DEPARTMENT: WATER AFFAIRS AND FORESTRY
REPUBLIC OF SOUTH AFRICA

# Determining the conservation value of land in Mpumalanga

**April 2002**

Prepared for

**DWAF/DFID STRATEGIC ENVIRONMENTAL ASSESSMENT**

Prepared by

A.J. Emery, M. Lötter and S.D. Williamson
Mpumalanga Parks Board
Private Bag X11338
Nelspruit
1200
mervyn@intekom.co.za

Strategic Environmental Assessment

DFID Department for International Development

# Executive Summary

This report is aimed at identifying areas of biodiversity importance within Mpumalanga through the use of existing data and expert knowledge, and the development of species and Geographic Information System (GIS) databases. This study adopted a similar approach to that developed by the Kwa-zulu Natal Nature Conservation Services in their report "Determining the conservation value of land in KwaZulu-Natal". The approach was based on the broad Keystone Centre (1991) definition of biodiversity (the variety of life and its processes), and therefore analysed the complete biodiversity hierarchy excluding the genetic level. The hierarchy included landscapes, three well-defined communities, one floristic region, one broad vegetation community and eight broad species groups (Figure 1.1). The species groups included threatened plants, economically important medicinal plants, mammals, birds, amphibians, reptiles, fish and invertebrates.

Species data and GIS coverages were obtained from a wide variety of sources. Digital coverages of two detailed vegetation communities, wetlands and forest, were compiled from all available sources. Special effort was made to map additional forests and wetlands that had not previously been mapped. Acocks Veld Types and Centres and Regions of Plant Endemism (Phytochoria) were used to define the broad plant communities. The species data were compiled from published papers, private and public collections in herbaria and museums, personal observations and MPB records. The resulting species databases afforded the MPB the opportunity to capture all its species records in databases, which in turn were used to investigate the various species layers. These layers were comprised of 81 threatened plants, 26 economically important medicinal plants, 8 amphibians, 27 birds, 11 fish, 13 invertebrates, 15 reptiles and 21 mammals. The spatial bias in the collection and recording of the species localities meant that they alone could not be used to represent the entire distribution of the species. Each species distribution was determined using simple spatial modelling to overcome this bias and data deficiency within the overall analysis.

Priority landscapes were identified by overlaying maps of conservation status (rarity, degree of transformation and protection status) and vulnerability (to land use change). The results of this analysis indicate that 13 (62%) of a total of 21 landscapes are under protected (< 10% under formal protection). Five landscapes (23%) have been transformed by more than 40% (the theoretical threshold beyond which ecological processes are significantly disrupted). Cultivation was the major cause of all dry type landscapes while forest plantations were the major cause of all wet type landscape transformations. Five (24%) of the landscapes are critically important for conservation action. These critical landscapes are distributed along the foothills and high lying areas of the escarpment.

A total of 4628 endorheic pans occur in Mpumalanga consisting of 2043 perennial- and 2585 non-perennial pans. While 3323 palustrine wetlands were identified covering an area of 128 030ha. The wetlands were classified into 1672 floodplains and 7395 seepage wetlands. The pans are well mapped, but a large proportion of both the seepage and floodplain wetlands are still unmapped for the province. Within a sample area of the Usutu River Catchment it was found that 27 % of floodplains and 43% of seepage wetlands were transformed and this was predominately caused by afforestation.

Various forest data sources were used and mapped in this study, identifying 1388 forest patches covering an area of 40 370 ha within Mpumalanga. This new coverage represents a

66% increase in the forest coverage from an original calculation of only 26 552 ha. The forests are generally small with an average patch size of only 29 ha. These forests were prioritised according to custodianship, size and area to perimeter ratios. The forests are well protected with 28% of all indigenous forests occurring within protected areas.

The identification of the important vegetation communities was based on a combination of weight values of endemicity, fragmentation, and protection status. Of the 20 vegetation communities within Mpumalanga, it was found that two were endemic and three were near-endemic to the province. Cultivation and Afforestation were identified as the major transformers of most vegetation communities within the province. Of the 20 vegetation communities, 17 were under conserved (<10%), with all the grasslands having less than 5% conserved. The Bankenveld to Sour Sandveld Transition and Themeda Veld were identified as the most important vegetation communities within the province.

Mpumalanga has an extraordinary diversity in plant species. It only comprises 3% of southern Africa's surface area, yet supports 21% of its species diversity. This diversity is not evenly distributed, but is predominantly confined to four Centres and two Regions of Endemism. The Lydenburg Centre of Endemism is proposed as a new centre for the first time in this report. The six phytochoria were mapped and described in terms of diversity, protection status and transformation. A high number of endemic plant taxa are confined to these phytochoria, many which are narrow endemics and subsequently on the MPB's threatened plant list. The Wolkberg Centre is the most transformed centre (46%) within Mpumalanga and is adequately protected (12%). However, within Mpumalanga the threatened Sekhukhuneland Centre is not formally protected within any nature reserves. Only 1.9% of the Lydenburg Centre is formally protected. More land needs to be incorporated within nature reserves to protect the province's biodiversity. A list of recommendations is suggested within the investigation.

Of the 81 threatened plant taxa selected for this analysis, one was assessed as Extinct in the Wild, nine as Critically Endangered, 16 as Endangered, 37 as Vulnerable, and 18 as Near Threatened. Important habitats for these plants include highveld and montane grasslands. The 81 species used in the modelling process do not adequately represent the geographical range all of the estimated 350 threatened plant taxa occurring on the MPB's threatened plant list. However, to the best of our knowledge, the collective map represents most areas that are critical in conserving threatened plants at the species level. Important areas with high scores should receive close scrutiny when evaluating development assessments that result in land transformation.

The trade in medicinal plants is huge, and it is highly unlikely that at current levels of exploitation, the sustainable supply of medicinal plants will ever meet the demand. It is important to be able to identify areas that could potentially support, or provide plants to the medicinal plant trade. Twenty-six economically important medicinal plants were selected and weighted according to their conservation status, availability, and popularity within trade. The potential distribution range of these plants were highlighted through the predictive modelling process, indicating areas of conservation and cultural value, often concealing a 'hidden economy' on which many rural communities still depend.

21 species of mammals were selected for this part of the analysis. Two of these were assessed as Critically Endangered, seven as Endangered, seven as Vulnerable and the others are Data

Deficient. Many of the assessed mammals occur outside of formally protected areas. Important habitats for these species include highveld and montane grasslands and savannah.

At least 567 bird species have been recorded from Mpumalanga Province. 27 of the Red Data species were selected for this analysis of which five are Critically Endangered, four are endangered and 15 have been assessed as Vulnerable. Important habitats for most of the bird species include highveld and montane grasslands and wetland areas. Areas highlighted as important areas for birds include the central areas and most of the southern part of Mpumalanga.

154 reptile species have been recorded from Mpumalanga. 86 of these are considered threatened, however of these only 15 were included in this study. Four of these are endemic to the province. Four reptile species were assessed as Endangered, nine as Vulnerable, one as Near Threatened and one as Least Concern. The areas highlighted as important for the conservation of reptiles include the Mpumalanga escarpment and associated high lying areas. Reptiles are threatened by the extensive afforestation in these areas, large, yearly fires and by collectors for the international trade.

51 Amphibian species are found within Mpumalanga, of which eight were included in this analysis. All eight species were assessed as vulnerable. Important habitats for these amphibians include high altitude grasslands near rivers and streams. Habitat destruction and the invasion of alien vegetation result in fragmentation of populations and this is probably the major threat facing all frog species.

Sixty-two indigenous and eleven exotic fish species have been recorded within Mpumalanga. Eleven fish species, which are endemic, near endemic, highly sensitive and/or with limited distributions in Mpumalanga, were selected for modelling. The predictive modelling process identified quaternary catchments to be important to the selected species. The decreased spatial and perennial flow of clean, sediment free water is the major threat to the survival of fish species in Mpumalanga.

Invertebrates are often ignored during conservation efforts, despite the important roles they play in an ecosystem. Only 13 invertebrate Red Data species are known from Mpumalanga, including seven butterfly and six dragonfly species. Five butterfly species were assessed as Endangered and two as Vulnerable. Three dragonfly species were assessed as Critically Endangered and three as Vulnerable. These species are all threatened by agricultural and forestry activities, which cause habitat destruction and the fragmentation of natural populations.

# Table of Contents:

# 1 Introduction

## 1.1. Background

This work provides a vital component required for the Strategic Environmental Assessment (SEA) process currently being undertaken by the Department of Water Affairs and Forestry (DWAF) through the sub-directorate Streamflow Reduction Activity Control. The database is expected to serve all planners, decision-makers, conservation authorities and land users in understanding the status of the landscape and its biodiversity and the consequent impacts of development.

## 1.2 Introduction

This project, within DWAF's SEA is aimed at producing a product or tool indicating the conservation value of land. It is a tool that will be useful both to developers and to decision-makers by indicating the sensitivity of the land to any activity resulting in transformation of the land surface. It is not aimed at restricting development, but to provide the environmental context for recommendations with regard to development. As such it may be used to identify the constraints for a given area prior to an on-site Environmental Impact Assessment. This will be useful to catchment advisory committees, and to environmental impact assessors. By the same token the land user will be able to see, prior to planning or submitting an application, what the environmental sensitivity of an area is.

This project has also afforded the MPB an opportunity to focus its limited resources on conserving the province's most important biodiversity assets. The status and current distribution of these assets have never been objectively identified nor their status communicated to management or the public in general, in a manner that enables proactive management.

This study is the second provincial initiative of its kind, and has been encouraged by the success of the KZNNCS study of KwaZulu Natal. A similar study has also been undertaken for the Eastern Cape Province. This will result in 'environmental surfaces' for all of the three provinces identified as critical in the National Level Screening undertaken by the DWAF SEA.

## 1.3 The importance of this component to the Strategic Environmental Assessment

The SEA approach taken by DWAF – for Stream Flow Reduction Activities and other forms of water use - is one that reviews opportunities and constraints, and establishes the context for decision-making in terms of environmental cost (or benefit) weighed alongside social and economic benefits (or costs). The conservation importance and value of the environment is one of the key constraints to development and may be sufficient to rule out any further consideration, no matter what the perceived socio/economic "benefit". Whatever the use, there is an equation to be balanced.

This project aims to define the conservation importance of key land units in the Mpumalanga Province. As such, it will provide one of the essential elements in negotiations and development assessment processes at policy, programme and project levels (decision support system).

## 1.4 Position within the Strategic Environmental Assessment plan of activity

This study supports Output 3 in the Logical Framework developed for the DWAF SEA (draft 4, 10 January 2000), i.e. "A Negotiation and Decision Support System, comprising methods and techniques, has been prepared for use by relevant decision-makers, stakeholders and role-players". Activity 3.2 requires that an "Information Management System incorporating the GIS/databases is to be designed, developed and implemented". This study will provide important elements of that information set.

It is critical that baseline information is collated for the SEA in catchments where land use decisions are being taken. This study will provide useful and valuable information that can immediately inform the License Assessment Advisory Committees currently constituted for decision-making in relation to forestry and for future Advisory Committees, which will be supporting the new Catchment Management Agencies.

## 1.5 Sources of information and general approach

The MPB adopted a process aimed at mobilising existing and available information into a comprehensive set of maps within a GIS. This was done by gathering, assimilating and analysing the existing data resident within Mpumalanga Parks Board (MPB), and information held by related institutions or individuals and making this fragmented knowledge real and useful to decision-makers and prospective land users. Maximum use was made of existing data sets, the Environmental Management Framework held by DEA&T, and data sets already in DWAF's possession. Mapped data is accompanied by attribute data to indicate the conservation values attributed to these assessments, and how these values were arrived at.

MPB utilised current information to provide a first iteration coverage of biodiversity hotspots, and other areas of conservation value. It is recognised that it will always be possible to improve upon this coverage and that the outputs of further research and survey work, by MPB and other environmental organisations, will have to be added to this work in the future.

## 1.6 Project Goal and Products

The overall goal of the project is to use existing data and expertise to identify the most important biodiversity assests and subsequently define areas of conservation importance within the Mpumalanga Province. This information is provided to the Department of Water Affairs and Forestry in Arc/Info format at a scale of 1:250 000 or better, and where possible at 1:50 000.

## 1.7 Objectives

The overall objectives of this study was to develop a Geographic Information System and map coverage's of the province, with attributes, indicating:

1) Sites of biodiversity conservation value and an indication of the importance for the conservation of biodiversity.

2) Areas of untransformed vegetation (by type) and a report, specifying the proportion of each vegetation type that remains untransformed within the province, and the country as a whole.
3) A report for public use outlining the concepts and procedures adopted in developing the coverages, the resultant maps and an interpretation of these for land use decisions.
4) A specific report outlining a strategy by which the information bases can be maintained and shared with the user communities.

The information is available in electronic format at a scale of 1:250 000 and is compatible with ArcView, ArcInfo GIS programmes and MS Office.

From the information presented, it is possible for land users to assess the degree of 'environmental opposition' likely to be encountered when applying for a use involving transformation from natural vegetation. The License Assessment Advisory Committee, Catchment Management Agency, or other decision-making body will also have key information at hand for the assessment of suitability in terms of best use of the land and water resource.

These coverages are not final and exhaustive, and that MPB by declaring its position on these areas does not confer a lack of interest or importance with regard to areas not highlighted.

## 1.8 Further Analysis Required

The Biobase Project has adequately highlighted areas of biodiversity value and almost succeeded in providing answers to nearly all of the research needs conceptualised at the onset of the Project. Due to unforeseen changes within the MPB, some objectives were not realised or considered from the onset of the project, and these are presented below:

1. Sites of biodiversity conservation value with an indication of the degree or nature of protection required for each site. Typically sites need to be valued as "untouchable', 'valuable', or 'not so valuable'. Explanations of values and how these are captured and set must be provided.
2. Based on results, the irreplacebility of land needs to be assessed. This needs to take into account coverage and land-use complementarety and identify a network of areas that require protection to ensure that the full compliment of species and communities identified through the Biobase Project are conserved.
3. GIS coverage identifying all sites for which protection is currently being considered planned or negotiated.
4. GIS coverage of all privately owned land currently managed as conservation areas.

## 1.9 Methodological Approach

(Note that this section has been drawn directly from the approach developed by KZNNCS)
The project essentially aims to identify areas of biodiversity importance. Biodiversity in the most general sense refers to "the variety of life and its processes" (Keystone Center 1991). Biodiversity in its entirety is complex; it is therefore useful to consider the different hierarchical levels of diversity from smallest to largest.

Genetic diversity - this refers to the variety of genetic building blocks found among individual representatives of a species. Genetic diversity occurs within and between populations of a species as well as between species.
Species diversity - the variety of living organisms found in a particular place.
Ecosystem diversity - this encompasses the broad differences between ecosystem types, and the diversity of communities, habitats and ecological processes occurring within each ecosystem type. It is harder to define ecosystem diversity because the 'boundaries' of communities (associations of species) and ecosystems are more fluid. As a result, the ecosystem concept is dynamic and can be applied at a variety of scales.
Landscape diversity - the variety of landscapes within a region and the diversity of elements and processes within and among these landscapes. Landscapes are homogeneous ecological units defined by distinctive combinations of elements that include landform, climate geology and vegetation.

To achieve the project goal, this hierarchical approach to defining diversity was followed. Knowledge of the spatial variation of genetic diversity is extremely poor and was therefore excluded from this analysis. Consequently, the project identified sites of intrinsic biodiversity importance based on their landscape, ecosystem/community and species level attributes (Figure 1.1). Important landscapes will be derived from the existing landscape classification and map for the province. Important ecosystems and communities were derived from the national vegetation maps, existing and improved maps of wetlands and indigenous forests. Sites important from a species perspective were derived from recorded and modelled distributions of important plants, mammals, birds, reptiles, amphibians, fish and invertebrates. In combining data sets within the hierarchical biodiversity level, species were weighted according to their IUCN category before being combined with other species layers. There is however no objective 'scientific' manner in which important sites identified at different levels in the biodiversity hierarchy can be weighted to produce the sites of intrinsic biodiversity value.

The project required the improvement of large number of existing map coverages. It is understood that these and all intermediate map products produced by the project will be delivered to DWAF.

Due to lack of personnel and resources within MPB, much data and knowledge needed to be captured from experts, museums and universities. The primary approach was aimed at capturing, cleaning and verifying existing data and then building on these databases by consulting experts, museums, and universities. The captured information was used to map the known value of the landscape and its biodiversity.

## 1.10 Project Team

Lead Agent
The project was undertaken by the Technical Services Section of the Mpumalanga Parks Board, and assisted by professional and technical staff where this was required. The full composition of the project team is as follows:

Research and Development Staff

| | |
|---|---|
| Mr. Kevan Zunkel | Previous Head Research and Development |
| Mr. Charles Ngobeni | Current Head Technical Services |

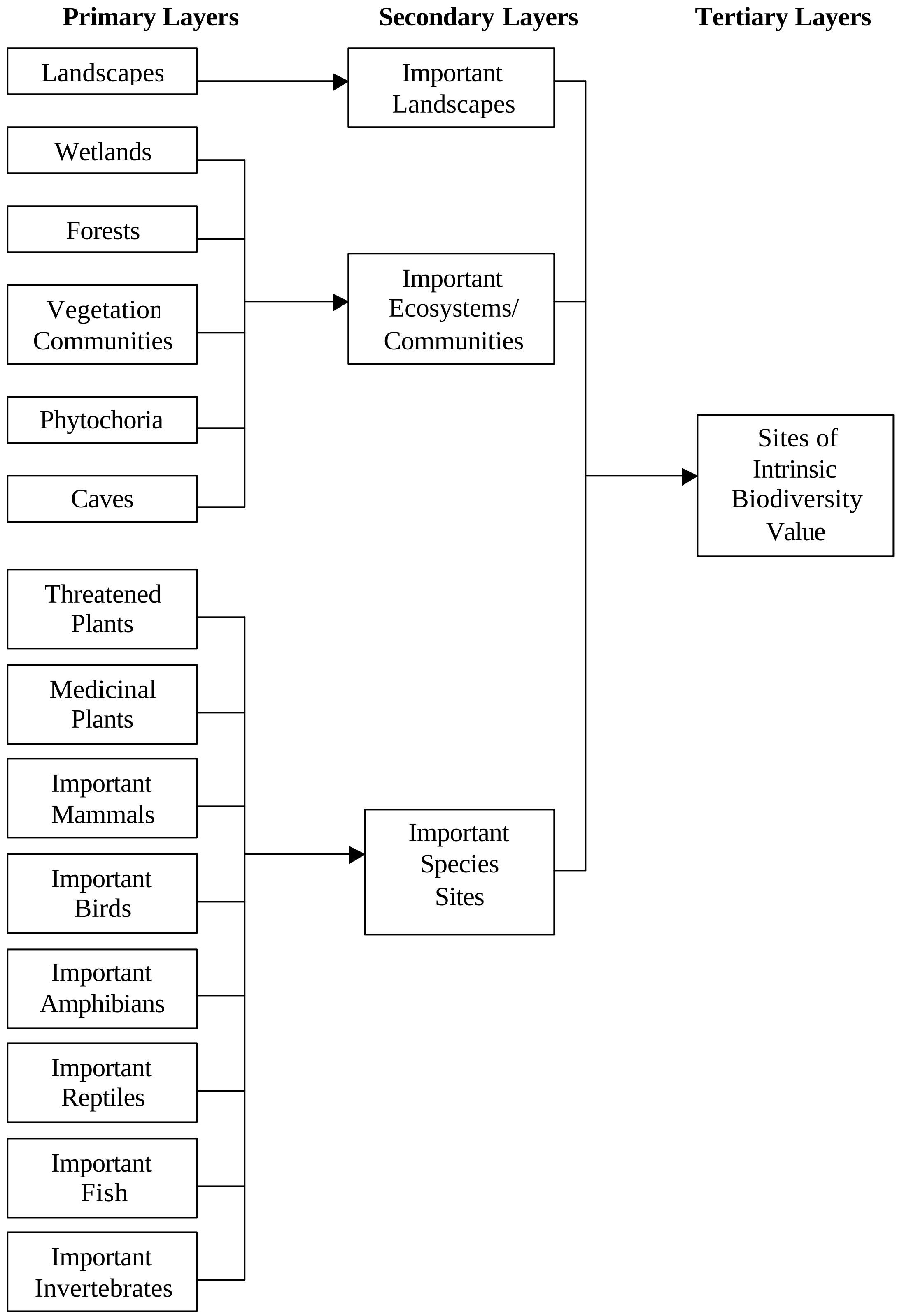


Figure 1.1 Schematic model illustrating the process by which sites of conservation value were identified.

| | |
|---|---|
| Mr. Marc Stalmans | Previous Reserve Ecologist |
| Mr. Koos de Wet | Terrestrial Scientist (entomologist) |
| Miss. Marlene Cohen | Mammologist |
| Mr. Gerrie Camacho | Mammologist |
| Miss Sonnette Krynauw | Botanist |
| Mr. Mervyn Lötter | Botanist |
| Miss. Nonkululeko Mthombeni | Botanical Technician |
| Mr. Jerry Theron | Herpetologist |
| Dr. Johan Engelbrecht | Aquatic Scientist |
| Mr. Francois Roux | Aquatic Services |
| Mr. Anton Linström | Wetland Scientist |

GIS and Database

| | |
|---|---|
| Mr. Anthony Emery | Previous Co-ordinator Information Management Services – Currently Private Consultant |
| Mrs. Brenda Thabethe | Previous Spatial Data Processing Technician |

Contract Workers
Mrs Sandra Williamson

## 1.11 Product ownership

Final product ownership resides jointly with DWAF and MPB. DWAF will use the information provided as part of a public database and no restrictions or protection are imposed upon its use except where the security of threatened species might be compromised. Full acknowledgement will be made by DWAF of the role played by MPB in assembling the data sets.

## 1.12 Conclusion

The compilation of the "Biobase" coverage for the Mpumalanga Province offers a most valuable output for decision-makers at the level of Advisory Committees to the Catchment Management Agencies, provincial planners, and local governments. The Biobase provides a major indicator in setting opportunities and constraints for development in the Mpumalanga Province

# 2 Identification of important landscapes

Contributor: A. Emery

## 2.1 Introduction

Landscapes have been defined as "kilometre-wide areas where a cluster of interacting stands or ecosystems are repeated in a similar form" (Forman and Godron, 1981). The structural components of landscapes can be classified as a patch, corridor or a matrix (Forman 1981). Turner (1989) emphasises that landscape ecology is scale independent but is dependent on the process and parameters of interest. In this study the interest is on a regional landscape class that will act as a surrogate to ensure the long-term maintenance of biodiversity and sustain ecosystem structure and functioning. Benn (2000) considers regional landscapes to consist of "three major elements: firstly, physical structure dictated by topography; secondly, surface texture dictated by variables such as soil and vegetation assemblages; and thirdly, three dimensional atmospheric influences primarily determined by climate and strongly influenced by altitude in some regions".

This study follows the methodology of identifying regional landscapes as defined by Fairbanks and Benn (2000) and the methodology of prioritising the landscapes as described by Benn (2000).

The regional landscape classification for Mpumalanga involved combining altitude, topography, and moisture balance coverages available for the province using standard multivariate and GIS overlay techniques. Layers describing vegetation (Low & Rebelo, 1996) and soil were not used directly in the demarcation of the landscapes, but rather as descriptors of the derived landscape classes (see Fairbanks & Benn, 2000 for details).

This chapter aims to identify the important landscapes of the province, independent of other hierarchical levels of biodiversity. The objectives are:

1) to assess the conservation status of the landscapes of Mpumalanga,
2) using the concept of vulnerability, to assess the level of threat posed by future land-use change to the landscapes of Mpumalanga,
3) to determine the major transformers of the landscapes of Mpumalanga,
4) by combining the measures of conservation status and vulnerability, to determine a ranked conservation priority status for each of the landscapes of Mpumalanga.

The approach developed by Benn (2000) for identifying priority landscapes has a number of important features. "Firstly, it considers both the current conservation status and the potential for future change in identifying priority landscapes. Landscapes and land-use are co-evolutionary, thus considering present and potential future land-use is critical. Present land-use patterns also give an indication of the level of current transformation, and when combined with the degree of protection provide a measure of current conservation status. Also, the approach is simple, yet scientifically sound providing an easily understood and repeatable method" (Benn, 2000).

Delineation of ecological landscapes is useful for the assessment of the regional representation of conservation areas, defining zones for sustainable ecological management, and as a framework for assessing the diversity of species and processes within landscapes.

## 2.2 Methods

### 2.2.1 Data sources

*Landscapes*

A detailed regional landscape coverage was developed by R. Sims-Castley, University of Port Elizabeth. The coverage defined 21 broad landscape classes in Mpumalanga, which were used in this analysis (Figure 2.1). The coverage comprised a 1km$^2$ grid resolution raster GIS layer describing features of the landscape classes.

*Land-cover map*

The National Land-Cover (NLC) database of South Africa (Thompson, 1999) was used to asses the level of land transformation within each landscape. The NLC database is based on 1994-1995 LANDSAT Thematic Mapper (TM) satellite imagery and describes 31 different land-use and land-cover classes. The NLC database is designed for 1:250 000 mapping applications with a minimum mapping unit of 25ha. The accuracy of the NLC database for Mpumalanga is between 72.7 and 82.1%, with an average of 78.5% (Thompson, 1999). The land-use classes represent areas that have been transformed from their natural vegetation to an alternative cover, and thus represent areas where natural vegetation and biodiversity has been lost (Wessels, 2000). Although degraded land does not necessarily represent a complete loss of natural vegetation and biodiversity, these areas were included with the transformed land as their diminished value for the conservation of landscapes; vegetation and species could not be assessed without extensive ground-truthing. The land-use and land-cover classes were assigned a transformation status according to their effect on the natural vegetation (Table 2.1).

*Protected Areas*

The protected areas map of Mpumalanga represents all areas that are formally protected under Act 10: the Mpumalanga Nature Conservation Act of 1998 or Act 57: the National Parks Act of 1976 and managed by the Mpumalanga Parks Board, Department of Agriculture, Conservation and Environment (DACE) or South African National Parks. The protected area boundaries were either digitised from 1:50 000 topocadastral maps or mapped using differentially corrected Global Position System data. Although significant areas of the Province enjoy protection in private nature and game reserves, the level of protection and appropriateness of the management applied varies widely from property to property and from one landowner to his successor. These protected areas were therefore not included in the analysis.

### 2.2.2 Analysis

The priority landscapes were identified using the analytical techniques developed by Benn (2000). Benn (2000) identified priority landscapes using the concepts of conservation status and vulnerability. "Conservation status was considered as a combination of landscape rarity, degree of transformation and protection. While, vulnerability indicates the potential threat of future land-use changes as measured by the diversity of land-uses presently occurring in a landscape. The latter assumes that if a class has been found to be accessible to a wide range of land-uses up to the present, then it is highly vulnerable to future change.

Spatial analysis was undertaken using ArcView 3.2 (ESRI, Redlands, California), and involved overlaying the landscape map with the land-cover and protected area maps (Figure 2.2) to derive the necessary information" (Benn 2000).

Table 2.1 Transformation statuses assigned to the NLC database land-cover classes.

| Land-Cover Code | Land-Cover Classes | Transformation Status |
|---|---|---|
| 1 | Forest and Woodland | Untransformed |
| 2 | Forest | Untransformed |
| 3 | Thicket & bushland (etc) | Untransformed |
| 4 | Shrubland and low Fynbos | Untransformed |
| 5 | Herbland | Untransformed |
| 6 | Unimproved grassland | Untransformed |
| 7 | Improved grassland | Transformed |
| 8 | Forest plantations | Transformed |
| 9 | Waterbodies | Untransformed |
| 10 | Wetlands | Untransformed |
| 11 | Barren rock | Transformed |
| 12 | Dongas & sheet erosion scars | Transformed |
| 13 | Degraded: forest and woodland | Transformed |
| 14 | Degraded: thicket & bushland (etc) | Transformed |
| 15 | Degraded: unimproved grassland | Transformed |
| 16 | Degraded: shrubland and low Fynbos | Transformed |
| 17 | Degraded: herbland | Transformed |
| 18 | Cultivated: permanent - commercial irrigated | Transformed |
| 19 | Cultivated: permanent - commercial dryland | Transformed |
| 20 | Cultivated: permanent - commercial sugarcane | Transformed |
| 21 | Cultivated: temporary - commercial irrigated | Transformed |
| 22 | Cultivated: temporary - commercial dryland | Transformed |
| 23 | Cultivated: temporary - semi-commercial/subsistence | Transformed |
| 24 | Urban / built-up land: residential | Transformed |
| 25 | Urban / built-up land: residential (small holdings: | Transformed |
| 26 | Urban / built-up land: residential (small holdings: | Transformed |
| 27 | Urban / built-up land: residential (small holdings: | Transformed |
| 28 | Urban / built-up land: residential (small holdings: | Transformed |
| 29 | Urban / built-up land: commercial | Transformed |
| 30 | Urban / built-up land: industrial / transport | Transformed |
| 31 | Mines & quarries | Transformed |

### 2.2.3 Landscape conservation status

Considering that landscapes are spatial units, rarity was measured as the areal percentage of Mpumalanga that a class occupied, rather than a count of the number of instances of each class. By overlaying the landscape and land-cover maps the percentage of each land-use class of each landscape class was derived. Similarly, by overlaying the landscape and protected areas maps, the percentage of landscape protection was obtained.

The percentage values for rarity and transformation were grouped into four classes based on natural breaks inherent in the data, in order to minimise the variance within the groups. Based on these groups each landscape was given a score for rarity and transformation ranging from 0.25-1 (Table 2.2).

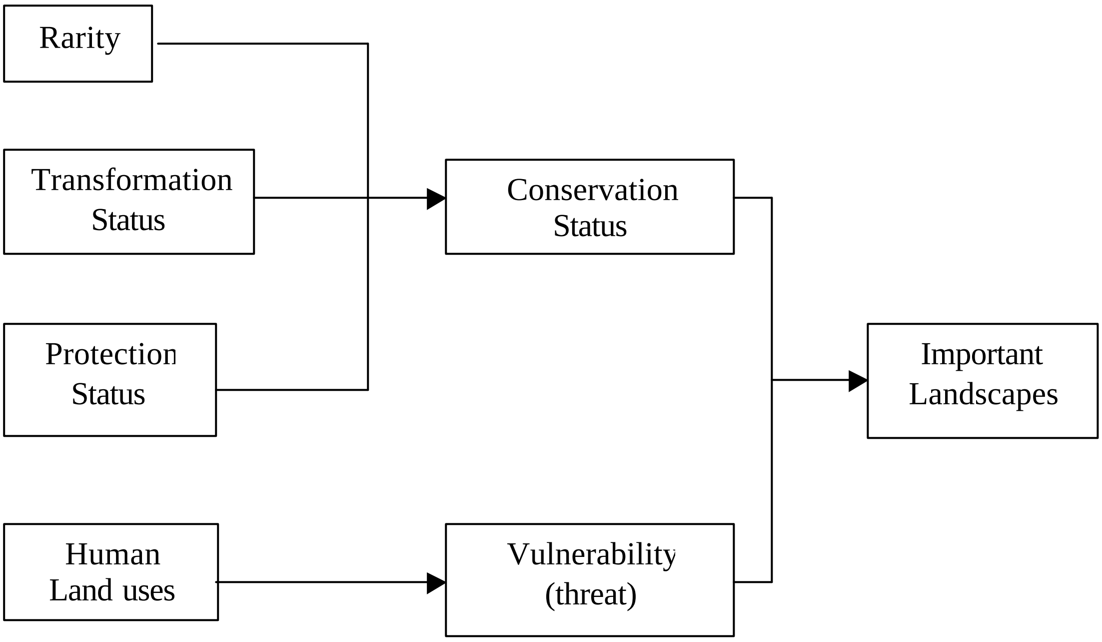


Figure 2.2 Cartographic model outlining the process followed to create the important landscape coverage.

Table 2.2 Rarity and transformation classes identified using natural breaks in the data, and the scores assigned to landscapes falling within these classes.

| **% Rarity** | **% Transformation** | **Score** |
|---|---|---|
| < 2.57 | > 43.17 | 1.00 |
| 2.57 – 5.34 | 32.26 – 43.17 | 0.75 |
| 5.34 – 13.3 | 14.2 – 32.26 | 0.5 |
| > 13.3 | < 14.2 | 0.25 |

Using the IUCN 10% threshold as a base limit and a 50 a 99 % breaks, four classes of protection were identified and landscapes given corresponding scores (Table 2.3).

Table 2.3 Scores assigned to landscapes based on their degree of protection where the IUCN recommendation of 10% under protection forms the cut-off for the highest score.

| **% Protection** | **Score** |
|---|---|
| < 10 | 1.00 |
| 10 - 50 | 0.66 |
| 50 - 99 | 0.33 |
| 100 | 0 |

Conservation status was then determined for each landscape class by averaging the scores for rarity, transformation and protection. Based on natural breaks in the data three classes equivalent to high, medium and low conservation status were identified and the landscapes allocated to these groups accordingly.

### 2.2.4 Landscape vulnerability

Vulnerability was calculated by determining the number of human land-use classes (as described by the NLC database) present within each landscape class. Vulnerability was expressed as percentages relative to the highest diversity of land-uses recorded for any of the landscape classes. High, medium and low vulnerability classes were identified using equivalent breaks of 100, and the landscapes placed into these groups.

### 2.2.5 Important landscapes

Using a 3x3 conservation status-vulnerability matrix, five relative priority groupings were identified to rank the landscapes in order of priority. Conservation status was given higher weighting in the determination of the ranked groups because its was based on fewer assumptions and, more importantly from a biodiversity perspective, measures the current status of a landscape class (Table 2.4).

Table 2.4 Conservation status-vulnerability matrix denoting the five priority groups used to rank the importance of the landscapes. The numbers in brackets denote the priority rank, with 1 being highest priority.

| | | **Vulnerability** | | |
|---|---|---|---|---|
| | | *Low (L)* | *Medium (M)* | *High (H)* |
| **Conservation Status** | *Low (L)* | LL (5) | LM (4) | LH (4) |
| | *Medium (M)* | ML (4) | MM (3) | MH (3) |
| | *High (H)* | HL (3) | HM (2) | HH (1) |

## 2.3 Results

### 2.3.1 Landscape conservation status

57.1% (12 out of 21) of the landscapes were assigned to the top rarity class, indicating that most cover a relatively small proportion of Mpumalanga. While, 23.8% (5 out of 21) were assigned to the class denoting the highest level of transformation, and 61.9% (13 out of 21) are currently protected by less than the IUCN standard of 10% (Table 2.5).

Table 2.5 Number of landscape classes in the different class ranges for rarity, degree of transformation and current protection.

| **% Rarity** | | **% Transformation** | | **%Protection** | |
|---|---|---|---|---|---|
| *Class* | *Number* | *Class* | *Number* | *Class* | *Number* |
| < 2.57 | 12 | > 43.17 | 5 | < 10 | 13 |
| 2.57 – 5.34 | 3 | 32.26 – 43.17 | 4 | 10 - 50 | 7 |
| 5.34 – 13.3 | 4 | 14.2 – 32.26 | 9 | 50 - 99 | 1 |
| > 13.3 | 2 | < 14.2 | 3 | 100 | 0 |

Table 2.6 Summary of percentage transformation per Land-use class for each Landscape Class.

| Landscape Class | Cultivated | Degraded | Forest plantations | Mines & quarries | Urban |
|---|---|---|---|---|---|
| Dry Mountainous/hilly Afromontane | 4.71 | 0.07 | 2.27 | 0.11 | 0.51 |
| Dry Mountainous/hilly Coastal | 31.14 | 0.00 | 0.00 | 0.00 | 1.11 |
| Dry Mountainous/hilly Highlands | 7.18 | 0.26 | 1.46 | 0.06 | 0.22 |
| Dry Mountainous/hilly Lowlands | 16.56 | 2.80 | 0.65 | 0.27 | 1.02 |
| Dry Undulating/flat Afromontane | 27.27 | 0.00 | 2.14 | 0.26 | 0.71 |
| Dry Undulating/flat Coastal | 6.50 | 1.45 | 0.00 | 0.00 | 0.65 |
| Dry Undulating/flat Highlands | 32.05 | 1.17 | 1.31 | 1.82 | 2.26 |
| Dry Undulating/flat Lowlands | 14.96 | 10.17 | 0.56 | 0.11 | 2.59 |
| Moist Mountainous/hilly Afromontane | 0.75 | 0.06 | 13.18 | 0.00 | 0.21 |
| Moist Mountainous/hilly Highlands | 2.29 | 0.61 | 24.91 | 0.00 | 0.73 |
| Moist Mountainous/hilly Lowlands | 6.85 | 1.47 | 17.01 | 0.06 | 0.80 |
| Moist Undulating/flat Afromontane | 4.81 | 0.00 | 16.42 | 0.09 | 0.45 |
| Moist Undulating/flat Coastal | 54.78 | 4.06 | 0.00 | 0.00 | 2.85 |
| Moist Undulating/flat Highlands | 7.67 | 1.46 | 33.21 | 0.07 | 0.76 |
| Moist Undulating/flat Lowlands | 16.74 | 2.19 | 30.43 | 0.01 | 0.95 |
| Wet Mountainous/hilly Afromontane | 0.00 | 0.00 | 31.81 | 0.00 | 0.00 |
| Wet Mountainous/hilly Highlands | 0.04 | 0.00 | 50.59 | 0.00 | 0.33 |
| Wet Mountainous/hilly Lowlands | 0.53 | 0.02 | 38.96 | 0.00 | 0.00 |
| Wet Undulating/flat Afromontane | 0.00 | 0.00 | 24.05 | 0.00 | 0.00 |
| Wet Undulating/flat Highlands | 0.58 | 0.00 | 75.60 | 0.00 | 0.61 |
| Wet Undulating/flat Lowlands | 0.00 | 0.27 | 88.22 | 0.00 | 0.00 |

*Major causes of transformation*

The major cause of all dry type landscapes is cultivation. Cultivation was also the major cause of transformation in the Moist Undulating/flat Coastal (54.78%) and in the Moist Undulating/flat Lowland landscape (17.74%) classes. Forest plantations were the major cause of transformations in all Moist or Wet type landscapes except the Moist Undulating/flat Coastal landscape type. Forest plantations were responsible for 88.22% of the transformation of the Wet Undulating/flat Lowlands and 75.6% of the Wet Undulating/flat Highlands.

The overall transformation caused by degraded land, Mines and Quarries and Urbanisation was small for most landscape classes. Degraded land caused the transformation of 10.17% of the Dry Undulating/flat Lowlands landscape.

The resulting conservation status scores showed that a large portion (42.8%, 9 out of 21) of landscapes are highly important, with 4 (19.0%) having the maximum possible conservation status score (Table 2.7). The landscape classes falling in the highest conservation status class occur along the Mpumalanga escarpment and foothills to the escarpment.

**2.3.2 Landscape vulnerability**

The greatest number of land-uses within a landscape class was 13, and was found in only one landscape class. The equivalent breaks classes showed that 9 (42.8%) of the landscape classes were assigned to the highest vulnerability class, with 5 (23.8%) in the lowest class (Table 2.8). Highly vulnerable landscapes are distributed through the Lowveld and the western Highveld excluding the escarpment.

Table 2.7 The conservation status classes identified using natural breaks in the data, and the number of landscape classes falling into each.

| Conservation status class (ranking) | Number of landscapes |
|---|---|
| 0.36 – 0.64 (low) | 4 |
| 0.64 – 0.8 (medium) | 8 |
| 0.8 - 1 (high) | 9 |

Table 2.8 The vulnerability classes identified using equivalent breaks in the data, and the number of landscape classes falling into each.

| % Vulnerability class (ranking) | Number of landscapes |
|---|---|
| 0 – 33.3 (low) | 5 |
| 33.3 – 66.6 (medium) | 7 |
| 66.6 - 100(high) | 9 |

### 2.3.3 Important Landscapes

Four of the ranked priority groups had landscape representatives with 1 landscape class (4.7%) falling in the highest priority group, 4 (19%) in the second, 11 (52.4%) in the third, 5 (23.8%) in the fourth and 0 (0%) in the lowest priority group (Table 2.9). The distribution of top priority landscapes is restricted to the foothills of the escarpment. Landscapes ranked in the second priority group are found on the high lying areas of the escarpment. The distribution of the top two important landscape groups largely reflects that of landscapes with the highest conservation status (Figure 2.3). This is expected as conservation status was given higher weighting. The lowest priority landscapes occur primarily in the Lowveld, where the Kruger National Park protects large areas of the existing landscapes, and on the eastern Highveld (Figure 2.3).

Table 2.9 The important landscape classes identified using conservation status – vulnerability matrix, and the number of landscape classes falling into each.

| Landscape Importance class (ranking) | Number of landscapes |
|---|---|
| 5 | 0 |
| 4 | 5 |
| 3 | 11 |
| 2 | 4 |
| 1 | 1 |

### 2.3.4 Potential for increasing landscape protection

For all landscapes representation in protected areas can be increased beyond the IUCN 10% standard by conserving currently unprotected and untransformed areas. This would however require 86.9% of the remaining untransformed land of the Wet Undulating/Flat Lowlands to be conserved (Table 2.10). Conservation protection could theoretically be increased to beyond 50% for 18 of the 21 regional landscapes.

Table 2.10. Area and percentage of remaining untransformed landscapes required to achieve 10% conservation status

| Landscape | Protected area (ha) | Percentage Protected (%) | Area still required to achieve 10% Protection (ha) | Percentage of untransformed landscape to achieve 10% protection |
|---|---|---|---|---|
| Dry Mountainous/hilly Afromontane | 0 | 0.00 | 6926 | 10.83 |
| Dry Mountainous/hilly Coastal | 3860 | 44.90 | 0 | 0.00 |
| Dry Mountainous/hilly Highlands | 22565 | 5.33 | 19804 | 5.15 |
| Dry Mountainous/hilly Lowlands | 33976 | 16.66 | 0 | 0.00 |
| Dry Undulating/flat Afromontane | 48 | 0.00 | 105576 | 14.35 |
| Dry Undulating/flat Coastal | 628639 | 71.76 | 0 | 0.00 |
| Dry Undulating/flat Highlands | 32497 | 1.39 | 201013 | 14.02 |
| Dry Undulating/flat Lowlands | 280324 | 39.87 | 0 | 0.00 |
| Moist Mountainous/hilly Afromontane | 3049 | 1.64 | 15525 | 9.74 |
| Moist Mountainous/hilly Highlands | 13273 | 3.79 | 21743 | 8.69 |
| Moist Mountainous/hilly Lowlands | 18790 | 12.75 | 0 | 0.00 |
| Moist Undulating/flat Afromontane | 5143 | 1.34 | 33266 | 11.07 |
| Moist Undulating/flat Coastal | 0 | 0.00 | 250 | 26.10 |
| Moist Undulating/flat Highlands | 1816 | 0.25 | 70670 | 17.15 |
| Moist Undulating/flat Lowlands | 1490 | 1.16 | 11325 | 17.79 |
| Wet Mountainous/hilly Afromontane | 6511 | 10.00 | 0 | 0.00 |
| Wet Mountainous/hilly Highlands | 36361 | 20.57 | 0 | 0.00 |
| Wet Mountainous/hilly Lowlands | 4476 | 14.08 | 0 | 0.00 |
| Wet Undulating/flat Afromontane | 0 | 0.00 | 214 | 13.17 |
| Wet Undulating/flat Highlands | 2791 | 7.24 | 1065 | 11.90 |
| Wet Undulating/flat Lowlands | 0 | 0.00 | 1501 | 86.86 |

## 2.4 Discussion

The top two priority landscape groupings identified by this study fall predominately outside of the historically identified priority areas namely the Steenkampsberg, Chrissiesmeer and Wakkerstroom areas. These areas although poorly protected are as yet not heavily transformed according to the 1995/96 NLC database. This analysis highlights the need to conserve the foothills of the escarpment (Figure 2.3). The current network of reserves on the escarpment plays an important role in conserving parts of landscapes from the second priority groupings. The low priority of the landscapes on the Highveld can be attributed to their large areal extent and perceived lack of threat in terms of number of land-uses and extent of transformation.

For all the priority landscapes there appears to be sufficient untransformed area available to achieve the IUCN minimum standard of 10% representation in protected areas. To achieve this, however, for the Wet undulating/flat lowlands would require 86% of the remaining untransformed land to be conserved. This is highly unlikely given the limitations of the NLC database (see below for discussion of possible limitations in the NLC database). "Clearly the goal of conservation is not only to ensure minimum landscape, habitat and species protection, but also to represent geographic gradients and to enable longer-term ecological and evolutionary processes to persist. Thus, the goal should not be simply to conserve 10% of a landscape area, but to conserve the variation across the landscape. The spatial variation of landscapes is the defining characteristic of these broader ecological systems, and is essential to landscape functioning and the persistence of the other levels of biodiversity, which occur within the landscape. However, present knowledge doesn't allow for identification of critical landscape elements, but some of this detail will be forthcoming from the analyses being undertaken on the other levels of biodiversity" (Benn, 2000).

### 2.4.1 Limitations and improvements

*Land-cover*

The land-cover database was developed in 1994/95 from satellite imagery and was used to determine the extent and spatial distribution of fragmentation within Mpumalanga. The land-cover database overestimates the extent of natural vegetation within Mpumalanga especially within the grasslands and savannahs. Degraded vegetation was defined by the National land-cover as areas having significantly higher reflectance levels than surrounding vegetation (Thompson, 1996). Vegetation degradation is thus a measure of reduced vegetation cover rather than a change in species composition. The effects of over-grazing and too frequent burning within the grasslands and savannahs causing species loss within the grasslands and both species loss and bush encroachment within savannahs is ignored by the NLC database. Old agricultural lands that have reverted back to grasslands would not have been detected as transformed or degraded land although these areas are species depauperate. It has been estimated that old lands can contribute between 12 to 21% of the total area transformed by cultivation (Macdonald, 1991), yet currently these areas are classified as unimproved grasslands in the NLC database. Additionally, major land transformations have taken place in the past five to six years since the production of the land-cover database. Most notable has been the establishment of sugarcane within the Lowveld in the Nkomati region, the increase in afforestation along the escarpment, the development of trout dams in the high altitude areas, the increase in open-cast mining on the Highveld and Sekhukhune area. The spread of alien, invasive species continue to cause major transformation throughout the Province. The analysis therefore clearly underestimates the extent of transformation.

This therefore emphasises the need for an updated land-cover map. The bias in the analysis could have been partially addressed through the availability of current coverages on areas under agriculture, from the Department of Agriculture, Conservation and Environment, dams and afforestation, from the Department of Water Affairs and Forestry, and areas under mining, from the Department of Energy and Mineral Affairs. These coverages were not available at the time of analysis and it is therefore recommended that the creation and maintenance of these databases becomes an important focus of the relevant departments.

This study has identified and prioritised the *landscapes* in terms of their conservation needs. As these landscapes continue to be transformed the percentage of the remaining area requiring conservation will continue to increase. It will also become increasingly difficult to find a suitable area to conserve with regard to size, composition and representation and condition of the landscape and the maintenance of ecosystem integrity. It is therefore crucial that suitable areas for conservation within the priority landscapes are identified and that appropriate conservation strategies be developed and implemented.

*Protected area database*

The database used only proclaimed reserves falling under the provincial ordinance, and does not include other forms of protected area; for example private game reserves and community conservation areas. The use of only provincial reserves is justified in that these areas are legally protected, whereas areas under private ownership can be easily transformed to another land-use. However, including all forms of protected area and ranking them according to the level of protection offered would give a more complete picture of current protection status.

*Landscape resolution*

"The resolution (1km$^2$) of the data used to produce the landscape map limits the size of the features that can be identified, including the boundaries between landscapes. It is widely recognised that landscape pattern analysis is sensitive to the spatial resolution of the source data. However, when identifying landscapes there has been a tendency to focus on finer elements within a landscape, rather than on the broader regional patterns, which truly define a landscape. In addition, most landscape definitions describe them as features covering tens of kilometres. Therefore, it is felt that the resolution of the landscape map is suitable and attained a balance between detecting local and regional heterogeneity" (Benn 2000). The Landscape map still requires ground-truthing and verification.

## 2.5 Conclusions

Despite the limitation mentioned above the analysis provides a realistic and practical assessment of the priority landscapes for conservation in Mpumalanga. The analysis can be improved by addressing some of the limitations mentioned above and by verifying the existence of the modelled landscape classes. In addition, it would be strengthened by the identification and understanding of the constituent elements of each landscape class. As this information and updated land-cover information becomes available it would be necessary to update the landscape priority map to reflect the current knowledge.

## 2.6 References

Benn, G.A. 2000. Identification of important landscapes. Chapter 2. Kwa-zulu Natal Strategic Environmental Assessment.

Fairbanks, D.H.K. & Benn, G.A. 2000. Identifying regional landscapes for conservation planning: a case study from Kwa-zulu Natal, South Africa. Landscape and Urban Planning. 50: 237-257

Forman, R.T.T. 1981. Interactions among landscape elements: a core of landscape ecology. In Perspectives in Landscape Ecology pp 35-48, Proceedings of the International Congress of Landscape Ecology, Veldhoven. Pudoc Publ., Wageningen. The Netherlands.

Forman, R.T.T. & Godron, M. 1981. Patches and structural components for a landscape ecology. BioScience 31: 733-740

Low, A.B. & Rebelo, A. (eds) 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

Macdonald, I.A.W. 1991. Man's role in changing the face of southern Africa. In *Biotic Diversity in Southern Africa, Concepts and Conservation*. Edited by B. J. Huntley. Oxford University Press Cape Town. pp 51-77.

Thompson, M.W. 1996. A standard land-cover classification scheme for remote-sensing application in South Africa. South African Journal of Science 92: 34-42.

Turner, M.G. 1989. Landscape ecology: the effect of pattern on process. Annual Review of Ecology and Systematics 20: 171-197

Wessels, K.J., Reyers, B. and Van Jaarsveld, A.S. 2000. Incorporating land cover information into regional biodiversity assessments in South Africa. *Animal Conservation* 3: 67-79.

# 3 Identification of important communities

## 3.1 Introduction

In the identification of important communities it was recognised that two well-defined communities, namely indigenous forests and wetlands, occur within the broader vegetation communities of the Province. Both forests and wetlands are important for their role in ecosystem processes and their richness in biodiversity. They thus provide areas of higher importance to the larger matrix of a particular vegetation community. Both forests and wetlands have been poorly mapped for the Province and it was thus necessary to compile coverages for these communities from existing sources and map additional data where possible. Caves represent unique ecosystems and were delineated using geological formations. In the absence of dedicated floristically based vegetation community map for the whole Province, the Acocks Veld Types were used. Phytochoria (Centres or Regions of Endemism) comprise unique floristic elements and represent areas of considerable floristic diversity rich in endemic species. Phytochoria were delineated from existing maps then further refined and assessed using GIS technology.

These coverages formed the basis for the analysis of the communities. Forests were prioritised according to their individual size, area to permieter ratios and custodianship. This was not possible for the wetlands due to their inter-linking nature. Wetlands were therefore all given the same priority of 1. The vegetation communities were prioritised using levels of endemism, fragmentation, transformation and protection. There was a strong correlation between phytochoria and the distribution of threatened plants species, so phytochoria weightings were halved to prevent duplication. The cave formations were not accurately delineated based on the occurrence of spcific caves, but were instead broadly delineated according to geology and subsequently their weightings were also halved and they received a value of 0.5.

## 3.2 Wetlands

Contributors: A. Linström and A. Emery

### 3.2.1 Introduction

The word "Wetland" is a family name given to many different types of specific habitats, ranging from springs, seeps, mires and fens in the upper catchment, to midland marshes and floodplains, to coastal lakes, mangrove swamps and estuaries at the bottom of the catchment. Rivers, which link all the above mentioned habitat types, are also classified as wetlands i.e. river bank/ stream bank wetlands.

Wetlands can be seen as one of the most valuable ecosystems in the world. In 1980 the International Union for the Conservation of Nature (IUCN) identified wetlands as being the third most vital life support systems on the planet. These systems can have an effect on the nature of entire catchments. Generally these effects are beneficial to the needs of human kind. Some of the services wetlands provide are hydrological values (water purification; streamflow regulation; including flood attenuation and baseflow augmentation; and groundwater discharge and recharge); erosion control value; and ecological value (maintenance of biotic diversity through the provision of habitat for wetland-dependent fauna and flora) (Kotze & Breen 1994).

According to the national classification system most of the wetlands in the Mpumalanga Province can be classified as palustrine wetlands, which consist of wetlands traditionally called marshes, swamps, fens and vleis. It also includes small shallow waterbodies and vegetated and unvegetated endorheic pans. Palustrine wetlands may be situated shoreward on river floodplains; in isolated catchments; or on slopes.

The aim of this study is to map, classify wetlands and to determine the impacts of different landuses on wetlands in the Mpumalanga Province.

### 3.2.2 Methods

Wetlands were identified, mapped and classified from aerial photographs, existing inventory information and field surveys. Palustrine wetland coverage was collated from various sources. A detailed coverage of the palustrine wetlands of the Steenkampsberg was obtained from the Wetland Consulting Services (Marneweck, Grundling & Grundling, 1999) and of the Upper Olifants River Catchment from a Water Research Commission Project (Palmer, Turpie, Marneweck & Batchelor, 2002). These wetlands were mapped from 1:30 000 aerial photographs. This was added to the already existing Mpumalanga Parks Board wetland database which had palustrine wetlands mapped for the Witbank Area, Usutu Catchment, Blyde River Catchment Reserve, Ohrigstad River, Nkomati River Catchment and Verloren Valei Nature Reserve. All these wetlands had been mapped off 1:30 000 scanned-in geo-referenced aerial photographs. Additional wetlands and pans were digitised on-screen from the 1:50 000 topo-cadastral map series of the province and classified accordingly. Within the Usutu catchment additional wetlands were mapped from enlarged 1:30 000 aerial photograph series.

For the purpose of this exercise the palustrine wetlands have been divided according to hydrogeomorphological features because of the important influence geomorphology has on local surface and groundwater movement patterns and the degree to which wetlands are open to lateral exchanges of sediments, nutrients and pollutants. To portray these values, wetlands have been divided into three functional groups (Table 3.2.1).

Table 3.2.1 Wetland functional groupings and it's associated wetland types.

| **Functional groupings** | **Wetland types** |
|---|---|
| Seepage wetlands | Wet grass and – meadows<br>Seeps<br>Sponges |
| Floodplains wetlands | Marshes<br>Swamps<br>Fringes<br>Leeves<br>Oxbows |
| Endorheic pans | Perennial pans<br>Non perennial pans |

The floodplain groupings were defined as areas occurring within a 100m radius of perennial rivers within the mapped wetland systems, and all wetlands mapped from the topo-cadastral map series. The remaining wetland areas were classified as seepage wetlands.

Although every attempt was made to identify all the wetlands within Mpumalanga, it is likely that additional wetlands will be found after some ground truthing and more information become available.

*Wetland verification*

A groundtruthing field trip was undertaken in the Chrissiesmeer, Lothair and Piet Retief area to determine the accuracy of the wetland classification. Wetlands were selected on an ad hok basis in the area and the following information was gathered at each wetland site: GPS reading, wetland type (seep or floodplain), dominant vegetation in the wetland and landuse activities in and outside the wetland. The percentage of floodplains and seepages correctly classified was calculated.

The percentage transformation within each wetland functional grouping for the whole Province was determined by overlaying them with the National Land Cover (NLC) database of South Africa's (Thompson, 1999) land-use classes. The NLC Database was developed from 1994-1995 LANDSAT Thematic Mapper (TM) satellite imagery and is suitable for 1:250 000 mapping applications (Thompson 1999). The NLC database is thus able to identify large-scale wetland alterations. The percentage and cause of transformation within floodplain and seepage wetland was also determined for a sample area within the Usutu catchment. The sample area, an East-west cross section, in the Piet Retief region of the Usutu catchment, spanning an area of 139 422ha was extensively mapped for wetlands off 1:30 000 aerial photographs. The sample area was used to determine if there was a difference in the percentage and cause of transformation if a more detailed wetland map existed, and try and provide more realistic estimates of transformation of wetlands.

### 3.2.3 Results and discussion

Three main functional wetland groupings were identified in the Mpumalanga Province. These wetland groupings are endorheic pans, seepage- and floodplain wetlands. The distributions of these wetland areas are shown in Figure 3.2.1. Fundamental to the understanding of wetlands is the production of a percentage impact for each of their different groupings.

Endorheic pans are contained in a topographic depression with the following characteristics: a closed drainage (lacking any outlet); flat basin floor; less than 2 m deep when fully inundated; and usually circular to oval in shape, sometimes kidney-shaped or lobed (Dini & Cowin 2000). Most of the endorheic pans occur in the wetter highveld region, mainly grassland biome, with the main concentration in the Lake Chrissies area. A total of 4 628 endorheic pans occur in Mpumalanga consisting of 2043 perennial- and 2585 non-perennial pans. The pan areas show a lack of integrated drainage and an average slope of less than one degree (Allen, Seaman and Kaletja 1995). A total of 89.34% of perennial pans are still intact with 10.66% being transformed (Table 3.2.3). The non-perennial pans are more heavily transformed with 31,13% being transformed and 68.84% still intact (Table 3.2.3).

Table 3.2.3 Status of Endorheic Pans in Mpumalanga.

| Pan type | Status | Area hectare | Percentage |
|---|---|---|---|
| **Perennial** | Untransformed 1 | 117067.94 | 89.34 |
| | Transformed 3 | 13973.67 | 10.66 |
| | | | |
| **Non-perennial** | Untransformed 1 | 65873.96 | 68.84 |
| | Degraded 2 | 29.44 | 0.03 |
| | Transformed 3 | 29790.13 | 31.13 |

Floodplain wetlands occur on a broad, generally flat landform, which is currently dominated by alluvial processes and can also occur adjacent to a well-defined river channel. Distinct morphological features, such as fringe wetlands, levees and oxbow lakes are present and the substrate is dominated by alluvial or deep hydric soils.

The wetland classification verification showed that 83% (10 of 12) of the floodplains were correctly classified, and that 77% (17 of 22) of the seepages were correctly classified (Table 3.2.4). Two of the incorrectly classified seepages were classified as pans in the field.

Table 3.2.4. Desktop wetland classification versus field survey classification.

| | **Field surveys** | | | |
|---|---|---|---|---|
| **Desktop Classification** | *Floodplain* | *Seepage* | *Pan* | *Total* |
| **Floodplain** | 10 (83%) | 2 (17%) | 0 | 12 |
| **Seepage** | 3 (14%) | 17 (77%) | 2 (9%) | 22 |

Using land-use classes from the NLC database it was determined that in Mpumalanga 87.29% of the floodplain wetlands are untransformed and 12.71% being transformed (Table 3.2.5). In the sample area 72.88% of the floodplain wetlands are untransformed and 27.12% are transformed (Table 3.2.6).

Seepage wetlands occur predominantly on a noticeable slope, including those on sloping valley bottoms and are commonly called seeps or sponges. These wetlands are associated with a perched water table and with saturated conditions close to the surface. The land use impact in Mpumalanga, affects 22.08% of the seepage wetlands and 77.92% are untransformed (Table 3.2.5). In the sample area of the Usutu River Catchment 57.02% of the seepage wetlands are untransformed and 42.98% are transformed (Table 3.2.6).

Table 3.2.5. The status of Floodplain & Seepage Wetlands in Mpumalanga.

| Type | Status | Area m2 | Percentage |
|---|---|---|---|
| **Floodplain** | Untransformed 1 | 43644.76 | 87.29 |
| **Floodplain** | Degraded 2 | 63.07 | 0.13 |
| **Floodplain** | Transformed 3 | 6289.61 | 17.58 |
| | | | |
| **Seepage** | Untransformed 1 | 60752.9 | 77.92 |
| **Seepage** | Degraded 2 | 116.255 | 0.15 |
| **Seepage** | Transformed 3 | 17100.04 | 21.93 |

Table 3.2.6 The status of Floodplain & Seepage wetlands in the sample area of the Usutu River Catchment

| Type | Status | Area in hectare | Percentage |
|---|---|---|---|
| Floodplain | Untransformed 1 | 2444.57 | 72.88 |
| | Transformed 3 | 909.78 | 27.12 |
| | | | |
| Seepage | Untransformed 1 | 4896.21 | 57.02 |
| | Transformed 3 | 3690.37 | 42.98 |

Several anthropogenic threats to floodplain and seepage wetlands have been identified and the extents of these have been quantified for a sample area in the Usutu river catchment in Table 3.2.7 and for the Mpumalanga Province in Table 3.2.8.

The scale and impacts of the different types of land uses are briefly outlined below.

3.2.3.1 Afforestation

Alien (exotic) plants, e.g. wattle, *Pinus spp.*, *Poplar spp.* and *Eucalyptus spp.*, are often planted in or close to wetlands. The sample area in the Usutu catchment reflects that afforestation has a 20.07% impact on floodplain wetlands and a further 36.34% impact on seepage wetlands (Table 3.2.7). For the Mpumalanga Province afforestation has a 4.56% impact on floodplain wetlands and a further 8.44% impact on seepage wetlands (Table 3.2.8). Timber plantations have a high impact on the water storage function of wetlands because the trees lose a lot of water, through transpiration. Some trees (e.g. *Eucalyptus spp.*) use more water than other trees (e.g. *Poplars spp.*, which lose their leaves in winter). Trees also have a strong negative effect on the habitat value of wetlands. Under increased shading beneath the trees, the vigour of indigenous plants, which are not adapted to these conditions, is reduced and they are often out-competed by alien invasive plants.

Table 3.2.7 The percentage impacts of various land-use on wetlands in the sample area of the Usutu River Catchment.

| **Wetland Type** | **Land use** | **Percentage impact** |
|---|---|---|
| Floodplain | Urban / Built-up land | 2.47 |
| | Mines & quarries | 0.11 |
| | Waterbodies | 0.41 |
| | Cultivated land | 4.47 |
| | Forest plantations | 20.07 |
| | Natural habitat | 72.47 |
| | | |
| Seepage | Urban / Built-up land | 0.67 |
| | Mines & quarries | 0.17 |
| | Waterbodies | 0.57 |
| | Cultivated land | 5.80 |
| | Forest plantations | 36.34 |
| | Natural habitat | 56.45 |

Table 3.2.8 The percentage impacts of various land-use on wetlands in Mpumalanga.

| **Wetland Type** | **Land use** | **Percentage impact** |
|---|---|---|
| Floodplain | Urban / Built-up land | 0.47 |
| | Mines & quarries | 0.58 |
| | Waterbodies | 1.06 |
| | Cultivated land | 6.96 |
| | Forest plantations | 4.56 |
| | Natural habitat | 86.37 |
| | | |
| Seepage | Urban / Built-up land | 0.32 |
| | Mines & quarries | 0.69 |
| | Waterbodies | 0.74 |
| | Cultivated land | 12.37 |
| | Forest plantations | 8.44 |
| | Natural habitat | 77.44 |

3.2.4.2 Cultivation (Agriculture)

In the Usutu Catchment cultivated land impacts on 4.47% of the floodplain wetlands and 5.80% of the seepage wetlands (Table 3.2.7). For the Mpumalanga Province cultivated lands have a 6.96% impact on floodplain wetlands and a further 12.37% impact on seepage wetlands (Table 3.2.8). Agriculture is one of the main reasons for the drainage of floodplain- and seepage wetlands, which has dramatic impacts on their hydrological value. This drainage can be described as the main threat to the integrity of wetlands. By draining a wetland it lowers the water table and thus provides greater depth for the root zone of crops or pastures. It also controls water flow, which decreases the volume and retention time of water in the wetland. This leads to a reduction in its value for storing water and enhancing sustained streamflow. This is in conflict with optimising the water storage and water quality enhancement function of a wetland. In addition, replacing the natural wetland vegetation with actively growing temperate crops or pastures is almost certain to increase water use during the critical dry season period (Kotze & Breen 1994).

Drainage or any other form of hydrological manipulation should be seen in the landscape context. The upland catchment areas are intrinsically erosional landforms and tend to export most elements (including nutrients, toxicants and sediments). Wetlands, however, are generally importers of elements because they are intrinsically depositional landforms. Thus, wetlands are likely to have a significant impact at the landscape level on elemental constituents in water. When a wetland is drained, the degradation process exceeds the aggradation processes. Such alterations normally change the direction of elemental flux from net import to net export (Kotze & Breen 1994).

Conversion of a wetland to cropland or planted pastures involves disruption of the hydrological regime, the total replacement of native wetland vegetation and the application of fertilisers. This is detrimental to the maintenance of biotic diversity. For the majority of valued wetland-dependent species the habitat value of the wetland would be completely lost (Kotze & Breen 1994).

This land use is a major threat to endorheic pans in Mpumalanga. Fields in crop farming regions often surround or encroach directly onto the periphery of pans, or even impinge into the actual basins of smaller non-perennial pans. Such pans are subjected to contamination and eutrophication by pesticides and fertilisers. The endorheic nature of pans exacerbates this problem and toxic substances concentrate in their basins. More than 70% of the pans in Mpumalanga are affected by farming practices (Allen, Seaman & Kaletja 1995).

3.2.3.3 Mining

In the Mpumalanga Province mining has a 0.58% impact on floodplain wetlands and a further 0.69% impact on seepage wetlands (Table 3.2.8). Mining operations are widespread in the Mpumalanga highveld coalfields. Opencast mines can totally destroy pans. Associated with the coalmines are power stations and power lines. Power stations require extensive water supplies, which in most cases is imported from the Vaal- and Nkomati rivers. Hence the importance of wetlands to provide sustainable water supplies. Heavy utilisation of water, from or close to wetlands can lower the water table and this can decrease the period of inundation in wetlands and pans. Power lines (and even telephone lines) constructed close to pans are a major source of mortality to flying waterbirds, which collide with these structures (Allen, Seaman & Kaletja 1995).

Wetlands are altered by pollutants from upstream or local mine runoff, and in turn change the quality of the water flowing out of them. Acid mine drainage from active and abandoned coalmines has been shown to seriously affect wetlands. Wetlands do, however, ameliorate acid mine drainage somewhat. They serve a purification function, but after a number of years of receiving wastewater they display a reduced ability to retain pollutants. This process, called ageing, suggests that wetland disposal plans should allow the wetland to rest from wastewater discharge (Mitch & Gosselink 1986). Some pans are used as containers for mines and power stations waste water.

3.2.3.4 Urban/Development

Factors associated with urbanisation, such as roads, recreational and residential developments, are encroaching rapidly on many wetlands. This can lead to the total destruction of wetland areas (habitat and biota) and wetland functions. The hydrology changes in response to initial site clearing and grading. This can increase storm water runoff and decrease the time for runoff to reach the stream, which then can increase peak discharges. The frequency and severity of flooding and erosion potential downstream can increase. The reduced streamflow during prolonged periods of dry weather due to less available water can cause perennial streams to become seasonally dry. The lack of wetlands and their purification functions can contribute towards increased water pollution during dry periods (Batchelor 1995).

3.2.3.5 Degraded areas

Several other threats can contribute towards the degraded state of some wetlands:

*Grazing*

Wetlands, particularly temporarily or seasonally wet grasslands, may provide highly productive grazing-lands for wild and domestic grazers. The two primary components of domestic stock grazing that affect wetland value are defoliation of plant material and trampling of soil surface and plant material (Kotze & Breen 1994).

It has been shown that heavy grazing has a detrimental effect on the hydrological state of wetlands, these include: disruption of flow patterns by paths, gully erosion, silting up of pools, encroachment of marginal vegetation into the wetland area, etc. Soil compaction reduces infiltration, which results in higher surface runoff and more rapid loss of water from the catchment. With increased runoff, streamflow response is more rapid, flooding increases and recharge of groundwater storage falls with the result that baseflow yields also fall. This can increase the risk of soil loss through surface wash and rill erosion (Kotze & Breen 1994).

*Burning*

Fires are a natural part of most plant communities and if applied as “naturally” as possible, will only impact positively. Two types of fire occur in wetlands: surface and subsurface fires. Surface burning, has short term impacts such as killing some animals which are not able to escape, it also has many positive effects (e.g. controlling alien plants and increasing the productivity of the indigenous plants which may increase the breeding success of certain wetland dependent animals) (Kotze & Breen 1994).

Subsurface fires destroy organic matter and disrupt soil structure, rendering the soil more susceptible to erosion and decreasing the water storage volume of the soil. These fires also release trapped nutrients and destroy emergent vegetation. Recovery of vegetation on seepage slope settings appears to be very slow, particularly where the organic matter has burnt to the bedrock. The ultimate effect varies according to wetland type and condition at the time of the burn. Subsurface fires are considered undesirable and burning should be avoided in drought years, particularly at the end of the dry season, when soils are at their driest and are most susceptible to combustion (Kotze & Breen 1994).

*Dams*

Dams are able to perform certain functions carried out by wetlands (e.g. sediment trapping and water storage) although dams are poor substitutes in certain respects (Begg 1986). For example the deep-water habitat that a dam provides for fauna and flora is very different from that previously offered by the now inundated wetland. Dams often appear beneficial by apparently increasing wildlife in the area. However, many of these newcomer species are generalist species, such as the Egyptian Geese (*Alopochen aegyptiacus)*, Guttural Toad (*Bufo* *gutturalis*), Common River Frog (*Afrana angolensis*), etc. whose habitats are not under threat at all (Theron *pers. comm.*[1]). Dams frequently destroy the threatened habitats of specialist species like Wattled Crane (*Grus carunculatis*), Whitewinged Flufftail (*Sarothrura ayresi*), Rattling Frog (*Semnodactylus weallii*), Bronze Caco (*Cacosternum nanum*), Striped Grass Frog (*Ptychadena porosissima*), and etc. (Theron *pers. comm.*). On a landscape level, dams can totally obstruct the movements of aquatic animals, most notably fish. A dam wall is an artificial barrier in a system that was once open for the natural migration of organisms.

One of the adverse effects of dams is on the first wet season flows. During the dry season most dam levels drop through evaporation and/or abstraction. This results in the first wet season flows being retained until the dam is sufficiently full. This can cause considerable alteration in the timing, and thus, success of the life cycle stages in the river biota below, as well as negatively effecting human users downstream. During low dry-season flows a series of dams can lead to the complete cessation of dry season flows.

Other wetland functions that accrue from their shallow nature, such as the photodegradation of certain organic pollutants, other purification processes and the high degree of exchange between wetland water and sediment, would also be detrimentally effected. Dams can bereave all the valuable nutrient rich sediment from water, creating silt hungry water that contribute towards bank erosion, this can be seen as one of the most adverse effects.

### 3.2.4 Recommendations

A hydrogeomorphological approach in defining wetlands for this study is valuable because of the important influences that hydrology and geomorphology has on the location and nature of wetlands in the landscape. The local surface and groundwater movement patterns and the degree to which wetlands are open to lateral exchanges of sediments, nutrients and other pollutants will make it possible to derive information on wetland functioning, as well as the relationship between ecosystem structure and functioning. Once the combined area of a particular wetland type is determined for a catchment, a powerful tool is created for assessing the magnitude of functions provided by certain wetland types and their potential value to humans (Dini & Cowan 2000).

The large difference between the percentage transformations of floodplain and seepages between the provincial study and the extensively mapped sample area of the Usutu catchment can largely be attributed to the following points. Most of the wetlands mapped for the Province are large floodplains and have thus not been completely transformed by cultivation or afforestation. The smaller seepage wetlands of the Province have selectively been mapped in relatively untransformed areas (e.g. Steenkaampsberg and Blyde River Canyon Nature Reserve). The mapping exercise in the sample area was able to identify both large and small floodplain and seepage wetlands even once transformed by cultivation or afforestation. The sample area thus gives a more realistic indication of the extent of transformation within the different wetland groups. This emphasises the need for a comprehensive map of all wetlands within the province.

Satellite imagery used for the NLC database only identifies major lands cover alterations caused by cultivation, forestry and mining. Smaller land use alterations such as draining,

[1] J. Theron, Herpetologist, Mpumalanga Parks Board. Tel no 013 - 7696006

dredging and small dams are not shown by this method. Although these smaller scale alterations are not identified they can individually be just as detrimental as the other larger scale impacts.

The early history of wetland management, a history that still influences many people today, was driven by the general dictate that wetlands are wastelands, harbouring disease, that at best should be avoided or, if possible, drained and filled. In the past wetland management usually meant wetland drainage. Landowners were encouraged to tile and drain wetlands to make the land suitable for agriculture and other uses.

Three main factors influence wetlands: water level, nutrient status and natural disturbances. Through human activity, modification of any one of these factors can lead to wetland alteration, either directly or indirectly. The most common alterations of wetlands are draining, dredging and filling; modification of the hydrologic regime; mining and mineral extraction; and water pollution. Wetland and surrounding land use management should be aimed at minimising interference with the hydrology of wetlands as this is the most important determinant of a wetland's structure and function (Mitch & Gosselink 1986).

Open cast and underground mining of coal has also affected wetlands in some parts of the province. Methods should be implemented to protect wetlands during mining and to create new wetlands as part of the reclamation process. All other land use activities that impact on the functional values of wetlands should be kept away from the edge with a buffer strip of at least 30m. This should minimise the impact of the land use practice on hydrological processes in the wetland habitat.

Much remains to be done concerning the conservation of wetlands. Management strategies aimed at land in private ownership, is as important as land acquisition for formal nature reserves. However, some of the larger, and perhaps a suite of representative wetlands, should be given formal conservation protection if for no other reasons than for their functional values, tourism and education potential. Consideration should be given to include many of the more important wetlands in formal conservation strategies. Therefore, many more wetland areas should be identified for inclusion in the Ramsar Convention. This aspect should be investigated, especially in the light of the demonstrated importance of wetlands for water protection and management.

The promotion of the importance of wetland conservation to key decision-makers, wetland managers, extension services and landowners who impact on these systems, has been sorely neglected. Awareness, the wise use and sustainable management should be enhanced. Wetland conservation must become part and parcel of the work of the forestry and agricultural industry, government departments, and interested members of the public. All related management strategies to support and highlight the importance of these wetland systems should be prioritised. A further step would be the restoration and rehabilitation of degraded wetlands, which will fall mainly outside the boundaries of protected areas. This, coupled with our obligations to the Ramsar Convention, lends support and justification to these recommendations.

### 3.2.5 Acknowledgements

The Rennies Wetland Project is gratefully acknowledged for the participation in and support for wetland field surveys. The contribution of digitised wetland information from the Piet Retief area by the Mondi Forest Company is also greatly acknowledged. Thanks are also due to Dr. Johan Engelbrecht who reviewed and contributed in completing this document.

### 3.2.6 References

Allan, D.G., Seaman, M.T. & Kaletja, B. 1995. The endorheic pans of South Africa. In: Cowan, G.I. (Ed) *Wetlands in South Africa*. Department of Environmental Affairs and Tourism.

Batchelor, G.1995. *To drain, retain or encourage wetland development in developing urban areas: some engineering considerations.* CSIR.

Begg, G.W. 1986. *The Wetlands of Natal (Part 1); an overview of their extent, role and present status*. Natal and Regional Planning Report 7.

Dini, J.A. & Cowan, J.A. 2000. *Classification system for the South African wetland inventory.* Second Draft. South African Wetlands Conservation Programme. Department of Environmental Affairs and Tourism.

Kotze, D.C., Breen, C.M. & Klug, J.R. 1994. *WETLAND-USE: A management decision support system for the KwaZulu-Natal midlands*. WRC Report No. 501/2/94. Water Research Commission. Pretoria

Marneweck, G.C., Grundling, P.L. & Grundling, A.T. 1999. *Environmental plan for the protection, maintenance and wise-use of wetlands on the Steenkampsberg Plateau, Report for use in conjunction with the associated map of the Steenkampsberg Plateau Part 1 and 2.* Wetland Consulting Services.

Mitch, W.J. & Gosselink, J.G. 1986. Wetlands Management. In: *Wetlands.* Van Nostrand Reinhold Company Inc. New York.

Palmer, R.W., Turpie, J., Marneweck, G.C., and Batchelor, A.L. 2002. *Ecological and Economical Evaluation of Wetlands in the Upper Olifants River Catchment.* WRC Report No. K5/1162

Thompson, M.W., 1996. A standard land-cover classification scheme for remote-sensing application in South Africa. *South African Journal of Science* 92: 34-42.

## 3.3 Forests

Contributors: M.C. Lötter, A. Emery and S. Williamson

### 3.3.1 Introduction

Mixed evergreen forests form the smallest and most widely fragmented biome in southern Africa covering only 0.3% of the land surface (Geldenhuys 1996). They occur in a fragmented belt extending from the winter-rainfall fynbos into the summer-rainfall grasslands. In Mpumalanga forests generally occur along the steep south- or east-facing slopes on the escarpment. They are found along an altitudinal gradient that extends from some of the drier lower-lying riparian areas up into the moist mist-belt region. In these areas forests frequent areas that offer some form of protection from fire, frost and dry desiccating winds. Fluctuations in the climate and factors such as soil fertility and structure can limit forest community development (King 1978; Granger 1984).

Many indigenous forests along the former Transvaal escarpment were extensively utilised by the early settlers. Much of the timber used in mining and house construction in Pretoria and Johannesburg originated from the forests along the escarpment from Barberton in the south to Duiwelskloof in the north. Over-exploitation in many of the forest patches has reduced the number of commercially utilisable trees, mainly Yellowwood (*Podocarpus* species), to such an extent that the exploitation of accessible forests is not economically feasible (Von dem Bussche 1990)

Forests cover only 0.08% of South Africa's surface area and 7.1% of the vascular species occur in forests. They thus have a relatively high species richness of 0.58 species/km², making it the second richest biome per unit area in southern Africa (Geldenhuys 1992). Fynbos has the highest species richness at 1.36 species/km² and grassland is third with 0.25 species/km² (Gibbs Russell 1987). This species richness remains relatively constant along the tropical-temperate gradient of southern Africa (Geldenhuys & Macdevette 1989). The general patterns in species richness suggest that undisturbed forest is somewhat richer than disturbed forest, and that mature forest is richer than regrowth or seral forest (Geldenhuys 1996).

Frequent fires reduce the number of forest margin species, which protect the forest interior from the penetration of fire and the drying effects of winds (Geldenhuys & MacDevette 1989). Exotic species increase the threat of fire damage at the peripheries of forest patches. The removal of forest products such as firewood, building materials, food and traditional medicines in some areas has resulted in a decrease in species richness and even the disappearance of small forests (Geldenhuys & MacDevette 1989). The small and fragmented nature ensures that forests are unlikely to support long-term resource removal that is sustainable (Adie & Goodman 2000).

In order to conserve forests, their value needs to be recognised. Forests play an important role in water and soil conservation. They provide a host of useful products, such as food, medicine and building material, and could be a potentially provide a source of pharmaceutical resources. Large numbers of invertebrates and birds (Geldenhuys & MacDevette 1989) are restricted to forest habitats. In addition, the small and fragmented nature of the forest biome makes the conservation and preservation of forests important (Granger 1984). Von dem Bussche (1990) lists the following utilisation activities that take place along the escarpment:

- collection of firewood by the local rural population,
- collection of medicinal plants and bark from selected indigenous trees in accessible areas,
- poaching of animals by the local rural population, and
- outdoor recreation (hiking trails, picnic sites, camps and forest drives).

A number of procedures or techniques have been used in the classification of vegetation communities (Acocks 1988; Cooper 1985; Geldenhuys 1992; Low & Rebelo 1996). The first basic type of classification was based on structure or physiognomy (Edwards 1983). The second type is that of phytosociology and incorporates floristic composition and the relationship to other plant communities (Morgenthal & Cilliers 1997). Unfortunately there is no current forest classification system that accurately distinguishes floristic differences and biogeographical affinities between forests in Mpumalanga. This study therefore, made use of only one forest type, i.e. the broadly accepted Undifferentiated Afromontane forest type (White 1983).

The aim of the forest investigation was to:

1. collate and map existing forest data within Mpumalanga Province, from all available sources and
2. assign a conservation value to mapped forests.

For the purpose of the forest investigation, the definition of the term ‘forest’ is taken from the CSIR meta-database project (Bailey *et al.* 1999) and is defined as follows:

A forest is a generally multilayered vegetation unit dominated by trees (largely evergreen or semi-deciduous) whose combined strata have overlapping crowns (i.e. the crown cover is equal to or greater than 75%), and where graminoids in the herbaceous stratum (if present) are generally rare. Fire does not play an important role in forest function or dynamics except at the fringes.

The only complete forest data set available for Mpumalanga Province was from the South African National Land-cover (NLC) database (Thompson 1996). This data was derived from LANDSAT TM satellite imagery. The data set is designed for the 1: 250 000 scale planning and modelling application level and had a minimum mapping unit of 25 ha (Fairbanks & Thompson 1996).

The NLC database classified forests as having a tree canopy cover greater than 70% and was able to exclude commercial plantations from the forest data-set (Thompson 1996). The 70% cover was slightly lower than the definition supplied within this forest investigation. It was expected that the Land-cover data set would overcompensate and show more forests than actually occurs in Mpumalanga. However this was not so and some of the known forests mapped from the aerial photographs were incorrectly classified as ‘thicket and bushland’ by the NLC database, therefore it was necessary to map additional forests from other sources.

### 3.3.2 Methods

3.3.2.1 Compilation of indigenous forest cover map

The forests mapped from the various data sets were combined and displayed on one complete forest coverage map, using ArcView GIS (3.2a), showing the distribution of Afromontane forest throughout Mpumalanga. Where there was overlapping of polygons, the polygon from the most reliable source was retained. The following sources were used to compile the final forest coverage.

1. The NLC database (Thompson 1996) was used to indicate the size and location of forest patches for Mpumalanga. However, it failed to indicate the presence of some forests in areas where biogeographically important forests are known to exist.
2. Regional indigenous forest coverages were also obtained from SAPPI, Komatiland Forests and Department of Water and Forestry Affairs. These forests were digitised from 1:10 000 orthophotos or aerial photographs.
3. Expert knowledge and the landscape position of each forest patch were used to distinguish forest patches from wattle clumps. These forests were on-screen digitised using ArcView GIS (3.2a) on 1:50 000 georeferenced topographical maps.
4. All available aerial photographs were studied and the individual forest patches were then indicated on the photographs. Indicated forest patches were on-screen digitised, using ArcView GIS (3.2a), onto the backdrop of 1:50 000 georeferenced topographical maps.

3.3.2.2 Assigning a conservation importance ranking to indigenous forests

A conservation value was assigned to each forest patch based upon an importance ranking procedure to highlight the forests of high conservation value. It is difficult to measure forest threats, such as the indiscriminate bark harvesting which is having a severe impact on certain forest patches. Therefore it was decided to concentrate on the high conservation value forests instead. The ranking procedure was based on assigning a weighting to individual forest patches according to forest size, ownership and area-perimeter ratios. These three weightings were combined into a single importance value and ranked.

3.3.2.3 Forest size

The final forest coverage map displayed all the forest patches, and represented data from various sources mapped at various scales. Consequently there was a wide range in forest patch size, from fine scale riparian patches less than one hectare as digitised by SAPPI, to the large forests recorded from the NLC database. All forests were ranked according to their size (Table 3.3.1). Large forests, which are uncommon in Mpumalanga, are expected to contain higher levels of species richness (Geldenhuys 1992). Bond (1989), in a review on forest biogeography, reiterated Darlington’s rule of thumb as a generalisation that a tenfold increase in area doubles the number of species. These large forests were thus given a higher importance ranking.

Table 3.3.1 Forest patch-size and the corresponding importance ranking allocated to each forest patch.

| Forest size (ha) | Importance ranking |
|---|---|
| 0 – 10 | 1 |
| 10 – 50 | 2 |
| 50 – 100 | 3 |
| 100 – 500 | 4 |
| > 500 | 5 |

3.3.2.4 Forest protection status

Forests were ranked and assigned a threat weighting according to forest custodianship. Ownership could determine the type and quality of forest management and possible human-related impacts on the vegetation. Forests protected within provincial reserves were assigned a lower rating than forests occurring on private lands which would be subject to resource harvesting.

Forest custodianship could only be assigned to one of two categories: protected or private. Most protected forests occur within provincial reserves and were given a low threat-weighting (Table 3.3.2). DWAF (Department of Water Affairs and Forestry) controlled state forests are in a process of being transferred to either the Mpumalanga Parks Board or SANP to manage. Therefore they are considered to be 80-100% protected and were weighted accordingly. Communal owned forests were classified as privately owned forests due to the abolishment of the communal/tribal owned land system. They now fall under Municipal jurisdiction.

Protection status weightings were divided by 3 and multiplied by 5 to give protection status equal weighting to the other attributes that were also weighted. This weighting represents the legal status of a forest, which should protect the forest in terms of plant collection, unlawful changes in land use, etc. The lower the protection status, the greater the threat status and consequently the higher the weighting received.

Table 3.3.2 Forest protection status and weighting

| **Forest custodianship** | **Protected status** | **Protection weighting** | **Protection Score** |
|---|---|---|---|
| 80-100% protected | Medium | 1 | 1.66 |
| 0-79% private/protected | Medium low | 2 | 3.33 |
| 80-100% private | Low | 3 | 5 |

3.3.2.5 Forest area to perimeter ratio

Forests with a higher area to perimeter ratio would have a larger ratio of forest margin to forest area. Therefore forests with a lower area to perimeter ratio would less likely be influenced by edge effects. They are expected to contain higher level of biodiversity, particularly from the faunal components. Narrow forest patches are mostly riparian and therefore their area to perimeter ratios cannot change easily. Large and more circular forests have lower area to perimeter ratio. These ratios were calculated for each forest using ArcView's 'natural break' function to split the values into five classes (Table 3.3.3).

Table 3.3.3 Area to perimeter status and weighting

| **Natural breaks** | **Area-perimeter ratio** | **Ratio weighting & score** |
|---|---|---|
| 0 – 28.33 | High | 1 |
| 28.33 – 60.83 | Medium high | 2 |
| 60.83 – 122 | Medium | 3 |
| 122 – 264.7 | Medium low | 4 |
| 264.7 - 616 | Low | 5 |

3.3.2.6 Forest conservation importance
To obtain a single conservation importance value for each forest Mpumalanga Province, the three forest weighting coverages were overlayed (Figure 3.3.1) to give a single weighting. This final score was then rationalised to a value out of 1 to make it compatible with the other sections of this Biobase project. The results of this weighting procedure highlighted those forests of high conservation importance.

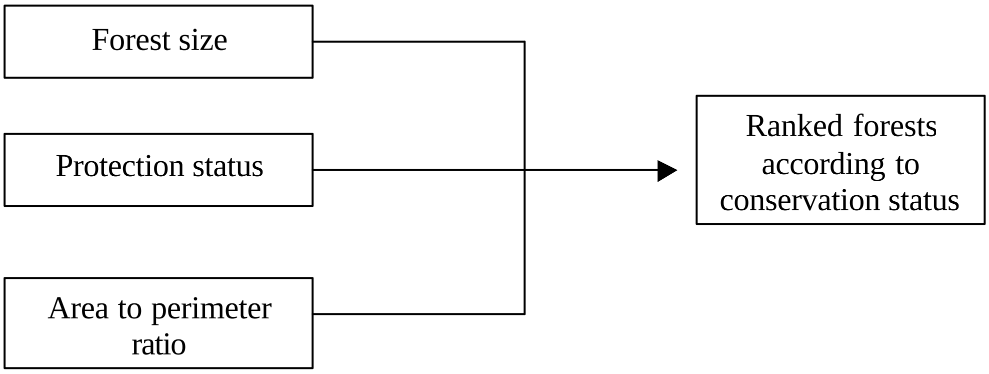


Figure 3.3.1 Cartographic model indicating the procedure used to rank forests according to conservation importance.

**3.3.3 Results**

Six data sources were used to compile the forest map for Mpumalanga, identifying 1388 forest patches. Figure 3.3.1 indicates the areas in which these forests occur and their importance ranking. These forest patches varied in size, ranging from the smallest patch at 0.002 ha, through to our largest forest patch 6120 ha. The average forest patch size is 29 ha and indigenous forests within Mpumalanga occupy a total area of 40 370 ha. Only 12 forests were larger than 500 ha, see Table 3.3.4 for description of forest ranking according to patch size. Some 149 forest patches occur within protected areas, representing 28% of the total size of all forests within Mpumalanga.

Table 3.3.4 Number and size of Afromontane forest patches within Mpumalanga

| **Forest Size (ha)** | **No. of forest patches in Mpumalanga** |
|---|---|
| 0 – 10 | 1021 |
| 10 - 50 | 270 |
| 50 - 100 | 29 |
| 100 - 500 | 56 |
| > 500 | 12 |

**3.3.4. Discussion**

The total previous estimate for Afromontane forests within Mpumalanga, was 26 552 ha (Bailey *et al*. 1999). This report therefore represents an increase in known forest coverage by 66% for Mpumalanga. By including the findings from the Biobase study, the total coverage of Afromontane forests for South Africa is now 276 819 ha, of which 14.6% occurs in

Mpumalanga. A total of 0.51% of Mpumalanga's land surface is covered with indigenous forest.

Although small forests scored relatively low importance weightings, they cannot be overlooked as they play an important role in providing corridors for gene flow between the larger more important forests. They are also important for the survival of many forest endemic species of invertebrates, amphibians, birds, mammals, reptiles and plants. For many of these species there is insufficient data to include them in the species chapters of this project.

Forests are threatened by commercial and subsistence agriculture, infrastructure development and resource utilisation. Without sound knowledge of the various plant communities, their floristic composition, distribution and their habitat requirements, effective land-use planning and conservation will not be possible (Morgenthal & Cilliers 1997). Therefore the identification, mapping and weighting of forests is the first step towards conserving forests and their biodiversity.

The province's forest research needs would include the following:

- maintenance of a database and GIS coverage listing and demarcating all the indigenous forests within Mpumalanga,
- determining the impact and distribution of alien vegetation on indigenous forests,
- determining which forest species are utilised by rural communities, and for which broad purpose (building, food, medicine, etc),
- evaluating impact of selective bark harvesting, specifically the supply and demand of bark products,
- determining the impact of recreational activities on selected indigenous forests, and
- incorporate and assess existing data according to current National Forest Classification that is underway.


### 3.3.5. Acknowledgements

Komatiland Forests, SAPPI and DWAF, are acknowledged for making their digitised forest coverage available to the project.


### 3.3.6. References


Acocks, J.P.H. 1988. Veld types of South Africa. *Memoirs of the Botanical Survey of South Africa*. No. 57.

Adie, H. & Goodman, P.S. 2000. Forests. In: Goodman, P.S. (ed.) Draft Report, *Determining the conservation value of land in KwaZulu-Natal*. Biodiversity Division: KwaZulu-Natal Nature Conservation Service.

Bailey, C.L., Schackleton, C.M., Geldenhuys, C.J., Moshe, D., Fleming, G., Vink, E.R., Rathogwa. N.R. & Cawe, S.G. 1999. *Guide to and summary of the meta-database pertaining to selected attributes of South African indigenous forests and woodlands*. Division of Water, Environment and Forestry Technology, CSIR.

Bond, W.J. 1989. Ecological biogeography and forests. In: Geldenhuys, C.J. *Biogeography of the mixed evergreen forests of southern Africa*. A report of the Terrestrial Ecosystems Section Ecosystems Section. Occasional Report No 45.

Cooper, K.H. 1985. *The conservation status of indigenous forests in Transvaal, Natal and OFS, South Africa*. Wildlife Society of Southern Africa, Durban.

Edwards, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14(2&3): 704-712.

Fairbanks, D.H.K. & Thompson, M.W. 1996. Assessing land-cover map accuracy for the South African Land-cover Database. *South African Journal of Science* 92: 465-470.

Geldenhuys, C.J. 1992. Richness, composition and relationships of the floras of selected forests in southern Africa. *Bothalia* 22(2): 205-233.

Geldenhuys, C.J. 1996. Southern African Forests: their biogeography, conservation and utilisation. Presented at: MAB/UNESCO Regional Seminar on Forests, Kandy, Sri Lanka.

Geldenhuys, C.J. and MacDevette, D.R. (1989) Conservation status of coastal and montane evergreen forest. *Biotic Diversity in Southern Africa: Concepts and Conservation*. Ed. Huntley, B.J. Oxford University Press, Cape Town.

Gibbs Russel, G.E. 1987. Preliminary floristic analysis of the major biomes in southern Africa. *Bothalia* 17,2: 213-227.

Granger, J.E. 1984. Fire in forests. In: van Booysen, P. & Tainton, N.N. (Eds) *Ecological effects of fire in South African Ecosystems.* Ecological studies no. 48. Heidelberg: Springer-verlag.

King, L.G. 1978. The geomorphology of central and southern Africa. In: Werger, M.J.A. *Phytogeography and ecology of southern Africa.* The Hague: W. Junk.

Low, A.B. & Rebelo, A.G. 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs & Tourism, Pretoria.

Morgenthal, T.L. & Cilliers, S.S. 1997. *The ecology and conservation of Pedlar's Bush*. Department of Plant and Soil Science, Potchefstroom University, Potchefstroom.

Thompson, M.W., 1996. A standard land-cover classification scheme for remote-sensing application in South Africa. *South African Journal of Science* 92: 34-42.

Von dem Bussche, G.H. 1990. Indigenous High Forests in the Transvaal with Special Reference to Inventory and Monitoring systems. *Suid-Afrikaanse Bosboutydskrif,* No. 158, September 1991.

White, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNSO MAP OF Africa. Natural Resources Research 20, UNESCO, Paris.

## 3.4 Vegetation Communities

Contributor: A. Emery

### 3.4.1 Introduction

Vegetation communities reflect a recurring assemblage of plant species of characteristic composition and structure, growing in an area of essentially similar environmental conditions and land use history (adapted from Gabriel & Talbot (1984)). Fragmentation, transformation and degradation adversely affect composition, functionality and structure of vegetation communities. Considering the importance of the primary production function of vegetation in terms of protecting soil and hydrological processes, it is important to derive and implement conservation strategies to mitigate these negative effects. Boundaries between vegetation communities are not necessarily distinct, as communities are situated along a continuum and gradually merge into each other. Vegetation communities have been described and/or mapped at various scales for different parts of Mpumalanga (Deall *et al.* (1989), Matthews *et al.* (1994) and Eckhardt *et al.* 1996). Yet, no single, detailed study covers the full extent of the Province. Therefore the existing Acocks Veld Type coverage was used as a surrogate vegetation community map for the Province.

The aim of this study was to identify vegetation communities of conservation importance by:
1) Identifying endemic and near-endemic vegetation communities
2) Determining the level of fragmentation and transformation within each community.
3) Identifying the major causes of transformation for each vegetation community.
4) Determining the level of protection afforded to each community.
5) Determining a conservation ranking based on their endemicity, fragmentation and protection status.

### 3.4.2 Methods

3.4.2.1 Data Sources:

*Vegetation Communities*

Acocks Veld Types of South Africa mapped at a scale of 1:1 500 000 (Acocks, 1975) were used to represent the vegetation communities within Mpumalanga (Fig 3.4.1). A total of 20 Vegetation communities are present in the Province. Acocks Veld Types were initially mapped to determine the agricultural potential of different areas within South Africa. Nevertheless it currently also provides the best vegetation community coverage for the province. Acocks Veld Types were used in preference to the Vegetation of South Africa, Lesotho and Swaziland published by Low and Rebelo (1996) as they better represent the variation of the vegetation in Mpumalanga than Low and Rebelo's coverage (M Lötter *pers. comm*[2], M Stalmans *pers. comm.*[3])

*Land-cover map*

The National Land-Cover (NLC) database of South Africa (Thompson, 1999) was used to asses the level of land transformation within each vegetation community. The NLC database is based on 1994-1995 LANDSAT Thematic Mapper (TM) satellite imagery and describes 31

[2] M. Lotter, Mpumalanga Parksboard

[3] M. Stalmans, P.O. Box 19139, Nelspruit, 1200

different land-use and land-cover classes. The NLC database is designed for 1:250 000 mapping applications with a minimum mapping unit of 25ha. The accuracy of the NLC database for Mpumalanga is between 72.7 and 82.1%, with an average of 78.5% (Thompson, 1999). The land-use classes represent areas that have been transformed from their natural vegetation to an alternative cover, and thus represent a loss of natural vegetation and biodiversity (Wessels, 2000). Although degraded land does not necessarily represent a complete loss of natural vegetation and biodiversity, these areas were included with the transformed land as their undoubtedly diminished value for the conservation of species and vegetation could not be assessed without extensive ground-truthing. The land-use and land-cover classes were assigned a transformation status according to their effect on the natural vegetation (Table 2.1).

*Protected Areas*
The protected areas map of Mpumalanga represents all areas that are formally protected under Act 10: the Mpumalanga Nature Conservation Act of 1998 or Act 57: the National Parks Act of 1976 and managed by the Mpumalanga Parks Board, Department of Agriculture, Conservation and Environment (DACE) or South African National Parks. The protected area boundaries were either digitised from 1:50 000 topocadastral maps or mapped using differentially corrected Global Position System data. Although significant areas of the Province enjoy protection in private nature and game reserves, the level of protection and appropriateness of the management applied varies widely from property to property and from one landowner to his successor. These protected areas were therefore not included in the analysis.

3.4.2.2 Analysis
Important vegetation communities were identified using concepts of endemicity, fragmentation, and protection status. The level of endemicity of a particular vegetation community is an important indicator of the level of responsibility Mpumalanga has in conserving that community. Fragmentation alters the community area, interior-perimeter ratios, patch shape, total patch boundary length, isolation, connectivity, and the number of patches. The level of fragmentation indicates the extent to which the community has been transformed and fragmented from its natural extent. Fragmentation negatively affects ecosystem functions and species population sizes and dispersal potential, thus reducing gene flow. The protection status indicates the level of formal protection that the vegetation community is being offered.

Spatial analysis was undertaken using ArcView 3.2a and ArcInfo 7.1 (ESRI, Redlands, California) and involved overlaying the Acocks Veld Type map with the NLC database and protected areas maps to derive the necessary information. The resulting endemicity, protection and fragmentation coverages were then additively overlayed to determine the important vegetation communities (Figure 3.4.2). Fragmentation was given a double weighting as it not only represents current level of transformation, but also serves as an indicator of the threat of future transformation and hence the need for conservation action on the remaining untransformed land.

*Endemicity*
A taxonomic unit is considered endemic when its extent is restricted to a defined region. For the purpose of this study the vegetation community was considered to be the taxonomic unit and the Mpumalanga provincial boundary the defined region. The level of endemicity of a

particular vegetation community is an important indicator of the level of responsibility Mpumalanga has in conserving that community. The endemicity of each vegetation community to Mpumalanga was determined by dividing the total area of the vegetation type occurring in Mpumalanga by the total area of that vegetation community within South Africa, Lesotho and/or Swaziland. An endemic vegetation community was defined as one in which greater than 90% of its extent falls within Mpumalanga, while a near-endemic vegetation community was defined as one in which between 61 to 90 % of its extent falls within Mpumalanga. Vegetation communities with less than 61 % of their extent in the Province were considered non-endemic (Table 3.4.1). Endemic communities were given a score of 1, near-endemic communities a score of 0.5, while non-endemic communities were given a score of 0 (Table 3.4.1).

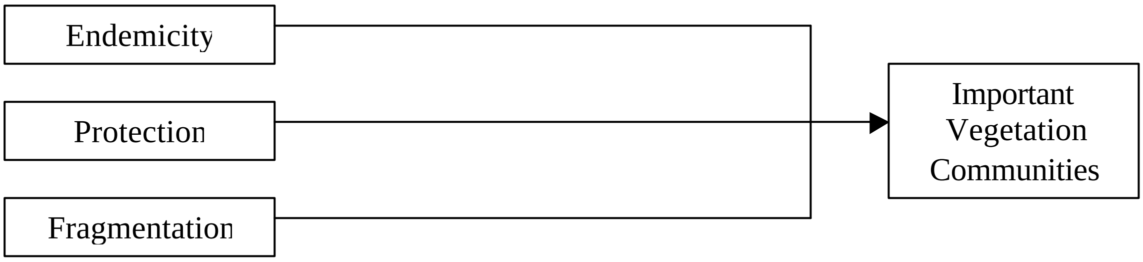


Figure 3.4.2 Cartographic model outlining the process followed to derive the important vegetation communities.

Table 3.4.1 Endemicity classes and corresponding weighting values.

| **Endemicity** | **Proportion of Vegetation community in Mpumalanga (%)** | **Weighting Value** |
|---|---|---|
| Endemic | >90 Endemic | 1.0 |
| Near-Endemic | 90 - 61 | 0.5 |
| Non-Endemic | <= 60 | 0 |

*Fragmentation*

The alteration of vegetation communities from natural vegetation to alternative land-uses such as agriculture, afforestation, or urbanisation results in their fragmentation (Bogaert *et al.*, 2000). Vegetation alteration has four main measurable effects on a vegetation community. It increases the number of patches, the distances between patches, the perimeter of the vegetation community, and reduces the total area of the vegetation community. To identify the remaining natural patches for each vegetation community, all the untransformed land was selected from the NLC database and overlayed with the vegetation communities' coverage. A single fragmentation index (Fi), as outlined by Bogaert *et al.* (2000), which measures total habitat area, perimeter, number of patches and patch isolation was used to determine fragmentation. The fragmentation index is always $0 \geq Fi \leq 200$. Where Fi = 0 represents a highly fragmented community and Fi = 200 a non-fragmented community. The resulting Fi values were split according to the natural breaks within the data and weighted according to their degree of fragmentation relative to the other vegetation communities (Table 3.4.2).

*Protection*
The protection status is an indication of how well the formal network of reserves are conserving particular vegetation types. The degree of formal protection granted to each vegetation community was calculated by overlaying the formal provincial and national reserve network for Mpumalanga over the vegetation communities. The percentage of each vegetation community protected was calculated for the area of each vegetation community within Mpumalanga. The IUCN guideline of 10% was used as a standard for the protection status. This guideline is useful as it indicates a minimum protected area required to deliver essential ecosystem services such as water catchment and release, soil protection, cleaning of air and to ensure maintenance of genetic diversity for future use. Vegetation communities with a protection status of over 20% require the least amount of further protection and were therefore given a weighting of 0, while those with a protection status less than 2% were given the highest weighting of 1 (Table 3.4.3). Intermediate values were assigned to the range in-between (Table 3.4.3).

Table 3.4.2 Fragmentation Index (Fi) classes and corresponding weighting values.

| **Fragmentation Index (Fi)** | **Weighting Value** |
|---|---|
| 132-142 | 1.0 |
| 142-149 | 0.8 |
| 149-156 | 0.6 |
| 156-163 | 0.4 |
| 163-181 | 0.2 |

Table 3.4.3 Protection status classes and corresponding weighting values.

| **Protection Status (%)** | **Weighting Value** |
|---|---|
| <2 | 1.00 |
| 2-5 | 0.75 |
| 5-10 | 0.50 |
| 10-20 | 0.25 |
| >20 | 0.00 |

### 3.4.3 Results

3.4.3.1 Vegetation communities
Twenty vegetation communities were identified as occurring within Mpumalanga. Acocks grouped these vegetation communities into five broader vegetation types (Acocks, 1975). Of the 20 vegetation communities within Mpumalanga one occurred in the Coastal Tropical Forest vegetation type, two in the Inland Tropical Forest types, five in the Tropical Bush and Savanna types, seven in the Pure and five in the False Grassland types (Table 3.4.4). The Coastal Tropical Forest is restricted to the Lebombo Mountains along the south-eastern border of the Province with Mozambique and Swaziland. The low lying areas of the province are comprised of the Tropical Bush and Savanna vegetation types while rising up the escarpment, Inland Tropical Forest types predominate. The high lying areas of the province are made up of the Pure and False Grassland types.

Table 3.4.4 Acocks vegetation communities within Mpumalanga; total area within South Africa, within Mpumalanga, and endemism status for Mpumalanga.

| Acocks Veld Type | Total Area (ha) | Mpumalanga (ha) | Endemism |
|---|---|---|---|
| **Coastal Tropical Forest** | | | |
| 6 - Zululand Thornveld | 525929 | 13003 | |
| **Inland Tropical Forest** | | | |
| 8 - North-Eastern Mountain Sourveld | 983527 | 327095 | |
| 9 - Lowveld Sour Bushveld | 1565907 | 475753 | |
| **Tropical Bush and Savanna** | | | |
| 10 – Lowveld | 2978014 | 1015663 | |
| 11 - Arid Lowveld | 1733643 | 501274 | |
| 12 – Springbok Flats Turf Thornveld | 553785 | 33199 | |
| 18 - Mixed Bushveld | 4179610 | 568258 | |
| 19 - Sourish Mixed Bushveld | 3288360 | 449355 | |
| **Pure Grassveld** | | | |
| 48 – Cymbopogon-Themeda Veld (Sandy) | 4915765 | 57679 | |
| 52 - Themeda Veld (Turf Highveld) | 1038901 | 1018000 | Endemic |
| 53 - Themeda Veld To Cymbopogon | 1150935 | 67756 | |
| 54 - Themeda Veld To Highland Sourveld Transition | 277187 | 202682 | Near-endemic |
| 55 - Themeda Veld To Bankenveld Transition | 63696 | 32928 | |
| 56 - Highland Sourveld To Cymbopogon | 1184088 | 917 | |
| 57 - North-Eastern Sandy Highveld | 1457719 | 1252527 | Near-endemic |
| **False Grassveld** | | | |
| 61 – Bankenveld | 2846803 | 996680 | |
| 62 – Bankenveld To Sour Sandveld Transition | 150005 | 149952 | Endemic |
| 63 - Piet Retief Sourveld | 997051 | 633503 | Near-endemic |
| 64 - Northern Tall Grassveld | 674611 | 136918 | |
| 65 - Southern Tall Grassveld | 1575858 | 4467 | |

3.4.3.2 Endemicity

Two vegetation communities are endemic, while another three are near-endemic to Mpumalanga. The Themeda Veld (Turf Highveld) and the Bankenveld to Sour Sandveld Transition are endemic to Mpumalanga while the Themeda Veld to Highland Sourveld Transition, North Eastern Sandy Highveld, and the Piet Retief Sourveld are near-endemics to Mpumalanga. All the endemic and near-endemic vegetation types are grassland vegetation communities.

3.4.3.3 Fragmentation

3.4.3.3.1 Fragmentation Index

The Springbok Flats Turf Thornveld is the most heavily fragmented vegetation community in Mpumalanga with a Fragmentation Index (Fi) of 133. Other highly fragmented vegetation communities are the Highland Sourveld to Cymbopogon –Themeda Veld Transition (138 Fi), and the Cymbopogon-Themeda Veld (Sandy) (142 Fi) (Table 3.4.5). The Northern Tall Grassland (163 Fi), North-Eastern Sandy Highveld (164 Fi), Themeda Veld to Cymbopogon-Themeda Veld Transition (168 Fi), Arid Lowveld (168 Fi) and Themeda Veld to Highland Sourveld Transition (180 Fi) are the least fragmented vegetation communities (Table 3.4.5).

3.4.3.3.2 Transformation

The Springbok Flats Turf Thornveld, being 74% transformed, is the most heavily transformed vegetation type within Mpumalanga. Other heavily transformed vegetation types are the Themeda Veld to Bankenveld Transition (56%), Highland Sourveld to Cymbopogon – Themeda Veld Transition (51%), Cymbopogon-Themeda Veld (Sandy) (49%), Bankenveld to Sour Sandveld Transition (44%) and the Lowveld Sour Bushveld (44%) (Table 3.4.5).

The Themeda Veld to Highland Sourveld Transition (20%), Arid Lowveld (21%) and the North-eastern Sandy Highveld (24%) are the least transformed vegetation types within Mpumalanga (Table 3.4.5).

Table 3.4.5 Fragmentation index and Percentage transformation of vegetation communities

| Vegetation Community | Fragmentation Index | Percentage Transformation |
|---|---|---|
| 12 – Springbok Flats Turf Thornveld | 133 | 74 |
| 56 - Highland Sourveld To Cymbopogon | 138 | 51 |
| 48 – Cymbopogon-Themeda Veld (Sandy) | 142 | 49 |
| 62 – Bankenveld To Sour Sandveld Transition | 145 | 44 |
| 52 - Themeda Veld (Turf Highveld) | 146 | 39 |
| 61 – Bankenveld | 146 | 39 |
| 9 - Lowveld Sour Bushveld | 147 | 44 |
| 55 - Themeda Veld To Bankenveld Transition | 148 | 56 |
| 8 - North-eastern Mountain Sourveld | 151 | 31 |
| 65 - Southern Tall Grassveld | 152 | 35 |
| 6 - Zululand Thornveld | 155 | 36 |
| 19 - Sourish Mixed Bushveld | 159 | 30 |
| 63 - Piet Retief Sourveld | 161 | 34 |
| 10 – Lowveld | 162 | 30 |
| 64 - Northern Tall Grassveld | 163 | 28 |
| 57 - North-Eastern Sandy Highveld | 164 | 24 |
| 18 - Mixed Bushveld | 165 | 33 |
| 11 - Arid Lowveld | 168 | 21 |
| 53 - Themeda Veld To Cymbopogon | 168 | 35 |
| 54 - Themeda Veld To Highland Sourveld Transition | 180 | 20 |

3.4.3.3.3 Major causes of transformation

*Mines and quarries:*

Mines and quarries were the smallest physical transformers of any of the vegetation communities and only contributed more than two percent to transformation in the Bankenveld vegetation community (Table 3.4.6). Mines and quarries do however, have a much larger and less obvious effect on the surrounding communities through air, soil, water and noise pollution (Macdonald, 1991).

Table 3.4.6 Summary of percentage transformation per Land-use class for each Vegetation community.

| Vegetation Community | Mines & quarries | Urban | Degraded | Forest plantations | Cultivated |
|---|---|---|---|---|---|
| 6 - Zululand Thornveld | 0.00 | 0.10 | 7.59 | 1.34 | 27.40 |
| 8 - North-Eastern Mountain Sourveld | 0.00 | 0.67 | 2.42 | 21.63 | 6.59 |
| 9 - Lowveld Sour Bushveld | 0.01 | 1.74 | 9.39 | 14.50 | 18.72 |
| 10 - Lowveld | 0.02 | 1.19 | 10.70 | 0.88 | 17.49 |
| 11 - Arid Lowveld | 0.25 | 1.73 | 5.17 | 0.00 | 13.65 |
| 12 - Springbok Flats Turf Thornveld | 0.15 | 2.91 | 15.46 | 0.03 | 55.50 |
| 18 - Mixed Bushveld | 0.14 | 2.05 | 15.58 | 0.02 | 14.77 |
| 19 - Sourish Mixed Bushveld | 0.28 | 3.53 | 8.95 | 0.22 | 16.72 |
| 48 - Cymbopogon-Themeda Veld (Sandy) | 0.40 | 2.36 | 5.96 | 0.34 | 40.16 |
| 52 - Themeda Veld (Turf Highveld) | 0.65 | 1.07 | 0.07 | 0.27 | 37.01 |
| 53 - Themeda Veld To Cymbopogon | 0.04 | 0.24 | 0.01 | 0.12 | 34.21 |
| 54 - Themeda Veld To Highland Sourveld Transition | 0 | 0.32 | 0 | 0.43 | 19.59 |
| 55 - Themeda Veld To Bankenveld Transition | 0.06 | 1.18 | 0 | 0.51 | 53.91 |
| 56 - Highland Sourveld To Cymbopogon | 0.00 | 1.10 | 10.38 | 0.26 | 38.39 |
| 57 - North-Eastern Sandy Highveld | 0.14 | 0.94 | 1.18 | 9.44 | 11.98 |
| 61 - Bankenveld | 2.12 | 7.88 | 0.00 | 1.78 | 27.68 |
| 62 - Bankenveld To Sour Sandveld Transition | 0.31 | 0.36 | 0 | 28.25 | 14.66 |
| 63 - Piet Retief Sourveld | 0.06 | 0.65 | 2.89 | 23.80 | 6.17 |
| 64 - Northern Tall Grassveld | 0.05 | 0.19 | 3.52 | 12.02 | 12.34 |
| 65 - Southern Tall Grassveld | 0.02 | 2.02 | 13.83 | 2.36 | 16.26 |

*Urbanisation*

The overall transformation attributed directly to urbanisation was small for most vegetation communities except the Bankenveld (7.88%)(Table 3.4.6). The indirect effects of urbanisation are however much larger due to the impoundment of rivers, the increase in water runoff from urban areas, eutrophication of rivers and dams downstream of urban areas, air pollution and the introduction of alien species (Macdonald, 1991).

*Degraded vegetation*

Degraded vegetation was defined by the NLC database as areas with a significantly higher level of radiation compared to its neighbouring areas (Thompson, 1999). Degraded areas are thus a measure of reduced ground cover, and are associated with subsistence farming, overgrazing or unsustainable levels of resource harvesting. Most degraded areas were restricted to the former homelands. Vegetation communities that are particularly degraded are the Mixed Bushveld (15.58%), Springbok Flats Turf Thornveld (15.46%), Southern Tall Grassveld (13.83%), Lowveld (10.70%), and Highland Sourveld to Cymbopogon (10.38%) (Table 3.4.6).

*Forest plantations*

Forest plantations have caused extensive transformation to the Bankenveld to Sour Sandveld Transition (28.25%), North-eastern Mountain Sourveld (21.63%), and Piet Retief Sourveld (23.8%) and high levels of transformation in the Lowveld Sour Bushveld (14.50%), Northern Tall Grassveld (12.2%), and North-eastern Sandy Highveld (9.4%) (Table 3.4.6). All of these vegetation types are grasslands except the Lowveld Sour Bushveld. The actual effects of forestry are far greater than the measurable effect of transformation as they not only result in the loss of natural ground cover, but also increase soil acidity, reduce run-off, increase soil erosion and provide opportunities for alien invasive species to invade the natural vegetation (Macdonald, 1991).

*Cultivated land*

Cultivated land in the form of subsistence, dry land, temporary dry land, temporarily irrigated and permanently irrigated land is the major transformer of 16 of the 20 vegetation communities within Mpumalanga (Table 3.4.6). Cultivated land has caused extensive transformation of the Springbok Flats Turf Thornveld (55.5%), Themeda Veld to Bankenveld Transition (53.91%), Cymbopogon-Themeda Veld (Sandy) (40.16%), Highland Sourveld To Cymbopogon (38.39%), Themeda Veld (Turf Highveld) (37.01%), Themeda Veld To Cymbopogon (34.21%), Bankenveld (27.68%) and the Zululand Thornveld (27.40%) (Table 3.4.6). Cultivation is a selective transformer, as only areas with a particular soil or position within the landscape will be transformed (Macdonald, 1991). Thus rocky outcrops and large wetlands are left untransformed, while the remaining areas are cultivated. This means that species favouring deeper soils are lost or become endangered. Cultivated lands may also result in increased soil erosion. Besides the obvious impacts of water abstraction for irrigation on stream-flow, irrigation of cultivated lands that are not irrigable also leads to altered soil structure. The use of pesticides causes the poisoning of species, while fertilisers cause eutrophication of rivers and dams.

3.4.3.4 Protection

Of the 20 vegetation communities within Mpumalanga only three had more than 10% of their area under protection. None of the grassland vegetation communities had more than 10% conserved and only the Piet Retief Sourveld had more than 4% protected (Table 3.4.7). The

Table 3.4.7 Protection status of vegetation communities within Mpumalanga

| Acocks Veld Type | Total area (ha) required to achieve conservation goals | Current area (ha) and % of total protected within Mpumalanga | Remaining area required to achieve 10% protection (ha) | Current area (ha) un-transformed in Mpumalanga | Percent of remaining un-transformed area requiring protection to achieve 10% protection |
|---|---|---|---|---|---|
| 6 - Zululand Thornveld | 1300 | 0 | 1300 | 8265 | 15.7 |
| 8 - North-Eastern Mountain Sourveld | 32709 | 35282 (10.8) | 0 | 224617 | 0.0 |
| 9 - Lowveld Sour Bushveld | 47575 | 30583 (6.4) | 16992 | 264646 | 6.4 |
| 10 – Lowveld | 101566 | 434881 (42.8) | 0 | 707854 | 0.0 |
| 11 - Arid Lowveld | 50127 | 488861 (97.5) | 0 | 396641 | 0.0 |
| 12 - Springbok Flats Turf Thornveld | 3320 | 2264 (6.8) | 1056 | 8617 | 12.3 |
| 18 - Mixed Bushveld | 56826 | 54298 (9.6) | 2528 | 383211 | 0.7 |
| 19 - Sourish Mixed Bushveld | 44936 | 16628 (3.7) | 28307 | 315879 | 9.0 |
| 48 - Cymbopogon-Themeda Veld (Sandy) | 5768 | 0 | 5768 | 29138 | 19.8 |
| 52 - Themeda Veld (Turf Highveld) | 101800 | 0 | 101800 | 620165 | 16.4 |
| 53 - Themeda Veld To Cymbopogon | 6776 | 0 | 6776 | 44292 | 15.3 |
| 54 - Themeda Veld To Highland Sourveld Transition | 20268 | 0 | 20268 | 161449 | 12.6 |
| 55 - Themeda Veld To Bankenveld Transition | 3293 | 0 | 3293 | 14600 | 22.6 |
| 56 - Highland Sourveld To Cymbopogon | 92 | 6 (0.6) | 86 | 448 | 19.2 |
| 57 - North-Eastern Sandy Highveld | 125253 | 8717 (0.7) | 116536 | 955983 | 12.2 |
| 61 – Bankenveld | 99668 | 0 | 99668 | 603374 | 16.5 |
| 62 - Bankenveld To Sour Sandveld Transition | 14995 | 1090 (0.7) | 13905 | 84604 | 16.4 |
| 63 - Piet Retief Sourveld | 63350 | 25217 (4.0) | 38134 | 420763 | 9.1 |
| 64 - Northern Tall Grassveld | 13692 | 2329 (1.7) | 11363 | 98378 | 11.6 |
| 65 - Southern Tall Grassveld | 447 | 0 | 447 | 2925 | 15.3 |

Arid Lowveld (97%) and Lowveld (43%) are the best-conserved vegetation communities within Mpumalanga (Table 3.4.7). The North-eastern Mountain Sourveld (10.8%) is also well conserved within Mpumalanga. The endemic vegetation communities are extremely poorly conserved with none of the Themeda Veld and less than 1% of the Bankenveld to Sour Sandveld Transition being conserved (Table 3.4.7). Of the near-endemic vegetation communities the Piet Retief Sourveld is the best conserved although less than 4% is protected, while the Themeda Veld to Highland Sourveld Transition and North Eastern Sandy Highveld have less than 1% protected (Table 3.4.7).

To achieve the recommended IUCN standard of 10% conservation of a vegetation community it is necessary to conserve more than 10% of the remaining area for all grassland vegetation communities except the Piet Retief Sourveld (Table 3.4.7). The Themeda Veld to Bankenveld Transition requires more than 22% of its remaining area to be protected, while the Cymbopogon Themeda Veld (Sandy) and Highland Sourveld to Cymbopogon require more than 19% to be protected (Table 3.4.7). Efforts to enhance the level of protection should aim at achieving this through contiguous areas.

3.4.3.5 Important Vegetation Communities

The endemicity, fragmentation and protection coverages were additively overlayed according to the weightings described in the methods section to determine the overall importance of each vegetation community (Table 3.4.8). This analysis identified the endemic Themeda Veld (Turf Highveld) and Bankenveld to Sour Sandveld Transition communities and the non-endemic Cymbopogon -Themeda Veld (Sandy) and Highland Sourveld to Cymbopogon communities as the most important vegetation communities. The Themeda Veld to Bankenveld Transition, Bankenveld, Springbok Flats Turf Thornveld, Zululand Thornveld, Southern Tall Grassveld and the Lowveld Sour Bushveld all received a higher importance than the three near-endemic vegetation communities.

The vegetation communities with the lowest importance values in terms of their endemicity, fragmentation index and level of protection are the Arid Lowveld, Lowveld and Mixed Bushveld. Figure 3.4.3 indicates where the important vegetation communities occur within Mpumalanga.

### 3.4.4 Discussion

3.4.4.1 Findings

The study identified two endemic and three near-endemic vegetation communities, all of which were grasslands. The endemic and near-endemic vegetation communities are important as the responsibility for conserving them rests entirely on the Mpumalanga Province. The two endemic vegetation communities are not only important because of their endemic status, but also because of their highly fragmented and very poor conservation status. Of the 20 vegetation communities 17 were under conserved, with all the grasslands having less than 5% of their area conserved. Eight of the 11 communities with a total score above a value of two, were grassland communities. This again places emphasis on the importance of grasslands within Mpumalanga and their need for conservation.

The Zululand Thornveld which has its most northern extent occurring within the province, is the only Coastal Tropical Forest community within Mpumalanga. It is only moderately transformed overall, but is not conserved at all within Mpumalanga. It has been moderately well conserved within KwaZulu-Natal (Moist Zululand Thornveld (7.98%) and

Dry Zululand Thornveld (12.85%)) (Goodman and Mckenzie, 2000), and is partially conserved within Swaziland in the Mlawula and Simunye Nature Reserves

Table 3.4.8: Important vegetation communities

| Acocks No. | *Acocks Veld Type* | Endemism | Importance Value |
|---|---|---|---|
| 52 | Themeda Veld (Turf Highveld) | Endemic | 3.60 |
| 62 | Bankenveld To Sour Sandveld Transition | Endemic | 3.60 |
| 48 | Cymbopogon-Themeda Veld (Sandy) | | 3.00 |
| 56 | Highland Sourveld To Cymbopogon | | 3.00 |
| 55 | Themeda Veld To Bankenveld Transition | | 2.60 |
| 61 | Bankenveld | | 2.60 |
| 12 | Springbok Flats Turf Thornveld | | 2.50 |
| 6 | Zululand Thornveld | | 2.20 |
| 65 | Southern Tall Grassveld | | 2.20 |
| 9 | Lowveld Sour Bushveld | | 2.10 |
| 63 | Piet Retief Sourveld | Near-endemic | 2.05 |
| 54 | Themeda Veld To Highland Sourveld Transition | Near-endemic | 1.90 |
| 57 | North-eastern Sandy Highveld | Near-endemic | 1.90 |
| 19 | Sourish Mixed Bushveld | | 1.55 |
| 53 | Themeda Veld To Cymbopogon | | 1.40 |
| 64 | Northern Tall Grassveld | | 1.40 |
| 8 | North-Eastern Mountain Sourveld | | 1.20 |
| 18 | Mixed Bushveld | | 0.90 |
| 10 | Lowveld | | 0.80 |
| 11 | Arid Lowveld | | 0.40 |

The Lowveld Sour Bushveld, which occurs along the foothills of the escarpment, is the most important Inland Tropical Forest vegetation type. Afforestation and cultivation have heavily transformed the Lowveld Sour Bushveld. This vegetation community is moderately well conserved, but further effort is still required. Although the Lowveld is very well conserved within the Kruger National Park and some of the Mpumalanga Parks Board Reserves, it has been extensively transformed by sugarcane farming within the last 5-6 years.

The Springbok Flats Turf Thornveld is the most important Tropical Bush and Savanna vegetation type. Although the Springbok Flats Turf Thornveld, which occurs marginally within Mpumalanga, has been very heavily transformed and fragmented, it is moderately well conserved (6.8%) within Mpumalanga. The major responsibility for further conservation of this vegetation community lies with the Northern Province. The remaining Tropical Bush and Savanna vegetation communities are all widespread and lightly transformed.

3.4.4.2 Limitations and Recommendations

The analysis made use of Acocks Veld Types, the land-cover database and the Protected area boundaries. The protected areas boundaries for the province are mapped at a scale of 1:50 000 or better and updated regularly. An up-to-date protected areas map for the whole of southern Africa would have allowed the assessment of the conservation status of each vegetation community not only within Mpumalanga, but also throughout southern Africa. The inclusion of areas under informal protection such as conservancies would have identified areas with alternative conservation strategies.

Acocks Veld Types were mapped at a scale of 1:1 500 000 and have not been updated since1951. The primary purpose of Acocks Veld Types map was to identify areas of uniform grazing potential and not necessarily areas of unique vegetation communities. Vegetation communities are sensitive to the scale of analysis, thus a single community mapped at a 1:1 500 000 scale may consist of many smaller vegetation communities, which would be identifiable at a larger scale. The identification of smaller vegetation communities would increase the number of endemic vegetation communities and influence the level of fragmentation and required protection within each community. There is a need for a more detailed, floristically based vegetation community map to be developed for Mpumalanga and surrounding regions.

The land-cover database was developed in 1994/95 from satellite imagery and was used to determine the extent and spatial distribution of fragmentation within Mpumalanga. The land-cover database overestimates the extent of natural vegetation within Mpumalanga especially within the grasslands and savannahs. Degraded vegetation was defined by the National land-cover as areas having significantly higher reflectance levels than surrounding vegetation (Thompson, 1996). Vegetation degradation is thus a measure of reduced vegetation cover rather than a change in species composition. The effects of over-grazing and too frequent burning within the grasslands and savannahs causing species loss within the grasslands and both species loss and bush encroachment within savannahs is ignored by the NLC database. Old agricultural lands that have reverted back to grasslands would not have been detected as transformed or degraded land although these areas are species depauperate. It has been estimated that old lands can contribute between 12 to 21% of the total area transformed by cultivation (Macdonald, 1991), yet currently these areas are classified as unimproved grasslands in the NLC database. Additionally, major land transformations have taken place in the past five to six years since the production of the land-cover database. Most notable has been the establishment of sugarcane within the Lowveld vegetation community in the Nkomati region, the increase in afforestation along the escarpment, the development of trout dams in the high altitude areas, the increase in open-cast mining on the Highveld and Sekhukhune area. Spread of alien, invasive species continue to cause major transformation throughout the Province.

The analysis therefore clearly underestimates the extent of transformation and fragmentation. This therefore emphasises the need for an updated land-cover map. The bias in the analysis could have been partially addressed through the availability of current coverages on areas under agriculture, from the Department of Agriculture, Conservation and Environment, dams and afforestation, from the Department of Water Affairs and Forestry, and areas under mining, from the Department of Energy and Mineral Affairs. These coverages were not available at the time of analysis and it is therefore recommended that the creation and maintenance of these databases becomes an important focus of the relevant departments.

This study has identified and prioritised the vegetation communities in terms of their conservation needs. As these vegetation communities continue to be transformed the percentage of the remaining area requiring conservation will continue to increase. It will also become increasingly difficult to find a suitable area to conserve with regard to size, species composition and representation and condition of the vegetation and the maintenance of ecosystem integrity. It is therefore crucial that suitable areas for conservation within the priority vegetation communities are identified and that appropriate conservation strategies be developed and implemented.

### 3.4.5 Acknowledgements

Dr. J. Engelbrecht, M. Stalmans, S. Krynauw, M. Lotter, and S. Williamson are thanked for their assistance and comments.

### 3.4.6 References

Acocks, J.P.H., 1975. *Veld Types of South Africa*. Second edition Memoirs of the Botanical Survey of South Africa, Botanical Research Institute, Pretoria, South Africa.

Bogaert, J., Van Hecke, P., Salvador-Van Eysenrode, D. and Impens, I., 2000. Landscape fragmentation assessment using a single measure. *Wildlife Society Bulletin* 28(4): 875-881

Deall, G.B., Theron, G.K. & Westfall, R.H. 1989. The vegetation ecology of the Eastern Transvaal Escarpment in the Sabie area. 2. Floristic classification. *Bothalia* 19: 69–89.

Eckhardt, H.C., Van Rooyen, N. & Bredenkamp, G.J. 1996. The plant communities and species richness of *the Alepidea longifolia – Monocymbium ceresiiforme* High-altitude Grassland of northern KwaZulu-Natal. *Koedoe* 39(1): 53–68.

ESRI, 1997. *Arc, Grid and ArcView Command References*. Environmental Systems Research Institute, Redlands, CA, USA.

Gabriel, H.W. & Talbot, S.S. 1984. Glossary of landscape and vegetation ecology for Alaska. *BLM–Alaska Technical Report* 10. U.S. Department of the Interior.

Low, A.B. & Rebelo, A., (eds) 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Macdonald, I.A.W., 1991. Man's role in changing the face of southern Africa. In *Biotic Diversity in Southern Africa, Concepts and Conservation*. Edited by B. J. Huntley. Oxford University Press Cape Town. pp 51-77.

Matthews, W.S., Bredenkamp, G.J. & Van Rooyen, N. 1994. The phytosociology and syntaxonomy of relatively low-altitude areas in the North-eastern Mountain Sourveld, in the eastern Transvaal escarpment region. *Koedoe* 37(2): 73–87.

Thompson, M.W., 1996. A standard land-cover classification scheme for remote-sensing application in South Africa. *South African Journal of Science* 92: 34-42.

Thompson, M.W., 1999. *South African National Land Cover database project data users manual final report (phase1, 2 and 3).* CSIR ARC Report ENV/P/C 98136 version 3.1.

Wessels, K.J., Reyers, B. and Van Jaarsveld, A.S. 2000. Incorporating land cover information into regional biodiversity assessments in South Africa. *Animal Conservation* 3: 67-79.

## 3.5 Phytochoria: Centres and Regions of Endemism

Mervyn Lotter, John Burrows and Anthony Emery

### 3.5.1 Introduction

Some areas are richer in species diversity than others. Myers (1990) shows the location of 20 hotspots worldwide (similar to Centres of Plant Endemism), using the criteria of species abundance, endemism and high levels of threat of destruction. The top ten sites on the list cover only 0.2% of the land on Earth but hold 13.8% of all plant species.

Mpumalanga has an extraordinary diversity in plant species, with estimated 4946 plant taxa occurring within the province. Yet Mpumalanga only comprises 3% of southern Africa's (area south of the Kunene, Okavango and Limpopo Rivers but excluding Angola, Mozambique and Zimbabwe) surface area and supports 21% of these countries' plant taxa. However this high level of plant diversity is not evenly distributed across Mpumalanga.

The demarcation of floristic regions is based on groups of taxa with more or less similar geographical distributions. Floristic regions can be classified hierarchically to reflect similarities and differences between regions. A *phytochorion* is a floristic (phytogeographical) region of any rank. At a particular scale, a phytochorion may also be called a 'centre of endemism' when distinguished by a high concentration of endemic plant taxa (Van Wyk & Smith 2001). Phytochoria usually incorporates different vegetation types, so it may include forest, grassland and bushveld, but these will have common recurring floristic elements

Most of southern Africa's endemic plants are concentrated in only a few, relatively small areas, known as regions or centres of endemism. Not only do these centres hold clues to the origin and evolution of the botanical diversity within a particular area, but these are also areas that, if conserved, would safeguard the greatest number of plant species (Van Wyk & Smith 2001). These areas are of considerable interest since they have the potential to include new or cryptic plant or animal species as yet undescribed and undiscovered. Therefore the conservation of these botanical centres of endemism may prove effective in protecting an unknown, yet unique faunal component, which may contain important keystone pollinators belonging to specialised pollination guilds (Goldblatt & Manning 2000). A pollination guild incorporates a specialised pollinator, responsible for pollination within a host of convergent plant taxa with similar floral features.

Before the various centres or regions can be assessed, some definitions relating to areas of endemism need to be clarified. *Regional Centres of Endemism*, as defined by White (1983) have at least 50% of their species confined to them, as well as having more than 1000 endemic species. *Regions* are broad floristic units that cover large geographical areas and are of little practical use when dealing with conservation issues at the local level (Van Wyk & Smith 2001). At a finer scale, the WWF/IUCN identified *Centres of Plant Diversity.* Criteria used to select these centres were that they had to be species-rich and/or known to contain a large number of species endemic to them. However centres of endemism usually coincide with centres of diversity (Van Wyk & Smith 2001). For the purpose of future research in this regard, Centres of Plant Endemism will be used instead of Centres of Plant Diversity, as the emphasis is on areas rich in endemics. Centres are also at a finer scale than Regions and usually have a more restricted geographical range, so that they are of more value and use to conservationists. *Hotspots* are very specific in their definition and are used at a global scale for areas with a high level of endemism that also face exceptional threats of extinction. To qualify, hotspots must have at least 1500 endemic plant species and have at least 75% of its habitat transformed. *Endemism* refers to a taxon limited in its range to a specified geographical area. A taxon which is also marginally present elsewhere, is termed a *near-endemic* (Van Wyk & Smith 2001).

When the geographical distributions of plants are mapped, certain recurring patterns emerge. In this way areas embracing high concentrations of species with restricted distributions can be distinguished (Van Wyk & Smith 2001). Although the demarcation of the centres of endemism is based on total floristic composition, threatened plants are usually highlighted because of their relative susceptibility to disturbance or development. Fortunately for the MPB, a lot of data has already been collected on these plants as part of Mpumalanga's threatened plant programme (Fourie 1986).

The species has often been the foundation for many conservation programmes (Hall 1993; Fourie 1986). However, there is a growing concern that these conservation efforts may fail to identify the ultimate causes of species declines, such as habitat loss. In addition these programmes do not cater for larger scale ecological processes, such as meta-population dynamics or pollination guilds, that may be responsible for maintaining species and their habitats (Botha 2002).

Mpumalanga Parks Board has over 300 species on its new list of proposed threatened plants for the province. It is difficult to concentrate conservation efforts on such a large number of plant taxa, particularly after the recent rationalisation of posts within the organisation. It is therefore necessary to concentrate efforts on species rich habitats particularly those rich in endemic taxa for which the MPB may be solely responsible.

The aims of this analysis therefore were to:

- highlight Mpumalanga's floristic diversity,
- demarcate centres and regions of endemism,
- use GIS technology to refine the boundaries of previously demarcated phytochoria,
- compare species richness between centres/regions,
- assess levels of transformation within centres/regions,
- determine the protection status of centres/regions, and
- propose the Lydenburg Centre as a new Centre of Plant Endemism.

Seven centres of plant diversity have been identified in southern Africa (Davis *et al.* 1994). The criteria used for the inclusion of sites as Centres are that they must be both species-rich and have high levels of endemism. Several southern African centres of endemism are included in the recent Centres of Plant Diversity directory of the WWF/IUCN (Davis *et al.* 1994). However these centres were only briefly discussed and provide a foundation for further refinement of local centres.

Within Mpumalanga, the recognition of two known regions and three centres was recently put forward and discussed in a review of the centres of plant endemism by Van Wyk & Smith (2001). The authors feel that the greater Lydenburg area also represents a unique area worthy of inclusion and it is therefore proposed as a new Centre of Plant Endemism. Each centre and region will be briefly discussed under the results section, incorporating the analysis conducted for this chapter.

### 3.5.2 Methods

3.5.2.1 Data sources

*Demarcation of Centres and Regions of Plant Endemism*

The various regions and centres were demarcated onscreen from existing maps using ArcView GIS (3.2a) technology, particularly those maps from the recent publication by Van Wyk & Smith (2001), which provided the most accurate scale for mapping, and for the first time provides a coverage for the Sekhukhuneland Centre. Unfortunately the Drakensberg Afromontane Region has never been officially mapped, and Professor Braam van Wyk (*pers. comm*.[4]) provided details to assist the authors in demarcating its boundary. Centres of Plant Endemism are rather abstract entities, their boundaries being difficult to define. Geology has a major influence on plant distribution and it was used to refine the boundaries of these centres.

*Weightings*

As previously mentioned, the various centres and regions were digitised for Mpumalanga. However the whole of the Wolkberg and Sekhukhuneland Centres, which are shared with Limpopo Province, were mapped in order to calculate size and transformation for these centres. Similarly the Barberton centre is shared with Swaziland. The value of the centres is considered to be of a higher conservation value than the regions, as they represent a more defined area with greater diversity. The regions in turn have a higher value than the surrounding flora. The centres of plant endemism correlated strongly with the modelled distribution range of the threatened plant taxa (Chapter 4.1). The overlap highlights the existence of the centres of endemism. Considering the overlap in coverage with the species layers, the weighting of the centres and regions were given half the values of those used in the veld types and landscape analyses. The centres and regions were weighted and the resulting GIS coverage was used in the analysis. Centres were given a weighting value of 0.5, regions a value 0.25, and surrounding areas a value of zero.

*Protected Areas*

The protected areas map of Mpumalanga represents all areas that are formally protected under Act 10: the Mpumalanga Nature Conservation Act of 1998 or Act 57: the National Parks Act of 1976. Although large parts of the province are protected within private nature and game reserves, the level of protection and appropriateness of the management applied varies widely from property to property and from one landowner to his successor. These protected areas were therefore not included in the analysis.

*Land-cover map*

The National Land-Cover (NLC) database of South Africa (Thompson 1999) was used to assess the level of land transformation within each centre and region of plant endemism. The NLC database is based on 1994-1995 LANDSAT Thematic Mapper (TM) satellite imagery and describes 31 different land-use and land-cover classes. The NLC database is designed for 1:250 000 mapping applications with a minimum-mapping unit of 25 ha. The accuracy of the NLC database for Mpumalanga is on average 78.5% (Thompson 1999). The land-use classes represent areas that have been transformed from their natural vegetation to an alternative cover, and thus represent a loss of natural vegetation and biodiversity (Wessels *et al*. 2000).

---

[4] Prof. Braam van Wyk, University of Pretoria, Pretoria, 0001.

3.5.2.2 Analysis

The ArcView shapefile was imported into ArcInfo 7.1 (ESRI, Redlands, California) for the various analyses. As regions represent very large areas, usually extending across political borders, they were clipped and analysed according to their status within Mpumalanga. The total area of the various centres was used, except when calculating the protection status for each of the centres. The spatial analysis involved overlaying the Centres and Regions of Plant Endemism maps with the NLC database and protected areas maps to derive the necessary information.

The following data were recorded from the ArcInfo analysis.

- size of each region within Mpumalanga,
- size of each centre, within and outside Mpumalanga,
- percentage transformation within each centre, within and outside Mpumalanga,
- percentage transformation of each region within Mpumalanga,
- number and size of land-use types for each centre or region, and the
- degree of protection for each centre or region within Mpumalanga.

The proposed Lydenburg Centre was further analysed for species richness and endemism with the aid of PRECIS (**Pre**toria National Herbarium **C**omputerised **I**nformation **S**ystem) data, which has been incorporated into a specialised provincial database, known as PLANTDAT. A literature survey and specialised knowledge was used in the selection and continuing selection of the endemic species. The following quarter degree grid squares were analysed for species richness: 2530AA, 2530AB, 2530AC, 2530AD, 2530BA, 2530CA, 2530CB, 2530CC, 2530CD. A revised flora count for the Barberton Centre of Endemism was also calculated using PLANTDAT.

### 3.5.3 Results

3.5.3.1 Centres and Regions of Plant Endemism and their Protection Status

The size and protection status of the centres and regions are displayed in Table 3.5.1 and Figure 3.5.1 indicates their locality within Mpumalanga. Total area of each centre was calculated together with the proportion of each occurring within Mpumalanga. As the full mapped extent of the two regions is unknown, the total size was obtained from literature (Davis *et al*. 2000).

Table 3.5.1 Size and protection status of centres and regions of endemism.

| **Centres of Plant Endemism** | **Total Area ($km^2$)** | **Area in Mpum. ($km^2$)** | **Proportion in Mpum.** | **% Protected in Mpum.** |
|---|---|---|---|---|
| Barberton Centre | 3988.4 $km^2$ | 2815.1 $km^2$ | 70.6% | 22.01% |
| Lydenberg Centre | 7397.6 $km^2$ | 7397.6 $km^2$ | 100.0% | 1.94% |
| Sekhukhuneland Centre | 5449.4 $km^2$ | 2655.4 $km^2$ | 48.7% | 0% |
| Wolkberg Centre | 5691 $km^2$ | 2355.1 $km^2$ | 41.4% | 12.01% |
| **Regions of Plant Endemism** | | | | |
| Drakensberg Afromontane Region | est. 84 500 $km^2$ | 28864 $km^2$ | est. 34% | 3.75% |
| Maputaland-Pondoland Region | est. 201 640 $km^2$ | 8906 $km^2$ | est. 4.5% | 60.48% |

The Sekhukhuneland Centre is in urgent need of legal protection. There are no proclaimed nature reserves within the Mpumalanga portion of the SCPE and there is only one small reserve offering the SCPE some form of legal protection in Limpopo Province; that is the 2 800 ha Potlake Nature Reserve.

3.5.3.2 Transformation of Centres and Regions of Endemism

The Wolkberg Centre is the most transformed centre of endemism within Mpumalanga at 46%, yet it is fortunate that larger natural areas still occur in Limpopo Province, bringing down its transformation level to 28.5% (Table 3.5.2). When considering its total area, the Barberton Centre is the most transformed centre at 31% with 22% of its surface area in Mpumalanga under plantations (see Table 3.5.3).

Table 3.5.2 Transformation of centres and regions of endemism within Mpumalanga, and southern Africa, together with NLC land-use types.

| **Centres of Plant Endemism** | **Percentage Transformed in Mpumalanga** | **Total Percentage Transformed** | **Number of land-use types in Mpumalanga** |
|---|---|---|---|
| Barberton Centre | 29.24% | 31.03% | 9 |
| Lydenberg Centre | 25.41% | 25.41% | 7 |
| Sekhukhuneland Centre | 16.69% | 28.57% | 8 |
| Wolkberg Centre | 45.94% | 28.47% | 7 |
| **Regions of Plant Endemism** | | | |
| Drakensberg Afromontane Region | 30.24% | No data | 12 |
| Maputaland-Pondoland Region | 13.78% | No data | 12 |

For more detail regarding transformation, Table 3.5.3 gives a breakdown of the various NLC land-use and land-cover classes for each centre of endemism within Mpumalanga.

### 3.5.4 Discussion and conservation value

3.5.4.1 Regions

Two Regions of Plant Endemism are recognised within Mpumalanga. These are the high-lying Drakensberg Afromontane Region and the more tropical Maputaland-Pondoland Region.

<u>Drakensberg Afromontane Region</u>

This archipelago-like region is discontinuous and incorporates an area of approximately. 84 500 km² in southern Africa. The number of plant species restricted to this specific region is not known, but species endemism is high (Davis *et al*. 1994). However White (1983) broadly describes the Afromontane region (extending to Ethiopia) to have an estimated species diversity of approximately 4000 and endemism is around 75%.

This region incorporates a number of distinct centres, such as the Barberton, Wolkberg and Lydenburg Centres within Mpumalanga, as well as the Drakensberg Alpine Centre in on the southern Drakensberg. Threats identified include fire misuse, alien plant invasion, over-grazing, timber plantations, uncontrolled bark-harvesting and firewood collection (Davis *et al*. 1994; Site Af67).

Maputaland-Pondoland Region

This region is largely continuous and incorporates an area of approximately 201 640 km². An estimated 7.5% of the region occurs within protected areas. Approximately 7000 plant taxa are recorded for the area, and endemism is around 26%. These endemics are concentrated in the grasslands. Threats identified are largely attributed to the high populations occurring in this region but also include timber plantations, extensive agriculture, urban and industrial development, alien plant invasions and dune mining (Davis *et al*. 1994; Site Af59).

Table 3.5.3 Percentage of NLC land-use and land-cover classes for each centre of endemism within Mpumalanga.

| **Land-use and land-cover in Mpumalanga** | **Barberton Centre** | **Lydenburg Centre** | **Sekhukhuneland Centre** | **Wolkberg Centre** |
|---|---|---|---|---|
| Barren rock | 0.03 | | | 0.01 |
| Cultivated: permanent - commercial dryland | | | 0.02 | 0.4 |
| Cultivated: permanent - commercial irrigated | | | 0.01 | 0.16 |
| Cultivated: temporary - commercial dryland | 0.29 | 4.96 | 4.21 | 0.5 |
| Cultivated: temporary - commercial irrigated | 0.22 | 1.47 | 2.3 | 0.99 |
| Cultivated: temporary - semi-commercial/subsistence dryland | 2.94 | | 12.71 | 1.18 |
| Degraded: forest and woodland | | | 2.18 | 1.92 |
| Degraded: thicket & bushland (etc) | 0.39 | | 4.87 | 0.17 |
| Degraded: unimproved grassland | 4.08 | | 0.03 | |
| Dongas & sheet erosion scars | 0.01 | | 0.52 | 0.11 |
| Forest | 0.20 | 0.87 | 6.55 | 5.63 |
| Forest and Woodland | 0.19 | | | 3.84 |
| Forest plantations | 22.08 | 18.54 | 0.08 | 22.23 |
| Improved grassland | 0.01 | | | |
| Mines & quarries | 0.07 | 0.07 | 0.49 | 0.01 |
| Thicket & bushland (etc) | 14.82 | 11.7 | 57.09 | 44.06 |
| Unimproved grassland | 53.69 | 61.65 | 7.73 | 17.81 |
| Urban / built-up land: commercial | 0.01 | 0 | | |
| Urban / built-up land: industrial / transport | 0.01 | 0.02 | | 0.09 |
| Urban / built-up land: residential | 0.93 | 0.35 | 1.15 | 0.7 |
| Waterbodies | 0.04 | 0.37 | 0.06 | 0.19 |
| **Total Percentage** | **100%** | **100%** | **100%** | **100%** |

3.5.4.2 Centres

Four centres are identified within Mpumalanga of which two are shared with Limpopo Province. The Barberton Centre of Plant Endemism is shared with Swaziland. The Lydenburg Centre is proposed here as a new centre.

Barberton Centre of Plant Endemism (BCPE)

The BCPE is largely a result of the surface-outcrops of volcano-sedimentary rocks belonging to the Barberton Supergroup. The Barberton Supergroup contains some of the oldest rocks on earth, with some rocks dating as far back as 3 500 million years.
Outcrops of serpentine occur throughout the BCPE, and these rocks give rise to soils with unusually high magnesium: calcium ratios. These soils, together with those derived from ultramafic rocks, are also associated with high concentrations of heavy metals, which are potentially toxic to plants (Van Wyk & Smith 2001). The serpentine areas show a range in altitude from 354 to 1648 m a.s.l. An estimated 6.4% of the serpentine area is protected (Balkwill *et al*. 1997).

Two subcentres can be identified within the BCPE, based on the distribution of endemic/near-endemic plant taxa recorded for each of these areas. The fundamental basis on which the endemics have evolved (soil toxicity versus dystrophic soils) is markedly different between the two subunits and warrant separation.

a) **Makhonjwa Subcentre**. Comprises all non-ultramafic (including non-serpentine) areas within the BCPE.
b) **De Kaap Subcentre**. Encompasses all serpentine and ultramafic-derived soils, extending over a range of altitudes. At least 31 plant species are edaphic specialists of which 13 are still to be described (Williamson *pers. comm*.[5]).

Most of the BCPE's endemics are confined to the grassland areas, with a few woody serpentine endemic plants in the lower lying areas. The endemics are largely herbaceous with endemism notably high in the families: Iridaceae, Lamiaceae, Liliaceae and Asteraceae. Table 3.5.4 summarises the important attributes of the BCPE. The BCPE is well protected within the Songimvelo and Barberton Mountainlands Nature Reserves.

Table 3.5.4 Summary of the important attributes of the BCPE (Van Wyk & Smith 2001)

| | |
|---|---|
| BCPE Size | 3988.4 km² |
| Total number of species/taxa | 2210 |
| Endemic/near-endemic taxa | > 80 |
| Rate of endemism | 3.6% |
| Percentage transformed in Mpumalanga | 29.24% |
| Percentage protected in Mpumalanga | 22.01% |

Lydenburg Centre of Plant Endemism (LCPE)

Geologically the LCPE is defined by, and encompasses the Pretoria Group, which is comprised predominantly of shale, quartzite and small quantities of andesite, with diabase intrusions. Of particular importance here are the Timeball Hill and Steenkampsberg geological formations. The LCPE occupies the region between the Wolkberg Centre of Plant Endemism (to the east) and the Sekhukhuneland Centre of Plant Endemism (to the west). The LCPE has an Afromontane flora, with links to the Zimbabwean highlands to the north (e.g. *Morella microbracteata, Helichrysum swynnertonii*), and the southern Drakensberg in the south (e.g. *Polypodium vulgare, Helichrysum melanacme*).

Two subcentres were identified for the LCPE, based on the distribution of endemic/near-endemic plant taxa recorded for each of these areas.

[5] Sandra Williamson, Private Bag 3, Wits, 2050.

a) **Long Tom Pass Subcentre**. Occurs along the high-lying Long Tom Pass area in the east with approximately 19 taxa exclusively endemic to this subcentre.
b**) Steenkampsberg Subcentre**. Occurs along the high-lying Steenkampsberg/ Dullstroom in the west with approximately 15 taxa strictly endemic to this subcentre.
All of the endemics are herbaceous and endemism is high within the families: Iridaceae, Orchidaceae, Asteraceae, Gesneriaceae and Ericaceae (in descending order of abundance).

The LCPE encompasses 46% of the province's flora in only 9.3% of its surface area. A total of 51 endemic, and near-endemic, plant taxa have been identified to date that are restricted to the LCPE. A total of 25.4% of this centre has been transformed of which 18.5% is as a result of afforestation. This is the centre of endemism, which is totally confined to Mpumalanga and not shared with any other province or country. Only 2% of this centre is protected within nature reserves. This low figure includes the Little Joker complex, Sterkspruit, Verloren Valei and Nooitgedacht Dam Nature Reserves. Table 3.5.5 highlights the important attributes of the LCPE while Table 3.5.6 presents a list of all the endemic/near-endemic plant taxa.

Table 3.5.5 Summary of the important attributes of the LCPE (Van Wyk & Smith 2001).

| | |
|---|---|
| LCPE Size | 7397.6 km² |
| Total number of species/taxa | 2266 |
| Endemic/near-endemic taxa | 51 |
| Rate of endemism | 2.5% |
| Percentage transformed in Mpumalanga | 25.41% |
| Percentage protected in Mpumalanga | 1.94% |

Sekhukhuneland Centre of Plant Endemism (SCPE)
This centre falls within the rainfall shadow of the Drakensberg Escarpment, and it is relatively more arid than the areas to the east. The endemic plants of the SCPE are primarily edaphic specialists that are derived from an unique geology. Heavy-metal soils are derived from the norite, pyroxenite and anorthosite formations that predominate over the region. Endemics are both herbaceous and woody with endemism high in the Anacardiaceae, Euphorbiaceae, Liliaceae (incorporating Asphodelaceae) and Lamiaceae (VanWyk & Smith 2001). Table 3.5.7 highlights other important attributes of the SCPE.

The SCPE forms part of the Bushveld (Igneous) Complex, which has ultramafic layers, the largest reserves of chrome and platinum-group metals in the world (VanWyk & Smith 2001). Surface outcrops of iron-rich chromite and vanadium are being removed at a rapid rate by strip or opencast mining, usually without any detailed knowledge of the flora on these sites (Siebert 2001). This mineral wealth has resulted in the operation of numerous mines in the Sekhukhuneland area causing the large-scale loss of valuable habitat.

Three subcentres are identified for the SCPE, based on the distribution of endemic/near-endemic plant taxa recorded for each of these areas (Siebert 2001).

a) **Roossenekal Subcentre** (Roossenekal-Dwars River area). Characterised by undulating norite hills. Six taxa are exclusively endemic to this subcentre.
b**) Leolo Mountain Subcentre**. The Leolo Mountains harbour relict patches of Afromontane forest, as well as rare wetlands on the summit. Six taxa are strictly endemic to this subcentre.

Table 3.5.6 List of the endemic/near-endemic plant taxa occurring in the LCPE

ANACARDIACEAE

*Rhus tumulicola* S.Moore var. *meeuseana* forma *pumilo*

*Rhus wilmsii* Diels

ASCLEPIADACEAE

*Riocreuxia aberrans* R.A.Dyer

ASPHODELACEAE

*Kniphofia rigidifolia* E.A.Bruce

*Kniphofia triangularis* Kunth subsp. *obtusiloba*

ASTERACEAE

*Cymbopappus piliferus* (Thell.) B.Nord

*Helichrysum albilanatum* Hilliard

*Helichrysum lesliei* Hilliard

*Helichrysum* sp. nov. (Burrows 7485 -aquatic species)

*Helichrysum* sp. nov. (Burrows 7688)

*Helichrysum summo-montanum* I.Verd.

CRASSULACEAE

*Crassula setulosa* Harv. var. *deminuta* (Diels) Tolken

ERICACEAE

*Erica atherstonei* Diels ex Guthrie & Bolus

*Erica holtii* Schweick.

*Erica revoluta* (Bolus) L.E.Davidson

*Erica subverticillaris* Diels ex Guth. & Bol.

FABACEAE

*Argyrolobium wilmsii* Harms

*Crotalaria monophylla* Germish.

GESNERIACEAE

*Streptocarpus cyaneus* S.Moore subsp. *long-tommii*

*Streptocarpus denticulatus* Turrill

*Streptocarpus hilburtii* Edwards in ed.

*Streptocarpus latens* Hilliard & B.L.Burtt

HYACINTHACEAE

*Eucomis vandermerwei* I.Verd.

*Ledebouria purpurea* (manuscript name)

*Ledebouria* sp. nov. (H&M 1151)

IRIDACEAE

*Gladiolus calcaratus* G.J.Lewis

*Gladiolus cataractarum* Oberm.

*Gladiolus exiguus* G.J.Lewis

*Gladiolus malvinus* Goldblatt & J.C.Manning

*Gladiolus rufomarginatus* G.J.Lewis

*Gladiolus vernus* Oberm.

*Hesperantha saxicola* Goldblatt

*Hesperantha* sp. nov. (Formosa)

*Hesperantha* sp. nov. (Mokobulaan - wetland)

*Watsonia wilmsii* L.Bolus

MESEMBRYANTHEMACEAE

*Delosperma lydenburgense* L.Bolus

*Khadia alticola* Chess. & H.E.K.Hartmann

ORCHIDACEAE

*Brownleea recurvata* Sond. (Lydenburg form)

*Disa alticola* H.P.Linder

*Disa amoena* H.P.Linder

*Disa bicolor* (manuscript name)

*Disa clavicornis* H.P.Linder

*Disa sp. nov.* (close to D. montana)

PASSIFLORACEAE

*Adenia wilmsii* Harms

POACEAE

*Melinis drakensbergensis* (C.E.Hubb. & Schweick.)

POLYGALACEAE

*Polygala nodiflora* Chodat

RANUNCULACEAE

*Clematis stewartiae* Burtt Davy

*Knowltonia transvaalensis* Szyszyl. var. *filifolia*

Knowltonia transvaalensis Szyszyl. var. *pottiana*

SCROPHULARIACEAE

*Graderia linearifolia* Codd

ZAMIACEAE

*Encephalartos humilis* I.Verd.

Table 3.5.7 Summary of the important attributes of the SCPE (Van Wyk & Smith 2001)

| | |
|---|---|
| SCPE Size | 5449.4 km² |
| Total number of species/taxa | ± 2200 |
| Endemic/near-endemic taxa | > 100 |
| Rate of endemism | 4.5% |
| Percentage transformed in Mpumalanga | 16.69% |
| Percentage protected in Mpumalanga | 0% |

c) **Steelpoort Subcentre** (Steelpoort-Burgersfort area). Located in the larger Steelpoort River valley, where it comprises undulating norite, pyroxenite and magnetite outcrops and hills. Twenty taxa are strictly endemic to this subcentre.

Wolkberg Centre of Plant Endemism (WCPE)
The WCPE is geologically comprised of the Black Reef Quartzitic Formation, Wolkberg Group and the dolomitic Chuniespoort Formation. Two subcentres are identified for the

WCPE, based on the distribution of endemic/near-endemic plant taxa recorded for each of these areas (Mathews *et al*. 1993).

a) **Blyde Subcentre**. Occurs south of the Olifants River along the Mpumalanga Escarpment, with approximately 36 taxa strictly endemic to this subcentre.
b**) Serala Subcentre**. Occurs to the north of the Olifants River along the Limpopo Escarpment, with approximately 15 taxa strictly endemic to this subcentre.

Nearly all of the endemics are herbaceous and endemism is high within the Asteraceae, Lamiaceae, Iridaceae and Asphodelaceae. A total of 12% of the WCPE is formally protected within Mpumalanga, with Blyde River Canyon Nature Reserve critical in the conservation of the Blyde Subcentre of Plant Endemism. Unfortunately the WCPE is the most transformed centre of endemism, with 46% of the natural vegetation transformed. Afforestation has had the greatest impact on this centre, with 22.2% under plantations. Table 3.5.8 highlights the important attributes of the WCPE.

Table 3.5.8 Summary of the important attributes of the WCPE

| | |
|---|---|
| WCPE Size | 5691 km² |
| Total number of species/taxa | ± 2500 |
| Endemic/near-endemic taxa | 97 |
| Rate of endemism | 3.9% |
| Percentage transformed in Mpumalanga | 46% |
| Percentage protected in Mpumalanga | 12.01% |

### 3.5.5 Conclusion

The Lydenburg area was investigated as a centre of plant endemism. A conservative approach was conducted and only those taxa strictly fitting the definitions were included. Taxa shared with neighbouring centres were not included. The proposed area met with the requirements of a high level of biodiversity and endemism. The high number of narrow endemics that are threatened highlights the need for conservation attention.

Van Wyk & Smith (2001) believe that vegetation classification and mapping has received considerable attention over the years in South Africa. However the classification and mapping of the distribution patterns of the region's flora has lagged behind. This section of the Biobase project was added in an attempt to address this shortfall, particularly considering the importance of these centres, and how further research can assist in the transition from being entirely species-based, to that of an approach incorporating habitat conservation through the linking up of floristic elements.

There is a strong correlation between centres of endemism and threatened plant distributions. Therefore centres should not be considered in isolation from the traditional

Threatened Plant Programme, but rather both incorporated on their relative merits of species and habitat conservation. What should ensue is an effort to incorporate centres of endemism within the Threatened Plant Programme of the MPB, together with monitoring data from the medicinal plant trade. This therefore highlights a need to revise the existing Threatened Plant Programme.

This investigative report was able to fulfil its objectives and the following recommendations are hereby made.

- Create a protected nature reserve within the SCPE as there is large amounts of mining and rural settlement pressures on Sekhukhuneland. Large tracts of natural land are still available.
- Improve effectiveness of alien plant eradication programmes. One of the greatest threats to biodiversity within Mpumalanga, is the invasion of natural area with alien vegetation. Subsequently the identification of areas rich in biodiversity is paramount to the cost-effective alien plant control programmes whose aim is also biodiversity conservation. In this regard the identification and delineation of centres of endemism should receive priority in the clearing programmes.
- Investigate occurrence of other centres and regions of endemism within Mpumalanga, as the Wakkerstroom area may qualify as such a centre.
- Delineate and assess the status of subcentres, as very little is known about their protection status, such as the protection status of the De Kaap Subcentre occurring on the ultramafic soils in the BCPE.
- Investigate and calculate how much of the centres are protected within privately owned/managed nature reserves. Protection status only gave cognisance to formally protected reserves.
- Finally, as stated above in the conclusion, there is a need to incorporate research into phytochoria and centres of endemism within the Threatened Plants Programme.

### 3.5.5 Acknowledgements

Professor Braam van Wyk is thanked for his assistance in compiling some of the coverages, as well as for comments on parts of this manuscript. Sandra Williamson and Marc Stalmans are thanked for comments regarding the Barberton Centre of Endemism. The National Botanical Institute in Pretoria is acknowledged for PRECIS (**Pre**toria **C**omputerised **I**nformation **S**ystem) data supplied from the National Herbarium.

### 3.5.6 References

Balkwill, K., Williamson, S.D., Kidger, C.L., Robinson, E.R., Stalmans, M. & Balkwill, M-J. 1997. Diversity and conservation of serpentine sites in southern Mpumalanga (Eastern Tvl.), S.A. In: *The ecology of ultramafic and metalliferous areas*. Eds: Jaffré, T., Reeves, R.D. & Becquer, T. Orstom, Numéro.

Botha, M. 2002. Endangered ecosystems: a new direction for conservation action. *Veld & Flora*, March 2002. Botanical Society, Claremont.

Davis, S.D., Heywood, V.H. & Hamilton, A.C. (eds). 1994. *Centres of plant diversity. A guide and strategy for their conservation.* Volume 1: Europe, Africa, South West Asia and the Middle East. IUCN Publications Unit, Cambridge, UK.

ESRI, 1997. *Arc, Grid and ArcView Command References.* Environmental Systems Research Institute, Redlands, CA, USA.

Fourie, S.P. 1986. The Transvaal, South Africa, Threatened Plants Programme. *Biological Conservation* 37: 23-42.

Goldblatt, P. & Manning, J.C. 2000. The long-proboscid fly pollination system in southern Africa. *Annuals of Missouri Botanical Garden* 87: 146-170.

Hall, A.V. 1993. Setting conservation priorities for threatened species: a joint grouping and sequencing method. *South African Journal of Botany* 59: 581-591.

Matthews, W.S., Van Wyk, A.E. & Bredenkamp, G.J. 1993. Endemic flora of the North-eastern Transvaal Escarpment, South Africa. *Biological Conservation* 63: 83-94.

Myers, N. 1990. The biodiversity challenge: expanded hotspots analysis. *Environmentalist* 10: 243-256.

Siebert, S.J. 2001. *Vegetation on the ultramafic soils of the Sekhukhuneland Centre of Endemism.* Unpublished PhD thesis, University of Pretoria.

Thompson, M.W. 1999. *South African National Land Cover database project data users manual final report (phase 1, 2 and 3)*. CSIR ARC Report ENV/P.C 98136 Version 3.1.

Wessels, K.J., Reyers, B, and Van Jaarsveld, A.S. 2000. Incorporating land cover information into regional biodiversity assessments in South Africa. *Animal Conservation* 3: 67-79.

White, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the Unesco/AETFAT/UNSO vegetation map of Africa. Natural Resources Research XX. Unesco, Paris.

## 3.6 Cave ecosystems in Mpumalanga

Contributor: L. Cohen

### 3.6.1 Introduction

The eastern Malmani dolomite karst cave area in Mpumalanga extends in a thin belt from the Blyde River Canyon area in the north to the Badplaas/Carolina area, which forms the southernmost tip (Fig 3.6.1). It extends through a number of Acocks' veld types but is dominated by typical escarpment vegetation, which includes fragmented patches of montane grasslands on mountain tops, with forest patches and savanna bushveld in the gorges and valleys.

Caves are considered as natural ecosystems where interaction between the biotic and abiotic environment takes place, through the exchange of materials. The fact that caves function as ecosystems on their own has gone largely unnoticed and the significance of these systems is generally overlooked due to limited knowledge of the subterranean environment.

Caves are controlled and restrictive environments where interaction between cave ecosystems and the external ambient environment, is limited. Linkages are however of fundamental importance for the functioning of these underground systems (Gamble 1981). These stable environments are thus very susceptible to disturbance.

Some individual caves consist of ecosystem components that are unique in terms of their features and characteristics. Certain characteristics and environmental processes are however, common to all caves in an area (Gamble 1981).

Gamble (1981) pointed out that the physical location of caves defines the features and stability of cave ecosystems. Factors such as the nature of the host rock, the external ambient conditions and the magnitude and morphology of the cave, determine the profile and details of karst cave ecosystems. Dolomite structures allow for the transmission and retention of water. Air and water flows are major components of interaction and play an important role in the formation of caves. Both these components are furthermore critical for the propagation and maintenance of the ecosystem afterwards. Airflow determines cave temperature whilst water flow is largely responsible for humidity, acting as a reservoir to sustain other assemblages within the cave.

In Mpumalanga, caves also occur, to a lesser degree, in geographical areas with different host rocks such as granite, quartzite and quartz-sandstone. These caves play an equally important function regarding biota, as the dolomite caves.

3.6.1.1 Importance of Karst environments and Cave systems

The stability of the undisturbed cave environment provides ideal microclimatic conditions for mineralogical, faunal and floral assemblages, to function. Temperature and humidity play a key role in maintaining these atmospheric conditions. Rare organisms and unique landforms as well as endemic minerals and biota are found in karst areas and caves. Karst landscapes are important for the maintenance of bio- and geodiversity.

Caves are key sites and fulfil very specific requirements to bats. Bats utilise them, primarily because they provide stable ideal microclimates for roost sites, maternity roosts and hibernation, protection from predators and locations relative to feeding. These requirements are highly specific and suitable caves are relatively rare. Temperature is of great importance in the selection of suitable roosting sites. Caves consist of unique biota most of which are dependent on the surface for food supplies. Bat guano plays a major role in the nutrient enrichment of cave ecosystems. This forms the primary source of food for a large number of cave organisms. Almost 40% of the bat species occurring in Mpumalanga, make use of caves.

Man can benefit economically from karst areas through surface land-uses such as agriculture and afforestation and subsurface uses in the form of specialised agricultural practices. Certain caves act as reservoirs for water withdrawal whilst the limestone resource within karst areas, is extracted and used for building, agricultural and industrial purposes. Two caves in Mpumalanga (Sudwala and Echo) have been commercialised for use as tourist attraction. Undeveloped caves are used by adventure groups and sport cavers.

Certain caves have high aesthetic, palaeontological, archaeological, geological, geomorphological and/or ecological value and some of these caves are of great historic, prehistoric, cultural and scientific value (O'Donoghue, 1996). Caves were used in the past as places for shelter and refuge and are still used for spiritual ceremonies and as sacred places and are thus also important from a cultural point of view. Caves are used for recreational purposes due to their aesthetic value. Developed caves fulfil an educational role and create awareness amongst the public regarding the sensitivity of these subterranean ecosystems.

### 3.6.2 Methods

The occurance and distribution of cave systems are not well documented. Most important caves in Mpumalanga Province occur in dolomite formations, therefore this geology was used to delineate important area for caves.

### 3.6.3 Discussion

#### 3.6.3.1 Threats to Cave and Karst Communities

Mpumalanga is fortunate to hold a range of unique, diverse and interesting caves throughout the karst cave area. Caves form part of a limited and non-renewable geological resource and are subject to increasing anthropogenic pressures. Several surface and subsurface activities exist, which affect caves and karst aquifers in the province.

*Surface disturbances*

These effects are indirect and are caused by the transformation of the natural environment over-lying and/or of catchment areas or ecosystems surrounding caves (Gamble 1981). Certain external land development activities, which may impact negatively on subterranean ecosystems include mining and quarrying, urban and industrial development, agricultural intensification, commercial afforestation and hydrological projects.

*Subsurface disturbances*

Direct interference with the subterranean environment takes place by physical human intrusion. Human activities cause internal disturbances through extraction of biota, importation of exotic species, abrasion, nutrient stress, graffiti, illumination and construction and services (Gamble 1981).

*Impacts*
The above-mentioned actions, together with their associated effects, can drastically impact on the functioning of ecological systems within caves. Air and water flow alterations, heat production, atmospheric accumulation and photosynthesis may cause aesthetic deterioration and affect the faunal, floral and mineralogical assemblages of caves.

Geographically, the largest part of the karst cave region in Mpumalanga is situated in areas where the main land-uses are afforestation and agricultural practices. Changes in drainage patterns of water on the surface over-lying the cave areas, as well as the mismanagement of surrounding natural ecosystems and their water catchments can lead to the alteration of the groundwater flow. This results in the dehydration or flooding of cave ecosystems, thus affecting humidity, microclimate and ecological functioning. External air and water pollution causes contamination and modification of the atmospheric, terrestrial and aquatic environments within caves.

Recreational demand is increasing at a rapid rate and places tremendous pressure on the internal cavern environment. Uncoordinated and uncontrolled access is of great concern. Gamble (1981) regarded this form of disturbance as the most detrimental to cave ecosystems.

3.6.3.2 Importance of mines for fauna

The gold digging era as well as prospecting and mining activities for other minerals have left Mpumalanga with various abandoned mining sites. The microclimates within some of these old mines or shafts are similar to caves and attract bats due to ideal environmental conditions. They utilise these sites for roosting, maternity roosts and hibernation purposes. Some sites within the province are occupied by rare bat species. Not many of them have been checked in the past and the possibility exists that they could hold large numbers of bats or species that are less common.

Bats will occupy these sites either as a result of being forced to vacate their traditional roosts due to human disturbance, alteration of their natural habitat or because these sites fulfil specific requirements.

Certain abandoned mines thus serve as important habitat sanctuaries for bats and other fauna in terms of shelter and breeding. Threats to these populations include the injudicious or indiscriminate closure or destruction of particular sites, the loss of important surrounding feeding habitat and human disturbance. Abandoned mining sites are in many cases as important to bats, as cave ecosystems and should be assessed before any alterations or developments are considered.

3.6.3.3 Conservation requirements and Recommendations

The importance of caves is poorly understood and as a result cave ecosystems, their associated assemblages and the wider environment on which they are dependent, have received very little conservation attention in the past.

Although one of the show caves in the province is declared as a National Monument, no guidelines exist to ensure environmentally sustainable management of caves.

Increased human population growth and recreational interest cause degradation to and place additional pressure on, sensitive cave ecosystems and the whole karst area. Thus it is necessary that management actions are drawn up and implemented accordingly.

The current state of knowledge regarding the management of subterranean ecosystems is limited, but the integrated and co-ordinated management of natural resources (land, water and vegetation) to minimise land degradation, improved awareness of sensitivity and stricter control regarding access to vulnerable caves, would facilitate protection. Most of the caves currently known fall outside the protected area network and the conservation responsibility therefore lies inherently, with the land owners.

There is currently a need for:

- a National Cave Conservation and Management Group
- negotiations amongst conservation authorities, caving and adventure groups, expertise representing all aspects of the cave environment and interested parties to set up a national conservation action plan for the protection of cave ecosystems and the wider karst environment
- Memorandums of Understanding between provincial conservation authorities and the South African Speleological Association and Caving clubs
- inventorying karst areas and caves and their components in South Africa / Mpumalanga
- assessment and classification or listing of the significance and sensitivity of caves according to a standard classification system. Gamble (1981) used resource contents, hazards and appeal to develop a cave classification system. Criteria that can be used for assessment are, cave biota and features of cultural, geological, geomorphological, paleontological, hydrological, recreational, educational and scientific interest (Chapman, 1993)
- identification of all the associated threats and impacts
- promulgation and enforcement of national and provincial legislation pertaining to the conservation of cave ecosystems, their associated biota as well as their surrounding environments
- implementation and enforcement of stricter and conservation wise management measures and regulations, for effective management of commercialised caves
- increased public awareness regarding the ecological values of caves and
- the proclamation of certain caves in Mpumalanga as Unique communities, under the current Mpumalanga Nature Conservation Act, No.10 of 1998

The above-mentioned will ensure that caves are considered in the preparation or implementation of any land-use management plan. Proposed development in areas where caves and/or old mines occur, should be subject to environmental impact assessments before re-opening, closure or any development, at such sites.

Karst areas and caves provide unique environments, are amongst the most vulnerable of landforms and are irreplaceable on an ecological scale. In order to protect their integrity, the maintenance of their resources on which they are dependent is of utmost importance.

### 3.6.4 Acknowledgements

This work formed part of a Provincial Biodiversity Database Project sponsored by the Department of Water Affairs and Forestry. Koos de Wet is thanked for assistance, comment and proof reading of documents in preparation.

### 3.6.5 References

Chapman, P. 1993. *Caves and Cave Life.* HarperCollins Publishers, London.

Gamble, F.M.1981. *The Management of Karst Cave Ecosystems in the Transvaal*. Unpublished. Dept. of Geography, University of Natal.

O'Donoghue, J. 1996. *Guidelines for Cave and Karst protection*. IUCN Commission on National Parks and Protected Areas.

## 3.7 Important communities coverage

The important communities' coverage was derived by additively overlaying the five communities coverages (forests, wetlands, vegetation communities and centres of plant endemism and caves). The overall weighting for each community was standardised to a maximum score of 1, unless otherwise indicated, during the overlay process. The smaller forest, wetland and cave coverages identify areas of higher importance within the broader plant communities. The centres of plant endemism identify areas of importance due to the occurrence of a high diversity of endemic plants.

This study identifies the escarpment areas surrounding Blyde Canyon Nature Reserve southwards to Sabie and Kaapsehoop, as well as the areas surrounding Lydenburg, Dullstroom, Sekhukhuneland, Groblersdal to Loskop Dam, Machadodorp, Barberton, Amsterdam to Dirkiesdorp, and Wakkerstroom as the most important communities (Figure 3.7.1).

While the important communities' coverage gives a broad overview of where important communities occur, it is unable to identify those areas that are critical for achieving the desired level of protection for each of these components. A follow up analysis is required to identify and ground-truth areas of critical importance within each vegetation community and develop appropriate management strategies for the conservation of these areas.

# 4 Identification of important species sites

Ideally, important species sites should be selected on the number and status of species within an area. Unfortunately the distribution of all the species is not known, and current species richness data is skewed by the difference in collection frequency for different parts of the Province. Since all species cannot be included in a study such as this, it was necessary to decide on which species to select to determine areas of species importance. It was decided to select species based on threat, rarity (IUCN or red data book status) and endemism. This was based on the fact that Mpumalanga has the sole responsibility for conserving provincial endemics, and a major responsibility to conserve the rare and threatened species, which are of national and international importance (Act 10: the Mpumalanga Nature Conservation Act of 1998).

Distribution data for the selected species were obtained from several sources including amateur and professional researchers and collectors, museums, universities and their associated research institutes, herbaria, and the MPB's own staff. These data were captured into the MPB databases. The data checking and verification protocols as set out by KwaZulu-Natal Nature Conservation Services report "Determining the conservation value of land in KwaZulu-Natal" were followed where possible. The protocols were as follows:

- Each distribution record was examined for the accuracy of associated details and where necessary referred back to the source, in many instances the collector for clarification.
- All records available digitally were directly imported into the database. Data available on paper were captured into the database and checked for transcription error by a second party.
- Where possible the person supplying the data was asked to assign a spatial resolution code (Table 4.1) to all location co-ordinates. Failing this a spatial resolution was assigned on the basis of the ability to determine the position of the record on a 1:50 000 map sheet using the description of the location.
- Since only records with minimum spatial resolution of 3 were to be used for modelling and since there was an inability to check spatial resolution 1 and 2 records, all spatial resolution 3 records were checked against a 1:50 000 map sheet.
- Subsequently, at least 10% (and usually a greater proportion) of the spatial resolution 3 location co-ordinates were checked by another person. If an unacceptable number of errors (>10%) were found in this sample, then all records were rechecked.
- All records for a taxon were then verified as a group by plotting the records against appropriate coverages (e.g. forests for a forest dwelling species) and any apparent anomalies were queried and if necessary, corrected.
- All location co-ordinates were recorded in degrees latitude and longitude.

*Species weighting*

To accommodate the difference in endemicity, rarity and threats between various species it was decided to weight the species according to their IUCN categories. Species with an IUCN rating of Extinct in the Wild, Critically Endangered or Endangered were assigned a weighting of 1 while those species with a weighting of Vulnerable or Near Threatened were assigned a value of 0.5 (Table 4.2). Species categorised as Least Concern or Data Deficient were not used for the purpose of this project, unless otherwise indicated (e.g. Popularity in muthi trade).

In the absence of an IUCN status or ability to assign an IUCN status the existing Red Data Book status was used for the species. In these cases a score of 1 was given to species with a Red Data Book status of Extinct or Endangered, and 0.5 to those that had a status of Vulnerable or Rare (Table 4.2).

Table 4.1 Spatial resolutions assigned to the location co-ordinates of records.

| Code | Description |
|---|---|
| 1 | GPS - Averaging or differential mode < 50 m |
| 2 | GPS - Single point mode, <=1:10 000 map, < |
| 3 | Map 1:12 000 to 1:50 000 scale, < 250 m |
| 4 | 251 -> 500 m |
| 5 | 501 > 1000 m |
| 6 | 1.1 -> 5 km |
| 7 | 5.1 -> 12 km (1/8 degree) |
| 8 | 12 -> 25 km (1/4 degree) |

Table 4.2 IUCN and Red Data Book categories and the corresponding Species weightings

| IUCN category | Red Data Book | Species Weighting |
|---|---|---|
| Extinct in the Wild | Extinct | 1 |
| Critically Endangered | - | 1 |
| Endangered | Endangered | 1 |
| Vulnerable | Vulnerable | 0.5 |
| Near Threatened | Rare | 0.5 |

## 4.1 Threatened Plants

Contributors: M.C. Lötter, S. Krynauw and S. Williamson

### 4.1.1 Introduction

Areas with heterogeneous landscapes, diverse geology and a variety of environmental conditions, provide a diverse number of habitats for plant species. These areas are normally associated with high levels of species endemism and richness. For this reason, and the fact that not all species are equal in the face of anthropogenic land conversion (Freitag & Van Jaarsveld 1997), some parts of the province are critically important for the conservation of threatened plants at the species level. Towards this end, threatened plants were used to identify areas of conservation importance at the species level. The identification of these sites is critical for the short- to medium-term conservation of these taxa.

The aim of this threatened plant investigation was to:

1. identify important threatened plants,
2. to model their likely distribution by mapping the potential for a taxon to occupy a certain area and
3. to produce one map indicating areas of high conservation value for the conservation of Mpumalanga's threatened plants.

### 4.1.2 Methods

4.1.2.1 Species selection

Species from the MPB's proposed list of threatened plants were assessed according to IUCN criteria version 3.0 (1999) and version 3.1 (2000). Species with high RDL ratings and for which sufficient distribution data existed were selected for modelling.

4.1.2.2 Source of records

Distributional data from the former Transvaal Threatened Plants Program (Fourie 1986) was used. Short field trips were conducted to gather specific data when it was lacking. Various amateur and professional botanists were consulted to provide additional plant localities and habitat data. The Protea Atlas Project supplied most of the data on the Proteaceae.

4.1.2.3 Modelling procedure

A database was designed within MS Access to capture all threatened plant data. The records used were captured either as point data from GPS readings, as point data read off 1:50 000 topographical maps, or rarely at the farm scale (for plants Extinct in the Wild). Additional data captured onto the database for each record included population size and structure, habitat details and potential threats. The locality records were imported into ArcView GIS (3.2a) where species distributions were mapped and modelled using a variety of environmental variables listed in Table 4.1.1. The electronic data was largely obtained from a Water Research Commission Report, TT82/96, entitled South African Atlas of Agrohydrology and Climatology (Schulze 1997).

The various predicted distribution maps were collectively overlaid to produce one final map for Mpumalanga, depicting areas of high conservation importance at the species level.

For some species, expert knowledge was used to determine the appropriate environmental variables that govern the distribution of the given taxon.

Table 4.1.1 Environmental variables utilised in modelling process.

| Environmental Variables | Units |
|---|---|
| Altitude/elevation | 50 metre intervals |
| Mean Annual Precipitation | Millimetres |
| Geology (1:250 000) | Lithology labels |
| Vegetation units | Acocks Veld Type |
| Average duration of frost period | Days < 0° |
| Morphology | Terrain Units |
| Lightning intensity (where applicable) | Flashes per $km^2$ per annum |
| Landscape types | MPB's 22 Landscape types (see Chapter 2) |
| July positive chill units | PCUs |
| Forests (where applicable) | Forest Arc View coverage |
| Streams (where applicable) | Non-perennial Arc View coverage |

4.1.2.4 Weighting and map compilation

The latest IUCN Red List categories and criteria (Version 3.0, 1999 and Version 3.1, 2000) were used to improve the objectivity in assessing the conservation status of species, thereby improving consistency amongst users (Hilton-Taylor 1997). Each taxon occurring within Mpumalanga and listed as potentially threatened by MPB, was assessed according to the latest IUCN criteria. The applicable conservation status categories were then assigned. Each modelled taxon was broadly weighted according to its threat status (Table 4.1.2). A weighting of 1 was applied to taxa in the categories Extinct in the Wild, Critically Endangered, and Endangered. Categories Vulnerable and Near Threatened were weighted 0.5.

### 4.1.3 Results

Of the 81 taxa that were modelled for the Mpumalanga province, 37 were assessed as Vulnerable and 18 as Near Threatened, receiving weightings of 0.5. The remaining 26 taxa were assigned weightings of 1, consisting of one taxon considered to be Extinct in the Wild, 16 Endangered taxa and 9 Critically Endangered taxa. Brief descriptions of the one taxon that is Extinct in the Wild and the eight Critically Endangered taxa are presented below:

***Eugenia pusilla*** N.E. Br. (Red Data status: **EW**)

This taxon is known from only a single old locality where it was recorded growing amongst rocky outcrops on granite or gneiss, in course sandy-loam soils. It occurred in Acocks veldtype number 63 (Piet Retief Sourveld). It was last collected in 1912 and

further excursions to try and locate this taxon have failed. *Eugenia pusilla* is now considered to be Extinct in the Wild (Van Wyk, *pers. comm.*). To model it, a 5 km buffer was placed around the historic farm boundary on which it is thought to have occurred.

***Aloe simii*** Pole Evans (Red Data Status: **CR** B1,2bcde)

This taxon favours wetland ecotones in the greater White River area, and non-perennial streams were buffered 150m on either side. The buffered zone was incorporated with the

Table 4.1.2 List, status and weights of threatened plants modelled.

| Taxon | Localities/ Records | Weight received | RDL Status |
|---|---|---|---|
| *Allophylus chaunostachys* Gilg | 8 | 0.5 | NT |
| *Aloe albida* (Stapf) Reynolds | 12 | 1 | EN B1B2abcde |
| *Aloe dewetii* Reynolds | 2 | 0.5 | VU D2 |
| *Aloe hlangapies* Groenewald | 16 | 0.5 | NT |
| *Aloe integra* Reynolds | 7 | 0.5 | VU A2ce B1abii,iii,,iv,v |
| *Aloe kniphofioides* Bak. | 24 | 0.5 | VU A2cde |
| *Aloe kraussii* Baker | 2 | 0.5 | NT |
| *Aloe modesta* Reynolds | 24 | 1 | EN B2abi,ii,iii,iv,v |
| *Aloe reitzii* Reynolds var. *reitzii* | 18 | 0.5 | VU D2 |
| *Aloe reitzii* Reynolds var. *vernalis* Hardy | 1 | 1 | EN D2 |
| *Aloe simii* Pole Evans | 6 | 1 | CR B12bcde |
| *Aloe thorncroftii* Pole Evans | 9 | 0.5 | VU D2 |
| *Aloe vryheidensis* Groenew. | 2 | 0.5 | NT |
| *Brachystelma chlorozonum* E.A.Bruce | 5 | 0.5 | VU D2 |
| *Brownleea recurvata* Sond. | 4 | 0.5 | VU B1abiii |
| *Cassipourea swaziensis* Compton | 2 | 0.5 | VU D2Rmz |
| *Ceropegia distincta* N.E.Br. subsp. *verruculosa* R.A.Dyer | 9 | 0.5 | VU D2 |
| *Cineraria hederifolia* Cron | 2 | 0.5 | VU D2 |
| *Crocosmia mathewsiana* (L.Bolus) Goldblatt ex M.P.de Vos | 3 | 0.5 | VU B1B2c |
| *Cyrtanthus bicolor* R.A.Dyer | 7 | 0.5 | NT |
| *Cyrtanthus epiphyticus* J.M. Wood | 2 | 0.5 | NT |
| *Cytinus* sp. nov. | 4 | 0.5 | VU D2 |
| *Disa amoena* H. P. Linder | 8 | 0.5 | VU D2 |
| *Disa extinctoria* Rchb.f. | 4 | 0.5 | NT |
| *Disa hircicornis* Rchb.f | 1 | 0.5 | NT |
| *Disa maculomarronina* MacMurtry | 3 | 0.5 | VU D2Pvo,Vw |
| *Disa montana* Sond. | 1 | 1 | CR B1a Bbiii |
| *Disperis stenoplectron* Rchb.f. | 5 | 0.5 | VU A2ce |
| *Elephantorrhiza praetermissa* J.H.Ross | 16 | 0.5 | NT |
| *Encephalartos cupidus* R.A.Dyer | 17 | 1 | CR A1B1B2abcde |
| *Encephalartos heenanii* R. A. Dyer | 53 | 1 | CR A1acdeB1B2abcdeC2a |
| *Encephalartos humilis* Verdoorn | 65 | 0.5 | VU A1acdB1B2bce |
| *Encephalartos laevifolius* Stapf & Burtt Davy | 39 | 1 | CR A1acdeB1 |
| *Encephalartos lanatus* Stapf & Burtt Davy | 35 | 0.5 | NT |
| *Encephalartos lebomboensis* Verdoorn | 37 | 1 | CR B1B2abcde |
| *Encephalartos middelburgensis* Vorster, Robbertse & S. van der Westh. | 44 | 1 | EN A1abcd B1B2abcdeC2a |
| *Encephalartos paucidentatus* Stapf & Burtt Davy | 57 | 0.5 | VU A1acdC1 |
| *Erica revoluta* (Bolus) L.E.Davidson | 5 | 1 | EN B1a B1biii |
| *Erica rivularis* L.E.Davidson | 17 | 0.5 | VU B1aB1biii |
| *Eucomis vandermerwei* Verdoorn | 13 | 1 | EN C2ai |
| *Eugenia pusilla* N.E. Br. | 1 | 1 | EW |

Table 4.1.2 cont'd

| Taxon | Localities/ Records | Weight received | RDL Status |
|---|---|---|---|
| *Eulophia leachii* Greatrex ex A.V.Hall | 9 | 0.5 | NT |
| *Faurea macnaughtonii* E.Phillips | 8 | 0.5 | NT |
| *Frithia humilis* P. M. Burgoyne | 8 | 1 | EN A3c B1aB1bi,ii,iii,iv,v |
| *Gladiolus appendiculatus* G.J.Lewis (Barberton) | 4 | 1 | EN B1B2c |
| *Gladiolus appendiculatus* G.J.Lewis (Marieps) | 3 | 1 | EN B1B2c |
| *Gladiolus appendiculatus* G.J.Lewis (Wakkerstroom)) | 3 | 1 | EN B1B2c |
| *Gladiolus calcaratus* G.J.Lewis | 6 | 0.5 | VU A1ce B1B2c |
| *Gladiolus cataractarum* Oberm. | 15 | 1 | CR A2ce C1 |
| *Gladiolus macneilii* Oberm. | 9 | 1 | EN C1 |
| *Gladiolus rufomarginatus* Lewis | 18 | 0.5 | VU D2 |
| *Gladiolus varius* F. Bolus | 18 | 0.5 | VU A1ce D2 |
| *Gladiolus vernus* Oberm. | 10 | 0.5 | NT |
| *Habenaria ciliosa* Lindl. | 2 | 0.5 | VU A2ce |
| *Kniphofia triangularis* Kunth subsp. *obtusiloba* (A.Berger) Codd | 9 | 0.5 | NT |
| *Ledebouria appresifolia* Hankey in ed | 2 | 0.5 | VU D2 |
| *Ledebouria* sp. nov. | 2 | 1 | EN A1ce B1B2c |
| *Leucospermum gerrardii* Stapf | 10 | 1 | EN B1aB1biii, iv |
| *Leucospermum saxosum* S.Moore | 4 | 0.5 | NT |
| *Nerine gracilis* R.A. Dyer | 3 | 0.5 | VU B2abi,ii,iii |
| *Orbea paradoxa* (Verdoorn) Leach | 3 | 0.5 | VUB2aB2biii,iv,v |
| *Orbeanthus hardyi* (R.A.Dyer) L.C.Leach | 3 | 0.5 | VU D2 |
| *Platycoryne mediocris* Summerh. | 1 | 1 | CR B2aB2biii, D2 |
| *Protea comptonii* Beard | 75 | 0.5 | NT |
| *Protea curvata* N.E. Br. | 25 | 0.5 | VU D2 |
| *Protea laetans* L.E.Davidson | 21 | 0.5 | VU D2 |
| *Protea roupelliae* Meisn. subsp. *hamiltonii* Beard ex Rourke | 2 | 1 | CR A4ac B12abi,ii,iii,iv,v C1 |
| *Protea subvestita* N.E. Br | 18 | 0.5 | NT |
| *Resnova megaphylla* Hankey in ed. | 3 | 0.5 | VU D2 |
| *Rhus batophylla* Codd. | 44 | 0.5 | VU D2 |
| *Satyrium microrrhynchum* Schltr. | 3 | 0.5 | VU A2ce |
| *Schizochilus crenulatus* H.P.Linder | 5 | 1 | EN B1aB1biii |
| *Schotia latifolia* Jacq. | 2 | 0.5 | VU D2 |
| *Streptocarpus decipiens* Hilliard & B.L.Burtt | 7 | 0.5 | VU D2 |
| *Streptocarpus denticulatus* Turrill | 3 | 0.5 | VU D2 |
| *Streptocarpus occultus* Hilliard | 3 | 1 | EN B1abi,ii,iii,iv,v |
| *Streptocarpus pogonites* Hilliard & B.L.Burtt | 5 | 0.5 | VU D2 |
| *Watsonia latifolia* Oberm. | 23 | 0.5 | NT |
| *Watsonia occulta* L. Bol. | 7 | 0.5 | VU A1ceB1B2cD2 |
| *Watsonia wilmsii* L. Bol. | 16 | 1 | EN B1b2c |
| *Zantedeschia pentlandii* (Whyte ex Watson) Wittm. | 42 | 0.5 | VU D2 |

standard environmental variables used in the modelling process. Alien plant invasion, plantations and urbanisation pose a serious threat to this taxon. The species is not protected on any nature reserve.

***Disa sp. nov.*** (closest to *D. montana*) (Red Data Status: **CR** B1,2biii)
This undescribed orchid is known from only one small population on top of Long Tom Pass. It mostly closely resembles *D. montana* that has its nearest locality is in the Eastern Cape. It occurs at an altitude of above 2000 metres a.s.l., where it grows with an undescribed *Ledebouria* species. It is not formally protected on any nature reserve.

***Encephalartos cupidus*** (Red Data Status: **CR** A1a B1,2abcde)
This cycad occurs on cliff faces and slopes of hills and mountains at an altitude of 700 to 1400 metres a.s.l. The taxon favours well-drained sandy loam soils derived from Blackreef quartzite. It is currently know only known from three large populations of which about 90% of its distribution range is protected within a nature reserve. The taxon has become extinct at two localities in the recent past. The main threats are from cycad collectors and its use in traditional medicine.

***Encephalartos heenanii*** R.A. Dyer (Red Data Status: **CR** A1acde B1,2abcde C2a)
*Encephalartos heenanii* is known from only two populations (possibly sub-populations) of which one occurs in Swaziland and the other in Mpumalanga. The taxon favours red ferralitic soils that are derived from granites and gneiss. It occurs at altitudes of between 750 and 1750 metres a.s.l . on mountain and hill slopes. Theft and habitat loss has resulted in a large population decline. It is protected on the Songimvelo Nature Reserve.

***Encephalartos laevifolius*** Stapf & Burtt Davy (Red Data Status: **CR** A1acde B1)
This cycad occurs at an altitude of 950 to 1800 metres a.s.l. It grows on cliffs and mountain slopes in well-drained soils derived from Blackreef quartzites. The taxon is very threatened by collectors as well as habitat loss due to exotic invasive plants. Signs of stem harvesting for traditional medicine has been observed. It is protected on the Blyde River Canyon Nature Reserve.

***Encephalartos lebomboensis*** Verdoorn (Red Data Status: **CR** B1,2abcde)
This cycad occurs in Acocks veldtype 6 (Zululand Thornveld) and grows at altitudes of 550 to 700 metres a.s.l. It occurs in well-drained soils derived from rhyolite on ridges and cliffs of mountain slopes. The taxon is threatened by collectors as well as habitat loss due to agriculture. *Encephalartos lebomboensis* is not formally protected on any nature reserve.

***Gladiolus cataractarum*** Oberm. (Red Data Status: **CR** A2ce C1)
This geophyte has a very restricted distribution along the Dullstroom plateaux. It has specialised habitat requirements as it grows on grassy cliffs next to streams and waterfalls in Acocks veldtype 57 (north-eastern Sandy Highveld). It favours sandy humus-rich quartzite derived soils and occurs at an altitude of between 1550 and 1950 metres a.s.l.. Habitat loss through afforestation and alien plant invasions, or the associated indirect change in habitat quality, has been the main cause of its decline. Currently the invasion of exotic plants along the streams and rivers is the main threat facing this taxon.

***Platycoryne mediocris*** Summerh. (Red Data Status: **CR** B2a B2biii D1)
This orchid is only known from one locality in southern Africa where it occurs along a humus-rich seepage area overlying a large granite outcrop at an altitude of 800 metres a.s.l. During the modelling process, a 150m buffer was used around non-perennial streams, together with standard environmental modelling data. The population has less than 50 mature individuals and it is heavily threatened by urban development as well as a decrease in the quality of the habitat of this taxon.

***Protea roupelliae*** Meisn. subsp. ***hamiltonii*** Beard ex Rourke (Red Data Status: **CR** A4ac B1,2abi,ii,iii,iv,v)
This dwarf protea is now only known from one locality. It grows in well-drained leached red soils, which are believed to be high in aluminium and generally considered toxic. Further soil tests are now being conducted by the University of the Witwatersrand. This narrow-endemic was previously known from one other locality that has now been afforested. Afforestation, grazing and trampling are some of the threats that have resulted in a dramatic decline in the population size. There are now only 180 plants left in the wild. A nature reserve was proclaimed to protect this taxon, yet the decline continues.

### 4.1.4 Discussion

The collective map represents most areas that are critical in conserving plants at the species level (Fig 4.1.1). Important areas with high scores should receive close scrutiny when evaluating development assessments that result in land transformation.

Critically important sites that are adequately delineated, include the following areas: Long Tom Pass; Steenkampsberg; Blyde River Canyon to Graskop; Barberton; greater LoskopDam area; Kaapsehoop; Amsterdam; and KwaMandhlangampisi mountainlands near Wakkerstroom.

Critically important sites believed to inadequately delineate through modelling include Sekhukhuneland; Mananga area; and greater Crocodile Gorge.

Unfortunately only 81 species were modelled and thus the collective map only deals with the most threatened taxa for which information was available. This is simply not enough species to reflect the distribution all of the 350 taxa on the MPB's proposed list of threatened plants. More data needs to be collected and the next iteration should then highlight weakly delineated areas.

The collective map shows the placement of provincial nature reserves to be beneficial towards the conservation of threatened plants. Notably, the following important reserves need mention: Little Joker complex; Paardeplaats; Songimvelo; Sterkspruit; Blyde; Verloren Valei and Barberton Mountainlands.

One of the greatest limitations encountered during the predictive modelling process, was the lack of suitable digital geological data. Many threatened plants are highly restricted to certain rock types with their resultant soil attributes, and this known knowledge could not be efficiently utilised to refine their potential distribution ranges. The current geological coverage is only accurate at a 1: 250 000 scale. Another serious limitation was the availability of adequate plant distribution data. Areas that received low score-values cannot be overlooked as they could represent under-collected areas. More field surveys need to be conducted in these areas to determine whether any threatened plant taxa occur there.

The end-point of any conservation programme for Red Data List species is to make provision for their long-term safety (Hall 1993). It is believed that the Biobase project has provided an opportunity to collate inventory and field work, captured through the threatened plants programme, into a format which can be fully utilised towards the long-term conservation of threatened plants. This is the first part of an iterative process, which will refine conservation efforts and actions in the future.

**4.1.5 Acknowledgements**

The authors wish to thank Horst Filter, Douglas MacMurtryi, Shane Burns, John Burrows, Andrew Hankey, Priscilla Burgoyne, Lourens Grobler and Jaco Truter for supplying additional plant localities. The Protea Atlas Project supplied detailed electronic localities and habitat data for species of the Proteaceae. Janice Golding and Janine Victor provided valuable advice with the Red Data assessments of the various taxa.

**4.1.6 References**

Fourie, S.P. 1986. The Transvaal, South Africa, Threatened Plants Programme. *Biological Conservation* 37: 23-42.

Freitag, S. & Van Jaarsveld, A.S. 1997. Relative occupancy, endemism, taxonomic distinctiveness and vulnerability: prioritising regional conservation actions. *Biodiversity and Conservation* 6: 211-232.

Hall, A.V. 1993. Setting conservation priorities for threatened species: a joint grouping and sequencing method. *South African Journal of Botany* 59: 581-591.

Hilton-Taylor, C. 1997. Red Data List of southern African plants. 2. Corrections and additions. *Bothalia* 27(2): 195-209.

IUCN 2000 *IUCN Red List categories.* IUCN Species Survival Commission. Gland, Switzerland.

Schulze, R.E. 1997. *South African Atlas of Agrohydrology and -Climatology*. Water Research Commission, Pretoria, Report, TT82/96.

## 4.2 Economically Important Medicinal Plants

Contributors: M.C. Lötter and S. Krynauw.

### 4.2.1 Introduction

The demand for medicinal plants within Mpumalanga is high, with approximately 700 tons of plant material being consumed annually. This level of demand is expected to increase in the future as a result of population growth and the increased use of indigenous medicines to treat AIDS and associated ailments. Demand for medicinal plants exceeds supply (Mander 1997) and to date *Siphonochilus aethiopicus* (Wild Ginger) has become extinct outside of protected areas in Mpumalanga.

It is estimated that in South Africa alone, there are 27 million indigenous medicine consumers and households are spending between 4% to 8% of their annual income on traditional medicine services. Financial incentives exist for gatherers who supply plants to muthi-markets. This large demand is higher than what can be sustainably harvested from natural resources. Intensive harvesting of wild plants is a serious threat to biodiversity with over 700 plant species actively traded in South Africa (Mander 1998).

In many rural areas of Mpumalanga, Western medicine is scarce or hard to come by and indigenous medicine plays a very important role in primary health care, providing rural communities with access to health care services. Mander (1997) reports that the current harvesting in Mpumalanga is unsustainable resulting in an increase in the scarcity of popular plants on communal lands. This is demonstrated by the high prices at a national level and declining plant size in market outlets.

The objectives of this investigation into the important medicinal plants were to:

- Use GIS technology to model the potential distribution range of selected important medicinal plants within Mpumalanga.
- Design and apply a weighting procedure that accurately weights each known medicinal plant according to their conservation status and popularity as medicinal plants in trade.
- Utilise the collective species layers to produce a map highlighting areas rich in medicinal plants.

### 4.2.2 Methods

4.2.2.1 Species selection

The main criterion used to select species, was the popularity of medicinal plants. Little information exists specifically for Mpumalanga Province, however enough literature and case studies were available to compile a list of important medicinal plant species, as well as to weight each species according to its popularity within the province. Useful literature included research conducted by the following;

- Myles Mander. He conducted a study on the utilisation of medicinal plants in the Bushbuckridge area (1997). He then also investigated the marketing and trade of medicinal plants in KwaZulu-Natal (1998).
- Anthony Cunningham (1988). He conducted a large study into the medicinal plant trade in the neighbouring KwaZulu-Natal Province (KZN).
- Lötter *et al.* (1998). Study on plant resource availability and status within the Mananga, Thambokhulu and Mbuzini areas.

- Williams *et al.* (2000). Study on the formal trade in medicinal plants within the Witwatersrand.

4.2.2.2 Source of records

Very little accurate distribution data exists for medicinal plants within Mpumalanga. Some data existed for plants that were part of the old Transvaal Threatened Plants Programme (Fourie 1986). However, for the other plants, use was made of local expert knowledge in the Luneberg area, provided by Mr Horst Filter. In addition a few short field trips were conducted to capture point records for relevant medicinal plant taxa.

4.2.2.3 Distribution modelling

Predictive species modelling was conducted using ArcView GIS (3.2) computer technology. Point data were used to calculate environmental determinants, the range of which was then used to predict where similar sites occur throughout Mpumalanga using standard GIS query methods. Each species listed in Table 4.2.2 was used in the predictive modelling procedure and the collective shape files were overlaid to produce one final map, depicting projected areas with a high number of medicinal plant species and of high conservation importance.

4.2.2.4 Importance ranking

The importance of medicinal plants is based on their conservation status, their popular as medicinal plants in trade and their estimated availability in the wild. Popularity and availability weightings were determined from expert knowledge and available literature, while their conservation status weightings were assigned according to their IUCN categories versions 3.0 and (1999) 3.1 (2000) (Table 4.2.2.). All selected species were assessed according to the IUCN categories and criteria. A score of 3 was assigned to taxa assessed as Extinct in the Wild (EW), Critically Endangered (CE) or Endangered (E). A score of 2 was assigned to taxa assessed as Vulnerable (VU) or Near Threatened (NT) and taxa scored 1 if assessed as Least Concern (LC) (Table 4.2.1). The importance values for each species was calculated by adding the popularity and the conservation status weightings and dividing the total by 6 (Table 4.2.2).

To determine the most important areas for the conservation of important medicinal plants, the different species layers were multiplied by their respective weightings and added together, using Arc View GIS (3.2a). This produced one map of Mpumalanga Province showing areas important for the conservation of the 26 priority medicinal plant species selected.

Table 4.2.1 Weighting system used to assess value of medicinal plants used in the collective layering process.

| **Conservation status** | **Weight** | **Popularity & availability** | **Weight** |
|---|---|---|---|
| Extinct in the Wild (EW), Critically Endangered (CE), Endangered (E) | 3 | High & scarce | 3 |
| Vulnerable (VU), Near Threatened (NT) | 2 | Medium & declining | 2 |
| Least Concern (LC) | 1 | Mentioned & widespread | 1 |

### 4.2.3 Results

A summary of the important medicinal plant taxa modelled, their conservation status, popularity measured through demand and availability is presented in Table 4.2.2.

Table 4.2.2 Summary of the conservation status, demand and availability, of the important medicinal plants identified for Mpumalanga Province.

| Taxon | Status | Weight | Demand & availability | Weight | Importance value | Convert to value out of 1 |
|---|---|---|---|---|---|---|
| *Acridocarpus natalitius* | NT | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Adenium swazicum* | CR | 3 | Medium & declining | 2 | 5 | 0.8 |
| *Alepidea amatymbica* var. *amatymbica* | VU | 2 | Top & scarce | 3 | 5 | 0.8 |
| *Alepidea longifolia* | LC | 1 | Mentioned & low | 1 | 2 | 0.3 |
| *Boophane disticha* | NT | 2 | Mentioned & low | 1 | 3 | 0.5 |
| *Bowiea volubilis* | EN | 3 | Top & scarce | 3 | 6 | 1 |
| *Clivia miniata* | VU | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Cryptocarya transvaalensis* | NT | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Curtisia dentata* | NT | 2 | High - medium | 2 | 4 | 0.7 |
| *Dioscorea* sp. nov. ined. J.P.H. Hurter | CR | 3 | Medium & declining | 2 | 5 | 0.8 |
| *Dioscorea sylvatica* | NT | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Eucomis autumnalis* subsp. *clavata* | NT | 2 | High - medium | 2 | 4 | 0.7 |
| *Eucomis montana* | NT | 2 | High - medium | 2 | 4 | 0.7 |
| *Eucomis pole-evansii* | NT | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Gunnera perpensa* | LC | 1 | Mentioned & low | 1 | 2 | 0.3 |
| *Haworthia koelmaniorum* | EN | 3 | Mentioned & low | 1 | 4 | 0.7 |
| *Haworthia limifolia* var. *arcana* | CR | 3 | Top & scarce | 3 | 6 | 1 |
| *Haworthia limifolia* var. *limifolia* | CR | 3 | Top & scarce | 3 | 6 | 1 |
| *Hypoxis hemerocallidea* | NT | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Ocotea bullata* | VU | 2 | Top & scarce | 3 | 5 | 0.8 |
| *Ocotea kenyensis* | VU | 2 | Mentioned & low | 1 | 3 | 0.5 |
| *Scilla natalensis* | NT | 2 | Top & scarce | 3 | 5 | 0.8 |
| *Scilla nervosa* | LC | 1 | Mentioned & low | 1 | 2 | 0.3 |
| *Siphonochilus aethiopicus* | CR | 3 | Top & scarce | 3 | 6 | 1 |
| *Urginea altissima* | NT | 2 | Medium & declining | 2 | 4 | 0.7 |
| *Warburgia salutaris* | EN | 3 | Top & scarce | 3 | 6 | 1 |

Descriptions and importance of each species modelled follow:

***Acridocarpus natalitius*** A.Juss. **var.** ***natalitius*** (Red Data status: **NT**)
The roots are utilised and subsequently harvesting is destructive. TRAFFIC identified this species as becoming increasingly difficult to obtain in South Africa and is one of a few plants traded internationally, coming from Mozambique and Swaziland (Marshall 1998). Mander (1997) ranked A. natalitius as the 2nd most popular medicinal plant traded in the Bushbuckridge area.

***Adenium swazicum*** Stapf (Red Data status: **CR A3cd**)
The harvesting of the large underground tubers is destructive. Utilisation appears to be localised, yet very severe. Steyn (*pers. comm.*[6]) reports of a relatively large population decimated by muthi collectors causing a 40% population decline over a period of a few months. Lötter *et al*. (1998) reported that *A. swazicum* was the 11th most sought after medicinal plant in the Managa-Mbuzini area, in south-eastern Mpumalanga, and that the traditional healers said plants had a restricted distribution and is no longer as common.

*Alepidea amatymbica* Eckl. & Zeyh. var. *amatymbica* (Red Data status: VU A3cd)
Harvesting of the rhizomes is destructive. The rhizome is utilised to treat headaches, colds chest and stomach complaints. Cunningham (1988) reported this taxon to be declining in population size in KZN. Mander (1997) ranked *A. amatymbica* var. *amatymbica* and *Siphonochilus aethiopicus* as the most sought-after medicinal plants, based on trade popularity, in the Bushbuckridge area. Mander (1998) calculated that 31.2 tons of rhizomes are traded in the Durban medicinal trade every year. Lötter *et al*. (1998) reported that *A. amatymbica* was the second most popular traded medicinal plant in the Managa-Mbuzini area, in south-eastern Mpumalanga, and that plants were being sourced from the highveld regions. Filter (*pers. comm.*[7]) reports this taxon to be heavily utilised and exploited in the Luneberg-Wakkerstroom area, and that it is now difficult to find growing in the wild.

***Alepidea longifolia*** E. Mey. *sens. lat.* (Red Data status: **LC**)
Harvesting of the rhizomes is destructive. The rhizomes are used to treat coughs (Hutchings 1996). Still regarded as a relatively widespread plant, *A. longifolia* is occasionally incorrectly harvested as *A. amatymbica* and several *ex situ* conservation measures have mistakenly propagated this taxon for sale to traditional healers, instead of *A. amatymbica*. It is believed that this taxon may be used as a substitute where *A. amatymbica* is no longer available. *Alepidea longifolia* is also used as marogo (spinach) (Van Wyk & Gericke 2000).

***Boophane disticha*** (L.f.) Herb (Red Data status: **LC**)
Harvesting of the large bulbs is destructive. These bulbs are very poisonous and are reported to be hallucinogenic. They are also used to treat headaches, chest and abdominal pain and insomnia (Van Wyk & Gericke 2000). This species is widespread but the plants are very slow growing surviving for up to 150 years (Van Wyk *pers. comm.*). Cunningham (1988) reported that in KZN, a 50kg bag of *B. disticha* bulbs was trading for R10.

[6] Mr Tommie Steyn, Bag X1088, Lydenburg, 1120.
[7] Mr Horst Filter, P.O. Box 20, Luneberg, 3183.

***Bowiea volubilis*** Harv. ex Hook.f. (Red Data status: **EN A2cde B1,B2abcde**)
The harvesting of the bulb is destructive. Large bakkie load of bulbs were confiscated near Ngodwana in 2000 (Strydom *pers. comm.*[8]). This species was identified by street traders as the 7th most sought after medicinal plant in the greater Durban area. An estimated 43 tonnes of bulbs are sold annually in Durban, which is the equivalent to 386 000 bulbs being traded each year (Mander 1998). Mander (1997) ranked *B. volubilis* as the 7th most popular medicinal plant traded in the Bushbuckridge area.

***Clivia miniata*** (Lindl.) Regel (Red Data status: **VU B2abii,iii,v**)
The plant (together with *Dioscorea sylvatica*) was identified by street traders as the 10th most sought after medicinal plant traded in Durban (Mander 1998). The disjunct and very limited occurrence of this species within the Barberton mountainlands highlights its vulnerability to utilisation. Collector pressure for the horticultural trade has also resulted in a large decline in its population size over the last 15 years (Hurter *pers. comm.*[9]).

***Cryptocarya transvaalensis*** Burtt Davy (Red Data status: **NT**)
The over harvesting of stem bark can be destructive. In certain areas along the Mpumalanga escarpment, entire trees are being cut down and all the bark stripped off. In the above-mentioned case, implicated people were arrested and they indicated that the bark was destined for the Gauteng muthi market. There is no mention of *Cryptocarya transvaalensis* in trade, however it closely resembles *Cryptocarya myrtifolia* from which it may be difficult to distinguish from bark alone. Therefore it may unknowingly be traded together with *C. myrtifolia* and thus has never before been picked up in trade. Street traders identified *Cryptocarya myrtifolia* as the 13th most sought after medicinal plant traded in the Durban area (Mander 1998).

***Curtisia dentata*** (Burm. f) C.A. Sm. (Red Data status: **NT**)
Harvesting of stem bark may be destructive. The bark is used to treat stomach ailments and diarrhoea. It is also used as an aphrodisiac and to cleanse the blood (Van Wyk *et al.* 1997). Cunningham (1988) calculated that 197 bags (50kg bags) of bark were traded by 54 traditional healers in KZN during the late 1980s. He also reported that *C. dentata* ranked within the top 15 plants reported to becoming increasingly scarce by herb traders in KZN. Mander (1998) calculated that 23.9 tons of bark is traded in the Durban medicinal plant trade every year. This tree is still widespread within the forests in Mpumalanga. However, collector pressure is increasing as KZN populations become depleted and attention is directed towards neighbouring provinces and countries.

***Dioscorea sylvatica*** (Kunth) Eckl. (Red Data status: **NT**)
The fleshy tuber is utilised and harvesting is usually destructive. Extracts from the tubers are taken for chest ailments, as blood purifiers and to treat swellings and rashes (Van Wyk & Gericke 2000). Hutchings *et al.* (1996) report that Diosgenin from the tubers was used to produce oral contraceptive compounds in the 1950's. *Dioscorea sylvatica* (together with *Clivia miniata*) was identified by street traders as the 10th most sought after medicinal plant traded in Durban (Mander 1998).

***Dioscorea* sp. nov**. ined. J.P.H. Hurter (Red Data status: **CR B1abv, C2aii**)
The caulescent tubers are utilised in traditional medicine. This undescribed species was only recently discovered and less than 200 plants exist in the wild, some of these showing signs of harvesting (Strydom *pers. comm.*). It is suspected that the tubers may also contain

[8] Mr Gerhard Strydom, Box 1380, Malalane, 1320.
[9] Johan Hurter, Lowveld Botanical gardens, Box 1024, Nelspruit, 1200.

Diosgenin as this taxon is used in combination with *Dioscorea sylvaticus* as a treatment against cancer. However it is unknown whether these plants possess any novel compounds.

***Eucomis autumnalis*** (Mill.) Chitt. **subsp. *clavata*** (Red Data status: **NT**)
Harvesting of bulbs is destructive. The bulbs are used to treat backache, fractures, fever and syphilis (Van Wyk & Gericke 2000). Populations of this taxon are believed to be widespread but subject to immense collector pressure, which is reducing population size and resulting in local extinction in certain areas. A decline in availability of this taxon has been reported by Cunningham (1988), Lötter *et al.* (1998) and Mander (1998). Mander (1998) determined *Eucomis autumnalis* to be the second most popular traded medicinal plant in the Durban medicine trade, with 73 tons traded annually. It was also rated as the most popular medicinal plant traded in the Witwatersrand (Williams *et al.* 2000). It is doubtful whether the current supply can meet the high demand.

***Eucomis montana*** Compton and ***Eucomis pole-evansii*** N.E.Br. (both Red Data status: **NT**)
*Eucomis montana* is a near endemic to Mpumalanga. Other *Eucomis* species are traded with *Eucomis autumnalis* and are believed to have the same uses. A visual inspection of the bulbs revealed that *E. montana* and *E. pole-evansii* contain the same homoisoflavones as *E. autumnalis* (Crouch, *pers. comm.*[10]). Therefore trade in these two taxa would also be expected. These species are difficult to identify at the species level when not in leaf or flower and it is therefore expected that trade in the bulbs of either *E. montana* or *E. pole-evansii* may go unnoticed as *E. autumnalis* in the muthi markets.

***Gunnera perpensa*** L. (Red Data status: **LC**)
The rhizomes are utilised and harvesting is destructive. The rhizomes are used to augment labour, assist in the expulsion of the placenta, and treat stomach disorders and menstrual pain (Van Wyk *et al.* 1997). Cunningham (1988) reported that the price paid per bag of rhizomes had more than doubled over a 10 year period, from 1970-1980. This species is wetland dependent.

***Haworthia limifolia* var. *arcana*** [RDL: **CR B1abii,iii,v**] and **var. *limifolia*** [RDL: **CR A4cd B2abiv,v**]) and ***Haworthia koelmaniorum*** Oberm. & D.S.Hardy (Red Data status: **EN C1**)
Whole plants are usually traded. There are very few morphological differences between the two varieties of *H. limifolia* and it is therefore assumed that both are used for the same purposes (Crouch, *pers. comm.*). Mander (1998) mentions that some healers and traders do not even distinguish between different species within the genus, let alone at a varietal level. *Haworthia koelmaniorum* is considered by Smith & Crouch (2001) to be part of *Haworthia limifolia* complex as one great mega-species, and therefore it is believed that it could have similar uses to that of *H. limifolia*, if the localities are discovered by muthi collectors. *Haworthia* is ranked by street traders in Durban as the 6$^{th}$ most sought after plant in the greater Durban area. An estimated 22.5 tonnes of *Haworthia* is traded annually in Durban, which is equivalent to 479 000 plants (Mander 1998). Mander (1997) ranked *Haworthia* species as the 6$^{th}$ most popular medicinal plant traded in the Bushbuckridge area. One population of *H. limifolia* var. *limifolia* on the outskirts of Barberton is now extinct.

---

[10] Dr Neil Crouch, Ethnobotanist, National Botanical Institute, Durban, 4001.

***Hypoxis hemerocallidea*** Fisch. & C.A. Mey. (Red Data status: **NT**)
The corm is utilised and harvesting is destructive. These plants are used to treat cancer, bladder disorders, insanity and urinary infections (Van Wyk *et al*. 1997). Mander (1998) records trade in *Hypoxis* spp. in the Durban traditional markets. However, it appears as if trade may be more popular amongst the white South African population, particularly after a popular article was published describing its "magical properties" (Louw 1997). Large quantities of corms are now being harvested and sold nationwide. *Hypoxis* corms were reported to be traded in 66% of the formal muthi shops in the Witwatersrand (Williams *et. al.* 2000).

***Ocotea bullata*** (Burch.) Baill. (Red Data status: **VU A3cd B2abii,v**)
The harvesting of stem bark can be destructive if harvested in an unsustainable manner. The bark can be smoked to relieve headaches, or applied to treat urinary disorders, stomach ailments and nervous disorders (Van Wyk *et al.* 1997). The bark was identified by street traders as the 2nd most sought after medicinal product sold in Durban, where an estimated 25.3 tonnes of bark is traded annually. This quantity is equivalent to bark from 1581 trees (Mander 1998).

***Ocotea kenyensis*** (Chiov.) Robyns (Red Data status: **VU B2abii,v**)
The extent of trade in *Ocotea kenyensis* is uncertain although there are reports of it being traded in Durban (Cunningham 1988). Isolated occurrences and low population numbers make it particularly vulnerable to exploitation.

***Scilla natalensis*** Planch. (Red Data status: **NT**)
The bulb is utilised and results in destructive harvesting methods. The Zulus use the plant to find the cause of an ailment (Douwes *et al.* 2001) and therefore Mander (1998) recorded this plant to be the most popular plant traded in the Durban medicinal plant trade with 95.5 tons of bulbs sold annually. The demand for *S. natalensis* is far greater than the supply, which has resulted in a decrease in the size of bulbs traded. In addition plants are now being sourced from neighbouring provinces putting the Mpumalanga populations under pressure (Crouch *pers. comm.*).

***Scilla nervosa*** (Burch.) Jessop (Red Data status: **LC**)
Harvesting of the bulbs is destructive. The bulbs are used to treat paediatric nervous conditions, dysentery and rheumatic fever. It is also reported to be widely traded in traditional medicine markets (Crouch *et al.* 1999). However, it is widespread and not believed to be in any danger of extinction owing to a very large population size and its limited usage.

***Siphonochilus aethiopicus*** (Schweinf.) B.L.Burtt (Red Data status: **CR A1abcd B1B2abcd**)
The rhizome is utilised and harvesting is destructive. Durban street traders rank this species as the 8th most sought after muthi plant in trade, with 1.9 tonnes of rhizomes traded annually. This weight is equivalent to 52 800 plants harvested annually (Mander 1998). In a similar study (Mander 1997), *Siphonochilus* and *Alepidea amatymbica* were ranked as the most popular medicinal plants in Mpumalanga. *S. aethiopicus* was extirpated from KZN as early as 1915 (Crouch *et al.* 2000) and in Mpumalanga it is now only found within protected areas. This plant was one of the first medicinal plants to have ever been recorded in trade, as in 1910, Burtt Davy recorded trade from the current Mpumalanga to Gauteng (Crouch *et al*. 2000).

***Urginea altissima*** (L. f) Bak.    (Red Data status: **NT**)
Harvesting of the bulbs is destructive. Bulbs are used to treat stomach disorders and venereal diseases (Lötter *et al.* 1998). Van Wyk & Gericke (2000) report it to be widely used in traditional medicine. Traditional healers from the Mbuzini-Mananga area during consultation reported that *U. altissima* is no longer common and has become very scarce (Lötter *et al.* 1998). It was rated within the top 3 most popular medicinal plants used by the three surveyed communities. *Urginea altissima* was identified by street traders in Durban as an important species for trade (Mander 1998). Filter (*pers. comm.*) reported *U. altissima* to be a rare, yet a very popular medicinal plant within the KwaMandhlangampisi mountainland area.

***Warburgia salutaris*** (Bertol.f.) Chiov.    (Red Data status: **EN A4acd**)
The stem bark is utilised and total bark harvesting can kill trees. Although this species has the ability to regenerate from the base, harvesting makes trees susceptible to fatal secondary infections. Durban street traders rank this species as the 3rd most sought after muthi plant in trade, with 17.2 tonnes of bark annually traded. This is equivalent to the bark harvested from 1075 trees (Mander 1998). Mander (1997) also ranked *W. salutaris* (together with *A. natalitius*) as the 2nd most popular medicinal plant traded in the Bushbuckridge area. These trees are so popular that today they are only found in protected conservation areas within KZN.

### 4.2.4 Discussion

It is highly unlikely that at current levels of exploitation, the sustainable supply of medicinal plants will ever meet the demand. Williams (*pers. comm.*[11]) reported that 15 organised public busses leave the Witwatersrand every weekend to traverse South Africa with the passengers collecting medicinal plants for the Fairdale ‘muthi’ market. The medicinal plant trade is a big industry and it is important to the welfare of about 80% of the black population within South Africa (Cunningham 1988). Medicinal plants contribute significantly to the primary health care system within South Africa, as Western medicine is often not available in rural areas. However, having established the importance of the medicinal plant trade, it is unfortunate to realise that the trade in many plants is unsustainable.

It is important to be able to identify areas that could potentially support, or provide plants to the medicinal plant trade. These areas are of a high biodiversity and conservation value, owing to increased collector pressure on an already stressed resource. The areas of land, highlighted through the predictive modelling process (Fig 4.2.1), indicate areas of conservation and cultural value, often concealing a ‘hidden economy’ on which many rural communities still depend.

The intricacies of conservation, and sustainable utilisation, still need to be refined. However, what is apparent is that the natural vegetation currently/potentially maintains important medicinal plant populations that cannot be lost or transformed. This investigative report was able to identify some of these important areas. However, this investigation is in its infancy and represents the first analysis of a long-term study. Not enough distribution data exists and more medicinal plants need to be atlassed and incorporated into future analyses. Unfortunately this study deals with only one facet of the medicinal plant trade, and that is the potential habitat in which many of these plants occur. However it should not be seen in isolation from a greater program which should look at

[11] Vivienne Williams, University of the Witwatersrand, Bag 3, Wits, 2050.

trade, markets, plant availability and autecological studies. Most of the important medicinal plants are threatened through trade and it is envisaged that specific methodologies be formulated within a revised Threatened Plant Program that will assess and monitor the status of these medicinal plants.

### 4.2.5 References


Crouch, N.R., Bronkhorst, M. and McCartan, S.A. 1999. Micropropagation of *Scilla nervosa* (Hyacinthaceae), a southern African medicinal bulb. *South African Journal of Botany*, 65(4): 306-307.

Cunningham, A.B. 1988. *An investigation of the herbal medicine trade in Natal/KwaZulu*, Investigational Report No 29. Institute of Natural Resources. Pietermaritzburg. pp. 149.

Douwes, E., Crouch, N.R. & Symmonds, R. 2001. Blue Squill in the Red: *Scilla natalensis* as a conservation charge. *Plantlife*, 24: 14-19.

Fourie, S.P. 1986. The Transvaal, South Africa, Threatened Plants Programme. *Biological Conservation* 37: 23-42.

Hutchings, A., Scott, A.H., Lewis, G. & Cunningham, A.B. 1996. *Zulu medicinal plants: An inventory*. University of Natal Press, Pietermaritzburg. pp. 474.

Lötter, M.C., De Wet, J.I. & Strydom, G. 1998. *Plant resource availability, status and uses in the Mananga, Thambokhulu and Mbuzini areas*. Mpumalanga Parks Board, internal document.

Louw. E. 1997. South Africa’s miracle muthi. *You* magazine 10 July.

Mander, M. 1997. *Medicinal plant marketing and strategies for sustaining the plant supply in the Bushbuckridge area and Mpumalanga Province*. DANCED – Community Forestry Project in the Bushbuckridge Area, DWAF, Nelspruit.

Mander, M. 1998. *Marketing of indigenous medicinal plants in South Africa: a case study in Kwa-zulu Natal*. Food and Agriculture Organisation of the United Nations, Rome.

Marshall, N.T. 1998. Searching for a cure: conservation of medicinal wildlife resources in East and Southern Africa. TRAFFIC International.

Smith, G.F. & Crouch, N.R. 2001. *Haworthia limifolia* var. *arcana* (Asphodelaceae: Alooideae): a new variety from eastern South Africa. *Bradleya* 19: 117-120.

Van Wyk, B., Van Oudtshoorn, B. & Gericke, N. 1997. *Medicinal plants of South Africa*. Briza Publications, Pretoria. pp. 304.

Van Wyk, B. & Gericke, N. 2000. *People’s plants: a guide to useful plants of southern Africa*. Briza Publications, Pretoria. pp. 351.

Williams, V.L., Balkwill, K. & Witkowski, E.T.F. 2000. Unravelling the commercial market for medicinal plants and plant parts on the Witwatersrand, South Africa. *Economic Botany* 54(3): 310-327.

## 4.3 Mammals

Contributors: L. Cohen, G. Camacho

### 4.3.1 Introduction

Mpumalanga is faunally diverse with approximately 163 mammal species consisting of 98 smaller and 64 larger species. It is the objective of Mpumalanga Parks Board (MPB) to conserve all of these species *in situ.*

The grassland and forest biomes sustain many endemic and red data mammal species. The grassland biome is one of the biomes in which Red Data Book (RDB) insectivore richness is concentrated (Gelderblom, Bronner, Lombard & Taylor, 1995). High mammalian species richness occurs in savannahs, which could be as a result of the wide variety of habitats available. In Mpumalanga Province, savanna areas with the availability of sufficient cover, karst areas, wetlands, pans and a well-managed mosaic of short and tall grassland, are habitats that significantly contribute towards the ecological requirements of certain mammal species.

Certain species in Mpumalanga, towards which conservation efforts for habitat protection should be directed, have been identified. Priority species can be used to emphasise key habitats, which are of conservation concern. These species thus contribute towards identifying priority areas of conservation importance and in determining the conservation value of land. Anthropogenic land conversion and habitat degradation and fragmentation are major threats to the continued existence of endemic and threatened fauna in the province.

A total of 21 species (including subspecies), have been selected for this study. They include Sclater's golden mole (*Chlorotalpa sclateri montana*), Cape molerat (*Georychus capensis yatesi*), Highveld golden mole (*Amblysomus septentrionalis*), Rough-haired golden mole (*Chrysospalax villosus rufopallidus* & *Chrysospalax villosus rufus*), Juliana's golden mole (*Neamblysomus julianae*), Robust golden mole (*Amblysomus robustus*), Meester's golden mole (*Amblysomus hottentotus meesteri*), Laminate vlei rat (*Otomys laminatus*), Peak-saddle horseshoe bat (*Rhinolophus blasii empusa*), Lesser long-fingered bat (*Miniopterus fraterculus*), Welwitsch's hairy bat (*Myotis welwitschii*), Short-eared trident bat (*Cloeotis percivali australis*), Oribi (*Ourebia ourebi*), Antbear (*Orycteropus afer*), African striped weasel (*Poecilogale albinucha*), Wild dog (*Lycaon pictus*), Pangolin (*Manis temminckii),* Aardwolf (*Proteles cristatus*), Leopard (*Panthera pardus*) and the Natal red rock rabbit (*Pronolagus crassicaudatus ruddi*).

### 4.3.2 Methods

*Species selection criteria*
Aspects used to prioritise species were rarity, range-restriction, evolutionary distinctiveness, taxonomic isolation, endemism, threats, likelihood of population recovery, IUCN Red list rating and Mpumalanga's contribution towards the conservation of these species. For the purposes of this study endemic means that the species only occurs within South Africa, Lesotho and Swaziland.

*Data sources*
Primary locality data was obtained from the Northern Flagship Institution (NFI) and supplemented with distribution records from the Mpumalanga Parks Board (MPB) mammal database, the South African Natural Heritage Programme (du Preez 2000), Ecoplan Monograph No.1 (Rautenbach 1982), MONDI, SAPPI, specialists in the respective fields and private individuals. Table 4.3.1 summarises the data sources and the types of data provided.

Table 4.3.1: Data sources and type.

| **Source** | **Type of Data** |
|---|---|
| MPB Database | Farms & Point |
| Northern Flagship Institution (NFI) | Farms & Latitude/ Longitude |
| Ecoplan Monograph No.1 (Rautenbach, 1982) | Farms & Latitude/ Longitude |
| Natural Heritage Programme Report 2000/2001 (du Preez, 2000) | Farms |
| MONDI, SAPPI, Specialists & Private individuals | Farms & Point |

*Modelling and weighting*
All available data either in the form of point data, farm name localities or Quarter Degree Squares (QDSs) were captured in digital form and imported into ArcView 3.2a.

Existing distribution records were overlaid with relevant environmental variables in order to predict the broadest distribution possible for each species. Environmental variables selected were based on information on habitat requirements (Apps (ed.) 2000; De Graaff, 1981; Roberts, 1951; Rautenbach, 1982; Smithers, 1986; Skinner & Smithers, 1990 & Taylor, 1998) and included elevation, Acocks (1988) veld types and Landcover, rainfall, wetlands and landscape morphology. Table 4.3.2 summarises the environmental predictors used for modelling.

The Provincial Red Data status of the priority species were assessed by MPB, according to IUCN Red List categories Version 3.1 (IUCN 2000a). Species assessed as Critically Endangered or Endangered were given a weighting of 1, and species with a status of Vulnerable or Near-Threatened, were allocated a weighting of 0.5. Table 4.3.3 lists the species and the assessed Red Data status and Weighting.

### 4.3.3 Results

**Cape molerat** (*Georychus capensis*) (Pallas, 1779)
(*Georychus capensis yatesi*) (Roberts, 1913)

The Cape molerat (*G. capensis*) is endemic to South Africa (SA). It occurs continuously through the Western and Eastern Cape. Two isolated populations probably representing the subspecies (*G. c. yatesi*) and a possible new species, occur in Mpumalanga and KwaZulu-Natal respectively.

Only seven records exist for the Mpumalanga Province. These represent the relict population occurring in the districts of Belfast, Ermelo and Wakkerstroom. Little is known about the genetic affiliation of the Mpumalanga population with the KZN and Cape populations. DNA material from the Wakkerstroom specimens has shown that these specimens have diverged genetically from the Cape form. It seems likely, that specimens

Table 4.3.2: Mammal species, total number of distribution records (n) and environmental variables used to model distribution.

| Species | n | Data | Elevation (m) | Veld types (Acocks, 1988) / Landcover | Rainfall (mm) | Wetlands | Landscape morphology |
|---|---|---|---|---|---|---|---|
| Cape molerat *G. c. yatesi* | 4 | | > 1650 | 8,57, 63 | | | |
| Sclater's golden mole *C. s. montana* | 1 | Pb | | Forests | | | |
| Highveld golden mole *A. septentrionalis* | 9 | | | 57, 62, 63 | | | Low Mountains:<br>Moderately undulating plains<br>Slightly irregular undulating plains<br>Slightly undulating plains and pans<br>Strongly undulating irregular land<br>Undulating hills and lowlands |
| Rough-haired golden mole *C. v. rufopallidus* | 1 | Pb | | | | | |
| Rough-haired golden mole *C. v. rufus* | 2 | | >1300 | | >800 | | Moist undulating / flat afromontane<br>Wet undulating / flat afromontane<br>Wet undulating / flat highlands |
| Juliana's golden mole *N. julianae* | 3 | Pb | | | | | |
| Robust golden mole *A. robustus* | 7 | | | | | | Moist undulating / flat afromontane |
| Meester's golden mole *A.. meesteri* | 4 | | 700-1500 | 8, 9, 18<br>Unimproved grasslands<br>Forests | 900-1200 | | |
| Laminate vlei rat *O. laminatus* | 3 | | | Unimproved grasslands | >1000 | | |
| Peak-saddle horseshoe bat *R. blasii* | 1 | | | Thicket & Bushland,<br>Forest & Woodland,<br>Degraded Thicket & Bushland<br>Degraded Forest & Woodland | | | |
| Lesser long-fingered bat *M. fraterculus* | 3 | | | Thicket & Bushland,<br>Forest & Woodland,<br>Degraded Thicket & Bushland<br>Degraded Forest & Woodland | | | |

Table 4.3.2 cont'd

| Species | n | Data | Elevation (m) | Veld types (Acocks, 1988) / Landcover | Rainfall (mm) | Wetlands | Landscape morphology |
|---|---|---|---|---|---|---|---|
| Antbear *O. afer* | 36 | Pb | | | | | |
| Oribi *O. ourebi* | 39 | Pb | | | +700 | | |
| African striped weasel *P. albinucha* | 1 | | > 600 | | | Non-perennial & Perennial Pans & Palustrine wetlands | |
| Wild dog *L. pictus* | 12 | Pb | | | | | |
| Pangolin *M. temminckii* | | | <1000 | Degraded thicket & bushland, Degraded forest & woodland, Forest & woodland | | | |
| Aardwolf *P. cristatus* | | | | Unimproved grasslands, Thicket & bushland, Forest & woodland | <800 | | |
| African Leopard *P. pardus* | | QDSs | | | | | |
| Natal red rock rabbit *P. c. ruddi* | 3 | | 800 | Moisture wet hilly areas, Grasslands | | | Moist rocky slopes |

Pb: Point plus buffer: Sclater's golden mole - 5 km radius around the type locality
Rough-haired golden mole (*C. v. rufopallidus*) - 5 km radius around the known locality
Juliana's golden mole - 4 km radius around the known localities
Short-eared trident bat - 5 km radius around the known localities
Aardvark - 10 km radius around all known localities
Oribi - 2 km radius around all known localities

QDSs: Quarter Degree Squares

Table 4.3.3 Summary of the Red Data Status and the Weighting of selected mammal species.

| Species | Provincial Status: IUCN 3.1 (2000a) | National Status: SARDB (1986) | Global Status IUCN (2000b) | Weighting |
|---|---|---|---|---|
| Cape molerat *G. c. yatesi* | EN B1ab(ii,iii) | Rare* | - | 1.0 |
| Sclater's golden mole *C. s. montana* | CR B2ab(ii,iii,v) | Indeterminate | C. sclateri: VU B1+2c | 1.0 |
| Highveld golden mole *A. septentrionalis* | VU B1ab(ii,iii) | - | - | 0.5 |
| Rough-haired golden mole *C. v. rufopallidus* | CR B2ab(iii,iv) | Vulnerable | VU B1+2c | 1.0 |
| Rough-haired golden mole *C. v. rufus* | EN B1ab(i,iii) | Vulnerable | VU B1+2c | 1.0 |
| Juliana's golden mole *N. julianae* | EN B2a(iii) | Indeterminate | CR B1+2c | 1.0 |
| Robust golden mole *A. robustus* | VU B2ab(ii,iii,v) | - | - | 0.5 |
| Meester's golden mole *A. h. meesteri* | VU B2ab(i,iii) | - | - | 0.5 |
| Laminate vlei rat *O. laminatus* | VU B2ab(i,iii) | - | - | 0.5 |
| Peak-saddle horseshoe bat *R. b. empusa* | EN B1ab(iii) | Indeterminate | LR/nt | 1.0 |
| Lesser long-fingered bat *M. fraterculus* | VU B2ab(iii) | - | LR/nt | 0.5 |
| Welwitsch's hairy bat *M. welwitschii* | EN B2ab(iii) | Indeterminate | - | 1.0 |
| Short-eared trident bat *C. p. australis* | EN B1ab(iii,iv) | Indeterminate | LR/nt | 1.0 |
| Antbear *O. afer* | Unknown | Vulnerable | - | 0.5 |
| Oribi *O. ourebi* | VU | Vulnerable | LR/cd | 0.5 |
| African striped weasel *P. albinucha* | Unknown | Rare | - | 0.5 |
| Wild dog *L. pictus* | EN | Endangered | EN C1 | 1.0 |
| Pangolin *M. temminckii* | VU | Vulnerable | LR/nt | 0.5 |
| Aardwolf *P. cristatus* | Unknown | Rare | - | 0.5 |
| African Leopard *P. pardus* | Unknown | Rare | - | 0.5 |
| Natal red rock rabbit *P. c. ruddi* | Unknown | Unknown | - | 0.5 |

CR=Critically Endangered, EN=Endangered, VU=Vulnerable, NT=Near-Threatened, LR/nt=Lower Risk/near-threatened.
National Status SARDB (1986): South African Red Data Book (SARDB) (Smithers, 1986)
Provincial Status IUCN (2000): Version 3.1: IUCN (2000a)
Global Status: 2000(b) IUCN Red List of Threatened Species
**G. c. yatesi*, which is considered a unique genotype, is not listed in the SARDB (Smithers, 1986), but Mugo, Lombard, Bronner, Gelderblom & Benn (1995) have recommended that this species be afforded at least Rare status.

from the Mpumalanga and KZN populations represent a taxon that is at least specifically different (Bronner, *pers. comm.*[12]).

In Mpumalanga this species is found in eastern highveld grassland (Acocks veld types (8), (57) & (63)). Specimens have been collected at elevations higher than 1650m a.s.l.. According to Roberts (1951), it occurs in loose or sandy soils bordering on pans.

The modelled distribution for this taxon indicated a far more extensive range than the known locality data. This distribution is shown as a continuous band from the northernmost part of the Steenkampsberg southwards to Wakkerstroom.

This taxon has not yet been recorded from any formally protected area. The Ermelo population occurs on a Municipal Reserve in the Ermelo district (Mugo *et al*, 1995) and the Wakkerstroom population on a registered Natural Heritage Site (NHS) within the proposed Grassland Biosphere Reserve (GBR).

This species could be threatened by the degradation of its preferred grassland veld types and wetland habitat. Specific threats include commercial afforestation, agricultural encroachment, heavy grazing and trampling by livestock, certain burning regimes, anthropogenic factors and hunting by domestic and feral dogs.

**Sclater's golden mole** (*Chlorotalpa sclateri*) (Broom, 1907)
(*Chlorotalpa sclateri montana*) (Roberts, 1924)

*C. sclateri* is endemic to the greater South Africa. The subspecies (*C. s. montana*) is endemic to Mpumalanga. According to available data, only one specimen has been collected near the southern border of the province in the Wakkerstroom district in 1924.

Sclater's golden mole appears to be a mountain specialist. The distribution of *C. s. montana* as noted by Roberts (1951), is moist kloofs of the Drakensberg at high altitudes, near Wakkerstroom. Skinner & Smithers (1990) associated the Wakkerstroom specimen with rocky hillsides. Lynch (1994) collected *C. sclateri* from Lesotho, in black turf soils amongst alpine shrub vegetation and sedges and short grassland on mountain slopes, near streams.

The type locality was buffered by a 5 km radius in order to protect the immediate surrounding habitat. Predictive modelling indicated that montane grasslands and rocky hillsides with associated valleys and forests in the south-western part of the Usutu catchment, could potentially hold populations of this species. It further showed that the species would potentially not range further west of Wakkerstroom (confirmed by Bronner, *pers. comm*).

The single known locality occurs on privately owned land which is registered as a NHS and encompassed by the proposed GBR.

Loss of montane grassland, forest and kloof habitat through incompatible agricultural and livestock practices (including certain fire regimes, overgrazing and trampling of wetlands and stream vegetation), alien plant infestation and forest destruction, could impact negatively on populations.

[12] Dr. Gary Bronner, University of Cape Town, Rondebosch, 7700

**Highveld golden mole** (*Amblysomus septentrionalis*) (Roberts, 1913)
*A. septentrionalis* is a cryptic species, which was formerly included in *A. hottentotus* (Bronner, 1996). The Highveld golden mole can, at this stage, be regarded as a Mpumalanga endemic. Current distributional data available (Bronner, 1996 & Bronner, *pers. comm.*) indicates that southern Mpumalanga is the core of distribution within South Africa.

Highveld golden moles are found in various grassland veld types at elevations above 700m a.s.l. and mean annual rainfall above 500 mm (Rautenbach, 1982). They normally occur on level ground that is soft, sandy or sandy loam. Specimens have also been collected from black clayey soils (Rautenbach, 1982).

The Highveld golden mole has so far been recorded from nine fragmented localities (22+ records) from the southern part of Mpumalanga. The areas in which *A. septentrionalis* occur are small, but populations within these areas seem to have relative high densities (Bronner, *pers. comm*.). Modelling predicted a relatively widespread distribution throughout the highveld areas of southern Mpumalanga and included the Nooitgedacht, Jericho Dam and Paardeplaats Nature Reserves as areas of potential occurrence.

This species has been recorded at Wakkerstroom and probably occurs in the Wakkerstroom Wetland Reserve. It has been recorded in non-provincial reserves i.e. Ermelo Municipal Reserve and Joshua Moolman Private Nature Reserve and on a farm registered as a NHS within the proposed GBR.

*A. septentrionalis* is adaptable and can coexist with man. However, changing land-use practices and mismanagement of grassland habitat threaten these populations. Other anthropogenic factors such as hunting by domestic dogs and pesticides could also affect the populations.

**Rough-haired golden mole** (*Chrysospalax villosus*) (A. Smith, 1833)
(*Chrysospalax villosus rufopallidus*) (Roberts, 1924)
(*Chrysospalax villosus rufus*) (Meester, 1953)

Both *C. v. rufopallidus* and *C. v. rufus* are endemic to and known from restricted areas in the Mpumalanga province. The Rough-haired golden mole is a grassland specialist. According to Roberts (1951), it prefers meadow-like or dry substrate on the fringes of damp vleis and marshes. It also often occurs in suburban areas (Taylor 1998) and seems to be adaptable.

A high degree of subspeciation occurs due to the localised distribution of this uncommon species. Five records (dating back to the 1910's and the 1920's) exist for *C. v. rufopallidus* and all the specimens were collected from the Wakkerstroom municipal area. *C. v. rufus* is known from six records (dating back to the 1920's and 1950's) in the Belfast and Sabie regions in the northern part of the province.

The single locality of *C. v. rufopallidus* which occurs in Acocks veld type (57), was buffered by a 5 km radius, due to a lack of distribution data and poorly defined habitat requirements. Roberts (1951) expected the distribution to extent further northwards, towards Belfast.

Modelling predicted an extended but fragmented distribution for *C. v. rufus* through the Blyde River Canyon Nature Reserve and Sabie areas, the Steenkampsberg/Dullstroom/ Belfast region, the north-western part of the Usutu catchment and the area directly north of Wakkerstroom and Volksrust. A contact zone between the subspecies *C. v. rufopallidus* and *C. v. rufus* probably exists between Belfast and Wakkerstroom.

*C. v. rufopallidus* possibly occurs in the Wakkerstroom Wetland Reserve, which is managed by MPB whilst *C. v. rufus* may occur in the Verloren Valei and Blyde River Canyon Nature Reserves and Songimvelo Game Reserve.

Threats include loss and/or degradation of grassland habitat through land modification and mismanagement of natural grassland and wetland areas. Trampling, overgrazing and burning of vegetation around vleis or marshes in winter could impact negatively on populations. Populations are vulnerable to anthropogenic factors such as hunting by domestic dogs (Taylor, 1998) or poisoning through insecticides.

**Juliana's golden mole** (*Neamblysomus julianae*) (Meester, 1972)
This globally critically endangered species (formerly *Amblysomus julianae*) is endemic to the north-eastern part of South Africa. Very few specimens have so far been collected in three widely separated areas (Pretoria, Nylstroom & Kruger National Park (KNP)) in the savanna biome.

Little is known about its habitat requirements. Juliana's golden mole's occurrence is widely discontinuous, which could indicate that it is not confined to specific climatic conditions and has a wide habitat tolerance or as more information becomes available, the opposite, that its specific habitat requirements are in fact limited (Rautenbach 1982). Therefore, each locality was buffered to a 4 km radius.

Juliana's golden mole seems to be associated with sandy soils in bush savanna. The Pretoria specimens were collected from a highveld grassland / bush savanna transitional zone, in sandy soils with rocky outcrops (Rautenbach 1982).

All three known localities in Mpumalanga occur in the KNP and the species is thus protected. These populations should be safe from usual threats encountered outside protected areas. However, development close to the particular localities, could impact on populations. The known population occurring in a Rest Camp in the KNP, can possibly be threatened by anthropogenic factors.

**Robust golden mole** (*Amblysomus robustus*) (Bronner, 2000)
*A. robustus* is a newly described species, which is related to two other cryptic species, *A. hottentotus* and *A. septentrionalis*. The Robust golden mole is endemic to the eastern Mpumalanga highveld and is known from the Belfast and Dullstroom areas.

Typical habitat includes montane grassland and vlei or marsh areas within North-eastern Mountain Sourveld (Acocks veld type (8)) in the Steenkampsberg area (Bronner 2000).

The predicted distribution extends southwards to two isolated areas, Chrissiesmeer and Wakkerstroom/Volksrust. A contact/hybrid zone between *A. robustus* and *A. septentrionalis,* could exist, in the Ermelo district (Bronner, *pers. comm.*).

Bronner (2000) reports that the low number of locality records could indicate a limited distribution of this species. The type locality of this species is the Verloren Valei Nature Reserve, which offers official protection status.

*A. robustus* is adaptable and coexists well with man. However, transformation of land through forestry and agricultural developments as well as hunting by domestic and feral dogs and insecticides can impact on populations. Proper management principles in terms of burning regimes and grazing practices need to be implemented to ensure the survival of this low vagile, localised subterranean species.

**Meester's golden mole** (*Amblysomus hottentotus*) (A. Smith, 1829)
(*Amblysomus hottentotus meesteri*) (Bronner, 2000)

Meester's golden mole is a new subspecies and a Mpumalanga endemic, described by Bronner in 2000. It has a unique coloration and can be distinguished externally by a characteristic mid-dorsal band of reddish-black fur.

It has been recorded from the Drakensberg escarpment where it ranges from the Mariepskop and Graskop areas, southwards to White River. Meester's golden mole is primarily found in mesic montane grasslands and indigenous forests on the transitional zone between grassland and savanna.

This species is included in the protected area network within the Blyde River Canyon Nature Reserve. Few locality records are available which could possibly indicate range-restriction (Bronner 2000).

Modelling predicted a potential range extending in a southward direction along the escarpment, towards the north-western border of Swaziland. Occurrence is predicted in the Ohrigstad Dam and Barberton Nature Reserves as well as the Songimvelo Game Reserve.

Meester's golden mole adapts to certain anthropogenic activities and coexists with man, in general. However, potential threats include habitat loss and degradation through commercial afforestation and prospecting and mining activities. Hunting by domestic and feral dogs and pesticides pose a threat to populations occurring in suburban areas. Management practices aimed at sustaining viable populations need to be implemented for natural areas on private land.

**Laminate vlei rat** (*Otomys laminatus*) (Thomas & Schwann, 1905)
*Otomys laminatus mariepsi* (Roberts, 1929)

The laminate vlei rat is a South African endemic. The subspecies *O. l. mariepsi* was collected by Roberts in 1929 at Mariepskop (type locality). Additional specimens were collected in the 1950's at Spitzkop, Sabie. Uncertainty exists, with regards to the particular subspecies involved at Spitzkop, and Meester *et al.* (1986) suggest that *O. l. mariepsi* may be synonymous with the nominate race. The subspecies has therefore not been recognised for this study. Rautenbach (1982) pointed out that more study material must be obtained and a revision of the genus done, in order to verify the status of the subspecies.

The distribution in South Africa ranges from the Mpumalanga escarpment southwards to the west of Swaziland into KZN and along the Transkei coast. The south-western Cape supports a relict population. *O. laminatus* is known from eight records at three localities in Mpumalanga province. The species seems to be restricted to the eastern escarpment, which is the northernmost distribution of its range in South Africa.

The laminate vlei rat occupies grasslands within the submontane zone in Mpumalanga and occurs sympatrically with *O. irroratus* and *O. angoniensis*.

Modelling suggested that the predicted distribution could extend in a band, southwards along the escarpment and the Swaziland border, towards the southern border of the province and Volksrust.

*O. laminatus* was recorded in the Blyde River Canyon Nature Reserve and could potentially occur in the Ohrigstad Dam, Songimvelo, Jericho Dam, Paardeplaats and Witbad Nature Reserves and the Wakkerstroom Wetland Reserve. Threats such as habitat loss and degradation through afforestation and mismanagement of natural grassland and wetland areas could impact negatively on populations.

**Peak-saddle horseshoe bat** (*Rhinolophus blasii*) (Peters, 1867)
(*Rhinolophus blasii empusa*) (K. Andersen, 1904)

Few scattered localities of *R. b. empusa* exist in South Africa within the Northern Province, Mpumalanga, KZN and Gauteng. The species is uncommon in Mpumalanga and has so far been recorded from only one locality.

Very little information is available on its habitat requirements but Smithers & Skinner (1990) report that this species seems to inhabit savanna woodland. It is a cave-dweller and is dependent on the availability of suitable caves and mines for use as day roosts. Rautenbach (1982) suggested that this species can be migratory to some extent and that certain caves are used for hibernation.

The distribution could extent into woodland areas throughout the province, depending on the availability of day roost habitat. *R. b. empusa* has thus far not been recorded from any nature reserve within Mpumalanga.

Populations are threatened by habitat loss and degradation through land transformation, which may affect the availability of natural prey items and roosting habitat. The use of agricultural insecticides, unintentional and intentional disturbance of surface and subsurface cave ecosystems as well as the destruction and closure of day roosting habitats (mines and caves) can impact negatively on populations.

**Lesser long-fingered bat** (*Miniopterus fraterculus*) (Thomas & Schwann, 1906)
The core of this species' distribution is situated in the southern African Subregion. *M. fraterculus* is uncommon in Mpumalanga and only three localities are known. It has been recorded from old mining sites in the Barberton district and recently from a cave in the Sudwala area. It is often found amongst colonies of *M. schreibersii*.

The Lesser long-fingered bat is a cave-dwelling species and has been recorded from savanna woodland areas in the Lowveld. It is dependent on suitable habitat or cover for roosting during the day. It could occur in woodland areas throughout the province but this distribution is subject to suitable day roost environments.

So far it has not been recorded from any provincially protected area in Mpumalanga. Habitat degradation and loss through land modification and mismanagement can lead to a reduction in the food supply and loss of roosting habitats. Human disturbances, and the destruction and closure of suitable cave and mining sites could be detrimental to populations occupying these habitats.

**Welwitsch's hairy bat** (*Myotis welwitschii*) (Gray, 1866)
The distribution of this species is wide, but patchy and discontinuous throughout its range in Africa. According to Taylor (1998), only 21 museum specimens are known from the subregion of which 10, were collected in South Africa. Three of these records are from Mpumalanga. Little is known about this species and its habitat requirements.

*M. welwitschii* seems to prefer savanna woodland. A variety of day roost habitats are utilised and Taylor (1998) reports that they have been collected from a factory, rolled-up banana leaves, scrubby bush, a cave and in savanna grassland.

Two of the localities are situated within the KNP. Degradation and loss of suitable habitat can affect populations.

**Short-eared trident bat** (*Cloeotis percivali*) (Thomas, 1901)
(*Cloeotis percivali australis*) (Roberts, 1917)

The core distribution of *C. percivali* is centred in the southern African subregion and is occupied by the above-mentioned subspecies. *C. p. australis* has been recorded from a few peripheral localities in Kenya, Malawi and northern Mozambique. Only 16 locality records exist for southern Africa of which seven occur in South Africa and one in Swaziland. Three localities occur in two different areas in Mpumalanga. Little is known about specific habitat requirements and therefore, the known localities were buffered by a 5 km radius.

It appears as if *C. p. australis* favours savanna woodland regions where substantial shelter is available for day time roosting. Colonies were found in caves, disused mines, irrigation tunnels and inspection tunnels in dam walls. Jacobs (*pers. comm.*[13]) recently discovered a new colony in Mpumalanga. Jacobs mentioned that this is only one of two breeding colonies known in South Africa.

Neither of the localities in Mpumalanga is officially protected. Major threats to the survival of these top predators are the use of agricultural insecticides, unintentional and intentional disturbance of surface and subsurface cave ecosystems as well as the degradation of foraging grounds and destruction and closure of day time roosting sites (caves, mines & other artificial structures).

**Antbear** (*Orycteropus afer*) (Pallas, 1766)
Although distributed throughout almost the entire country, the antbear occurs in low densities. They avoid rocky and dense woodland areas Lindsey (*pers. comm.*[14]). Taylor (unpublished data) noticed that steep areas are not frequented by antbears, but may form part of their home ranges. Within their wide distribution there are many areas where they are locally absent, either due to unsuitable terrain or lack of food (Skinner & Smithers, 1990). The Antbear is particularly associated with heavily utilised grasslands where there

[13] Dr. David Jacobs, University of Cape Town, Rondebosch, 7700
[14] P. Lindsey. University of Pretoria

are termite populations. Taylor (unpublished data) also mentioned that two animals found in the Congo were well within forests. This is contradictory to other literature. In the southern Free State he found the mean home range sizes of Aardvarks to be 3,5 $km^2$ (Taylor, unpublished data). Known localities were used to model their potential distribution.

This species occurs throughout most of the untransformed areas of the Mpumalanga province, on private as well as state-owned land. A single female will only produce one offspring, rarely twins, per annum (Smithers, 1986). Maintenance of the currently untransformed areas will therefore possibly not contribute to an increase in population numbers, but will only contribute towards the stabilisation of this species, provided that certain human threats are minimised.

**Oribi** (*Ourebia ourebi*) (Zimmermann, 1783)
There is no indication as to whether this species' numbers have declined or increased in the last few decades. Within Mpumalanga, Oribi distribution is localised and fragmented to certain suitable areas including conserved areas and remaining natural grassland. They select short well-managed grassland plateaus with patches of tall grass available to hide their young. Over-grazed and dense short grasslands are usually avoided (Smithers, 1986).

The distribution of the Oribi correlates strongly with that of the Antbear, as these areas are either undeveloped or have a protection status. The Oribi has small home ranges averaging between 34-49ha's in KwaZulu-Natal and Transvaal (Smithers, 1986). The localities were therefore buffered by a 2km radius.

**African striped weasel** (*Poecilogale albinucha*) (Gray, 1864)
Four subspecies have been described, but Skinner & Smithers (1990) report a lack of sufficient evidence to support this. Therefore, the subspecies have not been recognised for this study. The African striped weasel most often occurs in savanna and moist grassland with an annual rainfall of above 600mm. Very few observations have been made on this species in the wild.

The modelled data shows a uniformly fragmented distribution throughout the province except for the Lowveld region, with a higher occurrence in typical habitat towards the central grasslands and the south-eastern portion of the Usutu River catchment. Moist grassland associated with perennial and non-perennial pans and palustrine wetlands form an important part of their habitat. This explains the predicted occurrence for the central parts of Mpumalanga.

According to Smithers (1986) there is little evidence of a decline in either range or numbers of African Striped Weasel. However, they are a secretive species unknown to occur near human settlements and activities and thus it can be accepted that there has been a decline in their habitat. This species feed almost entirely on rodents and insects and are thus sensitive to pressures of intensive agriculture and grazing, which cause a reduction in availability of prey species. Land transformation will continue to play a role in the decline of this species. Their inability to coexist in close proximity to humans will also ensure that they are excluded from areas bordering transformed or developed areas.

**Wild dog** (*Lycaon pictus*) (Temminck, 1820)
Probably one of the most threatened species in South Africa and there has been a dramatic reduction in their distribution in the past (Smithers, 1986). They are found in low numbers

in the Kruger National Park and a few individuals seem to have strayed out of the park to reach the Verloren Valei Nature Reserve area. About five individuals have been occupying an area in the vicinity of the reserve for the last four years. Wild dog seem to prefer open plains or open savanna woodland, which suits their hunting technique.

This predator occupies home ranges up to 450 $km^2$ in the Kruger Park and 4000 $km^2$ in East Africa (Smithers, 1986). Outside the KNP they are in direct conflict with livestock farmers (Lindsey, *pers. comm.*). Direct persecution by farmers as well as habitat reduction and fragmentation poses a severe threat.

Due to the small sizes of most protected areas, it is not possible to protect this species outside of the Kruger National Park (KNP) in the Mpumalanga region. The latest figures for the Wild dog population in the KNP, indicates the population to be stable or declining, according to the draft document for the Proposed Guidelines for the Management of Wild dog in South Africa.

**Pangolin** (*Manis temminckii*) (Smuts, 1832)
This species is uncommon throughout its known range, which extends from south of the Sahara to the east of Africa and to the northern parts of South Africa. The pangolin seems to favour areas with moderate temperatures not dropping below 0° C (Swart, *pers. comm*[15]). It seems to favour mainly savanna woodland but has also been observed in floodplains and grassland areas (Smithers, 1986). Modelling was done on the typical habitat requirements.

This solitary species occurs in low numbers, and occupies large home ranges. The males in the Sabi Sand nature reserve have home ranges of up to 2000ha whereas the females move in areas of 500ha (Swart, *pers. comm*.). Their major threat seems to be the muti trade as there is a high demand for their scales. Only one young is born per year, seemingly in the drier months (Swart, *pers. comm*.). They are also vulnerable to agricultural developments and seem to be susceptible to insecticides. The South African Red Data Book for Mammals (Smithers, 1986) classifies the Pangolin as a Threatened species with a vulnerable status. Freitag & Van Jaarsveld (1997) rank the Pangolin fourth in conservation priority in a list of 197 mammal species for the former Transvaal.

No pangolins have as yet survived in captivity, possibly due to their specialised diet. Therefore, breeding these animals in captivity and replacing them in the wild is not possible at this stage (Swart, *pers. comm*.).

**Aardwolf** (*Proteles cristatus*) (Sparrman, 1783)
This species occurs throughout South Africa in low numbers. They seem to prefer areas with an annual rainfall below 800mm and avoid densely vegetated areas (Smithers, 1986) and will only occur where adequate food sources are available. These habitat requirements were used to model the areas for this species due to the fact that it has such a widespread occurrence in Southern Africa.

The Aardwolf is vulnerable to livestock farmers killing them mistakenly believing that they kill small domestic stock. They specialise on *Trinervitermes* termites and are therefore also vulnerable to the poisoning of these termites.

[15] J. Swart, Inyati Game Lodge, PO Box 9, Skukuza

**African Leopard** (*Panthera pardus*) (Linnaeus, 1758)
Of all wild Felidae, the leopard *Panthera pardus* has the widest range (Bothma 1998). It is a species known to be highly adaptable to human activities although they are vulnerable to habitat fragmentation. They occur extensively throughout Africa and Eurasia and at least nine subspecies have been described. They are unfortunately a species of popular appeal to both tourists as well as trophy hunters. Modelling was done for Mpumalanga on all the QDSs where they are known to occur.

They occupy large areas varying from 8 to 10 $km^2$ in prey rich areas such as the Wilpattu National Park in Sri Lanka and up to 2550.1 $km^2$ in the Kgalagadi Transfrontier Park (Bothma 1998). Very little is known about the impact of indiscriminate hunting and the population dynamics of this solitary species. Due to the large territories that this species can occupy it is threatened by habitat fragmentation. Other threats include the reduction in abundance of natural prey species and also indiscriminate persecution.

**Natal red rock rabbit** (*Pronolagus crassicaudatus ruddi*) (I. Geoffroy, 1823)
This is one of the few larger mammals endemic to this region. This rock rabbit occurs in rocky areas on steep, boulder-strewn hillsides, which have some grass cover (Skinner & Smithers 1990). They occur from sea level up to 1550m a.s.l. Two QDS localities and one point locality are known for this species within Mpumalanga but the typical habitat requirements were used to model the areas for this species.

Very little is known about the small distribution of this South African endemic subspecies. Its main threat is habitat loss due to afforestation.

### 4.3.4 Discussion

Extensive human activities and the neglect of grasslands and wetlands from a conservation perspective have placed these particular habitats under severe pressure. The savanna biome outside protected areas in Mpumalanga is also under tremendous pressure by agricultural development, prospecting and mining and habitat destruction. Habitat loss and fragmentation through commercial afforestation, agricultural development, wetland-degradation, human disturbance and the mismanagement of natural habitat are the main threats that could severely impact on mammal populations within Mpumalanga.

None of the smaller mammal species considered here is commonly found. This could be due to the individuals being overlooked, the lack and difficulty of collecting as well as the fact that they could be localised, with isolated populations occurring in suitable areas. Although vulnerable, the conservation status of *A. septentrionalis*, *A. h. meesteri* and *A. robustus* seem to be satisfactory due to their coexistence with man. Anthropogenic factors could however, still affect these species.

*Modelling and Data requirements*
The Provincial Red Data assessments and the modelled distributions of priority species must be made available to mammologists for comments and recommendations.

Few specimens of the golden mole, molerat, rodent and bat species described for this study, have been collected in the past. As a consequence, information on fine scale ecological requirements for these species is insufficient. Predicted occurrences for most of the smaller mammal species depict a broad distribution due to extrapolations based on landcover, vegetation types and landscape morphology. Serious limitations that hampered the construction of meaningful models were the absence of detailed habitat requirement and adequate distribution data.

*Conservation requirements and Recommendations*

The conservation importance of an area can only be enhanced if more is known about the distribution, abundance and the ecology of species as well as the processes that drive them. Intensive surveying and sampling of important species in Mpumalanga should be conducted. There is a desperate need to obtain additional distribution, ecological and genetic data for further studies of the priority species involved. Subsequent ground-thruthing and validation of species distributions need to be undertaken.

Subterranean mammals such as the golden moles and molerats have low vagility. These mammals could, according to Gelderblom *et al*. (1995) be highly endemic with high genetic differentiation between populations. They therefore need to be protected throughout their ranges. Endemism of small mammals in Mpumalanga is most pronounced in the montane regions. A very high level of insectivore endemism occurs in the grasslands of the Wakkerstroom area (Gelderblom *et al.,* 1995). This centre of endemism and hotspot (situated within the proposed GBR) should be regarded as a core area of conservation importance within Mpumalanga. Other grassland regions that need to be highlighted as areas of high conservation value, are the Steenkampsberg/Dullstroom/Belfast and the Blyde River Canyon/Graskop/Sabie areas. Several endemic insectivore and rodent species have been recorded in these areas.

South Africa has the highest number of endemic mammals and is regarded by Gelderblom and Bronner (1995) as the most important centre of endemism in the southern African subregion. Mpumalanga contributes greatly towards the number of endemic species and therefore plays a very important role in the conservation of these species and their genetic variability. The conservation responsibility rests with the Mpumalanga Parks Board.

Savanna regions in the Lowveld of Mpumalanga seem to be important for several bat species, a golden mole species and a spectrum of larger mammal species. Juliana's golden mole (recorded in the KNP) occurs exclusively in the savanna biome. The protection of day roosting (caves, mines & other artificial structures) and feeding habitat as well as natural habitat in general, is essential for maintaining the populations of some of these rare mammal species.

The Wild dog needs urgent attention for protective measures outside the borders of a few larger parks in South Africa. Very few areas are suitable enough in land area size to host this spectacular predator and they seem to be one of the most endangered mammal species in Africa.

Figure 4.3.1 indicates that there are many areas in Mpumalanga outside of the formally protected areas that are important for the threatened mammal species. Available distribution data indicate that most of the aforementioned species' localities occur on privately owned land. Adequate formal protection is required for all the selected species as well as for areas with high conservation value. Collaborative actions, regarding conservation strategies should be established between Conservation Authorities and private landowners. Habitat must be managed to sustain viable populations.

### 4.3.5 Acknowledgements

This work formed part of a Provincial Biodiversity Database Project sponsored by the Department of Water Affairs and Forestry. Anthony Emery is thanked for modelling the distribution of species and Sandra Williamson for assisting in the capture of data, the assessment of Provincial Red Data status and proof reading of documents in preparation. The Northern Flagship Institution is thanked for making available digital distribution data. Drs. Gary Bronner, David Jacobs and Peter Taylor are thanked for providing valuable information and comment on the selection of priority small mammal species and MONDI, SAPPI and private individuals for providing relevant locality information.

### 4.3.6 References

Acocks, J.P.H. 1988. *Veld Types of South Africa*. Memoir no.57. 3rd Ed. Botanical Research Institute, Department of Agriculture and Water Supply, South Africa.

Apps, P. (ed.) 2000. *Smithers' Mammals of Southern Africa. A field guide*. Cape Town, Struik publishers.

Bothma, J. du P. 1998. A Review of the Ecology of the Southern Kalahari Leopard. *Trans. Roy. Soc. S. Afr. 53 (2)*. 257-266.

Bronner, G.N. 1996. Geographic patterns of morphometric variation in the Hottentot golden mole, *Amblysomus hottentotus* (Insectivora: Chrysochloridae). A multivariate analysis. *Mammalia* 60(4): 729-751.

Bronner, G.N. 2000. New species and subspecies of Golden Mole (Chrysochloridae: *Amblysomus*) from Mpumalanga, South Africa. *Mammalia*, 64: 41-54.

De Graaff, G. 1981. *The rodents of southern Africa*. Butterworths, Pretoria.

Du Preez, C. 2000. *South African Natural Heritage Programme.* Annual Report 2000/2001. Department of Environmental Affairs & Tourism. Midrand.

Freitag, S. & Van Jaarsveld, A.S. 1995. Towards conserving regional mammalian species diversity: a case study and data critique. *S. Afr. J. Zool.* 30(3): 136-144.

Gelderblom, C.M. & Bronner, G.N. 1995. Patterns of distribution and current protection status of the endemic mammals in South Africa. *S. Afr. J. Zool.* 30: 127-135.

Gelderblom, C.M., Bronner, G.N., Lombard, A.T. & Taylor, P.J. 1995. Patterns of distribution and current protection status of the Carnivora, Chiroptera and Insectivora in South Africa. *S. Afr. J. Zool.* 30: 103-114.

IUCN. 2000a. *IUCN Red List Categories*. Prepared by the IUCN Species Survival Commission, IUCN, Gland, Switzerland.

IUCN. 2000b. *The 2000 IUCN Red List of Threatened Species*.

Lynch, C.D. 1994. The mammals of Lesotho. *Navorsinge van die Nasionale Museum Bloemfontein* 10(4): 177-241.

Meester, J.A.J., Rautenbach, I.L., Dippenaar, N.J. & Baker, C.M. 1986. Classification of southern African mammals. *Transvaal Museum Monograph* 5: 1-359.

Mugo, D.N., Lombard, A.T., Bronner, G.N., Gelderblom, C.M., & Benn, G.A. 1995. Distribution and protection of endemic and threatened rodents, lagomorphs and macrosceledids in South Africa. *S. Afr. J. Zool.* 30: 115-126.

Rautenbach, I.L. 1982. Mammals of the Transvaal. *Ecoplan Monogr.* 1: 1-211, Pretoria.

Roberts, A. 1951. *The Mammals of South Africa*. Pretoria: Trustees of the "Mammals of South Africa" Book Fund.

Skinner, J.D. & Smithers, R.H.N. 1990. *The mammals of the Southern Africa subregion*. Pretoria University Press, Pretoria.

Smithers, R.H.N. 1986. South African Red Data Book – Terrestrial Mammals. *South African National Scientific Programmes Report No. 125*.

Taylor, P.J. 1998. *The Smaller Mammals of KwaZulu-Natal*. University of Natal Press, Scottsville.

Taylor, A. 2001. Unpublished Data.

## 4.4 Birds

Contributor: L. Cohen and G. Camacho

### 4.4.1 Introduction

More than 567 bird species have been recorded in Mpumalanga. Approximately 71 Red Data species, of which 35 are threatened, occur within the area. There are no species endemic to Mpumalanga, but the province is the centre of distribution for two species, which are endemic to South Africa, and accommodates a species that is endemic to the Subregion.

The Mpumalanga province is represented by the Grassland, Forest and Savanna biomes. Some of South Africa's endemic and most threatened terrestrial and wetland-associated bird species are significantly dependent on the wetlands, short dense and tall grasslands and woodland regions of the Mpumalanga province. A total of 12 Important Birding Areas (IBAs) occur within the province and most are of critical ornithological importance. The Heyshope dam (within IBA SA020) and Chrissie Pans IBA (SA019), carry extremely large numbers of waterbird species. The Masibekela wetland, near the Lebombo Mountains in the Lowveld region, holds species that are uncommon in Mpumalanga and support relative large numbers and varieties of rallids. Species richness in the Lowveld is high, due to a diversity of habitats.

The presence or absence of bird species with specific habitat requirements can be indicative of the state of the environment. Bird species that can act as important savanna, grassland and wetland indicators, have been selected, in order to identify priority areas of conservation importance for birds, and to determine the conservation value of land within Mpumalanga Province. Habitat loss and degradation are the primary threats that impact severely on viable populations of these sensitive species.

The Red Data species selected were Whitewinged Flufftail, Rudd's Lark, Yellowbreasted Pipit, Bald Ibis, Botha's Lark, Wattled Crane, Blue Crane, Grey Crowned Crane, Blue Swallow, Pinkthroated Twinspot, Chestnutbanded Plover, Striped Flufftail, Southern Ground Hornbill, Blackrumped Buttonquail, Blue Korhaan, Stanley's Bustard, African Marsh Harrier, Grass Owl, Whitebellied Korhaan, Saddlebilled Stork, Lappetfaced Vulture, Whiteheaded Vulture, Bateleur, Cape Vulture, Martial Eagle, Peregrine Falcon and Taita Falcon .

### 4.4.2 Methods

*Species selection criteria*
Priority species were selected by using the following criteria; global and national red data status, endemicity, range restriction, threats, population numbers and lastly Mpumalanga's contribution towards the conservation of the species. For the purposes of this study endemic means that the species only occurs within South Africa, Lesotho and Swaziland.

*Data sources*
The Mpumalanga Parks Board (MPB) Database, was supplemented with information from the following sources: the Avian Demography Unit (ADU), Cape Town; The Northern Flagship Institution (NFI); TOTAL CWAC Report 1992-97; South African Crane Working Group (SACWG); Natural Heritage Sites Programme 2000/2001; The Important Bird

Areas of Southern Africa; The Water Research Commission Report TT82/96 and personal interviews with ornithologists (Dr. Warwick Tarboton, Mr. John McAllister & Mr. Kotie Herholdt); representatives from SAPPI and MONDI and private land owners. The data sources and the types of data provided are summarised in Table 4.4.1.

Table 4.4.1 Data sources and type.

| Source | Type of Data |
|---|---|
| Avian Demography Unit (ADU), Cape Town | Bird Atlas Data: Quarter Degree Squares (QDSs) |
| Northern Flagship Institution | Computerised : QDSs & Latitude / Longitude |
| TOTAL Co-ordinated Waterbird Count (CWAC) Report 1992-97 (Taylor, Navarro, Wren-Sargent, Harrison & Kieswetter, 1999) | Waterbird locality data: Latitude/ Longitude |
| The Important Bird Areas of Southern Africa (Barnes, 1998) | Bird locality data: IBA Latitude/ Longitude |
| South African Crane Working Group (SACWG) | Locality & breeding data: Farms |
| Dr. Warwick Tarboton, John McAllister & Kotie Herholdt | Locality & breeding data: Farms |
| Mpumalanga Parks Board | Bird database: Farms & Point |
| Natural Heritage Programme Report 2000/2001 (du Preez, 2000) | Locality data: Farms |
| Water Research Commission Report TT82/96 (Schulze, 1997) | Agrohydrological data |
| Water Research Commission Report TT82/96 (Schulze, 1997) | Climatological data |
| MONDI, SAPPI & Private individuals | Locality data: Farms |

*Modelling and weighting*

All available data in the form of point localities, farm name localities, or QDSs were captured in digital form and imported into ArcView GIS (3.2a). Predicted distribution maps were produced for each species by overlaying existing distribution records with information on habitat requirements as collated from literature (Maclean 1993; Barnes 2000; Ginn, McIlleron, & Milstein, 1989; Harrison, Allan, Underhill, Herremans, Tree, Parker & Brown, 1997 and Steyn, 1989). Environmental variables such as mean annual precipitation, elevation, Acocks (1988) veld types, landcover, mean annual temperature, landscape morphology and wetlands were also taken into account. Table 4.4.2 summarises the environmental predictors used for modelling of distributions.

The status of each species was nationally assessed according to the IUCN Version 3.1 (2000a) Red List categories. Species afforded Critically Endangered or Endangered status and/or species with specific breeding habitat were given a weighting of 1, whilst birds assessed as Vulnerable or Near-Threatened and/or species with a broad foraging habitat, were allocated a weighting of 0.5. Table 4.4.3 lists the species and the assessed Red Data status and Weighting.

Table 4.4.2: Environmental predictors used to model distribution.

| Species | Data | Elevation (m) | Vegetation types (Acocks, 1988) / Landcover | Rainfall (mm) | Mean annual Temperature (°C) | Wetlands | Landscape Morphology |
|---|---|---|---|---|---|---|---|
| Whitewinged Flufftail | | > 1700 | | | | Palustrine wetlands | |
| Rudd's Lark | | >1670 | 54,56,57 | | | | |
| Yellowbreasted Pipit | | >1400 | 57,62,63 | | | | |
| Bald Ibis | Pb | | 57,62,63,64 | | | | |
| Botha's Lark | | 1550-2320 | Unimproved grasslands | | | | Dry undulating / flat afromontane<br>Moist undulating / flat afromontane<br>Dry undulating / flat highlands<br>Frost 31- 60 days per year |
| Wattled Crane | Pb + QDSs breeding | | | | | | |
| Blue Crane | Pb + QDSs breeding | | Untransformed grasslands | | | | |
| Grey Crowned Crane | Pb + QDSs breeding | | | | | | |
| Blue Swallow | | 800-1900 | Grasslands | >1000 | | | |
| Pinkthroated Twinspot | | <400 | Thicket & Bushland,<br>Forest & Woodland,<br>Degraded Thicket & Bushland,<br>Degraded Forest & Woodland | 650-1100 | | | |
| Chestnutbanded Plover | | | | | | Perennial & Non-perennial wetlands | |
| Striped Flufftail | | | Unimproved Grassland | >900 | | | |

Table 4.4.2 cont'd

| Species | Data | Elevation (m) | Vegetation types (Acocks, 1988) / Landcover | Rainfall (mm) | Mean annual Temperature (°C) | Wetlands | Landscape Morphology |
|---|---|---|---|---|---|---|---|
| Southern Ground Hornbill | | <1500 | Thicket & Bushland, Forest & Woodland, Degraded Thicket & Bushland Degraded Forest & Woodland, Forests, Unimproved Grasslands, Degraded unimproved Grasslands | | >15 | | |
| Blackrumped Buttonquail | | >300-<1800 | Grasslands | >800 | | | Dark saturated clay soils. Avoids marshy areas |
| Blue Korhaan | | | | | | | Moderately undulating plains Slightly undulating plains & pans Undulating hills and lowlands Slightly undulating plains Hills and lowlands Slightly irregular undulating plains Strongly undulating irregular land |
| Stanley's Bustard | | | 8,9,12,18,19,52-54,56,57,61-65 | | | | |
| African Marsh Harrier | | <2000 | | | | Permanent wetlands. Pans & non-perennial pans >100ha= breeding. Forage in all other | |
| Grass Owl | | | 8,12,48,52-57,61-65 | | | | |

Table 4.4.2 cont'd

| Species | Data | Elevation (m) | Vegetation types (Acocks, 1988) / Landcover | Rainfall (mm) | Mean annual Temperature (°C) | Wetlands | Landscape Morphology |
|---|---|---|---|---|---|---|---|
| Whitebellied Korhaan | | | 8,9,12,18,19,48,52-57,61-65 Forest & Woodland, Thicket & Bushland, Unimproved Grassland | | | | |
| Saddlebilled Stork | | *<800 | Lowland Bushland, Forest & Woodland | | | | |
| Lappetfaced Vulture | | | 1,3,13,14 Thicket and Bushland, Degraded Thicket & Bushland, Forest & Woodland | | +18 | | |
| Whiteheaded Vulture | | | 1,3,13,14 | | +19 | | |
| Bateleur | QDSs | | | | | | |
| Cape Vulture | Pb + QDSs | | | | | | |
| Martial Eagle | Pb + QDSs | | | | | | |
| Peregrine Falcon | Pb | | | | | | |
| Taita Falcon | Pb | | | | | | |

Pb: Point plus buffer: Wattled Crane - 10 km radius around all breeding farms past and present, 5 km radius on all sightings.
Blue Crane, Grey Crowned Crane & Bald Ibis - 2 km radius on all breeding farms.
Peregrine Falcon - 5km radius on all cliff sites and sighting localities.
Taita Falcon - 30km radius on nesting site and including Blyde River Canyon NR
Martial Eagle - 10km at previous breeding site

* Applicable for nesting sites

### 4.4.3 Results

**Whitewinged Flufftail** (*Sarothrura ayresi*):This critically endangered species is the rarest of African rallids and has a small, highly fragmented population in South Africa. Its habitat requirements are highly specific and it seems to be confined to high-altitude palustrine wetlands. Although there are no reliable breeding records, it is very likely that this species is resident in South Africa.

In Mpumalanga, it has so far only been recorded from palustrine wetlands above 1700m a.s.l.. The modelled distribution predicted a highly fragmented distribution extending in a narrow belt from the Steenkampsberg region in the north, southwards to the Wakkerstroom area and in the Chrissie Pans/Breyten/Carolina areas. Taylor (1997b) evaluated some of these pans and except for one site, rated all the others as insignificant for rallids. Modelling correlates well with current and high-potential centres of occurrence.

The total non-breeding population in South Africa was estimated at 235 individuals and the Mpumalanga population at 33 (Taylor 1997b), representing about 14 % of the national population. This number could increase slightly, due to two new records in the Steenkampsberg area. In Mpumalanga, Whitewinged Flufftails were recorded in three QDSs and are encountered on a regular basis at only two sites. In addition, two other sites, with potentially suitable habitat, have been identified by Taylor (1997b).

The Wakkerstroom Wetland Reserve, where birds are recorded regularly, offers full official protection. This reserve is situated in the proposed GBR IBA. The Middelpunt locality is privately protected and encompassed by the Steenkampsberg IBA. A single bird was recorded in 2001 at the Verloren Valei Provincial Nature Reserve (Krige, *pers. comm.*[16]). The wetlands north of Wakkerstroom are not officially protected, but are within the proposed GBR IBA and some are situated on farms registered as Natural Heritage Sites (NHSs).

According to Taylor in Barnes (2000), population numbers in Mpumalanga seem to be stable, however changing habitat conditions such as mismanagement of wetland habitats and variations in rainfall could influence population numbers.

The most severe threat is habitat loss and degradation in the form of wetland modification and destruction which includes actions such as; damming, draining, water abstraction, burning regimes (annual burning followed by intense spring grazing), commercial afforestation, overgrazing, trampling and disturbance (Taylor 1997a).

**Rudd's lark** (*Heteromirafra ruddi*)
This critically endangered, endemic species is a biome and range-restricted resident. The distribution is fragmented and restricted to high-altitude and montane grasslands in Acocks veld types (54), (56) and (57). Rudd's Lark is a selective grassland habitat specialist and is restricted in Mpumalanga to areas with a rainfall of between 800-1000 mm per year (p.a.) (Tarboton, Kemp & Kemp, 1987). It has been recorded from nine QDSs in the province where it prefers short grassland on level areas e.g. hill tops and ridges without rocks.

Modelling predicted the occurrence of this bird in three core, fragmented areas ranging in a relative narrow band from the Steenkampsberg region in the north to Carolina/Ermelo/Lothair in the centre and Wakkerstroom/Volksrust in the south. The

[16] F. Krige, Mpumalanga Parks Board, P/O Box 98, Dullstroom,1110.

Table 4.4.3: Summary of the Red Data Status and Weighting of priority bird species.

| Species | National Status: IUCN * | National Status: SARDB ** | Global Status IUCN *** | Weighting |
|---|---|---|---|---|
| Whitewinged Flufftail | CR C2a(i) | CR A2c; B1+2a,b,c,d+3a,b,c; C1; C2a | EN B1+2abcde | 1 |
| Rudd's Lark | CR A3c | CR A2c | CR A2c | 1 |
| Yellowbreasted Pipit | VU B1b(i,ii,iii,iv,v); C1 | VU A2c; B1+2c; C1 | VU A2c; B1+ 2abcde; C1 | 0.5 |
| Bald Ibis | VU C1 | VU A2c; C1; C2b | VU A2c, C1+2b | 0.5 |
| Botha's Lark | EN B2ab(i,ii,iii,iv,v) | EN A1c; A2c; B1+2c,d,e | EN A1c+2c, B1+2bcde | 1 |
| Wattled Crane | CR C2a | CR A2c; C1; C2a | VU A1ace+2cde | 1 |
| Blue Crane | VU | VU A1a,c,d,e; A2b,c | VU A1abcde +2bcde | 0.5 |
| Grey Crowned Crane | VU C1 | VU A1a,c; A2b,c; C1 | - | 0.5 |
| Blue Swallow | CR C2a(i) | CR A1c; A2b,c; C1; C2a | VU A1ce+2ce; C1+2b | 1.0 |
| Pinkthroated Twinspot | NT | NT C1 | - | 0.5 |
| Chestnutbanded Plover | NT | NT B1+3ab | - | 0.5 |
| Striped Flufftail | VU C1 | VU A1c; A2c; C1; C2a | - | 0.5 |
| Southern Ground Hornbill | VU C2a(i) | VU C1 | - | 0.5 |
| Blackrumped Buttonquail | EN B1ab(i,ii,iii,iv,v); D1 | EN C2a | - | 1 |
| Blue Korhaan | VU A2c | NT A2c | LR/nt | 0.5 |
| Stanley's Bustard | VU C1 | VU A1a,c; A2b,c; C1 | LR/nt | 0.5 |
| African Marsh Harrier | VU C1 | VU A1c; A2b,c; C1 | - | 0.5 |
| Grass Owl | VU B1b(i,ii,iii,iv,v); C1 | VU A2c; C1 | - | 0.5 |
| Whitebellied Korhaan | VU C1 | VU A1c; A2c; C1 | - | 0.5 |
| Saddlebilled Stork | CR C1; C2a(i) | C1 | - | 1 |
| Lappetfaced Vulture | EN C2a(i) | C1 | VU C1 | 1 |
| Whiteheaded Vulture | EN C2a(i) | C1 | - | 1 |
| Bateleur | VU C1 | A1a; A2b; C1 | - | 0.5 |
| Cape Vulture | VU C2b | A1acd;A2bcd; C1; C2b | VU A1acd+2bcd, C1+2b | 0.5 |
| Martial Eagle | VU C1 | A1a; C1 | - | 0.5 |
| Peregrine Falcon | VU C2a | C2a | - | 0.5 |
| Taita Falcon | LR/nt | - | LR/nt | 0.5 |

CR= Critically Endangered, EN= Endangered, VU=Vulnerable, NT=Near-Threatened, LR/nt=Lower Risk/near-threatened.

*National Status (IUCN): Version 3.1: IUCN (2000a)

**National Status (SARDB): SA Red Data Book (SARDB) (2000), Version 2.3 & 3.0

***Global Status: The 2000(b) IUCN Red List of Threatened species predicted distribution extended into the central part and the Belfast area. Rudd's Lark occurs in the proposed GBR IBA, in the Steenkampsberg IBA and on farms registered as NHSs. The Verloren Valei Nature Reserve (encompassed by the Steenkampsberg IBA) is the only officially protected area in the world, holding Rudd's Lark.

Habitat loss and/or fragmentation through conversion of suitable grassland to forestry and intensified agricultural practices, are serious threats to this species (Barnes, 2000). The Mpumalanga escarpment and Wakkerstroom districts have been designated as prime commercial afforestation areas. This is a major threat to Rudd's Lark populations in the province, especially in view of the fact that the core global population of this species is centred in Mpumalanga. Barnes (2000) suspects that more than 80% of this species' population may disappear in the next three generations as a result of afforestation, if no measures are taken to prevent further habitat loss. Other threats involving further habitat destruction and grassland fragmentation, are mismanagement practices e.g. serious overgrazing and trampling, burning regimes followed by intensive grazing and trampling and mining (Barnes & Tarboton 1998b; Barnes 2000).

**Yellowbreasted Pipit** (*Hemimacronyx chloris*)
This vulnerable, endemic species is biome and range-restricted, and a resident found in grasslands with altitudes ranging from 1400m to 2400m a.s.l. The distribution is scattered and fragmented. Altitudinal migration to lower altitudes can take place after breeding. The Yellowbreasted Pipit has specialised breeding habitat requirements, which are restricted to a certain range of altitudes and to flat or gently rolling lush montane to submontane grassland. This species has so far been recorded in 14 QDSs in Mpumalanga.

Modelling indicated a predicted distribution in a continuous range in mid to higher-altitude grasslands extending from the Steenkampsberg region, southwards through the northern part of the Usutu River Catchment down to Wakkerstroom and Volksrust. The northern and southern parts of the predicted occurrence overlap well with major strongholds for this species. Modelling increased the potential occurrence to the Ermelo/Breyten/Carolina areas.

This species is officially protected in the Verloren Valei Nature Reserve (situated in the Steenkampsberg IBA), as well as the Paardeplaats Nature Reserve encompassed by the proposed GBR IBA. The proposed GBR IBA possibly holds 10-30% of the global population (Barnes & Tarboton 1998b). Populations also occur on farms registered with the Natural Heritage Program and can possibly occur on the Jericho dam Nature Reserve.

Barnes (2000) noted that if habitat loss, transformation and further fragmentation continue at the current rate, population declines of over 20% could be expected over the next three generations. The greatest threats to prime breeding habitat and continued existence of the species include forestry, agricultural intensification and fire regimes (Barnes 2000). This species' breeding success is particularly threatened by a combination effect of intense grazing and repeated incorrect burning practices (Muchai 2000).

**Bald Ibis** (*Geronticus calvus*)
This species is categorised as vulnerable as it is biome-restricted and endemic to the region. The Bald Ibis occurs mainly in montane and submontane grasslands along the Mpumalanga escarpment. No migrational or altitudinal movements are known to occur. Their range and breeding habitat sometimes extend into woodland areas. The birds forage over a wide variety of habitats including natural, unburned grassland, recently burnt areas

and cultivated lands. They normally breed in mountainous areas on cliffs, but recent observations (W.R. Tarboton *in litt.*) revealed that some small populations also use trees for breeding (Barnes 2000).

A variety of grassland habitat types are utilised for foraging and breeding purposes. Modelling therefore predicted a widespread distribution over most of the highveld grassland areas, within the province. However the true distribution is subject to suitable foraging and breeding grounds. Most of the breeding localities currently known in the province, are centred along mountainous and escarpment regions.

Farms, on which breeding has been recorded, were buffered by a 2 km radius to protect the habitat in the immediate vicinity of colonies. Bald Ibis breeding colonies occur in the Blyde River Canyon Nature Reserve IBA and could possibly occur on the Paardeplaats Nature Reserve within the proposed GBR IBA. A number of breeding colonies occur on private land within the Steenkampsberg IBA and the proposed GBR IBA. Several privately owned farms, on which breeding colonies occur, are registered as NHSs.

A decline in population numbers of more than 20% over the next three generations has been estimated (Barnes 2000), if habitat loss continues unabated. Habitat loss and degradation through forestry, mining, human overpopulation, intensive crop farming and disturbance are major threats to the continued survival of the species (Barnes 2000). Alien vegetation blocking flight routes, may hamper movement and pose a severe threat to fledglings in particular. This could cause birds to abandon their prime breeding sites (Cohen, *pers. obs.*[17]). Alien vegetation may also make sites available to predators and could pose a fire hazard to nests (Herholdt, *pers. comm.*[18]).

**Botha's Lark** (*Spizocorys fringillaris*)
This species is an endemic resident to South Africa, globally endangered and is highly range and biome-restricted. Its distribution is patchy and falls mainly in the Vaal River Catchment within the Moist Clay Highveld Grassland vegetation type. The core of its range in South Africa is centred in the southern Mpumalanga Highveld and the eastern Free State. Twelve of the 17 QDS's in which Botha's Lark was recorded in South Africa, occur exclusively in Mpumalanga. Within its range, it is localised and occurs on plateaus or hilly slopes in sour grasslands. Local movements take place after breeding (Tarboton *et al.*, 1987). Botha's Lark prefers short, heavily grazed natural grassland areas but avoids rocky areas, tall grass stands, wetlands and transformed areas (Barnes, 2000; Herholdt & Grobler, 1987).

Predictive modelling increased the distribution to include almost the entire south-western part of the province. It further extended the potential distribution to north-east of Ermelo. Reasons for the birds not being recorded in the predicted range need to be investigated.

The specific grassland vegetation type, with which Botha's Lark is associated, is not protected in any conservation area and as a result no known breeding populations occur on a provincial reserve. The proposed GBR IBA as well as the Amersfoort-Bethal-Carolina district IBA hold breeding populations. The latter holds significant numbers of this species (Barnes & Tarboton 1998b).

---

[17] L. Cohen, P/Bag X 1088, Lydenburg, 1120
[18] J.J. Herholdt, P.O. Box 4321, Lydenburg, 1120

Botha's Lark habitat is severely fragmented and has been transformed by over 50% in the last three generations (Barnes 2000). It is one of the species that has lost up to 80% of its global range and numbers due to agricultural land transformation (Barnes 2000). Agriculture (maize) is a severe threat. Commercial afforestation activities in the Wakkerstroom district will have a serious negative impact on populations. Mining and management practices such as burning regimes followed by intensive grazing could affect breeding birds in their habitat (Barnes 2000). Mpumalanga plays a primary role in ensuring the survival of this species. Conservation strategies to sustain viable populations on private land should include effective land management practices based on the ecological requirements of this species.

**Wattled Crane** (*Bugeranus carunculatus*)
This species is normally resident, but young birds and non-breeders can be nomadic and move substantial distances and over large areas. In Mpumalanga it is restricted to highland marshes and wetlands (> 1500m a.s.l.) in high rainfall, montane grassland regions. Wattled Crane utilise wetland habitat for breeding (mainly in winter) and foraging, and are thus wetland-dependent. Breeding habitats are highly specialised as nesting takes place in permanently inundated wetlands with predominantly sedge-based vegetation (Meine & Archibald in Barnes 2000).

A population decline of 38% has taken place over the last 20 years (McCann, Burke, Rodwell, Steinacker & Seal 2001). In 1980 the estimated population size in South Africa was 380 and census data show that it has since then declined to 235 individuals in 2000 (McCann *et al.* 2001). Mpumalanga was reported to hold the second most important population in South Africa in the early 1980's (McCann in press). A tremendous reduction took place between 1986 and 1994 with the largest reduction occurring in Mpumalanga. Wattled Crane, which are critically endangered, have the lowest reproduction potential of all 15 Crane species. The Mpumalanga population currently consists of 21 individuals, which comprises about 9% of the national population.

To determine the predicted distribution all known breeding and former breeding localities were buffered to a 10 km radius, whilst sightings were buffered by 5 km. This highlights the protection of known breeding and feeding sites. Core breeding and foraging areas (historical & present) for breeding pairs and floater flocks in the province include the Steenkampsberg, Chrissie Pans and the proposed GBR IBAs and the Lothair area. These areas are vital for the survival of the species.

The Verloren Valei Nature Reserve is the only provincial reserve within Mpumalanga, which formally protects breeding Wattled Crane. This species has been recorded at Jericho Dam Nature Reserve (JDNR) (Tarboton 1983) and foraging birds could possibly occur at the Paardeplaats Nature Reserve.

Dam construction, wetland drainage, intensified agriculture, and industrialisation are the most significant activities that may cause the loss and degradation of wetland habitats. Undisturbed grassland areas, surrounding wetland breeding sites are required for foraging purposes. The transformation of these natural areas to forestry and agriculture is detrimental for Wattled Crane survival. Collisions with powerlines, poisoning, the international bird trade and annual burning around wetlands in winter, also threaten their existence (Mc Cann in Barnes 2000).

**Blue Crane** (*Anthropoides paradiseus*)

The Blue Crane is a near endemic to South Africa and restricted to grasslands. Of the 15 Crane species worldwide, Blue Cranes have the most restricted range. They are considered as partial migrants, as they move out of their breeding territories in winter.

In Mpumalanga, these birds occur in sour grassland areas used for natural grazing. They prefer open grassland or damp situations for breeding, but will utilise cultivated areas, if no natural habitat is available. Shallow, seasonal wetlands may also be utilised for nesting but these birds are not wetland-dependent.

Blue Cranes are found in most grassland veld types in Mpumalanga, therefore grasslands were used to predict their possible distribution. Modelling predicted their occurrence over almost the entire province, except for the north-eastern and north-western parts (bushveld and lowveld regions). The greatest concentration of breeding birds seem to be centred on private land within the Steenkampsberg, Amersfoort-Bethal-Carolina districts, Chrissie Pans and the GBR IBAs (Mc Cann in Barnes 2000). Other breeding sites are scattered over the remaining highveld grassland areas within the province. Farms with recorded nesting sites were buffered with a radius of 2 km to protect the immediate surrounding habitat.

Blue Cranes have been sighted at the Blyde River Canyon, Verloren Valei, Jericho Dam (Tarboton, 1983), Loskop Dam and the Paardeplaats Nature Reserves.

Johnson in Barnes (2000) reported that Mpumalanga, formerly regarded as a stronghold for this nationally vulnerable species, has suffered dramatic population declines of up to 80%. The national population has suffered a decline of 20% over the last three generations (McCann in Barnes 2000). Loss of natural grassland habitat through agriculture, commercial afforestation and mining have forced birds to inhabit cultivated areas, thus exposing them to agrochemical poisoning. Barnes (2000) mentioned that poisoning could be the single greatest threat to South Africa's Cranes. Other threats impacting negatively on populations include collisions with powerlines, trade with chicks and nest site disturbance (McCann in Barnes 2000).

**Grey Crowned Crane** (*Balearica regulorum*)
This species has been assessed as nationally vulnerable. Its distribution is restricted to high-altitude and higher rainfall areas. It is resident, but may undertake small-scale local movements (Ginn *et al.* 1989).

Breeding and feeding habitats include both wetlands and surrounding open grasslands. Nests are built over water in tall wetland vegetation in summer. Grey Crowned Cranes have adapted well to certain land-use practices and forage extensively in cultivated lands.

Farms with nesting sites were buffered by a 2 km radius, to protect suitable habitat in the immediate vicinity. Distribution centres in the province are concentrated on central high-altitude grassland areas, ranging in a narrow band from the Steenkampsberg region in the north to the south-eastern part of the province. This south-eastern region is the core area of occupancy for the Grey Crowned Crane.

The Wakkerstroom Wetland Reserve, within the proposed GBR IBA, officially protects breeding populations. Grey Crowned Cranes have been recorded at the Jericho Dam and Verloren Valei Nature Reserves and may occur at the Paardeplaats Nature Reserve. The

Steenkampsberg, Amersfoort-Bethal-Carolina districts, Chrissie Pans and the proposed GBR IBAs support significant numbers of birds (McCann in Barnes 2000).

McCann in Barnes (2000) estimated that at least 20% of the population in South Africa has been lost in the last three generations. Intensive farming practices e.g. damming and draining cause wetland alteration and degradation. Natural grasslands are also lost to agriculture and commercial afforestation (Johnsson and Meine & Archibald in Barnes 2000). Other serious threats include poisoning, collisions with powerlines, electrocution, trade with chicks and hunting with dogs (McCann in Barnes 2000).

**Blue Swallow**(*Hirundo atrocaerulea*)
The Blue Swallow is biome-restricted and endemic to Africa. This species is globally vulnerable and is listed as critically endangered in South Africa. It is a breeding migrant and arrives at its breeding grounds in September and departs in mid-April to overwintering grounds in the northern part (tropical areas) of its range. Breeding only occurs in the southern parts of their range. Blue Swallows in South Africa are restricted to the fragmented sour grassland patches within the Limpopo Province, Mpumalanga and KZN. A single population is located within Swaziland.

Habitat and nesting requirements for Blue Swallows are specific and in Mpumalanga they occupy scattered grassland patches with high-altitude and high rainfall areas (>1000 mm p.a.). They only breed in North-eastern Mountain Sourveld (Acocks veld type (8)) in Mpumalanga, and are found in the Graskop, Sabie and Kaapschehoop areas. The birds frequent open montane mistbelt grasslands for foraging purposes and require suitable nesting holes within these areas. Typical sites include riverbanks, dongas, antbear holes, disused mining and prospecting shafts and artificial holes.

Modelling predicted a highly fragmented and scattered distribution in a narrow belt, along the eastern Drakensberg escarpment, extending from the Blyde River Canyon Nature Reserve to the mountains south of Barberton. Potential distribution is furthermore predicted for a small area in and around the Paardeplaats Nature Reserve on the southern border of the province. In addition, these birds could potentially occur in Songimvelo Game Reserve.

New areas situated within suitable foraging and breeding habitat should be surveyed for Blue Swallows.

The national population is estimated to consist of less than 250 mature individuals and recent monitoring indicated that ± 27 breeding pairs are currently active in Mpumalanga. The meta-populations are highly fragmented.

Evans & Barnes in Barnes (2000) mentioned that the Blue Swallow has lost 80% of its sour grassland habitat in the last three generations. A small Blue Swallow population is protected in the Blyde River Canyon Nature Reserve. Certain grassland areas (containing breeding populations) within the Graskop Grassland IBA, are managed by the MPB. In order to improve the conservation status of the Graskop Grasslands, MPB has now motivated for the declaration of these areas as a Unique Community under the Mpumalanga Nature Conservation Act nr.10. of 1998. The Misty Mountain and Kaapschehoop Blue Swallow localities are registered as Natural Heritage Sites and are recognised as IBA's.

The primary threat to the already severely fragmented grassland patches, is further grassland destruction through commercial afforestation. Another looming threat of great concern at many of the Mpumalanga localities is mining. Tourism activities, development, informal human settlements, overgrazing and uncontrolled access cause disturbances to breeding birds and at nesting sites. Certain burning practices (under and excessive burning) of grasslands can influence the availability of food. Alien plant invasion can impact on foraging habitat and can lead to the inaccessibility and abandoning of nest sites.

**Pinkthroated Twinspot** (*Hypargos margaritatus*)
The Pinkthroated Twinspot is range-restricted and endemic to southern Africa. Its global range extends from Lake St. Lucia in KZN northwards along the coast through the east of Swaziland to the Save River in southern Mozambique. Its distribution in Mpumalanga is limited to the south-eastern corner of the Lowveld region where it inhabits dry mixed woodland, thickets and thorny scrub. Little else is known about this species.

The Pinkthroated Twinspot is formally protected in the extreme south-eastern part of the KNP. Modelling extended the known distribution northwards, up to the Olifants River in the KNP. This species could possibly also occur in the Mahushe Shongwe and Masibekela Nature Reserves and the Mawewe Cattle/Game Reserve. It is well presented in the protected area network in KZN, but appears to be uncommon in southern Mozambique. The density of the population within Mpumalanga is unknown.

Habitat destruction and degradation that include agricultural development (sugar cane farming etc.), human settlements and the cutting of trees, are some of the most severe threats to these birds. The cage-bird trade in Mozambique is a threat to the remaining populations in Mpumalanga.

**Chestnutbanded Plover** (*Charadrius pallidus*)
Two geographically isolated subspecies of this Plover occur in Africa. The nominate race is endemic to southern Africa and has a widespread but localised occurrence. The distribution in southern Africa includes the south and west coast, saline pans and the central panveld. In Mpumalanga, breeding has only been recorded at the Chrissie Pans Lake complex. Occasional vagrants have been recorded in the eastern Lowveld regions.

The seasonal patterns of movement are not well understood. Up to 60 birds have been recorded in the Lake Chrissie area. Modelling indicated potential distribution throughout the panveld complex of the southern Mpumalanga highveld. This species' breeding grounds in Mpumalanga, are situated within the Chrissie Pans IBA, but are not officially protected within the protected areas network.

The breeding and nonbreeding habitats of this Plover are threatened by habitat degradation and loss. The use of agrochemicals for crops surrounding endorheic pans can cause pollution of these wetland sites. Mismanagement i.e. ploughing, overgrazing and trampling) damages shorelines and the associated vegetation. Commercial afforestation practices around pans influence the water levels of these pans.

**Striped Flufftail** (*Sarothrura affinis*)
The nominate race of this uncommon resident, is endemic to South Africa and Swaziland. It ranges from the eastern escarpment in the Limpopo Province southwards through Mpumalanga into the montane grassland areas in Swaziland, the Drakensberg region in KZN and the eastern Cape and Cape coastal regions to Cape Town.

Striped Flufftails in Mpumalanga have been recorded from montane sourveld grasslands. They normally inhabit areas with good ground cover and grass stands 35-100cm tall (Taylor 1997a). Striped Flufftails can also occupy grass near forest edges, bracken-filled gullies or grassland with woody vegetation. Rocky areas and steep slopes are avoided. The species is often associated with drainage lines or small marshy areas within grasslands, but is not confined to wetland habitats or moist areas.

It is normally regarded as sedentary, but local altitudinal movements that are subject to the availability of food and cover, may occur.

Modelling predicted that the distribution could range southwards in a band from the Blyde River Canyon Nature Reserve through the Usutu River Catchment to Volksrust on the southern border of the province. Striped Flufftails were recorded from the Blyde River Canyon Nature Reserve and the Kaapschehoop Natural Heritage Site. It is also predicted that these birds could occur in the Ohrigstad Dam, Sterkspruit, Verloren Valei, Jericho Dam, Paardeplaats and Witbad Nature Reserves as well as the Songimvelo Game Reserve. This species may occur in six IBA's in the province.

Major threats include habitat degradation and loss through commercial afforestation, agricultural development and mismanagement in terms of burning regimes and grazing practices.

**Southern Ground Hornbill** (*Bucorvus leadbeateri*)
The distribution of this breeding resident in Mpumalanga is now mostly confined to the KNP and conservation areas bordering onto it. Historical records indicate a much wider distribution in the past than areas currently occupied.

This carnivorous species frequents savanna and woodland areas and make use of montane grassland areas and agricultural lands, for foraging. Social breeding groups can consist of 2-11 birds (averaging 3-5 individuals/group) and occupy territories as large as 100 $km^2$ (Kemp in Barnes 2000). According to Kemp in Barnes (2000), groups consist of a single dominant pair, which attempts to breed every 2.6 years. A single chick only fledges successfully every 9.3 years.

Although birds forage over a wide range, suitable nesting sites (large trees and cliffs) are essential for birds to reside in areas. The Southern Ground Hornbill can possibly occur in six other IBA's within Mpumalanga, but will not necessarily breed there.

Modelling significantly enlarged the extent of occurrence and probably gives a good indication of the species' previous range. It is predicted that this species could range throughout most of the savanna and adjacent grassland areas in the province as well as in the north-eastern and southern parts of the Usutu catchment area.

It has been reported that the population has declined more than 10% in the last three generations and the remaining national population was estimated to be 1500-2000 individuals (Kemp in Barnes 2000). It is on this basis that the Southern Ground Hornbill has been listed as vulnerable (Kemp in Barnes 2000).

Factors limiting the continued existence of this species outside conservation areas include the loss of suitable breeding and foraging habitat through land-use changes. These birds utilise a variety of habitats for feeding but requires specific sites to commence breeding.

Disturbance at nesting sites, the removal of large hollow trees (DBH >40cm), afforestation of grassland foraging habitat, poisoning and persecution due to broken window panes has led to population declines and range-retraction in the past and can be detrimental for the species' survival.

This species is used for traditional practices and seems to be in high demand for medicinal use. The Southern Ground Hornbill is regarded in South Africa, as the wildlife species of greatest conservation concern from a traditional medicinal use point of view (Kemp in Barnes 2000). The reproductivity rate is slow and affects the recovery rate after population declines. The Southern Ground Hornbill is a low-density species in South Africa, and according to Kemp in Barnes (2000) it is difficult to sustain viable populations even in large conservation areas.

Population numbers and the distribution range will not increase and extend outside conservation areas unless private landowners and government authorities take the initiative and implement conservation strategies and control methods to combat the existing threats.

**Blackrumped Buttonquail** (*Turnix hottentotta nana*)
The race *nana* of this endangered species is presently known to occur primarily in the Usutu region within Mpumalanga. This highly threatened species is poorly known and has small fragmented populations (Barnes 2000). It is very secretive and inhabits grassland and savanna, mainly in moist woodland belts. 212-584 birds have been estimated to occur in the13 IBAs of Mpumalanga, Free State and KwaZulu-Natal (Barnes 2000). Both QDSs, from the Usutu River Catchment, from which this species has been recorded, are outside of these IBAs. One reserve may possibly host this species.

In South Africa breeding occurs in quite sparse, dry S*porobolus* grass <1m tall with open patches, knee-high *Themeda* veld and moist *Themeda/Trachypogon/Aristida* grassland around coastal marshes (Barnes 2000).

The main threat to the Blackrumped Buttonquail is habitat loss through afforestation, overgrazing, trampling, human settlements and excessive burning (Barnes 2000).

**Blue Korhaan** (*Eupodotis caerulescens*)
This bird is a near endemic to South Africa (Barnes 2000). Its Red Data category has changed from previous ratings in the SARDB as neither rare nor vulnerable to a near–threatened species. It inhabits mainly grassland, karoo scrub and cultivated fields (Maclean 1993). The massive threat posed by the loss of grassland, (up to 20%), necessitates future monitoring (Allan in Barnes 2000). The south-eastern parts of Mpumalanga plays an important role in the conservation of this species. Its range seems to have declined in the east of its distribution (Barnes 2000).

Allan in Barnes (1998) suggested that the Blue Korhaan should be the only southern African *Eupodotis* species considered for immediate conservation concern because of its restricted range and the intensive human pressures on its typical grassland habitat.

**Stanley's Bustard** (*Neotis denhami*)
This species frequents grassland and fynbos habitat, and is widespread but uncommon. The current trend of habitat loss is set to continue, unless proactive conservation measures are taken (Barnes 2000). It has been assessed as Vulnerable due to a population estimate of <5000 individuals. There are probably less than 1000 pairs (Herholdt, *pers. comm.*).

The subspecies *stanleyi* is an isolated endemic species to South Africa, Swaziland and Lesotho (Barnes 2000). Barnes (2000) noted that its habitat is almost totally confined to areas with open, exposed, hilly sour grassland and a high-rainfall. During the breeding season they occur at elevations of less than 2000m a.s.l. The majority of the typical habitats of the central grassland region are important, and sightings were made in almost all of the representative QDSs. Chrissie Pans and the proposed Grassland Biosphere Reserve probably support some of the most important nesting sites. This species is sensitive to human activities when breeding and moves down to lower altitude areas in nonbreeding season (Herholdt, *pers. comm.*).
Suitable habitat for Stanley's Bustard is being altered at a dramatic rate. According to Barnes (2000) it is suspected that over 20% of this species' population has disappeared over the last three generations.

**African Marsh Harrier** (*Circus ranivorus*)
The African Marsh Harrier is an African endemic found mainly south of the equator. It prefers marshlands including expanses of wet grassland. Although it mainly requires an aquatic habitat, it also forages in surrounding drier areas (Steyn 1989). This harrier is widely but scarcely distributed and one of its main distribution areas is the highveld region of Mpumalanga (Barnes 2000). Barnes (2000) reports the existence of 3000-5000 breeding pairs.

Threats include the drainage of wetlands, afforestation and veldfires. Barnes (2000) noted the extinction of this species as a breeder in Lesotho. Its typical habitat has also been transformed over the last decades and has this poses a serious threat to the survival of this species. The nesting spots are vulnerability as these birds nest in reedbeds or in grasslands at ground level (Steyn 1989).

All wetland areas inside Mpumalanga are important foraging areas. Wetlands of sizes larger than 100ha are also important as possible nesting sites. Its distribution is highly fragmented and a decline of approximately 20% over the last three generations has been estimated (Barnes 2000).

**Grass Owl** (*Tyto capensis*)
The Grass Owl is endemic to Africa and has been assessed globally as Vulnerable due to an estimated population size of <5000 individuals. Its key habitat requirements are rank grassland and wetlands at altitudes below 2100m a.s.l. (Barnes 2000). Tarboton *et al.* (1987) reported the evacuation of this species in seasonal wetlands that have dried up. As a resident species it is often forced to move to new foraging areas due to veldfires destroying its habitat (Steyn 1989). Steyn (1989) also noted that it is less versatile in its choice of prey species than e.g. the Barn Owl due to its specific habitat preference. *Otomys* spp. (vlei rat) seems to be the most common prey species utilised (Steyn 1989). This species is poorly protected within the protected areas network.

Fourteen Acock's Veld Types were used to model the distribution of this species (Table 4.4.2). Although most of the Usutu River Catchment was shown to provide possible suitable habitat it occurs at low densities. Large areas are already transformed or have been degraded and this will almost certainly contribute to the loss of individuals.

The specific ecological requirements of the Grass Owl make this bird susceptible to a multitude of land-use changes in South Africa (Barnes 2000). It appears to have undergone local population reductions due to habitat loss and fragmentation. The disappearance of rank grassland and wetlands are some of the most serious threats. The locations of nests make them vulnerable to fires and grazing by domestic stock (Steyn 1989). It has been estimated that a population loss of at least 10% has occurred in the last three generations, and that further losses could occur in the future (Steyn 1989).

**Whitebellied Korhaan** (*Eupodotis cafra*)
Due to an estimated population number of <5000 individual, this species was assessed as Vulnerable. It appears to occur at altitudes below 2000m a.s.l. and inhabits mainly grassland and open thornveld. Habitat suitable for this korhaan has been altered at a dramatic rate and estimations of a 20% decline in area of occupancy has been observed over the last three generations (Barnes 2000). Barnes (2000) also noted that the populations are becoming highly fragmented and that a population decline of at least 20% will continue if no measures are taken.

The Whitebellied Korhaan occurs at very low densities, (Herholdt, *pers. comm.*). even in its strongholds. Severe population fragmentation, cultivation and afforestation seem to be the major threats.

**Saddlebilled Stork** (*Ephippiorhynchus senegalensis)*
With less than 150 mature individuals in South Africa this stork has been listed as Endangered. Mpumalanga is one of the strongholds for this species in South Africa and is mainly restricted to the eastern parts. In Mpumalanga the KNP is its main stronghold where 20-30 breeding pairs have been observed (Barnes 1998). In other areas its solitary nesting habits and low reproductive output impairs rapid recovery from population losses (Barnes 2000). It occurs primarily within riverine habitats where it favours tall trees for nesting (Harrison *et al.* 1997).

This species is dependent on aquatic habitats, favouring large rivers, freshwater wetlands and floodplains. Pairs are territorial and require large areas, especially during breeding season. It is a slow breeder and sensitive to river pollution and wetland destruction. Threats include upstream impoundments and afforestation.

**Lappetfaced Vulture** (*Torgos tracheliotos)*
The Lappedfaced vulture has a small regional population of less than 200 pairs and it is possible that there are less than 100 breeding pairs within South Africa (Herholdt 1997). This population has declined dramatically during the 20$^{th}$ century and will most probably show a further decline of 10% over the next three generations (Barnes, 2000). This species is highly susceptible to poisons. The demand in the muti industry is also responsible for massive losses to this species. It is extremely sensitive to disturbances near the nesting sites and mining activities close to these sites can impel these birds to abandon their nests (Steyn 1989). In southern Africa nests are built in the trees on top of a canopy (Steyn 1989).

In Mpumalanga it is confined to the Lowveld especially the KNP and surrounding conservation areas. It seems to favour areas with temperatures averaging above 18°C on an annual basis (Harrison *et al.*, 1997) and areas with lower rainfalls (Steyn 1989).

**Whiteheaded Vulture** (*Trigonoceps occipitalis)*
The Whiteheaded Vulture is confined to the Lowveld region within Mpumalanga's boundaries, which forms an important area for its survival. This species occurs in low numbers primarily within game reserves and favours broadleaved woodland. It nest on top

of tree canopies in open surroundings where they can observe the surrounding area (Steyn 1989).

This species has been assessed as Vulnerable as it has a restricted range within South Africa and a very small breeding population of approximately 120 pairs (Barnes 2000). Herholdt (1997) noted that this species is mainly confined to the KNP where only 9 to 30 active nests were counted each year from 1982-1993. It inhabits drier areas with an annual average temperature above 19°C (Harrison *et al.* 1997).
It is susceptible to poisoned baits associated with problem-animal control and for traditional medicine purposes and is sensitive to nest site disturbances. Up to 10% of its population has been lost in the last three generations (Barnes 2000). Other scavenging birds and the Bateleur may be dependent on this species in order to help them detect food. Other main threats are habitat loss and disturbance. Trampling and overgrazing of grazing land, which causes the disappearance of small mammals from such areas, can also cause the decline in numbers of these birds.

**Bateleur** (*Terathopius ecaudatus)*
The Lowveld region of Mpumalanga plays an important role in the survival of this species. It is mainly restricted to the KNP and neighbouring private nature reserves. It may have lost 20% of its regional population in the last three generations (Barnes 2000) and it has disappeared from 80 % of its former range in the old Transvaal (Steyn 1989). Tall *Acacia* spp. and *Diospyros mespiliformes* trees alongside watercourses seem to be their favourite breeding areas.

Habitat destruction and lack of carrion for juveniles human persecution in the form of shooting, poisoning and disturbances at the nests seems to be the most common threats (Steyn 1989). Pesticides in eggs also seem to have reduced the range and populations according to Barnes (2000). Furthermore it seems that the reduction of this species prey base, as a result of habitat transformation, may be one of the most important factors limiting its densities.

**Cape Vulture** (*Gyps coprotheres)*
This species is regarded as a vulnerable species within South Africa, Lesotho and Swaziland and is an endemic to southern Africa. A drastic decline in roosting and breeding sites from approximately 441 to 167 has occurred during the $20^{th}$ century, and is extinct as a breeding species in Swaziland. It has probably declined by up to 30% from 1986-1997 in the Former Transvaal (Barnes 2000). The Lowveld plays an important role in the conservation of this species, although they do occur elsewhere. A known locality from south-eastern Mpumalanga is the most south-western extreme of the distribution within the province. Mpumalanga serves mainly as a foraging area for this species (Herholdt, 1997). It utilises a wide habitat range for foraging but are mainly dependant on cliffs for breeding purposes (Barnes, 2000). It will also roost in tall trees and pylons.

Threats include food shortages, electrocutions, drowning, poisonings and disturbance at breeding and roosting sites. Land transformations reduce the amount of available habitat suitable for this species. A small breeding colony from the farm Vogelstruispoort, bordering Loskopdam Nature Reserve, has disappeared since 1981 (Herholdt 1997).

**Martial Eagle** (*Polemaetus bellicosus)*
This species has lost up to 20% of its regional population within the last three generations and the breeding population is estimated to be less than 600 pairs. 80-100 pairs have been

estimated to occur in the Kruger National Park. The Lowveld region is the stronghold of this species within Mpumalanga although it is seen sporadically in other areas. They hunt from heights of up to 6km (Steyn, 1989) and also make use of perches on top of tall trees from where they dive down to catch prey (Camacho, *pers. obs.* [19]). This species occurs over a wide range of habitat including open grassland to savanna and relies on large trees for nesting sites.

This vulnerable species will continue to decline unless proactive policies to change private landowner's attitudes towards this species are implemented. Its distribution range shows a drastic decline and it is probably one of the species with the lowest numbers in Africa (Herholdt, *pers. comm.*). Major threats include the reduction of its prey base as a result of habitat transformation, direct persecution by livestock owners, drowning and indirect poisoning (Barnes 2000). This eagle is the most frequently recorded as drowned especially from sheer walled reservoirs

A former breeding site near Ermelo was buffered with a 10km radius. The wide range of these birds, of approximately 130 $km^2$, suggests that only birds foraging and nesting in very large conservancies are adequately protected (Barnes 2000).

**Peregrine Falcon** (*Falco peregrinus minor)*
Although this species is widespread, it occurs in low numbers. In South Africa, Swaziland and Lesotho this species is represented by a sparse resident race *F. p. minor* and long-distance migrants from the paleartic *F. p. calidus* (Barnes, 2000).

Approximately ten known breeding sites occur on the Mpumalanga escarpment. For modelling purposes these and other cliff sites were buffered by a 5 km radius to include possible nesting sites. It is probable that more suitable breeding habitat can be found in the northern central parts of Mpumalanga.

Major threats include collisions with overhead powerlines and fences during hunting and pesticide contamination may reduce breeding performance (Barnes 2000).

**Taita Falcon** (*Falco fasciinucha)*
Only a single known breeding locality occurs within the province, which together with the Blyde River Canyon Nature Reserve was buffered to a radius of 30 km for modelling purposes. It favours sheer cliffs for breeding sites, and its competition with the larger Peregrine Falcon has been suggested as a possible reason for the rarity of this species (Steyn, 1989). This is also probably the southern most distribution of this species.

Collectors at nesting sites pose a major threat to this species.

### 4.4.4 Discussion

The Mpumalanga province sustains strongholds of several threatened grassland and wetland-dependent bird species, which are biome and/or range-restricted. High species richness occurs in the savanna biome, especially within the Lowveld region.

Certain bird species such as the Saddlebilled stork, Whiteheaded Vulture and Lappetfaced Vulture are dependent on the Lowveld region for survival within Mpumalanga. Five of the six Vulture species occurring in Mpumalanga are listed as Endangered, Vulnerable or Rare

---

[19] G. Camacho, P/Bag X 1088, Lydenburg, 1120

in South Africa (Herholdt, 1997). The Onderberg region, which includes areas such as the Mananga Mountains, is currently being transformed at a tremendous rate, mainly by the planting of sugarcane. Agricultural practices are responsible for a huge loss of suitable habitat.

Mortalities resulting directly or indirectly from human activities, such as deliberate poisoning, drowning in reservoirs, and collision with overhead powerlines are some of the major causes of Vulture mortalities (Herholdt, 1997). A total of 21 adult African Whitebacked Vultures were found poisoned on the farm Leeuspruit 385 JU in 1998 (Camacho, *pers. obs.*).

Savanna, grassland and wetland habitats in the province are under tremendous pressure due to land modification. Foremost amongst these are commercial afforestation, incompatible livestock and agricultural practices, wetland alteration, mining activities and human overpopulation. Commercial afforestation is probably the greatest threat to the grasslands and agricultural development and mining threaten the savanna. The Mpumalanga escarpment and Wakkerstroom district have been designated as prime commercial afforestation areas. Regions with the highest diversity of birds are also targeted as prime forestry areas (Allan, Harrison, Navarro, van Wilgen & Thompson, 1997). Habitat fragmentation severely impacts on species with specialised habitat and breeding requirements. The rate of grassland and savanna alteration is alarming and severely threatens the continual survival of resident endemic species as well as the species richness, respectively.

*Modelling and Data requirements*

The National Red Data assessments and the modelled distributions of priority species must be made available to ornithologists for comments and recommendations.

Primary source data were obtained from Bird Atlas records, which are available only on a broad scale (QDS) and dates back to 1992. The lack of representative point data complicated modelling and made it difficult to predict precise distributions. Ecological requirements were in most cases taken into consideration to predict occurrence. Current records are centred on more accessible and known areas of occurrence of particular species.

*Conservation requirements and Recommendations*

Ground surveying should be conducted in predicted areas of occurrence to determine whether threatened taxa occur there. Current point data of most of the species is insufficient and additional data needs to be obtained. Under-surveyed areas identified from this analysis need additional monitoring.

No continuous monitoring of Crane species in the northern part of the Usutu River Catchment takes place at this stage. The SACWG plan to set up a monitoring network for this area (Morrison, *pers. comm.*[20]). Historical and former breeding sites need to be visited in order to evaluate the status of particular breeding sites, and they need to be rehabilitated if possible.

Taylor (1997a) recommended full protection status to all known and predicted Whitewinged Flufftail sites as well as proper management of these wetlands. He

[20] K. Morrison, South African Crane Working Group, P/Bag X 11, Parkview, 2122

furthermore mentioned that annual censuses should be conducted to estimate population numbers and trends, and that intensive surveys be carried out to search for breeding sites.

Underhill in Barnes (2000) suggested the compilation of an inventory of breeding sites of the Chestnutbanded Plover for southern Africa. Important sites need to be identified and the protection thereof, motivated.

The Southern Ground Hornbill is a low density species and requires extensive areas for the maintenance of viable populations. Key sites need to be identified in the province for possible re-introduction, at a later stage.

The montane and submontane grasslands from Blyde River Canyon in the north to Wakkerstroom in the south, are areas of high conservation value in the province (Fig 4.4.1). Parts of the savanna region, outside the protected area network, have been degraded to such an extent, that they can no longer sustain certain large terrestrial bird and raptor species. The KNP and adjacent privately owned conservation areas, now play an important role in conserving these species. Most of the records of the selected species occur on privately owned land. The protection status of all the selected species need to be enhanced. For the purpose of maintaining biotic diversity, MPB must look decisively into the possibility of acquiring land that includes species-rich areas. If land cannot be physically acquired, implementation of co-operative conservation actions or simply, managing of land on behalf of other parties, will contribute towards a greater conservation effort in areas lacking conservation status.

It is clear that the Mpumalanga province hosts a large number of important bird species. It is also under severe threat of land transformation and fragmentation and grassland and wetland habitats are not sufficiently represented within the protected area network. Although the savanna biome is well represented in the protected area network, woodlands outside conservation areas are under constant and severe threat due to extensive human pressure.

### 4.4.5 Acknowledgements

This work formed part of a Provincial Biodiversity Database Project sponsored by the Department of Water Affairs and Forestry. Anthony Emery is thanked for helping with the modelling of species and Sandra Williamson for assisting in the capture of data, assessment of Red data status and proof reading of drafts. The Northern Flagship Institution and the ADU, Cape Town are thanked for making available computerised and Bird Atlas data respectively. Thanks to: Warren McCleland for giving advice, assistance and comment on the prioritisation and modelling of important species; Dr. Warwick Tarboton and Mr. John McAllister for assistance in prioritisation, and making available locality data; Kotie Herholdt for advice, assistance with prioritisation and proof reading; Steven Evans (BirdLife South Africa) for providing a list of bird species of conservation priority; SACWG for breeding & foraging data; Douglas Harebottle (ADU) for assistance with the prioritisation of species; Private individuals for providing relevant distributional information; SAPPI and MONDI for locality data.

### 4.4.6 References

Acocks, J.P.H. 1988. *Veld Types of South Africa*. Memoir no.57. 3rd Ed. Botanical Research Institute, Department of Agriculture and Water Supply, South Africa.

Allan, D.G., Harrison, J.A., Navarro, R.A., van Wilgen, B.W. & Thompson, M.W. 1997. The impact of commercial afforestation on bird populations in Mpumalanga province, South Africa – insights from bird-atlas data. *Biological Conservation 79: 173-185*.

Barnes, K.N. (ed.) 1998. *The Important Bird Areas of southern Africa*. Johannesburg: BirdLife South Africa.

Barnes, K.N. (ed.). 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*, BirdLife South Africa, Johannesburg.

Barnes, K.N. & Tarboton, W.R. 1998b. Important Bird Areas of Mpumalanga. In: The Important Bird Areas of southern Africa. Barnes, K.N. (ed.). Johannesburg: *Birdlife South Africa. pp. 65-86*.

Du Preez, C. 2000. *South African Natural Heritage Programme. Annual Report 2000/2001*. Department of Environmental Affairs & Tourism. Midrand.

Ginn, P.J., McIlleron, W.G., & Milstein, P.le S. (eds.). 1989. *The complete book of southern African birds*. Cape Town: Struik Winchester.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. *The Atlas of Southern African Birds*. 2 vol. Birdlife South Africa, Johannesburg.

Herholdt, J.J. & Grobler, N.J. 1987. Field notes on the identification of Botha's Lark, Pinkbilled Lark and Rudd's Lark in the Orange Free State, with notes on their habitat. *Mirafra 4(3): 61-62*.

Herholdt, J.J. 1997. The Status and Conservation of Vultures in the Mpumalanga Province, South Africa. *Proc. of a Workshop on Vultures Res. & Cons. In sthrn Afr. pp. 13-20*.

IUCN. 2000a. *IUCN Red list Categories*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland.

IUCN. 2000b. *IUCN Red list of Threatened Species*.

Maclean, G.L. 1993. *Roberts' birds of southern Africa*. 6th Ed. Cape Town: John Voelcker Bird Book Fund.

Mc Cann, K., Burke, A., Rodwell, L., Steinacker, M & Seal, U.S. (eds.). 2001. *Population and Habitat Viability Assessment for the Wattled Crane (Bugeranus carunculatus) in South Africa*. Final Report from the Workshop held 31 July - 2 August 2000 in Wakkerstroom, South Africa.

Muchai, M. 2000. Grasveldvoëls projek. *INDABA INYONI* 3(4): 28

Schulze, R.E. 1997. South African Atlas of Agrohydrology and -Climatology. Water Research Commission, Pretoria, Report TT82/96.

Steyn, P. 1989. Birds of Prey of Southern Africa. Creda Press (Pty) Ltd, Cape Town.

Tarboton, W.R. 1983. Bird Checklists for Transvaal Provincial Nature Reserves. Project TN 6/4/4/9: A survey of threatened Transvaal bird species.

Tarboton, W.R., Kemp, M.I. & Kemp, A.C. 1987. Birds of the Transvaal. Gutenberg Book Printers, Pretoria.

Taylor, P.B. 1997a. *The status and conservation of rallids in South Africa: results of a wetland survey in 1995/96*. ADU Research Report No.23. Avian Demography Unit, University of Cape Town.

Taylor, P.B. 1997b. *South African palustrine wetlands: the results of a survey in summer 1995/96.* ADU Research Report No.24. Avian Demography Unit, University of Cape Town.

Taylor, P.B., Navarro, R.A., Wren-Sargent, M., Harrison, J.A. & Kieswetter, S. L. 1999. TOTAL CWAC report: Co-ordinated Waterbird Counts in South Africa, 1992-97. Cape Town: Avian Demography Unit, University of Cape Town.

## 4.5 Amphibians

Contributor: J.Theron

### 4.5.1. Introduction

Amphibian surveys by Jacobsen (1989), as well as recent and current surveys suggest that 51 species of amphibians currently occur in the Province of Mpumalanga. The present study concentrated mainly on Red Data species and species that are threatened or have relatively restricted distributions.

Eight species are considered as important for setting conservation priorities. In Mpumalanga: *Bufo gariepensis nubicolus* (Karroo toad), *Heleophryne natalensis* (Natal Ghost Frog), *Hemisus guttatus* (Spotted shovel-nosed Frog), *Hyperolius semidiscus* (Yellow-striped Reed Frog); *Strongylopus wageri* (Plain Stream Frog), Giant Bullfrog (*Pycicephalus adspersus*), Greater Leaf-folding Frog (*Afrixalis fornasinii*) and Whistling Rain Frog (Breviceps sp. nov.).

### 4.5.2. Methods

Localities listed in Jacobsen (1989), Transvaal Museum records and more recent surveys by several herpetologists, were checked and captured on an Amphibian Species Database. Where no GPS readings were available, as in the case of the older records, the data was captured either as a farm locality or at the quarter degree square level (QDS). The habitat requirements i.e. vegetation type, altitude, wetland type, and general habitat as reported by Jacobsen (1989), Lambiris (1989) and Passmore and Carruthers (1995) were also recorded. The localities were imported into ArcView GIS (3.2) and mapped. The resulting maps were overlaid with environmental variables in order to predict the broadest possible distribution for each species. These variables included Acocks vegetation types, elevation, mean annual precipitation, seasonal or perennial streams and rivers, slope and land-cover classes. Resulting distributions were also used to determine the conservation areas that could include these amphibians. The conservation status of the eight species was assessed according to the IUCN 3.1 Red List Categories (IUCN 2000). Each species was then given an importance weighting based on the IUCN category assigned. Species assessed as Endangered were assigned a rating of 1 and species assessed as Vulnerable and Near Threatened were assigned a rating of 0.5.

### 4.5.3. Results

4.5.3.1 Species descriptions

**Karroo toad (*Bufo gariepensis nubicolus* Hewitt, 1927)**

Within its broad distribution this subspecies occurs in open short, sparse grasslands, stony or flat rocky areas at altitudes of 2300 to over 3000 m in KwaZulu-Natal (Lambiris, 1989) and 1800 to 2300 m in Mpumalanga (Jacobsen, 1989). They are found under clumps of vegetation or under stones some distance away from water, in swampy areas and even in burrows of other animals (Jacobsen1989). The preferred breeding habitat is rain-filled depressions with emergent grassy vegetation, around which egg strings are entwined (Lambiris, 1998).

The predicted distribution of *Bufo gariepensis nubicolus* in Mpumalanga was determined using the elevation of 1800 to over 2 300 m and mean annual rainfall of more than 750 mm. It is predicted that this species is restricted to the high altitude montane grasslands in the south-eastern part of the province around Wakkerstroom to the Mt Anderson area, and the Steenkampsberg region.

The subspecies has a very limited distribution in Mpumalanga, and habitat alteration by agricultural practices and afforestation could threaten its survival. It has been recorded in three provincial nature reserves, but its conservation status is by no means secure. During recent surveys in Mpumalanga this species was not found and its population size is unknown. The taxonomic status of this subspecies is uncertain and needs clarification (Jacobsen 1989). Detailed surveys to determine current distribution and population density are required.

**Natal Ghost Frog (*Heleophryne natalensis* Hewitt, 1913)**
The typical habitat of the species is fast-flowing perennial mountain streams in dark kloofs with dense riparian vegetation. The breeding habitat appears to be clear streams flowing rapidly over rocky substrates. The larval stage covers at least two seasons, but the eggs of this species have never been found and the oviposition site is unknown (Lambiris 1989, Passmore and Carruthers 1995).

The predicted distribution of the Natal Ghost Frog was determined using montane forests, perennial streams and altitude. ArcView GIS maps of selected perennial streams were overlayed with forests, buffered to a 2 km radius, and clipped to an altitude of 800 m above sea level. It is predicted that in Mpumalanga this species is restricted to the relic montane forests of south-eastern Mpumalanga, mountains of the Elands River Valley, the Barberton Mountains and the Mpumalanga Escarpment.

This elusive species has a disjunct distribution due to specific habitat requirements and limited habitat availability. It is generally accepted that the tadpoles of *Heleophryne* spend at least two seasons in the rivers and streams before metamorphosing and the genus is therefore prevented from colonising non-perennial streams (Boycott 1988). In suitable habitats the population densities appear to be high, judging by the number of larvae observed. The tadpole stage is, however, vulnerable to afforestation and uncontrolled water abstraction. These activities could change perennial streams to seasonal streams, which would threaten the survival of the species. Although the species occurs in three provincial nature reserves namely, Blyde River Canyon Nature Reserve, Songimvelo Nature Reserve and Paardeplaats Nature Reserve, further conservation actions are still necessary due to the above-mentioned potential threats.

**Spotted Shovel-nosed Frog (*Hemisus guttatus* Rapp, 1842)**
The only record of this elusive species in Mpumalanga was from Piet Retief, collected in 1964 by Poynton (Jacobsen 1989). This record was confirmed in November 2000 when individuals of this species were observed at two localities near Piet Retief (Theron and Braack 2001).

Lambiris (1989) describes the habitat of *Hemisus guttatus* as open grassy areas or wooded grassland and it is usually found in burrows or under stones. The breeding habitat appears to be underground chambers near water. The breeding biology of the species is still not fully understood.

The predicted distribution of the species was determined using an elevation of less than 1400m a.s.l. and Acocks veldtypes 63 and 64. It is predicted that in Mpumalanga the species is restricted to an area extending from Piet Retief, through the Usutu Catchment to the Carolina-Badplaas region. This species has not been recorded from any of the protected areas of the province. The predicted distribution suggests that it could occur in the Songimvelo Nature Reserve.

As much of the area around Piet Retief has been extensively afforested, serious conservation efforts are needed for the survival of this species in that area. The revised Red Data List for South African Amphibians classified *Hemisus guttatus* as Near threatened (Harrison and Burger 2000). More detailed surveys are urgently needed to determine the true distribution and to ensure the conservation of the species in Mpumalanga. It is recommended that private or state landowners are made aware of the status of the species, and their help in conservation efforts be elicited.

**Plain Stream Frog (*Strongylopus wageri* Wager, 1961)**
The first distribution records for Mpumalanga were made in November 2000, when individuals of this species were observed at two localities between Piet Retief and Wakkerstroom (Theron and Braack 2001). These specimens were found in streams and small wetlands in grassland.

The species was previously only known from streams and rivers from the foothills and high slopes of the Natal Drakensberg Mountains. It also occurs in forested streams at lower altitudes and in grassland on the escarpment (Lambiris 1989, Passmore and Carruthers, 1995, Channing 1998). Wager (1965) and Channing (1998) reported that the species breeds during autumn and the cold, dry winter months. However, in Mpumalanga calls were heard, and eggs and tadpoles found in November, which suggests that the species could breed all year (Theron and Braack 2001).

ArcView GIS was used to overlay elevation data (> 1200 m a.s.l.), Acocks veldtypes nos. 8, 57, 62, 63, 64 and mean annual rainfall of more than 720 mm with the known distribution of this species. The resulting predicted distribution of the species includes the montane grasslands from south-eastern Mpumalanga and the Blyde River Canyon Nature Reserve in the north. The species has not been recorded within any protected areas in the province, but it is predicted that it should occur in eight provincial nature reserves. Although the predicted distribution of the species covers quite a large area, detailed surveys are necessary to determine the true distribution of the species. Current data is insufficient and can not be used to determine the true conservation status of the species. It is recommended that landowners with suitable habitat become involved in the protection of the habitat of this species.

**Yellow-striped Reed Frog (*Hyperolius semidiscus* Hewitt 1927)**
The species occurs and breeds along rivers and pans with moderately deep water and emergent reeds and bulrushes on the banks (Lambiris 1989, Passmore and Carruthers 1995). Lambiris (1989) mentions that the species is generally restricted to lowland areas, but this is not the case in Mpumalanga.

The predicted distribution of the species was determined using an elevation of 950 m to 1700 m a.s.l., Acocks veld types nos. 57, 62, 63 and 64 and mean annual precipitation of more than 750 mm. It is predicted that in Mpumalanga the species is almost entirely restricted to the Usutu Catchment, with a predicted marginal occurrence just outside the northern boundary of the study area.

The species has been recorded in only one provincial nature reserve, namely Songimvelo Nature Reserve. Although Jacobsen (1989) reported Jericho Dam as a locality for the species, it appears to occur outside the nature reserve. It is predicted that the taxon should occur in the Paardeplaats Nature Reserve, Jericho Dam Nature Reserve and Witbad Nature Reserve. Recent surveys have found only a few localities with low breeding densities. Outside of protected areas, the habitat of the species is threatened or degraded by afforestation and agricultural practices and effective conservation actions are required to ensure its survival within the province.

**Giant Bullfrog (*Pycicephalus adspersus* Tschudi 1838)**
As the largest southern African frog, it spends most of the year underground encased in a transparent cocoon, emerging only after heavy thunderstorms in summer. The Bullfrog breeds in shallow, temporary rain-filled pans and small wetlands in grassland and savanna (Passmore and Carruthers 1995), as well as in the Great Karroo (SAFAP). Although the species occurs widespread in southern Africa (Lambiris 1988), the populations in Mpumalanga are threatened by habitat degradation and fragmentation.

The predicted distribution of *P. adspersus* was determined using environmental variables such as elevation (800 to 1700 m a.s.l.) and mean annual rainfall of less than 750 mm. It is absent from high lying areas with high rainfall. In Mpumalanga the species occurs in Acocks Veld Types Nos. 12, 18, 19, 48, 52, 53, 55, 57 and 61. These habitats are estimated to be more than 40% transformed. Loskopdam Nature Reserve is the only provincial protected reserve where the Giant Bullfrog was recorded (Jacobsen et al 1986). For this reason the species is considered vulnerable in the Province.

**Greater Leaf-folding Frog (*Afrixalis fornasinii* Biaconi 1849)**
The species breeds in marginal vegetation of swamps, streams and dams. Nests are made by enclosing eggs within a folded leaf above water level (Passmore and Carruthers 1995).

Previously it was thought that the South African distribution of the species was confined to the coast of Kwa-zulu Natal. However, an inland population was very recently recorded near Komatipoort in Mpumalanga (Theron and Braack 2001).

Using ArcView modelling, it is predicted that the species should occur at an elevation of less than 400 m above sea level and in Acocks Veldtype No. 10. The habitat where the population was recorded is severely transformed by sugar cane farming. To such an extent that currently their only refuge is a small stream which flows though sugar cane fields.

It only occurs outside nature reserves and national parks. Acocks Veld type no. 10 is 28% transformed and degraded. Since 1995 there is a huge increase in crop farming and bush clearing within this area and is a serious threat to the survival of this isolated population. Although the species occurs elsewhere in southern Africa, it has a very restricted distribution in Mpumalanga and this marginal population should be protected.

**Whistling Rain Frog (*Breviceps* sp. nov.)**
The species occurs in forests and open woodlands in Kwa-zulu Natal, Swaziland and in the Komatipoort area in Mpumalanga. Members of this genus are terrestrial and the eggs are laid in underground nests. The larval stage is passed within the egg mass and metamorphosed froglets emerge from the nest (Passmore and Carruthers 1995).

The predicted distribution of the Whistling Rain Frog was determined using altitude and soil type. It is predicted that this species is restricted to Acocks Veld Type No. 10 with the clay/loam soil types no. 6, 7, 8 and 9 at elevations of less than 400 m above sea level. The species was recorded in only two localities in the Komatipoort area and both are outside provincial and national protected areas. Very little is known about the biology of this genus and a detailed survey of the true distribution of this species in Mpumalanga is necessary. The species occurs in Veld Type No.10 and the habitat degradation and threats are as for the Greater Leaf-folding Frog.

4.5.3.2 IUCN Ratings

The species were assigned an IUCN category based on their distributions and the fact that the eight species are threatened due to a decline in quality of habitat and the resulting fragmentation of populations. The IUCN categories assigned are presented in Table 4.5.1.

Table 4.5.1 List of amphibians with appropriate IUCN rating (IUCN 2000) and importance weightings

| Amphibian Species | IUCN category | Weighting |
|---|---|---|
| *Bufo gariepensis nubicolus* | VU A2c D2 | 0.5 |
| *Heleophryne natalensis* | VU A2c D2 | 0.5 |
| *Hemisus guttatus* | VU A2c D2 | 0.5 |
| *Hyperolius semidiscus* | VU A2c D2 | 0.5 |
| *Strongylopus wageri* | VU A2c D2 | 0.5 |
| *Pyxicephalus adspersus* | VU A2cd | 0.5 |
| *Afrixalus fornasinii* | VU A2c D2 | 0.5 |
| *Breviceps* sp. nov. | VU A2c D2 | 0.5 |

**4.5.4 Discussion**

This study has highlighted most of the Usutu River Catchment and small areas along the Mpumalanga escarpment as important for the conservation of threatened Amphibian species (Fig 4.5.1). None of the species discussed are endemic to Mpumalanga Province. However, the same environmental variables that determine the distribution patterns of these species, are also those factors that cause genetic isolation between populations. It is important to note that geographically distinct populations may differ genetically from the main population. If the objective is the conservation and maintenance of unique genetic variants in populations, the emphasis should be to conserve the species including these allopatric populations. The genetic diversity needed for the resilience of the species may reside in marginal populations.

The amphibian populations in Mpumalanga are faced with several environmental threats. Habitat destruction and alien vegetation resulting in fragmentation of populations is probably the major threats facing all frog species. Forestry and agriculture have already resulted in the rapid destruction and fragmentation of the habitat of populations of the species discussed here. Overgrazing and severe fires in the grassland catchment areas result in extensive silting up of streams and wetlands, threatening the breeding habitat of these frogs. The tadpoles of *Heleophryne natalensis,* which occur in clear, fast flowing streams, are particularly threatened by these factors.

The biphasic life cycle of most frogs, as well as their semi-permeable skin makes them particularly vulnerable to pollutants and other environmental stresses. Consequently frogs can be used as environmental biomonitors to indicate the quality of the environment. Chemical pollution and acidification constitute a major threat to frog populations. Heavy metals such as aluminium, cadmium, copper, zinc and iron are all toxic to amphibians. It can be inferred from studies on fish that nickel, lead and manganese will also have deleterious effects on frog populations (Bishop 1996).

Herbicides and pesticides often cause developmental abnormalities or mortalities. A recent report has shown that widely used and apparently safe herbicides containing the active ingredient glyphosphate are extremely toxic to tadpoles and frogs (Bishop 1996). These herbicides are widely used in plantations, as well as in nature reserves for alien plant control and the making of firebreaks.

Another threat to the continued survival of these frog species, is the damming of rivers, streams and wetlands. In many cases this action is followed by the introduction of alien fish species, with their associated parasites, for angling purposes in these dams. The preferred breeding habitat of five of the species discussed is natural, shallow, ephemeral pools and streams in palustrine wetlands. Deeper man-made dams and weirs alter and shrink the breeding habitat of these frogs considerably. Invasive predator fish species may also be a threat to the survival of the species.

The following conservation requirements and recommendations are suggested:

- Detailed surveys are necessary to determine precise geographical co-ordinates of amphibian populations.
- The conservation importance and habitat requirements of these populations should be made known to the appropriate landowners.
- Landowners and communities who are dependent on sensitive aquatic ecosystems need to be made aware that frogs are important bio-indicators of the health of these systems.
- Monitoring programs must be drawn up and the known populations and their habitats should be monitored annually.
- Guidelines for amphibian habitat conservation and management must be drawn up and made available to private or state landowners including mining industries, timber companies and crop/ livestock farmers.

### 4.5.5 Acknowledgements

Thanks are due to Johan Engelbrecht and Koos de Wet of the Mpumalanga Parks Board for their continued support and interest in the Amphibian Project and to Harold Braack who was part of many field trips.

### 4.5.6 References

Acocks, J.P.H. 1975. Veld types of South Africa. *Mem. Bot. Surv. S. Afr.* 40: 1-128

Bishop, P. 1996. *Arena: Friends in Low Places*, Vol.3 No. 8. TA Publications, University of the Witwatersrand, Private Bag 3, WITS, 2050.

Boycott, R. C. 1988. Description of a new species of *Heleophryne* Sclater, 1899 from the Cape Province, South Africa (Anura: Heleophrynidae). Ann. Cape Prov. Mus. (nat. Hist.).Vol.16 Part 11, 30 May 1988.

Channing, Alan. 1998.Montane Frogs: Frogs and Frog Atlassing in Southern Africa. Harrison, J.A. and Burger, M. (eds.) Avian Demography Unit, University of Cape Town, Rondebosch, 7701.

Harrison, J.A. and Burger M. 2000. SAFAP News 4. Avian Demography Unit, University of Cape Town, Rondebosch. 7701

IUCN 2000 *IUCN Red List Categories*. IUCN Species Survival Commission. Gland, Switzerland

Jacobsen, N.H.G. 1989. *A Herpetological Survey of the Transvaal*. Ph.D. Thesis, University of Pretoria.

Lambiris, A.J.L. 1989. *A Review of the Amphibians of Natal*. Lammergeyer 39, April 1989, 1-212

Passmore, N.I. and Carruthers, V.C. 1995. *South African Frogs. A Complete Guide*. Witwatersrand University Press, Johannesburg, Private Bag 3, WITS 2050.

SAFAP. South African Frog atlas Project. Avian Demography Unit, University of Cape Town.

Theron, J. and Braack, H.H, 2001. *An Amphibian Survey of Mpumalanga*. In prep.

Wager, V.A. 1965.A Guide to the South African Frogs. Second Edition. Wild Life Protection and Conservation Society of South Africa, Durban.

## 4.6 Reptiles

Contributors: S. Williamson and G. Theron

### 4.6.1 Introduction

Most current knowledge of the reptiles of Mpumalanga is based on a survey done by N.H.G. Jacobsen (1989) providing a detailed account of all reptiles in the then Transvaal province. This survey resulted in descriptions of life histories, habitat requirements and conservation status and maps of the known distributions. Jacobsen's (1989) survey revealed that 154 reptiles occur in the Mpumalanga Province and of these, 86 species are threatened. However, many of these threatened reptiles have relatively wide distributions and thus this study was restricted to Red Data species and species that are largely restricted to Mpumalanga.

Of the 15 reptile species considered for this study, 4 have been recorded exclusively from Mpumalanga. These are Haacke's flat gecko (*Afroedura haackei*), Mariepskop flat gecko (*Afroedura* sp. nov.), Rondavel flat gecko (*Afroedura* sp. nov.) and Wilhelm's flat lizard (*Platysaurus wilhelmi*). Other species considered in this study were: Abel Erasmus Pass flat gecko (*Afroedura* sp. nov.), Forest/Natal purpleglossed snake (*Amblyodipsas concolor*), Lowveld shieldnosed snake (*Aspidelaps scutatus intermedius*), dwarf chameleon (*Bradypodion transvaalense* complex), Sungazer/ Giant girdled lizard (*Cordylus giganteus*), Barberton girdled lizard (*Cordylus warreni barbertonensis*), Lebombo girdled lizard (*Cordylus warreni warreni*), Swazi rock snake (*Lamprophis swazicus*), Transvaal flat lizard (*Platysaurus orientalis orientalis*), Montane burrowing skink (*Scelotes mirus*), Breyer's longtailed seps/ Breyer's plated lizard (*Tetradactylus breyeri*). These species are also found in other provinces of South Africa. Of these, only four are listed in the Red Data Book (Branch 1988). The Swazi rock snake and Breyer's longtailed seps are listed as Rare, the Sungazer is listed as Vulnerable and Haacke's flat gecko as Restricted.

The aim of this part of the study was to use these species to indicate priority areas in Mpumalanga for the conservation of reptiles.

### 4.6.2 Methods

4.6.2.1 Distributions

Species that have relatively restricted distributions and known to be threatened were included in this study because they are more reliant on conservation action for their long-term survival in Mpumalanga.

Localities listed in Jacobsen's (1989) survey and sightings by herpetologists were checked and captured on a Reptile Species Database. As there were few GPS records available, most of the records were captured either as a farm locality or a grid locality (referring to the Quarter Degree Square in which the species occurred). The habitat requirements (i.e. vegetation type, altitude and general habitat), as reported by Jacobsen (1989) and Branch (1998) were also recorded. The localities were imported into ArcView GIS and mapped. The resulting maps were overlaid with the relevant environmental variables in order to predict the broadest distribution possible for each species. These variables included Acocks' (1975) vegetation types or Low and Rebelo (1996) vegetation types, elevation, median annual precipitation, slope and land-cover. The resulting distributions were also used to determine the conservation areas that possibly include these reptiles.

4.6.2.2 IUCN ratings

The reptile species were assessed according to IUCN version 3.1(2000) categories. Species endemic to Mpumalanga were assessed on a global basis and those also found in other province were assessed on a regional basis for the Mpumalanga province according to the guidelines in Gärdenfors *et. al.* (1999). An importance rating based on the resulting IUCN categories was then assigned to each species. Species assessed as Endangered were assigned a rating of 1 and species assessed as Vulnerable and Near Threatened were assigned a rating of 0.5.

### 4.6.3 Results

4.6.3.1 Distributions

**Haacke's flat gecko** (*Afroedura haackei*) RDB (1988) – Restricted

This small to medium sized gecko has only been recorded from a small area north-east of Barberton, which is represented by Acocks' veld type 10. It is also restricted to elevations of 500 - 1000 ma.s.l. (Jacobsen 1989) and to areas with a mean annual precipitation of 700 - 1000mm. These geckos shelter in crevices formed by exfoliating rocks on steep slopes with shallow soils. These habitat requirements were overlayed with the known distribution to determine the widest possible distribution. This resulted in a disjunct distribution from Barberton to Nelspruit and eastward to the western KNP south of the Sabie River. This species could be locally common in areas of suitable habitat but it is influenced by the removal of vegetation around the rocky outcrops by grazing, burning and woodcutting (Jacobsen 1989).

It has been recorded from the KNP (Branch 1988) and occurs within the Crocodilepoort Conservancy. The modelled distribution predicts that it could also occur in the Mthethomusha, Barberton Mountainlands and the Barberton Nature Reserves.

**Abel Erasmus Pass flat gecko** (*Afroedura sp. nov.*)

This species has been recorded from the area around the Abel Erasmus Pass in the Northern Province and from Bourke's Luck (Blyde River Nature Reserve) in Mpumalanga. In these areas it only occurs in Acocks' veld type 8 and is restricted to elevations of 850 – 1900masl. These variables were overlayed with unimproved grasslands from the Landcover Database (Thompson 1996) and then with geology (Vbr – Boshoek quartzite) to model the possible distribution.

The resulting distribution is a narrow band extending north-south through the Blyde River Nature Reserve. In these areas it would be found under flakes of exfoliating rock along cliff faces and along rocky outcrops on top of cliffs (Jacobsen 1989).

**Mariepskop flat gecko** (*Afroedura sp. nov.*)

This species has only been recorded from Mariepskop and God's Window within the Blyde River Nature Reserve. It is known to inhabit montane forests and has only been recorded from Acocks' veld type 8. It is also restricted to areas with a median annual precipitation of 1000mm to 2000mm. These variables were overlayed with one another and then with geology (Vw – Wolkberg shale) to model the predicted distribution.

This resulting distribution is a narrow band extending north-south through the eastern parts of the Blyde River Nature Reserve. In these areas it would inhabit crevices under pieces of exfoliating rock and between rocks (Jacobsen 1989).

**Rondavels flat gecko** (*Afroedura sp. nov*.)
The top of the rondavel closest to the Blyde Dam in the Blyde River Nature Reserve is the only known locality for this very restricted gecko (Jacobsen *pers. comm*[21].). Therefore, the entire top, flat area of this rondavel was used as the modelled distribution for this species.

Further research is needed to determine the true status of this gecko and how it is related to the other flat geckos occurring in Blyde River Nature Reserve.

**Forest/Natal purpleglossed snake** (*Amblyodipsas concolor*)
This snake is distributed from Natal, through Mpumalanga into Northern Province. In these areas it inhabits well-wooded or forested areas at elevations of 400 – 1500m. The locality data revealed that this species is restricted to areas with a median annual precipitation above 750mm. The elevation and precipitation variables were overlayed with Degraded Forest and Woodland, Degraded Thicket and Bushland, Forest, Forest and Woodland and Thicket and Bushland from the Land-cover Database (Thompson 1996). The resulting distribution is in a disjunct band from Blyde River Canyon, along the escarpment, over the Barberton area into Swaziland. In this area it would be found under rocks and rotting logs (Jacobsen 1989). It is also reported to burrow in humic soils (Branch 1998).

This species has only been recorded from the southern part of the Blyde River Nature Reserve, but it is predicted that it should occur in other parts of the Reserve and in the Mthethomusha, Barberton, Barberton Mountainlands and Songimvelo Nature Reserves.

The populations of this rare species have probably become fragmented and isolated due to the large-scale afforestation along the escarpment and continue to be threatened by habitat destruction due to afforestation.

**Lowveld shieldnosed snake** (*Aspidelaps scutatus intermedius*)
This species has been recorded from the eastern parts of Northern Province and Mpumalanga. It burrows into sandy soil (Branch 1998) or uses existing rodent burrows (Jacobsen 1989). It occurs in forests and woodlands, represented by Acocks' veld types 10 and 11, at elevations of 200 – 1400masl. Acocks' veld types, Landcover (Degraded Forest and Woodland, Degraded Thicket and Bushland, Forest, Forest and Woodland and Thicket and Bushland), elevation and soil type (loamy sand, sandy, sandy loam and very sandy) were overlayed to model the predicted distribution. The predicted distribution extends eastwards from Nelspruit, towards the southern parts of Kruger National Park and the northern border of Swaziland. This snake is also predicted to occur along the Lebombo Mountains and probably extends into western Mozambique.

It occurs throughout the southern Kruger National Park and could occur in the Mthethomusha and Mahushe Shongwe Nature Reserves. Outside the Kruger National Park many individuals are killed on roads.

[21] Dr. N. Jacobsen, P.O. Box 671, Wilderness, 6560

**Dwarf chameleon** (*Bradypodion transvaalense* complex)
Jacobsen (1989) recognises six as yet undescribed subspecies of this taxon, but Bain (*pers. comm*[22].) suggests that these forms be treated as one taxon. Until this situation is resolved the authors have treated them as a single taxon.

The Dwarf chameleons occur in a band from the Soutpansberg to Barberton in which tracts of drier country and vast river valleys separate the populations (Jacobsen 1989). These chameleons occur mainly in wet forests of escarpment kloofs, but can also adapt to forest fringes and well wooded gardens (Branch 1998). They are restricted to areas with an elevation of over 1000masl and a median annual precipitation of over 1000mm. These environmental variables were overlayed with Landcover (Forest, Thicket and Bushland and Degraded thicket and bushland) from Thompson (1996) to model the predicted distribution of this complex. The resulting distribution consists of disjunct patches extending south from the Blyde River Nature Reserve, along the escarpment towards Barberton.

One group has been recorded from the Blyde River Nature Reserve and it is predicted that they could also occur in the Mt Anderson Area. The Barberton group could occur in Barberton Mountainlands Nature Reserve and Songimvelo Game Reserve.

In other areas they are often killed during the burning of firebreaks and in veld fires and these events will isolate and fragment the populations further.

**Sungazer/ Giant girdled lizard** (*Cordylus giganteus*) RDB (1988) – Vulnerable
The Sungazer is endemic to an area of grassland extending from the north-eastern Free State, the western Kwazulu-Natal and to the south-eastern Mpumalanga. As it was very difficult to model a predicted distribution based on known habitat requirements, it was decided to buffer the farm localities to 2km. This buffered distribution is thus the predicted distribution. In these areas the lizards live in burrows in flat or sloping highveld grassland.

These lizards are threatened by habitat destruction caused by agriculture, mining, urban development activities, the pet and muti trade, as well as increased predation as a result of possible disturbance of the ecological balance in the remaining scattered grassland areas (Branch 1988).

This species has not been recorded from any provincial nature reserve (Jacobsen 1989). Although ESCOM proclaimed a reserve (400ha) adjacent to the Majuba Power Station, to which lizards were successfully relocated (Branch 1988), it is not considered large enough to maintain a viable population (Jacobsen 1989).

**Barberton girdled lizard** (*Cordylus warreni barbertonensis*)
In Mpumalanga this species has been recorded in the area around Nelspruit, eastwards to Malelane and southwards to Barberton. A record also exists from Nsulaze kop on the north-eastern border of Swaziland and from the southern border of Swaziland with Kwa-zulu Natal. These reptiles have been recorded from Acocks' veld types 9,10 and 63 and to elevations of 580 – 900masl. They select rocky hillsides with deep cracks in large boulders that are sheltered by trees. Thus, Acocks' veld types, elevation and steep and very steep slopes (from digital soil depth data) were overlayed to determine the predicted distribution. The resultant distribution extends from east of the Blyde River Nature

[22] M. Bain, Mpumalanga Parks Board, Sterkspruit Nature Reserve, 013-235 2075

Reserve, southwards towards Malelane and Barberton, along the escarpment through Swaziland and into northern Kwa-zulu Natal.

Localities from Barberton Municipal Nature Reserve and southern Kruger National Park have been recorded. It is also predicted to occur in the Barberton Mountainlands, Mthethomusha, Barberton and Songimvelo Nature Reserves (MPB). Jacobsen (1989) considered this species to be relatively secure elsewhere due to their preferred habitat and shy habits.

**Lebombo girdled lizard** (*Cordylus warreni warreni*)
This species has been recorded to occur along the Lebombo Range from south-eastern Mpumalanga through eastern Swaziland to northern Kwa-zulu Natal. It is restricted to Lebombo Arid Mountain Bushveld (Low and Rebelo 1996) at elevations of 300 – 800masl. These two habitat variables were overlayed to produce a predicted distribution for this species. The resulting distribution extends in disjunct band in the far eastern part of Mpumalanga from south of Olifants Camp in the Kruger National Park to the northern border with Swaziland. In these areas it would prefer well-wooded rocky outcrops (Branch 1998) and is found in crevices between or under rocks on rocky outcrops (Jacobsen 1989).

It is only protected in the Kruger National Park but it is unknown how large this population is. Both subspecies of *C. warreni* are threatened by exploitation for commercial sale (Jacobsen 1989).

**Swazi rock snake** (*Lamprophis swazicus*) RDB (1988) – Rare
This is a rare species, which is restricted to the eastern escarpment of Mpumalanga and Swaziland where it has been recorded from Acocks' veld types 8, 9 and 57. It also seems to be restricted to elevations of 1300 – 1900masl, areas with an annual precipitation of above 750mm and to areas that receive late or no frost. All of these variables were overlayed with each other and also with steep and very steep slopes (digital soil depth data) to determine the possible distribution. The resultant distribution extends from the Blyde River Nature Reserve southwards along the escarpment towards Barberton and north-western Swaziland. In these areas it would usually be found under rock slabs (Branch 1988) on rocky mountains and hillsides as well as rocky outcrops (Jacobsen 1989).

It has been recorded from the Malolotja Nature Reserve (Branch 1988) in Swaziland and from the Barberton Mountainlands Nature Reserve. It is predicted that it could also occur in the Ohrigstad and Blyde River Nature Reserves and the northern parts of Songimvelo Game Reserve. Elsewhere the developments of exotic plantations along the escarpment cause habitat destruction and isolate populations.

**Transvaal flat lizard** (*Platysaurus orientalis orientalis*)
Restricted to the Mpumalanga escarpment, this lizard is found on cliffs and rocky outcrops where it inhabits horizontal and vertical crevices between rocks. This species has been recorded from Acocks (1975) veld types 8,12,18,19,57 and 61 and elevations of 700 – 1700masl. These environmental variables and data from the Land-cover Database (Thompson 1996) (Forest, Degraded Forest and Woodland, Degraded Thicket and Bushland, Forest and Woodland and Thicket and Bushland) were overlayed to determine the predicted distribution in Mpumalanga. The resultant distribution is restricted to the northern and north-western parts of Mpumalanga.

It has only been recorded from the Blyde River Nature Reserve. However, the modelled distribution predicts that it could occur in some of the Department of Agriculture, Conservation and Environment (DACE) Nature Reserves i.e. Mkombo, Madala, Mabusa and SS Skosana Nature Reserves, the Scuinsdraai Nature Reserve (DEAT) and Loskop Dam Nature Reserve (MPB).

**Wilhelm's flat lizard** (*Platysaurus wilhelmi*)
Endemic to Mpumalanga, this species is restricted to granite outcrops and inselbergs associated with Acocks' veld types 9 and 10. In these areas it lives in narrow crevices formed by exfoliating granite and in crevices between rocks. The lithology types selected for modelling were based on the localities of the farms and information provided by Jacobsen (1989). Lithology types selected were Nelspruit Granite (Zne), Kaap Valley Granite (Zka), Un-named Potassic Granite & Granodiorite (ZB) and Timeball Hill and Rooihoogte Shale (Vt). These were overlayed with Acocks' veld types 9 and 10 to model the predicted distribution. The resulting distribution extends from the south-eastern Kruger National Park to east of the Blyde River Nature Reserve, south towards Barberton and east to Ngodwana.

This species is relatively widespread in the southern Kruger National Park, but has not been recorded from any provincial nature Reserve. However, it is predicted that it could occur in the Mthethomusha and Barberton Nature Reserves (MPB) and in the Crocodilepoort Conservancy. Elsewhere commercial exploitation (Jacobsen 1989) and granite mining could threaten it.

**Montane burrowing skink** (*Scelotes mirus*)
Endemic to southern Africa, this species occurs through Mpumalanga to Swaziland and northern Kwa-zulu Natal. It is found in montane grassland and scrub, represented by Acocks' veld types 8, 9, 10, 19, 57, 62, 63 and 64, at elevations of 800 – 2000masl. The veld types and elevation were overlayed with unimproved grassland from the Landcover Database (Thompson 1996) to model the predicted distribution. The resulting distribution is a broad band extending north south through the province to the west of the escarpment. In these areas the skink would be most frequent around rocky outcrops where scattered rocks provide sufficient cover.

It has been recorded in the Blyde River Nature Reserve and the Ohrigstad Dam Nature Reserve. It is predicted that it could also occur in the Mt Anderson Area, the Kwaggavoetpad, Barberton Mountainlands, Nooitgedacht Dam, Jericho Dam, Paardeplaats, Witbad and Songimvelo Nature Reserves.

**Breyer's longtailed seps/ Breyer's plated lizard** (Tetradactylus breyeri) RDB (1988) – Rare
The isolated populations of this slender lizard have been recorded in montane and highveld grassland areas of northern Mpumalanga, northern and central Natal and north-eastern Free State (Branch 1988). It has only been recorded from Acocks' veld types 6 and 8 and seems to be restricted to elevations of 1700 – 2000masl. To determine the predicted distribution this elevation range was overlayed with unimproved grasslands from the Landcover database (Thompson 1996). The resultant distribution is a wide band extending from the Lydenburg area, southwards through the central part of Mpumalanga, along the western boundary of the Usutu River Catchment towards Volksrust in the south.

This lizard has only been recorded from the southern part of the Blyde River Nature Reserve and Branch (1988) reported that it has been found on Mt Sheba Nature Reserve but no record exists from there. The modelled distribution predicts that it could also occur in the Mt Andersen Area, Paardeplaats and Wakkerstroom Nature Reserves.

In other areas it would be adversely affected by habitat destruction, livestock and uncontrolled burning (Branch 1988).

4.6.3.2 IUCN ratings

The reptile species could only be assigned an IUCN category according to their distributions (extent of occurrence) and the fact that all the reptiles are threatened due to a decline in quality of habitat and the fragmented nature of the populations. The IUCN category determined during this study is presented in Table 4.6.1 together with the importance weighting assigned to the categories.

Table 4.6.1 List of Reptile species and regional IUCN ratings (IUCN 2000) and the associated importance weighting.

| **Reptile Species** | **IUCN Category** | **Weighting** |
|---|---|---|
| *Afroedura haackei* (Haacke's flat gecko) | EN B1ab(iii) | 1 |
| *Afroedura sp. nov.* (Abel Erasmus Pass flat gecko) | EN B1ab(iii) | 1 |
| *Afroedura sp. nov.* (Mariepskop flat gecko) | EN B1ab(iii) | 1 |
| *Afroedura sp. nov*. (Rondavels flat gecko) | EN D | 1 |
| *Amblyodipsas concolor* (Forest/Natal purpleglossed snake) | VU B1ab(iii) | 0.5 |
| *Aspidelaps scutatus intermedius* (Lowveld shieldnosed snake) | VU B1ab(iii) | 0.5 |
| *Bradypodion transvaalense* complex (Dwarf chameleon) | VU B1ab(iii,v) | 0.5 |
| *Cordylus giganteus* (Sungazer/ Giant girdled lizard) | VU B1ab(iii,v) | 0.5 |
| *Cordylus warreni barbertonensis* (Barberton girdled lizard) | VU B1ab(iii) | 0.5 |
| *Cordylus warreni warreni* (Lebombo girdled lizard) | VU B1ab(iii) | 0.5 |
| *Lamprophis swazicus* (Swazi rock snake) | VU B1ab(iii) | 0.5 |
| *Platysaurus orientalis orientalis* (Transvaal flat lizard) | NT | 0.5 |
| *Platysaurus wilhelmi* (Wilhelm's flat lizard) | VU B1ab(iii) | 0.5 |
| *Scelotes mirus* (Montane burrowing skink) | LC | 0 |
| *Tetradactylus breyeri* (Breyer's longtailed seps) | VU B1ab(iii) | 0.5 |

4.6.3.3 Species not modelled

In addition to the species modelled and assessed here and to those previously modelled for the Usutu River Catchment, Jacobsen (*pers. comm.*) considers an additional 80 taxa to be threatened. Sundeval's garter snake (*Elapsoidea sundevallii sundevallii*) was not used in the study, as it is probably extinct in Mpumalanga (Jacobsen 1989). Most of the other reptiles are relatively widespread and occur throughout southern Africa and were thus not modelled and assessed for this study. However, these species cannot be ignored in any conservation action. Many of them occur in Montane on Rocky outcrops or hillsides along the escarpment or in Highveld Grasslands. Their habitats and distributions are similar to those of the modelled species. These species are, thus, also threatened by frequent widespread fires and extensive cultivation and afforestation occurring in Mpumalanga.

### 4.6.4 Discussion

Figure 4.6.1 indicates that a large proportion of Mpumalanga province is important for the conservation of threatened Reptile species. In the past conservation authorities have held reptiles as a low priority when determining important areas for conservation and management practices within reserves. However, when one considers that there are more endemic reptiles in southern Africa than any other vertebrates and that new species are being discovered regularly (Branch 1998) it becomes clear that these animals need higher consideration in conservation processes. 64% of the reptiles that occur within Mpumalanga are considered to be threatened and should be placed on the Red Data List as Near Threatened, Vulnerable or Endangered. Although this area is important in terms of species that need to be conserved, only 13.86% of this area is conserved within provincial nature reserves. This indicates that the Mpumalanga Province is not being effectively conserved.

Some appropriate management practices will include changing fire regimes to patch burns, restricting the destruction of termitaria, the removal of logs and the disturbance of rocks.

4.6.4.1 Conservation Recommendations

- Detailed surveys are necessary to determine precise localities of reptile populations, sizes of populations and to determine if there are other populations within the predicted distributions;
- Monitoring programs should be drawn up and the known populations and their habitats should be monitored annually. Monitoring actions must avoid methods that destroy important reptile habitats e.g. termitaria (Jacobsen 1989);
- The Conservation importance and habitat requirements of these reptile populations should be made known to landowners where these populations occur and
- Guidelines for reptile habitat conservation and management practices must be drawn up and made available to landowners.

### 4.6.5 References


Acocks, J.P.H. 1975 *Veld types of South Africa* (2nd Ed). Memoirs of the Botanical Survey of South Africa No. 40.

Branch, W.R. 1988 *South African Red Data Book – Reptiles and Amphibians*. South African National Scientific Programmes. Report No. 151.

Branch, B. 1998 *Field Guide to Snakes and other Reptiles of Southern Africa*. Struik Publishers, Cape Town.

Jacobsen, N.H.G. 1989 *A Herpetological survey of the Transvaal*. The Transvaal Directorate of Nature and Environmental Conservation.

Low, A.B. and Rebelo, A.G. 1996 *Vegetation of South Africa, Lesotho and Swaziland.* Department of Environmental Affairs and Tourism, Pretoria.

Schulze, R.E. 1997 *South African Atlas of Agrohydrology and –Climatology*. Water Research Commission, Pretoria, Report TT82/96.

Thompson, M.W. (1996) A standard land-cover classification scheme for remote-sensing application in South Africa. *South African Journal of Science* 92: 34-42

## 4.7 Fish

Contributors: J. S. Engelbrecht and F. Roux

### 4.7.1 Introduction

The freshwater fishes of southern Africa can be divided into distinct geographical categories, namely a tropical and a temperate fish fauna. The majority of freshwater fish in southern Africa can be classified as tropical and show a distinct relationship with the fish fauna of the Zambesi River. The temperate fish fauna on the other hand, is mostly endemic and often shows huge genetic differences between populations suggesting extremely long periods of isolation and even speciation between different catchments (Engelbrecht and van der Bank, 1996). At least sixty-two indigenous and eleven exotic species of fish have been recorded within Mpumalanga (Table 4.7.1).

Aquatic ecosystems in southern Africa support a rich biodiversity, for example about 270 fish species within 102 Genera and 38 Families are known from this region. It is difficult to give exact numbers as these figures are changing due to the discovery of new and cryptic species. One hundred and sixty of these species are primary freshwater fish species and it is important to note that 61% of these species are endemic to the region and that Mpumalanga Province has the second highest percentage of endemicity in South Africa. Fish are often on top of the food chain in the aquatic ecosystem, but also form an important part of the food chain for many terrestrial animals such as birds and mammals. The ever-increasing demand for water in South Africa is seriously effecting our freshwater ecosystems. It is important to note that an aquatic ecosystem comprises a physical aquatic habitat with its biota (both instream and riparian), linked to its physical, chemical and ecological processes. It is crucial that we recognise the fact that a water resource can be exploited to such an extent that the ecosystem breaks down and a river loses its resilience and ability to sustain its quantity and quality of water. This can also seriously effect terrestrial species that are directly or indirectly dependent on these systems.

The objective of this study was to map the known distribution of threatened, endemic and/or species with limited distribution in Mpumalanga as part of the GIS coverage to identify and rank sites in terms of their importance for conservation of fish.

### 4.7.2 Methods

Selecting fish species suitable for modelling was based on existing information such as Crass (1964), Gaigher (1969), Pott (1969), Gaigher & Pott (1973), Jubb (1967), Kleynhans (1984, 1986 & 1987), Skelton (1993 & 1996) and was supplemented by distribution records for Mpumalanga extracted from the MPB, J. L. B. Smith Institute of Ichthyology fish database and www.fishbase.com. Kleynhans (1984, 1986 & 1987) studied the distribution and ecology of several rare and threatened species in the former Transvaal and this study formed a sound basis for the selection of species to be modelled. However, more recent data revealed several other species needed to be included in this study.

Eleven indigenous fish species, which are endemic, near endemic, highly sensitive and/or with limited distributions in Mpumalanga, were selected for modelling. Species selected for modelling include:

Table 4.7.1: Fish species recorded within Mpumalanga

| Species | Common name | Comments |
|---|---|---|
| Amphilius natalensis | Natal mountain catfish | Sensitive & habitat specialist |
| Amphilius uranoscopus | Common mountain catfish | Sensitive & habitat specialist |
| Anguilla marmoratta | Madagascar mottled eel | Life-cycle threatened by dams |
| Anguilla mossambica | Longfin eel | Life-cycle threatened by dams |
| Anguilla nebulosa | African mottled eel | Life-cycle threatened by dams |
| Austroglanis sclateri | Rock catfish | Rare, Indigenous to Vaal River, distributed elsewhere |
| Awaous aenofuscus | Freshwater goby | Limited distribution in Mpumalanga |
| Barbus aeneus | Smallmouth yellowfish | Endemic to Orange-Vaal system, distributed elsewhere |
| Barbus afrohamiltoni | Hamiltons barb | Limited distribution in Mpumalanga |
| Barbus annectens | Broadstriped barb | |
| Barbus anoplus | Chubbyhead barb | Endemic SA. Complex of genetic unique species & populations |
| Barbus argenteus | Rosefin barb | Sensitive & habitat specialist |
| Barbus brevipinnis | Shortfin barb | Endemic SA. Genetic unique populations |
| Barbus eutaenia | Orangefin barb | Sensitive & habitat specialist |
| Barbus kimberleyensis | Largemouth yellowfish | Endemic to Orange-Vaal system Sensitive |
| Barbus lineomaculatus | Line-spotted barb | |
| Barbus marequensis | Large scale yellowfish | |
| Barbus mattozi | Papermouth | Limited distribution in Mpumalanga |
| Barbus motebensis | Marico barb | Endemic SA. Complex of genetic unique species & populations |
| Barbus neefi | Sidspot barb | Complex of genetic unique species & populations |
| Barbus paludinosus | Straightfin barb | |
| Barbus polylepis | Smallscale yellowfish | Endemic SA |
| Barbus radiatus | Beira barb | |
| Barbus toppini | East Coast barb | |
| Barbus treurensis | Treur River barb | Vulnerable. Endemic Mpumalanga. Sensitive & specialist |
| Barbus trimaculatus | Threespot barb | |
| Barbus unitaeniatus | Longbeard barb | |
| Barbus viviparus | Bowstripe barb | |
| Brycinus imberi | Spot-tailed robber | Limited distribution in Mpumalanga |
| Chetia brevis | Orange-fringed largemouth | Endemic southern Africa Vulnerable |
| Chiloglanis anoterus | Pennant-tail catlet | Endemic SA. Sensitive & habitat specialist |
| Chiloglanis bifucus | Incomati rock catlet | Endemic Mpumalanga. Critically endangered. Sensitive specialist |
| Chiloglanis emarginuatus | Pongola rock catlet | |
| Chiloglanis paratus | Sawfin rock catlet | Locally rare. Sensitive & habitat specialist |
| Chiloglanis pretoriae | Lompopo rock catlet | Endemic SA. |
| Chiloglanis sweirstrai | Lowveld rock catlet | Sensitive & habitat specialist |
| Clarias gariepinus | Sharptooth catfish | Endemic SA. Sensitive & habitat specialist |
| Ctenopharyngodon idella | Grass Carp | |
| Cyprinus carpio | Carp | Exotic |
| Gambusia affinis | Mosquitofish | Exotic |
| Glossogobius callidus | River goby | Exotic |
| Glossogobius giurus | Tank goby | |
| Hydrocynus vittatus | Tigerfish | |
| Hypophthalmicthys molitrix | Silver Carp | Limited distribution in Mpumalanga |
| Kneria auriculata | Southern kneria | Exotic |
| Labeo capensis | Orange River labeo | Endangered in Mpumalanga. Limited distribution in Mpu. |
| Labeo congoro | Purple labeo | Endemic to Orange-Vaal system, distributed elsewhere |
| Labeo cylindricus | Redeye labeo | Feeding & habitat specialist |
| Labeo molybdinus | Leaden labeo | Feeding specialist |
| Labeo rosae | Rednose labeo | Feeding specialist |
| Labeo ruddi | Silver labeo | Endemic SA. Feeding specialist |
| Labeo umbratus | Moggel | |
| Lepomis macrochirus | Bluegill sunfish | Endemic to Orange-Vaal system, distributed elsewhere |
| Marcusenius macrolepidotus | Bulldog | Exotic |
| Mesobola brevianalis | River sardine | Endemic SA. SA species to be described |
| Micralestes acutidens | Silver robber | |
| Micropterus dolomieu | Smallmouth bass | |
| Micropterus salmoides | Largemouth bass | Exotic |
| Oncorhynchus mykiss | Rainbow trout | Exotic |
| Opsaridium peringueyi | Barred minnow | Exotic |
| Oreochromis mossambicus | Mozambique tilapia | Endemic SA. Sensitive & habitat specialist |
| Petrocephalus catostoma | Churchill | |
| Poecilia reticulata | Guppy | Endemic SA. SA species to be described |
| Pseudocrenilabrus philander | Southern mouthbrooder | Exotic |
| Salmo trutta | Brown trout | |
| Schilbe intermedius | Silver catfish | Exotic |
| Serranochromis meridianus | Lowveld largemouth | |
| Synodontis zambezensis | Brown squeaker | Vulnerable |
| Tilapia rendalli | Redbreast tilapia | |
| Tilapia sparrmanii | Banded tilapia | |
| Varicorhinus nelspruitensis | Incomati chiselmouth | |
| Xiphophorus helleri | Swordtail | Endemic SA. Sensitive & feeding specialist |
| | | Exotic |

| | |
|---|---|
| *Barbus argentius* | Rosefin barb |
| *Barbus brevipinnis* | Shortfin barb |
| *Barbus treurensis* | Treur River Barb |
| *Chetia brevis* | Orange-fringed largemouth |
| *Chiloglanis bifurcus* | Incomati Rock Catlet |
| *Chiloglanis emarginatus* | Phongolo rock catlet |
| *Chiloglanis swierstrai* | Lowveld rock catlet |
| *Kneria auriculata* | Southern kneria |
| *Opsaridium peringueyi* | Barred minnow |
| *Serranochromis meridianus* | Lowveld largemouth |
| *Varicorhinus nelspruitensis* | Incomati chiselmouth |

All available distribution records for each of the selected species in Mpumalanga where compiled and mapped using ArcView. Initially the recorded distributions of the eleven selected freshwater fish were mapped from available distribution records onto a vector map of rivers in Mpumalanga. The potential distribution for each of these species was derived by overlaying and matching available geophysical variables to possible distribution patterns of the species on a vector map of the main rivers in the Usutu River catchment. Because river catchments or sub catchments are a primary determinant of fish species distribution, their potential distributions were derived only in sub catchments with known locality records for the species. These distributions where then used to select quaternary catchments potentially of importance to the selected species.

### 4.7.3 Results

*Species accounts*

***Barbus argenteus*** *(*Rosefin Barb*)*
Conservation status: Near Threatened
Number of records: 104
Distribution: This sensitive species is limited to clear fast flowing streams along the escarpment in Mpumalanga and KwaZulu Natal in the Inkomati and Phongolo River Systems. An isolated population also occurs in the Belvedere Creek in Blyde River Nature Reserve, which is the only population in the Limpopo River System. This species also occurs in the Cuanza and Kunene Rivers in Angola, but South African populations are expected to be genetically distinct from the northern populations.
Biology: This species keeps to pools and riffles in clear rocky streams. It feeds mainly on aquatic invertebrates as well as flying insects. Observations indicate that it possibly breeds on gravel in the fast flowing sections of the stream close to marginal vegetation.
References: Skelton, (1993), Jubb, (1967), Gaigher (1969), Gaigher and Pott (1973).
Modelling approach; This occurrence of this species is very dispersed throughout the province, suggesting that this species may have a high degree of habitat specialisation, which limits its distribution. Although they have a tendency to occur only in cooler streams at altitudes of 900 m to 1200 m a.s.l., their distribution is not clearly related to the known geophysical parameters. Modelling was therefore largely based on available distribution records.

***Barbus brevipinnis*** (Shortfin barb)
Conservation status: Near Threatened
Number of records: 37

Distribution: This species is endemic to Mpumalanga and occurs only in the upper reaches the Sabie and Phongolo Rivers. The Phongola River specimens are presently still confused with *Barbus pallidus*. However, genetic studies have clearly shown these populations to belong to *Barbus brevipinnis*. These studies also indicated that the populations in the different rivers or catchments are genetically unique (Engelbrecht and van der Bank, 1996). No populations occur within protected areas.
Biology: This species mainly keeps to pools and backwaters with marginal vegetation in small headwater streams. It feeds mainly on small aquatic invertebrates. Fecundity data suggest that it breeds throughout summer and spring and up to 1341 eggs has been found per female. This species has a maximum age of about 4 years.
References: Skelton (1993), Jubb (1967), Gaigher (1969), Gaigher and Pott (1973), Engelbrecht and van der Bank (1996) Schulz and Schoonbee (1999).
Modelling approach: The distribution of the species was not clearly related to known geophysical parameters. Therefore, modelling was based mainly on available distribution records and the fish's preference for smaller streams at altitudes above 900 m.a.s.l.

***Barbus treurensis*** (Treur River barb)
Conservation status: Vulnerable
Number of records: 8
Distribution: In 1956 specimens of this species were collected for the first time in the Treur River, a tributary of the Blyde River, Limpopo River system, Mpumalanga. It became very rare during the nineteen sixties as a result of the introduction of predatory fish and probably became extinct in the Treur River shortly thereafter. A small population was discovered in the upper reaches of the Blyde River, isolated above a waterfall, which protects it from predatory fish where it co-exists with *Amphilius natalensis.* This species was successfully reintroduced into the Treur River during 1994. Recent surveys have indicated that this species has largely repopulated the Treur River after this reintroduction.
References: Engelbrecht and Roux (1998/1999), Jubb (1967), Gaigher (1969), Kleynhans (1984, 1986 & 1987), Skelton (1993)
Biology: These fish are found only in larger clear mountain streams with loose large rocks/boulders and abundant deep pools where they feed on aquatic invertebrates, particularly insects. They breed in early summer, with both sexes developing small tubercles on the head.
Modelling approach: Although the distribution of this species seems to be related to altitude and geology, the availability of its preferred habitat remains a critical limiting factor. Based on altitudes between 1100 and 1500m.a.s.l. and geology it is likely that this species historically occurred in most of the Blyde and Treur Rivers above the Bourkes Luck Potholes (Engelbrecht and Roux, 1998/1999). However, regular stocking of the Blyde River with predacious fish (trout), makes most of the Blyde presently unsuitable for the reestablishment of this species.

***Chetia brevis*** (Orange-fringed largemouth)
Conservation status: Vulnerable
Number of records: 12
Distribution: This species is rare and is a near endemic to Mpumalanga. It is mainly restricted to the Lomati River in Mpumalanga with only a few records in the Komati River near their confluence. This species has also been recorded in some of the coastal lakes in Mozambique. This species was successfully translocated to dams in the Kruger National Park. Other populations are threatened by pollution and water extraction.

Biology: This species occurs mainly in pools and quiet stretches of rivers with sandy substrates and dense marginal vegetation where they feed on small fish and aquatic insects. It is a mouthbrooder and the female carries the eggs and larvae.
References: Jubb (1967), Gaigher (1969), Pienaar (1978); Kleynhans (1984 & 1986), Skelton (1993).
Modelling approach: The distribution of this species is largely catchment bound in the fish's preferred habitat. Modelling was further based on altitudes between 200 and 460 m.a.s.l. and the Tonga rapids as the upper limit in the Komati River.

***Chiloglanis bifurcus*** (Incomati rock catlet)
Conservation status: Critically Endangered
Number of records: 22
Distribution: This species is endemic to the Incomati River system in Mpumalanga. It is mainly known from the upper Crocodile and Elands Rivers. A single historic record suggests that this species also occurred in the upper Komati River below Nooitgedacht Dam while more recent records have confirmed its presence in the Komati River in Malalotja Nature Reserve (Swaziland) and the Msoli River (Songimvelo Nature Reserve). The absence of this species in Crocodile River below Kwena Dam during two recent surveys suggests that the abundance of this species has reduced significantly since the construction of the Kwena Dam. This disappearance may be related to the regulation of flow below the dam.
Biology: These fish occur in rocky rapids and cascades in altitudes of 700 to 1400 m.a.s.l. They prefer deeper waters (30-60 cm) over cobbles and feeds mainly on benthic invertebrates such as mayfly and caddis fly nymphs, blackfly and midge larvae and small snails. Breeding takes place during summer and these fish are partial spawners. Ever increasing abstraction of river water, flow regulation as well as pollution threatens this species.
References: Skelton (1987 & 1993), Jubb (1967), Kleynhans (1984& 1986), Gaigher (1969& 1973) and Heymans (1987).
Modelling approach: This species has a tendency to occur only in cooler streams at altitudes of 700 m to 1400 m.a.s.l. The high degree of habitat specialisation in this species probably limits its distribution and modelling was therefore largely based on available distribution records.

***Chiloglanis emarginatus*** (Phongolo rock catlet**)**
Conservation status: Vulnerable
Number of records: 32
Distribution: This species is rare in South Africa and its distribution is restricted to the headwaters and middle reaches of the Phongolo River System and the Nkomati River. It also occurs in the Pungwe and Zambezi Rivers but the South African populations are considered to be genetically distinct from the northern populations. This species has been recorded from Songimvelo Nature Reserve but recent surveys suggest a distinct reduction in the population size of this species in the Nkomati River. The management of water releases from Nooitgedacht and Vygenboom Dam are most probably responsible for this apparent reduction in population size, which may increase the conservation status of the species.
Biology: These fish feed mainly on *aufwuchs* and macrobenthic insects that they scrape from the rocks in riffle areas. This specialised diet is also reflected in the fish's short gut-length. Individuals mature at 40 mm SL and each female produces up to 320 eggs. Both sexes of this species ripen during November.

Habitat: These fish prefer shallow rocky riffles and runs in escarpment streams with cool clear moderately strong flowing waters.
References: Skelton (1987 & 1993), Jubb (1967), Kleynhans (1984 & 1986), Gaigher (1969& 1973), Gaigher and Pott (1973) and Heymans (1987).
Modelling approach: There are three distinct populations of this species in Mpumalanga, namely the Nkomati, Phongola and Usutu River populations. Modelling for this species was mainly based on available distribution records, potential distribution indicated by Kleynhans (1984) and altitudes of 900 to 1200 m a.s.l.

***Chiloglanis swierstrai*** (Lowveld rock catlet**)**
Conservation status: Near Threatened
Number of records: 4
Distribution: This species is restricted to the warmer sandy reaches of the Limpopo, Inkomati and Phongolo River Systems. It has been recorded in the Kruger National Park and in Songimvelo Nature Reserve.
Biology: This species keep to warmer sandy runs and riffles, burying itself in the sand where it mainly preys on aquatic macro-invertebrates. This fish is not common even in its preferred habitat. Breeding takes place in summer.
References: Skelton, (1993), Jubb, (1967), Gaigher (1969 & 1973), Gaigher and Pott (1973), Pott (1969) Heymans (1987).
Modelling approach. Modelling of this species was largely based on the larger perennial sandy stretches of river with altitudes below 900 m.a.s.l., as well as available distribution records

***Kneria auriculata*** (Southern kneria)
Conservation status: Endangered in Mpumalanga
Number of records: 12
Distribution: This species has been recorded from upland streams of lower Zambezi, Pungwe, Buzi, and Save Rivers in Zimbabwe and Mozambique. The identity of specimens from the Kafue and upper Zambezi requires confirmation. A relict southern pocket consisting of five small populations occurs in small headwater streams of the Crocodile River (Incomati River system). The building of dams and the introduction of trout into the area have drastically reduced the abundance of the species in some areas.
Biology: Shoals occur in pools of small, clear, silt-free, rocky streams. These fish have been reported to breathe air and to climb over damp rocks and up the sides of waterfalls during migrations. They scrape diatoms, algae, and detritus from rock surfaces and also take small aquatic insects such as mayfly nymphs and midge larvae. Individuals mature after a year and breeding takes place during spring and summer, with larger females bearing up to 600 eggs. They move on to flooded grasslands during the rainy season.
References: Skelton (1987 & 1993), Jubb (1967), Kleynhans (1984 & 1986), Gaigher (1969& 1973), Gaigher and Pott (1973).
Modelling approach: This species is catchment bound and has a tendency to occur only in cooler small upland streams at altitudes of 1100 to 1400 m a.s.l. The high degree of habitat specialisation for this species probably limits its distribution and modelling was therefore largely based on available distribution records.

***Opsaridium peringeuyi*** (Barred minnow)
Conservation status: Near threatened
Number of records: 42
Distribution: This species has been recorded from the Save, Limpopo, Incomati, Umbeluzi and Pongola Rivers.

Biology: This species prefers clean shallow perennial instream pools or slow runs (15-50cm) on a sandy or gravel substratum. They are often found feeding on drifting chironomid and simuliid larvae below rapids or their adults taken from the surface.
References: Skelton (1987 & 1996), Jubb (1967), Gaigher (1969& 1973), Gaigher and Pott (1973).
Modelling approach: In Mpumalanga, this species has a tendency to occur in streams at altitudes of 150 to 900 m a.s.l. and only within specific catchments. Modelling was therefore largely based on available distribution records.

***Serranochromis meridianus*** (Lowveld largemouth)
Conservation status: Near threatened
Number of records: 5
Distribution: This species is mainly confined to the Sabie-Sand tributaries, Incomati River system in Mpumalanga and the coastal pans of Mozambique and Maputaland. They have been introduced to impoundments in the Kruger National Park. Elsewhere they are threatened by depleted water supplies, sedimentation, pollution and invasive plants.
Biology: These fish prefer standing or slow-flowing pools with marginal vegetation and thrive in impounded waters. They prey on small fish, insects and other invertebrates, including snails. Males clear small nests and attract females with a quivering display. Eggs are laid in several bouts and are fertilised before a female collects them. They are thus batch spawners.
References: Skelton (1987), Jubb (1967), Gaigher (1969& 1973), Gaigher and Pott (1973).
Modelling approach: The distribution of the species does not show any relation to known geophysical parameters or catchment boundaries. Modelling was only based on available distribution records and the fish's preference for slow flowing rivers with marginal vegetation at altitudes below 400 m.a.s.l.

***Varicorhinus nelspruitensis*** (Incomati chiselmouth)
Conservation status: Vulnerable
Number of records: 11
Distribution: This species is endemic to the escarpment streams of the Inkomati and Phongolo River Systems. It does not occur in any protected area.
Biology: This fish prefers the shallow fast flowing streams, with a rocky substrate, of the escarpment. It congregates during the winter in the deep rocky pools, where it can occur in shoals of 50-100. This species feeds on algae and benthic invertebrates by scraping it from rocks with its hard mouth. It breeds in summer.
References: Skelton, (1987 & 1993); Jubb, (1967); Kleynhans, (1984); Gaigher (1969 & 1973), Gaigher and Pott (1973), Pott (1969) and Heymans (1987).
Modelling approach: Modelling of the species was mainly based on available distribution records, potential distribution indicated by Kleynhans (1984) and larger perennial streams at altitudes of 760 to 1100 m.a.s.l.

### 4.7.4 Discussion

The historic changes in boundaries of catchments and stream capturing made the movement of fish species across watersheds possible and are therefore one of the primary determinants of the present distribution of fish species in Mpumalanga. However, the availability of suitable climatic conditions and habitat is also crucial for the survival of a species in a catchment. All of the selected species showed some relationship to geophysical parameters such as elevation, precipitation, minimum and maximum daily temperatures and these were therefore the more useful variables to define the upper and lower limits of their distribution. However, modelling the potential distributions of the selected species was restricted by limitations in defining the available habitats in terms of geophysical parameters such as river type, minimum and maximum water temperature, flow velocity, substratum composition and pool- riffle ratios, etc.

Catchments in the eastern part of Mpumalanga Province have been shown to be important for the conservation of threatened Fish species (Fig 4.7.1). The major threat to the survival of the diversity of fish species in Mpumalanga includes decreased spatial and perennial flow of clean, sediment free water. The placement structures such as weirs and dams which can cause an obstruction migration and the stocking of these waters with exotic predatory fish species such as bass will also drastically reduce the chances of the survival of the indigenous fish fauna in Mpumalanga.

### 4.7.5 References


Crass, R. S. 1964. *Freshwater Fishes of Natal*. Shuter and Shooter, Pietermaritzburg, Natal.

Gaigher, I. G. 1969. Aspekte met betrekking tot die ekologie, geografie en taksonomie van varswatervisse in die Limpopo- en Incomatiriviersisteem. Ph.D. Thesis, Rand Afrikaans University, Johannesburg (in Afrikaans).

Gaigher, I. G. 1973. The habitat preferences of fishes from the Limpopo River system, Transvaal and Mozambique. *Koedoe*, 16: 103-116.

Gaigher, I. G. and Pott, R. 1973. Distribution of fishes in southern Africa. *South African Journal of Science*. **69**: 25-27.

Engelbrecht, J. S. and Roux, F. 1998/1999. A note on the reintroduction of Barbus treurensis Groenewald 1958 (Pisces: Cyprinidae) into the Treur River, Mpumalanga, South Africa. *South African Journal of Aquatic Science* **24** (1/2) 35-50.

Engelbrecht, J. S. and Van der Bank, F. H. 1996. Genetic relationships between seven species within the chubbyhead and goldie barb groups of minnows (Cyprinidae). *Journal of African Zoology* **110**(6): 381-396.

Heymans, G. W. 1987. Summary of the occurrence and distribution of 23 Freshwater fish species in the Songimvelo Game Reserve, Kangwane. Internal Report, Kangwane Parks Corporation.

Jubb, R. A. 1967. *Freshwater fishes of southern Africa*. A. A. Balkema, Cape Town, South Africa.

Kleynhans C. J. 1984. Die verspreiging en status van sekere seldsame vissoorte van die Transvaal en die ekologie van sommige species. PhD Thesis, University of Pretoria.

Kleynhans C. J. 1986. The distribution, status and conservation of some fish species of the Transvaal. *South African Journal of Wildlife Research*. **16**(4):135-144.

Kleynhans C. J. 1987 A preliminary study of aspects of the ecology of a rare minnow Barbus treurensis Groenewald 1958 (Pisces: Cyprinidae) from the eastern Transvaal, *South Africa. Journal of the Limnological Society of Southern Africa*. **13**(1):7-13.

Pott, R. McC. 1969. The fish life on the Pongola River and the effect of the erection of a dam on the fish populations. M.Sc thesis. University of the Witwatersrand.

Schulz G.W.C. 1999. Aspects of length, mass, fecundity, feeding habits and some parasites of the shortfin minnow, Barbus brevipinnis (Cyprinidae) from the Marite River, Mpumalanga, South Africa.

Skelton P.H. 1987. South African Red Data Book - Fishes. SA National Scientific Programs Report 137.

Skelton P.H. 1993. A complete guide to the freshwater fishes of southern Africa. Southern Book Publishers.

## 4.8 Invertebrates

Contributor: Koos de Wet

### 4.8.1 Introduction

The importance of invertebrates in ecological processes is often ignored from a conservation perspective and invertebrates are usually included in conservation areas as a matter of chance when conservation actions for larger animals are taking place. This may be beneficial to some species, but invertebrates often have specific micro climatic requirements that may become unsuitable for them through management actions based on the requirements of the larger more conspicuous vertebrate animals. Conservation actions specific to invertebrates in the Mpumalanga Parks Board have no priority. This is in spite of the important role invertebrates play in food chains, recycling of nutrients, maintenance of soil structure and fertility, pollination of many plants and as predators or parasites controlling pests (Wells, *et al*, 1983). Many species are also herbivores, competing with the vertebrate herbivores for the same food source. Invertebrates, especially aquatic species, may be suitable as indicators of change in ecosystems.

The first recorded concern over insect population decline is probably that of Queen Cristina De Borbon of Spain who asked Professor Graells to provide a plan for firefly protection in 1835 (Pyle, 1976). In 1923 the Insect Protection Committee of the Royal Entomological Society of London came into being in Britain (Morris, 1981). As early as 1930 it was noted in the United States that insect faunistic changes occur due to industrial activities (Claasen, 1933). In South Africa an awareness of and research interest in insect conservation has only developed in the last 15 years.

### 4.8.2 Methods

Very little data is available for our province. Data was obtained from the Transvaal Museum, Agricultural Research Council, the Conservation Planning Unit of the Department of Zoology and Entomology at the University of Pretoria, the Lepidopterist's Society, the Landcover database and the Agroclimatology database. To date, data for Araneae (spiders), termites, Lepidoptera and Odonata have been received. We also have information of a cicada, *Pycna sylvia*, which was found for the first time in 95 years since it was first discovered during a survey of animal life in the Groot Dwars River valley, commissioned by SRK Consulting (Malherbe, 2002). Red data status of the butterflies are according to Henning *et al*. (in press), and of the Odonata according to Samways (2002). Only thirteen invertebrate red data species are currently known from the Mpumalanga Province. This includes seven butterfly and six dragonfly species.

The potential distributions of six butterflies were modelled, using selected criteria from the available databases.

1. *Aloeides rossouwi* and *Dingana fraterna*: Elevation 1650-1850ma.s.l.; Annual rainfall 800mm-1000mm; Annual mean precipitation exceeded 20% of time; 31-35 frost days per year; Unimproved Grasslands; Moist Sandy Highveld Grassland (Low and Rebelo 1998); and 10 km buffer from the centre of the farm Driefontein 348JS.

2. *Aloeides barbarae*: Elevation 950-1850ma.s.l.; Annual rainfall >1000mm; Annual mean precipitation exceeded 20% of time; 0-2 frost days per year; Unimproved

Grasslands; Lowveld Sour Bushveld (Low and Rebelo 1998); and 10 km buffer from point just above Eureka City.

3. *Lepidochrysops swanepoeli* and *L. jefferyi*: Elevation 850-1850ma.s.l.; Annual rainfall 850-1200mm; annual mean precipitation exceeded 20% of time; frost 0-2 frost days per year; Unimproved Grasslands; Lowveld Sour Bushveld (Low and Rebelo 1998) and 10 km buffer from points just above Eureka City, Fairview mine and Noordkaap mine.

4. *Metisella meninx*: Wetlands and altitude between 1600 and 1700 ma.s.l.

Endangered species were weighted 1 and Vulnerable species weighted 0.5.

**4.8.3 Results**

4.8.3.1 Lepidoptera. (Butterflies)

***Aloeides rossouwi* (Endangered)**
The flight period of this butterfly is from September to February and it may have two broods, one in spring and one later in summer. It is found only on one peak, to the South-west of Stoffberg in small numbers and only about 12 can be seen on any one day and often none can be found during apparently suitable times of the year. Its habitat consists of rocky gullies below the peaks of a high grassy escarpment. The principal colony is now situated in a quarry. The type locality is situated next to stand of wattle that is invading the area. This butterfly in threatened by successional changes of the vegetation (Henning *et al.* in press).

***Aloeides barbarae* (Endangered)**
This butterfly flies in November and December. It is found only from one limited area along the road to Eureka City above Sheba mine near Barberton. Although the area of the colony is quite small, many specimens are often seen. The habitat consists of a fire climax grassy peak with scattered small rocks, which is surrounded by Sour Lowveld Bushveld (Low and Rebelo 1998). *A. barbarae* may be threatened by mining, informal settlement and recreational development (Henning *et al.* in press).

***Lepidochrysops swanepoeli* (Endangered)**
*Lepidochrysops swanepoeli* flies from September to November. It is found on a few grassy hills near Barberton above Sheba and Fairview mines. In some years only few specimens can be found, but in years when conditions are favourable many specimens can be seen over quite an extensive area. The habitat consists of grassy summits and slopes of North-eastern Mountain Grassland (Low and Rebelo 1998) surrounded by Sour Lowveld Bushveld (Low and Rebelo 1998). It may be threatened by mining, informal settlement and recreational development (Henning *et al*, in press).

***Lepidochrysops jefferyi*. (Endangered)**
It flies from October to December and can be found on grassy hilltops and slopes with scattered trees above the Noordkaap, Sheba, Fairview and Ulundi mines. At times, the population numbers can be quite high. The habitat consists of grassy summits and slopes of North-eastern Mountain Grassland (Low and Rebelo1998) surrounded by Sour Lowveld Bushveld (Low and Rebelo 1998). It may be threatened by mining, informal settlement and recreational development (Henning *et al*, in press).

***Dingana fraterna*. (Endangered)**
This butterfly has only been recorded flying during the second and third week of October and only a few specimens can by seen at any one time. The total number of individuals during the entire flight period is probably not more than a hundred individuals. The habitat is very small and consists of a very steep convex rocky ridge at the base of a deep valley on the eastern edge of the Highveld plateau in North-eastern Mountain Grassland (Low and Rebelo 1998) to the South-west of Stoffberg. It may be threatened by changes of its habitat (Henning *et al*, in press).

***Metisella meninx.* (Vulnerable)**
*Metisella meninx* flies from December to March in wetlands. Population size varies according to the habitat size and can vary from around twenty to more than one hundred. During wetter years populations are larger and during drier years some colonies may disappear altogether but some areas may be recolonised during wetter years. The habitat consists of marshy headwater areas. It has been found at six sites in Mpumalanga, but modelling suggests a possible wider spread in wetlands of the Province. It also occurs at other sites outside Mpumalanga Province. This butterfly may be threatened by alterations of its wetland habitat (Henning *et al*, in press).

***Aloeides nubilis.* (Vulnerable)**
*Aloeides nubilis* flies were only recorded in September and October. Only about twenty adults can be found on a good day at the Morgenzon colony and the colony would consist of about two hundred specimens during the entire flight period. Currently two colonies are known, one from Robbers Pass and one from Trout Hideaway. A pine plantation has destroyed suitable habitat at the type locality at Klipbankspruit. This species occurs in pristine grassland in the mist belt (Henning *et al*, in press).

4.8.3.2 Odonata (Dragonflies)

***Pseudagrion coeleste.* (Critically endangered)**
Known in South Africa from only one colony at the Lower Sabie weir in the Kruger National Park where it was not abundant. Since the floods of February 2000 it has not been found again and may be regarded as Regionally Extinct. Its preferred habitat is shaded riverine pools in Savanna, which have been disturbed by the floods. This dragonfly is probably not threatened elsewhere in Africa, where it occurs further north to Chad (Samways 2001).

***Pseudagrion inopinatum.* (Vulnerable)**
This dragonfly is very localised and is only known from two localities in Kwazulu-Natal and Badplaas, with Badplaas the type locality. It has not been observed since 1968. The Badplaas colony may have suffered from impacts of the February 2000 floods. This **endemic** dragonfly requires habitats consisting of montane streams with an abundance of long grasses and herbs on the banks. It is probably threatened by livestock farming, damming of streams and alien invasive species (Samways, 2001).

***Pseudagrion newtoni.* (Vulnerable)**
This dragonfly was formerly known only from Kwazulu-Natal but has not recently been observed there. The type locality at Nqutu is heavily disturbed. Currently, the only known locality is at Pilgrim’s Rest. This **endemic** species requires fine, long grasses and reeds at the margins of swift, clear, upland rivers. Threats to this species include cattle grazing on

the banks, alien invasive trees, damming of rivers and introduction of trout (Samways 2001).

***Pseudagrion sjoestedti pseudosjoestedti.* (Critically endangered)**
This species is known from South Africa, north to The Gambia. Locally it only occurred in the lower reaches of the Sabie River in the Kruger National Park where its habitat was destroyed by the floods of February 2000. It may be regarded as Regionally Extinct. Its preferred habitat are tree covered pools of Savanna rivers (Samways 2001).

***Aeshna ellioti usambarica.* (Vulnerable)**
Its distribution extends from South Africa, northwards to Ethiopia. In South Africa it was only known from a few specimens collected in the Soutpansberg and Mariepskop. Despite intensive searches it could not be found again in the Soutpansberg. It is now only known from the Mariepskop area and from Kaapsehoop, where it was recently discovered. Its habitat is montane pools adjacent to natural forest and the construction of farm dams adjacent to natural forest seems to benefit this species. Threats to this species include alien invasive trees and alien fish species (Samways 2001).

***Phyllomacromia monoceros.* (Critically endangered)**
This species is widely spread in southern Africa up to Kenya. In South Africa it is however, only known from one female specimen captured in 1911 at Barberton. Despite intensive searches it has not be found there again. Its habitat is montane streams in hot, bushy Savanna. Threats include invasive alien vegetation, mine effluent and possibly agricultural run-off and alien fish (Samways 2001).

### 4.8.4 Discussion
This study has highlighted the central highveld regions of Mpumalanga as important for the conservation of threatened invertebrates (Fig 4.8.1). The biggest threat to invertebrates is habitat destruction. Agricultural and forestry activities are the most extensive land uses that have resulted in the greatest loss of insect populations. Invasions by alien vegetation are also responsible for the loss of many colonies of butterflies specifically. Since butterflies often occur very localised, even small developments may result in the destruction of a colony, and in the case of very rare species this may lead to the extinction of that species.

Three of the listed dragonfly species were severely impacted by the flood of February 2000, the effect of which is amplified by the modification of catchments. Two species are regarded as Regionally Extinct as a direct result of the floods. One species is threatened by pollution and alien fish and one is threatened by overgrazing and the damming of swiftly flowing streams. One dragonfly, *Aeshna ellioti usambarica* is benefits from the building of dams.

The cicada *Pycna sylvia* that was rediscovered during an animal life survey illustrates the need of more research on our invertebrate populations as many are only known from type specimens. Where they are actually known, conservation action should be taken to ensure their future existence.

### 4.8.5 Acknowledgements
Thanks to Anthony Emery for assistance with the distribution modelling and Sandra Williamson and Mervyn Lötter for editing the text. To Graham Henning for making available the manuscript of the Red Data Book –Butterflies, before its publication and to

SRK Consulting and Anglo Platinum for making available the information on the cicada *Pycna sylvia*. We are also grateful for the intention of Anglo Platinum to continue research on this cicada.

### 4.8.6 References

Claasen, P.W., 1933. The influence of civilisation on the insect fauna in regions of industrial activity. *Ann. Entomol. Soc. Am*. 26:503-510.

Henning G.A., Henning S.F, Curle A.I. & Curle N.I. In press. *South African Red Data Book – Butterflies*. Preliminary publication – Mpumalanga Butterflies. Lepidopterists' Society of Africa.

Low, A.B. & Rebelo, A., (eds) 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

Malherbe, C. 2002. Cicada Specialist Study *Pycna sylvia* Distant. Report commissioned by SRK Consulting.

Morris M.G., 1981. Conservation of Butterflies in Britain. *Beih. Veröff. Naturschutz Landshaftspflege Ba.-Wurtt*. 21:35-47 Karlsruhe.

Pyle, R.M. 1976. *The eco-geographic basis for Lepidoptera conservation*. Ph.D thesis. Yale University, New Haven, Connecticut. 369 pp.

Samways, M.J. 2001. National Red List of South African Dragonflies (Odonata). *Journal of Odonatologia i*n press

Wells, S.M., Pyle, R.M. & Collins, N.M. 1983. *The IUCN Invertebrate Red Data Book*. IUCN. Gland, Switzerland.

## 4.9 Important Species Sites Coverage

The important species sites coverage was derived by additively overlaying the species layers comprising of threatened plants, medicinal plants, mammals, birds, amphibians, reptiles, fish and invertebrates. Since each species had been weighted according to its IUCN or Red Data Book rating it was possible to add all the species layers without further standardising the layers.

The most important areas for species were the areas within and surrounding Blyde Canyon Nature Reserve, the areas around Long Tom Pass, Dullstroom, Machadodorp, Songimvelo Game Reserve, Carolina, Warburton, Lothair, Paardeplaats Nature Reserve, and the escarpment between Sheepmoor and Wakkerstroom (Fig. 4.9.1).

This analysis identifies areas of cumulative importance for species, but falls short of identifying areas of critical importance for achieving the desired level of protection for each of the species used in the analysis. This means that a site may be identified as an area of low importance because only one species occurs or is predicted to occur in that area, but this may be the only such site. These sites would be identified through algorithms that identify the most efficient reserve network to conserve all the selected species. This is a priority follow-up analysis that needs to be conducted with sufficient ground-truthing.

# 5 Sites of Intrinsic Biodiversity Value

## 5.1 Introduction

The purpose of establishing this coverage was to identify areas of high biodiversity within the Mpumalanga Province. This is different to the identification of areas requiring protection to conserve all species of conservation importance. Margules and Pressey (2000) have recently reviewed the large and growing literature on this subject. This inevitably leads to the identification, establishment and management of protected areas that fill biodiversity protection gaps. Many of the approaches use complex computer algorithms to identify priority areas for conservation based on the current protected areas existing in the region under study. Since this study was aimed at identifying the biodiversity value of any unit of land within the catchment, a much more simple approach was adopted to establish this value in this study. Ultimately, from a conservation planning perspective the next logical step for this work would be a fully integrated and systematic identification of priority conservation areas.

## 5.2 Combining the Input Layers

In line with the objective of identifying land with high conservation value, all that was required was to combine the Important Communities and Important Species layers. In keeping with previous analyses, it was felt that no group was of greater importance than any other was. This premise has gave rise to two separate analyses:

1. One in which the community and total species layers were given equal weighting in the overlay procedure achieved by standardising two coverages (communities, and species) to the same maximum score of 1 (see Figure 1.1). This provides an analysis with an emphasis towards the communities.
2. A second in which the communities and all the species layers (plants, mammals, birds, amphibians, reptiles, fish and invertebrates) were additively overlayed using the already standardised weighting for each species and community. This analysis provides a greater emphasis at the species level.

The first analysis lays greater emphasis on the important communities, while the second analysis places more emphasis on the individual species layers. It is felt that the first analysis better represents the high biodiversity areas of Mpumalanga as the large number of species modelled, may skew the map/data to the benefit of the species, with little regard for community/ecosystem level analysis. At no point has a single species distribution been given equal weighting to the communities' coverage, although this could easily be achieved with the database as it currently stands.

## 5.3 Results

The first analysis (Figure 5.1), indicates that sites of highest biodiversity value are found primarily within Blyde Canyon Nature Reserve southwards to Sabie and Kaapsehoop, as well as the areas surrounding Lydenburg, Dullstroom, Machadodorp, Barberton, Carolina, Chrissiesmeer, Lothair southwards to Amsterdam, Dirkiesdorp, and Wakkerstroom as the most important communities (Figure 3.7.1).

The second analysis (Figure 5.2), emphasises the areas around within and surrounding Blyde Canyon Nature Reserve, surrounding the Long Tom Pass, Dullstroom, Machadodorp, Songimvelo Game Reserve, Carolina, Warburton, Lothair, Paardeplaats Nature Reserve, and the escarpment between Sheepmoor and Wakkerstroom.

## 5.4 Discussion

The analysis provides a simple additive overlay of the primary layers in the biodiversity hierarchy. Consequently, those areas that score highest do so as a result of being important for more that a single level in the hierarchy. This is equivalent to saying that the sites identified are rich in assets that are important for conserving biodiversity. This analysis does not identify sites that are critically important for conserving representative and viable samples of all important biodiversity elements in the province.

The two analyses undertaken indicate that the sites currently richest in important biodiversity assets are clearly in the vicinity of Blyde Canyon Nature Reserve, Sabie and, as well as the areas surrounding Lydenburg, Dullstroom, Machadodorp, Kaapsehoop, Songimvelo Game Reserve, Carolina, Chrissiesmeer, Lothair southwards to Amsterdam, Paardeplaats Nature Reserve, and Wakkerstroom (Figure 3.7.1).

# 6 Conservation Areas

Contributors: M.C. Lötter, A. Emery and K. Zunckel

## 6.1 Provincial Reserves

There are 13 proclaimed Nature Reserves (including National Parks) within Mpumalanga Province. A further 17 sites are considered as protected but still require legal recognition. These reserves, listed in Table 6.1, conserve a total of 1 148 956 ha (14.5%) of the 7 942 259 ha of Mpumalanga Province. However, if the Kruger National Park is excluded from the calculation, then only 3% of Mpumalanga is conserved. This not only highlights the importance of Kruger National Park as a conservation area, but also how inadequately the remainder of the province, particularly the areas of high conservation value, is conserved.

## 6.2 Conservancies

Eight conservancies exist within Mpumalanga and these are listed in Table 6.2. A total 80 756 ha of land is under the management of the 8 conservancies. The geographic locations of these conservancies are shown in Figure 6.1. Two new conservancies are in the process of being formed around the Paardeplaats and Witbad Nature Reserves.

## 6.3 Biosphere

The Ekangala Grassland Biosphere initiative seeks to establish and maintain a biosphere reserve aimed at securing the ecological integrity of the high altitude moist grasslands of Mpumalanga, KwaZulu-Natal and Free State provinces (Figure 6.1). The target area is approximately one million hectares of continuous grassland that hosts a high biodiversity, delivers essential ecosystem services and is under threat from unsustainable land use practices. Although being of such a high conservation importance, there is a serious lack of formally protected areas. The biosphere initiative seeks to use all available ‘tools’ at its disposal to highlight this situation and to persuade land owners and other stake holders to work together to enhance the conservation status of the area.

Of significance to the Biobase Project is the ecosystem services referred to above. The most significant of these is the water catchment properties of the grasslands and associated wetlands. When managed so as to maintain the vigor, grasslands provide strong and resilient cover for these high altitude areas. This cover ensures that weathering and erosive effect of precipitation is limited and that water ‘delivered’ into the drainage lines of Mpumalanga is of high quality. Together with the hydrological function of the associated wetlands, a sustained yield of water is also ensured.

A major challenge seen by the Ekangala Biosphere is to facilitate sustainable alternatives to the unsustainable options that are becoming more attractive to landowners. Extensive live stock farming, that has maintained the natural vegetation cover, is being threatened through stock theft and market forces and afforestation is an easy solution to the woes of these farmers. The transformation of grassland to a timber plantation is irreversible and loss of biodiversity and ecosystem vigor is inevitable.

Table 6.1 Nature Reserves of Mpumalanga Province.

| NAME | OWNERSHIP | TYPE | STATUS | SIZE (HA) |
|---|---|---|---|---|
| Barberton Mountainlands | MPB & Community | NR | Not Proclaimed | 21651.7 |
| Barberton Nature Reserve | MPB | NR | Not Proclaimed | 2424.8 |
| Blyde River Canyon Nature Reserve | MPB | NR | Proclaimed | 28425.0 |
| Jericho Dam Nature Reserve | MPB | NR | Proclaimed | 1915.8 |
| Komatipoort Area | Department of Works | A | Uncertain | 252.9 |
| Kruger National Park | SANP | NR | Proclaimed | 909800.0 |
| Kwaggavoetpad Nature Reserve | MPB | NR | Proclaimed | 7239.3 |
| Lomshiyo Cattle/Game Project | MPB & Community | CG | Not Proclaimed | 1503.7 |
| Loskop Dam Nature Reserve | MPB | NR | Proclaimed | 23174.9 |
| Mabusa Nature Reserve | DACE | NR | Not Proclaimed | 14883.3 |
| Mahushe Shongwe Nature Reserve | MPB & Community | NR | Not Proclaimed | 1139.6 |
| Mananga CARE Program | MPB & Community | CA | Not Proclaimed | 253.0 |
| Marble Hall Fisheries | DACE | F | Proclaimed | 0.6 |
| Masibekela Wetland | MPB & Community | NR | Not Proclaimed | 9890.6 |
| Mawewe Cattle/Game Project | MPB & Community | CG | Not Proclaimed | 9189.1 |
| Mdala Nature Reserve | DACE | NR | Not Proclaimed | 1530.6 |
| Mkombo Nature Reserve | DACE | NR | Not Proclaimed | 17439.2 |
| Mt Anderson Area | Private | A | Proclaimed | 1936.6 |
| Mthethomusha Nature Reserve | MPB & Community | NR | Not Proclaimed | 7116.9 |
| Nooitgedacht Dam Nature Reserve | MPB | NR | Proclaimed | 2962.2 |
| Ohrigstad Dam Nature Reserve | MPB | NR | Proclaimed | 2467.7 |
| Ossewakop | MPB | NR | Not Proclaimed | 725.9 |
| Paardeplaats | MPB | NR | Not Proclaimed | 2426.2 |
| Scuinsdraai Nature Reserve | DACE | NR | Not Proclaimed | 7989.0 |
| Siyabuswa Fisheries | DACE | F | Not Proclaimed | 255.0 |
| Songimvelo Nature Reserve | MPB | NR | Proclaimed | 47076.5 |
| SS Skosana Nature Reserve | DACE | NR | Not Proclaimed | 1816.5 |
| Sterkspruit Nature Reserve | MPB | NR | Proclaimed | 1508.1 |
| Verloren Valei Nature Reserve | MPB | NR | Proclaimed | 6060.4 |
| Wakkerstroom Wetland | MPB | NR | Not Proclaimed | 652.5 |
| Witbad Nature Reserve | MPB | NR | Proclaimed | 1078.4 |

Table 6.2 Conservancies within Mpumalanga Province.

| NAME | SIZE (HA) |
|---|---|
| Amsterdam | 26604.4 |
| Bakoondkrans | 899.8 |
| Jock of the Bushveld | 4620.9 |
| Ligwalagwala | 12638.5 |
| Lionspruit | 1615 |
| Mount Carmel | 5408 |
| Nu Scotland | 15791.9 |
| Reitvaal | 13177.9 |

## 6.4 Conclusion

The MPB needs to concentrate on trying to formally proclaim many of the legally unproclaimed Nature Reserves within the province. The national Biodiversity Bill, which is currently being drafted, makes provision for protected areas. The proposed system may have significant benefits to the current provincial reserve network.

By only looking at the provincial and national network of protected areas this study failed to identify and realise the importance of land under private management. Large tracts of land are being set aside and managed as private nature reserves and some of these areas may be situated in areas of high conservation value. These private reserves need to be documented, mapped and included within future analyses. This would highlight the importance of land under private management, and their benefit to conservation.

The current reserve network is conceivably capable of conserving much of the province’s areas of high biodiversity. The placement of reserves such as Blyde River Canyon, Songimvelo, Verloren Valei, Ohrigstad and Sterkspruit Nature Reserves is highly favourable for biodiversity conservation. However, this study highlights the need to establish a formal reserve network based around the Mount Anderson area. The recent acquisitions of state land in the Wakkerstroom and Barberton areas also now require formal proclamation.

The Biobase Project identified areas of high biodiversity, in that these areas are rich in the occurrence of important vegetation communities and species. The suitability of the current placement of reserves was briefly mentioned above, however this project failed to identify the irreplacebility value of a piece of land. This would require the identification of a network of protected areas that would ensure that the full compliment of species and communities identified through the biobase project are conserved.

# 7 Information Maintenance, Future Analysis and Sharing

Information maintenance, future analysis and sharing will follow the guidelines as outlined by KwaZulu-Natal Nature Conservation Services. The following text has therefore been taken directly from the KwaZulu-Natal Nature Conservation Services report "Determining the conservation value of land in KwaZulu-Natal" and altered slightly to suite the requirements of the Mpumalanga Parks Board.

Database maintenance
The databases which support this analysis comprise digital versions of mapped features including climatic variables, geology, soils and vegetation types, compiled digital maps including wetlands and forests, and derived maps including landscapes and all the species distribution maps. For the analysis to retain its current value into the future, the databases need to be improved and kept current. Probably the most critical of these is the land-cover coverage since all areas identified as important are done so only if they are untransformed. Since transformation of Mpumalanga natural areas is taking place at a rapid rate, it is critical that regular (minimum of five-year intervals) updates of the coverage are undertaken.

The wetland and forest coverages for the province are still incomplete. New wetland and forest data are becoming available as new areas are being surveyed, and these coverages need to be updated on an annual basis for them to remain useful. To meet the 1:50 000 mapping standards, however, both these ecosystems will have to be remapped using the most recent 1:50 000 or better aerial photography. Furthermore, both attribute databases need further development and attribute data capture. Currently, the MPB does not have the resources to maintain both these coverages in an updated form.

The vegetation community analyses used an available broad scale vegetation map, the National Land Cover database and Provincial reserve network as the basis of the analyses. Parts of the analysis will need to be updated as and when new conservation land is acquired or sold, or when a new land-cover map is completed. The whole analysis will need to be updated when a new vegetation community map is developed.

The species coverages are all dependant on the collection and sightings of the species themselves and the GIS layers used as dependent variables in the spatial modelling of the distributions. New distribution data are becoming available continuously as new surveys are undertaken, and the MPB undertake to maintain and update all species databases with the most current distribution data for species selected for the SEA analysis. As reasonable quantities of distributional data become available for a particular species, so its distribution will be remodelled and included in an update of the coverage.

It is recommended that the primary GIS layers (Figure 1.1) should be updated on an annual basis, incorporating any new information that has become available during the year.

*Future analysis*
The final coverages produced in this analysis, are expressions of relative importance value between areas. By grouping the values of areas into classes, one gets a visual impression of where sites with high biodiversity value in the province are. However, the overall analysis undertaken so far begs the question frequently asked by developers and conservation organisations with restricted budgets, namely: 'which sites are critical for the long term conservation of a representative sample of the provinces biodiversity?' Clearly

the focus of future analyses must tackle this question, which should also include the identification of linking corridors between the identified core conservation sites.

The species distribution modelling undertaken in this analysis was fairly simplistic, and did not employ a comprehensive set of statistical tools available for this purpose. Future analyses must include statistically appropriate distribution modelling of the most important species.

Data sharing and distribution

This study has developed a comprehensive set of maps indicating the biodiversity value of any piece of land outside of formally protected areas in the province. This information, although commissioned specifically to guide the Strategic Environmental Assessment process, is sought after by a wide variety of individuals and institutions undertaking development proposals and impact assessments. It is the intention of both DWAF and the MPB to circulate this information freely in the user community but at the same time minimising the time required to service requests for the information.

Currently, the MPB services all information and data requests manually. The request is made via e-mail or fax to Technical Services, an assessment of the data extraction charge made, and an agreement entered into to service the data request. The data is manually extracted to the user's specifications and forwarded to the user on the appropriate medium. There are several problems associated with this approach namely:

- Potential users are very often not familiar with GIS, hence the formulation of the data request is not structured in a manner that makes data extraction efficient. This often results in repeated communication between user and data technician to clarify and refine the request.
- The MPB is not staffed adequately to service large volumes of data requests. During peak periods this can lead to delays in data provision.
- The data if supplied without any written documentation (as is normal), can lead to substantial misinterpretation of the information. Quite often, a substantial amount of time is spent explaining and interpreting the results of the project to the potential data user.

After consideration of these problems and discussions with potential users of the data the following data browsing and supply options are recommended:

1) Develop a web based map viewing tool giving potential users an overview of the project and the data /information that is available from it. This is aimed at addressing the need of the initial inquirer, and would carry view only images and a brief explanation of the process by which the information on the images was derived and the circumstances suitable for its use. The web site would have a web form that could be completed submitted, should potential users require electronic versions of the GIS data underlying the maps.
2) Cut a CD containing the complete SEA report and all the primary level coverages (see Figure 1.1). Each coverage would be available in ESRI compatible formats with the document file in rich text format and accompanying database where appropriate. The CD would be sold on a cost recovery basis (e.g. R 200), and updated with new information on an annual basis.
3) Convert all data to vector format in the form of shape files and include the freeware GIS viewer Arc Explorer on the above CD.

Both options 2 and 3 above will require further resources to put in place.