservation organisations such as CapeNature to address environmental impacts caused by alien and/or invasive species.

a) Rondegat River rehabilitation project

The Rondegat River rehabilitation project is part of a long term project focusing on management of alien invasive fish species in a number of rivers in the CFR. The initial phase of the project, guided by an environmental impact assessment and an environmental management plan, aims to remove invasive alien fish species from three rivers in the Western Cape and one in the Eastern Cape (Figure 3a and 3b), starting with the Rondegat River in the Cederberg. The Rondegat project is a catchment-scale plan aimed at rehabilitation of the entire riverine ecosystem which was done by restoring the riparian zone through alien invasive plant clearing and the removal of alien invasive fish below a waterfall barrier to allow the indigenous species to recolonise. The project also served as a pilot project for the experimental use of rotenone for biodiversity restoration purposes in South Africa. The motivation for the project is presented in Impson (2007) and Marr *et al.* (2012) and was implemented following the Standard Operating Procedures (SOPs) for the use of rotenone in fish management from the American Fisheries Society (AFS) (Finlayson *et al.* 2010). Included in the final implementation plan were a number of project plans relating to Public Involvement, Communications, Fish Rescue, Fish Disposal, Piscicide Treatment and Site Safety and Security.

The Rondegat River treatment was implemented in February 2012 using the piscicide CFT Legumine containing rotenone as active ingredient. The treatment zone is approximately 4.5km long and treatment included seven treatment stations and a neutralisation station. The treatment concentration (50µg/l) and treatment duration (6h) was selected based on concentrations recommended by the AFS manual as well as on the results of bioassays conducted prior to implementation. (Jordaan, unpublished.) Smallmouth bass caught from the river prior to treatment were used as sentinel fish and were placed in keep nets in the treatment zone and below the neutralisation station. These were used to confirm the efficacy of the treatment as well as the neutralisation which was done using potassium permanganate. To determine the impacts of the treatment on non target species and to quantify the recovery of the indigenous biota a monitoring study was initiated which included pre and post treatment monitoring. The biomonitoring project is still ongoing and is coordinated by Dr Olaf Weyl from the South African Institute for Aquatic Biodiversity (SAIAB) and funded by the Water Research Commission. A technical report on the implementation of the Rondegat project, including all aspects of the treatment will be completed in 2012. Funding for implementation was supplied by the Working for Water (WfW) programme and specialist support for the project was provided by Dr Brian Finlayson, chairman of the Fish Management Chemicals Sub-committee of the American Fisheries Society, and Dr Jarle Steinkjer, a piscicide expert from the Norway Directorate of Nature Management.

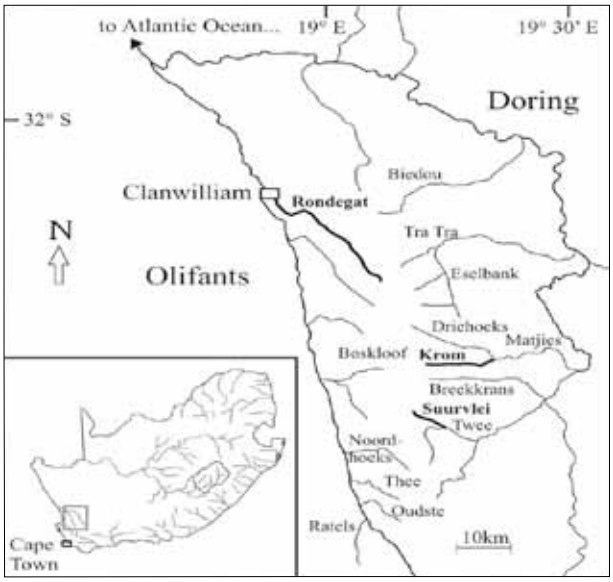

Figure 3a: Location of the Rondegat, Krom and Suurvlei Rivers in the Western Cape. These rivers were identified as being suitable for alien fish eradication using piscicides. (Source: EIA Report).

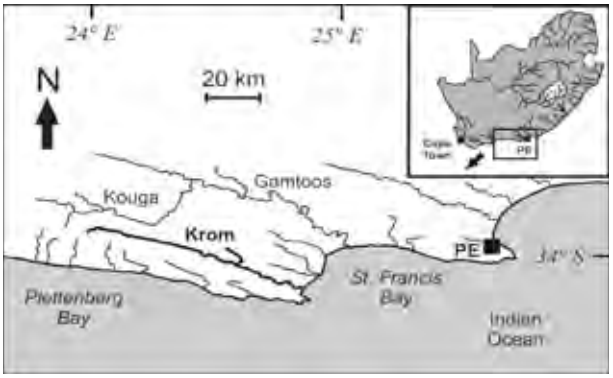

Figure 3b: Location of the Krom River in the Eastern Cape. This river was identified as being suitable for alien fish eradication using piscicides. (Source: EIA Report).

The Rondegat project has been successful from several perspectives. Preliminary results provide evidence that smallmouth bass has been successfully eradicated from the system and this will be confirmed by post-treatment monitoring. Stakeholder relationships have improved compared to the early phases of the project due to a strategic communications plan focusing on the need for conserving threatened indigenous species and ecosystems instead of only on managing alien species. The presence of two international experts in the use of piscicides provided valuable knowledge exchange and capacity building opportunities. The main shortfall of the project is the fact that the weir at the lower end of the treatment zone, which is the barrier to re-invasion of bass from lower section of the river and Clanwilliam Dam, was not upgraded prior to treatment. The existing weir construction may not be an adequate barrier and a risk of re-invasion exists. An environmental impact assessment for the upgrading of the weir is being undertaken and funds have been provided by WfW for the upgrade which is scheduled for 2012/2013. With regard to project communication, a number of stakeholders from the angling fraternity remain critical about aspects of the project, despite efforts to inform anglers about project objectives and progress. Following implementation of the project and the evaluation of the preliminary results, several recommendations were made regarding improvement of future treatments and these are summarised in a report to CapeNature by Finlayson and Steinkjer (2012).

b) Groot Winterhoek Freshwater Stewardship Corridor

The Groot Winterhoek Freshwater Stewardship Corridor project was initiated in 2009 with funding from the WWF Table Mountain Fund. The aim is to expand formally protected areas through the establishment of core biodiversity corridors capable of conserving priority aquatic ecosystems and species within CapeNature's Greater Cederberg Biodiversity Corridor (GCBC). The GCBC is an initiative aimed at conserving a priority area in the Cape Floristic Region through maintaining and restoring connectivity across the landscape. This area, which includes large sections of the Olifants-Doring catchment, is of exceptional conservation value in terms of its aquatic biodiversity and species richness and there is an urgent need to expand the terrestrial-focused strategies to include considerations of aquatic ecosystems and species. This is being achieved through voluntary stewardship agreements with private land owners in the form of conservation areas, biodiversity agreements and contract nature reserves.

There have also been a number of recent aquatic studies in the area which have identified conservation requirements for aquatic species and habitats, from broad regional scale conservation plans and ecological flow requirements to finer scale species management plans (Marriot, 1998; Bills, 1999; Impson *et al.* 2007; Marr *et al.* 2009; Bills and Impson, in press). The Freshwater Stewardship Corridor has provided a mechanism for implementing the recommendations of these studies and stewardship agreements and management plans are being finalized for four properties within the corridor. Of these, one will be a contract nature reserve and three will be protected environments. Figure 4 indicates the boundaries of the corridor as well as the location of Tandfontein Farm which is in the process of being declared a contract nature reserve.

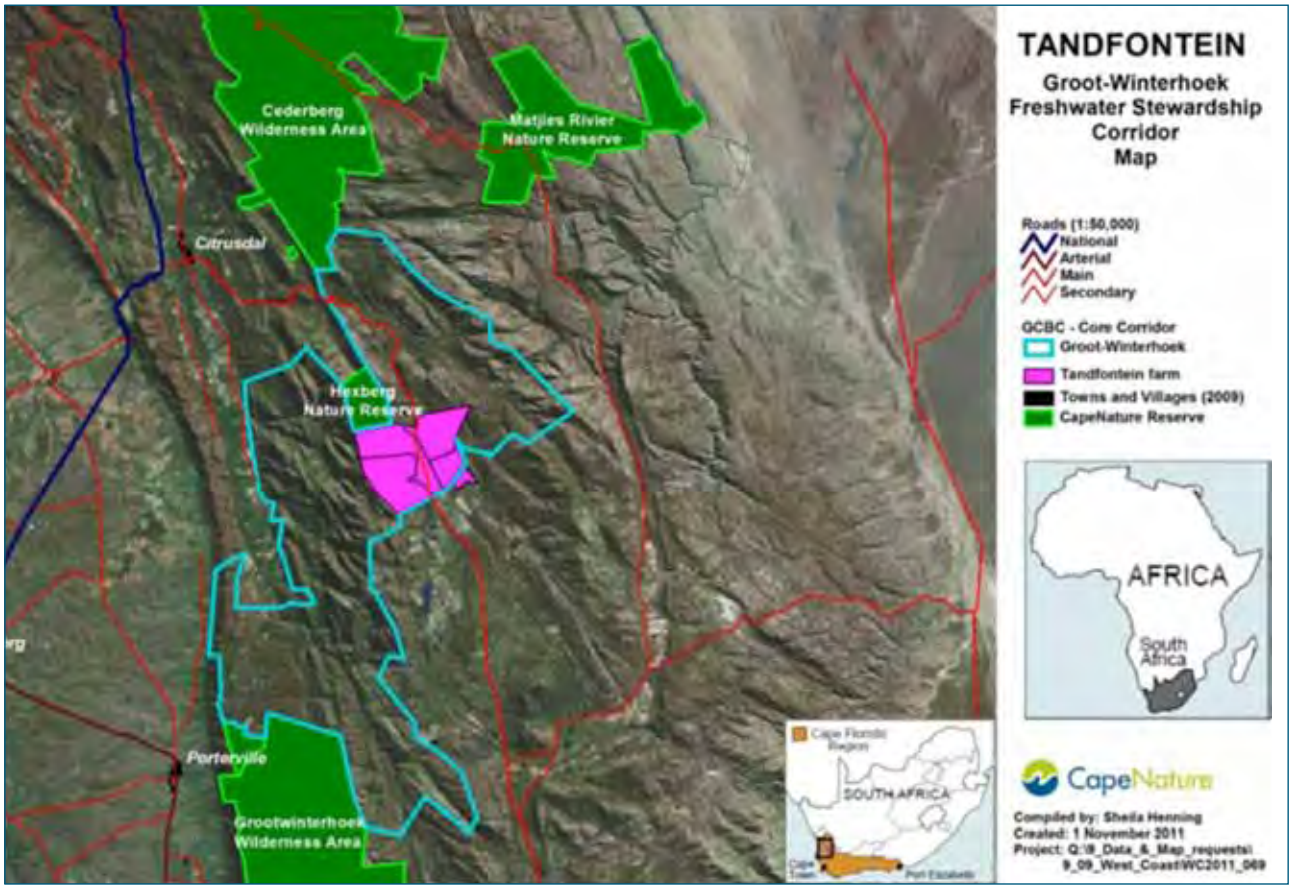

Figure 4: Map indicating the aquatic biodiversity corridor linking the Groot Winterhoek Wilderness Area to the Cederberg Wilderness Area. The farm Tandfontein is an example of one of the properties in the process of being signed as a contract nature reserve.

Other outputs from the project include improving awareness in local schools and farm worker communities and among landowners of the conservation importance of riverine ecosystems. Further conservation products from this project include a comprehensive alien fish management plan for the Twee River catchment aimed at the conservation of the Critically Endangered Twee River redfin (Van der Walt, 2011a). The project has also contributed tremendously in terms of confirming species records and determining distribution limits of these species in a number of rivers in the greater Cederberg.

c) Thee River bass eradication project

The Thee River is a tributary of the Olifants River and is home to six indigenous fish species which are threatened by a relatively recent invasion of spotted bass. Until 2007, when the first record of this species was reported, most of the river was largely unimpacted by human activity including the introduction of alien fish species. The river is of high conservation value and of particular importance for the survival of the Endangered spotted rock catfish (Bills, 1999). It is also one of the few remaining sites where recruitment of Clanwilliam yellowfish is currently taking place and where the fish assemblages are dominated by indigenous species (Impson *et al.* 2002). Extensive fish surveys and a project for the manual eradication of spotted bass from this river were initiated in 2010 (Van der Walt, 2011b).

Results of the fish surveys indicated that the indigenous species were significantly less abundant in the bass invaded area (Figure 5) while the results from the stomach content analysis showed a high percentage of indigenous fish in the diet of spotted bass. Removal of bass was done through construction of temporary gabion barriers which allowed the river to be divided into manageable sections for intensive gill netting, seine netting, spear fishing and electrofishing. Removal efforts were concentrated during summer when the flow was low and most of the bass were concentrated in pool habitat. To date, more than 350 bass have been removed and recent surveys provide strong evidence that the bass had been successfully eradicated. Follow-up surveys are needed to confirm this and the project shows that manual eradication of an alien species can be considered an alternative to the use of piscicides in certain areas where the use of chemical eradication methods is not feasible.

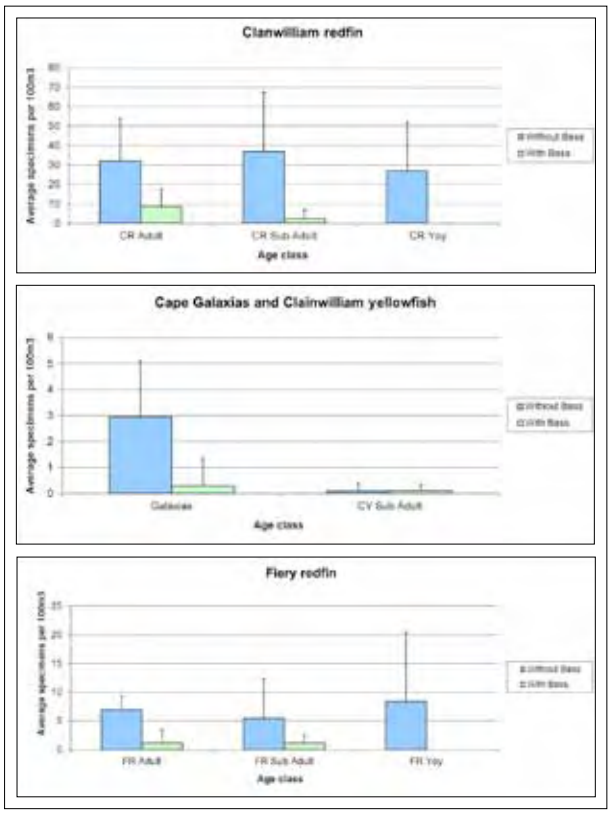

Figure 5: Results of the Thee River fish survey indicating that the four indigenous species were less abundant in the presence of smallmouth bass (Yoy = young of year size class). Source: Van der Walt (2011b).

d) Biodiversity Management Plan for Species (BMP-S)

Section 43 of the National Environmental Management: Biodiversity Act provides for the compilation of a Biodiversity Management Plan for Species (BMP-S) for any indigenous or migratory species in South Africa. The objective of a BMP-S is ensuring the long term survival in nature of the species to which the plan relates. Norms and Standards outlining the process for compiling a BMP-S were produced in 2009 and the purpose of these is to provide a national guideline and minimum standards for the development of biodiversity management plans for species. During 2011 two management plans were initiated for priority species. These were the Critically Endangered Barrydale redfin and the Endangered Clanwilliam sandfish.

The Barrydale redfin was selected as it is listed as Critically Endangered and has an extremely small distribution range limited to the Tradouw catchment near the town of Barrydale. Within this limited distribution range it faces the full range of threats to which the freshwater fish of the WCP are exposed. This situation presents an ideal opportunity to develop and implement a management plan with a relatively small stakeholder group while at the same time addressing all threats that are applicable to other species with much larger distribution areas and bigger, more complex stakeholder requirements. The BMP-S was initiated without dedicated funding as a joint project by CapeNature and SAIAB and a draft BMP-S document has been circulated to stakeholders for comment (Jordaan and Swartz, 2012). It is envisaged that a completed document will be produced towards the end of 2012 when the roles and responsibilities of implementing agents have been clarified.

The development of the Clanwilliam sandfish BMP-S is funded by the WWF Table Mountain Fund as a collaborative project between CapeNature and the Northern Cape Department of Environment and Nature Conservation (DENC) under the project management of Dr Bruce Paxton. The reason for selecting the sandfish for the development of a BMP-S was two-fold. Firstly, the current conservation initiatives aimed at protecting and/or rehabilitating habitat for the majority of endemic fish species of the Olifants-Doring catchment (e.g. the Groot Winterhoek Freshwater Stewardship Corridor) will not secure viable populations of Clanwilliam sandfish. This is despite the fact that it ranks as one of the most threatened species in the catchment and has been identified as a conservation priority by CapeNature (Impson, 2007). Adult populations of this species are restricted to the northern reaches of the Doring River and successfully recruiting populations are known from only two tributaries, of which the confined reaches of the Oorlogskloof-Koebee River system in the Northern and Western Cape are by far the most important (Paxton *et al.* 2002). Secondly, it is intended that the Clanwilliam sandfish serve as an umbrella species for the remainder of the threatened species in the catchment and a flagship species for conserving the threatened freshwater ecosystems in this river system as whole. The necessity for a species conservation plan and for addressing broader freshwater ecosystem concerns

was highlighted in the Wetland Assessment and Catchment Action Plan developed for the Bokkeveld Plateau (Job, 2009). In addition to providing guidelines for management interventions that will reduce the likelihood of future alien fish invasions, the BMP-S will therefore align with the former study and further its objectives by evaluating the potential impacts of wetland degradation on river ecosystems and endemic fish communities downstream.

A comprehensive survey of the distribution range of the sandfish was undertaken as part of the development of the BMP-S and the results indicated that the sandfish numbers have declined significantly compared to historical data (Paxton *et al.* 2002; Paxton *et al.* unpublished data). A draft BMP-S document was produced in 2011 for dissemination to stakeholders and implementing agents and presently the feedback from various stakeholders are in the process of being incorporated so that a finalised BMP-S can be submitted to the National Department of Environmental Affairs for approval (Paxton *et al.* 2012).

e) Book on Freshwater fishes of the Western Cape Province

A book on the indigenous species of the CFR was produced by Garrow and Marr (2012). The aim of the book is to create awareness among the general public of the remarkable species diversity and threatened conservation status of the indigenous species of the region. The book, while being valuable as a field guide, also offers excellent underwater photographs of most species. The book further highlights threats to these fishes and outlines actions that can improve conservation efforts for both the species and their habitats.

7. Fish monitoring programmes

At present there is no formal CapeNature monitoring programme in place for any of the indigenous fish species of the WCP and all existing monitoring and surveying is being done either as part of existing monitoring initiatives such as the River Health Programme (RHP) or as part of independent research. Limited monitoring of fish and aquatic ecosystems has been conducted on reserves and this has mainly focused on collecting distribution records and monitoring species presence and absence.

i) River Health Programme

An overview of the provincial River Health Programme (RHP) results obtained since 2004 is presented in the 2007 State of Biodiversity Report (Impson, 2007) and this report will only focus on surveys done from 2007 onwards by CapeNature. As the former implementing agent for the RHP, CapeNature conducted a comprehensive survey of all five RHP indices for the Breede River WMA during 2007-2009 and produced a State of River report in 2011. The results of the fish survey indicated that the distribution ranges of all indigenous species have shifted and contracted in recent years (Jordaan and Impson, unpublished data). Less than 26% of the surveyed sites were in the A/B (Natural/Good) category in terms of the integrity of the fish assemblage at the site and 46% of sites were in the D/E (Poor) category as presented in Figure 7. This can mainly be attributed to excessive and often unregulated water abstraction for both domestic and agricultural use, instream habitat modification due to unsound agricultural practices such as bulldozing and removal of the riparian vegetation, diffuse and point-source pollution, and the presence of alien fish species. Other results include

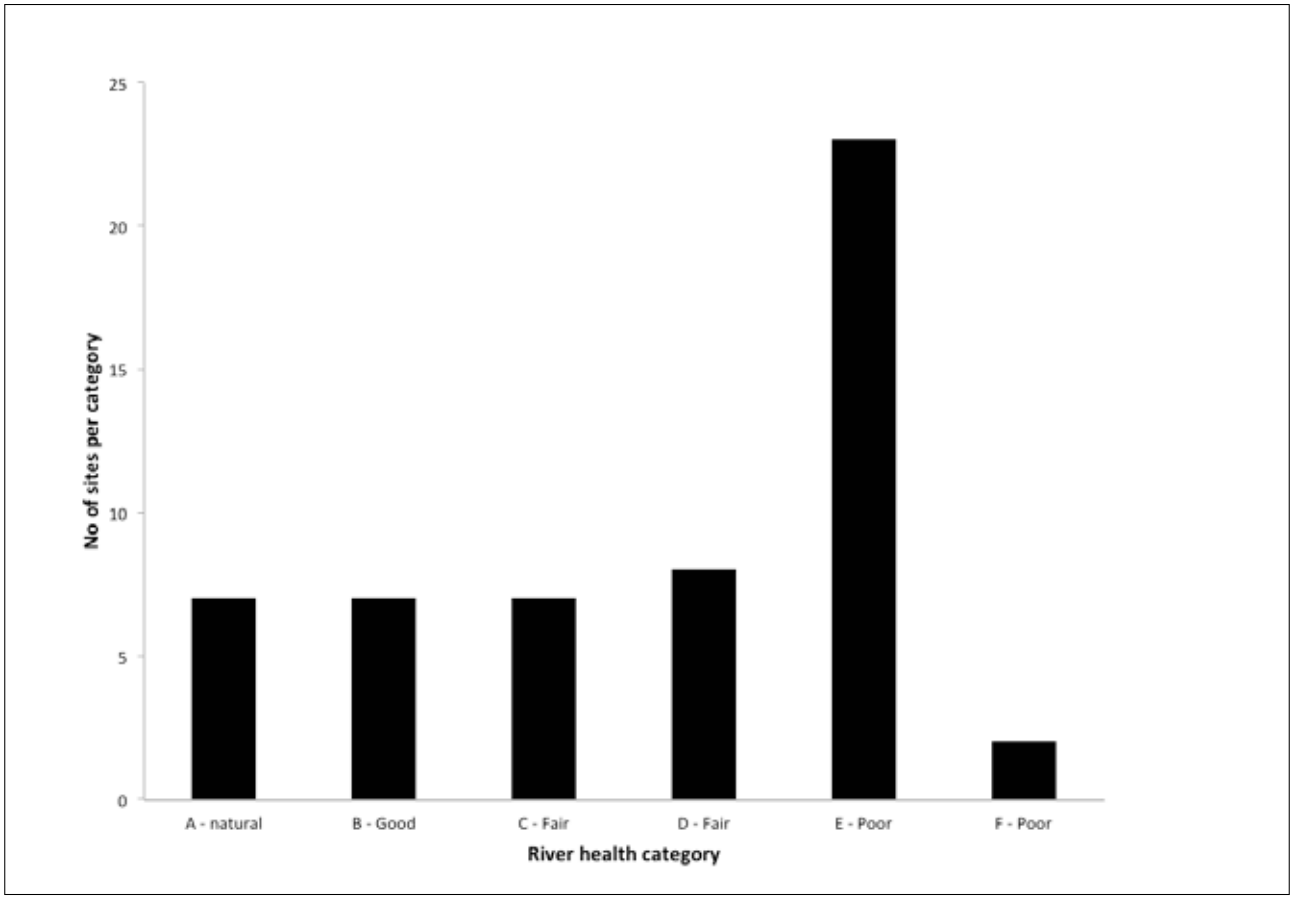

Figure 7: Bar chart indicating the number of sites per River Health Category following a comprehensive fish survey of the Breede River Water Management Area.

the very low numbers of whitefish recorded during the survey (present at only 1 of 54 sites) and the alarming frequency with which the presence of the alien invasive sharptooth catfish was detected (17 of 54 sites). The Berg-Breede river whitefish, a once abundant species in the main stream Breede River is today almost extinct in the river and this species now occurs mainly in large public dams such as Brandvlei and Kwaggaskloof and in sections of the Breede River below Brandvlei Dam. At all the sites where sharptooth catfish was recorded, they were the dominant species both in terms of numbers and biomass.

ii) Protected Area Management Plans

The National Environmental Management: Protected Areas Act (Act 57 of 2003) legislation requires the development and implementation of protected area management plans (PAMPs) for all formally protected areas in South Africa. For the Western Cape Province, CapeNature produced eight completed plans in 2011. These plans provided an opportunity to actively incorporate newly developed conservation planning products such as the National Freshwater Ecosystem Priority Areas (NFEPA) fish sanctuaries and priority wetland areas into formal reserve management. This served to elevate the level of awareness of reserve management staff with regard to aquatic conservation issues and ensured the inclusion of monitoring protocols for priority fish species and aquatic systems into the reserve management plan for implementation once the plans have been formally approved. It must be noted however, that many critically important fish conservation areas do not fall within the boundaries of formally protected areas in the Western Cape and therefore these areas cannot adequately protect all threatened species. This highlights the value of projects such as the Groot Winterhoek Aquatic Stewardship Corridor and expansion of stewardship in these areas.

8. Conservation planning products

a) National Freshwater Ecosystem Priority Areas

(NFEPA) project with special reference to fish sanctuaries

An overview of the development of the NFEPA project is presented in Chapter 2. A critical output from this project was the fish sanctuary layer (Figure 8) which identified critical conservation areas, support areas and fish corridors for all indigenous threatened fish species of the country including the species of the Western Cape. While focused on threatened species, fish sanctuaries also perform the function of conserving the widespread and common species. This product is enabling better and more thorough comment on relevant land use advice applications as well as allowing for better prioritisation of ecological monitoring of aquatic ecosystems on and off reserves. With many invasive alien species being economically valuable (for aquaculture and recreational angling) careful planning is required for supporting their associated economies while at the same time conserving indigenous fish species. The fish sanctuaries are thus critical for providing much-needed decision support in reviewing fish stocking applications both for aquaculture and recreational purposes. The fish sanctuaries are also extremely valuable for guiding introductions and reintroductions for conservation purposes.

b) CapeNature Indigenous Fish Utilisation Policy

Given the threatened status of the fish fauna of the WCP and the presence of a number of unique lineages which are in process of being described as separate species, there is a strong need for guiding principles for the utilisation of these fish.

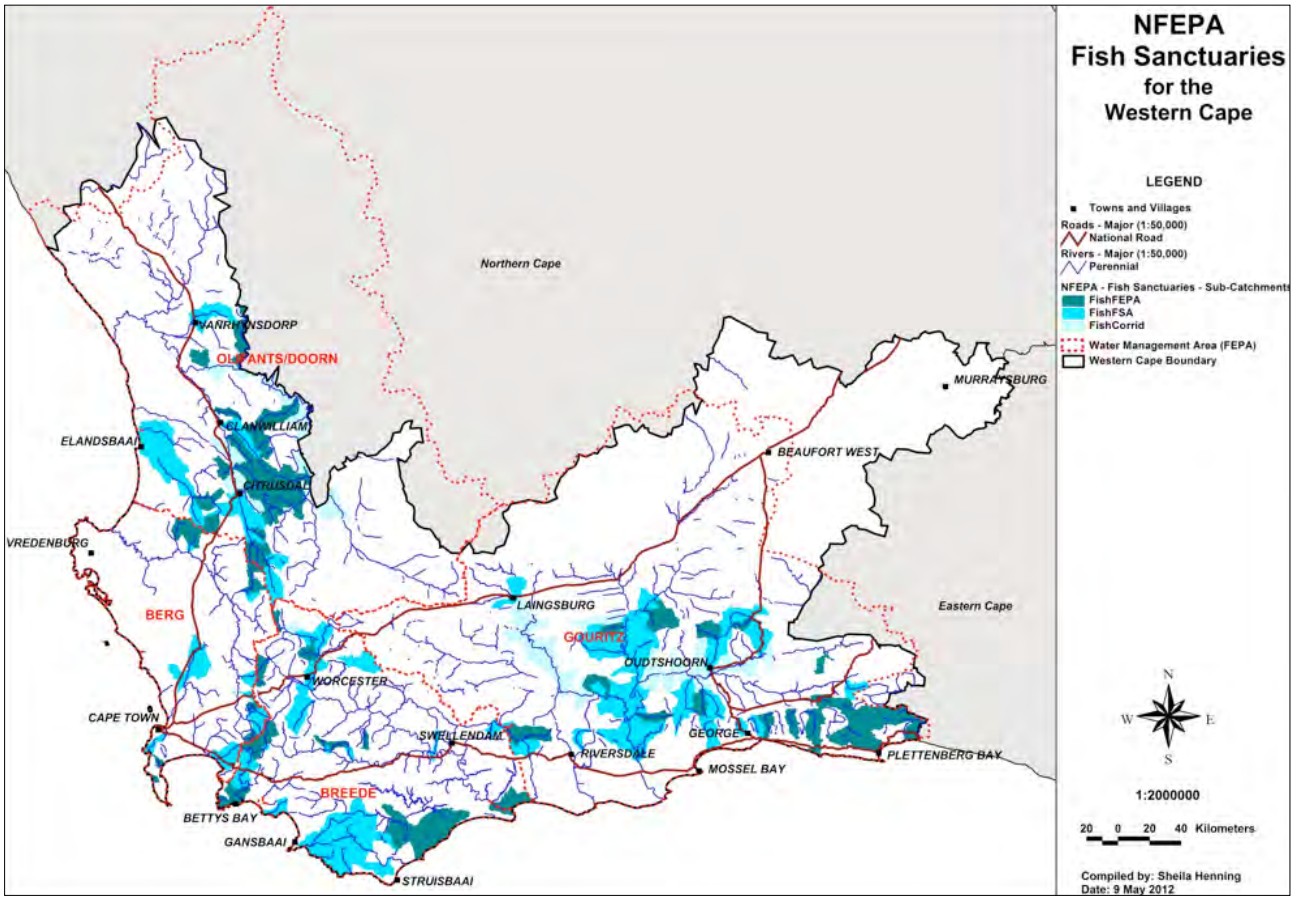

Figure 8: Fish sanctuary areas and support areas for the Western Cape as identified in the National Freshwater Ecosystem Priority Areas (NFEPA) project.

This is to ensure the conservation of genetic integrity and to prevent detrimental impacts from the utilisation of indigenous species. The aim of the policy is thus to govern the ecologically sound utilisation of these species in a consistent and transparent manner in order to ensure long term conservation benefit for the species. The policy has three goals: (1) to promote sustainable utilisation of indigenous fish through the development of a knowledge base and an active capacity building programme; (2) to establish guidelines for the utilisation of indigenous fishes; and (3) to establish guidelines for the disposal of surplus or unwanted animals.

For goal one, the policy defines clear objectives in terms of the need for establishing a provincial inventory and the need for long term monitoring of conservation status through initiating and/or supporting species monitoring programmes. It also highlights the need for promoting and supporting research required for improving knowledge and management of indigenous fishes. For goal two, clear guidelines are established for (i) research (collection methods, species, numbers, holding facilities, animal use ethics etc.); (ii) captive breeding (only as a final measure to save a species and to be guided by a BMP-S, no breeding for commercial purposes or pet trade) and (iii) capture, transport and possession (primarily introductions and re-introductions for conservation and angling purposes). Guidelines are also provided for the disposal of surplus or unwanted animals to prevent their release into the wild and these guidelines align with existing IUCN guidelines (IUCN, 2000).

The policy also includes a clearly defined stakeholder engagement process for both internal and external stakeholders. For internal (CapeNature) stakeholders the policy will serve as a decision support tool within the organisation as well as for improving knowledge and capacity for conserving the indigenous fish of the WCP. For external stakeholders, as users of the natural resource, the policy will also serve as an awareness creation tool as well as ensuring that applications to stock indigenous species are reviewed in a consistent and fair manner. It is envisaged that through appropriate stakeholder engagement the principles of the policy will be supported by external stakeholders. This will in turn aid in the decision making process relating to the evaluation of applications related to utilisation and thus be to the long term benefit of species specific conservation plans implemented by CapeNature or other relevant organisations.

9. Progress on the 2007 recommendations

a) Determine the extent and severity of invasion of WCP rivers by sharptooth catfish.

This recommendation was not addressed by a formal study focusing on the WCP as study area. However, through the work of the RHP and of a number of independent researchers, the extent of invasion of this species is far better known than before. It is now one of the dominant species in the main stream river sections of all four river systems in the WCP but the degree of invasion into mountain tributaries remains unknown. Determining the susceptibility of tributaries to invasion by this species is critical as these areas harbour many of the remaining indigenous fish populations. While sharptooth catfish favour bigger rivers and slow flowing waters, they survive in a wide range of habitats and have been proven to negatively impact on indigenous fish populations in areas where they have become established (Clarke *et al.* 2009).

b) Determine the biology, ecology and rehabilitation requirements of Clanwilliam sandfish *Labeo seeberi.*

A formal study on the biology and ecology of the Clanwilliam sandfish has not been initiated to date but a number of management interventions required to conserve the species and improve its conservation status were identified as part of the Clanwilliam sandfish BMP-S. As stated, the Clanwilliam sandfish is threatened in most of its native range by the presence of high numbers of alien invasive smallmouth bass and bluegill sunfish and due to the vast size of the area concerned, localized eradication plans such as the rotenone treatment of the Rondegat River or the manual bass eradication project in the Thee River are not feasible. The Oorlogskloof River in the Oorlogskloof Nature reserve near Nieuwoudtville is home to the biggest population of this species and for this reason conservation efforts will be focused here in a joint project between CapeNature and DENC. Annual monitoring of the Oorlogskloof was initiated in 2010 and will be done annually to determine trends in population and age structure. Linking this to monitoring data for environmental variables such as temperature and flow in this system will provide valuable information on the environmental requirements of this species. While this cannot replace a full study on the biology and ecology of the species, it will provide useful information for managing environmental flows in the catchment to the advantage of the resident sandfish population. Due to the fact that the Oorlogskloof population is potentially threatened by a recent invasion of banded tilapia, the BMP-S also highlights the need for considering ecologically and genetically appropriate translocations of this species.

c) Determine the biology, ecology and rehabilitation requirements of Berg-Breede whitefish *Barbus andrewi.*

A formal study on the biology, ecology and rehabilitation requirements of the Berg-Breede whitefish has to date not been conducted. This species has been extirpated from most of its natural range but large populations are present in a number of large public dams in the WCP. It has also been stocked into a number of privately owned farm dams within its natural distribution range. In order to address the rehabilitation requirements, a BMP-S should be developed for this species and the need for a study on the biology and ecology should be highlighted in the plan and addressed as soon as funding is available. Impson (2008) provided an overview of the present status and listed conservation interventions relevant to this species. An internal CapeNature management plan has been approved for the introduction of this species into a large storage dam in Paarl Mountain Nature Reserve but re-introducing into any natural systems should be addressed in a BMP-S and only considered once the threats which have caused their disappearance have been addressed. A genetic study of all major populations has been initiated and the results of this study will inform re-introductions and translocations.

d) Undertake biodiversity management and recovery plans for all fish species listed as Critically Endangered and Endangered.

The BMP-S Norms and Standards provide a framework for the development of conservation plans aimed at the long term survival in nature of the species to which the plan relates. As conservation of priority species and their habitats is dependent on the collaborative effort from a number of stakeholders, the

BMP-S process provides an ideal tool for achieving this goal. However, due to the level of detail required for developing a BMP-S, the process is lengthy and often requires project specific funding and dedicated project management which is not always available. For the two species for which a BMP-S was initiated, success was achieved by defining and quantifying management interventions required for conserving the species, but continued efforts are required for ensuring stakeholder commitment to the respective projects. While ideally a BMP-S is required for each of the species listed as Critically Endangered and Endangered, current staff and funding limitations within CapeNature will prevent the organisation from being able to drive all these plans to completion within the next five years. As an interim measure, conservation plans for each of the Critically Endangered and Endangered species should be developed. These can then be expanded into BMP-S's as the time and resources become available. This is currently proposed for the Twee River redfin where a conservation plan was drafted for this species by Impson (in press) and van der Walt (2011a) and the development of a BMP-S is part of a new funding application to the WWF Nedbank Green Trust. Alternatively, in areas where there are more than one priority species, an ecosystem management plan can be developed according to the relevant Norms and Standards which should include interventions required to protect each of the species included in the plan.

e) Quantify the recovery of biodiversity (fish, aquatic invertebrates, aquatic frogs) in rivers and dams after alien fishes have been eradicated.

The treatment of the lower section of the Rondegat River with rotenone to remove smallmouth bass and allow the indigenous fish to recover in this section of the river provided an opportunity for thorough scientific monitoring of the effects of rotenone on non target aquatic species, including aquatic invertebrates and frogs. A recovery study on the fish fauna of the river following the removal of smallmouth bass was also initiated and funded by the WRC. All monitoring (pre and post treatment) associated with the Rondegat project is executed by staff from SAIAB. Monitoring is ongoing and results will be available once monitoring is complete.

Following the recent manual removal of spotted bass from the Thee River, follow-up surveys are required to document the recovery of the indigenous fish community and the potential re-introduction of alien fish. To address and monitor the threat of re-introductions a public and landowner awareness programme should be implemented because most often the spread of alien and extra-limital species occurs through ignorance or the misguided actions of private individuals. This project and other work done as part of the Groot Winterhoek Aquatic Stewardship Corridor highlights the need for incorporating this project, which is at present a contract position funded externally, into the core business of CapeNature.

10. Recommendations

The following are regarded as priority actions for the next five years:

- The development of a comprehensive fish conservation plan for the WCP with clear goals and project plans.
- The development of conservation plans for priority species and developing the conservation plans into BMP-S when resources become available. Species should be prioritised based on a number of criteria including conservation status (starting with those that are Critically Endangered), the nature of conservation interventions required and the possibility for developing partnerships for implementation of conservation actions.
- Comprehensive surveys of all NFEPA fish conservation areas identified in Protected Area Management Plans with surveying expanding to off-reserve fish conservation areas if resources and capacity are available.
- The initiation of a study on effects of agrichemicals, with a focus on pesticides in critical fish conservation areas, to quantify this threat to indigenous fish.
- The initiation of a study to quantify the impact of sharptooth catfish in the Western Cape, especially in mountain tributaries.
- The implementation of river rehabilitation interventions, including the management of alien fish populations, in priority conservation areas following comprehensive stakeholder engagement. This should include completing the C.A.P.E. alien fish control project where four rivers (Rondegat, Krom, Suurvlei and Kromme) were identified as suitable rivers for the management of alien invasive fish species. An application was made to the WWF Green Trust for funding rehabilitation of Twee River catchment and if successful, should be a priority conservation intervention. Alien fish control projects have been proposed for additional rivers and it is crucial that these projects are guided by a provincial alien fish control programme that is supported by all relevant stakeholders.
- The drafting of best management practices and optimised standard operating guidelines for implementation of projects for alien fish removal using piscicides.
- The completion of the ecological monitoring study on Rondegat River and the publication of the results in both popular and scientific literature.
- The drafting of a policy on piscicide use and formulation of standard operating procedures for all aspects of a piscicide use operation.
- The drafting of a detailed communication strategy regarding the conservation status of and threats to the indigenous fishes of the WCP. This strategy should include suitable products, mechanisms and platforms to engage with the various stakeholders.

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CHAPTER 5

AMPHIBIANS

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CONTENTS

Executive Summary

The Western Cape Province (WCP) has 54 described frog species. Of these, three are Critically Endangered, four are Endangered, one is Vulnerable, six are Near Threatened and at least three remain to be described as new species and have their threat status formally evaluated. More than half of the frogs in the WCP are endemic to this province. Two South African species alien to the WCP have been recorded. There is only one invasive species (guttural toad) that is not indigenous at the provincial level although there are some large-scale movements of an indigenous species (painted reed frog) within the province. No invasive alien amphibians originating outside South Africa are known from the WCP. The threats to amphibians in the WCP are habitat loss, invasive alien plant species, too frequent and intense fires, and emergent diseases.

Introduction

Amphibians are the most threatened class of vertebrates with at least 32% of amphibians Threatened globally (Stuart *et al.* 2008, Hoffmann *et al.* 2010), which may be even be an underestimate of the threat (Alford 2011). There is much debate and ongoing research on why this is the case but there are still many amphibians for which the cause of the declines is unknown (e.g. Alford 2011, Lips *et al.* 2008). Current hypotheses for the widespread decline of amphibians include the bimodal lifestyle of most amphibians which may expose them to a wider range of pollutants. This is in conjunction with their permeable skin may make them more vulnerable than other classes; the spread of novel diseases and in particular exposure to chytrid fungus; increased UV; climate change; changing land-use and combinations of all of the above (see Collins 2010, Lips *et al.* 2008, Blaustein *et al.* 2003).

Within South Africa the conservation state for amphibians appears to be substantially better than the global situation with only 19 of the 118 (16%) of species listed in the Threatened categories (Measey *et al.* 2011a). However the Western Cape Province (WCP) unfortunately contributes a substantial number of these Threatened species. This is largely consequence of the high levels of amphibian endemism in the WCP and the small distributions that these endemic species tend to have. This, in conjunction with the extensive and ongoing transformation of the WCP, results in the relatively high levels of threat to the WCP frogs.

The period 2007 to 2012 saw a number of advances in the field of amphibian conservation science in South Africa. Foremost among these was a revision of the Threat Status of all frog species (Measey *et al.* 2011a) listed as Threatened in the 2004 threat assessment (Minter *et al.* 2004) plus new species described subsequent to the 2004 publication. These publications have particular relevance to the Western Cape Province as this province has a large number of endemic frog species and unfortunately also a large number of Threatened species. There are also still a number of undescribed endemic species in the WCP and a strategy to address this has been proposed (Channing *et al.* 2011).

Amphibian research is actively pursued by CapeNature and its partners at the South African National Biodiversity Institute, University of Cape Town, Stellenbosch University and the University of the Western Cape to obtain the knowledge required to conserve the amphibian component of the WCP's rich biodiversity and promote continued ecological functioning.

Methods

Data on the distribution of amphibians was extracted from the CapeNature Biodiversity Database. Threat status was drawn from Measey *et al.* 2011a. Amphibian taxonomy in the WCP is not affected much by taxonomic concerns on subspecies validity and currently there are no subspecies recognised in the WCP. However it is recognised that the prior classification of subspecies may be valid at the species level in at least one case (see Systematic account). As the amphibian threat status had been revised and standardised according to the IUCN criteria before the previous report, this report is able to compare the 2007 and 2012 threat status at both the regional and global scales.

For the species listed in this report the regional and global statuses are identical. This is largely due to the predominance of the area criterion (Criterion B) in driving threat status. Thus the species at threat in the WCP tend to be those with small distributions which are typically confined to the WCP and are thus endemic to the WCP. Because they are not found anywhere else, the regional status is also the global status.

Additional data on the status of frogs in the WCP was obtained from the CapeNature Long-term Frog Monitoring Project and ongoing monitoring of the Threatened species of the WCP (see Monitoring section; Turner *et al.* 2011).

Systematic Account

There are 54 described species that have been recorded in the WCP (see Table 1 and Table 3). One species, *Strongylopus springbokensis*, previously listed as occurring in the WCP (Turner & De Villiers 2007) was actually recorded just beyond the northern boundary of the WCP and was thus erroneously included in the 2007 list. It is however expected to occur in the southern extent of the Kamiesberg Mountain range which does enter the northern WCP. Surveys in this area are required to confirm its presence in the WCP.

There are currently no subspecies recognised among the WCP frogs. There may be merit in investigating the previously described subspecies of sand rain frog (Breviceps rosei) as this taxon may be obscuring cryptic species. For the purposes of this report only currently recognised species are considered.

Frog diversity is comparable or higher than Mediterranean-climate countries (Spain 36, Portugal 22, Italy 47, France 40 species, Chile 55). Western Australia has more species (77) but over a much larger area (2 525 500 km^2 vs. 129 462 km^2)

As stated in the 2007 report there is active research into the taxonomy and systematics of several of the WCP frogs and one new species, the rough moss frog (*Arthroleptella rugosa*), has been described since that report (Turner & Channing 2008). Several more species in the genera *Arthroleptella, Cacosternum* and *Capensibufo* await formal description. These actions are likely to increase the number of species endemic to the WCP as well increasing the number of frog species indigenous to the province.

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

Scientific Name	English Name
Amietophrynus pantherinus	western leopard toad
Amietophrynus pardalis	eastern leopard toad
Amietophrynus rangeri	raucous toad
Capensibufo rosei	Rose's mountain toad
Capensibufo tradouwi	Tradouw mountain toad
Poyntonophrynus vertebralis	southern pigmy toad
Vandijkophrynus angusticeps	sand toad
Vandijkophrynus gariepensis	Karoo toad
Vandijkophrynus robinsoni	paradise toad
Heleophryne hewitti	Hewitt's ghost frog
Heleophryne orientalis	eastern ghost frog
Heleophryne purcelli	Cape ghost frog
Heleophryne regis	southern ghost frog
Heleophryne rosei	Table Mountain ghost frog
Afrixalus knysnae	Knysna leaf-folding frog
Hyperolius horstockii	arum lily frog
Hyperolius marmoratus	painted reed frog
Kassina senegalensis	bubbling kassina
Semnodactylus wealii	rattling frog
Xenopus gilli	Cape platanna
Xenopus laevis	common platanna
Amietia angolensis	common river frog
Amietia fuscigula	Cape river frog
Amietia vandijki	van Dijk's river frog
Arthroleptella bicolor	Bain's Kloof moss frog
Arthroleptella drewesii	Drewes' moss frog
Arthroleptella landdrosia	Landdros moss frog
Arthroleptella lightfooti	Cape Peninsula moss frog
Arthroleptella rugosa	rough moss frog
Arthroleptella subvoce	northern moss frog
Arthroleptella villiersi	De Villiers' frog
Cacosternum boettgeri	common caco
Cacosternum capense	Cape caco
Cacosternum karooicum	Karoo caco
Cacosternum namaquense	Namaqua caco
Cacosternum nanum	bronze caco
Cacosternum platys	Flat caco
Microbatrachella capensis	micro frog
Poyntonia paludicola	montane marsh frog
Pyxicephalus adspersus	giant bullfrog
Strongylopus bonaespei	banded stream frog
Strongylopus fasciatus	striped stream frog
Strongylopus grayii	clicking stream frog
Tomopterna delalandii	Cape sand frog
Tomopterna tandyi	Tandy's sand frog
Breviceps acutirostris	strawberry rain frog
Breviceps fuscus	plain rain frog
Breviceps gibbosus	Cape rain frog
Breviceps montanus	Cape mountain rain frog
Breviceps namaquensis	Namaqua rain frog
Breviceps rosei	sand rain frog

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

Scientific Name	English Name
Amietia vandijki	Van Dijk's river frog
Arthroleptella bicolor	Bainskloof moss frog
Arthroleptella drewesii	Drewes' moss frog
Arthroleptella landdrosia	Landdros moss frog
Arthroleptella lightfooti	Lightfoot's moss frog
Arthroleptella rugosa	rough moss frog
Arthroleptella subvoce	northern moss frog
Arthroleptella villiersi	De Villiers' moss frog
Breviceps acutirostris	strawberry rain frog
Breviceps gibbosus	Cape rain frog
Breviceps montanus	Cape mountain rain frog
Breviceps rosei	sand rain frog
Vandijkophrynus angusticeps	sand toad
Amietophrynus pantherinus	western leopard toad
Cacosternum capense	Cape caco
Cacosternum karooicum	Karoo caco
Cacosternum platys	flat caco
Capensibufo rosei	Rose's mountain toad
Capensibufo tradouwi	Tradouw mountain toad
Heleophryne orientalis	eastern ghost frog
Heleophryne purcelli	Cape ghost frog
Heleophryne regis	southern ghost frog
Heleophryne rosei	Table Mountain ghost frog
Hyperolius horstockii	arum lily frog
Microbatrachella capensis	micro frog
Poyntonia paludicola	montane marsh frog
Strongylopus bonaespei	banded stream frog
Xenopus gilli	Cape platanna

Distribution Data

The number of frog distribution records that we were able to draw on for the current report was 17 450 which represents a small increase over the 16 308 records available for the 2007 report. Most new records were obtained by CapeNature staff.

Endemism

Fifty-four per cent (28 of 52) of the indigenous frogs in the WCP are endemic to the WCP. This is the same level of endemism as recorded in 2007. The level of endemism is likely to rise with the description of additional species in the province. The level of frog endemism is symptomatic of the varied but small and fragmented wetland habitats available in the WCP. There is a clear pattern of high endemism in the south-western part of the WCP (Figure 1).

Conservation Status

The numbers of amphibian species listed in the two most Threatened categories Critically Endangered (CR) & Endangered (EN) increased but the number of species listed as Vulnerable (VU) declined (Figure 2). These changes are due to improved taxonomic and distribution data (CapeNature, SANBI, UWC and UCT). Regional & Global threat status are the same for WCP frog species as the Threatened Species are endemic to WCP (Measey 2011a).

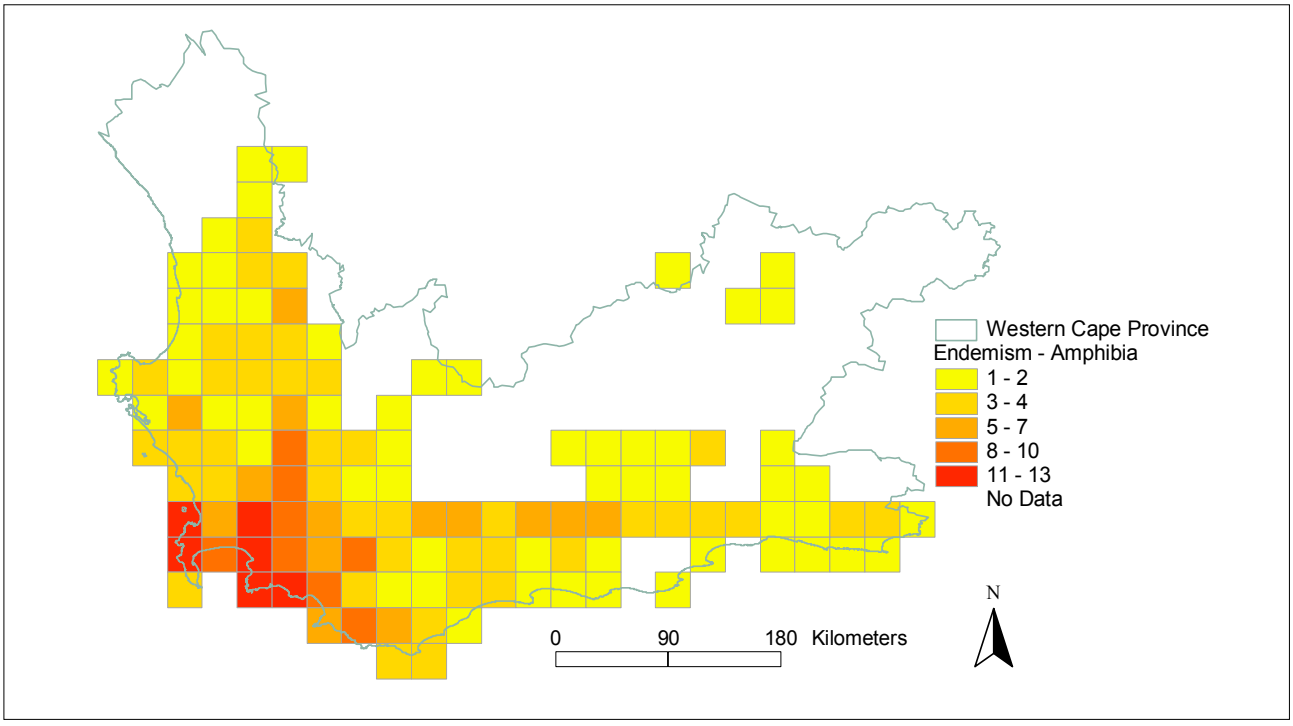

Figure 1. Numbers of endemic frog species per quarter degree square in the Western Cape Province.

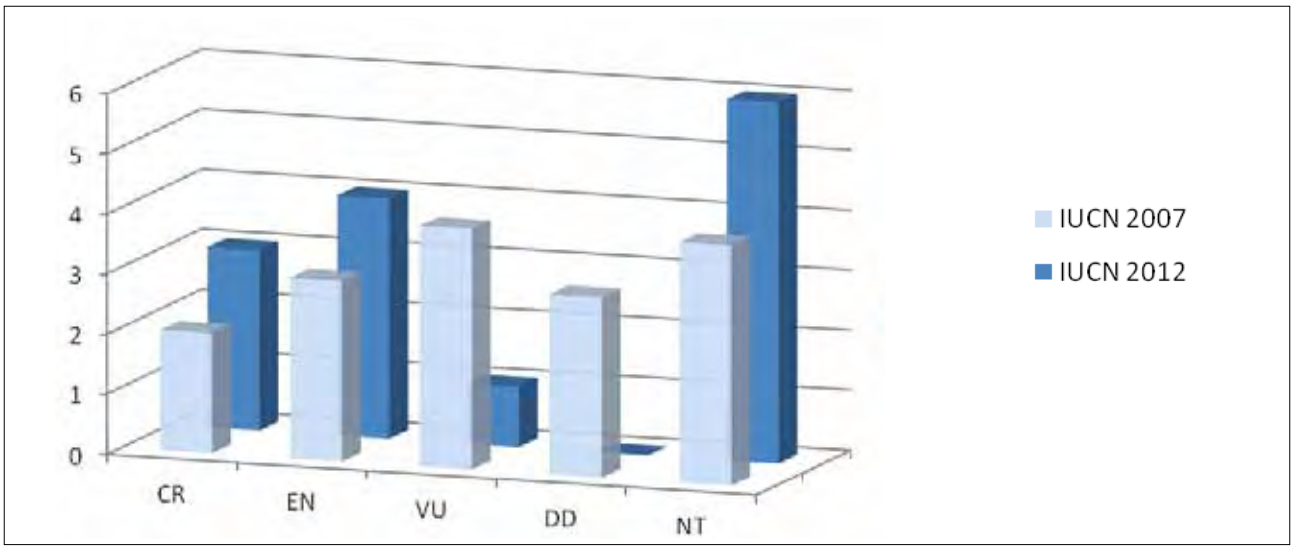

Figure 2. Summary threat status of Western Cape frogs comparing numbers of species in each IUCN threat category for 2007 and 2012.

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

Taxon	IUCN threat status
Afrixalus knysnae	Endangered (B1ab)
Amietia angolensis	Least Concern
Amietia fuscigula	Least Concern
Amietia vandijki	Least Concern
*Amietophrynus guttturalis**	Least Concern
Amietophrynus pantherinus	Endangered (B1ab+2ab)
Amietophrynus pardalis	Least Concern
Amietophrynus rangeri	Least Concern
Arthroleptella bicolor	Least Concern
Arthroleptella drewesii	Near Threatened
Arthroleptella landdrosia	Near Threatened
Arthroleptella lightfooti	Near Threatened
Arthroleptella rugosa	Critically Endangered (B1ab+2ab)
Arthroleptella subvoce	Endangered (B1ac+2ac)
Arthroleptella villiersi	Least Concern
Breviceps acutirostris	Least Concern
Breviceps fuscus	Least Concern
Breviceps gibbosus	Near Threatened
Breviceps montanus	Least Concern
Breviceps namaquensis	Least Concern
Breviceps rosei	Least Concern
Cacosternum boettgeri	Least Concern
Cacosternum capense	Near Threatened
Cacosternum karooicum	Least Concern
Cacosternum namaquense	Least Concern
Cacosternum nanum	Least Concern
Cacosternum platys	Least Concern
Capensibufo rosei	Vulnerable (B1ab+2ab)
Capensibufo tradouwi	Least Concern
*Chiromantis xerampelina**	Least Concern
Heleophryne depressa	Not evaluated
Heleophryne orientalis	Least Concern
Heleophryne purcelli	Least Concern
Heleophryne regis	Least Concern
Heleophryne rosei	Critically Endangered (B1ab+2ab)
Hyperolius horstockii	Least Concern
Hyperolius marmoratus	Least Concern
Kassina senegalensis	Least Concern
Microbatrachella capensis	Critically Endangered (B2ab)
Poyntonia paludicola	Near Threatened
Poyntonophrynus vertebralis	Least Concern
Pyxicephalus adspersus	Least Concern
Semnodactylus wealii	Least Concern
Strongylopus bonaespei	Least Concern
Strongylopus fasciatus	Least Concern
Strongylopus grayii	Least Concern
Tomopterna cryptotis	Least Concern
Tomopterna delalandii	Least Concern
Tomopterna tandyi	Least Concern
Vandijkophrynus angusticeps	Least Concern
Vandijkophrynus gariepensis gariepensis	Least Concern
Vandijkophrynus robinsoni	Least Concern
Xenopus gilli	Endangered (B1ab+2ab)
Xenopus laevis	Least Concern

Threatened species

Critically Endangered

Table Mountain ghost frog *Heleophryne rosei*

The Table Mountain ghost frog occupies a very restricted habitat in protected areas on Table Mountain. Adults of this species are very difficult to observe and so monitoring of this species is based on regular tadpole counts. Continued monitoring of the tadpoles in the breeding habitat of these species indicates that the populations are relatively stable over the reporting period at the monitoring sites. Lower rainfall since April 2010 has reduced the extent of stream habitat available to support the long-lived tadpoles which require perennial streams (also see Turner *et al.* 2011). Management of the water input into the streams must allow sufficient reserve flow to maintain the habitat for the tadpoles throughout the year. Erosion on footpaths near streams must also be minimised to reduce siltation of the streams.

Micro frog *Microbatrachella capensis*

Although most of this species' habitat was lost prior to the 1970s there is ongoing habitat loss and degradation, primarily due to the invasion of alien trees east of Kleinmond and on the Agulhas Plain. Despite these threats, several good populations persist (based on CapeNature's monitoring of the estimated number of calling males in 26 populations) and the area under formal protection has increased (see Habitat Status). Micro frogs continue to breed at an artificially excavated pond at Betty's Bay and a small population persists at a disused sand mine near Kleinmond.

Rough moss frog *Arthroleptella rugosa*

This recently described species (Turner & Channing 2008) has a naturally very small range which is restricted to seepage areas on the southern slopes of Klein Swartberg mountain immediately north of Caledon. The mountain is severely impacted by invasive alien plants (Figure 3) and fires in this fuel-laden vegetation will be more severe than in the fynbos vegetation this species evolved in. To address this threat CapeNature has initiated clearing of the invasive alien plants form this mountain with a funding from the United States Fish and Wildlife Service. Unfortunately a fire burnt most of the habitat of the rough moss frog habitat in early 2012 severely reducing the Rough moss frog populations. These populations are now monitored on a regular basis.

Endangered

Western leopard toad *Amietophrynus pantherinus*

This is a difficult taxon to manage as it occurs primarily in an area that is now extensively urbanised in Cape Town and another set of populations in the more rural areas to the east of Stanford. The urban environment poses both a suite of threats (roads which claim many deaths from vehicles during breeding and dispersal, pesticides, etc.) and a novel habitat in well-watered urban gardens which provide shelter, food and a reliable supply of moisture. The Western Leopard Toad Conservation Committee is a multi-stakeholder group that co-ordinates local conservation actions such as assisting western leopard toads to cross busy roads during their annual breeding migrations in Cape Town.

Figure 3. Invasion of pine trees in the habitat of the rough moss frog (*Arthroleptella rugosa*). There is now an active clearing programme in place to restore this habitat.

A systematic survey of the eastern part of the western leopard toad's distribution range yielded a number of new distribution records on the Agulhas Plain and confirmed presence at known sites. Various aspects of the phylogeography and ecology of the western leopard toad have been investigated by SANBI and UCT (Measey & Tolley 2009 and several manuscripts in preparation). The threats in the rural areas are less clear (they may be from historical climate and sea-level change) than in the urban areas and it may be that the more rural populations are in greater danger (Measey & Tolley 2009). More work needs to be done to establish which threats are important in the rural areas and how to mitigate them. The coastal areas east of the Agulhas Plain still require surveys to clarify the possible occurrence of this species in this area.

A draft Biodiversity Management Plan for Species (BMP-S) has been prepared and will be submitted to the national Department of Environmental Affairs for approval shortly (see section on BMP-S).

Cape platanna *Xenopus gilli*

The Cape platanna is restricted to several isolated water bodies scattered from the Cape Peninsula to Cape Agulhas. Recent phylogeographic research (Fogell *et al.* submitted) indicates that there may be a cryptic taxon obscured in this name as indicated by lineage divergence detected by an earlier study (Evans et al 1997). This will have immediate consequences for the threat evaluation of these taxa and for their conservation management. A monitoring programme is being developed by SANParks, CapeNature and SANBI which will also address the management of the threat posed by hybridisation with the common platanna (*Xenopus laevis*) which recently increased its population in the Cape Point area. Recent monitoring by CapeNature indicates several healthy populations of Cape Platanna in the Kleinmond area and on the Agulhas Plain.

Knysna leaf-folding frog *Afrixalus knysnae*

In the previous report it was stated that little was known about this species and a recommendation was made that more be found out about its distribution, habitat and breeding requirements. Unfortunately we have not learnt any more about this species. The recommendation is that a more concerted and systematic effort be applied to this species. This will require a locally-based effort that can survey the area over a long enough time to improve the probability of detection.

Northern moss frog *Arthroleptella subvoce*

A formal assessment of this species showed that it has a very small distribution and a very small number of populations. Although the species occurs mostly within the confines of a protected area, fires still have the ability to severely affect individual numbers. There had also been a recent encroachment on the breeding habitat of this species by Hakea. which has now been cleared. Regular management of this site is required to keep the Hakea out.

Vulnerable

Rose's mountain toad *Capensibufo rosei*

The frogs currently classified in the genus *Capensibufo* represent several species complexes (Tolley *et al.* 2010). This is not surprising given their fragmented distribution over the Cape Fold Mountains. This has strong implications for the threat assessment of these frogs. In particular, the remaining populations of *Capensibufo rosei* on the Cape Peninsula are in urgent need of assessment as a separate taxon, research to elucidate the threats facing these frogs as the causal factors remain enigmatic (K.A. Tolley &. G.J. Measey, unpublished data). Immediate conservation intervention is required despite its occurrence within a protected area – the Table Mountain National Park.

The only other Rose's mountain toad population that is monitored as part of CapeNature's long-term frog monitoring project is a population in the Hottentots-Holland Nature Reserve. This population, despite fluctuations in number, probably due to the local effects of fire (Turner & De Villiers unpublished data), continues to breed successfully.

The previously listed *Cacosternum capense* and *Breviceps gibbosus* were re-evaluated as Near Threatened due to their relatively extensive distribution and tolerance to a certain degree of human disturbance and habitat transformation – see the next section.

Figure 4. The Vulnerable Rose's mountain toad may be more threatened than its current listing suggests. Photo G.J. Measey.

Near Threatened

Drewes' moss forg *Arthroleptella drewesii*

Excessive fires and invasive alien plants continue to be the major threats to this frog. A recent fire burnt an extensive part of the range of this frog and a brief survey is required to assess the effects of this fire. No populations of this frog are currently monitored.

Cape Peninsula moss frog *Arthroleptella lightfooti*

The Cape Peninsula moss frog occurs in several scattered populations on the peninsula. Fortunately most of these fall within the Table Mountain National Park protected area. As a Near Threatened frog with a simple advertisement call it was selected for a research project to quantify population numbers using an automated microphone array and application of a statistical approach (spatially explicit capture-recapture analysis). This is being trialled at Silvermine within the Table Mountain National Park and will be used for several other moss frog (*Arthroleptella*) species.

If successful, this method can be used more widely for the monitoring of Threatened frogs, (see below).

Landdros moss frog *Arthroleptella landdrosia*

The Landdros moss frog is monitored as part of CapeNature's long-term frog monitoring project in the Hottentots-Holland Nature Reserve. At this monitoring site there has been poor recolonisation after a large fire in 2009. The species does however persist elsewhere in very rocky and cliff areas that are more protected from fire but at low numbers.

Montane marsh frog *Poyntonia paludicola*

The montane marsh frog is monitored at two sites in the WCP as part of CapeNature's long-term frog monitoring project. This species is still present in the Landdroskop area of the Hottentots-Holland Nature Reserve but no recolonisation of this species has occurred at the Swartboskloof monitoring site in the Jonkershoek Nature Reserve. This is despite the close proximity of a population which did survive a severe fire. Again, it appears that rockiness around the surviving population is related to survival as is the case with the moss frogs.

Cape caco *Cacosternum capense*

Research on the effects of agrochemicals on this species is still required as much of its habitat is under agriculture. It is not known which chemicals negatively affect the Cape caco or which are benign. If changes in agricultural practices can enhance the survival of this species within these transformed areas it will make a worthy contribution to the long-term persistence of this species. Research on the persistence of this species at agricultural sites will be most informative.

Cape rain frog *Breviceps gibbosus*

The extent of occurrence of this species is now known to be quite large, extending from the Cape Peninsula to the Cederberg and Piketberg Mountains. Within this area it is mostly confined to more densely vegetated areas with well-drained or loamy soils (generally on sloping ground). Its occurrence in gardens offers some scope for continued existence in urban and peri-urban areas but long-term persistence may be hampered by roads and other barriers to dispersal. There are suggestions that there is a threat posed by hadedas (*Bostrychia hagedesh*) which has expanded its range with anthropogenic habitat alteration (L.R. Minter, pers. comm.). Stomach content analysis of hadedas may allow some quantification of this threat.

The giant bullfrog (*Pyxicephalus adspersus*) was previously listed as Near Threatened regionally (South Africa) but has been re-evaluated to Least Concern based on its very large area of occurrence and limited spatial extent of the threats facing this species (Measey *et al.* 2011a). The regional and global status for this species are now the same.

All species previously listed as Data Deficient have been formally evaluated: Drewes' moss frog was evaluated as Near Threatened (see above); the karoo caco (*Cacosternum karrooicum*) and Van Dijk's river frog (*Amietia vandijki*) have been listed as Least Concern (Measey *et al.* 2011a).

Habitat Status

A significant advance since the previous report (Turner & De Villiers 2007) is the development of the National Freshwater Ecosystem Protection Assessment (NFEPA). This product is discussed in greater depth in Chapter 2 (this volume) but briefly it maps the locations and threat status of all freshwater bodies in South Africa. This product can be used to inform land-use decisions such that agricultural and other developments can be steered away from the most sensitive wetland sites.

The lowland species such as the micro frog, western leopard toad and Cape platanna are surrounded by transformed land and dispersal between populations may be difficult or impossible (see Measey & Tolley 2011).

The expansion of SANParks to include more lowland habitat on the Agulhas Plain and Garden Route benefits the Critically Endangered micro frog, Endangered Cape platanna and Endangered Western leopard toad in the west and the Knysna leaf-folding frog in the east, amongst many other species. All Threatened frogs in the WCP, with the exception of the rough moss frog occur within formally protected areas. The expansion of the Stewardship sites has incorporated more habitat for the Near Threatened Cape rain frog and Cape caco.

Threats

The main threats to frogs in the WCP continue as listed in the previous report i.e. habitat loss, invasive alien plants and emergent diseases (Turner & De Villiers 2007). Changing fire regimes in the fynbos biome are also emerging as a potential threat to frogs.

Habitat loss

Loss and degradation of habitat continues to be a threat, particularly within the urban areas such as Cape Town (Rebelo *et al.* 2011) and the adjoining coastlines. For example, habitat loss is still occurring along the coastal strip between Pringle Bay and Hermanus.

Fire

Parr & Chown (2008) noted that few studies have examined the effects of fire on amphibians (or reptiles or invertebrates). We are slowly gaining a better understanding of the role of fire in driving frog population dynamics, particularly in the Fynbos vegetation communities through the long-term monitoring of frog populations. Fire is of particular concern because when fire and alien plant infestations intersect the effects are intensified due to the higher fuel loads which may cause severe damage to wetlands (and other habitats).

Fire is a major concern as the frequency of fires continues to increase (Van Wilgen & Forsyth 2008) and taken in conjunction with the extensive spread of alien plants in the Cape floral Region (CFR), where several of the threatened WCP frogs occur, means that this threat is increasing in frequency and severity. A general recommendation arising from this situation in the south-western part of the CFR is that fires erupting in veld younger than 12 years be extinguished as soon as possible. This requires an extremely rapid fire-response time which is a severe challenge in mountainous terrain and will rely heavily on aerial attack methods such as the use of fixed-wing aircraft and heavy-load helicopters.

Emergent diseases

Little known of the prevalence and effects of disease with the exception of the chytrid fungus (*Batrachochytrium dendrobatidis*). This fungus has been responsible for severe population declines and extinctions elsewhere in the world (e.g. Daszak *et al.* 2003, Crawford *et al.* 2010). Chytrid fungus occurs

naturally and is widespread in South Africa. Recent research indicates that there are hybrid strains of the fungus which are more virulent and are being transported rapidly around the globe (Farrer *et al.* 2011). More than 10 000 of the indigenous common platanna (*Xenopus laevis)* are exported from the WCP each year (Weldon *et al.* 2007). This poses a significant source of disease (it is a known host of chytrid fungus) and parasite transmission. This frog is itself a successful invader of several other countries (Measey *et al.* 2012), increasing the risk associated with trade in this species. This means that strict controls on the movement of amphibians and other vectors are appropriate. Importing countries should implement strict biosecurity and hygiene requirements for any amphibians (and other aquatic organisms) originating from the WCP. Chytrid fungus and ranaviruses are listed as notifiable diseases by the World Organisation for Animal Health (OIE) (http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2012/; accessed May 2012).

Climate change

There have been several investigations of the predicted effects of climate change on amphibians globally, but this work is still being developed for South Africa. These include the shrinkage of available habitat for Appalachian salamanders under two scenarios of CO2 levels (Milanovitch *et al.* 2010). Hof *et al.* 2011 used a climate change modelling that incorporated the additive effects of pathogens and land-use change to predict that the greatest proportions of species negatively affected by climate change are projected to be found in Africa, parts of northern and South America and the Andes.

The WCP is a generally dry province and any climate change that may cause further aridity is likely to have some effect on the province's amphibians which are more water dependent than most other terrestrial animals. However, there is still much variance in the estimates of the predicted changes in rainfall in the province, the overall prediction for the WCP is for weaker frontal systems to the south, which could translate to weaker penetration of fronts and drier which may be compensated for by an increased orographic rainfall on mountain ranges (DEA 2011). In particular, it is necessary to know what these effects will be on a very fine geographic scale as many frog species are very patchily distributed within the province and this information is still lacking.

The effect of climate change on fire frequency and intensity, including its mediation through increased invasive alien woody plant growth and/or an increased grass sward, is also unknown but can be predicted to have a negative impact on fynbos-adapted frogs.

Introduced species

Amphibian invasions in South Africa are reviewed in (Van Rensburg *et al.* 2011) and although there are no invasive species alien to South Africa there are several local invasions, most of them affecting the WCP.

Painted reed frog *Hyperolius marmoratus*

This species was previously known to occur from Zimbabwe, through Limpopo, Mpumalanga, KZN, coastal Eastern and Western Cape as far west as Tsitsikamma (Passmore & Carruthers 1995). From the mid-1990s onwards populations appeared in Cape Town (Bishop 2004). Subsequently populations have been recorded throughout the Stellenbosch to Strand area, Villiersdorp, and much of the area between Swellendam and George (Tolley *et al.* 2008, Measey & Davies 2011). These populations comprise individuals with various genotypes indicating multiple introductions and multiple source populations (Tolley *et al.* 2008). Ongoing research is investigating the nature and extent of this range expansion (Davies *et al.* submitted).

Guttural toad *Amietophrynus gutturalis*

This widespread subtropical African species was only known to occur as far south as East London in the Eastern Cape. An introduced population (it is not known whether intentionally or accidentally) was first noticed in Cape Town in 2000 (De Villiers 2006). After noticing the spread of this population in the Constantia area, it was decided to institute control measures to contain the spread of this species which may be a direct competitor to the western leopard toad. This species spread has been contained by the CAPE Invasive Animal Action Group and the City of Cape Town and the population numbers appear to be stable. Continued control of this species is required to contain its influence and there is a realistic possibility of eradicating this species in the Western Cape Province.

Foam-nest frog *Chiromantis xerampelina*

There have been two instances of the sub-tropical and tropical Chiromantis xerampelina translocations to the WCP, one in Porterville and one in Stellenbosch. There is no evidence of this species establishing or breeding in the WCP and no action, apart from recording incidences of arrival this province, is recommended as yet.

Monitoring

CapeNature continues to monitor the high priority threatened frog species: Table Mountain ghost frog, Cape platanna, western leopard toad, northern moss frog, rough moss frog and micro 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 such as invasive alien vegetation clearing and erosion control.

The CapeNature long-term frog monitoring project has been running at two sites since 2003 and a third site (Groot Winterhoek) was added in 2007. Although frog population counts vary between years there are three species for which there is empirical reason for concern.

1. Populations of Landdros moss frog at the Landdroskop monitoring site have declined dramatically since a severe fire in 2009 and there is no sign of recovery yet. This is in marked contrast to the Swartboskloof population of De Villiers' moss frog (*Arthroleptella villiersi*) which has already returned to pre-fire population levels.
2. There is still no recolonisation of the Swartboskloof monitoring site by the montane marsh frog despite the continued presence of a nearby population.
3. At the Groot Winterhoek monitoring site burnt in 2008 and the population of northern moss frogs declined and is stable subsequent to the fire but has not yet reached pre-fire population levels.

The distribution and conservation status of the other Threatened species of the WCP are monitored through the continued collection of distribution data with full systematic surveys at most every ten years. CapeNature continues to conduct its long-term frog monitoring project in collaboration with local researchers.

The project has expanded from the initial two sites to include another high altitude near site Porterville and the site where the rough moss frog is monitored may be added to the suite of permanent monitoring sites. Results for the various species that occur at the monitoring sites are mentioned individually in the Threatened species section above. CapeNature continues to monitor the effects of fire on frogs and these data will be collated and analysed in 2013.

A research project is underway to examine the utility of automated acoustic statistical techniques to quantify the number of frogs participating in choruses (Measey *et al.* unpublished data). The results of the application of this technique should be available by the next State of Biodiversity Report in 2017.

Legal Status

The species proposed for listing under the Threatened and Protected Species (TOPS) regulations under the National Environmental Management: Biodiversity Act (NEMBA) Act No.10 of 2004 includes all species listed as Critically Endangered by the IUCN to be listed in the critically endangered category of the TOPS. The WCP Biodiversity Bill is currently being drafted and will take all WCP frog species into consideration for provincial protection.

BMP-S

A Biodiversity Management Plan for Species (BMP-S) has been drafted for the western leopard toad and now needs to be submitted for national approval. A BMP was deemed appropriate as a means to draw together the various different people and organisations responsible for conserving this species. This species occurs both in a few protected areas and on many private properties. Their presence in the urban environment makes conservation management of this species somewhat complex as many people are involved and there are various urban threats. It is however precisely because of the coordination of various people and interest groups that a BMP-S is desirable so that there can be a common agreed plan that everyone can refer to and carry out management accordingly.

The rough moss frog may also benefit from the compilation and implementation of a BMP-S.

Public awareness

There has been reasonable elevation of the conservation threats facing amphibians based largely on the global decline of amphibians and the GAA's publicity of amphibians as the most threatened class of vertebrate (e.g. Hoffman *et al.* 2010, Alford 2011, Stuart *et al.* 2008). The year 2008 was the international year of the frog with media devoted to promoting awareness and a local exhibition of frogs at the Two Oceans Aquarium in Cape Town.

Locally, public awareness of the threats facing the rough moss frog in Caledon has improved and there is support among many of the land owners for the conservation efforts in this region.

Awareness of the Threatened status of the western leopard toad is also good in the south peninsula of Cape Town and there is also improved awareness of this species in the eastern parts of its range a consequence of recent research conducted in the area. There is continued public involvement in conserving this species within the city of Cape Town.
In 2009 there was comprehensive update of the field guide to the frogs of southern Africa (Du Preez & Carruthers 2009) and an update of the popular book Frogs and Frogging in South Africa (Carruthers & Du Preez 2011).

There should be greater public awareness of the plight of WCP amphibians in general but there is also a knowledge gap in our understanding of some of the declines and there is a continual need to keep the public informed.

Research

Amphibian research in the Western Cape is active (at least 10 publications since 2007), but is driven by a very small number of individuals (see capacity below).

The Measey *et al.* 2011a publication contained a comprehensive review of the threat status of South Africa's frog and also listed and prioritised the research requirements for the effective conservation and monitoring of South African frogs. From this, the species listed in Table 4 concern the WCP:

Table 4. Threatened frog species requiring further conservation research in the Western Cape Province listed according to priority for monitoring (from Measey *et al.* 2011 b & c).

English name	*Scientific name*	Research & monitoring required	Priority
Rose's mountain toad	*Capensibufo rosei*	Presence/absence surveys. Population counts.	1
Knysna leaf-folding frog	*Afrixalus knysnae*	Tadpole surveys.	2
Table mountain ghost frog	*Heleophryne rosei*	Population counts.	3
Western leopard toad	*Amietophrynus patherinus*	Population counts.	4
Rough moss frog	*Arthroleptella rugosa*	Presence/absence surveys. Population counts.	5
Cape platanna	*Xenopus gilli*	Population counts.	6
Micro frog	*Microbatrachella capensis*	Presence/absence surveys. Population counts. Threats.	7
Northern moss frog	*Arthroleptella subvoce*	Presence/absence surveys. Population counts.	8

There has been some progress with taxonomic and systematic research over the reporting period: (Tolley *et al.* 2010) have shown that there is strong phylogeographic patterning within Strongylopus grayii and they call for more systematic work to conclude the systematic implications of their findings. This is not expected to affect the threat status of this taxon as populations are abundant across the WCP. In 2008 the Critically endangered rough moss frog was described (Turner & Channing 2008).

There have also been a number of publications on the conservation of frogs: Turner *et al.* 2011 recommend that research be conducted to assess dispersal distance and recolonisation success after fire to properly evalaute the risk of extinction of Threatened frog species in the fire-prone fynbos biome. (Mokhatla *et al.* 2011) examined the geographical congruence of anthropogenic impacts and amphibian presence and breeding sites and of particular concern for the WCP and concluded that the south-western Cape showed the greatest spatial congruence with the threats represented by human population density, percentage land transformation and alien plant species richness.

Measey & De Villiers (2011) document the reintroduction of the Cape platanna to Silvermine from Cape Point (both localities with the Table Mountain National Park) and demonstrated great longevity in this species but there was no evidence that the population is breeding. This reintroduction attempt indicates that there may be some scope for bolstering remaining populations of the Cape platanna, but highlights the difficulties in obtaining suitable sites and systematic monitoring of the success or otherwise of the reintroduction attempt.

There has also been work done on invasive frogs: The locally indigenous common platanna has established feral populations in Portugal, France, Italy, the United Kingdom, the United States of America, Chile and Japan (Measey *et al.* 2012). The authors modelled suitable habitat for this species and concluded that this species may not yet have reached its full invasive potential (Measey *et al.* 2012) and thus still poses a risk for further invasions. On a more local scale, Measey & Davies (2011) examined the invasion of frogs indigenous to South Africa to areas outside of their historical or natural range. Local invasions such as these may be just as damaging as invasions of species from other countries as is exemplified by the case of the sharptooth catfish (*Clarias gariepensis*) – see Chapter 4. Measey and Davies (2011) suggest that early detection and rapid response is an appropriate strategy for invaders indigenous to South Africa (indigenous extralimital species) but must be supported by sufficient resources and long-term commitment by managing authorities.

Funding

Funding for the conservation of amphibians is finally receiving some attention through the efforts of SANBI, even though funding and policy in a first world country such as the United States does not yet reach levels commensurate with the level of threat facing this class of vertebrates (Gratwicke *et al.* 2012). The United States Fish and Wildlife Service has provided funds to initiate clearing of the most crucial habitat for the rough moss frog. Additional funding will be required to ensure the maintenance of this habitat. Funding for research and monitoring is still insufficient (see Measey *et al.* 2011a and chapters within).

Capacity

In 2012 the situation that neither CapeNature nor South African National Parks have full-time herpetologists persists.

There is still more work to be done on the species inventory for the province although the current level of our knowledge is acceptable for most taxa there are a few where taxonomic clarity is urgently required as it directly affects threat status and consequent conservation actions. We are aware of undescribed taxa and it is the slow process of preparing species descriptions that is delaying a complete inventory for the province. Collaboration with external researchers remains essential to facilitate both the scientific research on frogs and the assimilation of scientific findings into conservation management. There is scope for greater public participation in collecting distribution data and the use of virtual museums and atlas projects (see the Frog Map at http://vmus.adu.org.za/ and http://za.ispot.org.uk).

Conclusions & Recommendations

The WCP is home to a unique and diverse suite of amphibians, especially for a largely temperate area. There are, however, some challenges in conserving this diversity although existing protected areas afford reasonable protection to many species. Lowland areas still require formal protection, especially for the micro frog, Cape platanna and western leopard toad. In particular, the extensive wetlands east of Kleinmond require formal protection.

It is clear that not all species in protected areas are free of threat. This seems particularly true of species with patchy distributions in the CFR such as those in the genera *Capensibufo*, *Arthroleptella* and *Poyntonia* which may be increasingly threatened by invasive alien plants and changing fire regimes. Monitoring of these populations must continue and additional effort put into the prevention of ecologically unwarranted fires. This includes the creation and maintenance of sensible fire breaks and tracer belts and rapid and effective response to fire with a focus on reducing the frequency of fires in seepage areas.

There are several threatened species of frogs in the WCP and several require focussed conservation action. These recommendations are listed in Table 5. Research requirements are listed according to Measey *et al.* 2011b & c in Table 4.

PAINTED REED FROG

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

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations
Capensibufo rosei Rose's mountain Toad	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.
Arthrolepotella 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.
Heleophryne rosei Table Mountain ghost frog	Biodiversity management plan to be written and submitted in terms of NEMBA.	Not written. A Biodiversity management plan may not be the right 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.
Amietophrynus pantherinus western leopard toad	Biodiversity management plan to be written and submitted in terms of NEMBA.	Draft completed.	Submit draft to Minister. Continue to obtain distribution records for eastern part of range.
Microbatrachella capensis micro frog	Biodiversity management plan to be written and submitted in terms of NEMBA.	Not written.	Investigate a Biodiversity Management Plan in terms of NEMBA for coastal wetlands.
Xenopus gilli Cape platanna	Biodiversity management plan to be written and submitted in terms of NEMBA.	Not written.	As above. Also facilitate development of monitoring protocol.
Afrixalus knysnae	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.
Arthroleptella subvoce northern moss frog	N/A	N/A	Incorporate in long-term monitoring project.
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.
Arthroleptella lightfooti Lightfoot's moss frog	Specific actions to be published in conservation assessment.	Conservation assessment published.	Several populations will be monitored.
Arthroleptella drewesii Drewes' 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.
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.
Cacosternum capense Cape caco	Susceptibility to agro-chemicals needs to be ascertained.	Research not conducted yet.	Prepare research proposal for this species.
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

CAPE PLATANNA

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MOUNTAIN SEEP

CHAPTER 6

REPTILES

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CONTENTS

MARBLED LEAF-TOED GECKO

Executive Summary

One hundred and fifty-three reptile species and subspecies have been recorded in the Western Cape Province. Of these, 22 are endemic to the WCP and eight species are alien to the WCP. Only one of these eight alien species – the Cape Dwarf Day Gecko (*Lygodactylus capensis*) is known to have established breeding populations. The changes in species numbers from the previous report are due to improved and expanded distribution data and a number of taxonomic changes which has increased the number of species known to occur in the WCP.

Of the indigenous species, one is Critically Endangered, one is Endangered, nine are Vulnerable, 15 are Near Threatened and at least seven remain to be described as new species and have their threat status formally evaluated. The changes from the previous report are due to the rigorous re-evaluation of the threat status according to the latest IUCN standards and taxonomic changes.

Urgent conservation action is required to stabilise and bolster the remaining populations of the Critically Endangered geometric tortoise.

Introduction

South Africa has a wealth of reptile diversity (Branch 2006) and the WCP makes a substantial contribution (37%) to the national reptile diversity. This is due to a number of endemic species in the WCP, particularly those that are restricted to the fynbos biome. Reptiles are represented by a very diverse group of animals (although, strictly speaking, birds are also reptiles e.g. Rest *et al.* (2003), Modesto (2004), they are dealt with in their own chapter) ranging from marine-living turtles, a local hotspot of terrestrial tortoises to an extensive array of lizards and a broad selection of snakes (which are themselves derived lizards, Vidal & Hedges [2005]).

The most important development in the period since the last reptile state of biodiversity report (Turner *et al.* 2007) was the completion of the South African Reptile Conservation Assessment (SARCA). The SARCA evaluated the threat status of all South African reptile species according to the IUCN threat criteria (IUCN 2001). During this process, many disparate sources of reptile distribution information were collated and field trips were conducted to several poorly sampled localities. The threat statuses determined by the SARCA were used in the current report even though the completed SARCA book (Bates *et al.* in press) was submitted for printing in 2012 it was unfortunately not published before this chapter was complete which meant that certain details of the assessments were not available to the authors of this chapter.

Many reptiles do not respond well to human activities and habitat transformation and the number of threatened reptile species is increasing with increasing land transformation and habitat fragmentation in the WCP (see Chapter 1). Few reptile conservation issues have received sufficient attention from either the public or private (NGO) sectors. It is hoped that publications such as this chapter will improve awareness of the threats to reptiles and the necessity of conserving this suite of species.

Methods

There are a number of taxonomic difficulties within the reptiles of the WCP which influences both the number of taxa (as the endpoints of taxonomic classification) known to occur in the WCP and their threat status. An example of this complication is that the number of reptile taxa is currently represented by both species and subspecies (a finer level of taxonomic classification). Due to continued taxonomic uncertainty in certain groups of reptiles there are still subspecies recognised despite the subspecific rank being poorly defined and often not a consistent evolutionary lineage (a continuous line of ancestry) e.g. Frost (1992), Haig *et al.* (2006). As it is expected that the variation described by the subspecies designations may indicate species distinctions, the approach in this chapter is to include described subspecies in the reptile biodiversity statistics. It must however be borne in mind that currently described subspecies may not coincide with lineage based evolutionary groups and that in some cases e.g. the tent tortoise *Psammobates tentorius* (Rheta Hofmeyr, University of the Western Cape, pers. comm.) the situation may be even more complex than indicated by current subspecific designations. Similar complexity is also evident a larger geographical scale with the marsh terrapin (*Pelomedusa subrufa*) – see Fritz *et al.* (2011).

Threat status was taken from the SARCA (Bates *et al.* in press) and readers are referred to the SARCA for further details on the threats to reptiles.

This chapter used 28 614 distribution records to draw distribution statistics. Threat status was drawn from the SARCA (Bates *et al.* in press).

Systematic account

As was the case in the previous two WCP State of Biodiversity Reports (Baard & de Villiers 2002, Turner *et al.* 2007), new species of reptiles continue to be discovered and described. However, the changes in the number of species and subspecies known to occur in the WCP (153 vs. 148) since the 2007 report is largely due to better distribution data and more attention that has been paid to records of alien retile species.

The reptile species currently known to occur in the Western Cape Province are listed in Appendix 1. There is however a multitude of taxonomic problems listed in Branch *et al.* (2006) and there are at least 13 genera (*Pachydactylus, Bradypodion, Agama, Nucras, Pedioplanis, Acontias, Scelotes, Cordylus, Hemicordylus, Psammophis, Bitis, Homopus, Psammobates*) that have remaining taxonomic problems in the WCP. As recommended by Tolley *et al.* (2006) there is now an actively curated animal tissue bank at SANBI with an associated database for the storage of reptile tissue samples which will facilitate continued taxonomic and systematic research.

Distribution Data

The current report is based on a total of 28 614 reptile records in the CapeNature Biodiversity Database. This increase in data from the 2007 report (24 216) is primarily due to new observations by CapeNature staff with further records from the Survey of Cederberg Amphibians and Reptiles for Conservation and Ecotourism (SCARCE). During this period the SARCA collected and collated a number of records from many additional sources. The SARCA records additional to the CapeNature records still need to be incorporated into the CapeNature Biodiversity Database.

Invasive Alien Species

Eight reptile species that are not indigenous to the WCP have been recorded (Appendix 1). There are even fewer invasive alien reptile species in the WCP and one of the three known invasive species (listed below) is indigenous to the northern and eastern provinces of South Africa. Although there is little evidence at present of deleterious impact from these species in the WCP, there have been no formal studies investigating this. The current global trend of increasing reptile trade for pets and this applies to South Africa too (Van Wilgen *et al.* 2008, 2009a), increases the likelihood of introduction due to the increased likelihood of escapes and a greater sampling of species characteristics that may facilitate introduction.

The species favoured in the reptile trade are those that are colourful or patterned, easy to maintain, inexpensive and tend to come from the Boidae (boas), Pythonidae (pythons), Elapidae (cobras and relatives), Viperidae (vipers and adders), Chamelonidae (chameleons) and the Testudinidae (tortoises and terrapins) (Van Wilgen *et al.* 2009a). From a prevention of new invasions perspective it may be beneficial to focus control on species that originate from areas with similar climates to the WCP (see Van Wilgen at al. 2009b). Rigorous risk assessments (see Van Wilgen *et al.* 2008) for the import of new species into the province are required to reduce the probability of invasion.

The control of invasive species at a national level through the NEMBA IAS regulations does not make allowance for the differential treatment of different (bio)geographic areas. This is critical as invasive species from other regions within South Africa may be as or more detrimental than species from other countries or continents. CapeNature aims to address this implementation gap in the provincial Biodiversity Act.

The flowerpot snake (*Ramphotyphlops braminus*) originates from India but has been anthropogenically distributed widely across the world. No new records of this species were obtained since the last WCP State of Biodiversity Report. However its small size and fossorial habits make detection probabilities low. The expected impact from this species is also expected to be low as it is not known to occur in the WCP in large numbers and it is primarily associated with urban and cultivated areas (all records in the CapeNature Biodiversity database are from transformed areas).

A single new record of the tropical house gecko (*Hemidactylus mabouia*) was received since 2007. It is expected that this species will become increasingly prevalent in the WCP due to the high probability of repeat introductions: it is a human commensal species that may enter vehicles, tents, caravans and other goods that may be moved into the WCP and the increasingly suitable habitat as human habitations expand and urban climates become more suitable and extensive.

The Cape Dwarf Gecko (*Lygodactylus capensis*) occurs in northern and eastern provinces of South Africa but has been introduced to the Eastern Cape Province and Free State and is now also known from several localities in the WCP (de Villiers 2006, Jacobsen 2012). The geographic origin of the individuals in the WCP is as yet to be determined by population assignment. This will require extensive geographic sampling across the natural range of this widespread species. This is not considered a high priority at present due to the limited extent of the invasion and due to the lack of an obvious impact on indigenous species. This is however speculation and should ideally be investigated by scientific research.

Although the leopard tortoise (*Stigmochelys pardalis*) is indigenous to the WCP, its distribution within the province has been expanded through humans moving this species around. It is not yet known whether this species will be able to expand its range in the province further without continued human assistance.

Endemism

Currently, 22 of the 145 known indigenous reptile taxa are endemic to the Western Cape Province (Table 1). This is a relatively low level of endemism when compared to the fish or amphibians but it is expected as many of the reptile taxa, and the snakes in particular, are more mobile than the other two groups and are more capable of traversing the large arid tracts of the WCP which are significant barriers to the other two classes. There are at least two centres of endemism in the WCP in the south west and in the Cederberg (Figure 1; also see Meyer *et al.* 2010). The level of reptile endemism in the WCP is however expected to increase slightly with taxonomic changes that are underway.

Conservation Status

The threats to South Africa's reptiles had last been assessed in 1988 in the South African Red Data Book – Reptiles and Amphibians (Branch 1988). This meant that the threat status of the WCP reptiles was very out of date for the previous two

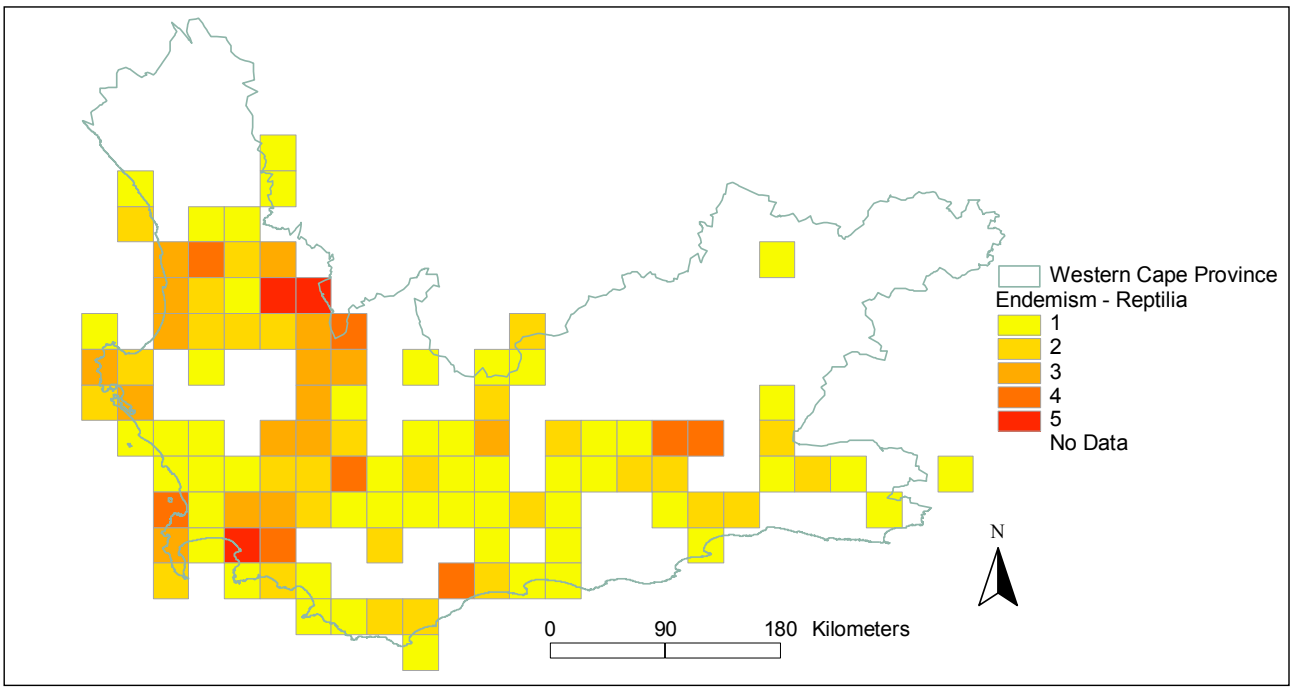

Figure 1. Map showing reptile endemism for each quarter degree in the Western Cape Province.

Table 1. Reptile species endemic to the Western Cape Province.

Taxon name	English name
Afroedura hawequensis	Hawequa flat gecko
Afrogecko swartbergensis	Swartberg African leaf-toed 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
Microacontias lineatus grayi	striped legless skink
Psammobates geometricus	geometric tortoise
Scelotes bipes	silvery dwarf burrowing skink
Scelotes gronovii	Gronovi's dwarf burrowing skink
Scelotes kasneri	Kasner's dwarf burrowing skink
Scelotes montispectus	Tableview dwarf burrowing skink

WCP State of Biodiversity Reports (Baard & De Villiers 2002, Turner *et al.* 2007). The SARCA attempted a comprehensive review of all South African reptiles and reviewed and applied current IUCN criteria (IUCN 2001) to all WCP species. In summary, one species is Critically Endangered, one species is Endangered, six species are Vulnerable, 11 species are Near Threatened 11 and one is listed as Data Deficient in South Africa. The marine turtles were assessed on a regional basis and this resulted in some differences to the Global assessments for these species. Globally all marine turtles are threatened by loss of suitable breeding habitat, harvesting of eggs and adults and when caught as 'by-catch' in other fishing activities. Previously marine turtles have been considered as vagrants to the WCP and did not get a detailed treatment in the previous WCP State of Biodiversity Reports.

In summary, the statistics for the Critically Endangered and Vulnerable categories increased (got worse) but the number of species listed in the Endangered category declined (got better); see Table 2 and Figure 2. These changes are due to improved distribution data (from SARCA), rigorous application of the updated threat assessment rules and a genuine decrease in Psammobates geometricus (Baard & Hofmeyr, in press). For some of the marine turtles the Regional status is better than the Global status statistics due to the differential treatment of the marine turtles which are largely non-breeding visitors to South Africa and none breed in the WCP.

Critically Endangered

Geometric tortoise *Psammobates geometricus*
Geometric tortoises have a close association with West Coast Renosterveld, which has been reduced to less than 3% of its original size (McDowell & Moll 1992), with remaining fragments interspersed among agricultural and urban developments. Most habitat fragments are suboptimal due to alien invasion or the rockiness of the terrain, and/or are too small to support viable populations. Hofmeyr *et al.* (2012) determined that the home range size of female geometric tortoises could be up to 45 ha, which exceeds the size of most habitat fragments.

Table 2. Threat status of Western Cape Province reptiles. The asterisk denotes differences between the Regional and Global assessments.

Species	Regional IUCN	Global IUCN
Psammobates geometricus	Critically Endangered	Critically Endangered
Dermochelys coriacea	Endangered *	Critically Endangered
Homopus signatus	Vulnerable	Vulnerable
Bradypodion pumilum	Vulnerable	Vulnerable
Hemicordylus nebulosus	Vulnerable	Vulnerable
Psammophis leightoni	Vulnerable	Vulnerable
Bitis armata	Vulnerable	Vulnerable
Caretta caretta	Vulnerable *	Endangered
Cordylus macropholis	Near Threatened	Near Threatened
Cordylus niger	Near Threatened	Near Threatened
Goggia braacki	Near Threatened	Near Threatened
Homopus boulengeri	Near Threatened	Near Threatened
Cordylus oelofseni	Near Threatened	Near Threatened
Afroedura hawequensis	Near Threatened	Near Threatened
Scelotes gronovii	Near Threatened	Near Threatened
Scelotes kasneri	Near Threatened	Near Threatened
Scelotes montispectus	Near Threatened	Near Threatened
Chelonia mydas	Near Threatened *	Endangered
Eretmochelys imbricata	Near Threatened *	Critically Endangered
Lepidochelys olivacea	Data Deficient *	Vulnerable

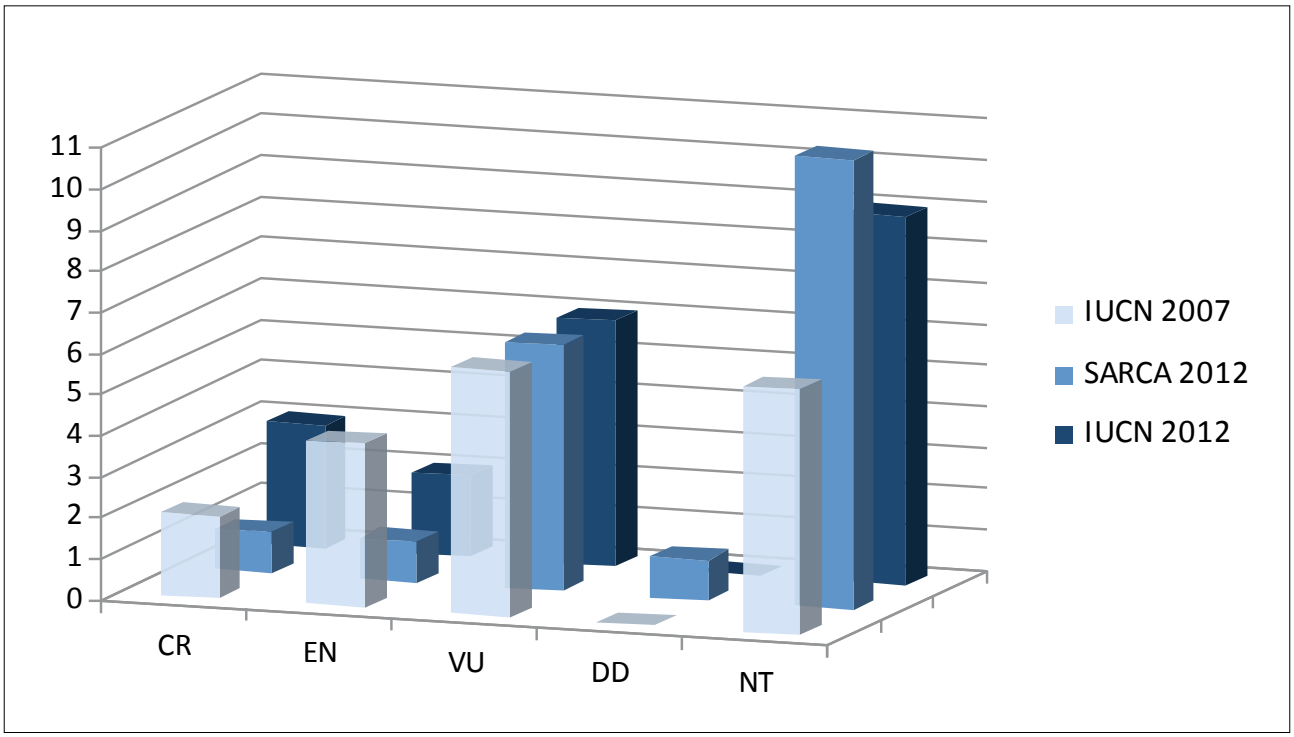

Figure 2. The number of Western Cape Province reptile species in each threat category. The SARCA 2012 statuses refer to Regional status for some species whereas the IUCN 2012 statuses refer to Global statuses.

The geometric tortoise was placed in the higher risk category of Critically Endangered (previously Endangered) due to its limited extent of occurrence and small area of occupancy within its range largely due to habitat destruction for agriculture. It also faces on-going threats in the forms of continued habitat loss due to further agricultural development, fires and an unquantified impact from baboons, crows and feral pigs (the latter destroying the habitat and likely feed on both eggs and hatchlings), fires, and climate change.

The largest pristine habitat, with ca. 1 000 ha optimal for geometric tortoises (Baard 1990), was destroyed by a wildfire in January 2012. Intensive post-fire surveys indicated a mortality rate of 60%, and a pre-fire population density of less than 15% of estimates made in the 1980s (Baard 1990). Several factors probably contributed to the steep reduction in population size. Fire frequencies, with concomitant high mortalities, increased over the past 30 years (Mike Gregor, personal communication), and population recovery was limited because of the absence of nearby population to recolonise recovering habitat. Additionally, several episodes of drought since the 1980s probably had an adverse effect on fecundity, because egg production of geometric tortoises decreases significantly in the year following low rainfall (Hofmeyr *et al.* 2006). Long-term shifts in climate could thus have a profound effect on the survival of geometric tortoises.

Figure 3. The Critically Endangered geometric tortoise (*Psammobates geometricus*). Photo A.A. Turner.

The number of live geometric tortoises probably does not exceed 1 000, and the species appears to be on the brink of extinction. Existing populations need immediate and sustained intervention, and it is of the greatest urgency to secure critical habitat in more than one region of its distribution.

Urgent and sustained action is required to maintain the last remaining populations (see Table 4).

Endangered

Leatherback turtle – *Dermochelys coriacea*
The leatherback turtle does breed on the northern shores of South Africa and is tolerant of colder water. It is likely that this species makes extensive use of WCP waters as is indicated by satellite tracking data (Lambardi *et al.* 2008). There are also regular but infrequent records of hatchlings stranded on WCP beaches in addition to the incidental bycatch of this species by fishing operations (Honig *et al.* 2007).

Vulnerable

Cape dwarf chameleon *Bradypodion pumilum*
The Cape dwarf chameleon has a limited distribution in the western WCP and is facing continued pressure due to habitat loss (Tolley *et al.* 2010). Despite several concerns expressed in the popular media, it is not affected by mechanical grape harvesting (Tolley & Measey 2007) and occurs at very low densities in vineyards. However there are increasing concerns about the illegal trade of this species. Another concern is that this is a wetland-associated species and the continued degradation and transformation of wetlands (Tolley *et al.* 2010 and see Chapter 2) is a concern for the population strongholds of this species. The predicted effects of global climate change on the Cape dwarf chameleon are negative which may further shrink suitable habitat for this species (Houniet *et al.* 2009).

In one of the few studies to address population structure and behaviour in relation to habitat fragmentation in a WCP reptile, Tolley *et al.* (2010) showed that there are age-related survival rates and differential dispersal between males and females between different age classes. Their study also indicated that the quality of the habitat may be important in its ability to support chameleons and that this should be taken into consideration

in the design of functional dispersal corridors for this species. This information is required for management interventions such as where chameleons may need to be translocated from sites targeted for development and in re-introduction programmes (e.g. Armstrong 2008). The studies on the Cape dwarf chameleon, although not comprehensive as yet, can be used as a model for the kind of research and information required to properly assess and manage other Threatened reptiles that have received inadequate attention.

Speckled padlopen *Homopus signatus*
There are ongoing taxonomic problems despite recent detailed research on this topic as the current subspecies distinctions do not match lineage divergence: two subspecies were recognised based on morphological differences, but because *H. signatus cafer* is not monophyletic and thus not a valid taxon, the current subspecies delineation cannot be retained (Daniels *et al.* 2010). The authors proposed that the morphotypes reflect selection for crypsis on granites and sedimentary rocks, respectively. The genetic structure in the species corresponds to geography (Daniels *et al.* 2010), and translocation should be avoided to retain current genetic diversity and to limit vulnerability of morphotypes on substrates where they do not blend in. Thus the populations from differing underlying geologies should be managed as separate ecotypes.

The SARCA recently re-evaluated the listing of *H. signatus* from Near Threatened to Vulnerable (Baard & Hofmeyr, in press). Extensive surveys of the southern distribution range indicated increased levels of habitat destruction for crop production (mainly rooibos tea) and habitat degradation by overgrasing (mainly by goats). This resulted in local population declines and extinctions, which is exacerbated by exploitations for the pet trade. Additionally, climate change may further compromise the status of H. signatus. Extended droughts have a negative impact on egg production (Loehr *et al.* 2011) and reduce growth rates (Loehr *et al.* 2007); the latter would further impact reproductive output because fecundity increases with body size (Loehr *et al.* 2011). These physiological responses to alterations in climate necessitate east-west habitat corridors to enable movements to regions with sufficient rainfall (Loehr *et al.* 2009).

Dwarf crag lizard *Hemicordylus nebulosus*
The dwarf crag lizard is vulnerable due to an extremely small range and tight habitat requirements (see Costandius *et al.* 2006). This situation is unlikely to improve and may perhaps worsen if the climate of the south-western WCP becomes warmer and drier as the dwarf crag lizard is adapted to a cool and moist climate (Costandius *et al.* 2006). As it is melanistic it should benefit from a faster heating rate (see Clusella-Trullas *et al.* 2009) under the conditions it has evolved in but will have to spend more time sheltering if ambient temperatures increase. The effects of climate change on reptiles in the WCP are discussed more generally below.

Cape sand snake *Psammophis leightoni*
Taxonomic problems and poor distribution data from the northern parts of the WCP continue to hamper a proper biological and conservation understanding of this species. Declines and local extinctions in transformed areas such as parts of greater Cape Town indicate that this species requires untransformed habitat for survival.

Southern adder *Bitis armata*
The southern adder has disappeared from much of its former range which is now under housing. Several remaining populations are very small and fragmented. It is a very cryptic species that is difficult and time-consuming to locate and surveys targeted at detecting this species may be required to assess its presence in remaining habitat fragments.

Loggerhead turtle *Caretta caretta*
There is very little data on their use of WCP waters but this species is frequently reported in the WCP and is likely to be making significant use of the WCP oceans. Remote tracking of this species may inform the conservation management of this species in WCP waters.

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 transformation (mostly housing developments) of this narrow coastal strip to which they are restricted.

Two species occur in the Karoo: Braack's dwarf leaf-toed gecko (*Goggia braacki*) and Boulenger's padloper (*Homopus boulengeri*). There is little information on the exact extents of the distribution of Braack's dwarf leaf-toed gecko or on population size estimates. Although Boulenger's padloper has a relatively wide distribution, no viable populations were found during extensive surveys of 20+ localities in the Karoo where the species was recorded previously (V.J.T. Loehr pers. comm.; M.D. Hofmeyr pers. obs.). Furthermore, landowners indicated that they no longer encounter these tortoises, indicating that the species is in decline, with local extinctions. Further studies are called for to ascertain if the status of Boulenger's padloper should be elevated to Vulnerable.

A further two species occur in the Cape Fold Mountains: Oelofsen's girdled lizard (*Cordylus oelofseni*) and the Hawequa flat-tailed gecko (*Afroedura hawequensis*). Oelofsen's girdled lizard has a very limited range and a pending taxonomic revision will require re-assessment of this species-complex.

The remaining two species in the Near Threatened category are marine turtles: the green turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelys imbricata*). The green turtle has a large global distribution but does not breed in the WCP. Elsewhere in the world this turtle has experienced extensive subpopulation declines in all major ocean basins and, to a lesser extent, incidental mortality relating to marine fisheries and degradation of marine and nesting habitats (Semminoff 2004) which is why it is considered Endangered at a global scale. Its apparently peripheral occurrence in South Africa makes this species of less concern in the WCP but there is clearly more research required on this species use of the WCP marine waters.

The hawksbill turtle, apart from suffering the typical marine turtle threats of net and fishing line entanglement, harvesting for meat and eggs, is also subject to harvesting for its shell. The decline of the global population of this species in the last three generations has been in excess of 80% and globally the species is considered Critically Endangered (Mortimer 2008). Hawksbill turtles are not known to breed in the WCP. The hawksbill turtle is seldom reported from WCP waters and it typically occurs in warmer waters than are found in the WCP but it must be borne in mind that there are transient eddies of very warm water

that move along the south-western and southern WCP shores. However there is very little data available to judge the extent of this species' utilisation of Cape waters and it is assumed that this species is a vagrant to our waters and is not threatened by local activities. This assumption should be tested by empirical research in collaboration with researchers monitoring breeding populations of this species.

Data Deficient

Olive Ridley turtle (*Lepidochelys olivacea*)
Globally the species is regarded as Vulnerable (Abreu-Grobois & Plotkin 2008). As with the other marine turtles, information on the threats and population health of olive Ridley turtles in South Africa is lacking.

Population Monitoring

Since the previous State of Biodiversity Report, CapeNature teams made a concerted effort to map all potential geometric tortoise sites and assess the presence or absence of the species by extensive surveys and discussions with landowners. The results showed that habitat deterioration at sites where the species was known to occur rendered populations extinct at three sites and compromised populations at several other sites. The species' presence was confirmed at 15 localities and efforts should continue to establish population size and status at all of these sites. Three geometric tortoise populations are regularly monitored. Population density is low, but appears to remain relatively stable at two sites, whereas there was a dramatic decline in population size at the third and largest site. It is imperative to extend the monitoring programme to include all viable populations over the species' distribution in order to prevent further local extinctions.

No other reptiles have been identified at this stage for focussed population monitoring.

Biodiversity management plans for species (BMP-S)

A BMP-S is planned for the Geometric Tortoise. The very fragmented distribution and multiple affected parties make the BMP-S an appropriate tool to direct the multiple conservation efforts that will be required to conserve this species.

CapeNature plans to start the process by holding stakeholder meetings over the next year in each of the three regions of the species' distribution. Stakeholders will include landowners of all habitat fragments where geometric tortoises occur, and one of the objectives will be to negotiate protection of the species and their habitat on all such land. An outflow of these meetings will be to develop a first draft of the BMP-S.

Habitat Status

Meyer *et al.* 2010 suggest that the east-west orientation of the Tankwa Karoo National Park is appropriate as a corridor for reptile movement as there has been more historical movement along this axis than the north-south axis. In contrast, the western costal lowlands of the WCP require increased connectivity along the north-south axis to allow movement of the many sand-dwelling reptiles along this north - south oriented habitat. A coastal-inland (east-west) transect shows considerable species turnover (Meyer *et al.* 2010, CapeNature & Stellenbosch University, unpublished data). In summary, the north-western parts of the WCP require both east-west and North-South corridors to sustain the ecological and evolutionary requirements of WCP reptiles.

Threats

Loss of habitat is still the greatest threat to the persistence of reptiles in the WCP. There is continued urban and agricultural expansion (see Chapter 1) and transformed areas have poorer reptile diversity (pers. obs.). Even after cultivation is stopped the effects may linger a long time as Masterson *et al.* (2009) have demonstrated in the grassland biome.

Illegal collection for the pet trade affects several species; these are largely the attractive species such as the dwarf chameleons (*Bradypodion*), dwarf adders (*Bitis*) and tortoises (see Van Wilgen *et al.* 2009a, 2009b). Although several cases of illegal trade have been successfully prosecuted constant vigilance is required by officials and the public.

Global climate change is a growing concern. Houniet *et al.* (2009) investigated the potential effects of climate change on the distribution and extent of suitable climate niches for several *Bradypodion* species. Different species niches responded differently to the predicted changes in temperature and rainfall with some showing increased distributions and others showing decreased distributions. Of the species that occur in the WCP, *B. pumilum* showed a decrease in available niche extent whereas *B. occidentale* showed an increase. *B. pumilum* is associated with more mesic and well-vegetated habitat and *B. occidentale* with a more open and arid niche. Similarly, Tolley *et al.* (2009) show that suitable climate niche for Burchell's sand lizard (*Pedioplanis burchelli*) will decline with predicted climate change but that the southern rock agama (*Agama atra*) will not suffer a significant loss. This demonstrates the difficulty in summarising the nett effect of climate change on reptiles and other species with varying habitat requirements.

Sinervo *et al.* 2010 presented a global assessment of the predicted impacts of global climate change on reptiles based on a global model based on physiological parameters and concluded that there will be many local and species extinctions – up to 39 and 20% respectively by 2080. This paper included several WCP species. This research highlighted the importance of sufficient time at the correct temperature to allow foraging and breeding behaviour in lizards and the importance of local extinctions. However the generality of the model they employed is likely to be substantially reduced by not taking into account the form of the frequency distributions of environmental temperatures and the range of mean body temperatures and the shape of the mean body temperature frequency distribution (Clusella-Trullas & Chown 2011). More generally, predictions of reptile and other ectotherms' responses to climate change will have to incorporate temperature variation and precipitation regimes and not only changes in average temperature (Clusella-Trullas *et al.* 2011). This presents a significant challenge as predictions of temperature change are far more reliable than predictions of changing rainfall regime in the WCP which are dependent on the specific global climate models employed (e.g. see Hewitson & Crane 2006).

Fishing

At the country scale, the South African pelagic longline fishery targeting tuna and swordfish is estimated to catch 223 sea turtles (loggerhead, leatherback, green and hawksbill) per annum as bycatch (Honig *et al.* 2007). This represents a significant impact on a group of reptiles that are all Threatened. Honig *et al.* (2007) indicate that some of this bycatch is occurring off the WCP coast (reportedly 1-2 turtles per operator per year).

SPOTTED HARLEQUIN SNAKE

Although these figures are relatively small, mitigation measures such as circle hooks should still be put in place to help reduce pressure on these Threatened species.

Muthi

Various studies elsewhere in South African indicate significant harvesting of reptiles for the muthi trade (Ngwenya 2001, Whiting *et al.* 2011) but a similar study has not yet been published for the WCP.

Emergent threats

One of the more insidious and difficult to control threats is the emergence of introduced pathogens. There are several diseases that afflict captive reptiles and their spread to the wild is a growing concern. The recent discovery of fatal *Chrysporium sp.* infections in free-ranging eastern Massasauga rattlesnakes in North America (Allender *et al.* 2011) is a case in point. There is still much more research that needs to be conducted to assess and manage this threat.

Public Awareness

Poor public perception of reptiles and the need for their conservation persists despite positive exposure on television (programmes such as Groen and 50/50 and newspapers such as Die Burger). Poor awareness may also be a symptom of the limited interaction of much of the public with reptiles due to the scarcity of reptiles in the rapidly expanding, transformed environment.

Research

Reptiles as a taxonomic group do not receive as much academic attention in South Africa as is required for their proper conservation management and most academic studies are limited to the works from Stellenbosch University (primarily lizard ecology & systematics); the University of the Witwatersrand (reptile diversity and snake ecology) and the University of the Western Cape (tortoise diversity and ecology). There is still a need to document the ecological requirements of many reptile species and a growing need to assess the areas required to support viable populations.

Apart from the work already cited in this chapter, much other work has been done, particularly on the systematics, taxonomy and phylogeography of reptiles in the WCP. This work although not generally directly addressing conservation issues, underlies subsequent conservation research and decisions. Examples of this work since the 2007 report include: Adalsteinsson *et al.* (2009) on leptotyplopids; Bauer *et al.* (2006) on geckos; Daniels *et al.* (2006, 2007) on legless skinks and angulate tortoises; and Stanley *et al.* (2011) on cordylids.

Capacity

Neither CapeNature nor South African National Parks have full-time herpetologists or reptile biologists. Although there is herpetological expertise in these organisations and SANBI there is no dedicated position monitoring and implementing conservation action for reptiles in the WCP. The limited systematic herpetological capacity is largely responsible for the continued slow rate of species descriptions despite an increasingly refined ability to discern this cryptic diversity in the field and laboratory (see Branch *et al.* 2006).

Table 3. Progress of 2007 reptile conservation recommendations.

2007 Recommendation	2012 Response
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.
Investigating basic systematics.	Several studies underway & several have 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.
Completing conservation status assessments	Done.
Researching basic habitat requirements, population biology and ecology	We are reliant on external investigators to assess this. Some work has been *Bradypodion pumilum* (see Research above).
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.

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

2012 Recommendations
Institute measures to safeguard remaining populations of geometric tortoises from fire and feral pigs.
Vigorously pursue Stewardship arrangements with landowners that have geometric tortoise populations.
Actively monitor WCP reptile species in the pet trade.
Broaden the effort to collect marine turtle records from WCP waters.
Continue to collect distribution data on all Threatened and Near Threatened WCP reptile species.

There is not enough reptile expertise to adequately research, assess and conserve all the threatened reptile species in the WCP. Despite this, the situation in the WCP is perhaps better than in the rest of SA where there is an even sparser distribution of reptile biologists and conservationists. This situation will have to be addressed before the most threatened species reach the point beyond which recovery requires intensive and expensive interventions.

Conclusions & Recommendations

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

Although the taxonomic and systematic knowledge is actively being improved there is an even greater challenge ahead to properly assess the population levels and habitat requirements of many of the South African reptiles, especially those which have been assessed as Threatened.

Conservation of reptiles in the WCP is almost entirely dependent on the conservation of habitat to protect reptiles. Species-specific conservation action will however be required, and urgently required to ensure the future of reptiles such as the Geometric Tortoise.

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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	

Taxon name	English name	Alien
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	
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 dwarf leaf-toed gecko	
Goggia hewitti	Hewitt's dwarf leaf-toed gecko	
Goggia hexapora	Cedarberg dwarf leaf-toed gecko	
Goggia lineata	striped leaf-toed gecko	
Goggia microlepidota	small-scaled leaf-toed 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	

Taxon name	English name	Alien
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 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	
Pachydactylus geitje	ocellated gecko	
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	

Taxon name	English name	Alien
Psammobates tentorius trimeni	Namaqua tent tortoise	
Psammobates tentorius verroxii	Bushmanland tent tortoise	
Psammophis crucifer	cross-marked grass snake	
Psammophis leightoni	fork-marked sand snake	
Psammophis namibensis#	Namib sand 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	
Ramphotyphlops 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	

CHAPTER 7

AVIFAUNA

K. Shaw & L. Waller

Scientific Services CapeNature

CONTENTS

CAPE VULTURE

Executive Summary

The conservation status of the avifauna of South Africa is twelve years out of date and is in urgent need of review. This is currently being addressed using data collected through a number of national projects, the predominant one being the South African Bird Atlas Project 2 which was initiated in 2007, the year of the previous State of Biodiversity Report. This project is not only confirming known changes in species populations and distributions, but is also identifying previously undetected changes in predominantly some of the more common species. The contribution of both professional and citizen scientists in the collection of data for monitoring programmes implemented on a national basis is currently and will in future assist in the conservation assessments of South African bird species. Monitoring programmes to predict the impacts of wind turbines are still in the early stages, but analysis of the data will assist with implementation of measures to mitigate these impacts.
An increase in the number of threatened species in the province has been recorded, although this has been attributed to an increase in the number of threatened vagrants being observed. At the Western Cape provincial scale, 10 additional species were uplisted to threat categories of a more severe scale, while 5 were downlisted between 2007 and 2012. The coastal and inshore species of the province are of particular conservation concern.

Introduction

The Western Cape Province is not known for its high diversity of birds. Despite this, nearly 600 species have been recorded for the province, approximately 45% of which are considered resident species. Significant proportions of populations of threatened species occur within the province placing a substantial responsibility on conservation authorities at all levels of government operating within the province. The conservation status of the birds as presented in "The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes 2000) is long overdue for a revision. Birdlife South Africa has undertaken this task and is currently busy with the revision, although it will not be completed in time for this report.

The threats to birds as identified in the previous state of biodiversity reports have not dissipated. Studies and monitoring programmes have, however, been initiated on the effectiveness of mitigation measures to reduce collisions with powerlines and these will provide information and guidance on the way forward. The drive for greener energy in the form of wind turbines has added another threat of unknown impact. While there is plethora of information internationally on the impacts of wind farms on birds, the relevance thereof to South Africa is unknown. Pre- and post-construction monitoring is being advocated to rectify this and will provide information on how to mitigate impacts.

Avifauna monitoring in this province has benefited from a number of National Projects that have been running for several years. These projects are now producing substantial insights into population trends and changes in distribution patterns of various threatened species which will guide conservation actions in the future.

Methods

Data used in this chapter were obtained from numerous national and provincial monitoring programmes. The species list was created using the list from the 2007 State of Biodiversity (SOB) Report, a species list maintained by Trevor Hardaker (Chairman of the South African Rarities Committee) for the Western Cape as well as any new species that had been recorded by the South African Bird Atlas Project 2 up till the end of February 2012. Population data for a number of species was obtained from the Coordinated Avifaunal Road count and from the CapeNature and the Department of Environmental Affairs (Oceans and Coasts Branch) bird monitoring programmes.

The International Union for Conservation of Nature (IUCN) and the Eskom Red Data Book of South Africa, Lesotho and Swaziland (Barnes 2000) were used to determine the conservation status of the Avifauna species. The latter publication evaluates the species within the South African context while the IUCN evaluates the species on a global context. The Eskom Red Data Book of South Africa, Lesotho and Swaziland (Barnes 2000) is, at the time of this document going to press, being reviewed and the updates will be taken into account in the next SOB report. The IUCN conservation status is assessed regularly and is therefore comparatively up to date.

Avifaunal statistics

The number of species recorded for the Western Cape Province is 599 (Table 1), the majority of which are resident in the province (Figure 1). This is higher than the 517 reported in the 2007 SOB Report (Shaw, 2007) and is primarily due to additional vagrant species recorded since 1991. The avifauna species list for the SOB 2007 report used data from the first South African Bird Atlas Project which spanned the six year period 1985 to 1991 (Harrison *et al.* 1997). For this SOB 2012 report, a few extra pelagic species sighted over the coastal waters bordering the province, species that have visited the province for a short while (vagrants) as well as species whose extreme southern distribution range just enters the province have contributed to the increase in the species number.

The number of species alien to South Africa recorded in the Western Cape Province has not increased over the last five years. Rose-ringed parakeet (*Psittacula krameri*), budgerigar (*Melopsittacus undultus*), the cockatiel (*Nymphicus hollandicus*) and Schalow's turaco (*Tauraco schalowi*), although recorded, have not been included in the species list for the province as none have established a feral population.

The pet trade is often the origin of species occurring outside their natural distribution range. Birds are very mobile and it is often very difficult, even with alien species, to determine whether species have escaped from cages or have managed to disperse naturally. The three species (Livingstone's turaco *Tauraco livingstonii*, long-tailed paradise-whydah *Vidua paradisaea* and purple indigobird *Vidua purpurascens*), categorised as originating from the cage bird industry, are all indigenous to South Africa. However, given their popularity in the pet trade industry and the remoteness of their distribution relative to the provincial boundary, it is assumed that these species are escaped cage birds.

The increase in the number of Threatened species (Figure 2) is due to an increase in the number of Threatened species recorded for the province, the majority of which are vagrants. As stated above, the Eskom Red Data Book of South Africa, Lesotho and Swaziland (Barnes 2000) has not been updated since publication. A concerted effort is been made to update this publication in the second half of 2012, which will unfortunately be too late to include in this report. Figure 3 illustrates the number of species per IUCN category according to the IUCN Red List (IUCN, 2011). It is, however, difficult to interpret the figure properly without understanding the information used to create the graph. Needless to say 10 species were uplisted to a more severe category and 5 species were downlisted between 2007 and 2012. Furthermore 15 species, not recognised as true species in 2007 are now subsequently recognised as true species.

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international treaty to protect wildlife against overexploitation and to ensure that the international trade in specimens of wild animals and plants does not threaten their survival in the wild. CITES lists species in appendices based on certain criteria. Trade in specimens of CITES listed species follows certain regulations depending in which Appendix the species in concern is listed.

A revision of the Appendices by CITES has reduced the number of listed South African species. Initially the country of Ghana placed those indigenous species that qualified into either Appendix I or Appendix II. They listed the rest of the bird species indigenous to the country under Appendix III. A number of these latter species are also indigenous to South Africa and therefore by default South Africa had a number of species listed under Appendix III. The reasons for the listing of these species under Appendix III by Ghana have been re-evaluated and found wanting. They have therefore been removed and the only South African species currently listed in CITES are either Appendix I or II (Figure 4). The two additional CITES II species listed for 2012 are two vagrant raptor species recorded within the Province during the last five years.

Priority species

Given the number of bird species recorded in the Western Cape, it is difficult to monitor every single species, especially within current staff and budget constraints. In addition to this there are a number of species that can be omitted when considering where to direct conservation effort e.g. the 174 species that are vagrant to the Western Cape. The monitoring of bird populations is a useful tool in indicating species' response to environmental changes (de Villiers, 2009). In order to direct conservation effort, priorities need to be set. In terms of the avifauna of the Western Cape, these priority species were identified by allocating scores to a set number of biological and non-biological categories and then ranking the species according to their respective total scores (Shaw, 1995). A revision taking into account the substantial changes in taxonomy of a number of avifaunal groups and any other relevant new information was undertaken in 2004 (CapeNature, unpubl. data). It is envisaged that the prioritisation process will be repeated in the near future as knowledge of, specifically distribution and inferred population trends due to the South African Bird Atlas Project 2, has improved. Table 2 lists the 26 and 39 species that were identified as high priority and intermediate priority species respectively for conservation action in the 2004 revision. Research and monitoring of some of these priority species have provided adequate data to enable biologists to determine population trends over the long term. A number of these priority species for which there are long term datasets and where conservation initiatives have been implemented are discussed below.

a) African Penguin *Spheniscus demersus*

The African penguin is endemic to the Benguela Upwelling Ecosystem and can be found in the coastal waters from northern Namibia to southern KwaZulu-Natal (Frost *et al.* 1976, Shelton *et al.* 1984). They breed at 25 islands and four mainland localities (Kemper *et al.* 2007), of which 9 islands and 2 mainland sites occur within the Western Cape Province. However, no breeding has been recorded for Lamberts Bay Bird Island since 2006 (Crawford *et al.* 2008). As penguin numbers declined through the 20th and 21st century, penguin populations at some sites such as Seal Island, Penguin Island and Albatross Island in Namibia, and Bird Island, Lambert's Bay in South Africa have become locally extinct (Crawford *et al.* 1995a,b, Kemper *et al.* 2007). A new colony at De Hoop Nature Reserve was established in 2003 and this was attributed to penguins attempting to shorten the distance between Dyer Island and the colonies in the Eastern Cape (Underhill *et al.* 2006). This colony has however not persisted, likely due to land based predation pressure (CapeNature unpubl. data).

Historically the total population was estimated at c. 1.5–3 million in 1910 (Shannon and Crawford 1999). This declined to three hundred thousand penguins in 1956 (Rand 1963a,b), and

declined even further to 70 000 breeding pairs in the 1978/79 season (Shelton *et al.* 1984). Subsequent population trends are indicated in Figure 5. As at 2011, the global population is estimated at c. 26 000 pairs, its lowest recorded level, with the Western Cape Province containing c. 34% of the global African penguin population (Department of Environmental Affairs & CapeNature unpubl. data). The species is currently listed as Vulnerable in the South African Red Data Book (Barnes, 2000), but currently qualifies for categorisation as Endangered, and is listed as Endangered as per the IUCN (IUCN, 2011).

Factors contributing to this decline in the early part of the 19th century included egg exploitation, habitat degradation and disturbance as a result of guano scraping (Frost *et al.* 1976, Shannon and Crawford 1999). Breeding birds were disturbed during this practise, causing nest desertion and predation on eggs and chicks by kelp gulls *Larus dominicanus* (Frost *et al.* 1976) and the removal of guano destroyed penguin breeding habitat.

Currently, threats to African penguins include catastrophic oiling events (Underhill *et al.* 1999, 2006, Crawford *et al.* 2000, Barham *et al.* 2007, Wolfaardt *et al.* 2009), chronic oiling (Parsons and Underhill 2005, CapeNature unpubl. data), predation by Cape fur seals *Arctocephalus pusillus pusillus* (Makhado *et al.* 2006) and great white shark *Carcharodon carcharias* (Johnson *et al.* 2006), and predation of eggs and small chicks by kelp gulls (Voorbergen *et al.* 2011). The greatest current threat to African penguins is considered to be the scarcity of food (Crawford *et al.* 2007a, Crawford *et al.* 2011). A mismatch between fish availability and seabird breeding colonies during the summer spawning period has had significant implications for the seabirds of the region (Crawford *et al.* 2007a). In the Benguela Upwelling Ecosystem, changes in the relative abundance of sardine and anchovy have been linked to changes in diet, breeding population size and breeding success of various seabird populations, including Cape gannet, African penguin, Cape cormorant, and swift tern populations (Crawford and Dyer 1995, Crawford 2003, Crawford *et al.* 2006, 2007a, 2011, Underhill *et al.* 2006).

The African penguin monitoring programme includes conducting an annual census of breeding pairs, counts of moulting birds and the marking and tracking of individual birds using flipper bands with unique alphanumerical codes. Besides this monitoring, a number of research projects are currently in progress:

- An experiment initiated in 2008 by the Department of Agriculture, Forestry and Fisheries investigates the efficacy of fishing closures around certain islands and how this would benefit the African penguin. This is being supported by CapeNature, SANParks and UCT's Animal Demography Unit (ADU) and Percy FitzPatrick Institute.
- The study of breeding adult foraging behavior, chick growth and condition and breeding penguin diet analyses is contributing to this study.
- The movement patterns of post-fledgling birds and their foraging areas are also being investigated by means of satellite tracking devices by UCT's ADU.
- A comprehensive health evaluation for the African penguin is currently also being carried out by SANCCOB where the exposure to and prevalence of disease agents is evaluated and diseases that may have management and conservation significance identified.

Conservation efforts in the province include:

- Responding to both catastrophic and chronic oil spill events through the rescue, rehabilitation and release of affected adults and chicks.
- The removal of individual seals seen to be preying on penguins is conducted under strict permit conditions.
- The removal, hand-rearing and release of chicks abandoned at the end of the breeding season. In the light of the overall population declines this is receiving increased attention as a conservation intervention.
- The alleviation of the loss of breeding habitat by providing artificial houses. This is taking place at most colonies to provide protection from extreme weather events and predation.
- An African penguin Biodiversity Management Plan for the South African component of the population.

b) Cape Vulture *Gyps coprotheres*

The Cape vulture is endemic to southern Africa with more than 95% of the population occurring within South Africa (Hockey *et al.* 2005). It is listed as Vulnerable in the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes, 2000). Not all colonies are monitored on a regular basis, making it difficult to determine the numerical trends of the population as a whole. In 2011, however, a concerted effort was made to count all colonies and it is estimated that the current population of Cape vultures is in the region of 2 848 breeding pairs (Wolter 2011). The Western Cape Province has only one small population situated at Potberg within the De Hoop Nature Reserve. This population has been monitored since the early 1970's and while the population initially declined it has increased since the mid 1980's (Figure 6). The Potberg colony is monitored monthly, weather dependant. During these surveys, breeding activity and marked birds are recorded and counts of free-flying birds are done. The marking of individual birds (mostly nestlings) was re-initiated in 1999. Initially birds were fitted with unique combinations of colour leg bands, but in 2006 these leg bands were replaced with patagial (wing) tags with unique alpha-numeric codes.

In the Western Cape Province the predominant cause of mortalities is collisions with powerlines, mostly distribution lines. These incidents are investigated and in areas of repeat collisions, necessary mitigation measures are fitted to the lines to increase the visibility and thus reduce the risk of collisions. Other threats facing the species in the province include drowning in reservoirs and inadvertent poisoning. In the immediate vicinity of the Potberg colony there are not many large, deep, open reservoirs and where problems have occurred necessary mitigation measures that allow trapped birds to climb out of the reservoirs have been put into place. The vultures forage over agricultural lands, feeding on the carcasses of dead livestock (mostly sheep) and therefore may come into contact with agro-chemicals which can cause sub-lethal poisoning. Poisoned birds are usually easily caught, placed in a rehabilitation facility, treated and released once fully recovered. In terms of ensuring that there is enough food in the landscape for the vultures, farmers are encouraged to leave the carcasses of livestock in the fields instead of removing them to be buried or burnt or if they are removed, to place the carcasses at a site easily accessible to the vultures.

c) Bank Cormorant *Phalacrocorax neglectus*

The bank cormorant is endemic to the Benguela Upwelling System of southern Africa (Hockey *et al.* 2005) with its range extending from the Hoanib River mouth in Namibia to Quoin Rock in the Western Cape Province (Crawford 1997).

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The global bank cormorant population has undergone an c. 70% decline between 1975-1981 and 2007 (Cooper 1981, Crawford *et al.* 1999, Crawford *et al.* 2008) resulting in the species being listed as Vulnerable in the South African Red Data Book (Barnes 2000), while globally it is listed as Endangered according to the IUCN list of threatened species. The entire South African population of bank cormorants is located within the Western Cape Province and in 2011 the population was estimated at 470 pairs. At the 8 localities counted regularly, the numbers of breeding birds decreased from > 600 pairs in 1990 to < 300 pairs in 2006 (Crawford *et al.* 2008) (Figure 7).

The reductions or alteration in the availability of the bank cormorants main prey species, the Cape rock lobster *Jasus lalandii* (e.g. Crawford *et al.* 1999, 2008; Kemper *et al.* 2007) has played a role in the bank cormorant decline. The collapse of the Cape rock lobster to the North of Cape Town is considered to have contributed to the collapse of the populations at Malgas and Dassen Islands in the 1980s (Crawford *et al.* 1999, 2008). Another factor in their decline is human disturbance such as harbour development which has caused the desertion of at least four bank cormorant breeding colonies and reduced numbers at six others (Crawford *et al.* 1999). At Robben Island, which contains South Africa's largest colony, nests are restricted to the end of the harbour walls, probably as a result of the level of human activity on and around the island (Sherley *et al.* 2012). Nests and chicks lost to storms (Cooper 1986), and predation of adults and fledglings by Cape fur seals (David *et al.* 2003) has also impacted the population. More recently, climate variability (Sherley *et al.* 2012) and food quality (Ludynia *et al.* 2010a,b) have been investigated as contributing factors to the ongoing population decline.

Regular annual breeding censuses are conducted at 8 of the most important colonies in the Western Cape Province by CapeNature and Department of Environmental Affairs which contributes to the analysis of total population trends.
A research project initiated in 2012 by the University of Cape Town will attempt to determine the role that the changes in prey availability and climate within the southern Benguela Upwelling System played in past bank cormorant declines in southern Africa and to try and understand the population's vulnerability to climate variability in the future. Another objective of this project is to develop an annual monitoring programme to improve the understanding of the factors driving the current population dynamics of the species, as well as to initiate long-term datasets (breeding success, adult and juvenile survival) which will contribute to conservation decision making and ecosystem modelling studies.

d) Cape Gannet *Morus capensis*

The Cape gannet breeds on three islands in Namibia and three islands in South Africa. South Africa comprises about 93% of the breeding population, with c. 30% located within the Western Cape Province at the breeding colonies of Bird Island (Lambert's Bay) and Malgas Island (Kemper *et al.* 2007).

In 1956 the global population of Cape gannets was estimated at c. 254 000 breeding pairs, with 80% occurring in Namibia. The population had halved to 126 000 pairs by 2006 with 90% occurring in South Africa (Crawford *et al.* 2007b). There has been a shift in the centre and distribution of Cape gannets. In 1956/57, Namibia was home to 80% of the breeding Cape gannets. This declined to 50% in 1978/1979 and to only 7% in 2005/2006 (Crawford *et al.* 2007b). In the Western Cape Province, the proportion breeding increased from 12% in 1956/57 to 21% in 1978/79 and 25% in 2005/06, and the Eastern Cape Province from 7%, 28% and 68% respectively (Crawford *et al.* 2007b). The population in South Africa remains above 120 000 pairs, yet with decreases in the Western Cape Province and increases in the Eastern Cape Province, coinciding with the eastward displacement of sardine *Sardinops sagax* and anchovy *Engraulis encrasicolus*, the main prey of Cape gannets (DEA Internal Report 2012) (Figure 8).

As a result of the population decline the species is listed as Vulnerable in the South African Red Data Book (Barnes 2000). The primary reasons for these declines have been attributed to a lack of prey (Crawford *et al.* 1983, Crawford *et al.* 2007), especially in Namibia. The number of Cape gannets breeding in both Namibia and South Africa is significantly correlated to the biomass of pelagic fish, primarily sardine and anchovy (Crawford *et al.* 2007b). Predation by Cape fur seals is a significant threat to this species (David *et al.* 2003, Makhao *et al.* 2006, Wolfaardt and Williams 2006). Cape gannet are also caught as a by-catch in long line fisheries (Ryan and Boix-Hinzen 1998).

Monitoring in the Western Cape focusses on annual counts of breeding adults that are conducted on an annual basis by Department of Environmental Affairs as well as obtaining diet samples from adults and chicks. In addition, the foraging behaviour of breeding adults with chicks is monitored annually using back-mounted global positioning system (GPS) devices, since 2002 on Malgas Island by the Percy FitzPatrick Institute at the University of Cape Town and since 2010 on Algoa Bay Bird Island by the Nelson Mandela Metropolitan University. Over that period chicks are also weighed and measured in order to ascertain their growth and condition which gives an indication of local feeding conditions.

Research projects in the Western Cape Province have focussed primarily on investigating the flexibility of Cape gannet foraging behaviour and energetics and exploring the relationships between these aspects with simultaneous distribution and abundance of food resources, as well as catches of purse-seine fishing boats (Pichegru *et al.* 2009, 2010; Okes *et al.* 2009; Mullers & Navarro 2010).

The South African colonies are of critical importance to the Cape gannet given that they contain over 90% of the world's Cape gannet population. Effective management to protect these colonies is crucial to the species long term survival in the wild. The increase in predation by seals on seabirds off southern Africa is exacerbating the population declines of seabirds caused by human impact on the marine ecosystem (Makhado *et al.* 2006) and is a threat that needs intensive management action. The increasing population of kelp gulls (*Larus domincanus*) on some colonies (e.g. Malgas Island) is also of major concern, as they can take a large proportion of gannet eggs and small chicks (SANParks, unpubl. data) from nests at the border of the colony. This predation is exacerbated by the increasing patchiness of the gannet colony, due to the decrease in number of breeding gannets.

e) Blue Crane *Anthropoides paradiseus*

The blue crane is listed as vulnerable in the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes, 2000) and is virtually endemic to South Africa with only a small population occurring around the Etosha Pans in Namibia and a few birds resident in Swaziland and Lesotho. The species has declined in much of its former stronghold mostly due to habitat loss, but has adapted well to the artificial habitat of the wheat producing areas of the Western Cape Province(Shaw, 2003) to such a degree that it is estimated that about 50% of the total population now occurs in the Western Cape Province(McCann, 2001). The population is still increasing in these areas as depicted by the data from the Coordinated Avifaunal Road Count Project (CAR) coordinated by the ADU of the University of Cape Town (Figure 9). The blue crane in the Western Cape Province is monitored together with a number of other large terrestrial birds bi-annually as part of the CAR project (See 5b below).

A ringing programme was initiated in 1993 where a number of young un-fledged birds are fitted each year with unique combinations of colour leg bands. Although this programme is technically still in operation, it is unfortunately dependent on whether a fieldworker is available for the province. Since this post is funded through sponsorship, the ringing of birds does not always take place.

The biggest threat to the blue crane in the province is collision with powerlines (Shaw, 2010). All incidents are recorded and reported to Eskom and where frequent collisions occur mitigation measures are fitted to the lines. Other threats include inadvertent poisoning; collisions with fence lines, legs tangled in baling twine, drowning in water troughs and catching birds for pets (Shaw, 2000). Many of these threats can be reduced through increasing awareness of these hazards in the agricultural sector. In the Western Cape Province this is done by the government sector (CapeNature and the Department of Agriculture) and by the Overberg Crane Group, a non-governmental organisation

f) Bustards and Korhaans

Six species of Otididae (Bustard and Korhaan family) have been recorded within the province, two of which are vagrants to the province. Of the four species that are resident within the province, two (Ludwig's bustard *Neotis ludwigii* and Denham's bustard *N. denhami*) are listed as vulnerable in the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes, 2000). Ludwig's Bustard occurs in the arid regions of the Province and no surveys are been carried out on the species within the province. The Denham's bustard, southern black korhaan (*Afrotis afra*) and Karoo korhaan (*Eupoditis vigorsii*) are, however, monitored biannually as part of the CAR project. Although the latter two species are not currently priority species for CapeNature's monitoring programme, they are endemic to South Africa and southern Africa respectively and were included to illustrate how they respond to man-made habitats. Denham's bustard occurs primarily on the agricultural areas within the Western Cape Province especially the intensive agricultural areas. The density increase in Denham's bustard shown in Figure 10 suggests that agricultural practices in these areas provides suitable habitat for the species (Allan, 2003). The density of Karoo korhaan as depicted in (Figure 11) remains more or less constant, while that of the southern black korhaan shows a decline (Figure 12). The southern black korhaan prefers natural vegetation (Hockey *et al.* 2005). It is both the reduction of this vegetation type, as well as the compromising of the remaining fragments by conversion to agriculture that the decline may be attributed to.

Current threats to the bustards and korhaans vary between species. Studies on Ludwig's bustard in the Northern Cape Province show that the species is highly susceptible to collisions with powerlines (J. Shaw pers comm, Schutgens 2012). In contrast to this, it seems that Denham's Bustard, while occurring in areas with higher densities of powerlines, are not prone to collisions with powerlines (J. Shaw pers comm, K.A. Shaw pers obs.). CapeNature's Stewardship Program has identified important remnant fragments of indigenous vegetation in the wheat producing areas for protection which will provide habitat for the southern black korhaan and breeding habitat for Denham's bustard. While the objective is to protect the rare and endangered vegetation types, these two species will also benefit from the programme. Historically both bustard species were hunted as game, but are now protected and no hunting is allowed.

CAPE GANNET: K. SHAW

Conservation initiatives

Two conservation initiatives that contribute substantially to understanding and determining the state of avifauna within the province and South Africa are the Coordinated Avifaunal Road Count (CAR) and the South African Bird Atlas Project 2 (SABAP2), both of which are coordinated by the ADU situated in the University of Cape Town's Department of Zoology. There are no other monitoring projects taking place at a national level dealing with as wide a diversity of avifauna species over a relatively long time scale that can compare with these two programmes. The other initiatives worthy of mention are the compilation of Biodiversity Management Plans for Species (BMP-S) or Ecosystems (BMP-e) and the Important Bird Area Programme (IBA). In terms of the biodiversity management plans a separate BMP-S for specific species may not be required and the management of the species can be incorporated into a BMP-e. For the management of a specific avifaunal species a BMP-S is more appropriate than a BMP-e and is discussed below.

a) South African Bird Atlas Project 2

The Project was launched in July 2007 following the successful completion of the South African Bird Atlas Project 1 which ended in 1991 with the printing of the results in 1997. The object is to record the presence/absence (including breeding) of birds within pre-determined areas, which in the case of SABAP2 are 5X5 minute squares over the whole of South Africa, Lesotho and Swaziland. At the end of April 2012 nearly 70 000 surveys have been carried out covering just over 60% of South Africa. In terms of the Western Cape just under 14 500 surveys have been undertaken covering 79% of the Western Cape pentads (http://sabap2.adu.org.za/). These surveys are carried out by keen amateur and professional birders (just over 1 000 observers) and the data is submitted to the ADU for analysis. The data collected by this project was used to update the species list of the province and will play a crucial role in the revision of the Red Data book species list.

b) Coordinated Avifaunal Road Count

The CAR Project was launched in July 1993 and requires teams of observers to follow set routes counting a suite of terrestrial birds. This is done twice a year (January and July) on set dates throughout the country. The project does not record the absolute abundance of a species, but uses a standardised technique that provides a measure of relative abundance. The project monitors over 20 species of birds along 350 fixed routes covering more than 19 000 km. The data used to produce the graphs for the blue crane, Denham's bustard and the two korhaan species in section 4 were generated from this project illustrating the usefulness of this project in the monitoring of targeted species. Figure 13 illustrates the number and coverage of the routes within the Western Cape Province.

c) Biodiversity Management Plans for Species

The National Environmental Management: Biodiversity Act (No 10 of 2004), makes provision in Section 43 for the compilation of Biodiversity Management Plans for either an ecosystem or an indigenous species. The Norms and Standards for BMP-S was published in the Government Gazette (Government Notice No. R. 214) March 2009, specifying what must be included in such a management plan. To date very few Biodiversity Management Plans for species have been approved by the Minister. The African penguin BMP-S is the only bird management plan that has been submitted and approved by the Department of Environmental Affairs. The only other BMP-S for an avifaunal species that will be applicable to the Western Cape Province is the one being compiled for the three South African crane species. The Crane BMP-S is facilitated by the African Crane Conservation Programme of the Endangered Wildlife Trust and to date a workshop has been held where threats and actions to mitigate the threats were identified.

d) Important Bird Area Programme

This is a programme of BirdLife International and its partner and partner-designate organisations. BirdLife South Africa is the partner in South Africa. The purpose of the programme is the identification and protection of

a network of sites at a biogeographical scale ensuring the long-term viability of naturally occurring bird populations. It entails selecting sites according to set criteria that would then qualify them for IBA status. The initial process was carried out in the mid 1990's culminating in a report (Barnes, 1998) in which a number of sites were identified throughout South Africa. Twenty-five sites were identified in the Western Cape. Unfortunately since the report this programme has stagnated and very little work has been done in the Western Cape for various reasons. In 2009 the IBA programme was revived and BirdLife South Africa has recently employed a regional conservation manager for the Western Cape. The priority for the next few years in the Western Cape will be to re-evaluate existing sites and identify any new sites using information from projects like SABAP2.

Threats

Habitat destruction and degradation

Habitat destruction and degradation still remains the greatest threat to avifaunal diversity within the Western Cape. While certain species such as the blue crane have adapted to man-made habitats and have increased in numbers others like the southern black korhaan that require natural vegetation have declined both in numbers and in distribution. Despite the increase in blue crane numbers, collisions with the numerous powerlines traversing the Province is a concern and while it is been addressed it is done on a reactive basis. Attempts in the past to proactively implement mitigation measures have not been successful as it is difficult to predict where the problem sites are and there is some scepticism about the effectiveness of the mitigation devices. Ludwig's bustard is very susceptible to powerline collisions and it may be the reason for the recent decline in the species population. Studies by the Percy FitzPatrick Institute are being undertaken to look into this issue. The move to greener energy in the form of wind and solar farms has recently provided new challenges to conservationists. While there is a magnitude of literature and studies on the impacts of these types of developments on birds, they are all based primarily on European and American case studies. It is difficult to predict what the impact of these developments will have on the birds. Discussions with the wind energy industry have been positive and have resulted in the implementation of pre- and post-construction monitoring. Pre-construction monitoring helps predict where possible issues will arise and informs the developer on the actual configuration of the tower layout, while post-construction monitoring alerts one to issues not identified during the pre-construction period.

Food supply

There are a number of species (mostly near-shore marine birds) that are currently declining and the actual reasons are not really understood. Food availability is thought to be the primary reason for this, but it is not clear what is affecting this change in availability. Substantial research and surveys into the food supply of African penguin, Cape gannet and cormorant species are being carried out by the Department of Agriculture, Forestry and Fisheries, and various research institutions at the University of Cape Town. The information on other coastal and in inshore species is less detailed, and this needs attention.

Invasive species

The threat from alien invasive species is fortunately restricted to two species, the house crow *Corvus splendens* and the mallard *Anas platyrhynchus.* The house crow is restricted to the Cape Town Meteropole area and there is a programme run by the City of Cape Town Municipality to remove the birds. The removal of the mallard on the other hand is more complex as the species is kept and sold as pets. This entails a whole different approach including media and awareness campaigns. Success in this aspect has been slow, but progress has been made with the development of a national mallard strategy and the inclusion of the species in the Alien Invasive Species Regulations of the National Environment Management: Biodiversity Act (No 10 of 2004).

Disease

Avian flu remains a threat to the Ostrich Industry and the industry suffers losses due to export embargos placed on them by importing countries. Studies have shown that wild birds do carry various strains of avian flu (Olsen *et al.* 2006), but it is not clear what the source of the disease is within the ostrich industry. There is a concern that ostrich famers will take matters into their own hands and try and remove all possible sources of diseases which may include the use of drastic measures to prevent wild birds from coming into contact with ostriches. As blue cranes are often found in close proximity to ostriches and in fact forage from ostrich feed bins this could be a serious threat to the species.

Recommendations

The next few years are going to be very informative for deepening our understanding of the status of Avifauna in the Western Cape. The new red data listing process is under way and a product is imminent before the end of mid – 2013. The re-evaluation of the IBA sites in the Western Cape will be completed within the period before the next SOB report. The revised prioritisation of the avifauna within the Western Cape would also have been completed by this time. In terms of the latter this could either re-affirm the existing list or change it slightly based on new information gleaned from programmes such as SABAP2 and CAR. Furthermore the African penguin Biodiversity Management Plan will be gazetted by the end of 2012 and many of the actions identified within the plan will need to be implemented within the next five years. Biodiversity Management Plans are a fairly new concept within South Africa and it is expected to gain favour with many conservationists, which could lead to more species management plans in the near future. The process has already been initiated for the three indigenous crane species and the Cape Vulture.

A number of monitoring programmes for the priority species listed in Table 2 are already in place, but there are still species on the list that are not being monitored. In some species e.g. the Knysna warbler *Bradypterus sylvaticus* and striped flufftail *Sarothrura affinis* the compilation of monitoring programmes is going to take some innovative thinking as these species are difficult to survey and monitor and for this reason have been ignored in the past. The coastal and inshore birds are another group of priority species where the lack of monitoring programmes has led to inconsistent monitoring and this needs to be addressed as a matter of urgency. There are a substantial number of threatened and near-endemic species within this group.

Progress with those recommendations made in the 2007 State of Biodiversity Report has been varied. Information dissemination to the public via media and other forms of communication has occurred and will continue to do so both on a planned or ad hoc basis. Unfortunately very little progress has been made into the development and testing of mitigation measures to reduce the impact of damage causing birds. There are a number of mitigation measures available, but very little research has been undertaken to determine the effectiveness of the measure. The Percy FitzPatrick Institute has however carried out research on the impact of powerlines on birds and the mitigation thereof, while the Endangered Wildlife Trust's Wildlife Energy Interaction Program is monitoring the effectiveness of the mitigation measures fitted to powerlines to prevent collisions. The priority for stewardship sites in the Western Cape is understandably the remnants of highly threatened vegetation types. Nevertheless a number of stewardships sites have been negotiated within the identified Important Bird Areas of the Province. Unfortunately the Stewardship Programme of CapeNature is not negotiating new contracts due to a lack of resources.

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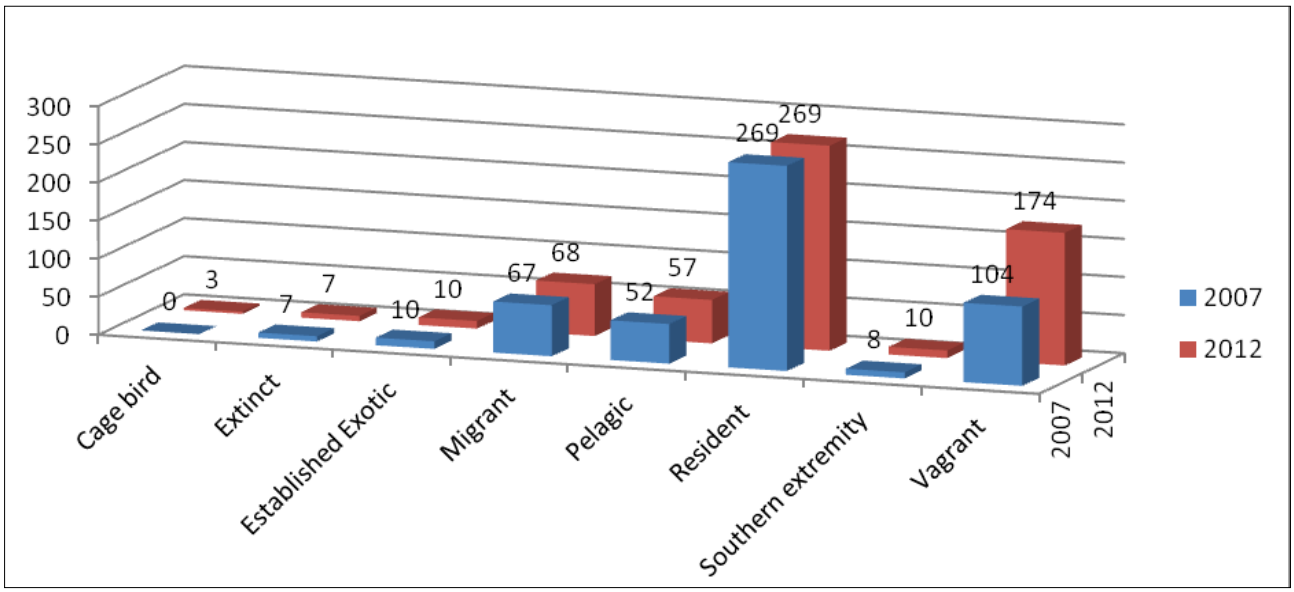

Figure 1. Number of Western Cape bird species in each distribution category for 2007 and 2012.

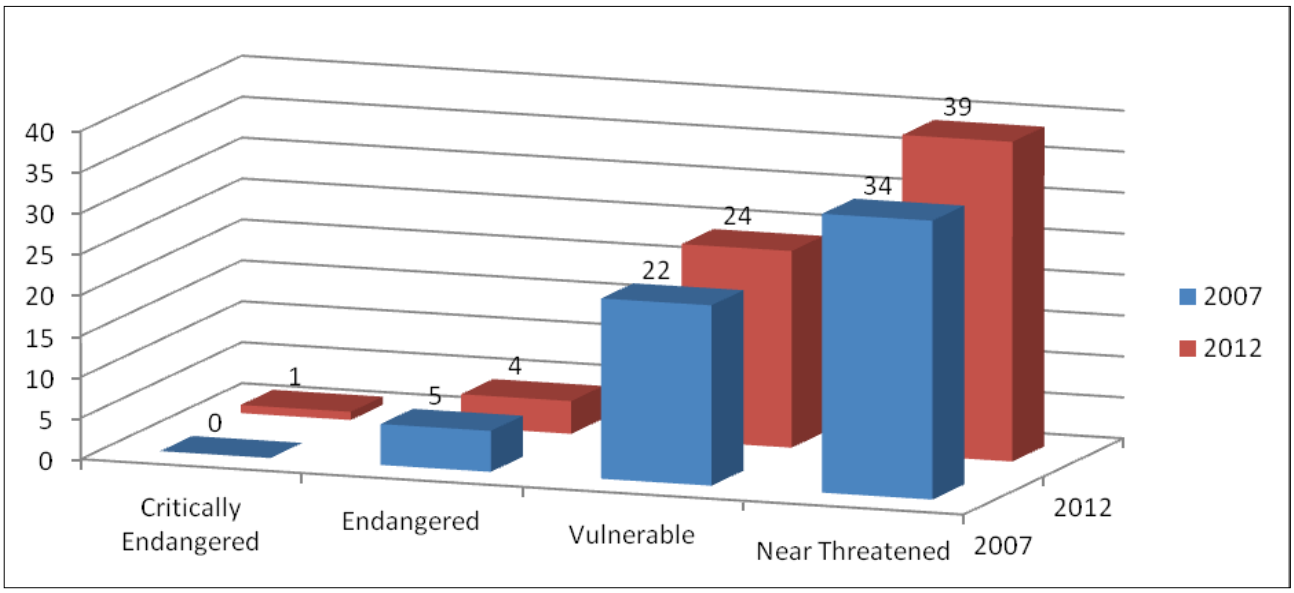

Figure 2. Number of Western Cape bird species occurring in each IUCN threat category according to Barnes (2000).

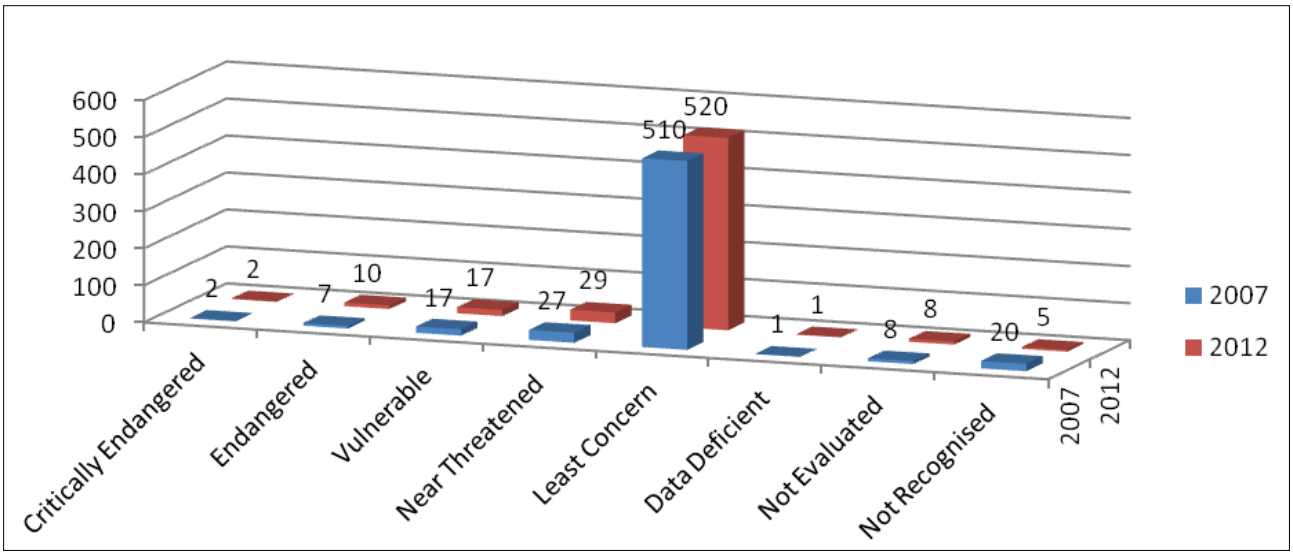

Figure 3. Number of Western Cape birds occurring in each IUCN threat category according to the IUCN Red list.

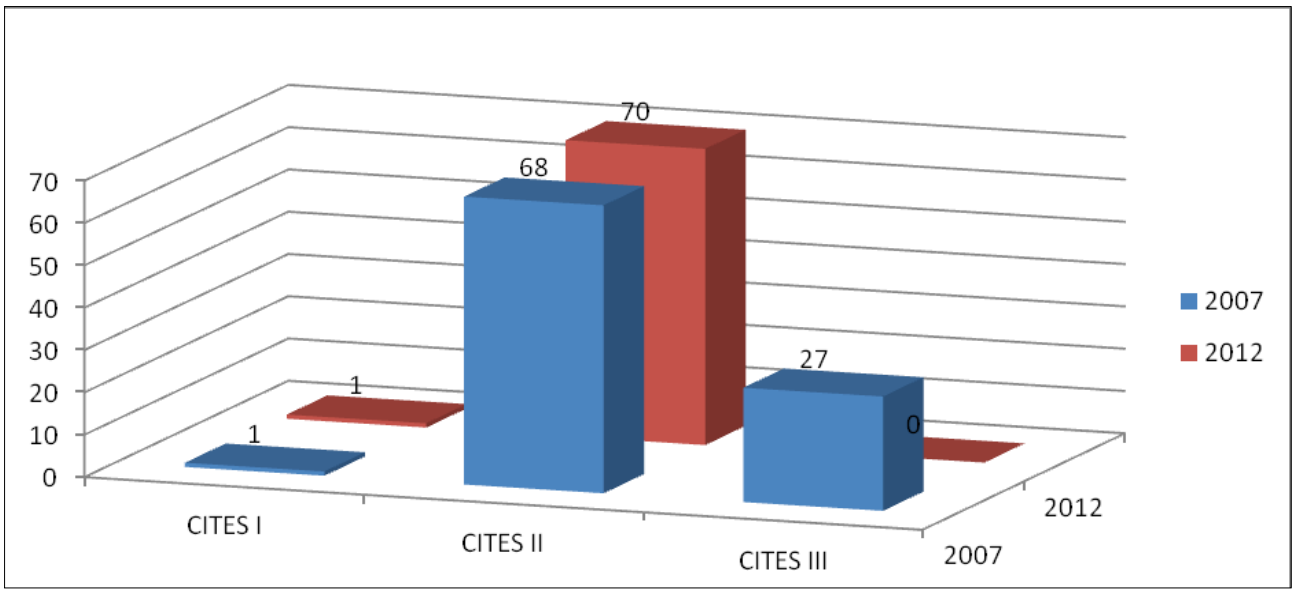

Figure 4. Number of Western Cape bird species occurring within each Appendix of the Convention of International Trade of Endangered Species.

Figure 5. South African and Western Cape population trend of the number African penguin Spheniscus demersus breeding pairs.

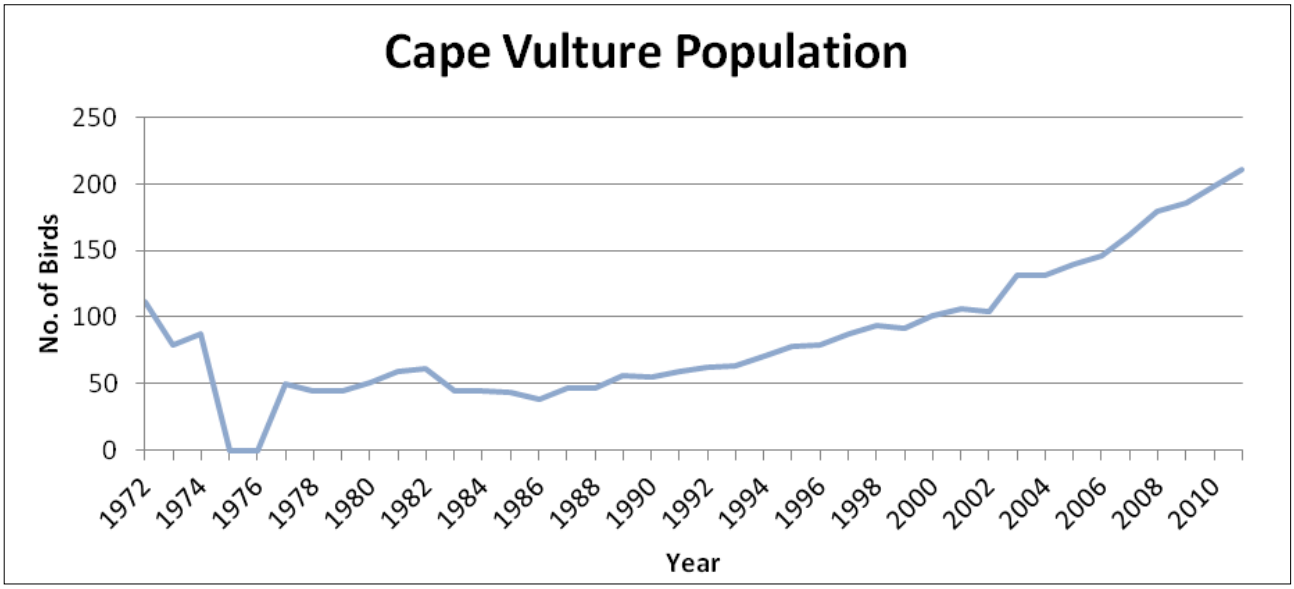

Figure 6. Population trend of the number of Cape vultures Gyps coprotheres in the Western Cape.

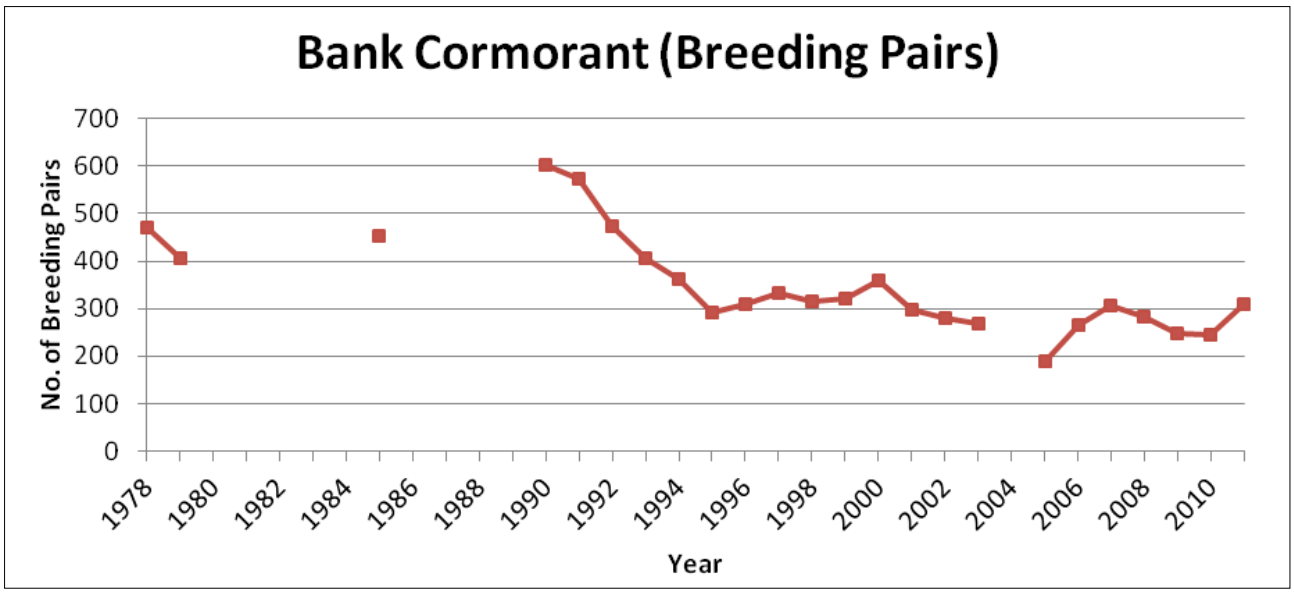

Figure 7. Population trend of the number of breeding pairs of bank cormorants Phalacrocorax neglectus recorded at Lambert's Bay Bird, Malgas, Marcus, Jutten, Vondeling, Dassen, Robben and Dyer Islands.

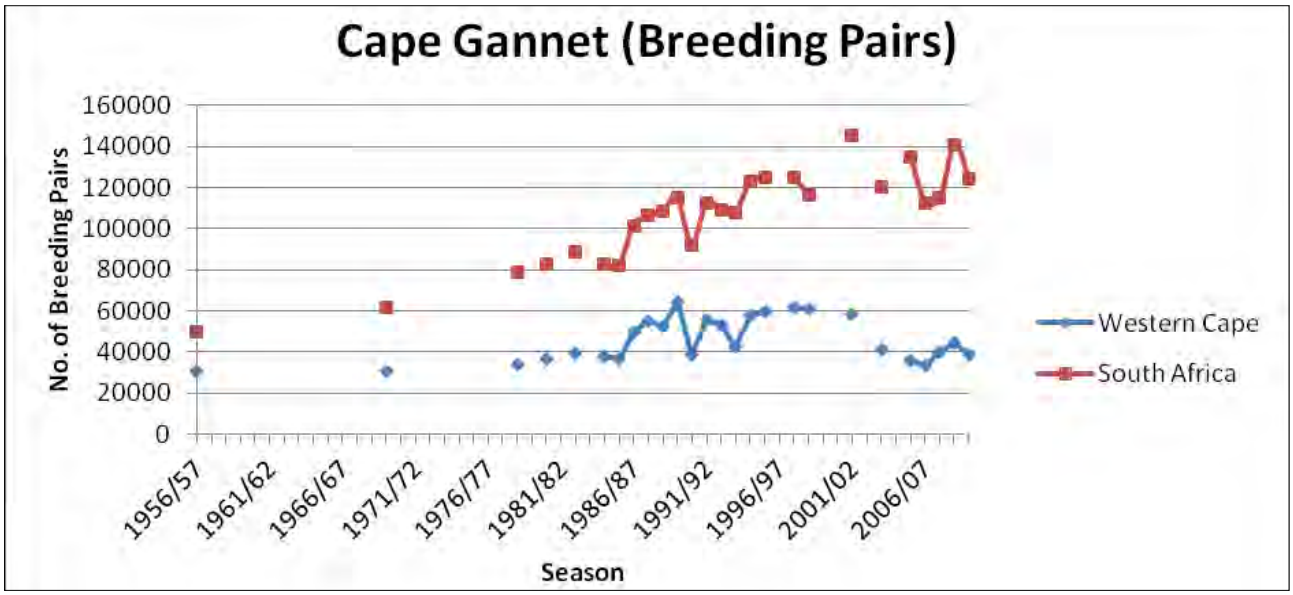

Figure 8. South African and Western Cape population trend of the number Cape gannet Morus capensis breeding pairs.

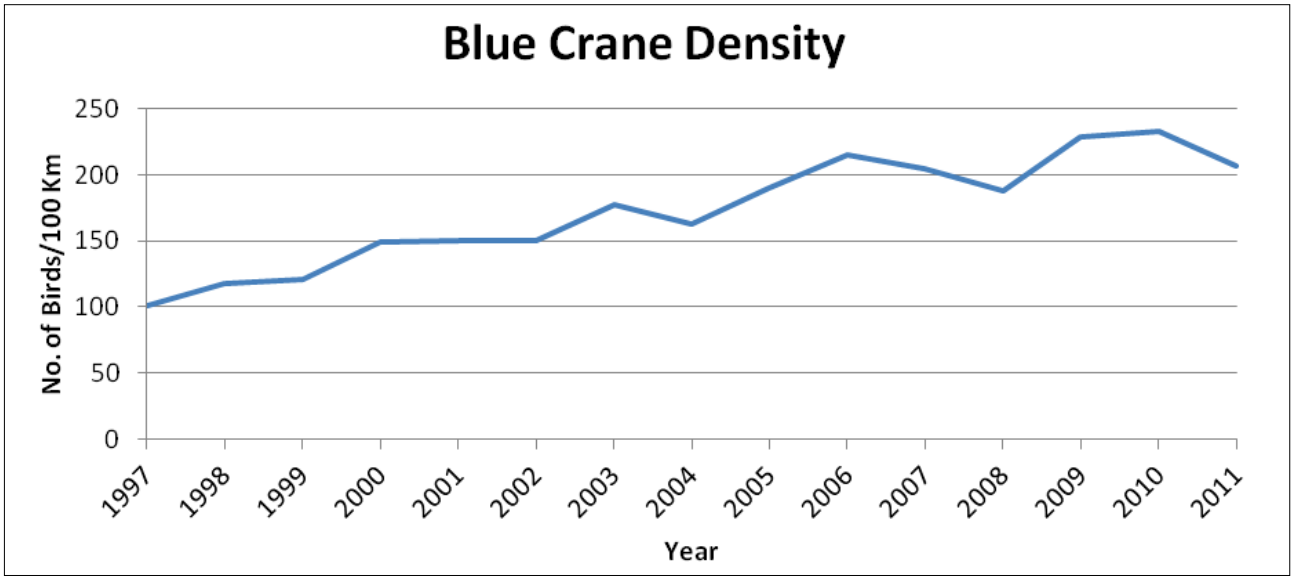

Figure 9. Density expressed as number of birds per 100 Km of blue crane Anthropoides paradiseus in the Western Cape. Data supplied by the Animal Demography Unit of the University of Cape Town.

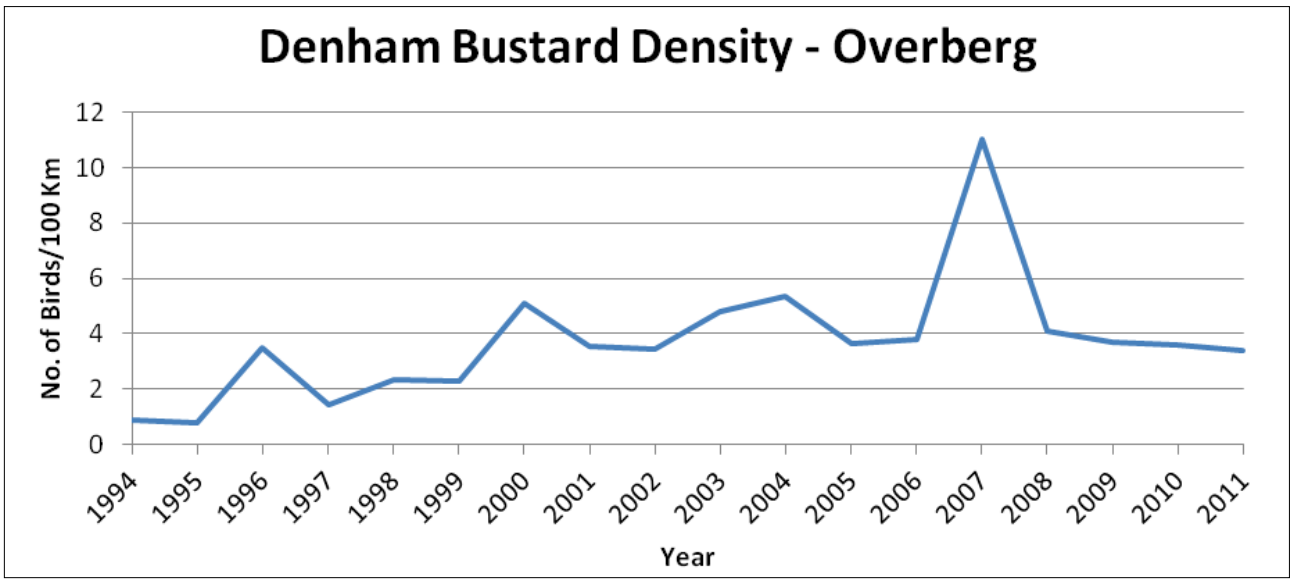

Figure 10. Density expressed as number of birds per 100 Km of Denham's bustard Neotis denhami in the Western Cape. Data supplied by the Animal Demography Unit of the University of Cape Town.

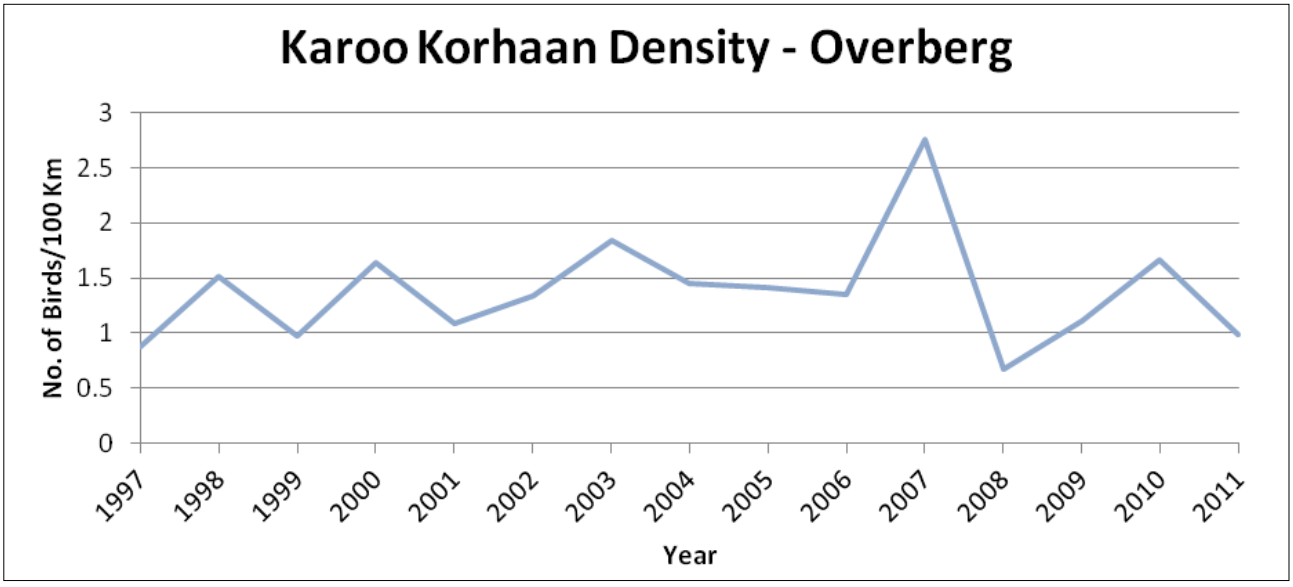

Figure 11. Density expressed as number of birds per 100 Km of Karoo korhaan Eupoditis vigorsii in the Western Cape. Data supplied by the Animal Demography Unit of the University of Cape Town.

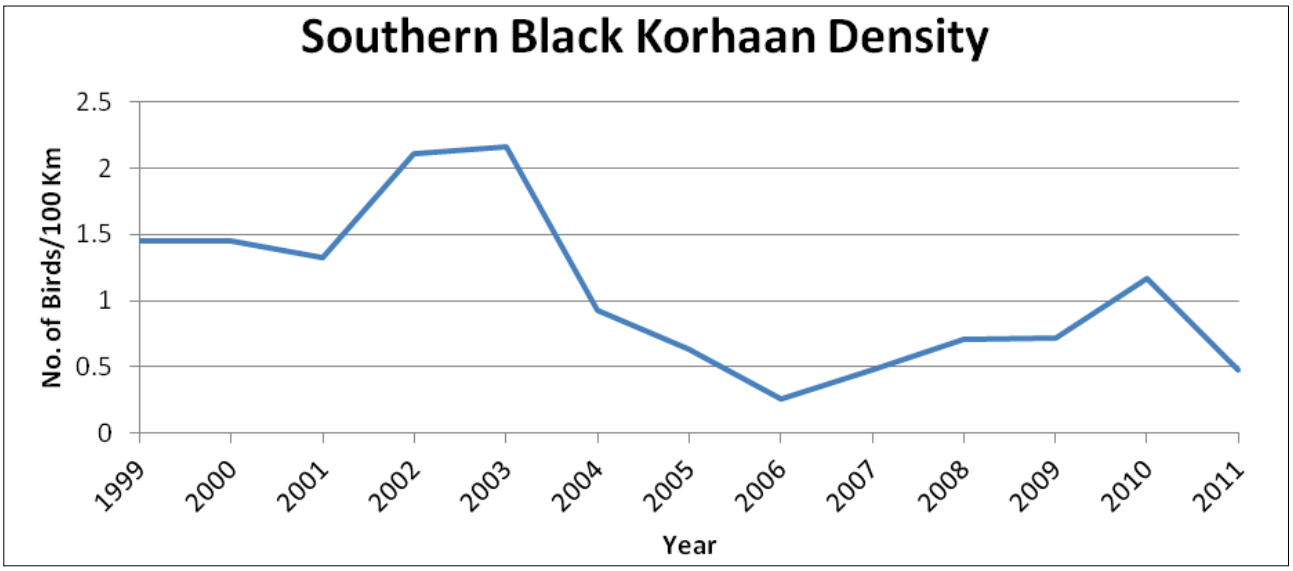

Figure 12. Density expressed as number of birds per 100 Km of southern black korhaan Afrotis afra in the Western Cape. Data supplied by the Animal Demography Unit of the University of Cape Town.

Table 1:
List of bird species that occurs or occurred in the Western Cape. The information was generated from the South African Bird Atlas Project 1 for the 2007 report. For the 2012 report, the information was generated using the 2007 list, species information from Trevor Hardaker and the SABAP 2 project.

English Name	*Scientific Name*	Western Cape Status	South African Conservation Status	IUCN Conservation Status	CITES
Abdim's Stork	*Ciconia abdimii*	Vagrant	Null	Least Concern	
Acacia Pied Barbet	*Tricholaema leucomelas*	Resident	Null	Least Concern	
African Black Duck	*Anas sparsa*	Resident	Null	Least Concern	
African Black Oystercatcher	*Haematopus moquini*	Resident	Near Threatened	Near Threatened	
African Black Swift	*Apus barbatus*	Migrant	Null	Least Concern	
African Crake	*Crecopsis egregia*	Vagrant	Null	Least Concern	
African Crowned Eagle	*Stephanoaetus coronatus*	Resident	Near Threatened	Least Concern	II
African Cuckoo	*Cuculus gularis*	Vagrant	Null	Least Concern	
African Cuckoo Hawk	*Aviceda cuculoides*	Vagrant	Null	Least Concern	II
African Darter	*Anhinga rufa*	Resident	Null	Least Concern	
African Dusky Flycatcher	*Muscicapa adusta*	Resident	Null	Least Concern	
African Emerald Cuckoo	*Chrysococcyx cupreus*	Migrant	Null	Least Concern	
African Finfoot	*Podica senegalensis*	Resident	Vulnerable	Least Concern	
African Firefinch	*Lagonosticta rubricata*	Vagrant	Null	Least Concern	
African Fish-Eagle	*Haliaeetus vocifer*	Resident	Null	Least Concern	II
African Golden Oriole	*Oriolus auratus*	Vagrant	Null	Least Concern	
African Goshawk	*Accipiter tachiro*	Resident	Null	Least Concern	II
African Grass-Owl	*Tyto capensis*	Resident	Vulnerable	Least Concern	II
African Harrier-Hawk	*Polyboroides typus*	Resident	Null	Least Concern	II
African Hobby	*Falco cuvierii*	Vagrant	Null	Least Concern	II
African Hoopoe	*Upupa africana*	Resident	Null	Not Recognised	
African Jacana	*Actophilornis africanus*	Vagrant	Null	Least Concern	
African Marsh-Harrier	*Circus ranivorus*	Resident	Vulnerable	Least Concern	II
African Olive-Pigeon	*Columba arquatrix*	Resident	Null	Least Concern	
African Openbill	*Anastomus lamelligerus*	Vagrant	Near Threatened	Least Concern	
African Palm-Swift	*Cypsiurus parvus*	Vagrant	Null	Least Concern	
African Paradise-Flycatcher	*Terpsiphone viridis*	Resident	Null	Least Concern	
African Penguin	*Spheniscus demersus*	Resident	Vulnerable	Endangered	II
African Pied Wagtail	*Motacilla aguimp*	Vagrant	Null	Least Concern	
African Pipit	*Anthus cinnamomeus*	Resident	Null	Not Evaluated	
African Pitta	*Pitta angolensis*	Vagrant	Null	Least Concern	
African Purple Swamphen	*Porphyrio madagascariensis*	Resident	Null	Least Concern	
African Pygmy Kingfisher	*Ispidina picta*	Vagrant	Null	Least Concern	
African Quailfinch	*Ortygospiza atricollis*	Resident	Null	Least Concern	
African Rail	*Rallus caerulescens*	Resident	Null	Least Concern	
African Red-eyed Bulbul	*Pycnonotus nigricans*	Resident	Null	Not Evaluated	
African Reed-Warbler	*Acrocephalus baeticatus*	Migrant	Null	Not Evaluated	
African Rock Pipit	*Anthus crenatus*	Resident	Null	Least Concern	
African Sacred Ibis	*Threskiornis aethiopicus*	Resident	Null	Least Concern	
African Scops-Owl	*Otus senegalensis*	Regionally Extinct	Null	Least Concern	II
African Snipe	*Gallinago nigripennis*	Resident	Null	Least Concern	
African Spoonbill	*Platalea alba*	Resident	Null	Least Concern	

English Name	*Scientific Name*	Western Cape Status	South African Conservation Status	IUCN Conservation Status	CITES
African Stonechat	*Saxicola torquatus*	Resident	Null	Least Concern	
African Wood-Owl	*Strix woodfordii*	Resident	Null	Least Concern	II
Agulhas Long-billed Lark	*Certhilauda brevirostris*	Resident	Near Threatened	Not Evaluated	
Allen's Gallinule	*Porphyrio alleni*	Vagrant	Null	Least Concern	
Alpine Swift	*Tachymarptis melba*	Migrant	Null	Least Concern	
American Golden Plover	*Pluvialis dominica*	Vagrant	Null	Least Concern	
American Purple Gallinule	*Porphyrio martinicus*	Vagrant	Null	Least Concern	
Amethyst Sunbird	*Chalcomitra amethystina*	Resident	Null	Least Concern	
Amur Falcon	*Falco amurensis*	Vagrant	Null	Least Concern	II
Antarctic Petrel	*Thalassoica antarctica*	Pelagic	Null	Not Evaluated	
Antarctic Prion	*Pachyptila desolata*	Pelagic	Null	Least Concern	
Antarctic Tern	*Sterna vittata*	Migrant	Null	Least Concern	
Anteating Chat	*Myrmecocichla formicivora*	Resident	Null	Least Concern	
Arctic Tern	*Sterna paradisaea*	Migrant	Null	Least Concern	
Atlantic Petrel	*Pterodroma incerta*	Pelagic	Null	Endangered	
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	Pelagic	Near Threatened	Endangered	
Australian Gannet	*Morus serrator*	Vagrant	Null	Least Concern	
Baillon's Crake	*Porzana pusilla*	Resident	Null	Least Concern	
Baird's Sandpiper	*Calidris bairdii*	Vagrant	Null	Least Concern	
Balearic Shearwater	*Puffinus mauretanicus*	Pelagic	Null	Critically Endan-gered	
Banded Martin	*Riparia cincta*	Migrant	Null	Least Concern	
Bank Cormorant	*Phalacrocorax neglectus*	Resident	Vulnerable	Endangered	
Barn Owl	*Tyto alba*	Resident	Null	Least Concern	II
Barn Swallow	*Hirundo rustica*	Migrant	Null	Least Concern	
Bar-tailed Godwit	*Limosa lapponica*	Migrant	Null	Least Concern	
Bar-throated Apalis	*Apalis thoracica*	Resident	Null	Least Concern	
Bateleur	*Terathopius ecaudatus*	Vagrant	Vulnerable	Near Threatened	II
Bearded Vulture	*Gypaetus barbatus*	Regionally Extinct	Endangered	Least Concern	II
Black Crake	*Amaurornis flavirostris*	Resident	Null	Least Concern	
Black Cuckoo	*Cuculus clamosus*	Migrant	Null	Least Concern	
Black Cuckooshrike	*Campephaga flava*	Migrant	Null	Least Concern	
Black Harrier	*Circus maurus*	Resident	Near Threatened	Vulnerable	II
Black Heron	*Egretta ardesiaca*	Vagrant	Null	Least Concern	
Black Kite	*Milvus migrans*	Migrant	Null	Least Concern	II
Black Saw-wing	*Psalidoprocne holomelas*	Migrant	Null	Least Concern	
Black Sparrowhawk	*Accipiter melanoleucus*	Resident	Null	Least Concern	II
Black Stork	*Ciconia nigra*	Resident	Near Threatened	Least Concern	II
Black Tern	*Chlidonias niger*	Vagrant	Null	Least Concern	
Black-backed Puffback	*Dryoscopus cubla*	Resident	Null	Least Concern	
Black-bellied Starling	*Lamprotornis corruscus*	Resident	Null	Least Concern	
Black-bellied Storm-Petrel	*Fregetta tropica*	Pelagic	Null	Least Concern	
Black-browed Albatross	*Thalassarche melanophris*	Pelagic	Near Threatened	Endangered	
Black-chested Prinia	*Prinia flavicans*	Vagrant	Null	Least Concern	
Black-chested Snake-Eagle	*Circaetus pectoralis*	Vagrant	Null	Least Concern	II

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Black-collared Barbet	*Lybius torquatus*	Vagrant	Null	Least Concern	
Black-crowned Night-Heron	*Nycticorax nycticorax*	Vagrant	Null	Least Concern	
Black-eared Sparrowlark	*Eremopterix australis*	Southern Extremity	Null	Least Concern	
Black-headed Canary	*Serinus alario*	Resident	Null	Least Concern	
Black-headed Gull	*Chroicocephalus ridibundus*	Vagrant	Null	Least Concern	
Black-headed Heron	*Ardea melanocephala*	Resident	Null	Least Concern	
Black-headed Oriole	*Oriolus larvatus*	Resident	Null	Least Concern	
Black-legged Kittiwake	*Rissa tridactyla*	Vagrant	Null	Least Concern	
Black-necked Grebe	*Podiceps nigricollis*	Resident	Null	Least Concern	
Black-shouldered Kite	*Elanus caeruleus*	Resident	Null	Least Concern	II
Blacksmith Lapwing	*Vanellus armatus*	Resident	Null	Least Concern	
Black-tailed Godwit	*Limosa limosa*	Migrant	Null	Near Threatened	
Black-throated Canary	*Crithagra atrogularis*	Vagrant	Null	Least Concern	
Black-winged Lapwing	*Vanellus melanopterus*	Resident	Near Threatened	Least Concern	
Black-winged Pratincole	*Glareola nordmanni*	Vagrant	Near Threatened	Near Threatened	
Black-winged Stilt	*Himantopus himantopus*	Resident	Null	Least Concern	
Blue Crane	*Anthropoides paradiseus*	Resident	Vulnerable	Vulnerable	II
Blue Korhaan	*Eupodotis caerulescens*	Vagrant	Near Threatened	Near Threatened	II
Blue Petrel	*Halobaena caerulea*	Pelagic	Null	Least Concern	
Blue Waxbill	*Uraeginthus angolensis*	Vagrant	Null	Least Concern	
Blue-cheeked Bee-eater	*Merops persicus*	Vagrant	Null	Least Concern	
Blue-mantled Crested-Flycatcher	*Trochocercus cyanomelas*	Resident	Null	Least Concern	
Bokmakierie	*Telophorus zeylonus*	Resident	Null	Least Concern	
Booted Eagle	*Aquila pennatus*	Migrant	Null	Least Concern	II
Bridled Tern	*Sterna anaethetus*	Vagrant	Null	Least Concern	
Brimstone Canary	*Crithagra sulphuratus*	Resident	Null	Least Concern	
Broad-billed Prion	*Pachyptila vittata*	Pelagic	Null	Least Concern	
Broad-billed Sandpiper	*Limicola falcinellus*	Vagrant	Null	Least Concern	
Bronze-winged Courser	*Rhinoptilus chalcopterus*	Vagrant	Null	Least Concern	
Brown Booby	*Sula leucogaster*	Vagrant	Null	Least Concern	
Brown Noddy	*Anous stolidus*	Vagrant	Null	Least Concern	
Brown Snake-Eagle	*Circaetus cinereus*	Vagrant	Null	Least Concern	II
Brown-backed Honeybird	*Prodotiscus regulus*	Resident	Null	Least Concern	
Brown-hooded Kingfisher	*Halcyon albiventris*	Resident	Null	Least Concern	
Brown-throated Martin	*Riparia paludicola*	Migrant	Null	Least Concern	
Buff-breasted Sandpiper	*Tryngites subruficollis*	Vagrant	Null	Near Threatened	
Buff-spotted Flufftail	*Sarothrura elegans*	Resident	Null	Least Concern	
Buffy Pipit	*Anthus vaalensis*	Vagrant	Null	Least Concern	
Buller's Albatross	*Thalassarche bulleri*	Pelagic	Null	Near Threatened	
Bulwer's Petrel	*Bulweria bulwerii*	Pelagic	Null	Least Concern	
Burchell's Coucal	*Centropus burchellii*	Resident	Null	Least Concern	
Burchell's Courser	*Cursorius rufus*	Resident	Null	Least Concern	
Cape Batis	*Batis capensis*	Resident	Null	Least Concern	
Cape Bulbul	*Pycnonotus capensis*	Resident	Null	Least Concern	
Cape Bunting	*Emberiza capensis*	Resident	Null	Least Concern	

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Cape Canary	*Serinus canicollis*	Resident	Null	Least Concern	
Cape Clapper Lark	*Mirafra apiata*	Resident	Null	Least Concern	
Cape Cormorant	*Phalacrocorax capensis*	Resident	Near Threatened	Near Threatened	
Cape Crow	*Corvus capensis*	Resident	Null	Least Concern	
Cape Eagle-Owl	*Bubo capensis*	Resident	Null	Least Concern	II
Cape Gannet	*Morus capensis*	Resident	Vulnerable	Vulnerable	
Cape Glossy Starling	*Lamprotornis nitens*	Resident	Null	Least Concern	
Cape Grassbird	*Sphenoeacus afer*	Resident	Null	Least Concern	
Cape Long-billed Lark	*Certhilauda curvirostris*	Resident	Null	Least Concern	
Cape Longclaw	*Macronyx capensis*	Resident	Null	Least Concern	
Cape Parrot	*Poicephalus robustus*	Regionally Extinct	Endangered	Least Concern	II
Cape Penduline-Tit	*Anthoscopus minutus*	Resident	Null	Least Concern	
Cape Robin-Chat	*Cossypha caffra*	Resident	Null	Least Concern	
Cape Rock-jumper	*Chaetops frenatus*	Resident	Null	Least Concern	
Cape Rock-Thrush	*Monticola rupestris*	Resident	Null	Least Concern	
Cape Shoveler	*Anas smithii*	Resident	Null	Least Concern	
Cape Siskin	*Crithagra totta*	Resident	Null	Least Concern	
Cape Sparrow	*Passer melanurus*	Resident	Null	Least Concern	
Cape Spurfowl	*Pternistis capensis*	Resident	Null	Least Concern	
Cape Sugarbird	*Promerops cafer*	Resident	Null	Least Concern	
Cape Teal	*Anas capensis*	Resident	Null	Least Concern	
Cape Turtle-Dove	*Streptopelia capicola*	Resident	Null	Least Concern	
Cape Vulture	*Gyps coprotheres*	Resident	Vulnerable	Vulnerable	II
Cape Wagtail	*Motacilla capensis*	Resident	Null	Least Concern	
Cape Weaver	*Ploceus capensis*	Resident	Null	Least Concern	
Cape White-eye	*Zosterops virens*	Resident	Null	Not Recognised	
Capped Wheatear	*Oenanthe pileata*	Resident	Null	Least Concern	
Cardinal Woodpecker	*Dendropicos fuscescens*	Resident	Null	Least Concern	
Caspian Plover	*Charadrius asiaticus*	Vagrant	Null	Least Concern	
Caspian Tern	*Sterna caspia*	Resident	Near Threatened	Least Concern	
Cattle Egret	*Bubulcus ibis*	Resident	Null	Least Concern	
Chat Flycatcher	*Bradornis infuscatus*	Resident	Null	Least Concern	
Chatham Albatross	*Thalassarche eremita*	Pelagic	Null	Vulnerable	
Chestnut-banded Plover	*Charadrius pallidus*	Resident	Near Threatened	Near Threatened	
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	Resident	Null	Least Concern	
Chorister Robin-Chat	*Cossypha dichroa*	Resident	Null	Least Concern	
Chukar Partridge	*Alectoris chukar*	Exotic	Null	Least Concern	
Cinnamon-breasted Bunting	*Emberiza tahapisi*	Vagrant	Null	Least Concern	
Cinnamon-breasted Warbler	*Euryptila subcinnamomea*	Resident	Null	Least Concern	
Citrine Wagtail	*Motacilla citreola*	Vagrant	Null	Least Concern	
Cloud Cisticola	*Cisticola textrix*	Resident	Null	Least Concern	
Collared Pratincole	*Glareola pratincola*	Vagrant	Near Threatened	Least Concern	
Collared Sunbird	*Hedydipna collaris*	Resident	Null	Least Concern	
Comb Duck	*Sarkidiornis melanotos*	Vagrant	Null	Least Concern	II
Common Black-headed Gull	*Larus ridibundus*	Vagrant	Null	Least Concern	

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Common Chaffinch	*Fringilla coelebs*	Exotic	Null	Least Concern	
Common Cuckoo	*Cuculus canorus*	Vagrant	Null	Least Concern	
Common Fiscal	*Lanius collaris*	Resident	Null	Least Concern	
Common Greenshank	*Tringa nebularia*	Migrant	Null	Least Concern	
Common House-Martin	*Delichon urbicum*	Migrant	Null	Least Concern	
Common Moorhen	*Gallinula chloropus*	Resident	Null	Least Concern	
Common Myna	*Acridotheres tristis*	Exotic	Null	Least Concern	
Common Ostrich	*Struthio camelus*	Resident	Null	Least Concern	
Common Quail	*Coturnix coturnix*	Migrant	Null	Least Concern	
Common Redshank	*Tringa totanus*	Migrant	Null	Least Concern	
Common Ringed Plover	*Charadrius hiaticula*	Migrant	Null	Least Concern	
Common Sandpiper	*Actitis hypoleucos*	Migrant	Null	Least Concern	
Common Scimitarbill	*Rhinopomastus cyanomelas*	Vagrant	Null	Least Concern	
Common Starling	*Sturnus vulgaris*	Exotic	Null	Least Concern	
Common Swift	*Apus apus*	Migrant	Null	Least Concern	
Common Tern	*Sterna hirundo*	Migrant	Null	Least Concern	
Common Waxbill	*Estrilda astrild*	Resident	Null	Least Concern	
Common Whimbrel	*Numenius phaeopus*	Migrant	Null	Least Concern	
Corn Crake	*Crex crex*	Vagrant	Null	Least Concern	
Cory's Shearwater	*Calonectris diomedea*	Pelagic	Null	Least Concern	
Crab Plover	*Dromas ardeola*	Vagrant	Null	Least Concern	
Crested Barbet	*Trachyphonus vaillantii*	Vagrant	Null	Least Concern	
Crowned Cormorant	*Phalacrocorax coronatus*	Resident	Near Threatened	Near Threatened	
Crowned Hornbill	*Tockus alboterminatus*	Vagrant	Null	Least Concern	
Crowned Lapwing	*Vanellus coronatus*	Resident	Null	Least Concern	
Curlew Sandpiper	*Calidris ferruginea*	Migrant	Null	Least Concern	
Damara Tern	*Sterna balaenarum*	Migrant	Endangered	Near Threatened	
Dark-backed Weaver	*Ploceus bicolor*	Southern Extremity	Null	Least Concern	
Dark-capped Bulbul	*Pycnonotus tricolor*	Vagrant	Null	Near Threatened	
Denham's Bustard	*Neotis denhami*	Resident	Vulnerable	Near Threatened	II
Desert Cisticola	*Cisticola aridulus*	Southern Extremity	Null	Least Concern	
Diderick Cuckoo	*Chrysococcyx caprius*	Migrant	Null	Least Concern	
Double-banded Courser	*Rhinoptilus africanus*	Resident	Null	Least Concern	
Drakensberg Rock-jumper	*Chaetops aurantius*	Vagrant	Null	Least Concern	
Dunlin	*Calidris alpina*	Vagrant	Null	Least Concern	
Dusky Indigobird	*Vidua funerea*	Vagrant	Null	Least Concern	
Dusky Sunbird	*Cinnyris fuscus*	Resident	Null	Least Concern	
Dwarf Bittern	*Ixobrychus sturmii*	Vagrant	Null	Least Concern	
Eastern Clapper Lark	*Mirafra fasciolata*	Vagrant	Null	Not Recognised	
Eastern Long-billed Lark	*Certhilauda semitorquata*	Southern Extremity	Null	Least Concern	
Egyptian Goose	*Alopochen aegyptiacus*	Resident	Null	Least Concern	
Egyptian Vulture	*Neophron percnopterus*	Regionally Extinct	Regionally Extinct	Endangered	II
Elegant Tern	*Sterna elegans*	Vagrant	Null	Near Threatened	

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Eleonora's Falcon	*Falco eleonorae*	Vagrant	Null	Least Concern	II
Emerald-spotted Wood-Dove	*Turtur chalcospilos*	Vagrant	Null	Least Concern	
Eurasian Bittern	*Botaurus stellaris*	Vagrant	Critically Endangered	Least Concern	
Eurasian Curlew	*Numenius arquata*	Migrant	Null	Near Threatened	
Eurasian Golden Oriole	*Oriolus oriolus*	Migrant	Null	Least Concern	
Eurasian Hobby	*Falco subbuteo*	Migrant	Null	Least Concern	II
Eurasian Oystercatcher	*Haematopus ostralegus*	Vagrant	Null	Least Concern	
European Bee-eater	*Merops apiaster*	Migrant	Null	Least Concern	
European Honey-Buzzard	*Pernis apivorus*	Migrant	Null	Least Concern	II
European Nightjar	*Caprimulgus europaeus*	Vagrant	Null	Least Concern	
European Roller	*Coracias garrulus*	Migrant	Null	Near Threatened	
European Storm-Petrel	*Hydrobates pelagicus*	Pelagic	Null	Least Concern	
Fairy Flycatcher	*Stenostira scita*	Resident	Null	Least Concern	
Fairy Prion	*Pachyptila turtur*	Pelagic	Null	Least Concern	
Familiar Chat	*Cercomela familiaris*	Resident	Null	Least Concern	
Fiery-necked Nightjar	*Caprimulgus pectoralis*	Resident	Null	Least Concern	
Fiscal Flycatcher	*Sigelus silens*	Resident	Null	Least Concern	
Flesh-footed Shearwater	*Puffinus carneipes*	Pelagic	Null	Least Concern	
Forest Buzzard	*Buteo trizonatus*	Resident	Null	Least Concern	II
Forest Canary	*Crithagra scotops*	Resident	Null	Least Concern	
Fork-tailed Drongo	*Dicrurus adsimilis*	Resident	Null	Least Concern	
Franklin's Gull	*Larus pipixcan*	Vagrant	Null	Least Concern	
Freckled Nightjar	*Caprimulgus tristigma*	Resident	Null	Least Concern	
Fulvous Duck	*Dendrocygna bicolor*	Vagrant	Null	Least Concern	
Gabar Goshawk	*Melierax gabar*	Resident	Null	Least Concern	II
Garden Warbler	*Sylvia borin*	Vagrant	Null	Least Concern	
Garganey	*Anas querquedula*	Vagrant	Null	Least Concern	
Gentoo Penguin	*Pygoscelis papua*	Vagrant	Near Threatened	Least Concern	
Giant Kingfisher	*Megaceryle maximus*	Resident	Null	Least Concern	
Glossy Ibis	*Plegadis falcinellus*	Resident	Null	Least Concern	
Golden-breasted Bunting	*Emberiza flaviventris*	Southern Extremity	Null	Least Concern	
Goliath Heron	*Ardea goliath*	Vagrant	Null	Least Concern	II
Great Crested Grebe	*Podiceps cristatus*	Resident	Null	Least Concern	
Great Egret	*Egretta alba*	Resident	Null	Least Concern	
Great Knot	*Calidris tenuirostris*	Vagrant	Null	Least Concern	
Great Reed-Warbler	*Acrocephalus arundinaceus*	Vagrant	Null	Least Concern	
Great Shearwater	*Puffinus gravis*	Pelagic	Null	Least Concern	
Great Spotted Cuckoo	*Clamator glandarius*	Migrant	Null	Least Concern	
Great White Pelican	*Pelecanus onocrotalus*	Resident	Near Threatened	Least Concern	
Greater Double-collared Sunbird	*Cinnyris afer*	Resident	Null	Least Concern	
Greater Flamingo	*Phoenicopterus ruber*	Resident	Near Threatened	Least Concern	II
Greater Frigatebird	*Fregata minor*	Pelagic	Null	Least Concern	
Greater Honeyguide	*Indicator indicator*	Resident	Null	Least Concern	
Greater Kestrel	*Falco rupicoloides*	Resident	Null	Least Concern	II

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Greater Painted-snipe	*Rostratula benghalensis*	Resident	Near Threatened	Least Concern	
Greater Sand Plover	*Charadrius leschenaultii*	Migrant	Null	Least Concern	
Greater Sheathbill	*Chionis albus*	Vagrant	Null	Least Concern	
Greater Striped Swallow	*Hirundo cucullata*	Migrant	Null	Least Concern	
Greater Yellowlegs	*Tringa melanoleuca*	Vagrant	Null	Least Concern	
Great-winged Petrel	*Pterodroma macroptera*	Pelagic	Null	Least Concern	
Green Sandpiper	*Tringa ochropus*	Vagrant	Null	Least Concern	
Green Wood-Hoopoe	*Phoeniculus purpureus*	Resident	Null	Least Concern	
Green-backed Camaroptera	*Camaroptera brachyura*	Resident	Null	Least Concern	
Green-backed Heron	*Butorides striata*	Vagrant	Null	Least Concern	
Grey Crowned Crane	*Balearica regulorum*	Vagrant	Vulnerable	Vulnerable	II
Grey Cuckooshrike	*Coracina caesia*	Resident	Null	Least Concern	
Grey Heron	*Ardea cinerea*	Resident	Null	Least Concern	
Grey Petrel	*Procellaria cinerea*	Pelagic	Near Threatened	Near Threatened	
Grey Plover	*Pluvialis squatarola*	Migrant	Null	Least Concern	
Grey Sunbird	*Cyanomitra veroxii*	Vagrant	Null	Least Concern	
Grey Tit	*Parus afer*	Resident	Null	Least Concern	
Grey Wagtail	*Motacilla cinerea*	Vagrant	Null	Least Concern	
Grey-backed Camaroptera	*Camaroptera brevicaudata*	Vagrant	Null	Not Evaluated	
Grey-backed Cisticola	*Cisticola subruficapilla*	Resident	Null	Least Concern	
Grey-backed Sparrowlark	*Eremopterix verticalis*	Resident	Null	Least Concern	
Grey-backed Storm Petrel	*Garrodia nereis*	Pelagic	Null	Least Concern	
Grey-headed Albatross	*Thalassarche chrysostoma*	Pelagic	Vulnerable	Vulnerable	
Grey-headed Gull	*Larus cirrocephalus*	Resident	Null	Least Concern	
Grey-headed Kingfisher	*Halcyon leucocephala*	Vagrant	Null	Least Concern	
Grey-winged Francolin	*Scleroptila africanus*	Resident	Null	Least Concern	
Ground Woodpecker	*Geocolaptes olivaceus*	Resident	Null	Least Concern	
Groundscraper Thrush	*Psophocichla litsitsirupa*	Vagrant	Null	Least Concern	
Gull-billed Tern	*Sterna nilotica*	Vagrant	Null	Least Concern	
Hadeda Ibis	*Bostrychia hagedash*	Resident	Null	Least Concern	
Half-collared Kingfisher	*Alcedo semitorquata*	Resident	Near Threatened	Least Concern	
Hamerkop	*Scopus umbretta*	Resident	Null	Least Concern	
Harlequin Quail	*Coturnix delegorguei*	Vagrant	Null	Least Concern	
Hartlaub's Gull	*Larus hartlaubii*	Resident	Null	Least Concern	
Helmeted Guineafowl	*Numida meleagris*	Resident	Null	Least Concern	
Horus Swift	*Apus horus*	Migrant	Null	Least Concern	
Hottentot Buttonquail	*Turnix hottentottus*	Resident	Null	Least Concern	
Hottentot Teal	*Anas hottentota*	Resident	Null	Least Concern	
House Crow	*Corvus splendens*	Exotic	Null	Least Concern	
House Sparrow	*Passer domesticus*	Exotic	Null	Least Concern	
Hudsonian Godwit	*Limosa haemastica*	Vagrant	Null	Least Concern	
Icterine Warbler	*Hippolais icterina*	Vagrant	Null	Least Concern	
Indian Peafowl	*Pavo cristatus*	Exotic	Null	Least Concern	
Indian Yellow-nosed Albatross	*Thalassarche carteri*	Pelagic	Vulnerable	Endangered	
Jackal Buzzard	*Buteo rufofuscus*	Resident	Null	Least Concern	II

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Jacobin Cuckoo	*Clamator jacobinus*	Migrant	Null	Least Concern	
Karoo Chat	*Cercomela schlegelii*	Resident	Null	Least Concern	
Karoo Eremomela	*Eremomela gregalis*	Resident	Null	Least Concern	
Karoo Korhaan	*Eupodotis vigorsii*	Resident	Null	Least Concern	II
Karoo Lark	*Calendulauda albescens*	Resident	Null	Least Concern	
Karoo Long-billed Lark	*Certhilauda subcoronata*	Resident	Null	Least Concern	
Karoo Prinia	*Prinia maculosa*	Resident	Null	Least Concern	
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	Resident	Null	Least Concern	
Karoo Thrush	*Turdus smithi*	Resident	Null	Not Recognised	
Kelp Gull	*Larus dominicanus*	Resident	Null	Least Concern	
Kentish Plover	*Charadrius alexandrinus*	Vagrant	Null	Least Concern	
Kerguelen Petrel	*Lugensa brevirostris*	Pelagic	Null	Least Concern	
King Penguin	*Aptenodytes patagonicus*	Vagrant	Null	Least Concern	
Kittlitz's Plover	*Charadrius pecuarius*	Resident	Null	Least Concern	
Klaas's Cuckoo	*Chrysococcyx klaas*	Migrant	Null	Least Concern	
Knysna Turaco	*Tauraco corythaix*	Resident	Null	Least Concern	II
Knysna Warbler	*Bradypterus sylvaticus*	Resident	Vulnerable	Vulnerable	
Knysna Woodpecker	*Campethera notata*	Resident	Near Threatened	Near Threatened	
Kori Bustard	*Ardeotis kori*	Southern Extremity	Vulnerable	Least Concern	II
Kurrichane Buttonquail	*Turnix sylvaticus*	Vagrant	Null	Least Concern	
Lanner Falcon	*Falco biarmicus*	Resident	Near Threatened	Least Concern	II
Lappet-faced Vulture	*Aegypius tracheliotos*	Regionally Extinct	Vulnerable	Vulnerable	II
Large-billed Lark	*Galerida magnirostris*	Resident	Null	Least Concern	
Lark-like Bunting	*Emberiza impetuani*	Resident	Null	Least Concern	
Laughing Dove	*Streptopelia senegalensis*	Resident	Null	Least Concern	
Layard's Tit-Babbler	*Parisoma layardi*	Resident	Null	Least Concern	
Lazy Cisticola	*Cisticola aberrans*	Vagrant	Null	Least Concern	
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Pelagic	Null	Least Concern	
Lemon Dove	*Aplopelia larvata*	Resident	Null	Least Concern	
Lesser Black-backed Gull	*Larus fuscus*	Vagrant	Null	Least Concern	
Lesser Crested Tern	*Sterna bengalensis*	Vagrant	Null	Least Concern	
Lesser Flamingo	*Phoenicopterus minor*	Migrant	Near Threatened	Near Threatened	II
Lesser Grey Shrike	*Lanius minor*	Vagrant	Null	Least Concern	
Lesser Honeyguide	*Indicator minor*	Resident	Null	Least Concern	
Lesser Kestrel	*Falco naumanni*	Migrant	Vulnerable	Least Concern	II
Lesser Moorhen	*Gallinula angulata*	Vagrant	Null	Least Concern	
Lesser Sand Plover	*Charadrius mongolus*	Vagrant	Null	Least Concern	
Lesser Spotted Eagle	*Aquila pomarina*	Vagrant	Null	Least Concern	II
Lesser Striped Swallow	*Hirundo abyssinica*	Vagrant	Null	Least Concern	
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	Resident	Null	Least Concern	
Lesser Yellowlegs	*Tringa flavipes*	Vagrant	Null	Least Concern	
Levaillant's Cisticola	*Cisticola tinniens*	Resident	Null	Least Concern	
Light-mantled Albatross	*Phoebetria palpebrata*	Pelagic	Near Threatened	Near Threatened	
Lilac-breasted Roller	*Coracias caudatus*	Vagrant	Null	Least Concern	

English Name	*Scientific Name*	Western Cape Status	South African Conservation Status	IUCN Conservation Status	CITES
Little Bee-eater	*Merops pusillus*	Vagrant	Null	Least Concern	
Little Bittern	*Ixobrychus minutus*	Resident	Null	Least Concern	
Little Blue Heron	*Egretta caerulea*	Vagrant	Null	Least Concern	
Little Crake	*Porzana parva*	Vagrant	Null	Least Concern	
Little Egret	*Egretta garzetta*	Resident	Null	Least Concern	
Little Grebe	*Tachybaptus ruficollis*	Resident	Null	Least Concern	
Little Rush-Warbler	*Bradypterus baboecala*	Resident	Null	Least Concern	
Little Shearwater	*Puffinus assimilis*	Pelagic	Null	Least Concern	
Little Sparrowhawk	*Accipiter minullus*	Resident	Null	Least Concern	II
Little Stint	*Calidris minuta*	Migrant	Null	Least Concern	
Little Swift	*Apus affinis*	Resident	Null	Least Concern	
Little Tern	*Sterna albifrons*	Migrant	Null	Least Concern	
Livingstone's Turaco	*Tauraco livingstonii*	Escape	Null	Least Concern	
Long-billed Crombec	*Sylvietta rufescens*	Resident	Null	Least Concern	
Long-billed Pipit	*Anthus similis*	Resident	Null	Least Concern	
Long-crested Eagle	*Lophaetus occipitalis*	Vagrant	Null	Least Concern	II
Long-tailed Jaeger	*Stercorarius longicaudus*	Pelagic	Null	Least Concern	
Long-tailed Paradise-Whydah	*Vidua paradisaea*	Escape	Null	Least Concern	
Ludwig's Bustard	*Neotis ludwigii*	Resident	Vulnerable	Endangered	II
Macaroni Penguin	*Eudyptes chrysolophus*	Vagrant	Near Threatened	Vulnerable	
Maccoa Duck	*Oxyura maccoa*	Resident	Null	Near Threatened	
Magellanic Penguin	*Spheniscus magellanicus*	Vagrant	Null	Near Threatened	
Malachite Kingfisher	*Alcedo cristata*	Resident	Null	Least Concern	
Malachite Sunbird	*Nectarinia famosa*	Resident	Null	Least Concern	
Mallard Duck	*Anas platyrhynchos*	Exotic	Null	Least Concern	
Mangrove Kingfisher	*Halcyon senegaloides*	Vagrant	Null	Least Concern	
Manx Shearwater	*Puffinus puffinus*	Pelagic	Null	Least Concern	
Marabou Stork	*Leptoptilos crumeniferus*	Vagrant	Near Threatened	Least Concern	
Marsh Owl	*Asio capensis*	Resident	Null	Least Concern	II
Marsh Sandpiper	*Tringa stagnatilis*	Migrant	Null	Least Concern	
Marsh Warbler	*Acrocephalus palustris*	Vagrant	Null	Least Concern	
Martial Eagle	*Polemaetus bellicosus*	Resident	Vulnerable	Near Threatened	II
Matsudaira's Storm Petrel	*Oceanodroma matsudairae*	Vagrant	Null	Data Deficient	
Mocking Cliff-Chat	*Thamnolaea cinnamomeiventris*	Vagrant	Null	Least Concern	
Montagu's Harrier	*Circus pygargus*	Vagrant	Near Threatened	Least Concern	II
Mountain Wheatear	*Oenanthe monticola*	Resident	Null	Least Concern	
Mute Swan	*Cygnus olor*	Exotic	Null	Least Concern	
Namaqua Dove	*Oena capensis*	Resident	Null	Least Concern	
Namaqua Sandgrouse	*Pterocles namaqua*	Resident	Null	Least Concern	
Namaqua Warbler	*Phragmacia substriata*	Resident	Null	Least Concern	
Narina Trogon	*Apaloderma narina*	Resident	Null	Least Concern	
Neddicky	*Cisticola fulvicapilla*	Resident	Null	Least Concern	
Northern Black Korhaan	*Afrotis afraoides*	Southern Extremity	Null	Not Evaluated	II
Northern Giant-Petrel	*Macronectes halli*	Pelagic	Near Threatened	Least Concern	

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Northern Rockhopper Penguin	*Eudyptes moseleyi*	Vagrant	Null	Endangered	
Northern Royal Albatros	*Diomedea sanfordi*	Pelagic	Null	Endangered	
Northern Shoveller	*Anas clypeata*	Vagrant	Null	Least Concern	
Olive Bush-Shrike	*Telophorus olivaceus*	Resident	Null	Least Concern	
Olive Thrush	*Turdus olivaceus*	Resident	Null	Least Concern	
Olive Woodpecker	*Dendropicos griseocephalus*	Resident	Null	Least Concern	
Orange River White-eye	*Zosterops pallidus*	Resident	Null	Least Concern	
Orange-breasted Sunbird	*Anthobaphes violacea*	Resident	Null	Least Concern	
Osprey	*Pandion haliaetus*	Migrant	Null	Least Concern	II
Pacific Golden Plover	*Pluvialis fulva*	Vagrant	Null	Least Concern	
Pale-winged Starling	*Onychognathus nabouroup*	Resident	Null	Least Concern	
Pallid Harrier	*Circus macrourus*	Vagrant	Near Threatened	Near Threatened	II
Pallid Swift	*Apus pallidus*	Vagrant	Null	Least Concern	
Palm-nut Vulture	*Gypohierax angolensis*	Vagrant	Null	Least Concern	II
Parasitic Jaeger	*Stercorarius parasiticus*	Pelagic	Null	Least Concern	
Pearl-breasted Swallow	*Hirundo dimidiata*	Migrant	Null	Least Concern	
Pectoral Sandpiper	*Calidris melanotos*	Vagrant	Null	Least Concern	
Peregrine Falcon	*Falco peregrinus*	Resident	Near Threatened	Least Concern	I
Pied Avocet	*Recurvirostra avosetta*	Resident	Null	Least Concern	
Pied Crow	*Corvus albus*	Resident	Null	Least Concern	
Pied Kingfisher	*Ceryle rudis*	Resident	Null	Least Concern	
Pied Starling	*Spreo bicolor*	Resident	Null	Least Concern	
Pink-backed Pelican	*Pelecanus rufescens*	Vagrant	Null	Least Concern	
Pink-billed Lark	*Spizocorys conirostris*	Vagrant	Null	Least Concern	
Pintado Petrel	*Daption capense*	Pelagic	Null	Least Concern	
Pin-tailed Whydah	*Vidua macroura*	Resident	Null	Least Concern	
Plain-backed Pipit	*Anthus leucophrys*	Resident	Null	Least Concern	
Pomarine Jaeger	*Stercorarius pomarinus*	Pelagic	Null	Least Concern	
Pririt Batis	*Batis pririt*	Resident	Null	Least Concern	
Protea Seedeater	*Crithagra leucopterus*	Resident	Null	Least Concern	
Purple Heron	*Ardea purpurea*	Resident	Null	Least Concern	
Purple Indigobird	*Vidua purpurascens*	Escape	Null	Least Concern	
Red Knot	*Calidris canutus*	Migrant	Null	Least Concern	
Red Lark	*Calendulauda burra*	Vagrant	Vulnerable	Vulnerable	
Red Phalarope	*Phalaropus fulicaria*	Vagrant	Null	Least Concern	
Red-backed Shrike	*Lanius collurio*	Vagrant	Null	Least Concern	
Red-billed Firefinch	*Lagonosticta senegala*	Southern Extremity	Null	Least Concern	
Red-billed Oxpecker	*Buphagus erythrorhynchus*	Vagrant	Null	Least Concern	
Red-billed Quelea	*Quelea quelea*	Southern Extremity	Null	Least Concern	
Red-billed Teal	*Anas erythrorhyncha*	Resident	Null	Least Concern	
Red-billed Tropicbird	*Phaethon aethereus*	Vagrant	Null	Least Concern	
Red-capped Lark	*Calandrella cinerea*	Resident	Null	Least Concern	
Red-chested Cuckoo	*Cuculus solitarius*	Migrant	Null	Least Concern	
Red-chested Flufftail	*Sarothrura rufa*	Resident	Null	Least Concern	

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Red-eyed Dove	*Streptopelia semitorquata*	Resident	Null	Least Concern	
Red-faced Mousebird	*Urocolius indicus*	Resident	Null	Least Concern	
Red-footed Booby	*Sula sula*	Vagrant	Null	Least Concern	
Red-footed Falcon	*Falco vespertinus*	Vagrant	Null	Near Threatened	II
Red-fronted Tinkerbird	*Pogoniulus pusillus*	Vagrant	Null	Least Concern	
Red-headed Finch	*Amadina erythrocephala*	Vagrant	Null	Least Concern	
Red-knobbed Coot	*Fulica cristata*	Resident	Null	Least Concern	
Red-necked Phalarope	*Phalaropus lobatus*	Vagrant	Null	Least Concern	
Red-necked Spurfowl	*Pternistis afer*	Resident	Null	Least Concern	
Red-necked Stint	*Calidris ruficollis*	Vagrant	Null	Least Concern	
Red-rumped Swallow	*Hirundo daurica*	Vagrant	Null	Least Concern	
Red-tailed Tropicbird	*Phaethon rubricauda*	Pelagic	Null	Least Concern	
Red-throated Wryneck	*Jynx ruficollis*	Vagrant	Null	Least Concern	
Red-winged Francolin	*Scleroptila levaillantii*	Resident	Null	Least Concern	
Red-winged Starling	*Onychognathus morio*	Resident	Null	Least Concern	
Reed Cormorant	*Phalacrocorax africanus*	Resident	Null	Least Concern	
Rock Dove	*Columba livia*	Exotic	Null	Least Concern	
Rock Kestrel	*Falco rupicolus*	Resident	Null	Least Concern	II
Rock Martin	*Hirundo fuligula*	Resident	Null	Least Concern	
Rockhopper Penguin	*Eudyptes chrysocome*	Vagrant	Near Threatened	Vulnerable	
Roseate Tern	*Sterna dougallii*	Resident	Endangered	Least Concern	
Ruddy Turnstone	*Arenaria interpres*	Migrant	Null	Least Concern	
Ruff	*Philomachus pugnax*	Migrant	Null	Least Concern	
Rufous-cheeked Nightjar	*Caprimulgus rufigena*	Migrant	Null	Least Concern	
Rufous-chested Sparrowhawk	*Accipiter rufiventris*	Resident	Null	Least Concern	II
Rufous-eared Warbler	*Malcorus pectoralis*	Resident	Null	Least Concern	
Sabine's Gull	*Larus sabini*	Migrant	Null	Least Concern	
Sabota Lark	*Calendulauda sabota*	Southern Extremity	Null	Least Concern	
Salvin's Albatross	*Thalassarche salvini*	Pelagic	Null	Vulnerable	
Salvin's Prion	*Pachyptila salvini*	Pelagic	Null	Least Concern	
Sand Martin	*Riparia riparia*	Migrant	Null	Least Concern	
Sanderling	*Calidris alba*	Migrant	Null	Least Concern	
Sandwich Tern	*Sterna sandvicensis*	Migrant	Null	Least Concern	
Scaly-feathered Finch	*Sporopipes squamifrons*	Resident	Null	Least Concern	
Scaly-throated Honeyguide	*Indicator variegatus*	Resident	Null	Least Concern	
Sclater's Lark	*Spizocorys sclateri*	Resident	Near Threatened	Near Threatened	
Secretarybird	*Sagittarius serpentarius*	Resident	Near Threatened	Vulnerable	II
Sedge Warbler	*Acrocephalus schoenobaenus*	Vagrant	Null	Least Concern	
Sentinel Rock-Thrush	*Monticola explorator*	Resident	Null	Least Concern	
Shaft-tailed Whydah	*Vidua regia*	Vagrant	Null	Least Concern	
Short-toed Rock-Thrush	*Monticola brevipes*	Resident	Null	Least Concern	
Shy Albatross	*Thalassarche cauta*	Pelagic	Vulnerable	Near Threatened	
Sickle-winged Chat	*Cercomela sinuata*	Resident	Null	Least Concern	
Slender-billed Prion	*Pachyptila belcheri*	Pelagic	Null	Least Concern	
Snowy Egret	*Egretta thula*	Vagrant	Null	Least Concern	

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Soft-plumaged Petrel	*Pterodroma mollis*	Pelagic	Null	Least Concern	
Sombre Greenbul	*Andropadus importunus*	Resident	Null	Least Concern	
Sooty Albatross	*Phoebetria fusca*	Pelagic	Near Threatened	Endangered	
Sooty Falcon	*Falco concolor*	Vagrant	Null	Near Threatened	II
Sooty Shearwater	*Puffinus griseus*	Pelagic	Null	Near Threatened	
Sooty Tern	*Sterna fuscata*	Vagrant	Null	Least Concern	
South African Cliff-Swallow	*Hirundo spilodera*	Vagrant	Null	Least Concern	
South African Shelduck	*Tadorna cana*	Resident	Null	Least Concern	
South Polar Skua	*Catharacta maccormicki*	Pelagic	Null	Least Concern	
Southern Bald Ibis	*Geronticus calvus*	Regionally Extinct	Vulnerable	Vulnerable	II
Southern Black Korhaan	*Afrotis afra*	Resident	Null	Not Evaluated	II
Southern Black Tit	*Parus niger*	Vagrant	Null	Least Concern	
Southern Boubou	*Laniarius ferrugineus*	Resident	Null	Least Concern	
Southern Carmine Bee-eater	*Merops nubicoides*	Vagrant	Null	Least Concern	
Southern Double-collared Sunbird	*Cinnyris chalybeus*	Resident	Null	Least Concern	
Southern Fulmar	*Fulmarus glacialoides*	Pelagic	Null	Least Concern	
Southern Giant-Petrel	*Macronectes giganteus*	Pelagic	Near Threatened	Least Concern	
Southern Grey-headed Sparrow	*Passer diffusus*	Resident	Null	Least Concern	
Southern Masked-Weaver	*Ploceus velatus*	Resident	Null	Least Concern	
Southern Pale Chanting Goshawk	*Melierax canorus*	Resident	Null	Least Concern	II
Southern Pochard	*Netta erythrophthalma*	Resident	Null	Least Concern	
Southern Red Bishop	*Euplectes orix*	Resident	Null	Least Concern	
Southern Royal Albatross	*Diomedea epomophora*	Pelagic	Null	Vulnerable	
Southern Tchagra	*Tchagra tchagra*	Resident	Null	Least Concern	
Southern Yellow-billed Hornbill	*Tockus leucomelas*	Vagrant	Null	Least Concern	
Speckled Mousebird	*Colius striatus*	Resident	Null	Least Concern	
Speckled Pigeon	*Columba guinea*	Resident	Null	Least Concern	
Spectacled Petrel	*Procellaria conspicillata*	Pelagic	Endangered	Vulnerable	
Spectacled Weaver	*Ploceus ocularis*	Vagrant	Null	Least Concern	
Spike-heeled Lark	*Chersomanes albofasciata*	Resident	Null	Least Concern	
Spotted Crake	*Porzana porzana*	Vagrant	Null	Least Concern	
Spotted Eagle-Owl	*Bubo africanus*	Resident	Null	Least Concern	II
Spotted Flycatcher	*Muscicapa striata*	Migrant	Null	Least Concern	
Spotted Thick-knee	*Burhinus capensis*	Resident	Null	Least Concern	
Spur-winged Goose	*Plectropterus gambensis*	Resident	Null	Least Concern	
Squacco Heron	*Ardeola ralloides*	Vagrant	Null	Least Concern	
Steppe Buzzard	*Buteo vulpinus*	Migrant	Null	Least Concern	II
Steppe Eagle	*Aquila nipalensis*	Vagrant	Null	Least Concern	II
Streaked Shearwater	*Calonectris leucomelas*	Pelagic	Null	Least Concern	
Streaky-headed Seedeater	*Crithagra gularis*	Resident	Null	Least Concern	
Striped Flufftail	*Sarothrura affinis*	Resident	Vulnerable	Least Concern	
Subantarctic Skua	*Catharacta antarctica*	Pelagic	Null	Least Concern	
Swallow-tailed Bee-eater	*Merops hirundineus*	Vagrant	Null	Least Concern	
Swee Waxbill	*Coccopygia melanotis*	Resident	Null	Least Concern	
Swift Tern	*Sterna bergii*	Resident	Null	Least Concern	

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Tambourine Dove	*Turtur tympanistria*	Resident	Null	Least Concern	
Tawny Eagle	*Aquila rapax*	Vagrant	Vulnerable	Least Concern	II
Tawny-flanked Prinia	*Prinia subflava*	Vagrant	Null	Least Concern	
Temminck's Courser	*Cursorius temminckii*	Vagrant	Null	Least Concern	
Terek Sandpiper	*Xenus cinereus*	Migrant	Null	Least Concern	
Terrestrial Brownbul	*Phyllastrephus terrestris*	Resident	Null	Least Concern	
Thick-billed Weaver	*Amblyospiza albifrons*	Vagrant	Null	Least Concern	
Three-banded Plover	*Charadrius tricollaris*	Resident	Null	Least Concern	
Tractrac Chat	*Cercomela tractrac*	Resident	Null	Least Concern	
Tristan Albatross	*Diomedea dabbenena*	Pelagic	Endangered	Critically Endangered	
Verreaux's Eagle	*Aquila verreauxii*	Resident	Null	Least Concern	II
Verreaux's Eagle-Owl	*Bubo lacteus*	Resident	Null	Least Concern	II
Victorin's Warbler	*Cryptillas victorini*	Resident	Null	Least Concern	
Village Indigobird	*Vidua chalybeata*	Vagrant	Null	Least Concern	
Violet-backed Starling	*Cinnyricinclus leucogaster*	Vagrant	Null	Least Concern	
Wahlberg's Eagle	*Aquila wahlbergi*	Vagrant	Null	Least Concern	II
Wailing Cisticola	*Cisticola lais*	Resident	Null	Least Concern	
Wandering Albatross	*Diomedea exulans*	Pelagic	Vulnerable	Vulnerable	
Water Thick-knee	*Burhinus vermiculatus*	Resident	Null	Least Concern	
Wattled Crane	*Bugeranus carunculatus*	Regionally Extinct	Critically Endangered	Vulnerable	II
Wattled Starling	*Creatophora cinerea*	Resident	Null	Least Concern	
Wedge-tailed Shearwater	*Puffinus pacificus*	Pelagic	Null	Least Concern	
Western Marsh Harrier	*Circus aeruginosus*	Vagrant	Null	Least Concern	II
Western Reef Heron	*Egretta gularis*	Vagrant	Null	Least Concern	
Whiskered Tern	*Chlidonias hybrida*	Migrant	Null	Least Concern	
White Stork	*Ciconia ciconia*	Migrant	Null	Least Concern	
White-backed Duck	*Thalassornis leuconotus*	Resident	Null	Least Concern	
White-backed Mousebird	*Colius colius*	Resident	Null	Least Concern	
White-backed Night-Heron	*Gorsachius leuconotus*	Vagrant	Vulnerable	Least Concern	
White-bellied Storm-Petrel	*Fregetta grallaria*	Pelagic	Null	Least Concern	
White-breasted Cormorant	*Phalacrocorax carbo*	Resident	Null	Least Concern	
White-browed Coucal	*Centropus superciliosus*	Vagrant	Null	Least Concern	
White-browed Scrub-Robin	*Cercotrichas leucophrys*	Vagrant	Null	Least Concern	
White-browed Sparrow-Weaver	*Plocepasser mahali*	Vagrant	Null	Least Concern	
White-chinned Petrel	*Procellaria aequinoctialis*	Pelagic	Near Threatened	Vulnerable	
White-faced Duck	*Dendrocygna viduata*	Resident	Null	Least Concern	
White-faced Storm-Petrel	*Pelagodroma marina*	Pelagic	Null	Least Concern	
White-fronted Bee-eater	*Merops bullockoides*	Vagrant	Null	Least Concern	
White-fronted Plover	*Charadrius marginatus*	Resident	Null	Least Concern	
White-headed Petrel	*Pterodroma lessonii*	Pelagic	Null	Least Concern	
White-necked Raven	*Corvus albicollis*	Resident	Null	Least Concern	
White-rumped Sandpiper	*Calidris fuscicollis*	Vagrant	Null	Least Concern	
White-rumped Swift	*Apus caffer*	Migrant	Null	Least Concern	
White-starred Robin	*Pogonocichla stellata*	Resident	Null	Least Concern	

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White-tailed Tropicbird	*Phaethon lepturus*	Vagrant	Null	Least Concern	
White-throated Bee-eater	*Merops albicollis*	Vagrant	Null	Least Concern	
White-throated Canary	*Crithagra albogularis*	Resident	Null	Least Concern	
White-throated Swallow	*Hirundo albigularis*	Migrant	Null	Least Concern	
White-winged Tern	*Chlidonias leucopterus*	Migrant	Null	Least Concern	
White-winged Widowbird	*Euplectes albonotatus*	Vagrant	Null	Least Concern	
Willow Warbler	*Phylloscopus trochilus*	Migrant	Null	Least Concern	
Wilson's Phalarope	*Steganopus tricolor*	Vagrant	Null	Least Concern	
Wilson's Storm-Petrel	*Oceanites oceanicus*	Pelagic	Null	Least Concern	
Wood Sandpiper	*Tringa glareola*	Migrant	Null	Least Concern	
Woolly-necked Stork	*Ciconia episcopus*	Vagrant	Null	Least Concern	
Yellow Bishop	*Euplectes capensis*	Resident	Null	Least Concern	
Yellow Canary	*Crithagra flaviventris*	Resident	Null	Least Concern	
Yellow Wagtail	*Motacilla flava*	Vagrant	Null	Least Concern	
Yellow-bellied Eremomela	*Eremomela icteropygialis*	Resident	Null	Least Concern	
Yellow-billed Duck	*Anas undulata*	Resident	Null	Least Concern	
Yellow-billed Egret	*Egretta intermedia*	Resident	Null	Least Concern	
Yellow-billed Kite	*Milvus aegyptius*	Migrant	Null	Not Recognised	II
Yellow-billed Stork	*Mycteria ibis*	Vagrant	Near Threatened	Least Concern	
Yellow-breasted Apalis	*Apalis flavida*	Vagrant	Null	Least Concern	
Yellow-crowned Bishop	*Euplectes afer*	Vagrant	Null	Least Concern	
Yellow-fronted Canary	*Crithagra mozambicus*	Vagrant	Null	Least Concern	
Yellow-throated Petronia	*Petronia superciliaris*	Vagrant	Null	Least Concern	
Yellow-throated Woodland-Warbler	*Phylloscopus ruficapilla*	Resident	Null	Least Concern	
Zitting Cisticola	*Cisticola juncidis*	Resident	Null	Least Concern	

Table 2. List of conservation priority bird species occurring within the Western Cape Province updated in 2004 (CapeNature unpubl. data).

High Priority	
African Penguin	*Spheniscus demersus*
Cape Vulture	*Gyps coprotheres*
Damara Tern	*Sterna balaenarum*
Bank Cormorant	*Phalacrocorax neglectus*
Lesser Flamingo	*Phoenicopterus minor*
Martial Eagle	*Polemaetus bellicosus*
Cape Gannet	*Morus capensis*
Crowned Cormorant	*Phalacrocorax coronatus*
African Black Oystercatcher	*Haematopus moquini*
African Grass Owl	*Tyto capensis*
African Crowned Eagle	*Stephanoaetus coronatus*
Hottentot Buttonquail	*Turnix hottentottus*
Ludwig's Bustard	*Neotis ludwigii*
Great White Pelican	*Pelecanus onocrotalus*
Greater Flamingo	*Phoenicopterus ruber*
Kori Bustard	*Ardeotis kori*
Denham's Bustard	*Neotis denhami*
Caspian Tern	*Sterna caspia*
Secretarybird	*Sagittarius serpentarius*
Striped Flufftail	*Sarothrura affinis*
Marsh Owl	*Asio capensis*
Cape Cormorant	*Phalacrocorax capensis*
Gabar Goshawk	*Melierax gabar*
Common Tern	*Sterna hirundo*
Knysna Turaco	*Tauraco corythaix*
Cape Eagle-Owl	*Bubo capensis*
Intermediate priority	
White Stork (Breeding)	*Ciconia ciconia*
African Marsh-Harrier	*Circus ranivorus*
Blue Crane	*Anthropoides paradiseus*
Baillon's Crake	*Porzana pusilla*
African Jacana	*Actophilornis africanus*
Greater Painted-Snipe	*Rostratula benghalensis*
Chestnut-Banded Plover	*Charadrius pallidus*
Eurasian Curlew	*Numenius arquata*
Antarctic Tern	*Sterna vittata*
Narina Trogon	*Apaloderma narina*
Cape Rock-Jumper	*Chaetops frenatus*
Little Sparrowhawk	*Accipiter minullus*
Red Knot	*Calidris canutus*
Ruff	*Philomachus pugnax*
Whiskered Tern	*Chilodonias hybrida*
Half-Collared Kingfisher	*Alcedo semitorquatta*
Common House-Martin	*Delichon urbicum*
Victorin's Warbler	*Cryptillas victorini*
Namaqua Warbler	*Phragmacia substriata*
Cape Sugarbird	*Promerops cafer*
Black Stork	*Ciconia nigra*
Southern Pale Chanting Goshawk	*Melierax canorus*

Intermediate priority	
Black Harrier	*Circus maurus*
Peregrine Falcon (Breeding)	*Falco peregrinus*
Peregrine Falcon (Non Breeding)	*Falco peregrinus*
Ruddy Turnstone	*Arenaria interpres*
African Snipe	*Gallinago nigripennis*
Jacobin Cuckoo	*Calamtor jacobinus*
African Emerald Cuckoo	*Chrysococcyx cupreus*
Green Wood-Hoopoe	*Phoeniculus purpureus*
Scaly-Throated Honeyguide	*Indicator variegatus*
Agulhas Long-Billed Lark	*Certhilauda brevirostris*
Starred Robin	*Pogonocichla stellata*
Green-Backed Camaroptera	*Camaroptera brachyura*

CHAPTER 8

MAMMALS

C. Birss and N. G. Palmer

Scientific Services CapeNature

CONTENTS

LEOPARD

Executive Summary

The Western Cape Province (WCP) has 172 described mammal taxa (species and subspecies). Of these, 19 are Threatened listed in the South African Red Data Book, based on regional assessments. Three are Critically Endangered, four are Endangered, ten are Vulnerable and 18 are Near Threatened. Seven of eight taxa are extant and endemic to the ECP while nine are near endemic and some taxa are considered locally Extinct in the Wild. The world-renowned plant diversity and diversity of vegetation communities of the WCP provides a diverse landscape and a variety of habitats and ecotones for which evidence suggests an associated level of speciation in other taxa, including mammals. Populations within species and subspecies may be on divergent paths which may lead to speciation and if significant adaptive differentiation is evident, management of separate evolutionary lineages for conservation purposes is appropriate. The shift in focus (back) to the conservation of genetic variation for the enablement of adaptation to environmental change, especially in relation to the diversity in habitats within the WCP, for the next five years will be supported by the current and on-going genetic research into genetic variation and differentiation. Recent analysis of IUCN Red List data highlighted invasive alien species as the third most severe threat to birds and mammals. Together with climate change, they have become one of the most difficult threats to reverse. This chapter reset the baseline for future reporting based on regional assessments and additions of species based on genetic evidence for speciation and the use of lower taxonomic ranks where the informants for conservation action and planning require such.

Introduction

Nearly one-quarter (22%) of the world's mammal species are known to be globally threatened or extinct, 63% are known not to be threatened, and 15% have insufficient data to determine their threat status. Habitat loss, affecting over 2,000 mammal species, is the greatest threat globally. The second greatest threat is utilisation which is affecting over 900 mammal species, mainly those in Asia, (IUCN, 2008). The disappearance of populations is a prelude to species extinction and even though the current estimate of threatened mammal species in the Western Cape (11%) is low when compared to the global percentage (22%) or the national percentage (18.7%), the impact of loss of populations/ecotypes/potential evolutionary significant units, should not be under-estimated. The terrestrial vertebrates of the WCP contain many lineages within species that may represent cryptic species (similar species that may be hard to discern using morphology) (Linder *et al.* 2010).

Several larger mammals including cheetah, spotted hyaena and wild dog can be considered as 'Extinct in the Wild' in the Western Cape. Reintroductions of the large carnivores in particular, require vast areas to accommodate even a semblance of their historic distribution range and associated behavioural and nutritional requirements. An additional concern is the significant expense that may be required to mitigate and compensate for potential human, wildlife and stock conflicts.

The diversity of vegetation types and the generally low productive potential of the natural vegetation (low levels of palatable browse and grazing) along with the cold, wet winters and different parasites, make the WCP habitats generally unsuitable for most game-farmed species. The CapeNature Game Translocation and Utilisation Policy (GTUP) 2010, introduces the principle that landowners will be encouraged to compile simple game management plans, including a basic habitat assessment, for their properties. In accordance with this principle and the implementation of a system to manage this, the game management plan will list taxa indigenous to the Western Cape and South Africa that the landowner wishes to obtain, and the relevant risks associated with such taxa, based on the habitat assessment. The game management plan will provide management and monitoring guidelines to mitigate for, or prevent, such risks. This system is intended to promote sound ecological management and self-regulation amongst landowners, and a closer, more co-operative relationship with CapeNature. This is also intended to promote co-responsibility for game management between the authorities and the game industry.

Methods

As with the previous two State of Biodiversity Reports (2002 & 2007) on mammals in the Western Cape, the resulting species lists (Appendix A) for the WCP are derived from literature which is supported by data in the CapeNature Biodiversity database (including museum records), which currently hold ~ 50 000 mammal distribution records of varying precision. The species list excluded species which are only known to be kept in captivity, alien species which have been accidentally or deliberately introduced, and species which are known from the pet trade.

The second edition of *Historical Incidence of the Larger Mammals in the broader Western and Northern Cape* by CJ Skead was published in 2011 and was edited by AF Boshoff, GIH Kerley and PH Lloyd and significantly informs our knowledge of the recent historical distribution of many mammal species.

The third edition of *The Mammals of the Southern African Subregion* (Skinner & Chimimba 2005) provided the main taxonomic reference. For bats, distribution and taxonomy was derived from the online publication of the African Chiroptera Report 2011 (van Cakenberghe & Seamark, 2011) and the Monadjem *et al.* 2010 edition of Bats of Southern and Central Africa: A biogeographic and taxonomic synthesis.

The online publication developed and maintained by the IUCN Species Survival Commission (SSC), the IUCN Red List of Threatened Species, Version 2011.2, was referenced for updates of the conservation status of the mammal species of the Western Cape. Regional Assessment conducted for South African mammal species, including certain subspecies are collated in the Red Data Book of the Mammals of South Africa (SARDB): A Conservation Assessment: Southern Africa (Friedmann & Daly, 2004), facilitated by the Conservation Breeding Specialist Group (CBSG) and the Endangered Wildlife Trust (EWT) and is cited for the conservation status threat categories at a national and provincial scale. Differences in the IUCN- and SARDB threat classifications are due to the scale of assessments (global versus regional) and the regional assessments are deemed most relevant to this report.

The online Catalogue of Life: Species 2000 & ITIS Catalogue of Life, 15th March 2012, was consulted regarding uncertainties pertaining to taxonomic classification.

Published as well as unpublished reports, (included in the reference list), were cited for additional information on status, distribution, systematics, genetics and conservation for Western Cape mammal species.

Systematic account

"…the origin of species, whether allopatric or sympatric, is a process, not an event. For the formation of a new species, like the boiling of an egg, there is some freedom to argue about when it is completed." Begon, Townsend & Harper (2006). This quote is apposite in the light of the on-going evaluation of the validity of the many described subspecies of South African mammals (Bronner et al 2003, Skinner & Chimimba 2005, Smit *et al.* 2008, etc.). Given the current state and for the purposes of this report, the Western Cape mammals are listed at subspecies level where these have been described.

The WCP is endowed with a world-renowned plant diversity and diversity of vegetation communities, (Le Roux *et al.* 2007) providing a diverse landscape and of variety in habitats and ecotones. Evidence suggests that the richness in habitat diversity has led to an associated level of speciation in other taxa, with new species and subspecies still being described. On-going genetic research on mammals especially micro-mammals is indicative of higher levels of variation than has been captured in systematic accounts based on physiology and morphology. De Queiroz (2007) states that geographic information is crucial because nearly all species exhibit geographic variation and that it is possible for larger differences to exist between populations within the same old- and geographically widespread species than between populations from different but recently separated species. These variations can be detected with the aid of ever more refined genetic analytical techniques. The recent application of genetic analysis will continue to shed light on these taxonomic issues and has already revealed the presence of previously un-described mammal species in the Western Cape: *Elephantulus pilicaudus* (Smit *et al.* 2008) and several un-described shrews in the genus *Myosorex* (Willows-Munro 2011). Aside from species and subspecies distinctions, when geographic variations are associated with different lineages they can be assigned either as an Evolutionary Significant Unit (ESU) or an ecotype.

Evolutionary Significant Units and Ecotypes

Implementation of management actions at species level is well justified. However, as in the case of bontebok (*Damaliscus pygargus pygargus*) which is endemic to the Western Cape, management actions to preserve genetic variation at subspecies level to avoid hybridisation with blesbok (*Damaliscus pygargus phillipsii*) is warranted.

As alluded to above, populations within species and subspecies may be on divergent paths which may eventually lead to speciation and if significant adaptive differentiation is evident, management of separate evolutionary lineages for conservation purposes is appropriate. Such management should aim at achieving a balance between the cost of maintaining different populations and the risks of outbreeding depression or benefits from hybridizing populations. These populations are referred to as ESUs and have been identified through genetic analysis in Cape mountain zebra (*Equus zebra zebra*) and the riverine rabbit (*Bunolagus monticularis*), (C. Matthee, Stellenbosch University, pers.comm).

Table 1. Species requiring research on the presence and distribution of ESUs.

Oreotragus oreotragus	klipspringer
Pelea capreolus	grey rhebok
Philantomba monticola monticola	blue duiker
Raphicerus campestris	steenbok
Raphicerus melanotis	Cape grysbok
Redunca fulvorufula	mountain reedbuck
Sylvicapra grimmia	common duiker
Tragelaphus scriptus	bushbuck

Genetically distinct geographic populations within species, adapted to specific environmental conditions, exhibiting phenotypic differences (morphology or physiology) stemming from environmental heterogeneity (diversity) are capable of interbreeding with other geographically adjacent populations without loss of fertility or vigour. Such populations do, however, exhibit a continuous, gradual geographic variation imposing analogous phenotypic and/or genetic variation, referred to as clinal variation. These populations are referred to as ecotypes.

Ecotypes present in mountain reedbuck (*Redunca fulvorufula*), klipspringer (*Oreotragus oreotragus*), steenbok (*Raphicerus campestris*) , Cape grysbok (*Raphicerus melanotis*), grey rhebok (*Pelea capreolus*), common duiker (*Sylvicapra grimmia*), blue duiker (*Philantomba monticola monticola*) and bushbuck (*Tragelaphus scriptus*) are subject to threats posed to the maintenance of evolutionary processes associated with adaptation, speciation and population resilience which need to be mitigated for through the application of restrictions on translocations of these species. In species exhibiting ecotypes, the ecotype-populations may be endemic to the WCP or a part of the WCP. This has particular reference to the smaller antelope (game) species, which may be considered for translocation within the game farming industry. The majority of these species still occur outside formally protected areas and fenced game reserves and the maintenance of genetic diversity will not be achieved through injudicious mixing of genetic material/ecotypes trough translocations and other management actions.

Taxonomic changes

Taxonomic revision of the Fynbos golden mole (*Amblysomus corriae*) and the Hottentot golden mole (*Amblysomus hottentotus*) resulted in A. corriae being split into *Amblysomus corriae corriae* and *Amblysomus corriae devilliersii* (no longer *Amblysomus hottentotus devilliersii*). *Amblysomus c. devilliersii* is endemic to the WCP, limited to the region from Stellenbosch to Riversdale and A.c. corriae is near endemic to the WCP, occurring from George to Humansdorp. The long-tailed forest shrew (*Myosorex longicaudatus*) has been split into *Myosorex longicaudatus boosmani*, locally endemic to the BoosmansbosWilderness Area, and *Myosorex longicaudatus* longicaudatus, a near endemic, occurring east of Knysna, (Skinner & Chimimba, 2005).

Further taxonomic revisions in light of genetic evidence for significant variation within the smaller mammal species of the Western Cape are expected.

There is little accurate information concerning the former distribution of the Cape warthog (*Phacochoerus aethiopicus aethiopicus*). Du Plessis (1969), Skead (1980-1987, 2007), and Rookmaaker (1989) cited records of warthogs, possibly the Cape species, from the Cape Province (previously Western-, Northern- and Eastern Cape). In spite of being easily observed and identified, there is surprisingly little evidence of warthogs being seen by the earlier European explorers and naturalists, and many references to wild pigs do not distinguish between warthogs and feral domestic pigs or bushpigs (Skead, 2007).

Distribution Data

The number of mammal distribution records that we were able to draw on for the current report was 50 139 which represents a 21 088 increase over the 29 051records available for the 2007 report.

Endemism

Table 2 lists the levels of endemism for the WCP mammal species: Nine species of mammals, eight of which are extant, are endemic to the WCP 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 WCP but extends marginally into the Northern Cape and/or Eastern Cape provinces.)

Table 2: Endemism of Western Cape mammal species.

Scientific Name	English Name
Species endemic to the WCP	
Acomys subspinosus	Cape spiny mouse
Amblysomus corriae devilliersii	Fynbos golden mole (West)
Bathyergus suillus	Cape dune molerat
Cryptochloris zyli	Van Zyl's golden mole
Damaliscus pygargus pygargus	bontebok
Dasymys capensis	Cape water rat
Hippotragus leucophaeus	blue antelope (extinct)
Myosorex longicaudatus boosmani	Boosmansbos long-tailed forest shrew
Tatera afra	Cape gerbil
Species near endemic to the WCP	
Amblysomus corriae corriae	Fynbos golden mole (East)
Bunolagus monticularis	riverine rabbit
Chlorotalpa duthieae	Duthie's golden mole
Chrysochloris asiatica	Cape golden mole
Equus zebra zebra	Cape Mountain zebra
Eremitalpa granti granti	Grant's golden mole
Georychus capensis	Cape molerat
Myomyscus verreauxi	Verreaux's mouse
Myosorex longicaudatus longicaudatus	Knysna long-tailed forest shrew
Raphicerus melanotis	Cape grysbok

Conservation Status

The WCP has a total of 172 mammal taxa, including intraspecific taxa (subspecies) according to our current knowledge included as appendix II. Of these taxa, two are Extinct (the blue antelope, *Hippotragus leucophaeus* and the quagga, *Equus quagga quagga*) and 19 are Threatened: three Critically Endangered, four Endangered and ten Vulnerable. Thus 11% of the mammal species in the WCP are Threatened. Of the remaining taxa, 19.8% are Data Deficient, 10.5% are Near Threatened and 56.4% are known not to be threatened (Least Concern). From a country-wide perspective, 18.7% of South African mammal species are threatened.

Officially none of the Western Cape mammal species are classified as "Extinct in the Wild" (IUCN) as all the candidate species occur elsewhere is South Africa. However, within the WCP of the Threatened species, cheetah (*Acinonyx jubatus*), spotted hyaena (*Crocuta crocuta*) and wild dog (*Lycaon pictus*) are not known to occur and survive as independent, free-living populations and are considered "Locally Extinct in the Wild" (IUCN).

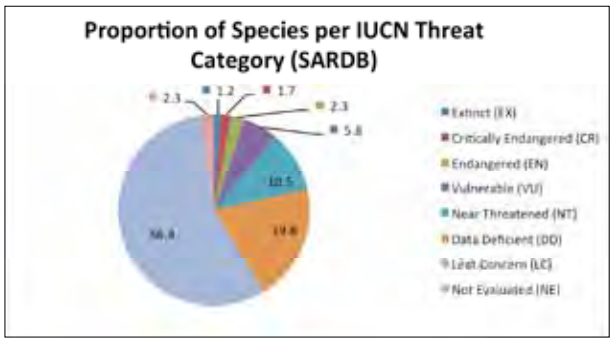

Figure 1: Representation of proportion of Western Cape mammal species per IUCN threat category as per the SARDB 2004.

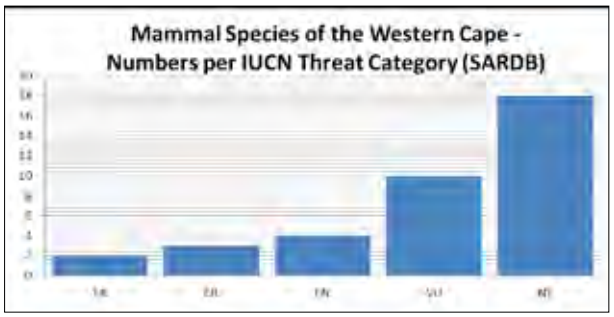

Figure 2: Mammal Species of the Western Cape - Numbers per IUCN Threat Category (SARDB), including Near Threatened.

Threatened species

Critically Endangered

Three of the ten Critically Endangered- SARDB listed species for South Africa are distributed in the WCP.

The **black rhinoceros** (*Diceros bicornis*) is perceived, in a global context, as a high profile, Critically Endangered species of great value. Its populations throughout most of Africa have declined sharply as a direct result of the internationally organised illegal trade in rhino products (especially horn). The Rhino Management Group (RMG) was formed in 1989 to give effect to the "Conservation plan for the black rhinoceros Diceros bicornis in South Africa and Namibia" that had been adopted earlier that year. Participation in the group was extended to Swaziland and Zimbabwe in 1996, Botswana in 2010, thereby widening its regional influence. It fell under the SADC umbrella in 2001, (RMG, 2012). The RMG states that the primary conservation visions with regard black rhinoceros for South Africa are to have at least 3,000 D.b.minor and 500 D.b.bicornis and preferably more black rhino of each of the two indigenous subspecies in South Africa, and at least three D.b.minor populations greater than 100 and another 10 greater than 50; and at least one D.b.bicornis population greater than a 100 and one greater than 50. The vision for Black rhino conserservation in South Africa (Knight *et al.* 2010) is to contribute to the recovery and persistence of the global black rhino populations by having viable popualtions of the indigenous subspecies in natural habitat throughout their former range within Sought Africa and managed as part of a regional metapopulation. The South-western black rhinoceros (*Diceros bicornis bicornis*), historically occurred in the WCP and has been re-introduced into the Karoo National Park as part of a series of translocations of this threatened species by SANParks, aimed at ensuring a healthy gene flow and increased population growth throughout its natural distribution range within the framework of a meta-population management strategy.

The **Riverine rabbit** (*Bunolagus monticularis*), considered a near endemic to the Western Cape, and is endemic to the central Karoo, for which the Western Cape population has been identified as an Evolutionary Significant Unit (ESU), is both IUCN and SARDB 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 Programme to coordinate Riverine rabbit conservation, to maintain and facilitate close relationships with landowners, relevant authorities, research institutions to ensure the survival of the riverine rabbit and its habitat.

Van Zyl's golden mole (*Cryptochloris zyli*), endemic to the WCP, and is only known from one locality along the West Coast, in the vicinity of Lambert's Bay and Compagnies Drift. It is considered to be threatened by habitat loss through poor land management, overgrazing, crop cultivation, poor irrigation techniques and mining. Very little is known about the golden moles in general due to their fossorial nature, spending almost their entire life underground. This particular golden mole has very few voucher specimens let alone information on its natural history.

Endangered

Species SARDB listed as Endangered for the WCP include 4 of the 18 species listed for South Africa. None of these four species are endemic to the Western Cape.

The **Antarctic true blue whale** (*Baleaenoptera musculus intermedia*) is an open oceanic species believed to use South Africa's regional waters as a migratory corridor with feeding occurring at the high latitudes of the Antarctic and breeding occurring in sub-tropical waters. The present population is estimated at less than 5% of the original numbers and the small population size might be responsible for the slow rate of the populations' recovery (Friedmann & Daly, 2004).

The **Southern elephant seal** (*Mirounga leonina*) occurs on Prince Edward Island and Marion Island with considerable movement at sea resulting in sightings off the South African coastline, with sightings along the Western Cape coastline between Gordon's Bay and Plettenberg Bay. They inhabit the rocky shores of offshore islands and breed at the Prince Edward Islands (Friedmann & Daly, 2004).

The Wild dog (*Lycaon pictus*) is not known to occur and survive as independent populations outside captive conditions within their historic range and is considered "Locally Extinct in the Wild".

The White-tailed mouse (*Mystromys albicaudatus*) has a widespread but patchy distribution throughout South Africa and Lesotho from the Western Cape to KwaZulu-Natal and north to Gauteng. It inhabits areas with sandy soils and good ground cover but habitat is being severely fragmented and is decreasing in size due to agriculture and other development. Avery et al (2005) only recorded them from 3 of 64 barn owl pellets deposition sites. The only known population from a protected area is found on the Blaauberg Nature Reserve.

Vulnerable

Species SARDB listed as Vulnerable for the WCP, include 10 of the 29 species listed for South Africa. One of these ten species is endemic to the Western Cape, while two are considered near endemic.

Cheetah (*Acinonyx jubatus*) are not known to occur and survive as independent populations outside captive conditions within their historical range in the WCP and are considered "Locally Extinct in the Wild". Re-introduction of cheetah to areas which will be viable in the long term, by being of a suitable size to accommodate their behavioural and nutritional requirements and by implementation of a meta-population management plan is recommended. Captive populations provide for education and research purposes and breeding programmes are only for producing animals to make the ex situ population viable without having removing animals from the wild. There are enough animals in the wild to be used for any reintroduction projects. There is no direct conservation benefit to the wild population from captive bred stock, (Friedmann & Daly, 2004)

Lion (*Panthera leo*) have been re-introduced into the ~ 90 000 hectare Karoo National Park by SANParks in 2010 in a bid to restore the natural functioning of the predator-prey balance in the ecosystem as well as to ensure that all historically-occurring species are once again conserved in the Park. Reintroductions of large carnivores, particularly lion, requires vast areas to accommodate their behavioural and nutritional requirements and pose potential for incurring vast financial expenses to mitigate for potential human-, wildlife- and stock conflicts through fencing, tracking and monitoring. The establishment of sustainable lion populations requires active and intensive management, including monitoring of habitat, predator-prey relationships, prey populations and conspecifics. A meta-population management plan approach including a strategy to avoid inbreeding, localised overpopulation, disease control and the enhancement of community relations is recommended as an outcome of the SARDB conservation assessment, (Friedmann & Daly, 2004).

The Sperm whale (*Physeter macrocephalus*) is an open oceanic species which occurs in the deep waters of all the worlds' oceans. It feeds in mesopelagic and benthypelagic habitat which is currently little affected by human activity and the only possible threat is the consequence of an unbalanced sex ratio due to prior overharvesting of large males relative to females (Friedmann & Daly, 2004).

The Bryde's whale (*Balaenoptera brydei*) is an open oceanic and coastal species occurring in the waters of the tropical and subtropical waters of all the worlds' oceans. The coastal form is threatened by the competition for pelagic fish with the fishing industry (Friedmann & Daly, 2004).

Indian Ocean bottle-nosed dolphin (*Tursiops aduncus*) are distributed in the temperate to tropical waters of the Indian Ocean and occur in near-shore waters less than 50 meters deep from Kosi Bay in KwaZulu-Natal to Mossel Bay in the Western Cape. A separate migratory stock has been identified to move between Durban in KwaZulu-Natal and Plettenberg Bay in the Western Cape. This species is threatened by reduced prey availability through the decrease in foraging habitat by the developments of harbours and the requirement for quay space resulting in estuary degradation, unsustainable fishing, pollution and shark net by-catch (Freidmann & Daly, 2004)

Indo-pacific hump-backed dolphin (*Sousa chinensis*) occur in coastal waters form False Bay to Kosi Bay and are dependent on the coastal nearshore water less than 30 meters deep. They are primarily associated with large rivers and shallow bays, but spread throughout the region. The degradation of estuaries and nearshore habitat through building expansion of harbours and increase in boating activity threaten their foraging habitats and extensive fishing pressure, recreational boating activities in well-developed tourism areas, chemical pollution and estuary closure or siltation are considered to collectively threaten the status of the South African populations (Friedmann & Daly, 2004).

Grant's golden mole (*Eremitalpa granti)* is distributed along the western coast of South Africa and Namibia.In South Africa occurs from Langebaan in the Western Cape to the Orange River mouth in the Northern Cape. It lives in sand dune habitats, particularly the foredunes adjacent to the coast, and is primarily threatened by diamond mining and disturbance to dune habitats by kelp harvesting as well as the removal of their prey base which is supported by kelp (Friedmann & Daly, 2004).

Blue duiker (*Philantomba monticola monticola*) is widespread along the coastal belt in forest and dune thickets along the south-eastern coast of South Africa, extending into adjacent montane forest. Blue duikers are highly selective foragers of litter and fruits and are dependent on the structure of the understory of the forest. Their habitats are fragmented throughout the Eastern Cape and KwaZulu-Natal, potentially resulting in at least 4 separate Evolutionary Significant Units. This species is threatened by deforestation, habitat modification, coastal developments, thicket clearing, agriculture and grazing impacts (Friedmann & Daly, 2004).

Bontebok (*Damaliscus pygargus pygargus*), historically endemic to the southern south eastern Renosterveld regions of the Western Cape currently also occur in extra-limital populations outside the WCP. Habitat loss due to agriculture, hybridisation with Blesbok (Damaliscus pygargus phillipsi), small population sizes and climate change are threats to this species (Friedmann & Daly, 2004). Hybridisation is currently responsible for genetic contamination of many populations on private land.

Cape mountain zebra (*Equus zebra zebra*) populations are mainly distributed within its former range from the Eastern Cape into the Western Cape on mountainous terrain in semi-arid temperate shrubland, dominated areas of grass and shrub mosaics with sufficient grass cover, particularly Themeda triandra,

on rugged terrain. Injudicious relocation of animals may have led to local declines and poor performance as well as exposure to hybridisation with Hartmann's mountain zebra (Eguus zebra hartmannae) and populations may also be threatened by wildfires and the Equine sarrcoid virus in localised areas. Inbreeding and loss of genetic heterozygosity in current isolated (and small) populations require interventions to avert local extinctions, (Friedmann & Daly, 2004).

Non-threatened species of conservation concern

Near Threatened

Species SARDB listed as Near Threatened for the WCP, include 18 of the total of 172 species occurring in the province. Two of the 18 species, namely the honey badger (*Mellivora capensis*) and the brown hyaena (*Parahyaena brunnea*) are of conservation concern in that they are indicative of ecosystem functions outside of formally protected areas. Both species were widely distributed throughout the WCP. Honey badger numbers are considered low and subject to unknown changes in population size and it is recommended that population distribution and size be monitored, also that data on genetic variation be collected to aid taxonomic resolution. Brown hyaenas suffer from continued persecution resulting in artificially low numbers and very limited distribution, requiring monitoring and increased public awareness. Most recent records come from escapees.

Least Concern

The majority of the WCP mammal species which are categorised and regulated, as either game species, damage causing animals (DCAs) or ecotypes, are of the 97 species listed as Least Concern, SARDB, but due to their regulatory requirements, are considered of conservation concern.

The game species include red hartebeest *(Alcelaphus buselaphus)*, springbok *(Antidorcas marsupialis)*, hippopotamus (Hippopotamus amphibius), African elephant *(Loxodonta africana)*, klipspringer *(Oreotragus oreotragus)*, grey rhebok *(Pelea capreolus)*, steenbok *(Raphicerus campestris)*, Cape grysbok *(Raphicerus melanotis)*, mountain reedbuck *(Redunca fulvorufula)*, common duiker *(Sylvicapra grimmia)*, African buffalo *(Syncerus caffer)*, eland *(Taurotragus oryx)*, bushbuck *(Tragelaphus scriptus)* and kudu *(Tragelaphus strepsiceros)*. As already mentioned, ecotypes present in the smaller antelope species are subject to threats posed to the maintenance of evolutionary processes associated with adaptation, speciation and population resilience which need to be mitigated for through the application of restrictions on translocations of these species.

Black-backed jackal (*Canis mesomelas*), caracal (*Caracal caracal*), leopard (*Panthera pardus*), Cape clawless otter (*Aonyx capensis*) and chacma baboons (*Papio ursinus ursinus*) are not known to be threatened with extinction at an international or regional (national) scale, but their importance in the maintenance of ecosystem functioning and exhibition of local variation and adaptation, coupled with their proneness for human-wildlife conflict, warrant their consideration for conservation concern in the WCP, identifying the need for research and monitoring to ensure that all conservation- and other impacting actions are sustainable.

Data Deficient

Of the 33 WCP mammal species which are SARDB listed as Data Deficient, the African striped weasel (*Poecilogale albinucha*) is of particular conservation concern primarily due to its documented range extension, warranting the collection of further distribution data to determine trends in the extent of its range. This particularly in light of the decline recorded in the eastern portion of its range.

Habitat Status

The CapeNature Protected Area Expansion Strategy (CN PAES) and Implementation Plan 2010 – 2015 (Purnell *et al.* 2010) has been finalised and is being implemented. The CN PAES is based on fine scale spatially explicit products which considers mammal species priorities, reflected in the Conservartion Action Priority Maps (CAPMaps). CAPMaps are potentially updated annually with new distribution data. Priority sites, i.e. Sanbona and Kromrivier private land conservation initiatives are identified as priority conservation action sites which favour conservation of the riverine rabbit and where conservation initiatives have already been identified and implemented.
The Grand Canyon extension of Anysberg Nature Reserve has been approved and will provide additional habitat for Cape mountain zebra and potentially support the re-introduction of the south-western black rhinoceros.

Threats

"....Invasive alien species are one of the leading and most rapidly growing threats to food security, human and animal health and biodiversity. A recent analysis of IUCN Red List data highlighted invasive alien species as the fifth most severe threat to amphibians, and the third most severe threat to birds and mammals. Together with climate change, they have become one of the most difficult threats to reverse", (IUCN ISSG, 2012), and today, alien invasion is second only to habitat loss as a cause of species endangerment and extinction, (Lowe *et al.* 2000, 2004).

Introduced species

The Western Cape Game Translocation and Utilisation Policy (GTUP), implemented in 2011, in a bid to support the game farming economy in the WCP, provides for the introduction of extra-limital game species 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;

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- to mitigate and reduce any impact posed by extra-limital game species to the unique environment of 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.

The policy 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 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 Utilisation Policy (GTUP) for the WCP;
- to acknowledge the intention (and opportunities) of the game farmer.

Introduced Alien Invasive Species (AIS)

When species are categorized as "alien invasive", it is understood that the potential risks of introductions outweigh any potential benefits and that sufficient evidence of their invasive qualities (directly or implied), exists, and begs for the application of the precautionary principle, cautioning against any deliberate introductions.

Once a population has established, eradication attempts will be successful only if the rate of removal exceeds the rate of population increase, immigration is prevented, all reproductive animals are removed, detection is possible at low densities, the benefits of eradication outweigh the costs, and strong support is obtained from government and the public (Bomford & O'Brien, 1995).

The IUCN Species Survival Commission in collaboration with the Commission on Ecology, and the commission on Environmental Policy, Law and Administration formulated "Guidelines for introductions, re-introductions and re-stocking", which states the following: "The establishment of introduced alien species has broken down the genetic isolation of communities of co-evolving species of plants and animals. Such isolation has been essential for the evolution and maintenance of diversity of plants and animals composing the biological wealth of our planet. Disturbance of this isolation by alien species has interfered with the dynamics of natural systems causing the premature extinction of species." The Convention on Biological Diversity (CBD) states that each contracting party shall, as far as possible and appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species. The IUCN guidelines acknowledge that certain introductions can be beneficial to man and also state that the "Introductions of an alien species should only be considered if clear and well defined benefits to man or natural communities can be foreseen", and "if no native species is considered suitable for the purpose for which the introduction in being made."

Nyala (*Tragelaphus angasii*) and Impala (*Aepyceros melampus*) are classified as alien invasive species (AIS) and deliberate introductions into the WCP are not supported, however, under the auspices of the IUCN "Guidelines for introductions, re-introductions and re-stocking", provision is made for the consideration and evaluation of deliberate introductions of alien invasive 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 the industry. Therefore, the introduction of extra-limital and alien invasive species requires an explicit assessment of risk relative to benefit, (Chown & Spear, 2009). The Convention on Biological Diversity (CBD, United Nations, 1993) stipulates that a risk assessment is required for actions, such as species introductions, that may cause harm to biodiversity. Risk assessment involves the quantification of the probability of an undesirable outcome to an action and it is a fundamental component of national policies concerning the introduction of non-indigenous species.

This approach may require broad consultation and a strict experimental control while the maintenance of existing populations of nyala and impala which are not intensively managed is discouraged.

Feral pigs (*Sus scrofa*), 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. Introduced to many parts of the world, they damage crops, stock and property and transmit many diseases such as Leptospirosis and foot and mouth disease. Pigs dig up large areas of native vegetation and spread weeds, disruptecological processes andnegatively affect population dynamics and species composition. They are omnivorous and their diet can include land tortoises, sea turtles, sea birds and endemic reptiles. Management of this invasive species is complicated by the fact that complete eradication is often not acceptable to communities that value feral pigs for hunting and food, (Lowe *et al.* 2000, 2004). Chown and Spear (2009) state that in analyses done for the United States, feral pigs (through herbivory, predation, competition and habitat effects) are an extinction threat to more species than are competition, predation, herbivory and hybridisation from other non-indigenous species (excluding feral and domestic animals), and that, feral pigs seem to be a species of particular concern globally. Thus, the feral pig has had a considerable impact, both via predation and habitat disturbance, in its introduced range. Several relatively healthy populations of feral pigs exist in the wild and by all indications, have found a foothold in South Africa with the epicentre in the WCP. 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).

The European rabbit (*Oryctolagus cuniculus*), 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 the land. Rabbits are most destructive in arid and semi-arid zones where soils are fragile and more prone to erosion once ground cover is removed, this is important to note given that over 90% of South Africa's landscape is classified as arid, semi-arid or sub-humid, (Hamman, 2008).

CapeNature has been liaising with the Robben Island Nature Reserve for a number of years and has advised on the management of alien animals on Robben Island to address the population fluctuations of European rabbits and fallow deer (*Dama dama*) and over-utilisation of natural ecosystems found on the Island: The live removal of rabbits to the mainland is strictly prohibited and even though CapeNature does not advocate the translocation of alien invasive species within the WCP, advised that fallow deer, if not culled, could be removed from the Island subject to strict conditions aimed at avoiding the consequences of further spread of alien fallow deer in the WCP, such as the potential for transmitting paratuberculosis (Johne's disease) to native ungulates, damage to riparian and woodland habitats (including over-browsing, trampling and ring-barking of young trees).

Unfortunately, numerous introductions of **fallow deer** into South Africa and the WCP have resulted in well-established feral 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. CapeNature has already partnered with SANParks to remove the fallow deer from Table Mountain National Park. Support for this removal was given in joint statements by the WWF, the Wildlife and Environment Society of South Africa (WESSA), the Endangered Wildlife Trust (EWT), the Botanical Society of South Africa (BotSoc), the Wilderness Foundation and the Working for Water programme (WfW), (Hamman, 2008).

A review conducted by Chown & Spear (2009) on Non-indigenous ungulates as a threat to biodiversity provides several recommendations regarding the management of non-indigenous ungulate species,these include:

- conducting quantitative research concerning the biodiversity impacts of non-indigenous ungulates, particularly in regions with diverse introduced and indigenous ungulate assemblages;
- prohibition on introductions of non-indigenous ungulate species that are likely to produce fertile offspring (hybridize) with indigenous ungulate species in the wild;
- prohibition on introductions of non-indigenous ungulates to areas with rare and/or endemic plants which are not adapted to herbivory;
- discouragement of introductions of species which are functionally different from indigenous species in an area;
- prevention of escape in instances where non-indigenous ungulates are kept;
- mandatory risk assessment for the further introduction of non-indigenous species including quantitative research wherever feasible and deemed necessary.

Legal Status

The species proposed for listing under the Threatened or Protected Species (ToPS) regulations under the National Environmental Management: Biodiversity Act (NEMBA) Act 10 of 2004 includes mammal species SARDB listed as Threatened or Near Threatened which are impacted on by any of the restricted activities listed in the Threatened or Protected Species Regulations (ToPS), 152 of 2007. The listing of commercial game farm species which are not Threatened or Near Threatened as well as the drafting on Norms and Standards for the Translocation of game species is currently under development and guided by the Department of Environmental Affairs. The WCP Biodiversity Bill is currently being drafted and will take all WCP mammal species into consideration for provincial protection.

BMP-S

Section 43 of the National Environmental Management: Biodiversity Act (NEM: BA), 10 of 2004, provides for the compilation of biodiversity management plan for species (BMP-S), aimed at the long-term survival in nature of species to which the plan relates, and, in terms of Section 9 of the Act, in accordance with Norms and Standards as published in Regulation 214 of 2009.

Mountain Zebra *Equus zebra* (thus including *E. z. zebra* and *E. z. hartmanii*) are listed as Endangered under the Threatened or Protected Species Regulations (ToPS), 152 of 2007, as amended by 69 of 2008, in terms of Section 56 of the Act.

A partnership between CapeNature, The Wilderness Foundation and the Table Mountain fund has been established to initiate and work towards the drafting of the Cape mountain zebra (CMZ) BMP-S. This partnership aims to achieve the following (initiated in 2011):

- to convene both a CMZ Working group (WG) meeting, followed by a CMZ BMP-S workshop;
- to contextualise the efforts of the CMZ WG into the BMP-S process;
- to ensure participative multi-stakeholder engagement towards drafting the BMP-S;
- to establish a CMZ BMP-S Reference Group;
- to establish a CMZ BMP-S Planning Committee;
- to strengthen and build partnerships toward the development and maintenance of the CMZ BMP-S.

A BMP-S for black rhinoceros (*Diceros bicornis*) was jointly developed and drafted by the South African members of the SADC RMG and was printed in the Government Gazette No 34304 of 24 May 2011 for public comment.

Public awareness

Black-backed jackal, caracal, leopard and chacma baboons dominate in the local media primarily as a result of human-wildlife conflict, soliciting emotive responses and influencing perceptions of the general public with regard to the priorities and roles of the conservation authorities. However, recently public awareness of the plight of the Critically Endangered riverine rabbit was boosted over the Easter period at a national level and poaching and illegal trade in rhinoceros horn has been broadcast both nationally and internationally via electronic media, providing various platforms for creating, stimulating and boosting public awareness, not only of the large charismatic species, but also of the general illegal use and trade of animal products.

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.

Monitoring and Research

Dr Rebecca K Smith from the Durham University with funding from the Darwin Initiative in the United Kingdom, conducted an evaluation of the Cape mountain zebra (CMZ) monitoring on De Hoop Nature Reserve. After field rangers at De Hoop Nature Reserve were trained to identify CMZ from their individual stripe patterns and to collect population data using handheld computers with CyberTracker software she reported in 2006 that the CMZ population monitoring had been successfully re-established. Dr Susanne Shultz, a Royal Society Dorothy Hodgkin Research Fellow and research assistant, Christine Stanley from the Institute of Cognitive and Evolutionary Anthropology at the University of Oxford evaluated the monitoring results and provided corrective guidance and assistance to new staff at De Hoop Nature Reserve from September to November 2010 to ensure the continuation of the CMZ monitoring project.

During 2009, the national bontebok working group met and discussed the initiation of a bontebok meta-population management strategy and proposed the use of genetic analyses for the testing of purity in bontebok as well as testing for hybrids in bontebok and blesbok. The genetic research by Dr Desire Dalton was aimed at developing markers which could identify private alleles which only occurred in bontebok or only occurred in blesbok. A total of 13 markers were initially developed at the Centre for Conservation Science at the National Zoological Gardens of South Africa in Pretoria, resulting in a bontebok and blesbok hybridisation test using two cross species markers, which is now being incorporated into policy at a national level to test for purity.

The Virtual Museum (VM) provides the platform for citizen scientists to contribute to biodiversity projects. This innovative concept was developed by the Animal Demography Unit (ADU) at the University of Cape Town. The Cape Leopard Trust and the ADU are collaborating to develop a Virtual Museum for Mammals, MammalMAP (formerly VIMMA), which will act as a repository for distribution records of mammal species for the whole of Africa and is being coordinated by Dr Tali Hoffman of the ADU. CapeNature participates on the steering committee and aims to continue collaborating in the future.

Rogan Fourie, a master's student from the University of Cape Town has initiated carbon isotope research on bontebok, Cape mountain zebra and eland at De Hoop Nature Reserve towards collaborating on finding research answers related to habitat use and quality for these species on De Hoop Nature Reserve.

Leopard distribution and population ecology research with the aid of camera traps and collaring has been conducted in collaboration with CapeNature by the Landmark Foundation – J McManus and the Cape Leopard Trust – Q Martins.

Prof Conrad Matthee, form the University of Stellenbosch, involved in genetic research, has been working on genetic analyses of riverine rabbits, indicating the existence of ESUs distinguishing the Western Cape populations from the Northern Cape populations.

CapeNature is collaborating on research on Cape clawless otters with the University of Cape Town, the National Zoological Gardens (NZG), Tswane University of Technology, the University of the Free State and a Hungarian Science Bilateral facilitated through the NZG and the National Research Foundation (NRF). The research by Thabang Madisha is aimed at the genotyping of faecal DNA, while the research by Nicola Okes focusses on spatial ecology and pollution burdens of the Cape clawless otter in the Cape Peninsula.

It has been identified that further work on assessing the presence and distribution of ESUs and ecotypes of several WCP mammal species, some are listed in Table 1. CapeNature has also been requested to assist in the assessment of ecotype and ESU translocation criteria for the development of the Norms and Standards for Translocation of Game, by DEA.

Where research has been identified as priority conservation action for a species, this is reflected in Table 3. Recommended conservation actions for WCP mammals in order of priority.

Capacity

The mammalogist post was filled in 2012 after being vacant for a year, resulting in lack of continuity and a workload back-log.

Collaboration with external researchers and scientific institutions remains essential to facilitate both the scientific research on mammals and the assimilation of scientific findings into conservation management.

Conclusions & Recommendations

Western Cape mammal species have been initially prioritised based on their current threat categories (IUCN & SARDB), endemism, protection within the protected areas system and legislative protection against imminent threats. This to inform a semblance of prioritisation of conservation action for the next reporting period to address focussed conservation action and recommendations as listed in Table 3, recommended conservation actions for WCP mammals in order of priority. It has however been identified that a comprehensive systematic prioritisation of the mammals of the WCP for conservation action, needs to be conducted.

The shift in focus to the conservation of genetic variation for the enablement of adaptation to environmental change, especially in relation to the diversity in habitats within the WCP, for the next five years will be supported by the current and on-going research into genetic variation and differentiation.

This chapter reset the baseline for future reporting based on regional assessments and additions of species based on genetic evidence for speciation and the use of lower taxonomic ranks where the informants for conservation action and planning require such.

"I believe that nature conservation authorities in this country should now develop the themes of genetic conservation and evolutionary ethics, and work their principles into present management practices. The first stage of this operation must be education, both without and within the conservation establishment. If the professional conservationist does not understand the issues involved, genetic conservation is a lost cause." John Comrie Greig, 1977. This statement formed the basis for bontebok regulatory and management measures through the prohibition of translocation of Bontebok to farms where conspecific blesbok already occurred. Although the subsequent conservation action was not focussed on the suitability of habitat, habitat quality and the conservation of co-evolutionary processes for bontebok, at the time, our understanding of the interactions between a species and its environment has increased to enable a more thorough approach.

John Comrie Greig also stated that "Where possible, conservationists should aim at the separate conservation of as many of the component eco-typical gene pools within each species as is practical", and "Blind faith in existing taxonomic arrangements at subspecies level should be actively discouraged. Named species rarely do more than hint at the true extent for genotypic variation within a species, and are merely convenient and subjective labels attached to readily recognisable populations."

Table 3. Recommended conservation actions for Western Cape Province mammals in order of priority.

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations
Bunolagus monticularis Riverine rabbit	Develop Protected Areas Expansion Strategies towards ensuring conservation of riverine rabbit habitat; Implement monitoring.	CapeNature Protected Areas Expansion Strategy, fine scale maps and Conservation Action Priority Maps developed 2010; Riverine rabbit working group conducts monitoring.	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.
Cryptochloris zyli Van Zyl's golden mole	Implement monitoring.	No monitoring implemented. Distribution data obtained through research.	Ensure CAPMap updates for priority mammal species distributions; Monitor land transformation as a surrogate for habitat status at fine scale.
Mystromys albicaudatus White-tailed mouse	Implement monitoring.	No monitoring implemented. Distribution data obtained through research.	Ensure CAPMap updates for priority mammal species distributions; Develop monitoring protocol to assess persistence of populations.
Equus zebra zebra Cape mountain zebra	Continue monitoring of De Hoop CMZ population.	Monitoring continued and evaluated by external researchers.	Develop BMP-S for CMZ.
Sousa chinensis Indo-pacific hump-backed dolphin	Develop marine mammal conservation priorities to inform MPA management.	National Biodiversity Assessment 2011 incorporates marine mammal priorities.	Collect survey data from coastal protected areas and MPAs to inform MPA and coastal protected area management.
Damaliscus pygargus pygargus Bontebok	Implement monitoring. Develop/refine purity tests.	No monitoring implemented. Genetic testing for pure bontebok developed by National Zoological Gardens.	Develop meta-population management strategy and implement genetic testing, develop policy, test all CapeNature bontebok.

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations
Eremitalpa granti Grant's golden mole	Implement monitoring.	No monitoring implemented. Distribution data obtained through research.	Ensure CAPMap updates for priority mammal species distributions; Develop monitoring protocol to assess persistence of populations.
Baleaenoptera musculus intermedia Antarctic true blue whale	Develop marine mammal conservation priorities to inform MPA management.	National Biodiversity Assessment 2011 incorporates marine mammal priorities.	Collect distribution information in MPAs.
Tursiops aduncus Indian Ocean bottle-nosed dolphin	Develop marine mammal conservation priorities to inform MPA management.	National Biodiversity Assessment 2011 incorporates marine mammal priorities.	Collect distribution information in MPAs.
Physeter macrocephalus Sperm whale	Develop marine mammal conservation priorities to inform MPA management.	National Biodiversity Assessment 2011 incorporates marine mammal priorities.	Collect distribution information in MPAs.
Philantomba monticola monticola Blue duiker	Implement monitoring.	No monitoring implemented.	Conduct evaluation and research on ecotypes and ESUs.
Parahyaena brunnea Brown hyaena	No recommendation.	N/A	Ensure CAPMap updates for priority mammal species distributions;
Lycaon pictus Wild dog	No recommendation.	N/A	Ensure CAPMap updates for priority mammal species distributions;
Diceros bicornis Black rhinoceros	No recommendation.	N/A	Provincial representation on SADC RMG; Assess potential for introductions in accordance with BMP-S and RMG objectives.
Mirounga leonine Southern elephant seal	Develop marine mammal conservation priorities to inform MPA management.	National Biodiversity Assessment 2011 incorporates marine mammal priorities.	Collect distribution information in MPAs.
Balaenoptera brydei Bryde's whale	Develop marine mammal conservation priorities to inform MPA management.	National Biodiversity Assessment 2011 incorporates marine mammal priorities.	Collect distribution information in MPAs.
Acinonyx jubatus Cheetah	No recommendation.	N/A	Assess potential for introductions in accordance with national cheetah conservation priorities.
Panthera pardus Leopard	Continue research.	Research by Cape Leopard Trust and Landmark Foundation facilitated through agreements.	Ensure CAPMap updates for priority mammal species distributions;
Mellivora capensis Honey badger	No recommendation.	N/A	Collect distribution data and initiate the collection of genetic material for taxonomic assessment.
Aonyx capensis Cape clawless otter	No recommendation.	N/A	Ensure CAPMap updates for priority mammal species distributions; Collaborate and facilitate collaboration on research projects: faecal DNA collection, spatial ecology and pollution burdens.
Canis mesomelas Black-backed jackal	No recommendation.	N/A	Evaluate DCA management protocols, facilitate scientific research in support of DCA management protocols.
Caracal caracal Caracal	No recommendation.	N/A	Evaluate DCA management protocols, facilitate scientific research in support of DCA management protocols.

Taxon	2007 Recommendations	2007 Action implemented	2012 Recommendations
Panthera leo Lion	No recommendation.	N/A	Evaluate and asses applications for introductions.
Papio ursinus ursinus Chacma baboon	No recommendation.	N/A	Facilitate the review and establishment of Baboon management plans.
Game Species	Develop Game Utilisation Policy;	Game Translocation and Utilisation Policy (GTUP) developed and implemented 2011. Game management plan evaluation guidelines developed and disseminated.	Develop and monitor the implementation of the GTUP and game management plans.
Ecotypes and ESUs	No recommendation.	N/A	Ensure CAPMap updates for priority mammal species distributions; Conduct evaluation and research on ecotypes and ESUs – coordinate evaluation for DEA of 12 national species.
Poecilogale albinucha African striped weasel	No recommendation.	N/A	Ensure CAPMap updates for priority mammal species distributions; Assess range expansion.
Alien Invasive Species	Develop Game Utilisation Policy; Implement AIS strategies.	Game Translocation and Utilisation Policy (GTUP) developed and implemented 2011; Feral pig control strategy developed.	Refine and prioritise actions plans for AIS strategy for invasive mammal species; Assess and evaluate applications for introduction of non-indigenous mammals into the WCP.

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CAPE MOUNTAIN ZEBRA: SCOTT RAMSAY

Appendix A:
List of mammal taxa known to occur in the WCP with regional (SARDB) and global (IUCN) threat categories.

Family	*Scientific name*	English name	IUCN Threat Category	SARDB Threat Category
Balaenidae	*Eubalaena australis*	Southern right whale	Least Concern	Least Concern
Balaenopteridae	*Balaenoptera acutorostrata subsp.*	Dwarf minke whale	Least Concern	Data Deficient
Balaenopteridae	*Balaenoptera bonaerensis*	Antarctic minke whale	Data Deficient	Least Concern
Balaenopteridae	*Balaenoptera borealis*	Sei whale	Endangered (A1ad)	Data Deficient
Balaenopteridae	*Balaenoptera edeni*	Bryde's whale	Data Deficient	Vulnerable (D1)
Balaenopteridae	*Balaenoptera musculus brevicauda*	Pygmy blue whale	Data Deficient	Data Deficient
Balaenopteridae	*Balaenoptera musculus intermedia*	Antarctic true blue whale	Critically Endangered (A1abd)	Endangered (D)
Balaenopteridae	*Balaenoptera physalus*	Fin whale	Endangered (A1d)	Data Deficient
Bathyergidae	*Bathyergus suillus*	Cape dune molerat	Least Concern	Least Concern
Bathyergidae	*Cryptomys hottentotus*	Common molerat	Least Concern	Least Concern
Bathyergidae	*Georychus capensis*	Cape molerat	Least Concern	Least Concern
Bovidae	*Alcelaphus buselaphus*	Red hartebeest	Least Concern	Least Concern
Bovidae	*Antidorcas marsupialis*	Springbok	Least Concern	Least Concern
Bovidae	*Damaliscus pygargus pygargus*	Bontebok	Near Threatened	Vulnerable (D1)
Bovidae	*Hippotragus leucophaeus*	Blue antelope	Extinct	Not Evaluated
Bovidae	*Oreotragus oreotragus*	Klipspringer	Least Concern	Least Concern
Bovidae	*Oryx gazella*	Gemsbok	Least Concern	Least Concern
Bovidae	*Pelea capreolus*	Grey rhebok	Least Concern	Least Concern
Bovidae	*Philantomba monticola monticola*	Blue duiker	Least Concern	Vulnerable (C1; C2a(i))
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern	Least Concern
Bovidae	*Raphicerus melanotis*	Cape grysbok	Least Concern	Least Concern
Bovidae	*Redunca fulvorufula*	Mountain reedbuck	Least Concern	Least Concern
Bovidae	*Sylvicapra grimmia*	Common duiker	Least Concern	Least Concern
Bovidae	*Syncerus caffer*	African buffalo	Least Concern	Least Concern
Bovidae	*Tragelaphus oryx*	Eland	Least Concern	Least Concern
Bovidae	*Tragelaphus scriptus*	Bushbuck	Least Concern	Least Concern
Bovidae	*Tragelaphus strepsiceros*	Kudu	Least Concern	Least Concern
Canidae	*Canis mesomelas*	Black-backed jackal	Least Concern	Least Concern
Canidae	*Lycaon pictus*	Wild dog	Endangered (C2a(i))	Endangered (D)
Canidae	*Otocyon megalotis*	Bat-eared fox	Least Concern	Least Concern
Canidae	*Vulpes chama*	Cape fox	Least Concern	Least Concern
Cercopithecidae	*Cercopithecus pygerythrus*	Vervet monkey	Least Concern	Least Concern
Cercopithecidae	*Papio ursinus ursinus*	Chacma baboon	Least Concern	Least Concern
Chrysochloridae	*Amblysomus corriae corriae*	Fynbos golden mole (East)	Near Threatened	Near Threatened
Chrysochloridae	*Amblysomus corriae devilliersii*	Fynbos golden mole (West)	Near Threatened	Near Threatened
Chrysochloridae	*Amblysomus hottentotus*	Hottentot golden mole	Least Concern	Data Deficient
Chrysochloridae	*Chlorotalpa duthieae*	Duthie's golden mole	Vulnerable (B1ab(iii))	Least Concern
Chrysochloridae	*Chlorotalpa sclateri*	Sclater's golden mole	Least Concern	Data Deficient
Chrysochloridae	*Chrysochloris asiatica*	Cape golden mole	Least Concern	Data Deficient
Chrysochloridae	*Cryptochloris zyli*	Van Zyl's golden mole	Endangered (B1ab(iii))	Critically Endangered (B1ab(iii)+2ab(iii); D)

Family	*Scientific name*	English name	IUCN Threat Category	SARDB Threat Category
Chrysochloridae	*Eremitalpa granti granti*	Grant's golden mole	Least Concern	Vulnerable (B2ab(ii,iii,iv))
Delphinidae	*Cephalorhynchus heavisidii*	Heaviside's dolphin	Data Deficient	Data Deficient
Delphinidae	*Delphinus capensis*	Long-beaked common dolphin	Data Deficient	Least Concern
Delphinidae	*Delphinus delphis*	Short-beaked common dolphin	Least Concern	Least Concern
Delphinidae	*Feresa attenuata*	Pygmy killer whale	Data Deficient	Data Deficient
Delphinidae	*Globicephala macrorhynchus*	Short-finned pilot whale	Data Deficient	Data Deficient
Delphinidae	*Globicephala melas edwardii*	Long-finned pilot whale	Data Deficient	Least Concern
Delphinidae	*Grampus griseus*	Risso's dolphin	Least Concern	Data Deficient
Delphinidae	*Lagenorhynchus obscurus*	Dusky dolphin	Data Deficient	Data Deficient
Delphinidae	*Orcinus orca*	Killer whale	Data Deficient	Data Deficient
Delphinidae	*Peponocephala electra*	Melon-headed whale	Least Concern	Least Concern
Delphinidae	*Pseudorca crassidens*	False killer whale	Data Deficient	Least Concern
Delphinidae	*Sousa chinensis*	Indo-pacific hump-backed dolphin	Near Threatened	Vulnerable (B1ab(ii,iii))
Delphinidae	*Stenella attenuata*	Pantropical spotted dolphin	Least Concern	Data Deficient
Delphinidae	*Stenella coeruleoalba*	Striped dolphin	Least Concern	Least Concern
Delphinidae	*Stenella longirostris longirostris*	Spinner dolphin	Data Deficient	Data Deficient
Delphinidae	*Tursiops aduncus*	Indian Ocean bottle-nosed dolphin	Data Deficient	Vulnerable (B2ab(ii,iii,v) C2a(ii))
Delphinidae	*Tursiops truncatus*	Atlantic Ocean bottlenosed dolphin	Least Concern	Data Deficient
Elephantidae	*Loxodonta africana*	African elephant	Vulnerable (A2a)	Least Concern
Emballonuridae	*Taphozous mauritianus*	Mauritian tomb bat	Least Concern	Least Concern
Equidae	*Equus quagga quagga*	Quagga	Extinct	Extinct
Equidae	*Equus zebra zebra*	Cape Mountain zebra	Vulnerable (C1)	Vulnerable (D1)
Felidae	*Acinonyx jubatus*	Cheetah	Vulnerable (A2acd; C1)	Vulnerable (D1)
Felidae	*Caracal caracal*	Caracal	Least Concern	Least Concern
Felidae	*Felis nigripes*	Black-footed cat	Vulnerable (C2a(i))	Least Concern
Felidae	*Felis silvestris*	African Wild Cat	Least Concern	Least Concern
Felidae	*Leptailurus serval*	Serval	Least Concern	Near Threatened
Felidae	*Panthera leo*	Lion	Vulnerable (A2abcd)	Vulnerable (D1)
Felidae	*Panthera pardus*	Leopard	Near Threatened	Least Concern
Herpestidae	*Atilax paludinosus*	Marsh mongoose	Least Concern	Least Concern
Herpestidae	*Cynictis penicillata*	Yellow mongoose	Least Concern	Least Concern
Herpestidae	*Galerella pulverulenta pulverulenta*	Cape grey mongoose	Least Concern	Least Concern
Herpestidae	*Herpestes ichneumon*	Large grey mongoose	Least Concern	Least Concern
Herpestidae	*Suricata suricatta*	Suricate	Least Concern	Least Concern
Hippopotamidae	*Hippopotamus amphibius*	Hippopotamus	Vulnerable (A4cd)	Least Concern
Hyaenidae	*Crocuta crocuta*	Spotted hyaena	Least Concern	Near Threatened
Hyaenidae	*Parahyaena brunnea*	Brown hyaena	Near Threatened	Near Threatened
Hyaenidae	*Proteles cristatus*	Aardwolf	Least Concern	Least Concern
Hystricidae	*Hystrix africaeaustralis*	Porcupine	Least Concern	Least Concern

Family	*Scientific name*	English name	IUCN Threat Category	SARDB Threat Category
Kogidae	*Kogia breviceps*	Pygmy sperm whale	Data Deficient	Least Concern
Kogidae	*Kogia sima*	Dwarf sperm whale	Data Deficient	Least Concern
leporidae	*Pronolagus saundersiae*	Hewitt's red rock rabbit	Least Concern	Least Concern
Leporidae	*Bunolagus monticularis*	Riverine rabbit	Critically Endangered (C2a(i))	Critically Endangered (C2a(i))
Leporidae	*Lepus capensis*	Cape hare	Least Concern	Least Concern
Leporidae	*Lepus saxatilis*	Scrub hare	Least Concern	Least Concern
Macroscelididae	*Elephantulus edwardii*	Cape rock elephant-shrew	Least Concern	Least Concern
Macroscelididae	*Elephantulus pilicaudus*	Karoo rock elephant-shrew	Data Deficient	Data Deficient
Macroscelididae	*Elephantulus rupestris*	Smith's rock elephant-shrew	Least Concern	Least Concern
Macroscelididae	*Macroscelides proboscideus*	Round-eared elephant-shrew	Least Concern	Least Concern
Molossidae	*Sauromys petrophilus*	Flat-headed free-tailed bat	Least Concern	Least Concern
Molossidae	*Tadarida aegyptiaca*	Egyptian free-tailed bat	Least Concern	Least Concern
Muridae	*Acomys subspinosus*	Cape spiny mouse	Least Concern	Least Concern
Muridae	*Aethomys granti*	Grant's rock mouse	Least Concern	Least Concern
Muridae	*Dasymys capensis*	Cape water rat	Not Evaluated	Not Evaluated
Muridae	*Dendromus melanotis*	Grey climbing mouse	Least Concern	Least Concern
Muridae	*Dendromus mesomelas*	Brants' climbing mouse	Least Concern	Least Concern
Muridae	*Dendromus mystacalis jamesoni*	Chestnut climbing mouse	Least Concern	Least Concern
Muridae	*Desmodillus auricularis*	Short-tailed gerbil	Least Concern	Least Concern
Muridae	*Gerbillurus paeba*	Hairy-footed gerbil	Least Concern	Least Concern
Muridae	*Grammomys dolichurus*	Woodland mouse	Data Deficient	Data Deficient
Muridae	*Malacothrix typica*	Large-eared mouse	Least Concern	Least Concern
Muridae	*Mastomys coucha*	Multimammate mouse	Least Concern	Least Concern
Muridae	*Mastomys natalensis*	Natal multimammate mouse	Least Concern	Least Concern
Muridae	*Micaelamys namaquensis*	Namaqua rock mouse	Least Concern	Least Concern
Muridae	*Mus minutoides*	Pygmy mouse	Least Concern	Least Concern
Muridae	*Myomyscus verreauxi*	Verreaux's mouse	Not Evaluated	Least Concern
Muridae	*Mystromys albicaudatus*	White-tailed mouse	Endangered (A3c)	Endangered (A3c)
Muridae	*Otomys irroratus*	Vlei rat	Least Concern	Least Concern
Muridae	*Otomys laminatus*	Laminate vlei rat	Least Concern	Least Concern
Muridae	*Otomys saundersiae*	Saunders' vlei rat	Least Concern	Least Concern
Muridae	*Otomys unisulcatus*	Bush vlei rat	Least Concern	Least Concern
Muridae	*Parotomys brantsii*	Brants's whistling rat	Least Concern	Least Concern
Muridae	*Parotomys littledalei*	Littledale's whistling rat	Least Concern	Near Threatened
Muridae	*Petromyscus barbouri*	Barbour's rock mouse	Least Concern	Least Concern
Muridae	*Petromyscus collinus*	Pygmy rock mouse	Least Concern	Least Concern
Muridae	*Rhabdomys pumilio*	Striped mouse	Least Concern	Least Concern
Muridae	*Saccostomus campestris*	Pouched mouse	Least Concern	Least Concern
Muridae	*Steatomys krebsii*	Krebs' fat mouse	Least Concern	Least Concern
Muridae	*Tatera afra*	Cape gerbil	Least Concern	Least Concern
Mustelidae	*Aonyx capensis*	African clawless otter	Least Concern	Least Concern

Family	*Scientific name*	English name	IUCN Threat Category	SARDB Threat Category
Mustelidae	*Ictonyx striatus*	Striped polecat	Least Concern	Least Concern
Mustelidae	*Mellivora capensis*	Honey badger	Least Concern	Near Threatened
Mustelidae	*Poecilogale albinucha*	African striped weasel	Least Concern	Data Deficient
Myoxidae	*Graphiurus murinus*	Woodland dormouse	Least Concern	Least Concern
Myoxidae	*Graphiurus ocularis*	Spectacled dormouse	Least Concern	Least Concern
Neobalaenidae	*Caperea marginata*	Pygmy right whale	Data Deficient	Least Concern
Neobalaenidae	*Megaptera novaeangliae*	Humpback whale	Least Concern	Near Threatened
Nycteridae	*Nycteris thebaica*	Egyptian slit-faced bat	Least Concern	Least Concern
Orycteropodidae	*Orycteropus afer*	Aardvark	Least Concern	Least Concern
Otariidae	*Arctocephalus gazella*	Antarctic fur seal	Least Concern	Near Threatened
Otariidae	*Arctocephalus pusillus pussilus*	Cape fur seal	Least Concern	Least Concern
Otariidae	*Arctocephalus tropicalis*	Subantarctic fur seal	Least Concern	Least Concern
Pedetidae	*Pedetes capensis*	Springhare	Least Concern	Least Concern
Phocidae	*Hydrurga leptonyx*	Leopard seal	Least Concern	Not Evaluated
Phocidae	*Lobodon carcinophagus*	Crabeater seal	Least Concern	Not Evaluated
Phocidae	*Mirounga leonina*	Southern elephant seal	Least Concern	Endangered (A2b)
Physeteridae	*Physeter macrocephalus*	Sperm whale	Vulnerable (A1d)	Vulnerable (A2bd)
Procavidae	*Procavia capensis*	Rock dassie	Least Concern	Least Concern
Pteropodidae	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat	Least Concern	Least Concern
Pteropodidae	*Rousettus aegyptiacus*	Egyptian fruit bat	Least Concern	Least Concern
Rhinocerotidae	*Diceros bicornis bicornis*	Black rhinoceros	Vulnerable (D1)	Critically Endangered (D)
Rhinolophidae	*Rhinolophus capensis*	Cape horseshoe bat	Least Concern	Near Threatened
Rhinolophidae	*Rhinolophus clivosus*	Geoffroy's horseshoe bat	Least Concern	Near Threatened
Soricidae	*Crocidura cyanea*	Reddish-grey musk shrew	Least Concern	Data Deficient
Soricidae	*Crocidura flavescens*	Greater red musk shrew	Least Concern	Data Deficient
Soricidae	*Crocidura fuscomurina*	Tiny musk shrew	Least Concern	Data Deficient
Soricidae	*Crocidura silacea*	Lesser grey-brown musk shrew	Least Concern	Data Deficient
Soricidae	*Myosorex longicaudatus boosmani*	Boosmansbos long-tailed forest shrew	Vulnerable (B1ab(iii))	Near Threatened
Soricidae	*Myosorex longicaudatus longicaudatus*	Knysna long-tailed forest shrew	Vulnerable (B1ab(iii))	Near Threatened
Soricidae	*Myosorex varius*	Forest shrew	Least Concern	Data Deficient
Soricidae	*Suncus infinitesimus*	Least dwarf shrew	Least Concern	Data Deficient
Soricidae	*Suncus varilla*	Lesser dwarf shrew	Least Concern	Data Deficient
Suidae	*Potamochoerus larvatus koiropotamus*	Bushpig ssp. koiropotamus	Least Concern	Least Concern
Vespertilionidae	*Cistugo lesueuri*	Lesueur's wing-gland bat	Least Concern	Near Threatened
Vespertilionidae	*Eptesicus hottentotus*	Long-tailed serotine bat	Least Concern	Least Concern
Vespertilionidae	*Kerivoula lanosa*	Lesser woolly bat	Least Concern	Near Threatened
Vespertilionidae	*Laephotis namibensis*	Namibian long-eared bat	Least Concern	Not Evaluated
Vespertilionidae	*Miniopterus fraterculus*	Lesser long-fingered bat	Least Concern	Near Threatened
Vespertilionidae	*Miniopterus schreibersii*	Schreiber's long-fingered bat	Near Threatened	Near Threatened

Family	*Scientific name*	English name	IUCN Threat Category	SARDB Threat Category
Vespertilionidae	*Myotis tricolor*	Temminck's hairy bat	Least Concern	Near Threatened
Vespertilionidae	*Neoromicia capensis*	Cape serotine bat	Least Concern	Least Concern
Viverridae	*Genetta genetta*	Small-spotted genet	Least Concern	Least Concern
Viverridae	*Genetta tigrina*	Large-spotted genet	Least Concern	Least Concern
Ziphidae	*Berardius arnuxii*	Arnoux's beaked whale	Data Deficient	Data Deficient
Ziphidae	*Hyperoodon planifrons*	Southern bottlenose whale	Least Concern	Least Concern
Ziphidae	*Indopacetus pacificus*	Longman's beaked whale	Data Defient	Data Deficient
Ziphidae	*Mesoplodon densirostris*	Blainville's beaked whale	Data Deficient	Data Deficient
Ziphidae	*Mesoplodon grayi*	Gray's beaked whale	Data Deficient	Data Deficient
Ziphidae	*Mesoplodon hectori*	Hector's beaked whale	Data Deficient	Data Deficient

CHAPTER 9

ARTHROPODS

A. Veldtman

Scientific Services CapeNature

CONTENTS

Introduction

Invertebrates 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. Moreover, insect conservation is considered a relatively new, although neglected, discipline in South Africa (Samways *et al.* 2012). Progress in this field has however been made through various initiatives at species and landscape level (Samways *et al.* 2012).

The focus on the Cape Floristic Region's (CFR) exceptionally high floristic diversity (e.g. Cowling *et al.* 1992; Cowling and Lombard 2002) has somewhat overshadowed its faunal diversity and, in consequence, there is a dearth of information on insect species diversity within the CFR, although their functional significance is appreciated. The consensus view is that diversity is low (Johnson 1992; Giliomee 2003), although several local scale studies of specific host plants and their herbivores suggest that insect richness might be much higher than is generally thought to be the case (e.g. Cicadellidae: Davies 1988a,b; gall-forming insects: Wright and Samways 1998). However, few groups have been subject to careful surveys, and most comparisons have been qualitative and based on examinations of studies that differ substantially in their methods (although the work by Wright and Samways (1998) on galling insect species richness is a notable exception).

Moreover, the determinants or correlates of insect diversity in this region are poorly explored. Only a few, recent studies have explored relationships between the diversity of certain groups and the environment. For example, Wright and Samways (1998) found that gall-insect species richness was positively correlated with Fynbos plant species richness and was not influenced by environmental variables such as elevation and aspect. In addition, it has been shown that Fynbos plant characteristics (e.g. infrutescence openness and wall thickness) play a major role in determining the abundance, and frequency of occurrence of insect borers on Protea species (Wright and Samways 2000). Botes *et al.* (2006) showed that, across an elevational gradient in the Cederberg, temperature explained significant proportions of the variation in ant species density and abundance, and, together with area and several vegetation variables, contributed significantly to the separation of the ant assemblages in the major vegetation types and biomes in their study area.

More importantly, several studies have found positive relationships between insect and plant species richness in the biomes of the CFR (Proche- and Cowling 2006, 2007; Proche- *et al.* 2009). It is also a centre of bee diversity (Kuhlmann 2009) and according to Samways and others (2012) the same trend has been found for other groups such as some beetles, pollen wasps, dragonflies, antlions and lacewings. Thus, the attention and protection that the CFR receives in terms of its floral diversity might provide some protection for its insect diversity (Samways *et al.* 2012).

This is the first time that Arthropods are covered in the State of Biodiversity Report. To date, the insect species richness of the Western Cape has not been adequately established. This chapter thus covers only a few groups of relatively well known groups of Arthropods for the Western Cape.

The coverage in the State of Biodiversity Report will be expanded as our knowledge of the group expands and our capacity in CapeNature grows.

Endemism

Considering the high levels of plant endemism in the Cape Floristic Region (Goldblatt 1978), similar levels of insect endemism might be expected. However, given our incomplete knowledge of the arthropod diversity in the Western Cape, it is very difficult to establish endemism of the group. 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).

Endemism is most pronounced amongst flightless taxa. For example, each of the 17 species of the wingless stag beetle genus Colophon of the Lucanidae is restricted to a single mountain peak in the Western Cape. 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.

However, it is not possible to give accurate levels of endemism of insects in the Western Cape given that the actual species richness has not been established. New species are still discovered for relatively well known groups such as ants (Mbanyana and Robertson 2008), dragonflies (Samways 2008) and katydids (Naskrecki and Bazelet 2012) and even a whole new order has recently been discovered, namely the "heelwalkers" or Mantophasmatodea (Picker *et al.* 2002). Samways *et al.* (2012) suggested that a checklist of insects that includes information on their endemism and threat status would assist with, and promote conservation efforts for insects and that the South African National Biodiversity Institute would be the most logical manager for such data.

Figure 1. The new species of katydid, *Griffiniana duplessisae*, discovered in the Cederberg Nature Reserve. a) Female and b) male.

Conservation Status

To date, there have not been any major co-ordinated efforts to carry out Red List assessment of invertebrate taxa in South Africa (Samways *et al.* 2012). Nonetheless, Red Listing has been undertaken for a few specific taxa on an ad hoc basis by expert groups (Samways 2002). There are currently 93 insects on the IUCN Red List, of which 86 species are categorised as threatened and two lycaenid butterfly species considered Extinct. However, most of the assessments are severely outdated (Samways *et al.* 2012).

Insecta/Hexapoda

Odonata - Dragonflies and damselflies
The only assessments that have been formally conducted according to the latest IUCN criteria (IUCN 2001) are those for the Odonata (Samways 2006a; Samways and Grant 2006a; Suhling *et al.* 2009). The Western Cape has a rich dragonfly fauna with many endemic species. These have all been assessed as part of the IUCN/SSC Africa Freshwater Assessment.

A freshwater health 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. 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 these species has indicated that they have an ancient lineage. Species in the genus Syncordulia for example diverged some 60 million years ago. Yet today, these species, along with several others, survive in remarkably small populations. In turn, these species are more resilient than one would think, as they recover very quickly when invasive alien trees removed. It is not that the trees are alien per se that is the problem but that they shade out the sunny habitat that the dragonflies require for all their life activities.

There are three species of dragonfly of great concern in the Western Cape. *Orthetrum rubens* (CR) was discovered in the early part of the last century on Table Mountain but has not been seen there since. The last records of it are from Du Toits Kloof in the mid-1970s. Despite intensive searches, it has never been confirmed as rediscovered. Another species, *Metacnemis angusta* (CR) was only known from a female specimen collected at Ceres in the 1920s. It was then not seen until 2003 when it was rediscovered in one pond at the base of Fransschoek Pass (on the Villiersdorp side). The pond was characteristically with a good growth of the aquatic plant *Aponogeton*. Of concern, is that this pond dried out in 2010 and the species has not been seen again. The third species is *Proischnura polychrommatica* (EN) was last seen in the early 1960s at Fransschoek. It was rediscovered in 2003 in a neighbouring pond to that where *M. angusta* occurred. It has not been seen since 2010. Both these last species were actually known only where invasive alien wattle trees had been removed.

Figure 2. a) *Metacnemis angusta* (CR) and b) *Proischnura polychrommatica* (EN). Photos: M. Samways.

Lepidoptera – Butterflies and moths

The butterfly fauna of South Africa has been well studied over many years, and the group is taxonomically well known, with a few minor issues unresolved. In addition, the distribution of species 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 surprising that butterflies form the bulk of the species on the Red Data List for insects. However, the assessments on the IUCN list were done in 1996 (Henning and Henning 1989). The butterflies of South Africa are currently being assessed according to the latest IUCN criteria (IUCN 2001) as part of the South African Butterfly Conservation Assessment (SABCA) project, and a preliminary assessment was published in 2009 (Henning *et al.* 2009). Eight butterfly species have been characterised as Critically Endangered in the WCP (Table 1).

Figure 3. Barber's Cape Flats Ranger (*Kedestes barberae bunta*) (CR). Photo: S. E. Woodhall.

Currently, only three of the critically endangered butterfly species listed for the Western Cape is formally protected. The Scarce Mountain Copper (*Trimenia malagrida malagrida*) 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 is also protected in the Table Mountain Nature Reserve. This species will be safe in the long term only if habitat management plans are continuously updated. However, no practical measures or monitoring were undertaken after the passing of legislation in 1974. The last known locality is currently in the Table Mountain National Park.

The Brenton Blue Butterfly (*Orachrysops niobe*) is well protected on the 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.

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. 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.

Other insects

The Colophon beetles and two ant species are also Red Listed, but these assessments are outdated. The National Survey of Isoptera was carried out from 1958 and continued for more than 20 years by the ARC National Collection of Insects, covering South Africa and Namibia (Samways *et al.* 2012). This resulted in the termites of South Africa being taxonomically well known. Even though no other insects have been assessed, experts are reluctant to undertake this daunting task due to the uncertainty of population numbers and distributions for most insect species (Samways *et al.* 2012).

Arachnida – Spiders and mites

Information from the South African National Survey of Arachnida (SANSA) (Dippenaar-Schoeman *et al.* 2010) shows in the Western Cape 65 spider families are known, which represents 91% of the families reported to occur in South Africa as well as 343 genera and 863 species (42%) of the total for South Africa. Of these species, about 35% are endemic to the province. Surveys are continuing in the Cederberg Wilderness Area and Table Mountain National Park as well as smaller WCP reserves.

As with insects, spiders have several qualities to support human well-being and life on Earth. For example, in the face of urgent conservation issues, they can be used as valuable bio-indicators (Cardoso *et al.* 2010), i.e., taxa whose presence or abundance readily reflects some measure of the character of the habitat within which they are found. Most arachnid orders are known to be sensitive to pollution and alterations in habitat structure (Oxbrough *et al.* 2005). They are also abundant, speciose and relatively easy to collect. Spiders are an important predatory group of terrestrial animals, and play an important role in biological control in agro-ecosystems (Dippenaar-Schoeman, 2001), while only a few species are considered to be of medical importance to humans (Dippenaar-Schoeman and Müller, 2000).

Table 1. Critically Endangered butterfly species of the Fynbos Biome (Henning *et al.* 2009).

Species	Common name	IUCN Status
Stygionympha dicksoni	Dickson's Brown	CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Chrysoritis dicksoni	Dickson's Strandveld Copper	CR A3ce; B2ab(i,ii,iii,iv,v)
Chrysoritis thysbe schloszae	Schlosz's Opal	CR C2a(i)
Orachrysops niobe	Brenton Blue	CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C2a(ii)
Thestor brachycerus brachycerus	Knysna Skolly	CR B2ab(i,ii,iii)
Trimenia malagrida malagrida	Scarce Mountain Copper	CR A4ce; 2ab(i,ii,iii,iv,v); D
Trimenia wallengrenii wallengrenii	Wallengren's Silver-spotted Copper	CR A3ce; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Kedestes barberae bunta	Barber's Cape Flats Ranger	CR A2ce; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); D

Studies of spider diversity in South Africa have gone through an intense growth phase over the past ten years, and have now reached a stage where reflections on patterns and processes observed could provide meaningful input into the identification of further work (Foord *et al.* 2011a, b). South African spider systematics and ecology are still in an exploratory phase, although the country is perhaps the best-studied on the continent, and traditional approaches to mapping diversity have enabled spider ecologists in the country to generate species lists that are often resolved up to species level. Very few other studies on mega-diverse invertebrate groups in Africa can match this taxonomic resolution. This descriptive phase will provide the foundations for more integrative work in future, and any attempts to ignore the importance of providing baseline biodiversity and taxonomic data will hamper subsequent attempts to develop a deeper understanding and appreciation of this unique heritage.

The South African National Survey of Arachnida (SANSA) was initiated to address our obligations under the Convention on Biological Diversity by discovering, describing and inventorying the South African arachnid fauna (Dippenaar-Schoeman and Craemer, 2000).
In addition to this, the project has to date also included a strong element of public involvement.

Figure 4. *Desis formidabilis.* Photo: N. Larsen.

Distribution sampling in the Western Cape Province

In addition to these new accessions, data on spider species richness of WCP were obtained from:

1) existing data sets based on information on all the preserved specimens housed in several natural history collections worldwide and published in the primary literature (15 500 records)
2) primary data of specimens housed in the National Collection of Arachnida (NCA) at the ARC-Plant Protection Research Institute (PPRI), Pretoria (45 000 records)
3) a digital photographic database containing images of species recorded by the public and researchers. These digital data are available online (www.arc.agric.za). Also included are unpublished MSc and PhD theses and longer-term surveys that were undertaken since the seventies.

Extensive sampling was carried out in the WCP during the second phase of SANSA, but gaps in the database still remain. Species lists are now available for the Karoo National Park (Dippenaar-Schoeman *et al.* 1999); Swartberg Nature Reserve (Dippenaar-Schoeman *et al.* 2005); De Hoop Nature Reserve (Haddad and Dippenaar-Schoeman 2009); Robben Island (Mukherjee *et al.* 2010) as well as an overview of the cave spiders (Dippenaar-Schoeman and Myburgh 2009) and a species list of spiders collected on Proteacea (Coetzee *et al.* 1990).

Figure 5. The baboon spider *Harpactira namaquensis.* Photo: Esther van der Westhuizen.

Long-term monitoring

The Coast To Karoo Transect

The Coast to Karoo Transect is 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 is the first of its kind in South Africa and the Western Cape and is now also replicated in Sani Pass and in Limpopo. The project is currently run by the Centre for Invasive Biology 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.). The initial aim of the work was to document abundance and richness patterns of these groups across a full altitudinal transect to understand the determinants of this variation. However, Arachnida and Collembola identifications are also underway from the bycatch, proofing very useful for researchers in these fields.

To date 135 ant species (of which many are new and undescribed, see Mbanyana and Robertson 2008) belonging to 29 genera have been collected across the transect. In addition, 103 species of arachnids in 40 families have been collected. Ten of these species are known to be new species and must still be described.

Threats

Invasive and alien species

Alien and invasive arthropod species cover most insect orders, arachnids and other non-insect arthropods (Picker and Griffiths 2011). Several of these species were introduced deliberately (e.g. as biological control agents).
However, many species are still introduced by accident and may have dire consequences if left unmanaged. One such example is the European wasp.

Vespula germanica
The European wasp, Vespula germanica is native to Europe, North Africa and 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 and 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.

Vespula germanica was first recorded in South Africa on the Cape Peninsula in 1974, although it may have been present before 1970 (Whitehead 1975; Whitehead and Prins 1975). Unlike the situation in Australasia and the Americas, there has not been a rapid expansion of the wasp in South Africa and to date it remains restricted to the Cape Peninsula and Stellenbosch. Although it became abundant in Newlands, it was never recorded far away from Table Mountain. Work by Tribe and Richardson (1994) indicated that the wasps' current distribution in the Western Cape fell within a climatically marginal part of the potential range. However, the climate envelope indicates favourable range from the Southern Cape all the way up to east Africa. Once it has reached these areas it is likely to spread rapidly and cause significant ecological and economic damage along the East coast. Recently, *V. germanica* has been observed near Mosselbay (December 2011) and the Stellenbosch Insect Museum has yielded a confirmed record from Plettenbergbay (Veldtman *et al.* 2011). The wasp is thus no longer limited to the Boland of the Western Cape and may be spreading outside the province at the moment. Furthermore, once it has crossed the international borders, the chance of an African eradication is unlikely.

Impact and Potential Threat

The most obvious impact of the European wasp is as a general nuisance to the public. The real threat of the wasp, however, is to agriculture and the ecology, where the economic impact can be considerable.

In New Zealand the wasps have been shown to be a threat to the indigenous fauna (Thomas *et al.* 1990; 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 utilisation 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 (Jackson 1996). 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.

Control Measures

Edwards (1980) proposed nine control methods by which European wasps might be controlled. Only three of these methods have attracted attention, and are considered as viable options. These are: 1) to destroy the nest, 2) poison baits, and 3) biological control. The biocontrol question is particularly attractive in the South African context, as the fact the European wasp in South Africa hardly spread for more than two decades (Tribe and Richardson 1994) suggests the possibility that an indigenous pest or disease limited the success of the wasp in South Africa (Whitehead 1975). Elucidating such biocontrol would be of significance in South Africa and world-wide.

Figure 6. The two invasive wasps. a) *Vespula germanica* and b) *Polistes dominulus*. Photo: Pia Anderson

Polistes dominulus
A second species, the European paper wasp, *Polistes dominulus* is a new arrival (post 2005, see Eardley *et al.* 2009) but seems to already occupy a similar range to *V. germanica*, despite having arrived 35 years earlier. The workers of both species look very similar in colour and size but *P. dominulus* 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. dominulus* is thus potentially very different, being a much more recent establishment and fast-spreading, potentially having different biodiversity impacts than *V. germanica*.

Recommendations

Given the predictions of climatic changes in the Western Cape it is not clear what the direct and indirect effects of these changes in the environment are likely to mean for insects, largely because the insect fauna is poorly under-stood and the determinants, or even correlates, of variation in insect diversity in the region are so poorly understood.

Moreover, as signatories to the Convention on Biodiversity, South Africa is required to develop a strategic plan for the conservation and sustainable utilisation 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).

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. It is impossible to attempt to protect something if you do not know what you are dealing with. Given the fact that it has been shown that there are correlations between insect species richness and biomes in the Western Cape (see discussions above) some protection might be provided to certain arthropod groups in protected areas such as CapeNature reserves. However, it is impossible to determine how much protection is still needed given our lack of knowledge.

Currently, the capacity constraints and priorities in CapeNature make us 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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CHAPTER 10

PLANTS AND VEGETATION

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Scientific Services CapeNature

CONTENTS

MONILARIA: A LE ROUX

Executive Summary

The Western Cape Province (WCP) has 13 489 recorded plant taxa (species, subspecies and varieties). This constitutes more than 56% of the 24 008 taxa recorded for the whole of South Africa (SA). A large number of plant taxa, 6 776, are endemic to the WCP. The vast majority plant taxa in the WCP, 13 003 (96%) are indigenous and 486 (4%) are naturalised (originally from outside the WCP). Of the naturalised taxa, 291 (2%) of the WCP flora are invasive species. Unfortunately, 1 709 of the WCP plants are Threatened - this makes up the majority (68%) of SA's Threatened species. Twenty one species in the WCP are extinct (65% of all extinct species in SA).

Of the 163 vegetation units found in the WCP, 123 (76%) are endemic or near endemic to the WCP. Of the latter, 40 vegetation units have very little of their total area (0.1 to 5%) securely conserved in 2012 compared to 37 in 2007. Eighteen endemic or near endemic vegetation unit have no area under secure protection in 2012 compared to 26 in 2007. The areas under secure conservation of three vegetation units improved by more than 10% between 2007 and 2012.

Only two of the 58 threatened terrestrial ecosystem in the WCP are not endemic or near endemic to the WCP. There are 21 Critically Endangered Ecosystems in the WCP of which ten have no official protection. Of these, 5 (Central Rûens Shale Renosterveld, Swartland Shale Renosterveld, Swartland Silcrete Renosterveld, Lourensford Alluvium Fynbos and Western Rûens Shale Renosterveld) have less than 10% natural vegetation remaining and they have no secure protection. These five units need urgent conservation attention. Of the 14 Endangered Ecosystems six have no protection. Nine of the 23 ecosystems classified as Vulnerable have no protection.

The large proportion of endemic and threatened flora and vegetation units in the WCP place an enormous responsibility on the governments of both SA and the WCP to ensure the survival of this unique flora. In the Fynbos or Cape Floristic Region, the greatest threats to the plant taxa are permanent habitat loss (including urban expansion, infrastructure development, agricultural expansion), Invasive alien plant species and habitat degradation (such as overgrazing and inappropriate fire regimes) (SANBI 2012).

A recent study indicates that the rate of discovery of new species in Fynbos has remained basically constant for 250 years and shows no sign of levelling off. Improved molecular techniques, updating outdated revisions of genera and more fieldwork in gap areas is likely to see this trend continue. There are many more new species to be found and this has profound bearing on our conservation activities and our contributions towards ensuring the sustainable development of the Western Cape economy.

Invasive alien plants (IAP's) are the second largest threat after habitat loss to conserving ecosystems and biodiversity in the Western Cape. Not only do IAP's threaten natural resources, but can impose enormous costs on industries such as agriculture and forestry. In addition, IAP's threaten delivery of ecosystem services (e.g. water production) which threatens our livelihoods. Substantial funding has been allocated to address IAP's. Initiated in 1995, the Working for Water Programme (WfW) aims at addressing IAP's in South Africa and also provide employment for impoverished communities. But we are not winning the battle against IAP's in the Western Cape. Although large areas

have been cleared, it has been predicted that at the given rates of spread (~10%/yr), current efforts are not enough to stem the tide. Where progress has been made, this has been mainly due to a combination of biocontrol and mechanical clearing.

Introduction

The Western Cape Province (WCP) is endowed with a world-renowned plant diversity and diversity of vegetation communities. This province hosts two of six, or 33%, of the world plant kingdoms, namely the Cape Floral Kingdom or, redefined as the Greater Cape Floral Region (GCFR) to include the whole winter rainfall area in SA (the Cape Floristic Region or fynbos and the Succulent Karoo Biome) (Born *et al.* 2007), and the Palaeotropical Kingdom. Two of the 34, or 6%, of the world's Biodiversity Hotspots (Mittermeier *et al.* 2004), five of the nine or, 55%, biomes found in SA (Mucina *et al.* 2006) and 163 of 435, or 37%, of the vegetation units of SA (Mucina *et al.* 2006). These above classifications can be seen as representing vegetation or ecosystems at different spatial scales.

As with the high levels of plant species diversity, the high number of endemic or near endemic vegetation units in the WCP (123 units, 76% of the units in the WCP and 28% of the units in SA) places enormous responsibility on the authorities and public to ensure these vegetation units survive.

This Province has a global responsibility to ensure that healthy, functioning ecosystems are achieved to maintain this biodiversity heritage. Chapter 2, Section 24 of the South African Constitution states that Everyone has the right:

a. to an environment that is not harmful to their health or well-being; and
b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:
    i. prevent pollution and ecological degradation;
    ii. promote conservation; and
    iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

In essence, securing healthy, functioning ecosystems can be achieved with several mechanisms but all do not ensure the same level of protection and security. To address this, areas under conservation have been classified into three Western Cape Conservation Categories (WCCC), from WCCC1 with the strongest legislation to WCCC3 with the weakest legislation (See chapter 1). Protected areas are however not the only means of ensuring healthy ecosystem but wise land use planning and wise decision-making also strive to adequately address the requirements of the ecological environment so as to ultimately assist in achieving overall societal well-being in the Province.

In the last few years, the South African National Biodiversity Institute's (SANBI) plant database, PRECIS (data available on www.posa.sanbi.org), has been used extensively for conservation assessment. This database, with it's approximately 1 000 000 records, together with the Threatened Plant Species database (SANBI 2012) and the new vegetation map with accompanying vegetation descriptions (Mucina *et al.* 2006) is the present primary basis for conservation assessment.

On 9 December 2011 the National list of terrestrial ecosystems that are threatened and in need of protection was published under the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 OF 2004). This document contains the first national list of threatened terrestrial ecosystems (using the vegetation units by Mucina et el. 2005 as surrogates for ecosystems) and provides supporting information to accompany the list. It also includes individual maps and detailed information for each listed ecosystem. This document, together with spatial data for listed ecosystems, was accessed from SANBI's Biodiversity GIS (BGIS) website (http://bgis.sanbi.org) and the calculations of areas and percentage cover for this State of Biodiversity Report was done with the Biodiversity Analysis Toolkit developed by Andrew Turner and Tim Sutton.

Methods

Flora

Data on the plant taxa in the Western Cape Province were obtained from Plants of South Africa online checklist (http://posa.sanbi.org) managed by SANBI . The IUCN Threat categorisation was obtained from the 2012 Red List of South African Plants (SANBI 2012).

Vegetation

For the vegetation analyses, the vegetation map of SA (Mucina *et al.* 2006) was used for the biome and vegetation units. The Biodiversity Analysis Toolkit developed by Andrew Turner and Tim Sutton were used to calculate areas and percentage cover.

For the vegetation units the term "near endemic" was used when 70-99% the vegetation unit occurred in the WCP.

Threatened Terrestrial Ecosystems

On the 9th of December the National list of terrestrial ecosystems that are threatened and in need of protection was published under the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 OF 2004). This document contains the first national list of threatened terrestrial ecosystems and provides supporting information to accompany the list. It also includes individual maps and detailed information for each listed ecosystem. This document, together with spatial data for listed ecosystems, was accessed from SANBI's Biodiversity GIS (BGIS) website (http://bgis.sanbi.org) and the calculations of areas and percentage cover for this State of Biodiversity Report was done with the Biodiversity Analysis Toolkit developed by Andrew Turner and Tim Sutton.

Systematic account, distribution and endenism

Flora

A full systematic account of the plants of the WCP is beyond the scope of this report and thus only summary figures will be presented here. Similarly distribution data for the WCP are insufficient for a thorough analysis of patterns of endemism across the WCP (it is hoped that the growth of high resolution spatial data for plant distributions will make such an analysis feasible in the near future).

There are 13 489 plant taxa (species, subspecies and varieties) recorded for the WCP (PRECIS 2012). This represents more than 56% of the 24 008 taxa (PRECIS 2012) recorded for South Africa. Of the plant taxa in the WCP, 13 003 (96%) are indigenous and 486 (4%) are naturalised (originally from outside

Figure 1. *Moraea loubseri*, a Critically Endangered species thought to be extinct, was re-discovered in September 2011.

the WCP). Of the naturalised taxa, 291 or 2% of the WCP flora are invasive species. Unfortunately, 1 709 of the WCP plants are Threatened - this makes up the majority (68%) of SA's Threatened species. Twenty one species in the WCP are extinct (65% of all extinct species in SA).

A large percentage of WCP flora is endemic to the province: 6 624 taxa or 51% of the species indigenous to the WCP (SANBI 2012).

Vegetation

The Western Cape Province hosts two of the six of the world's plant kingdoms (the Greater Cape Floral Kingdom (GCFK) and the Palaeotropical Kingdom, as well as two of the 34 world's Biodiversity Hotspots (Mittermeier *et al.* 2004). Of the nine biomes found in SA (Mucina *et al.* 2005), five are found in the WCP (the Grassland Biome is almost negligible in the WCP with only 0.03% found in here).

One hundred and sixty three of the 435 of the vegetation units (37%) found in South Africa are represented in the WCP. Of these, 104 (64%) are endemic and a further 19 (12%) are near endemic (70-99% cover of unit) in the WCP (Table 2). Eighteen endemic or near endemic vegetation unit have no area under secure protection in 2012 compared to 26 in 2007. The areas under secure conservation of three vegetation units improved by more than 10% between 2007 and 2012.

The conservation of these 123 endemic or near endemic vegetation units (76% of WCP vegetation units) is thus totally the responsibility of the Western Cape government.

These classifications can be seen as representing ecosystem diversity on different geographical scales and show that the WCP is biologically diverse across all these scales.

Conservation Status

Flora

The number of plant taxa in the WCP that are listed as Threatened is a large number at 1 709. Of these, 37 are Critically Endangered and Presumed Extinct, a further 296 are critically endangered, 575 Endangered and 801 are Vulnerable (SANBI 2012). There are 21 Extinct taxa and three are Extinct in the Wild and 37 Critically Endangered, Possibly Extinct. This last category, CR PE, is a fluid one because every field season seems to yield a re-discovery or two, e.g. *Moraea loubseri,* a Critically Endangered species thought to be extinct, was re-discovered in September 2011 (Figure 1).

In total there are 2 984 plant taxa of Conservation Concern in the WCP, i.e. species that have a high conservation importance for conserving plant diversity and includes Threatened species plus those classified in the categories Extinct in the Wild, Regionally Extinct, Near Threatened, Critically Rare, Rare, Declining and Data Deficient due to insufficient information being available to make an assessment (SANBI 2012).

Table 1. Percentages of biomes based on Mucina *et al.* (2005) found in SA and the WCP with percentages conserved by the different Western Cape Conservation Categories in the Western Cape. Calculations done in UTM 34 (WGS84) projection and may differ from the figures in Le Roux *et al.* (2007) due to the calculations based on Lambert projection then.

Biome	Total ha in SA	% of Biome in WCP	% of Biome protected in WCCC1 areas		% of Biome protected in WCCC2 areas		% of Biome protected in WCCC3 areas	
			2007	2012	2007	2012	2007	2012
Albany Thicket Biome	3 162 121	5.43	0.4	0.4	0.1	0.1	0.3	0.5
Desert Biome	737 038	0	0.0	0.0	0.0	0.0	0.0	0.0
Forest Biome	107 002	46.71	26.9	24.8	0.5	0.5	0.4	0.7
Fynbos Biome	8 525 176	78.99	9.4	9.7	8.0	7.8	8.5	10.2
Grassland Biome	36 431 847	0.03	0.0	0.0	0.0	0.0	0.0	0.0
Indian Ocean Coastal Belt	1 694 812	0	0.0	0.0	0.0	0.0	0.0	0.0
Nama-Karoo Biome	26 033 064	11.28	0.3	0.3	0.0	0.0	0.5	0.5
Savanna Biome	42 322 529	0	0.0	0.0	0.0	0.0	0.0	0.0
Succulent Karoo Biome	8 700 652	34.92	1.0	2.0	0.4	0.5	1.1	1.3

Of importance to CapeNature is the Critically Rare category. These are species only known from one population that currently is not exposed to any direct or plausable potential threat. These tend to be found at high altitudes and/or within conservation areas but would be especially vulnerable to climate change or one-off events. Increased emphasis should be placed on targeted fieldwork to ensure that these species remain Critically Rare and not become Critically Endangered or Extinct in the Wild.

The decline in species listed in the Extinct category (from to 27 to 21) from the previous report to the current report is due to a number of taxa being erroneously placed in this category in previous assessments, as was noted in the 2007 report (Le Roux *et al.* 2007).

Vegetation

The conservation status of these biomes, vegetation units and threatened terrestrial ecosystems are assessed by the contribution of the area covered by protected areas in the Western Cape Conservation Category 1 (WCCC1), or areas with strong legislative security (see Chapter 1 for the definitions of WCCC).

Biomes

Nine biomes are found in SA and five are represented in the WCP. Almost no Grassland, only 0.03% is found in the WCP. The three biomes with the greatest representation in the WCP are: the Fynbos Biome (79% of SA), Forest Biome (47% of SA) and the Succulent Karoo Biome (35% of SA) (Table 1). The area under conservation of the Fynbos Biome (near endemic to the WCP) has increased by 0.3% in the WCCC1 category, decreased by 0.2% in the WCCC2 category and increased by 0.7% in the WCCC3 category in the last five years. This increase was mainly due to the Stewardship Programme that has been initiated. The target of 10% conserved of the Fynbos Biome (not taking the protected areas in the Eastern Cape into consideration) has almost been achieved (9.7%) in the WCCC1 category, indicating that it is securely conserved. However, figure is skewed, as mostly mountain fynbos is well conserved and the lowland fynbos and renosterveld are not adequately conserved. The aim of the Stewardship Program is to get more of these threatened habitats into formal conservation. The area of Forest Biome conserved has decreased in the last five years most likely due to the refinement of the Garden Route National Park boundaries. However, the Western Cape still securely conserves half of this biome. Even though the conservation status of the Succulent Karoo Biome in the WCP has improved slightly (in the Knersvlakte by about 1%) it still needs to be improved considerably.

Vegetation Units

There are 435 vegetation units mapped for South Africa, Lesotho and Swaziland (Mucina *et al.* 2006) and 163 (37%) are found in the WCP. Of the 163 units in the WCP, 104 (64%) are endemic and a further 19 (12%) are near endemic (70-99% cover of unit) in the WCP (Table 2). The conservation of these 123 vegetation units (76% of WCP vegetation units) is thus totally the responsibility of the Western Cape government. Of these (40 endemic and 6 near endemic units) have more than 10% of their area in WCCC1 protected area. Eighteen units, all in mountainous areas except for the Overberg Dune Strandveld, have more than 30% of their area conserved by WCCC1 protected areas. Although not adequately conserved by WCCC1 protected areas, there are a number of the endemic vegetation units well covered by WCCC2 & WCCC3 protected areas, especially through Mountain Catchment Areas and Biosphere Reserves. However it must be borne in mind that these two categories cannot guarantee long-term protection. Thirty-nine endemic vegetation units have less than 2% or no protection at all by WCCC1 category areas.

Of the latter, 40 vegetation units have very little of their total area (0.1 to 5%) securely conserved in 2012 compared to 37 in 2007. Eighteen endemic or near endemic vegetation unit have no area under secure protection in 2012 compared to 26 in 2007. The areas under secure conservation of three vegetation units improved by more than 10% between 2007 and 2012.

The conservation by WCCC1 areas of the endemic Knersvlakte Quartz Vygieveld and Central Knersvlakte Vygieveld and the near endemic Northern Knersvlakte Vygieveld in the Vanrhynsdorp Endemic Centre in the Suculent Karoo has increase significantly by more than 10%.

Table 2. Percentages of vegetation units based on Mucina *et al.* (2005) found in the Western Cape with percentages conserved of the different Western Cape Conservation Categories in the Western Cape. Calculations done in UTM 34 (WGS84) projection and may differ from the figures in Le Roux *et al.* (2007) due to the calculations then based on Lambert projection then. There reduction in areas conserved in 2012 compared to 2007 is mostly due refinement of GIS boundaries. The National list of threatened terrestrial ecosystems that are threatened and in need of protection was published in 2011 under the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 OF 2004). Ecosystems listed under D1 have been highlighted in italics.

Threatened Ecosystem Category	Vegetation Unit	Total ha of Veg-etation Unit / Threatened Ecosystem in SA	% of Veg-etation Unit / Threatened Ecosystem in WCP	Total ha remaining of Veg-etation Unit / Threatened Ecosystem in SA	% of remaining of Threat-ened Ecosystem	% of Veg-etation Unit in WCCC1 2007	% of Veg-etation Unit in WCCC1 2012	% of Veg-etation Unit in WCCC2 2007	% of Veg-etation Unit in WCCC2 2012	% of Veg-etation Unit in WCCC3 2007	% of Veg-etation Unit in WCCC3 2012
	Swartberg Altimontane Sandstone Fynbos	5080	100			87.4	87.4	12.6	12.6	0.0	0.0
	Fynbos Riparian Vegetation	1689	100			78.7	78.8	18.7	17.1	0.0	0.0
	Central Inland Shale Band Vegetation	9847	100			68.4	69.8	22.5	21.2	1.6	1.6
	North Kammanassie Sand-stone Fynbos	33255	100			66.3	66.3	13.0	13.0	0.0	0.0
VU D1	*Hawequas Sandstone Fynbos*	105105	100	100944	96.0	53.8	54.0	35.2	34.9	5.0	13.3
	Potberg Sandstone Fynbos	10728	100			49.1	49.1	2.0	2.0	48.8	34.7
	Western Coastal Shale Band Vegetation	13465	100			42.7	44.2	29.9	29.3	10.4	14.7
	South Sonderend Sandstone Fynbos	38066	100			39.1	41.2	38.3	37.6	10.2	11.2
CR A1	Peninsula Granite Fynbos	8869	100	2647	29.8	39.2	39.6	0.0	0.0	0.0	1.4
	South Rooiberg Sandstone Fynbos	38806	100			34.2	37.9	10.2	6.7	12.0	25.8
	North Rooiberg Sandstone Fynbos	31850	100			33.1	35.8	24.9	23.8	8.1	11.3
	Western Altimontane Sand-stone Fynbos	3751	100			33.9	33.9	66.1	66.1	0.0	0.0
	Central Knersvlakte Vygieveld	29250	100			14.0	29.1	0.0	0.0	0.0	0.0
	Matjiesfontein Shale Fynbos	10645	100			28.9	28.9	0.2	0.2	0.0	5.3
	De Hoop Limestone Fynbos	68606	100			28.7	28.7	0.9	0.9	1.1	1.1
	Knersvlakte Quartz Vygieveld	121225	100			17.4	28.0	0.0	0.0	0.0	0.0
	North Hex Sandstone Fynbos	39402	100			24.9	24.9	55.4	55.4	0.0	0.0
	Olifants Sandstone Fynbos	105858	100			22.6	22.6	42.2	42.2	9.8	9.8
	Winterhoek Sandstone Fynbos	118987	100			22.1	22.1	60.3	60.3	0.0	0.0
	South Langeberg Sandstone Fynbos	122282	100			21.1	21.9	55.1	55.0	1.6	1.5
VU D1	*Cederberg Sandstone Fynbos*	244854	100	204198	83.4	17.1	21.8	27.1	25.5	22.3	19.7
	Northern Inland Shale Band Vegetation	26432	100			16.8	21.4	65.3	61.9	9.5	8.3
	Central Coastal Shale Band Vegetation	6863	100			19.9	20.4	45.7	45.7	1.0	1.0
	North Sonderend Sandstone Fynbos	51301	100			19.4	19.4	52.9	52.8	0.0	0.5
	Blombos Strandveld	6006	100			19.1	19.1	20.1	20.1	1.9	2.0
CR A1	Elgin Shale Fynbos	27946	100	4495	16.1	14.4	16.1	7.2	6.7	56.4	78.5
	South Hex Sandstone Fynbos	32060	100			16.1	16.1	74.8	74.8	0.0	0.0
VU D1	*Boland Granite Fynbos*	49906	100	27816	55.7	9.5	14.3	23.9	20.9	11.5	55.2
	South Kammanassie Sand-stone Fynbos	30414	100			12.8	14.2	56.9	56.8	0.0	0.0
	North Outeniqua Sandstone Fynbos	87846	100			11.2	10.8	0.0	0.0	9.9	9.9
VU D1	*Agulhas Limestone Fynbos*	29438	100	17682	60.1	8.8	9.5	4.3	4.3	12.7	13.0

Threatened Ecosystem Category	Vegetation Unit	Total ha of Veg-etation Unit / Threatened Ecosystem in SA	% of Veg-etation Unit / Threatened Ecosystem in WCP	Total ha remaining of Veg-etation Unit / Threatened Ecosystem in SA	% of remaining of Threat-ened Ecosystem	% of Veg-etation Unit in WCCC1 2007	% of Veg-etation Unit in WCCC1 2012	% of Veg-etation Unit in WCCC2 2007	% of Veg-etation Unit in WCCC2 2012	% of Veg-etation Unit in WCCC3 2007	% of Veg-etation Unit in WCCC3 2012
	Swartberg Shale Fynbos	7509	100			8.6	8.6	2.5	2.5	0.0	35.5
	Western Little Karoo	419818	100			8.5	8.5	0.8	1.7	0.4	0.4
EN A1	Agulhas Sand Fynbos	23046	100	7801	33.8	7.6	7.6	0.6	0.6	0.0	0.0
CR A1	Swartland Alluvium Fynbos	46987	100	11729	25.0	1.8	7.6	6.1	1.6	6.7	50.2
	Western Gwarrieveld	75906	100			1.8	7.5	3.9	3.8	27.1	25.3
	Matjiesfontein Shale Reno-sterveld	212463	100			7.2	7.2	5.9	5.9	0.0	1.1
	Namaqualand Spinescent Grassland	52257	100			6.8	7.0	0.0	0.0	0.0	0.0
	Breede Shale Fynbos	31838	100			5.2	5.5	24.7	26.1	1.0	1.3
EN A1	Potberg Ferricrete Fynbos	4046	100	1672	41.3	5.5	5.5	0.0	0.0	94.5	51.0
	Matjiesfontein Quartzite Fynbos	126728	100			5.1	5.1	3.9	3.9	0.0	1.3
	Kango Conglomerate Fynbos	40561	100			5.1	5.1	6.7	6.7	4.3	4.3
VU A1	Swellendam Silcrete Fynbos	86785	100	42878	49.4	4.2	4.8	0.3	0.3	5.4	5.1
	Little Karoo Quartz Vygieveld	11484	100			4.6	4.6	6.8	6.8	0.0	0.0
CR A1	Elim Ferricrete Fynbos	66528	100	15085	22.7	4.6	4.4	1.9	2.2	8.1	8.3
VU A1&D1	Hopefield Sand Fynbos	179882	100	86786	48.2	1.8	2.9	2.3	2.3	53.3	52.2
VU A1	Montagu Shale Renosterveld	163657	100			2.0	2.5	6.4	6.3	1.7	1.3
	Robertson Granite Fynbos	1699	100			2.5	2.5	38.8	38.8	0.0	0.0
VU A1	Kango Limestone Renoste-rveld	50177	100	25892	51.6	2.4	2.4	0.7	0.7	13.4	13.4
CR D1	*Atlantis Sand Fynbos*	69833	100	31493	45.1	2.1	2.1	1.5	1.5	60.8	60.8
EN C	Western Cape Milkwood Forest	1589	100	1309	82.4	1.8	1.8	3.0	3.0	18.8	20.3
	Breede Shale Renosterveld	104587	100			1.6	1.6	4.8	5.2	0.0	5.1
VU A1	Breede Sand Fynbos	9275	100	4471	48.2	1.5	1.5	1.5	1.5	0.0	71.0
CR A1	Rûens Silcrete Renosterveld	20970	100	2171	10.4	0.0	1.4	0.2	0.2	11.9	3.2
VU A1&D1	Leipoldtville Sand Fynbos	275679	100	130423	47.3	0.0	1.2	0.1	0.9	0.4	0.4
CR A1	Cape Lowland Alluvial Vegetation	35821	100	10287	28.7	1.1	1.2	0.3	0.3	4.9	3.5
	Graafwater Sandstone Fynbos	125413	100			0.0	1.0	0.0	1.1	0.0	0.0
EN A1	Greyton Shale Fynbos	26884	100	10409	38.7	0.8	0.9	5.6	5.6	26.9	26.9
CR A1&D1	Swartland Granite Renoste-rveld	94785	100	11565	12.2	0.2	0.7	0.8	0.6	40.1	64.6
CR A1	Eastern Rûens Shale Reno-sterveld	276902	100	33966	12.3	0.2	0.6	0.1	0.1	7.2	1.6
	Robertson Karoo	61274	100			0.5	0.5	1.2	1.5	0.0	2.8
EN A1	Breede Alluvium Fynbos	51044	100	21910	42.9	0.2	0.4	3.0	3.9	7.6	34.8
CR A1	Central Rûens Shale Reno-sterveld	201063	100	14932	7.4	0.4	0.4	0.0	0.1	1.1	1.1
CR A1&D1	Swartland Shale Renoste-rveld	494712	100	37372	7.6	0.1	0.4	0.6	0.5	5.4	11.0
	Montagu Shale Fynbos	163660	100	92788	56.7	0.4	0.4	3.6	3.6	0.0	0.0
CR A1&D1	Cape Flats Sand Fynbos	54584	100	6859	12.6	0.3	0.3	0.3	0.3	18.8	21.7

Threatened Ecosystem Category	Vegetation Unit	Total ha of Veg-etation Unit / Threatened Ecosystem in SA	% of Veg-etation Unit / Threatened Ecosystem in WCP	Total ha remaining of Veg-etation Unit / Threatened Ecosystem in SA	% of remaining of Threat-ened Ecosystem	% of Veg-etation Unit in WCCC1 2007	% of Veg-etation Unit in WCCC1 2012	% of Veg-etation Unit in WCCC2 2007	% of Veg-etation Unit in WCCC2 2012	% of Veg-etation Unit in WCCC3 2007	% of Veg-etation Unit in WCCC3 2012
CR A1	Swartland Silcrete Renosterveld	9989	100	641	6.4	0.3	0.3	0.0	0.0	7.3	11.2
CR A1	Lourensford Alluvium Fynbos	5529	100	374	6.8	0.2	0.2	2.6	2.6	0.0	0.5
CR A1	Western Rûens Shale Reno-sterveld	118997	100	11018	9.3	0.0	0.2	0.8	0.7	10.6	16.0
VU A1	Breede Alluvium Renoste-rveld	49813	100	25067	50.3	0.1	0.1	0.9	0.9	0.0	0.7
VU D1	*Piketberg Sandstone Fynbos*	46053	100	39738	86.3	0.0	0.1	1.9	1.9	0.0	0.0
VU A1	Ceres Shale Renosterveld	49162	100	23794	48.4	0.1	0.1	0.7	0.7	0.6	0.6
	Breede Quartzite Fynbos	9811	100			0.1	0.1	7.1	7.1	0.0	12.0
CR A1	Muscadel Riviere	42238	100	6400	15.2	0.0	0.1	0.3	0.3	0.1	0.1
VU A1	Eastern Little Karoo	155495	100	87186	56.1	0.1	0.1	0.6	1.5	0.5	0.6
EN A1	Mossel Bay Shale Renoste-rveld	79589	100	32625	41.0	0.0	0.0	0.2	0.2	0.0	0.0
	Canca Limestone Fynbos	112212	100			0.0	0.0	3.9	3.9	2.7	3.0
EN A1	Kouebokkeveld Alluvium Fynbos	18002	100	5833	32.4	0.0	0.0	1.4	1.4	1.2	1.2
VU A1	Kouebokkeveld Shale Fynbos	42791	100	22439	52.4	0.0	0.0	18.0	18.0	0.9	0.9
VU A1	Piketberg Quartz Succulent Shrubland	240	100	141	58.8	0.0	0.0	0.0	0.0	0.0	0.0
VU A1	Swartland Alluvium Renoste-rveld	6253	100	2972	47.5	0.0	0.0	0.0	0.0	1.6	1.6
	Citrusdal Vygieveld	12665	100			0.0	0.0	4.3	5.6	35.4	35.4
	Klawer Sandy Shrubland	12574	100			0.0	0.0	0.0	0.0	0.0	0.0
	Knersvlakte Dolomite Vygieveld	5798	100			0.0	0.0	0.0	0.0	0.0	0.0
	Robertson Granite Renoste-rveld	1922	100			0.0	0.0	28.6	28.6	0.0	0.0
	Saldanha Limestone Strand-veld	3569	100			0.0	0.0	0.7	0.7	99.3	99.3
	Southern Cape Valley Thicket	17732	100			0.0	0.0	1.0	1.0	0.0	0.0
	North Langeberg Sandstone Fynbos	103081	100			12.9	12.9	44.9	44.9	0.0	0.4
VU A1	Albertinia Sand Fynbos	70770	100	40036	56.6	5.0	5.0	3.3	3.3	3.4	3.1
CR D1	*Overberg Sandstone Fynbos*	116903	100	94171	80.6	4.6	8.2	3.5	4.0	16.9	17.7
CR D1	*Kogelberg Sandstone Fynbos*	91530	100	73570	80.4	57.2	58.4	18.8	17.6	20.6	23.3
	South Outeniqua Sandstone Fynbos	157386	100			47.7	28.8	0.2	0.2	1.8	1.9
CR A1	Knysna Sand Fynbos	15370	100	2570	16.7	2.8	2.5	0.9	0.9	2.4	2.3
EN A1	Garden Route Granite Fynbos	43160	100	12814	29.7	1.2	0.2	0.2	0.2	2.3	2.3
	Lamberts Bay Strandveld	45156	100			1.4	1.8	8.2	8.2	0.0	0.0
VU A1	Saldanha Flats Strandveld	76097	100	35890	47.2	15.0	14.2	0.1	0.1	84.9	85.6
EN A1	Groot Brak Dune Strandveld	20277	100	10440	51.5	0.0	0.0	0.7	0.7	8.0	8.9
EN D1	*Peninsula Sandstone Fynbos*	23268	100	20888	89.8	90.5	90.6	0.0	0.0	0.0	0.3
VU A1	Cape Winelands Shale Fynbos	8570	100	4072	47.5	12.8	13.3	27.9	27.3	13.1	43.0
EN D1	*Cape Flats Dune Strandveld*	42426	100	16233	38.3	5.5	5.6	5.1	5.1	25.7	25.9
EN A1	Saldanha Granite Strandveld	23503	100	8570	36.5	8.9	7.9	1.3	1.3	89.5	90.4

Threatened Ecosystem Category	Vegetation Unit	Total ha of Veg-etation Unit / Threatened Ecosystem in SA	% of Veg-etation Unit / Threatened Ecosystem in WCP	Total ha remaining of Veg-etation Unit / Threatened Ecosystem in SA	% of remaining of Threat-ened Ecosystem	% of Veg-etation Unit in WCCC1 2007	% of Veg-etation Unit in WCCC1 2012	% of Veg-etation Unit in WCCC2 2007	% of Veg-etation Unit in WCCC2 2012	% of Veg-etation Unit in WCCC3 2007	% of Veg-etation Unit in WCCC3 2012
EN A1	Hangklip Sand Fynbos	8121	100	3641	44.8	15.6	15.6	6.5	6.5	46.8	54.9
CR A1	Peninsula Shale Renosterveld	2972	100	527	17.7	18.4	18.4	0.0	0.0	0.0	0.0
	Overberg Dune Strandveld	39374	100			36.3	36.7	10.8	10.7	5.0	4.1
	Langebaan Dune Strandveld	43814	100			30.7	29.0	1.6	1.6	44.8	46.5
	Vanrhynsdorp Gannabosveld	97152	99			0.0	0.0	0.0	0.0	0.0	0.0
	Swartruggens Quartzite Fynbos	164567	99			3.7	9.9	3.1	3.1	52.6	46.4
	Cape Lowland Freshwater Wetlands	7196	98			26.3	27.3	2.1	2.1	7.9	8.3
	South Swartberg Sandstone Fynbos	108422	97			47.3	47.3	33.8	33.8	0.1	0.1
	Gamka Thicket	147362	97			9.0	9.1	1.5	1.6	7.2	11.0
EN A1	Cape Vernal Pools	20	95	6	30.0	0.0	0.0	0.0	0.0	0.0	0.0
	Doringrivier Quartzite Karoo	47202	94			0.0	0.0	0.0	0.0	8.6	8.6
	North Swartberg Sandstone Fynbos	86385	93			70.9	70.9	5.2	5.2	0.0	6.3
VU A1	Garden Route Shale Fynbos	56633	93	25169	44.4	2.4	2.2	1.2	1.2	3.5	5.3
	Cape Inland Salt Pans	8461	93			23.6	23.1	0.2	0.2	5.7	6.1
	Gamka Karoo	2031811	89			2.1	2.1	0.2	0.2	0.0	0.0
	Swartberg Shale Renoste-rveld	27629	87			8.2	8.2	1.3	1.3	0.0	38.2
	Vanrhynsdorp Shale Reno-sterveld	23980	86			0.0	0.0	0.0	0.0	0.0	0.0
	Knersvlakte Shale Vygieveld	88524	85			0.0	0.4	1.1	1.1	0.0	0.0
	Southern Afrotemperate Forest	80005	79			44.9	39.9	1.1	1.1	1.1	1.6
	Northern Knersvlakte Vygieveld	151437	78			0.2	15.4	0.0	0.0	0.0	0.0
	Koedoesberge-Moordenaars Karoo	471100	77			0.3	0.3	0.4	0.4	0.0	0.0
CR A1	Langkloof Shale Renosterveld	20715	72	5536	26.7	0.0	0.0	0.0	0.0	1.1	1.1
	Namaqualand Arid Grassland	70462	70			0.0	0.7	0.0	0.0	0.0	0.0
	Cape Coastal Lagoons	4647	68			2.3	1.9	1.6	1.6	34.3	34.7
	Agter-Sederberg Shrubland	90583	68			0.9	2.7	0.0	0.0	31.6	29.9
	Central Mountain Shale Renosterveld	123556	64			0.0	0.0	0.0	0.0	0.0	0.0
	Prince Albert Succulent Karoo	258239	62			2.2	2.3	0.5	0.5	0.0	6.1
	Arid Estuarine Salt Marshes	5678	61			0.0	0.0	0.0	0.0	24.1	24.1
	Cape Estuarine Salt Marshes	10238	54			19.7	19.9	0.0	0.0	25.8	25.8
	Tanqua Wash Riviere	212886	54			4.6	8.7	2.2	2.2	0.4	0.4
	Uniondale Shale Renoste-rveld	134130	53			0.0	0.1	0.0	0.0	4.6	4.6
	Swartruggens Quartzite Karoo	55919	51			5.5	7.6	2.9	2.9	27.1	24.9
	Tanqua Karoo	698509	48			0.1	2.8	2.7	2.7	1.1	1.1
	Southern Cape Dune Fynbos	18644	47			13.7	14.4	1.5	1.5	0.8	0.9
	Namaqualand Sand Fynbos	94083	42			0.0	0.0	0.0	0.0	0.1	0.1

Threatened Ecosystem Category	Vegetation Unit	Total ha of Veg-etation Unit / Threatened Ecosystem in SA	% of Veg-etation Unit / Threatened Ecosystem in WCP	Total ha remaining of Veg-etation Unit / Threatened Ecosystem in SA	% of remaining of Threat-ened Ecosystem	% of Veg-etation Unit in WCCC1 2007	% of Veg-etation Unit in WCCC1 2012	% of Veg-etation Unit in WCCC2 2007	% of Veg-etation Unit in WCCC2 2012	% of Veg-etation Unit in WCCC3 2007	% of Veg-etation Unit in WCCC3 2012
VU D1	*Bokkeveld Sandstone Fynbos*	136140	39	111364	81.8	0.0	0.3	0.3	0.0	0.0	0.0
	Southern Karoo Riviere	530575	38			0.1	0.1	0.0	0.0	0.0	0.0
	Namaqualand Strandveld	392345	37			0.0	0.0	0.2	0.2	2.8	2.8
	Kouga Sandstone Fynbos	240535	37			6.3	6.3	1.6	1.6	7.7	7.7
	Tsitsikamma Sandstone Fynbos	228136	34			14.2	15.5	0.0	0.0	0.2	1.2
	Upper Karoo Hardeveld	1173536	31			3.5	3.6	0.0	0.0	1.7	1.7
	Namaqualand Klipkoppe Shrubland	1094915	29			0.1	0.3	0.0	0.0	0.0	0.0
	Namaqualand Riviere	85493	26			1.0	1.2	0.0	0.0	0.1	0.1
	Freshwater Lakes	16173	23			13.0	13.1	0.0	0.0	0.5	0.5
	Willowmore Gwarrieveld	231293	19			0.1	0.1	0.1	0.1	0.0	3.5
	Cape Seashore Vegetation	22815	18			2.6	4.0	1.1	1.1	4.7	3.8
	Kamiesberg Mountains Shrubland	42564	18			0.0	0.0	0.1	0.1	0.0	0.0
VU A1	Eastern Coastal Shale Band Vegetation	7824	18	3463	44.3	11.4	7.0	0.1	0.1	0.9	0.9
	Namaqualand Blomveld	381268	13			0.0	0.0	0.0	0.0	0.0	0.0
	Namaqualand Seashore Vegetation	6773	11			0.0	0.0	0.0	0.0	0.0	0.0
	Eastern Upper Karoo	4991575	10			0.0	0.0	0.0	0.0	1.8	1.8
	Tanqua Escarpment Shrubland	132050	7			0.7	6.5	0.0	0.0	0.0	0.0
	Namaqualand Heuweltjieveld	254039	7			0.0	0.0	0.0	0.0	0.0	0.0
	Grootrivier Quartzite Fynbos	56527	6			0.0	0.0	0.0	0.0	0.0	2.3
	Eastern Inland Shale Band Vegetation	10901	6			1.1	1.1	0.4	0.4	3.9	3.9
	Kouga Grassy Sandstone Fynbos	414373	5			0.0	0.0	0.2	0.2	0.1	0.1
	Eastern Lower Karoo	833254	4			0.0	0.0	0.0	0.0	0.0	0.0
	Roggeveld Shale Renosterveld	291471	4			0.0	0.1	0.0	0.0	0.0	0.0
	Western Upper Karoo	1713693	3			0.0	0.0	0.0	0.0	0.8	0.8
	Namaqualand Salt Pans	9980	2			0.0	0.0	0.0	0.0	0.0	0.0
	Karoo Escarpment Grassland	841118	2			0.3	0.4	0.0	0.0	0.0	0.0
	Southern Coastal Forest	16623	0			0.0	0.0	0.0	0.0	0.0	0.0

Threatened terrestrial ecosystems

In order to reduce the rate of ecosystem and species extinction, the National Environmental Management: Biodiversity Act (Act 10 of 2004) provides for listing of threatened or protected ecosystems.

National Spatial Biodiversity Assessment (NSBA) (2004) included one of the first attempts to measure ecosystem status at a national scale. The only criterion that this early assessment used to indicate ecosystem status was the degree of irreversible habitat loss. The more recent NEMBA listing has allowed for a much more comprehensive assessment and additional criteria have been introduced. Criteria now include:

- A1: Irreversible loss of natural habitat
- A2: Ecosystem degradation & loss of integrity
- B: Rate of habitat loss
- C: Limited extent & imminent threat
- D1: Threatened plant species associations
- D2: Threatened animal species associations
- E: Fragmentation
- F: Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan

Due to data constraints and need to set and test criteria, only Criteria A1, D1 and F have been applied thus far. Criteria A2 and C have only been applied to forests. Unfortunately, we were unable to apply criteria F to the Western Cape as we do not have a provincial scale systematic conservation plan and there were other technical details that needed to be resolved. The two main criteria used in the Western Cape were therefore Criteria A1 (irreversible loss of natural habitat) and D1 (threatened plant species associations) (Table 2).

The application of these criteria yields a categorisation of the ecosystems as: Critically Endangered, Endangered, Vulnerable or Protected (Table 3).

While more recent land cover data resulted in changes to the status of some vegetation types, the most significant changes came about as a result of the introduction of criteria D1 (threatened plant species associations). Ecosystems with naturally high levels of plant rarity and endemism such (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.

The implications of listing terrestrial threatened ecosystems:

Among other things, listed threatened ecosystems should be taken into account in spatial planning (e.g. municipal IDPs and SDFs) and in environmental authorisations. Listing Notice 3 of the NEMA Environmental Impact Assessment Regulations (R546 of 2010) identifies activities that require a basic assessment in identified geographical areas. Activity 12 in Listing Notice 3 refers specifically to critically endangered or endangered ecosystem listed in terms of the Biodiversity Act. The clearance of 300m^2 of more of vegetation in these ecosystems will trigger the need for environmental authorisation. As a result large areas will now have an unprecedented degree of environmental oversight and the number of EIAs for small developments within the Western Cape (particularity in the Overberg) is set to increase significantly.

How do threatened ecosystems and Critical Biodiversity Areas relate?

Critical Biodiversity Areas are those terrestrial and aquatic features which much be safeguarded in their natural state as they are critical for conserving biodiversity pattern and maintaining ecological functioning. CBAs include habitats that are not yet threatened, but in order to prevent the loss and fragmentation of these ecosystems, CBAs represent the most optimal layout to meet conservation targets. Listing threatened ecosystems are also not to ensure the persistence of landscape-scale ecological processes or to ensure the provision of ecosystem services.

Table 3. The categories of threatened ecosystems and their definitions as used in the National Environmental Management: Biodiversity Act listing.

Critically Endangered (CR) ecosystems	•ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation.
Endangered (EN) ecosystems	•ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems.
Vulnerable (VU) ecosystems,	•ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems.
Protected ecosystems	•ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed as critically endangered, endangered or vulnerable

Recommendations:

- CapeNature should explore ways to ensure that CBAs are included under Criteria F when the list of threatened ecosystems is updated.
- We need work with our partners to gather data to eventually feed into the currently inactive criteria.
- We need to work with our partners to groundtruth habitats listed under criteria D1 in areas of potential conflict so it can be quickly confirmed if an area is of conservation value or not.

Conservation status of Threatened Terrestrial Ecosystems:

There are 58 threatened terrestrial ecosystem in the WCP of which only two are not endemic or near endemic to the WCP.

Of the 21 Critically Endangered Threatened Ecosystems, four are securely protected by more than 10% and seven Ecosystems are protected between 1 and 10%. Ten Critically Endangered Ecosystems need protection and of these, Central Rûens Shale Renosterveld, Swartland Shale Renosterveld, Swartland Silcrete Renosterveld, Lourensford Alluvium Fynbos and Western Rûens Shale Renosterveld have less than 10% natural vegetation remaining and they have no secure protection. These five units need urgent conservation attention.

There are 14 Endangered Ecosystems of which two have protection of more than 10%, 6 have protection of between 1 and 10% and six have no protection.

Twenty-three ecosystems are classified as Vulnerable. Five have protection of more than 10%, 9 have protection of between 1 and 10% and 9 have no protection.

The distribution of threatened terrestrial ecosystems are shown in Figure 2.

Threats

Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of each threat (Figure 3, SANBI 2012).

Habitat loss

In the WCP habitat loss, which includes the irreversible conversion of natural vegetation for infrastructure development, urban expansion, crop cultivation, timber plantations and mines is, as in SA, by far the most severe threat. This habitat loss is mostly in the lowland areas and represented by the threatened terrestrial ecosystems as seen in Figure 2.

Invasive alien plants

Invasive alien plants (IAP's) are the second largest threat after habitat loss to conserving ecosystems and biodiversity in the Western Cape. Not only do IAP's threaten natural resources, but can impose enormous costs on industries such as agriculture and forestry.

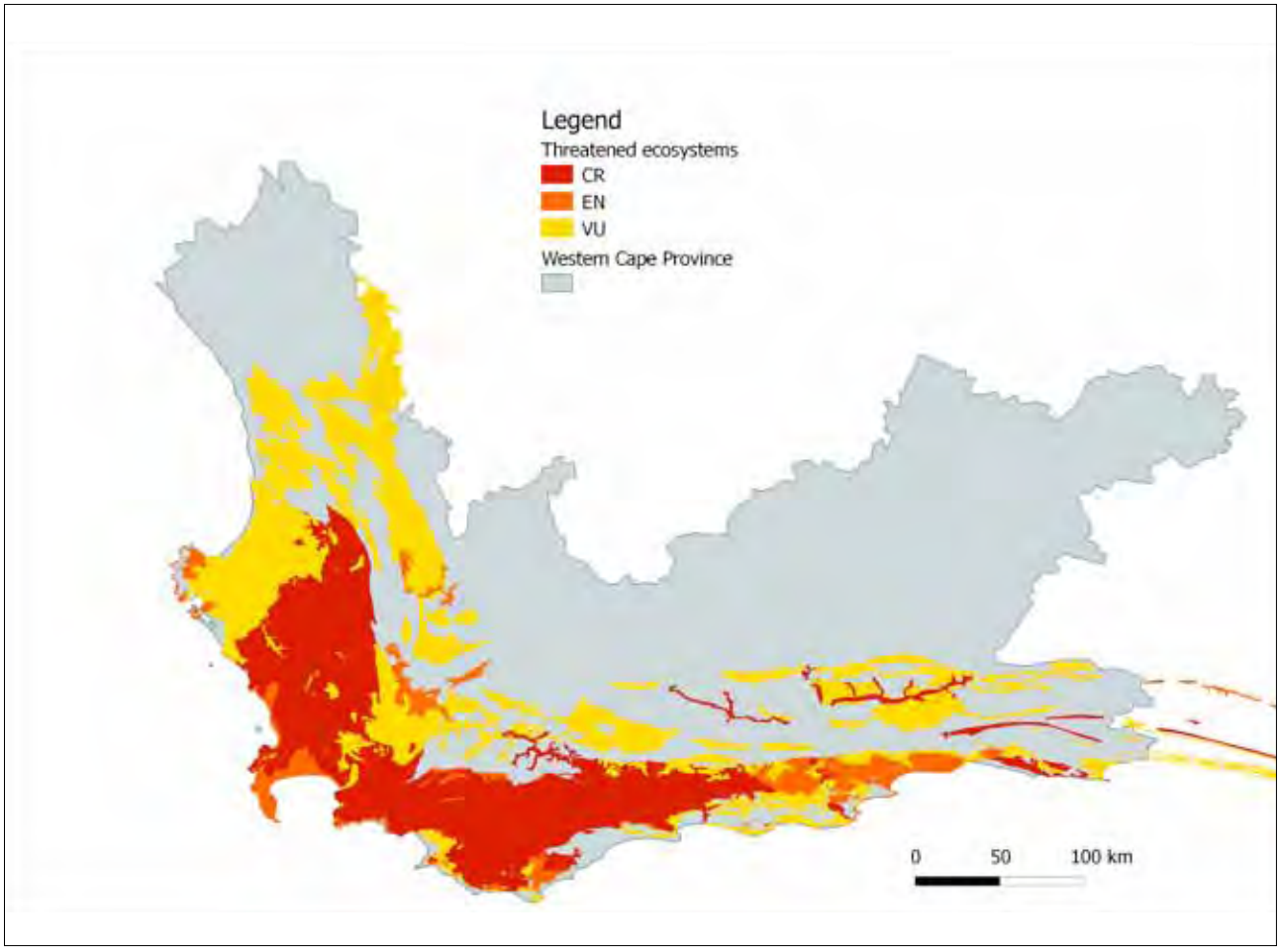

Figure 2. Listed Threatened terrestrial ecosystems of the Western Cape Province.

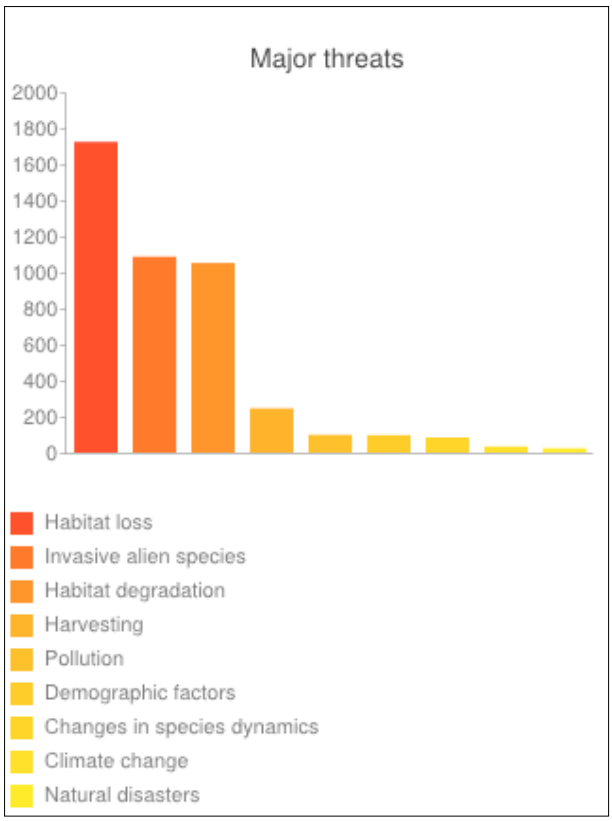

Figure 3. Major threats to the South African flora (SANBI 2012).

In addition, IAP's threaten delivery of ecosystem services (e.g. water production) which threatens our livelihoods (Van Wilgen *et al.* 2008a). Substantial funding has therefore been allocated to address IAP's. Initiated in 1995, the Working for Water Programme (WfW) aims at addressing IAP's in South Africa and also provide employment for impoverished communities.

Are we winning the battle against IAP's in the Western Cape? While the available information is insufficient to confidently answer this question, an assessment of WfW by van Wilgen *et al.* (2012), provides valuable insights. Although large areas have been cleared, van Wilgen and colleagues predict that at the given rates of spread (~10%/yr), current efforts are not enough to stem the tide. Where progress has been made, this has been mainly due to a combination of biocontrol and mechanical clearing. Notably, biocontrol has by far been the most effective and sustainable method and future management of IAP's would benefit from increased investment in this area. Pinus and Eucalyptus species currently have no biocontrol agents, although for Eucalyptus spread is mainly along water courses. Pines invade drier and inaccessible areas and are therefore the main concern for the near future given that Acacia and Hakea species' spread have been reasonably limited due to biocontrol. Pine plantations are a source of high propagule pressure and given the lack of biocontrol for Pinus species, it is not unreasonable to be concerned bearing in mind that this genus is also commercially important. Future decline in other invasive species (e.g. Acacia and Hakea species) may also result in pines spreading to previously unsuitable areas (van Wilgen & Richardson 2012).

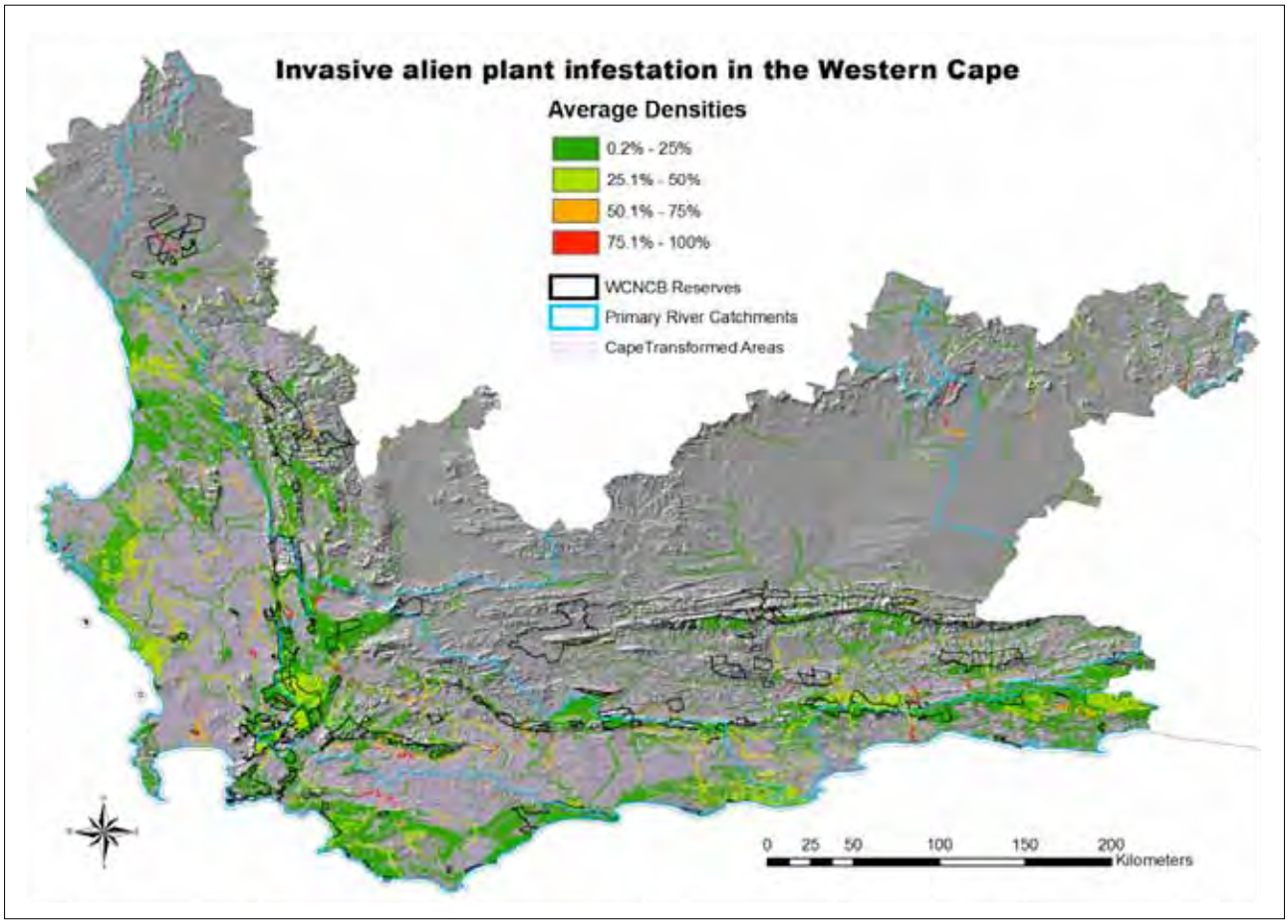

Figure 4. Invasive alien plant infestation in the Western Cape (adapted from Kotze *et al.* 2010).

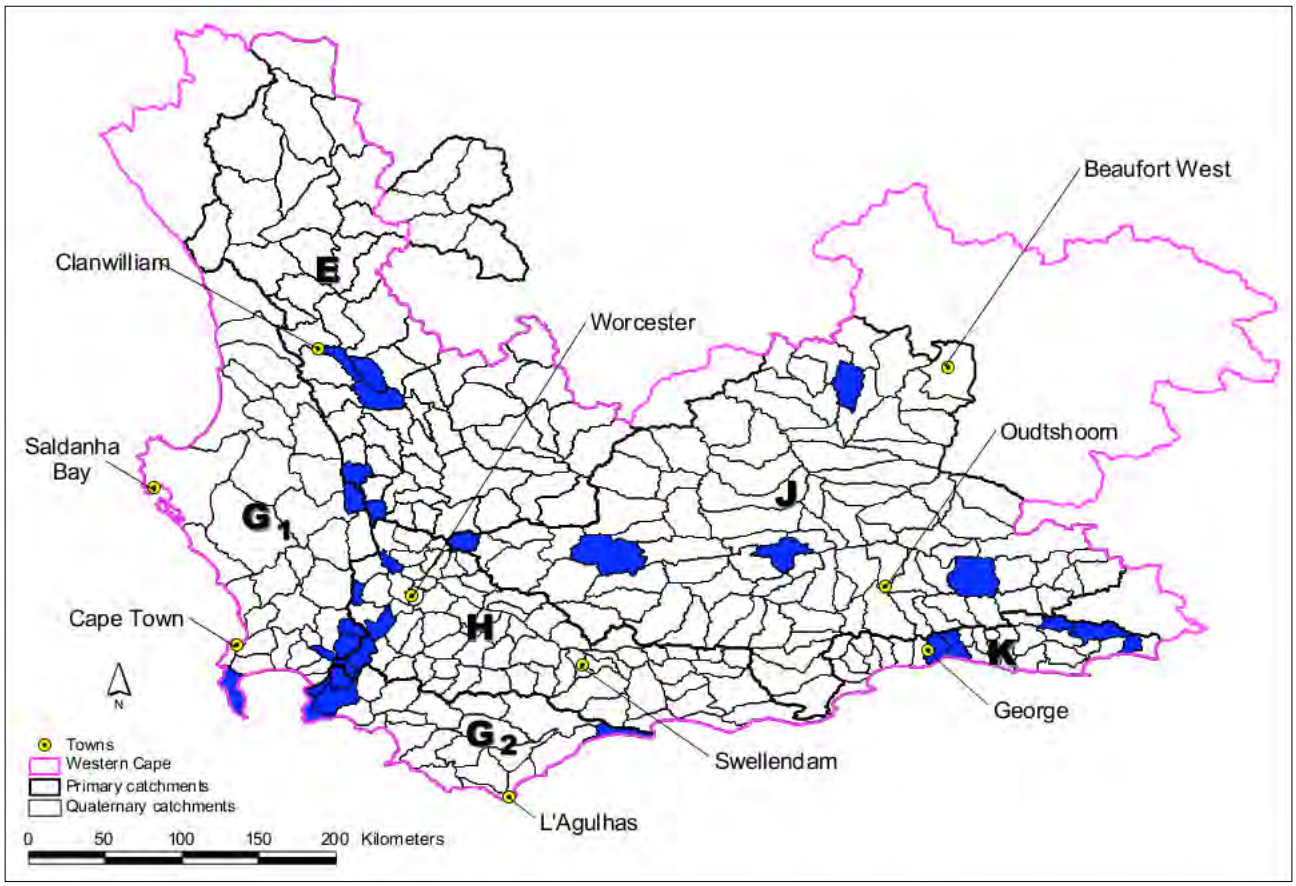

Figure 5. Five highest priority quaternary catchments per primary catchment in the Western Cape as identified by Forsyth *et al.* 2009. The Berg (G1) and Breede (H) primary catchments are the most important in the fynbos biome according to van Wilgen *et al.* (2008).

Since 2002, R 155 075 194, has been spent on IAP clearing contracts managed by CapeNature, while in addition, R 227 296931 was spent by WfW in the Western Cape since 1999. Working for Water has played an active role in clearing new areas and increasing following up clearing. There has been on average an increase in the follow up to initial ratio from 2006/07-2009/10 when compared to the period 2001/02-2005/06. This indicates a shift in focus due to WfW policy interventions. A recent assessment of WfW, however indicates that the best impacts are made by prioritizing important areas using time-based goals with increased levels of planning, monitoring and evaluation. This assessment also noted that an increase in biocontrol research and implementation is necessary since this method has enjoyed the largest success in the reduction of IAP's.

To properly assess the status of IAP infestation in the Western Cape, reliable species distribution data are necessary for at least the major invaders. The National Invasive Alien Plant Survey (NIAPS) published in 2010, provides such range and abundance data at the quaternary catchment scale. The national survey was intended to guide policy and inform decision makers through repeatable methodologies resulting in comparisons of progress over time. The NIAPS data should only be interpreted at the quaternary catchment scale due to methodological and statistical reasons. Please refer to Kotze *et al.* (2010) for a more detailed discussion on NIAPS data. Figure4 shows infestation levels of the dominant IAP species, based on the first NIAPS survey. The following State of Biodiversity Report in 2017 will therefore include an evaluation of IAP infestations over the five year period.

Prioritisation of IAP clearing in the Western Cape

Since funding for alien clearing is limited, it is important to allocate resources wisely. Some of the heard learnt lessons since 1996 include: too many alien clearing projects, no/insufficient follow ups and working in low priority areas. Objective prioritisation methods are therefore necessary so that resources can be allocated in a manner which is cost effective and reduces impacts of IAP's.

Forsyth *et al.* 2009 have determined through expert workshops and prioritisation methods, which quaternary catchments in the Western Cape should receive attention (Figure 5), while in Van Wilgen *et al.* 2008b, the Breede and Berg primary catchments are identified as the highest priority in the fynbos biome. It is important to note that criteria used in prioritisation exercises vary between studies, and to properly interpret and analyse results, the individual reports need to be consulted. A separate prioritisation study within CapeNature reserves identified important compartments within reserve clusters. Results of this study are not included in this provincial level report, but are available upon request.

Habitat degradation

This includes threats such as overgrazing, inappropriate fire management (which may be either too frequent, too infrequent or out of season fires) and clearing of indigenous woody shrubs and trees. Inappropriate fire regimes are a major threat in the Fynbos Biome. These threats may appear to leave natural vegetation intact, but causes a disturbance and breakdown of essential ecosystem processes, resulting in the loss of sensitive species.

Harvesting

Recently conducted research (Petersen et al 2012) has indicated that a significant amount of the city of Cape Town's informal economy is reliant on natural resources. Increasing poverty, high levels of unemployment and low levels of education mean that the harvesting and trading of wild harvested products is increasingly attractive as an income generator. In around the City of Cape Town, 250 plant species are currently utilised in informal trade. Uses include medicinal, flowers, food source, fibre and nursery. Of these, 181 have been assessed for the Red Data list and 30 of these species are Threatened (13 Vulnerable, 14 Endangered and 3 Critically Endangered) (Petersen *et al.* 2012).

CapeNature is currently constructively engaging with informal and formal users of indigenous plants in order to better understand and manage the demands of an expanding urban population on the Western Cape's natural resources.

Up to 80% of South African households use herbs for cultural and medicinal purposes (Petersen *et al.* 2012) and, given the cost of Western medicine, this trend is likely to continue (Petersen pers comm).

Pick n Pay funded the Sustainable Harvesting Project, based at CapeNature's Walker Bay Office. The project's aims are regulating and promoting the best practice and certification within the fynbos harvesting industry. This project needs to be continued and alternative funding is to be obtained.

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) volunteer groups who are coordinated by the Threatened Species Programme run by SANBI. In the Gouritz Region, the local CREW group is remarkably well organised and collaborating closely with CapeNature and SANParks. They have obtained lists of species of conservation concern for on- and off-reserve areas and plan their outings annually to search for and monitor as many species as possible. Whenever possible, they are accompanied by field rangers and these outings have proven to be invaluable learning experiences for the reserve staff. All data collected are captured on the official CREW datasheets and sent to SANBI for inclusion in the TSP database. Over the past 5 years they have submitted 785 datasheets covering close to 420 species of conservation concern.

In terms of fire monitoring, post-fire parent-seedling ratio monitoring of Protea indicator species is being done on most of the mountain catchment reserves to determine the success of seedling recruitment after fire. Permanent Protea plot monitoring is being implemented on some nature reserves to determine the juvenile periods of indicator species as a measure of minimum fire return interval.

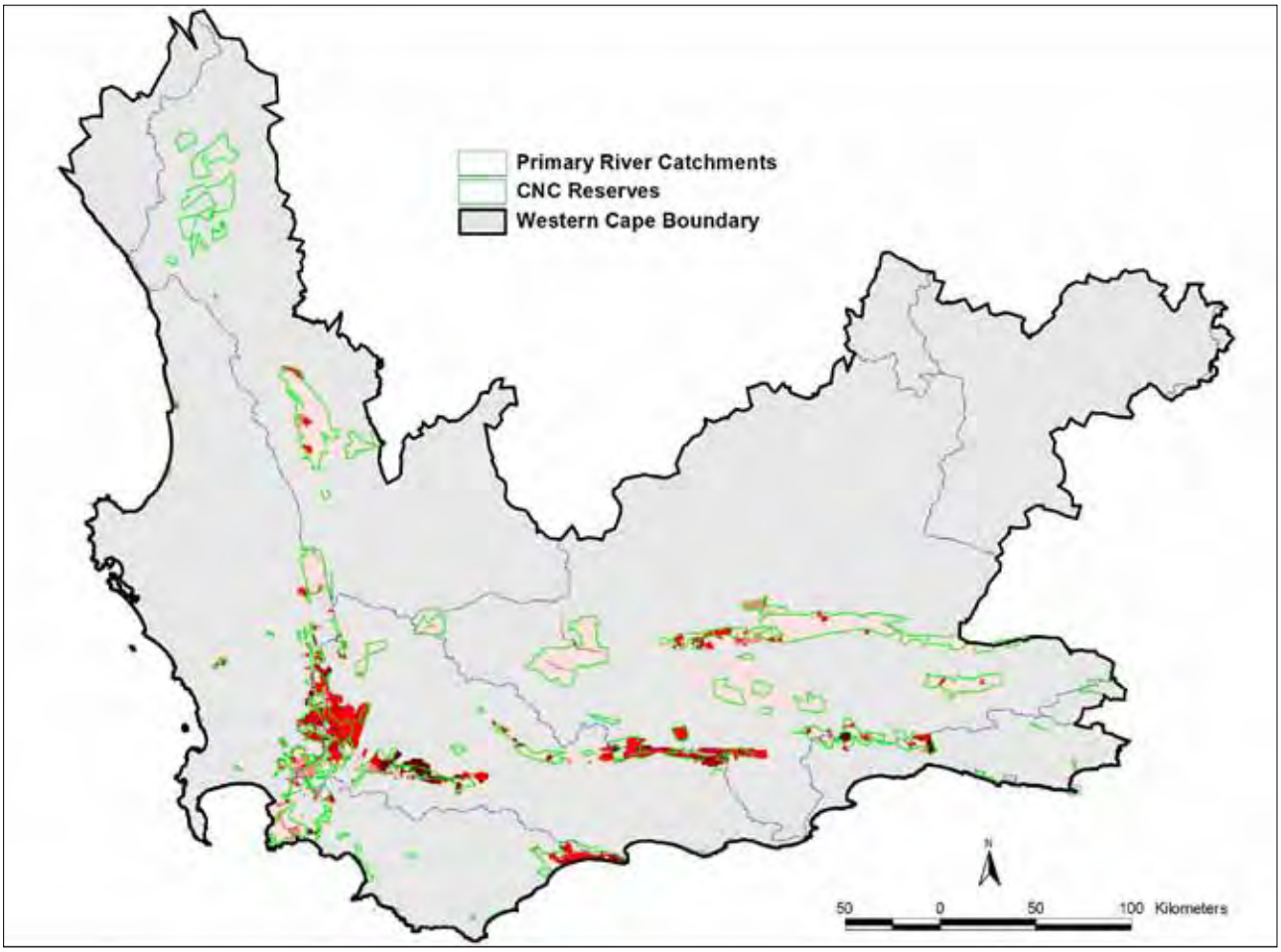

Figure 6. Combined IAP densities for Pinus, Acacia and Hakea species on provincial nature reserves and mountain catchment areas managed by CapeNature. Darker red indicates higher density. Not all reserves were assessed and non-shaded reserves should not be interpreted as IAP-free areas.

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Analyses of these data linked to the fire histories of certain nature reserves have been undertaken and used or presented in various instances, e.g.:

- Results of a detailed analysis of the fire history and Proteaceae monitoring data of the Outeniqua Nature Reserve were presented at the Fynbos Forum during 2006 and are informing fire management on the reserve;
- An analysis of fire regimes in the Swartberg Mountain Range was published by Seydack et al (2007);
- A study on the effect of recurrent fires on slow-growing Proteaceae in the Swartberg Mountains was undertaken and presented at two Fynbos Forums during 2007 and 2008;
- The fire history, permanent Protea plot and post-fire monitoring data of the Kammanassie Nature Reserve were analysed and presented at various internal meetings during 2009 and 2010;
- A study on the ecological impacts of the Boland fires is currently underway and preliminary results have been presented at the Fynbos Forum during 2012.

Monitoring of the distribution, densities and spread of invasive alien plant species on nature reserves has been taking place in certain areas whilst other areas have been neglected. Repeated questions as to whether the situation on the ground is improving or not have triggered a detailed analysis of the status of invasive alien plant control on each of the reserves in the Gouritz Region. The results have been presented at the Fynbos Forum during 2011 and documented in a report (Schutte-Vlok and Meyer 2011).

Recovery of over-grazed areas on land purchased for conservation by WWF-SA have been monitored on specific reserves, e.g. the monitoring of Augea and Atriplex invasions on Groenefontein Nature Reserve (part of the Gamkaberg Conservation Area) to determine management requirements. The results of an analysis of the data collected over an 8 year period have been presented at internal meetings and a national conference during 2011.

Monitoring of the success of Portulacaria afra (Spekboom) plantings during 2008 and 2010 to restore degraded Spekboomveld in the Klein Karoo has been done and documented in a research report (Weber 2011).

Other methods of monitoring implemented on nature reserves include taking fixed point photographs to determine whether vegetation change is taking place as a result of specific actions/events that have taken place (e.g. recovery of veld after controlled burns or landslides, implementation of erosion control measures, removal of stock/game, etc.).

Invasive alien species

At the provincial scale, the National Alien Plant Survey will be an important monitoring tool since it will be repeated using methodologies that allow comparison over time. Figure 6 shows an evaluation of IAP infestation on CapeNature reserves for prioritisation purposes. Although not all reserves were assessed, the scale at which this study was done was suitable for planning. CapeNature as yet does not have adequate monitoring programmes in place for effectively tracking IAP's on reserves over time, although much progress has been made towards this recommendation.

Research

A large number of research projects are currently being undertaken in the Fynbos and Succulent Karoo biomes by students from the tertiary institutions from all over South Africa and abroad. These range from taxonomic studies on specific taxa, to genetic studies to determine evolutionary relationships, ecological studies focused on pollination syndromes, population dynamics, and particularly the effects of climate change on species and communities, biomes and adaptive responses. Results of these studies are being presented at conferences and forums and published in scientific papers. Research in the Fynbos Biome is being guided by the Fynbos Forum Research Strategy.

A recent study indicates that the rate of discovery of new species in Fynbos has remained basically constant for 250 years and shows no sign of levelling off (M. Treurnicht pers. Comm.). Improved molecular techniques, updating outdated revisions of genera and more fieldwork in gap areas is likely to see this trend continue. There are many more new species to be found and this has profound bearing on our conservation activities and our contributions towards ensuring the sustainable development of the Western Cape.

For the Succulent Karoo, a group of researchers and scientists from various institutions (including the CSIR, NMMU, UCT, US, CapeNature, private individuals) established the Klein Karoo Study Group during 2006 to focus research on this area, because very little was known about the area and it had been identified as a species rich and highly threatened area. Research topics focussed on ecosystem services (water, grazing potential, restoration, carbon sequestration, tourism value, pollination services), vegetation dynamics and transformation, land use change, etc. (Le Maitre and O'Farrell in press; O'Farrell *et al.* in press; Reyers *et al.* 2009; Egoh *et al.* 2010; Herling *et al.* 2009; Wheeler 2009; etc.). The results of most of these studies have been fed back to the stakeholders living in the Klein Karoo via presentations to the Gouritz Initiative Forum and papers loaded onto the website of the Gouritz Initiative (www.gouritz.com).

Invasive alien species

CapeNature is working in partnership with SANBI's Invasive Species Programme on addressing emerging invasive species while management costs are still relatively low. Indigenous invasive species are also a growing concern, although a much lower priority than alien invasive plants. It is often unclear how these species should be addressed and future research could be invaluable in this regard.

Capacity

There is limited botanical skill within CapeNature represented by two Botanist posts although other staff members also have good botanical knowledge they do not function in dedicated botanist roles. The WCP still relies heavily on SANBI to drive and collate the TSP for this province. This programme in turn gets much of its information from the Custodians of Rare and Endangered Wildflowers (CREW) programme. CREW has also assisted the Stewardship programme and contributed towards monitoring on reserves (Southern Cape). Continued cooperation among conservation organisations and the public in the WCP is absolutely essential to have a chance at conserving the vast number of Threatened species and ecosystems in this province. Collaboration with SANBI's Invasive Species Programme looks at emerging alien invasive plants with the aim of early detection and eradication. Considering the threats which IAP's and fire poses to CapeNature reserves and the province in general, additional posts are required in this regard.

Conclusions and recommendations

Vegetation/threatened terrestrial ecosystem

In the near future, the 10 Critically Endangered Ecosystems in the WCP that have no official protection should be targeted to be included in WCCC1 protected areas. Of these, 5 (Central Rûens Shale Renosterveld, Swartland Shale Renosterveld, Swartland Silcrete Renosterveld, Lourensford Alluvium Fynbos and Western Rûens Shale Renosterveld) have less than 10% natural vegetation remaining and no secure protection. These five units need urgent conservation attention. The six Endangered Ecosystems that have no protection and nine Vulnerable ecosystems have no protection should also receive attention.

Data is urgently needed to eventually feed into the currently inactive criteria of the threatened terrestrial ecosystems. This can only be achieved by collaboration with other partners. We need to work with our partners to ground-truth habitats listed under criteria D1 in areas of potential conflict so it can be quickly confirmed if an area is of conservation value or not. CapeNature should explore ways to ensure that the Critical Biodiversity Areas (CBAs) are included under Criteria F when the list of threatened terrestrial ecosystems is updated.

Invasive alien species

For the effective management of invasive alien plants, CapeNature needs to implement the province-wide prioritisation based on biodiversity conservation related criteria that it is developed in collaboration with its partners in IAP control. For this to take place there has to be alignment of clearing contracts with areas identifies for prioritisation and there are now plans in place with WfW to do exactly this.

To conduct thorough, accurate and up to date IAP clearing prioritisation good data on current levels and extents of infestation and clearing history is required and a continual effort is required to maintain sufficient data standards. Another important part of IAP control that needs to feed into this process is the extent and effectiveness of biocontrol agents. Biocontrol projects (mainly releases and monitoring) are underway on CapeNature reserves although insufficient information is available at this stage to report here. We recommend a detailed progress reports which will be assessed in the next WCP State of Biodiversity Report.

Constant vigilance is required to identify new potentially invasive plant species. This is critical as it is much more cost-effective to control AIS in the earliest stages of invasion and before impacts on indigenous biodiversity and ecosystem functioning escalates.

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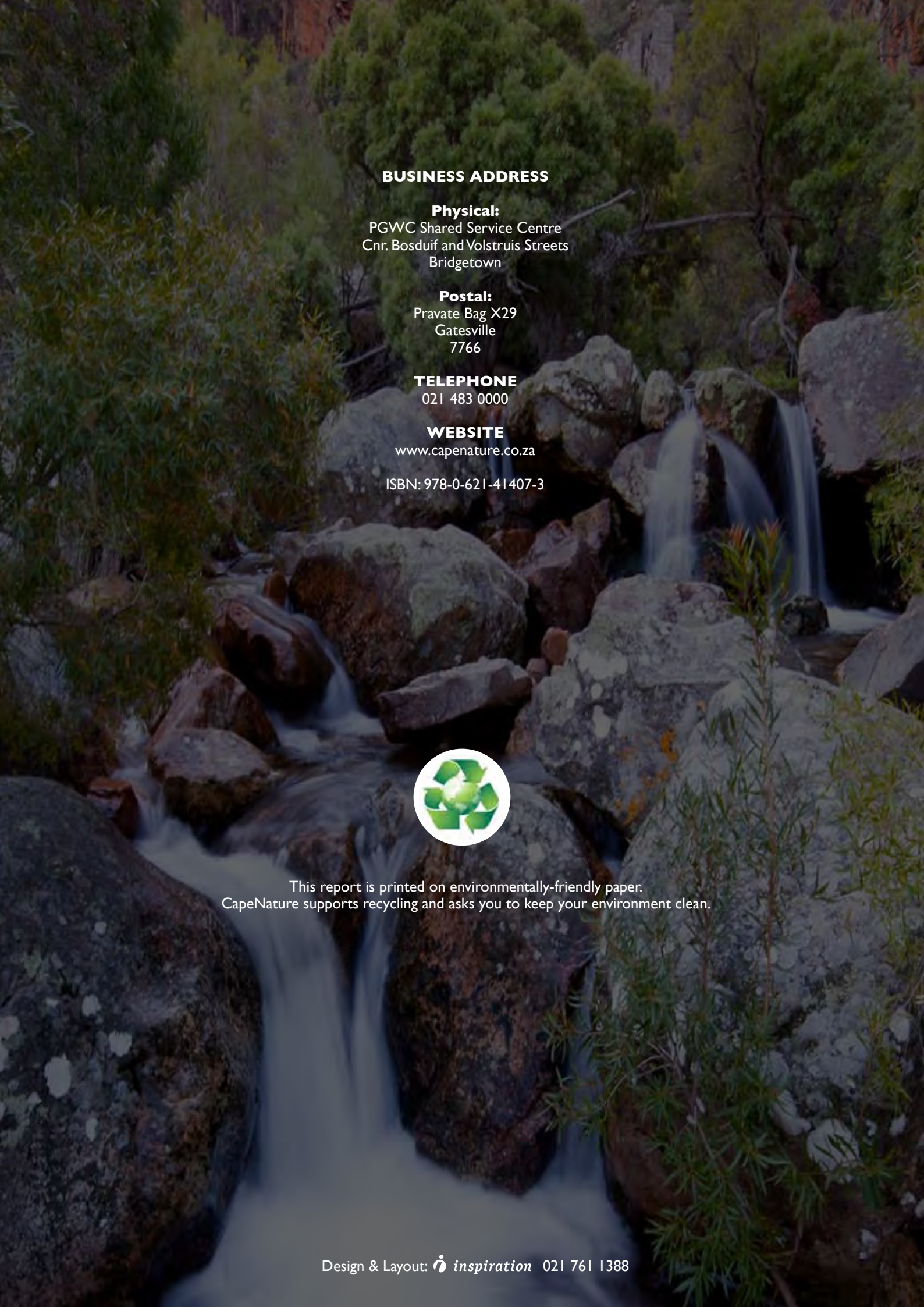

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