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IUCN – The World Conservation Union

Securing Protected Areas in the Face of Global Change

Lessons Learned from the South African Cape Floristic Region

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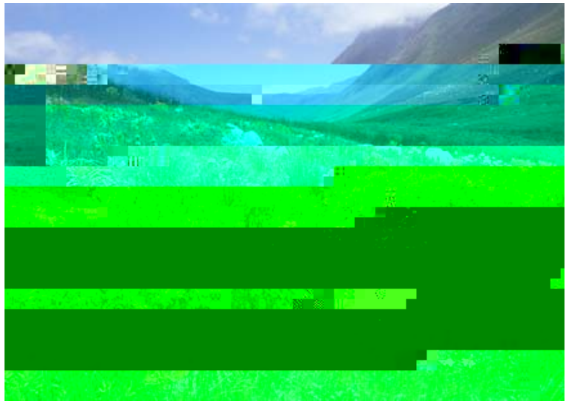

A Report by the Ecosystems, Protected Areas and People Project

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Cover: A view of the Kogelberg Biosphere Reserve (Photo: Amida Johns)

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Executive Summary

The Ecosystems, Protected Areas and People Project, supported in part by the UNEP-GEF, has developed a Protected Areas Learning Network (PALNet), to enable organisations responsible for protected area policy and management to share the lessons they are learning in coping with global change factors. One project component is a network of Field Learning Sites.

The South African Cape Floristic Region (CFR) was identified as a

change. Much remains to be done to allow detailed guidelines to be fully implemented by all stakeholders on the ground.

As a background to this work, the report summarises information on

Foreword

The Ecosystems, Protected Areas and People (EPP) Project, supported in part by the UNEP-GEF, has developed a Protected Areas programme with local stakeholders for the purpose of building on, articulating, analysing, sharing and promoting replication of lessons being learned from work already funded and ongoing.

The South African National Biodiversity Institute (SANBI) is the local partner of the EPP project in respect of the Cape Floristic Province in South Africa. This publication documents the first year's report on the lessons that have been learnt at the site in responding to climate change impacts on biodiversity, protected areas and their management. The EPP project will track the progress being made and the lessons being learned in the process of dealing with these impacts at the Cape Floristic Province site over the coming years and document them for sharing over PALNet for use by the global protected areas community that might be interested in the specific management issues.

1. Introduction

The South African **Cape Floristic Region** (CFR) (Figure 1.1) has been identified as a Field Learning Site (FLS) where researchers, planners, managers and other stakeholde res.6(en()3.3cd5n)ud4e3874217.7006 0 TD-0.000
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This report is a first attempt to draw together lessons learned from early efforts to plan and implement adaptive responses to climate change. The report does not aim to prescribe. We are not promoting a single best practice to address the challenges and opportunities brought by climate change, although we subscribe to the published principles of climate change-integrated **conservation strategies** (Hannah et al. 2002b). We aim to offer lessons learned and guidelines that may be useful in southern Africa and beyond, not to provide a manual. It is important to note that to date the pioneering work in the CFR has mostly dealt with

- **regional climate change and biotic response modelling and**
- **systematic conservation planning for climate change,**

and that it is still a long way to go until the outcomes of this work will be fully implemented by all stakeholders on the ground.

Recognising that climate change could indeed be one of the major future threats to biodiversity in the CFR, conservation agencies, organisations and universities in the region have increasingly begun developing response strategies. In this context, it is encouraging to see these strategies cautiously being converted from modelling and planning activities to monitoring and management initiatives, and that they also address various projected climate conditions – because climate change is more than just “global warming”. Furthermore, it is increasingly realised that climate change will interact with other stresses to ecosystems, such as habitat transformation and fragmentation, invasive alien species and overexploitation. Realistic response strategies to climate change cannot ignore these ancillary threats.

2. The Field Learning Site

2.1 The national context of the Cape Floristic Region

South Africa has an extensive system of formally protected areas. There are 950 terrestrial protected areas covering nearly 6% of the total land area of South Africa (Rouget et al. 2004). The goal is to enlarge the system of formally protected areas steadily from 6% to 8% by 2010 and later to 10% and to ensure that all significant vegetation types are included (DEAT 2003). Since 1994, national and provincial governments and their conservation agencies have acquired some 360 000 ha in new and/or expanded reserves. These efforts are ongoing and changes in the protected areas system are taking place every year.

National protected area legislation in South Africa has recently

- Forest nature reserves and forest areas (declared in terms of the National Forests Act, Act 84 of 1998).

In addition to this national legislation, each of the nine provinces in South Africa is responsible for provincial legislation relating to protected areas.

Of the 950 terrestrial protected areas, 479 are so-called Type 1 protected areas, including 20 national parks covering some 3.6 million hectares (Table 2.1.1), and 471 are Type 2 protected areas (Rouget et al. 2004). The distinction between Type 1 and Type 2 protected areas is made based on the degree of biodiversity protection provided.

Table 2.1.1. National parks in South Africa (SANParks 2005)

National park	**Proclaimed**	**Current size (ha)**
Addo Elephant	1931	74 339
Agulhas	1999	5 690
Augrabies Falls	1966	41 676
Bontebok	1931	2 786
Golden Gate Highlands	1963	11 633
Kgalagadi Transfrontier (formerly Kalahari Gemsbok)	1931	959 103
Karoo	1979	77 094
Knysna National Lake Area	1985	15 000
Kruger	1926	1 962 362
Mapungubwe (formerly Vhembe-Dongola)	1998	28 000
Marakele	1993	50 726
Mountain Zebra	1937	24 663
Namaqua	1999	72 000
Richtersveld	1991	162 445
Table Mountain (formerly Cape Peninsula)	1998	24 310
Tankwa-Karoo	1986	43 899
Tsitsikamma	1964	63 942
Vaalbos	1986	22 697
West Coast	1985	36 273
Wilderness	1985	10 600
Total	**-**	**3 689 238**

Type 1 protected areas are state-owned and supported by strong legal and institutional structures with clear mandate of biodiversity protection, whereas Type 2 protected areas represent various degrees of protection and have legal and institutional structures that are consistently weaker (Rouget et al. 2003b). Type 1 protected areas include national parks, prov6H 48cionaiversiscn8i1412 Tw[prote)5.4(c)-2.9(tion, 628.6105 Tm0.0007 five provincial departments, for example in the Northern Cape and Eastern Cape, and five statutory boards, for example the Western Cape Nature Conservation Board (WCNCB).

Clearly, there is a need to further consolidate, expand and rationalize South Africa’s protected areas system and its management. This need is well documented, for instance, in the 1997 White Paper on the Conservation and Sustainable Use of South Africa’s Biological Diversity and the 2001 policy statement “A bioregional approach to South Africa’s protected areas” by the Department of Environmental Affairs and Tourism (DEAT). Innovative systematic conservation planning exercises such as the Cape Action Plan for the Environment (CAPE), Succulent Karoo Ecosystem Plan (SKEP) and Subtropical Thicket Ecosystem Plan (STEP) are dealing with the consolidation and expansion of South Africa’s protected areas system. The experience gained in these planning exercises has in fact made the country a world leader in the field of systematic conservation planning (Balmford 2003). The new Protected Areas Act is also a first major step in rationalization in protected area legislation, but it will take much more to make South Africa’s protected areas fit for the future.

In keeping with the requirements of the Convention on Biological Diversity, South Africa is currently preparing a National Biodiversity Strategy and Action Plan (NBSAP). The NBSAP, which is led by DEAT, has several components (Driver 2004). The biodiversity conservation component of the NBSAP includes a conservation plan for the whole of South Africa, called the National Spatial Biodiversity Assessment, which is led by SANBI. The National Spatial Biodiversity Assessment is using systematic conservation planning methods to identify priority areas within the country (Rouget et al. 2004). One of its products is a list of threatened

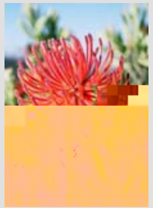
ecosystems across South Africa. It also provides an important national context for conservation plans at the sub-national scale. The NBSAP will finally develop an action plan for each identified priority area, which will then be reviewed and revised every five years.

2.2 The local context of the Cape Floristic Region

The CFR covers a total land area of 87 892 km^2 in the Western and Eastern Cape provinces of South Africa at the southern tip of Africa (see Figure 1.1). Fynbos, the predominant vegetation type in the CFR, occurs only in South Africa, and is an everco3wergrassy0.0s Tc09(ofa 61(ceae3(Cc)-6(

endemism and associated biological and ecological processes, the CFR was recently added to UNESCO's World Heritage List (Box 2.2.1).

Box 2.2.1. The CFR: A recent addition to UNESCO's World Heritage List



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Eight protected areas, covering 553 000 ha, were added, as a serial site representative of the CFR, to UNESCO's World Heritage List on July 1, 2004, for the following reasons (see http://whc.unesco.org): The CFR is one of the richest areas for plants in the world. It represents less than 0.5% of the area of Africa but is home to nearly 20% of the continent's flora. The site displays outstanding ecological and biological processes associated with the Fynbos vegetation, which is unique to the CFR. Finally, the outstanding diversity and endemism of the Cape flora are among the highest worldwide.

Biodiversity conservation in the CFR is, however, faced with many exceptional challenges. There are about 1400 Red List, or threatened, plant species, one of the highest known concentrations of such species in the world (Cowling and Hilton-Taylor 1994). Furthermore, there is a high proportion of plant species with very small species ranges and/or population sizes in the Cape flora, and plant species are neither uniformly nor randomly distributed, but concentrated in smaller nodes highly vulnerable to threats such as future land use change and climate change.

At present more than 75% of the total area of the CFR is in private landownership and about 20% lies in formally protected areas. About 30% of the region has already been transfor

The 163 Type 1 protected areas comprise 60% and the 96 Type 2 protected areas 40% of the total area under conservation (Table 2.2.1).

Table 2.2.1. Formally protected areas in the CFR (see Rouget et al. 2003b)

Class	**Type**	**Number of sites**	**Current size (km^2)**
Type 1	National parks	16	527.8
	Provincial nature reserves	96	8 924.3
	Local authority nature reserves	44	285.5
	DWAF forest nature reserves	7	118.0
Type 2	National heritage sites	37	226.8
	Private nature reserves	23	82.6
	Mountain catchment areas	14	5 802.1
	DWAF demarcated forest areas	17	246.9
	Private demarcated forest areas	2	33.6
	Protected natural environments	3	172.0
Total	**-**	**259**	

patterns (see Pressey et al. 2003) have been achieved for only 25 habitat types, whereas for 33 habitat types less than 20% of the conservation targets have been achieved. Disturbingly, most of the habitat types for which targets have not been achieved occur in the lowlands highly threatened by future land use change and climate change.

The existing protected areas system is ineffective not only in protecting biodiversity patterns but also in protecting biodiversity processes, although overall it encompasses 8% or more of each related spatial surrogate (Rouget et al. 2003a, Rouget et al. 2003b). Spatial surrogates, or components, of large-scale biodiversity processes (50 – 50 000 ha) were identified that, if protected, would enable the persistence of plant lineage upland habitats since they are home to the greatest plant diversity and endemism. Rapid protected area expansion also happened from the 1950s to mid 1970s, after most of the lowland habitats had been transformed by agriculture, thus limiting options for protecting them. After the mid 1980s, conservation agencies inherited large state-owned mountain catchment areas, which were later proclaimed as protected areas. However, they were primarily intended for water production and protection, and there was thus no explicit consideration given to their conservation value. Since the 1980s, management considerations (especially in respect of managing fire) have further reinforced the reservation bias. Because it is practically easier to manage one contiguous block than several scattered blocks, protected areas have been expanded by purchasing adjacent areas and thus enlarging the proportion of mountain areas already over-represented in the existing protected areas system, adding to its geographic bias.

In conclusion, the protected areas system in the CFR is faced with many challenges even without climate change. For example, it needs to become representative in terms of both biodiversity patterns and processes, and it needs to be managed more efficiently and effectively for both biodiversity and people. Clearly, with climate change the challenges will be exacerbated, and protected areas planners and managers will require additional resources to rise successfully to these challenges.

3. Global Change Factor Affecting the Site

Anthropogenic climate change is expected to be a major future threat to the biodiversity in the CFR (Midgley et al. 2002, 2003) – in addition to past, present and future habitat transformation and fragmentation, invasive alien species and overexploitation. Climate change could impact on species, ecosystems, human systems and protected areas in many ways, and some impacts of climate change are already apparent. These impacts present not only considerable challenges but also opportunities for protected areas planners and managers in the region.

Anthropogenic atmospheric change causes climate change in the same ways as natural atmospheric changes have done for millennia. Atmospheric change impacts on biodiversity in two ways. First, it directly affects the biosphere through increased atmospheric CO_2 concentrations, decreased stratospheric O_3 concentrations, which lead to increased UV-B radiation at the earth's surface, increased tropospheric O_3 concentrations and increased atmospheric N deposition. Second, it indirectly affects the biosphere through altering the natural greenhouse effect, through changing atmospheric concentrations of greenhouse gases such as $CO_{2,}$ CH_4 and N_2O. These gases trap heat in the earth's atmosphere and, thereby, cause climatic changes such as changes in global temperature, precipitation and atmospheric circulation patterns.

Surprisingly little is known about the direct effects of atmospheric change on the Cape region. Mooney et al. (2001) suggest that increased atmospheric CO_2 concentrations are expected to change community

2) Community composition and configuration

Changes in presence/absence and relative/absolute abundance (evenness/richness)
Formation of non-analogue communities (new species assemblages)

3) Ecosystem functioning, services and states

Changes in phenology (the timing of events such as flowering)
Changes in nutrient cycling and natural resource supply (e.g. water)
Changes in predator-prey, parasite-host, plant-pollinator and plant-disperser relationships
Changes in ecosystem services such as pest control, pollination and soil stabilization
Ecosystem switches following changes in ecosystem functioning and disturbance regimes

4) Disturbance regimes

Changes in the intensity, frequency and seasonality of periodic and extreme events such as fires, floods, droughts and other extreme weather events

to respond to them. Species distribution

4. The Response Strategy

4.1 Introduction

To date, there has been no unified response strategy to climate change in the CFR, let alone South Africa. Instead, different stakeholders such as researchers, planners and managers of a number of conservation agencies, organisations and universities have started to address the climate change issue in many ways on different spatial and temporal scales. In doing so, some principles and practices have emerged that are now widely applied in biodiversity conservation in the CFR and beyond, in particular in the fields of regional modelling and systematic conservation planning. These principles and practices are being evolved continuously, and it is important to keep in mind that the success of many of them oTd499epT for different climate change scenarios for the year 2050. These maps were later reproduced in international journals (Hannah et al. 2002a) and helped to develop climate change-integrated conservation strategies. The South African Country Study on Climate Change also resulted in the first publication dedicated exclusively to

As indicated above some of these findings have already been

Having looked at some of the regional modelling studies, we will now explore what their findings mean for protected areas planners and managers, and how modelling influenced planning in the region, using some systematic conservation planning exercises as examples.

4.5 Systematic conservation planning

Many of the measures that are now being proposed to ensure or, at least, enhance the resistance and resilience of landscapes and reserves to climate change are not new. Based on common landscape ecological principles (see Dramstad et al. 1996 for instance), they have long been proposed to protect biodiversity in healthy, living landscapes with a high degree of landscape connectivity. In many cases, the explicit consideration of climate change impacts just seems to further stress the importance of these basics of landscape and reserve design. Shafer (1999) provides an overview of options for making reserves fit for changing climates (see Box

Figure 4.5.1. Present and future ranges of Proteaceae with and without overlap in the Southwest of the CFR showing some protected areas. The arrow points at the Kogelberg Biosphere Reserve.

For the CFR, Hannah and Salm (2003) also stressed the considerable importance of upland conservation in the face of climate change. They found that existing reserves contain sufficient area, especially in the uplands, to accommodate most of the required range adjustments, although these adjustments are complex and often conflicting. However, some new reserves are required to full climate change scenarios of doubled atmospheric CO_2 concentrations (Figure 4.5.2) (Rouget et al. 2004). These areas appear to be somewhat resilient to climate change and should therefore be focused on in future conservation planning and action because they are most likely to maintain and sustain biome-specific biodiversity patterns and processes. In the Fynbos biome, these areas extend mainly along the Cape Fold Mountains and south coast, whereas areas along the west coast do not exhibit any resilience to climate change on the biome level. A fundamental flaw of this approach could, however, be the assump

Box 4.5.3. Identifying priority areas for bioclimatic representation

For the species level, Pyke et al. (2005) invented a novel method to identify and prioritise areas based on their value for improving representation of bioclimatic conditions for multiple species with changing climates. They essentially accomplished a bioclimatic gap analysis of the existing protected areas system in the CFR for a single climate parameter (mean annual precipitation) under present and future climate conditions using some 300 Proteaceae taxa.

Their study in a nutshell: First, they evaluated bioclimatic representation across the range of each species for habitat both within and outside protected areas under 2000 and 2050 climates. Then they evaluated the coverage of the existing reserve network for the species using a bioclimatic representation index. This index indicates whether the reserve network, or a single reserve, will be wetter or drier in the future than current CFR-wide climate conditions suitable for the species. Then they applied this new metric as a weighting to the portion of each species' range that is not yet well represented bioclimatically in the protected areas. This helps to identify and prioritise areas where the addition of new protected areas might improve bioclimatic representation. Finally, they aggregated this information for all species and identified priority areas of high value for improving bioclimatic representation.

Under current climate conditions, they found only a modest reservation bias in the existing reserve network. However, if the reserve system is not supplemented, in 2050 it will capture an increasingly skewed sample of climatic conditions occupied by Proteaceae at present. Pyke et al. (2005) recognized at least three areas with high value for multiple species to close the gaps in the existing reserve network in the CFR.

To evaluate the bioclimatic representation value of currently proposed reserves, they also assessed the seven implementation stages of the CAPE conservation plan, both individually and in total. Fortunately, they found that many of the most valuable areas for improving bioclimatic representation coincide with priority areas already earmarked for future conservation action in the CAPE conservation plan.

Furthermore, the soon to be implemented stages 1 and 2 of the CAPE conservation plan, targeted at key biodiversity patterns and processes (see Cowling et al. 2003), will already make the most substantial improvements to bioclimatic representation within protected areas. This seems to indicate that the CAPE planning process was successful in identifying priority areas that are important for alleviating climate change impacts, although the latter were considered only qualitatively rather than quantitatively.

Key message (Pyke et al. 2005):

In biodiversity hotspots with many endemic species that have limited environmental tolerances, bioclimatic representation provides an effective surrogate of direct biodiversity measures when setting conservation priorities.

Box 4.5.4. Identifying priority areas for poorly dispersing species

A climate change-integrated gap analysis can be based on species distributions if spatially explicit information on their required range shifts and dispersal patterns and processes is available. To answer the question how to identify priority areas for poorly dispersing species, which will have to move from formerly suitable areas to newspecies,

5. Lessons Learned and Guidelines

5.1 What has been achieved?

2. Potential climate change impacts on biodiversity can be identified in various ways: brainstorming, experimental studies in the field and labs, regional climate change and biotic response modelling. Good quality datasets and expert know-how are required for modelling, and partnerships are necessary (public-private, universities, organisations, agencies, overseas) to collect baseline data and species distribution data and mine expert knowledge. Climate change-sensitivity can be estimated using rules of thumb or guidelines such as these by Shafer (1999) (see Box 3.2). A first climate change-sensitivity analysis of all the reserves in a particular region can be done using information on climate change-sensitive species and ecosystems in general. While early broad brush assessments of climate change impacts driven by common sense and a basic ecological understanding may allow ballpark estimates, more detailed modelling reveals many nuances in ecosystem responses and species-specific concerns that are important for conservation planning.

3. Regional modelling can indicate the rates, magnitudes and directions of expected biodiversity response and potential climate change winners and losers. Species with small geographic ranges and poor dispersal abilities are at high risk from climate change. Climate change is likely to reduce the geographic ranges of most indigenous species, with only a few appearing to benefit in terms of range gains (e.g. Hannah et al. 2005). This effect raises the risk of stochastic extinction. The major impact on Fynbos plants is likely to be through the effects of drought (as a result of combined warming and drying and even increased human pressures on water resources). In the CFR, modelling also indicates that climate change impacts could be greater in the lowlands than in the uplands. Thus, modelling potential climate change impacts is a key element of a response strategy. However, modelling introduces many levels of uncertainty and this need to be explicit. Ongoing assessment of updated climate scenarios is also a priority to gauge when vegetation and species modelling needs updating.

4. Modelling can inform planning despite the uncertainty involved. A strategy of making sure for each vegetation type that a full range of altitudinal and latitudinal environments is captured is sound. Ensuring habitat heterogeneity within reserves (e.g. altitudinal, latitudinal and topographic), buffer zones around reserves and landscape connectivity outside reserves is also sound. The current goal of ocean to mountain corridors applied in the CAPE conservation plan is a sound strategy. To alleviate climate change impacts, riverine corridors, upland-lowland gradients, macroclimatic gradients and habitat connectivity are targeted in the systematic conservation planning exercises in the CFR (Table 2.2.2). On coarse, regional scales, riverine corridors, upland-lowland gradients and macroclimatic gradients are important features for ensuring habitat connectivity (see CAPE, SKEP and STEP projects), whereas on finer, sub-regional scales, habitat connectivity needs perhaps to be defined and determined by other features (see Cape Lowlands Renosterveld Project). In the CFR, the existing and currently proposed reserves could eventually provide reasonable buffering against climate change impacts, according to recent modelling studies. However, the high levels of uncertainty relating to species range shift

5. Ancillary human pressures and stresses exacerbate climate change impacts on species persistence and need therefore to be reduced – habitat transformation and fragmentation are clear examples that limit natural adaptation strategies.
6. Based on common landscape ecological principles and first indications on the nature of climate change impacts on biodiversity, healthy, living landscapes with a high degree of landscape connectivity can be designed.
7. Regional coordination of conservation planning is required (e.g. CAPE, SKEP and STEP projects): Initiatives in bioregional planning and management (such as the National Spatial Biodiversity Assessment) are greatly aided by the use of geographic information systems, and can incorporate climate change projections explicitly.
8. Local implementation is required (e.g. Cape Lowlands Renosterveld Project): Regional strategies must be translated to local implementation, and this is greatly assisted by an awareness of how local initiatives have been driven by regionally identified imperatives such as climate change. These imperatives will also assist in motivating both on- and off-reserve conservation efforts (such as conservation stewardships).
9. Research/Management: There are still many unknowns that require further data collection, expert knowledge-mining, and synthesis. For example, we know very little about how fire frequency and intensity might interact with population persistence with climate change. We are also quite ignorant about the interactive impacts of invasive alien species and climate change.

5.3 List of options and guidelines for stakeholders

Before we provide stakeholder-specific options and guidelines we emphasize some guiding principles for all stakeholders (see Box 5.3.1).

Box 5.3.1. Guiding principles for all stakeholders (with options)

1) Start now: doing nothing is no option (see Box 6.1)

Stakeholder workshop and regional framework for action
Baseline data collection, mapping and monitoring
Experimental studies both in the field and labs

2) Think ahead: put it in perspective

Regional modelling of climate change and biodiversity responses (see Box 3.1)
Climate change-sensitive species, ecosystems and reserves (see Box 3.2)
Climate change-integrated site-specific sensitivity analyses
Net loss or gain of species in reserves (see Table 4.5.1)
Ecological and economic impacts

3) Think big: broaden your horizons

Integrated land-use planning, decision-making and management on a trans-regional scale aimed at healthy, living landscapes with a high degree of landscape connectivity
Regional reserve networks that, together with linkages in the landscape such as critical corridors, maintain ecosystem services and ecological and evolutionary processes

4) Think clean: live by example

Reduce greenhouse gas emissions in your field by increasing both the use of renewable energy and efficiency of energy use
Raise environmental awareness for climate change mitigation and adaptation through outreach activities and sound communication strategies

5) Think twice: am I up to date and is my response strategy up to date?

5.3.1 Guidelines for researchers

1. <u>Collaborate with planners, managers and policy-makers</u>
   When part of a response strategy, research should be demand-driven rather than supply-driven. Understanding the needs and wants of

potential users helps to ensure the applicability of research results in land-use planning, decision-making and management.

2. Collect baseline data and species distribution data
   For modelling, planning, monitoring and managing efforts, baseline data and species distribution data are required. If these are not available yet in your region, targeted data collection, for example in collaboration with conservation agencies and organisations, is critical.
3. Carry out experimental studies both in the field and labs
   Particularly if baseline data and species distribution data are not available yet, and modelling is thus not possible, experimental studies such as greenhouse experiments or translocation experiments can help to identify climate change-sensitive species and ecosystems.
4. Carry out regional climate change and biotic response modelling
   Different models and scenarios should be used to identify climate change-sensitive species and ecosystems and the rates, magnitudes and directions of expected biodiversity response for different species and regions. Modelling should also be extended to human systems. Modelling studies should seek to communicate effectively key messages to the public, planners, managers and policy-makers.

5.3.2 Guidelines for planners

1. Consider climate change in systematic conservation planning
   A number of qualitative and quantitative approaches to considering climate change as an integral factor in systematic conservation planning and systematic reserve-site selection are available.

2. Buffer representation targets for biodiversity patterns and processes
   Climate change may alter species distributions, ecosystem functioning, services and states. Buffering representation targets should reduce the risk of protecting not enough areas or the wrong areas.
3. Increase habitat heterogeneity and altitudinal variation within reserves
   New reserves and additional areas for existing reserves should be identified based on regional modelling of climate change and biodiversity responses and common landscape ecological principles.
4. Increase landscape connectivity outside reserves
   Species migrations in response to climate change will require, in many cases, a biodiversity-friendly landscape matrix. Critical migration routes should be secured through both on- and off-reserve conservation.
5. Consider radical solutions for exceptionally threatened species
   It may be necessary to consider translocating species to pre-identified safe habitats in the wild, storing genetic resources in gene or seed banks, or securing species in clone banks or in protected ex-situ conservatories. Each of these strategies needs to be considered in cost/benefit terms.

5.3.3 Guidelines for managers

1. Explore options to increase both the use of renewable energy and efficiency of energy use in your protected area
   Reducing greenhouse gas emissions means reducing the risk of potential climate change impacts. In many cases, more energy-efficient appliances make sense both environmentally and economically.

2. <u>Complete site-specific sensitivity analyses in collaboration with others</u>
   An assessment of the vulnerability and adaptability of your protected area and its management to climate change is critical. Collaboration with conservation agencies, organisations and universities can help with mapping, monitoring and modelling to identify, both within and outside your protected area, potential climate change winners and losers as well as other important issues.
3. <u>Adjust management plans and protocols accordingly</u>
   The management of disturbance regimes, for example fire regimes, and invasive alien species requires adjustments with changing climates. In addition, extreme events might become more frequent and intense with potentially hazardous consequences for the biodiversity and people within and outside your protected area. Therefore, emergency plans and protocols need to be reviewed and revised.
4. <u>Develop simple monitoring strategies to detect early warning signs</u>
   Adaptive protected areas management needs to be able to respond to changes quickly. A set of biotic and abiotic climate change indicators should therefore be monitored continuously. Attempt to link with regional, national and even international early-warning networks.
5. <u>Develop partnerships to link on- and off-reserve conservation</u>
   Human pressures on protected areas are likely to increase. Buffer zones around your reserve, reducing other environmental stresses within it, and landscape connectivity outside your reserve may be critical to allow species to migrate in response to climate change. Partnerships with private landowners could ensure or enhance the persistence of biodiversity within or outside your reserve.

6. <u>Explore options to raise environmental awareness for climate change mitigation and adaptation in collaboration with others</u>
   Both the public and policy-makers need to be informed about the challenges and opportunities brought by climate change. Protected areas provide a unique opportunity to communicate key messages both to local people and tourists. Collaboration with conservation agencies, organisations and universities can help with designing and realising a sound communication strategy.

5.3.4 Guidelines for policy-makers

1. <u>Develop policies and strategies to reduce greenhouse gas emissions</u>
   National and provincial governments and their agencies should lead by example through increasing both the use of renewable energy and efficiency of energy use. Success stories and sound incentive systems may encourage other sectors to follow without requiring sanctions.
2. <u>Develop regional and local policies and strategies for the mitigation of and adaptation to potential climate change impacts</u>
   Even if all greenhouse gas emissions were to stop now, climate change would still impact on species, ecosystems, human systems and protected areas for some time to come. Sound climate change-integrated policies and strategies are critical for all sectors, not the least because, as climate change continues, opportunities for mitigation and adaptation narrow and become more expensive and less feasible.
3. <u>Take into account potential climate change impacts in legislation relating to biodiversity conservation and protected areas</u>
   The implementation of climate change-integrated conservation plans

and programmes requires both on- and off-reserve conservation initiatives. Legal mechanisms such as conservation stewardships are therefore recommended to involve private landowners.

Box 6.1. Making landscapes and reserves fit for changing climates

1. Consult all stakeholders and coordinate a workshop to determine what is known/unknown about regional climate change impacts and what are the stakeholders' needs and wants
2. Develop a regional framework for modelling, planning, monitoring and managing activities based on what is known/unknown and what is needed and wanted
3. Carry out baseline data collection, mapping and monitoring; experimental studies both in the field and labs; and regional modelling of climate change and biodiversity responses
4. Consider climate change as an integral factor in systematic conservation planning and systematic reserve-site selection and adjust the protected areas system accordingly
5. Consider climate change as an integral factor in reserve and matrix management aimed at healthy, living landscapes with a high degree of landscape connectivity
6. Ensure regional coordination, across national and provincial borders, and local implementation of your response strategy in cooperation with all stakeholders
7. Carry out regional monitoring of climate change, biodiversity responses, and reserve and matrix management, and review and revise your response strategy regularly

In the CFR, we look back on a relatively short history of researching and responding to the climate change issue. Many lessons have, however, been learned already and they should encourage and enable others who might be facing similar situations to cope with climate change. Clearly, doing nothing is no option. At the same time, while our learning process continues, we look ahead to the future, hoping that 1) greenhouse gas emissions and, in turn, the risk of potential climate change impacts will be reduced globally, 2) our growing understanding of regional climate change impacts continues to feed back into land-use planning and decision-making on all scales, and 3) the persistence of the globally significant biodiversity in the CFR will prove our response strategies, which are being evolved continuously, to be ultimately successful.

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Abbreviations

BotSoc	Botanical Society of South Africa
CAPE	Cape Action Plan for the Environment
CFR	Cape Floristic Region
CH_4	Methane
CO_2	Carbon dioxide
DEAT	Department of Environmental Affairs and Tourism
DWAF	Department of Water Affairs and Forestry
EPP	Ecosystems, Protected Areas and People
FLS	Field Learning Site
IPCC	Intergovernmental Panel on Climate Change
N	Nitrogen
N_2O	Nitrous oxide
NBSAP	National Biodiversity Strategy and Action Plan
O_3	Ozone
PALNet	Protected Areas Learning Network