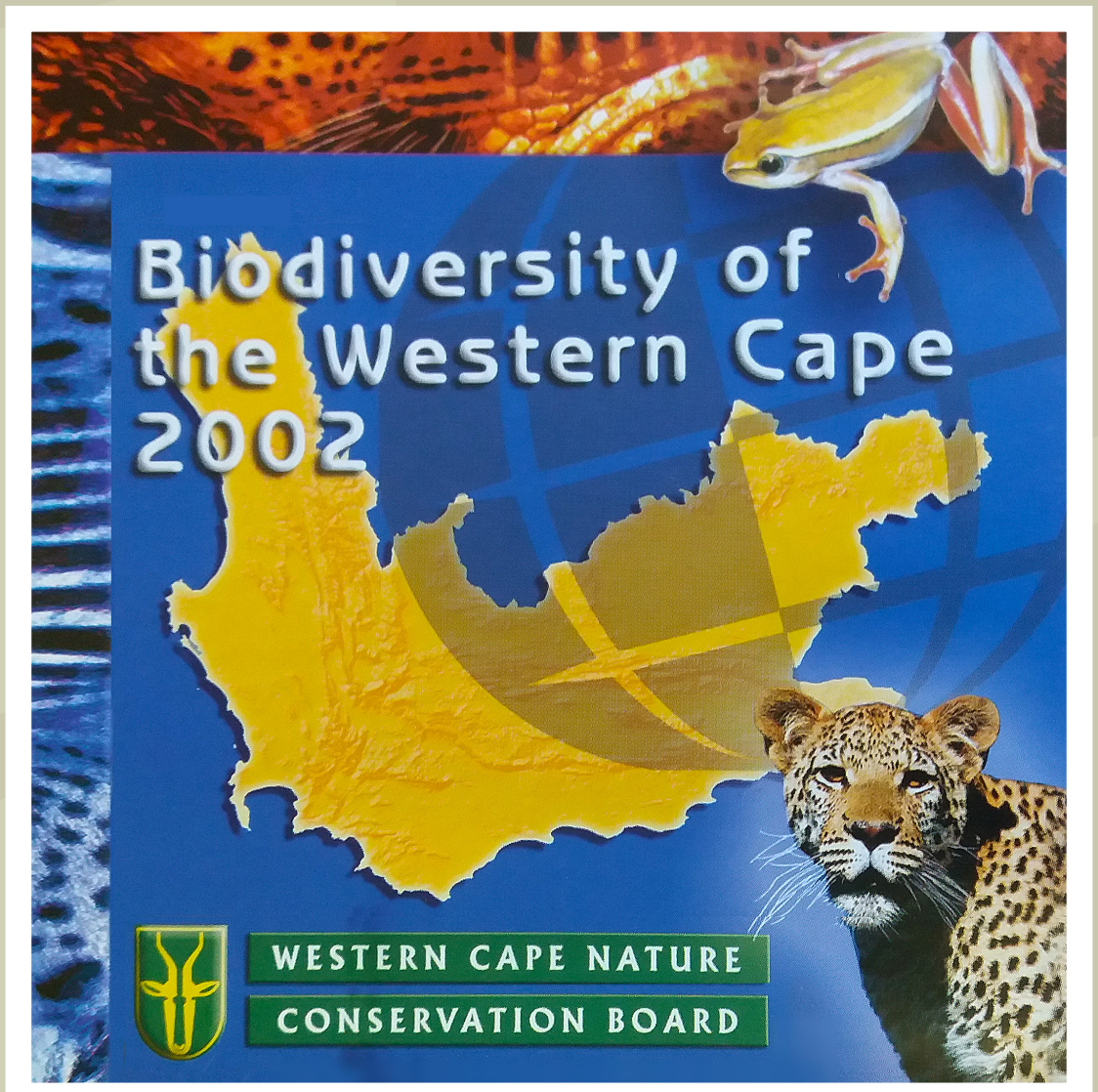
Biodiversity of the Western Cape 2002
WESTERN CAPE NATURE
CONSERVATION BOARD

State of Biodiversity: Western Cape Province, South Africa
Introduction

Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

The Western Cape Province is fortunate to house two of the world's biodiversity hotspots – the Fynbos and Succulent Karoo biomes. However, threats to the environment are increasing throughout the world and particularly in the Western Cape Province, where a large proportion of the land has been transformed to a state unsuitable for many of the species making up this unique biodiversity. This has necessitated a process to evaluate, monitor and report on the status of the natural environment. From this, well informed and considered conservation plans can be drawn up to help ensure the sustainable utilisation of our natural heritage.

There is a great need to synthesize all our biodiversity knowledge, regarding both patterns and processes. In the last five years great strides have been made in achieving this synthesis, e.g. Cape Action for People and the Environment (C.A.P.E.), the Succulent Thicket Ecosystem Plan (S.T.E.P.) and the Succulent Karoo Environmental Plan (S.K.E.P.). In 1998 the Western Cape Nature Conservation Board (W.C.N.C.B.) initiated a State of Biodiversity programme, which will attempt to evaluate the status of the faunal and floral species as well as other environmental components occurring in the Western Cape (including the Cape Floristic Kingdom which extends into the Eastern and Northern Cape).

This first State of Biodiversity report for the Western Cape concentrates on the freshwater fish, amphibians, reptiles, mammals and birds, as well as the status of conservation areas, both statutory and private. It is an assessment of the past and present distribution of the faunal diversity and conservation areas and will serve as a benchmark for subsequent five-yearly updates. These updates should reveal trends in the status of the biodiversity and conserved areas. The programme will provide assessments of the progress of recommendations arising from previous reports. The flora and invertebrates will be dealt with in the next report.

For the Western Cape Nature Conservation Board this has been a most exciting programme because it is a collaborative, multi-disciplinary, multi-institutional effort involving conservation agencies, museums, universities, research institutes, NGO's and other associations. We wish to acknowledge and thank all partners, namely Northern Cape Nature Conservation Service, Eastern Cape Nature Conservation, South African National Parks, Worldwide Fund for Nature, South Africa, Institute for Plant Conservation, South African Institute for Aquatic Biodiversity, Albany Museum, Port Elizabeth Museum, Northern Flagship Institute, Iziko (Museums of Cape Town), and the Universities of Cape Town, Rhodes, Western Cape and Stellenbosch for the data supplied as well as their input into this report.

Western Cape Nature Conservation Board commitment to biodiversity conservation

Much care and thought has gone into what is needed, worldwide, nationally and locally, to ensure the survival of the planet. This has resulted in many international policies and conventions as well as national and provincial laws and regulations having been put into place in the last few years to aid and guide the conservation and sustainable utilization of our natural resources. It is therefore the commitment of the Western Cape Nature Conservation Board (W.C.N.C.B.) to fulfill its obligation towards the maintenance of biodiversity in the Western Cape as required and prescribed by these policies, conventions, laws and regulations, especially the UN Convention on Biological Diversity (see APPENDIX I). However, to be able to utilize this legislation knowledge of the biodiversity of the Western Cape and the Cape Floristic Kingdom, as well as the status of these species and processes, is a prerequisite.

To achieve this commitment, W.C.N.C.B. aims to:

- establish an optimally placed network of representative conservation areas, both statutory and private, as well as to create co-operative management structures within the Western Cape boundaries;
- address specific conservation issues in the Western Cape;
- ensure that accurate and comprehensive biodiversity data for proper and effective environmental planning and impact assessment processes are provided;
- collect, collate, analyse and present current biological data and co-ordinate future data collections relating to the distribution, status and ecological requirements of the plant and animal species necessary for functioning ecosystems in the Western Cape in order to provide a framework for the longterm monitoring of the state of biodiversity; and
- evaluate conservation performance, progress and achievements in the Western Cape.

The State of Biodiversity programme will ensure that the W.C.N.C.B. will:

- produce an initial State of Biodiversity report, based on the current state of knowledge regardless of gaps and imperfections, by the year 2002 covering the vertebrate components of the Province's biodiversity and the status of statutory and privately conserved areas (the floral and invertebrate components will be addressed in the next State of Biodiversity report);
- produce subsequent five-yearly reports monitoring the status of the biodiversity over time, which will serve as an environmental auditing process to evaluate conservation

performance, progress and achievements in the interest of being accountable to the people of the Western Cape;

- facilitate focused attention and actions on specific conservation issues, e.g. identifying areas of biological importance for conservation actions (such as biosphere reserves and conservancy initiatives) as well as other specific conservation projects (such as crane, vulture, penguin, geometric tortoise and endemic fish conservation projects);
- maintain and create infrastructure to capture, store, retrieve and analyse current and future biological data on the plant and animal species, as well as ecological systems and processes of the Western Cape, through an integrated, computerised biodiversity database system and biodiversity analysis tool kit;
- provide easy access to biodiversity data to the public through the Conservation Planning Unit (http://cpu.uwc.ac.za) needed for the implementation of the C.A.P.E., S.K.E.P. and S.T.E.P. as well as for other environmental planning; and
- improve public knowledge and appreciation of the Western Cape's unique natural heritage through an effective programme of environmental awareness and education.

APPENDIX I POLICIES, CONVENTIONS, LAWS AND REGULATIONS APPLYING TO CONSERVED AREAS

INTERNATIONAL

- IUCN Caring for the earth: A strategy for sustainable living World Conservation Strategy
- UN Convention on Biological Diversity (CBD)
- UN Framework Convention on Climate Change (FCCC)
- UNESCO World Heritage Convention (WHC)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Migratory species of wild animals (BONN Convention)
- Agreement on the conservation of African-Eurasian migratory waterbirds
- Convention on Wetlands of International importance especially as waterfowl habitat (RAMSAR Convention)
- International Convention to combat desertification in countries experiencing serious drought and/or desertification, particularly in Africa
- World Trade Organization: General Agreement on Tariffs and Trade
- Protocol on Wildlife Conservation and Law Enforcement in the Southern African Development Community
- The Lusaka Agreement on Cooperative Enforcement Operations directed at illegal trade in Wild Fauna and Flora.
- Convention Relative to the Preservation of Fauna and Flora in Their Natural State, 8 November 1933 (London)
- International Convention for the Regulation of Whaling (as amended), 2 December 1946 (Washington)
- Convention of the World Meteorological Organization with Related Protocols, 6 March 1947 (Washington)
- Convention on the International Maritime Organization, 6 March 1948 (Geneva)
- International Plant Protection Convention, 6 December 1951 (Rome)
- Convention on the Territorial Sea and Contiguous Zone, 29 April 1958 (Geneva)
- Convention on the Continental Shelf, 29 April 1958 (Geneva)
- Convention on Fishing and Conservation of the Living Resources of the High Seas, 29 April 1958 (Geneva)
- International Convention on the Protection of New Varieties of Plants, 2 December 1961 (Paris)
- Agreement Concerning Rivers of Mutual Interest between Portugal (Mozambique), Swaziland and the Republic of South Africa, 13 October 1964
- Convention on the Conservation of the Living Resources of the South-East Atlantic, 23 October 1969 (Rome)
- International Convention on Civil Liability for Oil Pollution Damage, 29 November 1969 (Brussels)
- International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 29 November 1969 (Brussels)
- Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxic Weapons and their Destruction, 10 April 1972 (London, Moscow, Washington)
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 29 December 1972 (London, Mexico, Moscow, Washington)
- International Convention for the Prevention of Pollution from Ships, 2 November 1973 (London)
- Protocol on Environmental Protection to the Antarctic Treaty, 4 October 1991 (Madrid)
- Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, 13 January 1993 (Paris)

NATIONAL:

- Environment Conservation Act, 1989 [No. 73 of 1989]
- National Environmental Management Act, 1998 [No. 107 of 1998]
- World Heritage Convention Act, 1999 [No. 109 of 1999]
- National Water Act, 1998 [No. 36 of 1998]
- National Forests Act, 1998 [No. 84 of 1998]
- National Veld and Forest Fire Act, 1998 [No. 101 of 1998]
- Mountain Catchment Areas Act, 1970 [No. 63 of 1970]
- Conservation of Agricultural Resources Act, 1983 [No. 43 of 1984]
- Marine Living Resources Act, 1998 [No. 18 of 1998]
- Animals Protection Act, 1962 [No. 71 of 1962]
- Performing Animals Protection Act, 1935 [No. 24 of 1935]
- Sea-shore Act, 1935 [No. 21 of 1935]
- Sea Birds and Seals Protection Act, 1973 [No. 46 of 1973]
- National Parks Act, 1976 [No. 57 of 1976]
- Game Theft Act, 1991 [No. 105 of 1991]
- National Heritage Resources Act, 1999 [No. 25 of 1999]
- Tourism Amendment Act
- Mineral Development Draft Bill
- Disaster Management Bill
- Animal Diseases Act, 1984 [No. 35 of 1984]
- Customs and Excise Act, 1964 [No. 91 of 1964]
- The Constitution of the Republic of South Africa Act, 1996 [No. 108 of 1996]
- Agricultural Pests Act, 1983 [No. 36 of 1983]
- Genetically Modified Organisms Act, 1997 [No. 15 of 1997]
- Criminal Procedures Act, 1977 [No. 51 of 1977]
- Police Services Act, 1995 [No. 68 of 1995]
- National Monuments Act, 1969 [No. 28 of 1969]
- Prevention and Combating of Pollution of the Sea by Oil Act, 1981 [No. 6 of 1981]
- Wrecks and Salvage Act, 1996 [No. 94 of 1996]
- Water Act, 1956 [No. 54 of 1956] (marine pollution)
- Dumping at Sea Control Act, 1980 [No. 73 of 1980]
- Nuclear Energy Act, 1982 [No. 92 of 1982]
- Railways and Harbours Control and Management (Consolidation) Act, 1957 [No. 70 of 1957]
- Water Services Act, 1997 [No. 108 of 1997]
- Mineral Act, 1991 [No. 50 of 1991]
- Occupational Health and Safety Act, 1993 [No. 85 of 1993]

Many new acts, policies, strategies and procedures are currently being drafted. Provincial and local policies, *etc.* also need to be taken into account.

State of Biodiversity: Western Cape Province, South Africa Biodiversity Database

Andrew A. Turner
Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

To provide information on the substantial biodiversity of the Western Cape province a well-structured relational database that can store data for all living organisms in the province was developed.

The database consists of two main parts. The first stores information about each of the taxa and their taxonomic relationships from kingdom to species or subspecies (or variety in the case of plants). Other relevant information includes conservation information as represented by IUCN Red List status, South African Red Data Book status, CITES appendix and provincial ordinance is stored for each taxon. In addition, each taxon is classified according to its indigenousness and endemism at a set of scales ranging from the Cape Floristic Region to the continent of Africa.

The second part stores distribution data for individuals of the taxa. These may be in the form of museum and herbarium specimens, observations or other kinds of visual and auditory records that describe the presence of an organism at a particular place in space and time. The precision with which we know the place, time and identity of the taxon recorded are also stored in the record. In addition, there are many other attributes that may be stored for each of these records such museum accession number, collector information, locality descriptions, ownership of the data, notes, habitat data

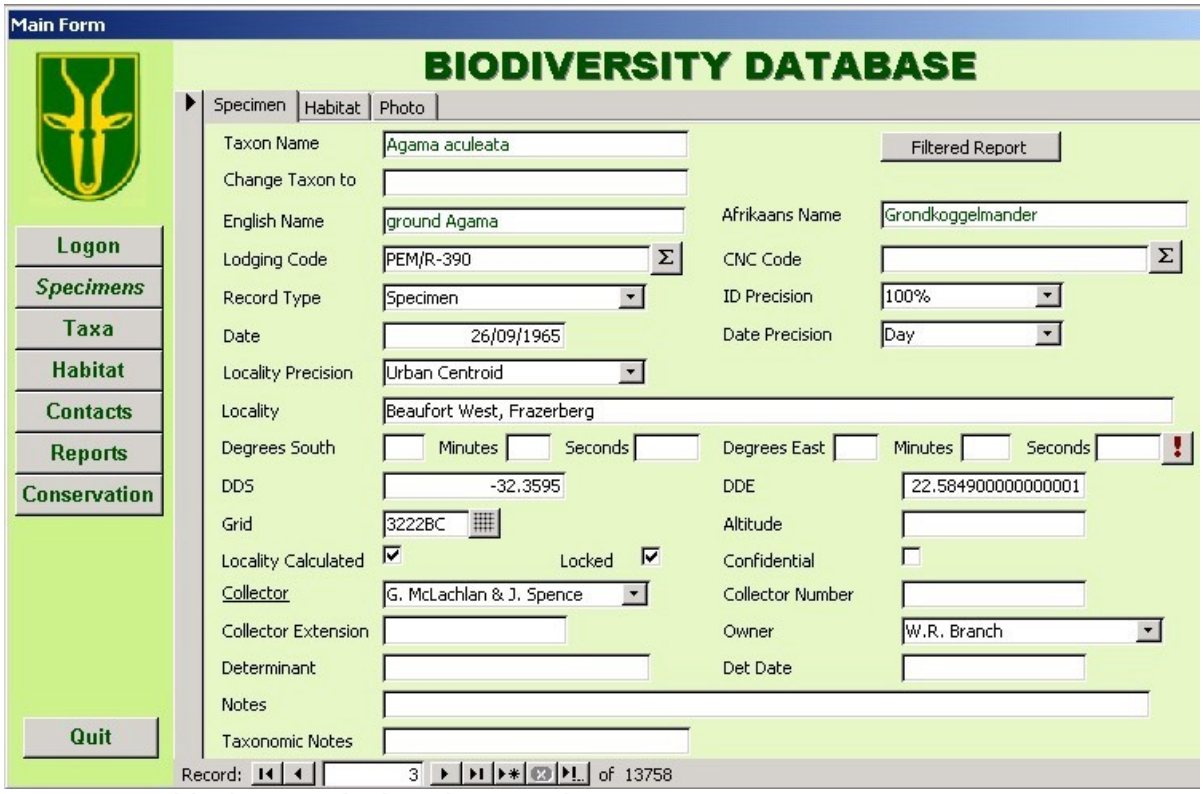

Figure 1. A typical distribution record in the Biodiversity Database.

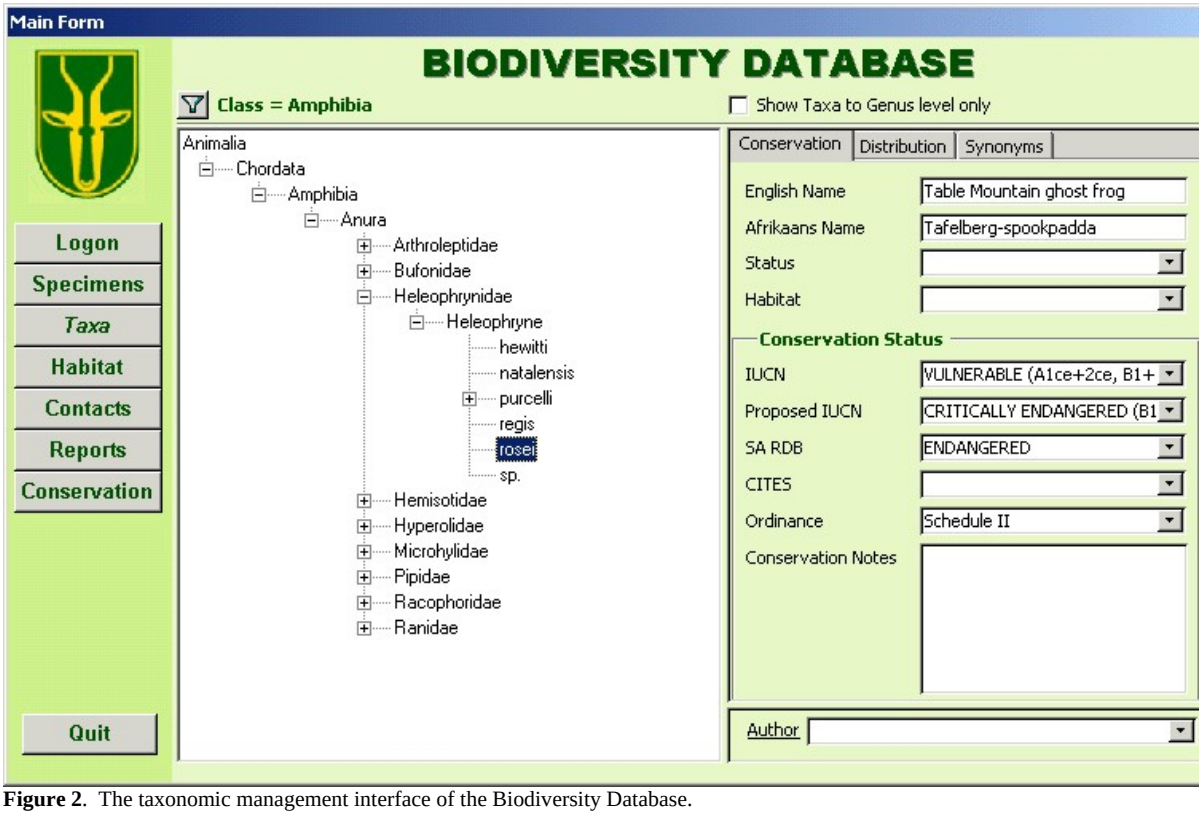

Figure 2. The taxonomic management interface of the Biodiversity Database.

and various taxon-specific attributes one may want to record. Digital images such as photos or scans of each specimen are also stored and displayed by the database.

All the data is made available to the users through a user-friendly graphical interface. As described in the Biodiversity Analysis Toolkit (BAT) below, the database was designed from the start to integrate with a GIS.

Data quality

Data quality is assessed from the combination of the three precision attributes i.e. identification, temporal and spatial precision. Most data (96%) have dates precise to the day but many of the older museum records have poorer date precision. The vast majority of the data (99%) is identified to species level or better. Most data (96%) has a spatial precision to the nearest quarter degree (15 minutes), the bulk of which is made up of bird data from the South African Bird Atlas Project, with only 2.7% i.e. 36794 records with point localities. The total number of records in the database at the time of writing was 1 363 854 and is distributed among the classes as depicted in Table 1.

Data collation

The extensive collections made by W.C.N.C.B. and various datasets made available by collaborating partners were imported into the Biodiversity Database and where necessary spatial, temporal and taxonomic identity precisions were allocated from the information available. Newly captured data was entered directly into the database. Various checks were made to verify the integrity of the data. These checks were made by specialist biologists at W.C.N.C.B. who are familiar with the taxonomy and general distribution ranges of the taxa in their study area.

What outputs does the database produce?

The database produces three different types of reports:

1. General statistics on information held in the database.
   The database can produce summary statistics on the data such as the number of records per year; list the taxa stored in the database; tables of endemism and indigenousness; conservation status; labels for botanical specimens and

Table 1. Number of records in each taxonomic class.

Kingdom	Class	Records
Plants	Bryopsida	700
	Cycadatae	6
	Dicotyledonae(Magnoliiopsida)	31572
	Filicopsida	248
	Hepaticopsida	57
	Lycopodiopsida	11
	Monocotyledonae(Liliopsida)	11887
	Pinatae	28
Animals	Amphibia	6609
	Aves	1277438
	Chondrichthyes	20
	Mammalia	13064
	Osteichthyes	6318
	Reptilia	13792
Unknown	Unknown	2101

details of the distribution records.

2. Taxon-specific reports that display information for just a particular class of organism. Due to the vast amount of data and the large range of taxa accommodated in the database, most users only work with particular taxonomic groups. The taxon-specific reports produce similar statistics to the general reports but only for the taxonomic group selected by the user.
3. GIS reports which display the results from analyses run using the BAT (see the section entitled Biodiversity Analysis Toolkit below).

The database is continuously updated with new information and new reporting facilities as they are needed.

State of Biodiversity: Western Cape Province, South Africa Biodiversity Analysis Toolkit

Andrew A. Turner and Tim Sutton
Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

The Biodiversity Analysis Toolkit (BAT) integrates the specimen and observation data stored in the Biodiversity Database with a Geographical Information System (GIS). A series of programmes for the ArcView 3.x GIS application achieve this goal. Data stored in the Biodiversity Database can be visualized spatially using overlays of remotely sensed imagery and administrative data such as regional and conservation area boundaries. The BAT provides the ability to display distribution data for a single taxon or an entire taxonomic group (at the Kingdom, Phylum, Class, Order or Family level). The Biodiversity Data is mapped dynamically in 'real time', meaning that changes in the underlying database can be immediately reflected in the ArcView environment.

Visualisation of Biodiversity Data in a GIS environment is an important method of quality control for data recorded in the database – particularly in the case of spatial data. Spatial errors in biodiversity data are easily overlooked in a non-spatial database environment, whilst they are often readily observable in the GIS environment. When one views biological data in its spatial context, one can relate the distribution of the taxa to many other spatial phenomena such as vegetation types, rainfall, altitude and even the distribution of other taxa.

Precision Constraints

Metadata in the Biodiversity Database describes the spatial, temporal and taxonomic precision of each observation record. This information is used by the BAT to filter data used for analysis purposes and the display of distribution maps. Additionally the BAT allows biodiversity data restricted to a given time envelope to be used. Metadata describing the taxonomic precision, temporal precision, spatial precision and time envelope are stored in the GIS for any given data layer derived from the Biodiversity Database. This information is also included in all of the GIS reports (as discussed in the next section) that are produced by the BAT.

Reports produced by the Biodiversity Analysis Toolkit

Checklist Reports

Two checklist generation tools are provided by the BAT i.e. standard and graphical checklists.

The standard checklist tool facilitates automatic reserve species checklist production. Additionally, these tools have useful application when carrying out assessments of the recorded diversity of a cadastral unit or any other demarcated land unit. A typical application would be to identify which taxa have been recorded on a land parcel earmarked for development. This can be used to assess which taxa may be affected by the development. It should be noted that this type of decision support application depends on a well-populated biodiversity database.

The graphical checklist differs from the standard checklist by generating a locality map image of each area for which a checklist is generated. The map displays whatever background GIS layers such as Landsat 5 imagery, contours, reserve or cadastral boundaries that are visible in the ArcView view. Taxon distribution records are shown as a point data overlay on the background map layers.

Representivity Reports

Two representivity reports are produced by the BAT; point representivity and polygon (area) representivity analyses.

The goal of the point representivity analysis is to determine what proportion of taxa (represented by point data) occurring within a parent area (*e.g.* the provincial boundary) is represented in each child polygon area (*e.g.* nature reserves).

For example this technique can be used to ascertain the contribution each reserve makes towards representing the total alpha diversity of reptiles in the Western Cape Province (W.C.P.). The report will show the fraction (and raw number) of W.C.P. reptile taxa represented in each reserve. In a similar manner, IUCN and SA-RDB (South African Red Data Book) species representivity is also calculated during this process to show the numbers of taxa that are listed on the IUCN and SA-RDB lists.

The polygon representivity analysis follows the same concept as outlined above, but uses areas (rather than points) as a basis of comparison.

The Polygon Representivity Analysis can be used to assess what proportion of a land classification is represented by an area. For example, the Polygon Representivity Analysis can be used to assess what proportion of forest (a land classification) is represented in nature reserves.

Gap Analysis Reports

These reports are essentially the opposite of the point representivity reports and will list the taxa not recorded within an area relative to a larger bounding (parent) area *e.g.* what species found within the provincial boundary are not represented in the reserve network. For each of the "Gap" species their conservation status is listed to help in any prioritisation processes that will needed in conservation planning.

Hotspot Analysis

The HotSpot analysis uses taxon observation data as the basis for generating a taxon richness map. The purpose of the HotSpot analysis is to calculate the number of distinct taxa that occur in each 15" (quarter degree square) grid cell for a given area. HotSpots can be calculated in various different ways - for example HotSpot analyses based on Alpha diversity, IUCN species, SA-RDB species, and Endemism can be performed. The analysis can be run on a Family, Order, Class, or All data lodged in the Biodiversity Database. When the analysis is complete, the results are displayed in graduated colour intensity to represent the number of taxa in each grid cell. The 'hottest' grid cells (most taxa per QDS grid) are indicated in dark colours, and the 'coolest' grid cells (least taxa per QDS grid) are drawn with light colours.

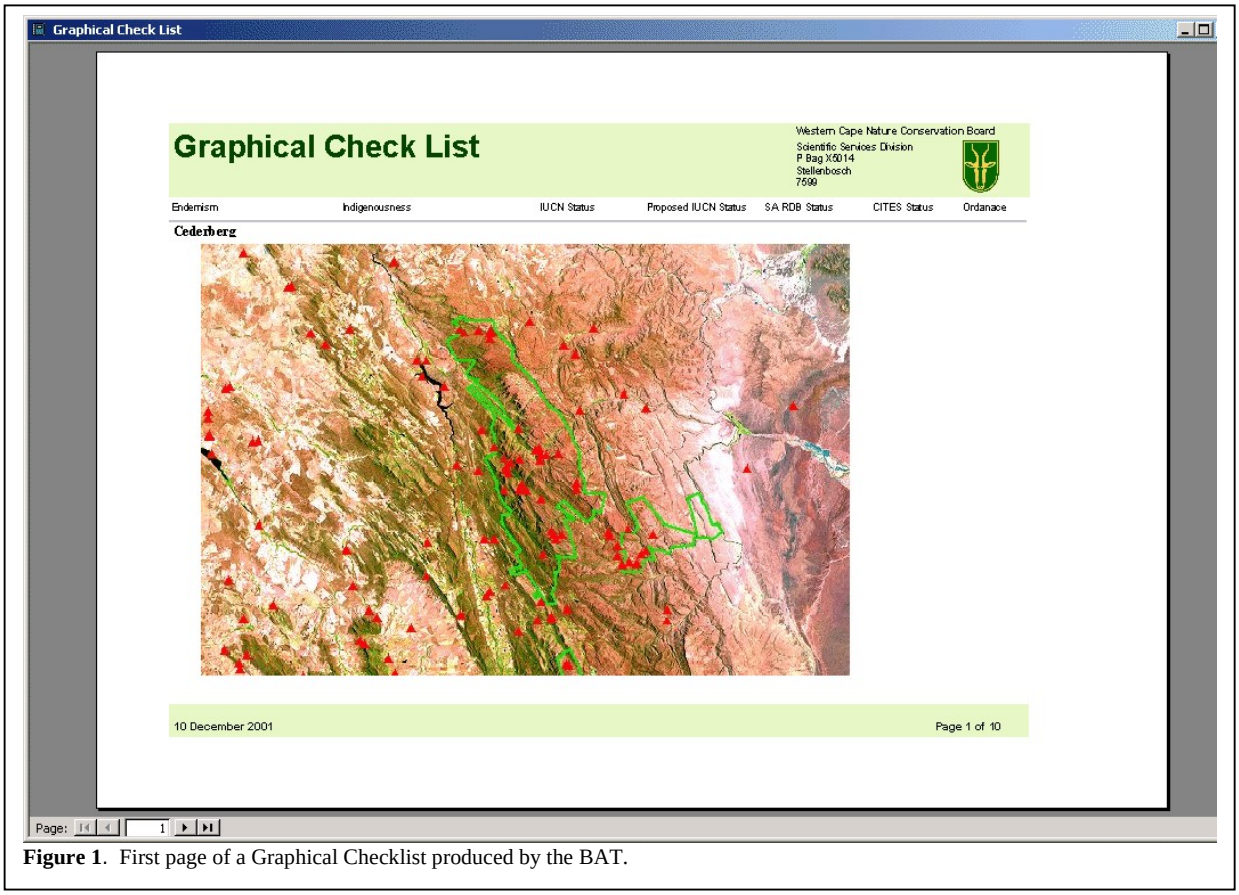

Figure 1. First page of a Graphical Checklist produced by the BAT.

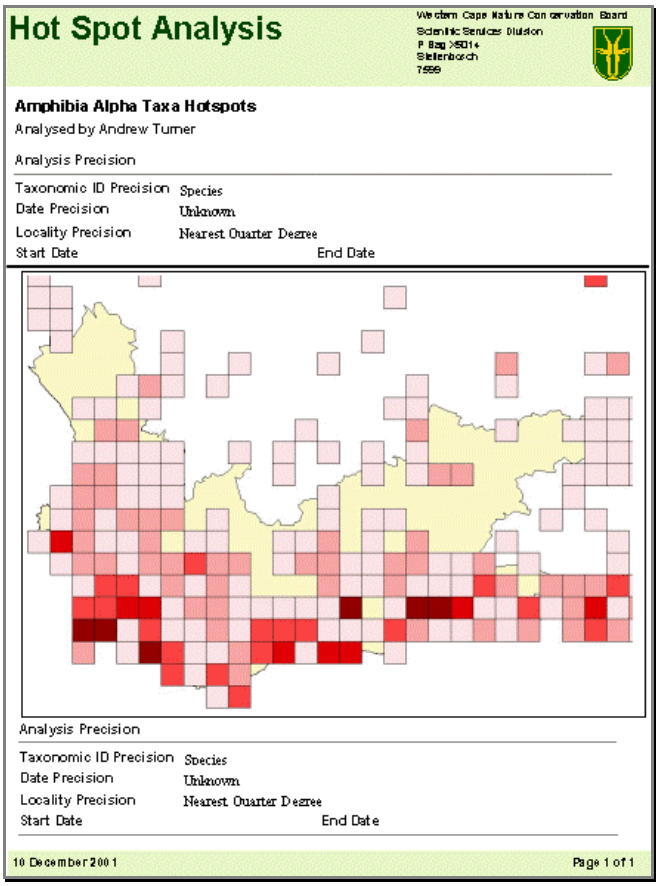

Figure 2. Example of a HotSpot report from the BAT.

Distribution maps

The Species Distribution Map analysis is used to produce point or QDS range maps for a given taxonomic Class.

Reserves Database

In addition to the biological data stored in the Biodiversity Database, protected area spatial data is stored in a Reserves database. This allows the many attributes of the protected areas to be managed in a consistent and easy to use manner relative to GIS packages. The data is still visualised and analysed with the aid of a GIS package and can produce GIS compatible files on the fly.

State of Biodiversity: Western Cape Province, South Africa
Freshwater Fishes

N. Dean Impson[1], I. Roger Bills[2] and Jim A. Cambray[3]
[1]Scientific Services
Western Cape Nature Conservation Board
Private Bag X5014
STELLENBOSCH
7600
[2]South African Institute of Aquatic Biodiversity
Private Bag 1015
GRAHAMSTOWN
6140
[3] Makana Biodiversity Centre
Albany Museum
GRAHAMSTOWN
6139

Introduction

The indigenous freshwater fish fauna of the Western Cape Province (W.C.P.), although species depauperate, is arguably its most threatened biotic component. Of its 18 primary freshwater fish species, 14 are threatened including nine that are endangered. (Table 1). The fish fauna of the W.C.P., like the flora, has a high level of endemicity (nine species) (50%) and is thus reliant on effective conservation of rivers of the province for survival.

The south-western Cape, where most of these species occur, is recognised as a centre for a distinct "Cape" component of the ichthyofauna of Africa (Skelton 1994). The fauna is dominated by cyprinids (14 species) with two austroglanids, an anabantid and a galaxiid. Taxonomic groups characteristic of the W.C.P. include *Pseudobarbus* (the W.C.P. has six of its seven species) and *Sandelia.* Cape galaxias *Galaxias zebratus* is regarded as a Gondwana relic with its closest relatives in South America (Waters and Cambray 1997). Likewise, *Austroglanis* have been hypothesised to be the sister-group to the relict family *Horabagrus* from southern India (De Pinna 1993).

The ichthyofauna is characterised by isolated and geographically restricted ranges, high levels of endemicity, inflexible life history styles and a low resilience to disturbance (Skelton 1987). The most notable endemic fish hotspot in southern Africa is the Olifants River System, found mainly within the W.C.P. (Skelton *et al.* 1995) which has 10 species of which eight are endemic and all are threatened with extinction.

The major threats to these fishes are predation by and competition with invasive alien fishes and habitat degradation and destruction by inappropriate agricultural development (Impson and Hamman 2000). Placing indigenous fishes within nature reserves does not help conserve them if they share their habitat with predatory alien species such as smallmouth bass *Micropterus dolomieu* and rainbow trout *Oncorhynchus mykiss* and competitors such as carp *Cyprinus carpio*. Permanent eradication of these species is necessary within reserves to effectively conserve W.C.P. fishes.

Rivers, especially their middle and lower reaches, are poorly conserved within the W.C.P., resulting in their biota encountering ever-increasing levels of anthropogenic disturbance. The longitudinal nature of rivers makes them extremely difficult to conserve (Davies *et al.* 1993), as ideally whole systems including their catchments require protection. In addition, crucial shortages of trained staff at the Western Cape Nature Conservation Board (W.C.N.C.B.) and Department of Water Affairs and Forestry (D.W.A.F.) need to be addressed for legislation and conservation management to be effective in this province.

This chapter is based largely on a report by the authors on freshwater fish conservation for the Cape Action Plan for People and the Environment (C.A.P.E.). The C.A.P.E. is an analysis of the biodiversity and identification of biodiversity hotpsots of the Cape Floral Kingdom (C.F.K.), and was executed by the University of Cape Town. The primary purpose of this paper is to review the distribution records of W.C.P. freshwater fishes and identify river areas of critical importance for the future survival of these fishes. In addition, attention is focussed on other important conservation issues such as threats to rivers and their biota, constraints to effective conservation, the status and accuracy of our knowledge, and research and conservation actions being undertaken. The report is concluded with recommendations for the effective conservation of these fishes.

Methods

Distribution records at the Western Cape Nature Conservation Board, South African Institute of Aquatic Biodiversity and Albany Museum (including South African Museum records) were amalgamated to develop fish distribution maps for the W.C.P. using a geographical information system (GIS) package (Arc View 3.1) which included overlays of the rivers and formally conserved areas. Maps were used to identify river areas

Table 1: Primary indigenous freshwater fishes of the Western Cape Province.

Family	Species	Common name	Distribution (from Skelton 1993)	IUCN status*	W.C.P. Endemic
Austroglanididae	*Austroglanis barnardi* (Skelton 1981)	Spotted rock catfish	Olifants River system	CR	Yes
"	*Austroglanis gilli* (Barnard 1943)	Clanwilliam rock catfish	Olifants system	VU	Yes
Cyprinidae	*Barbus andrewi* Barnard 1937	Whitefish	Berg and Breede systems	VU	Yes
"	*Barbus anoplus* Weber 1897	Chubbyhead barb	Widespread in S.A.	NL	No
"	*Barbus calidus* Barnard 1938	Clanwilliam redfin	Olifants system	EN	Yes
"	*Barbus capensis* A. Smith 1841	Clanwilliam yellowfish	Olifants system	VU	No
"	*Barbus erubescens* Skelton 1974	Twee River redfin	Olifants system	CR	Yes
"	*Barbus serra* Peters 1864	Sawfin	Olifants system	EN	No
"	*Labeo seeberi* Gilchrist and Thompson 1911	Clanwilliam sandfish	Olifants system	CR	No
"	*Labeo umbratus* (A. Smith 1841)	Moggel	Widespread in S.A.	NL	No
"	*Pseudobarbus afer* Peters 1864	Eastern Cape redfin	Coastal rivers of from Mossel Bay to Sundays River	LR (nt)	No
"	*Pseudobarbus asper* (Boulenger 1911)	Small-scale redfin	Gourits and Gamtoos systems	VU	No
"	*Pseudobarbus burchelli* (A. Smith 1841)	Burchell's redfin	Breede and Duiwenhoks systems	EN	Yes
"	*Pseudobarbus burgi* Boulenger 1911	Berg River redfin	Berg, Verlorenvlei, Langvlei and Eerste (now extinct) systems	CR	Yes
"	*Pseudobarbus phlegethon* Barnard 1938	Fiery redfin	Olifants system	EN	Yes
"	*Pseudobarbus tenuis* Barnard 1938	Slender redfin	Gourits and Keurbooms systems	EN	Yes
Galaxiidae	*Galaxias zebratus* Castelnau 1861	Cape galaxias	Widespread in Cape Floral Kingdom	LR (nt)	No
Anabantidae	*Sandelia capensis* (Cuvier 1831)	Cape kurper	Widespread in W.C.P.	NL	No

*from Baillie and Groombridge 1996; where CR=critically endangered, EN=endangered, VU=vulnerable, LR (nt)=lower risk, near threatened and NL=not listed.

of critical importance to the conservation of these fishes. The authors then used a desk-top analysis to summarise existing knowledge of other issues of relevance to the conservation of W.C.P. freshwater fishes and their associated ecosystems.

Results and discussion

Biodiversity Statistics

INDIGENOUS, ENDEMIC AND ALIEN SPECIES: The W.C.P. is home to relatively few indigenous freshwater fishes (18 species), the majority of which are endemic (eight species) or near endemic (eight species) (Table 2). The near endemics are species endemic to the C.F.K. (see Impson *et al.* 1999). Only two indigenous species, the chubbyhead barb *Barbus anoplus* and the moggel *Labeo umbratus*, are widespread outside the province. The province, unfortunately, also has an alarmingly high number of alien fish species (16 species), including 13 invasive species; the impacts of which are summarised in Table 3.

RED DATA SPECIES: The W.C.P., like the C.F.K., is characterised by one of the highest percentage concentrations of threatened fish species worldwide. Only the chubbyhead barb, Cape kurper *Sandelia capensis* and moggel are regarded as safe although some populations of each of these species are under threat. These include isolated populations in tributaries that may be or are genetically distinct *e.g.* Berg River redfin *Pseudobarbus burgi* from Verlorenvlei System (Bloomer and Impson 2000).

SPECIES IN CONSERVATION AREAS: Freshwater fishes of the W.C.P., including threatened species, would appear to be well

conserved as only two of the 18 indigenous species, both critically endangered (spotted rock catfish *Austroglanis barnardi* and Twee River redfin *Barbus erubescens)*, have not been recorded from formally conserved areas (Table 4). Some species are relatively well conserved, for example the widespread Cape kurper (in 16 provincial nature reserves and five local authority

Table 2. Origin of the 18 indigenous freshwater fishes recorded within the Western Cape Province.

Scientific Name	Endemic	Near endemic	Endemic to South Africa	Endemic to southern Africa
Austroglanis barnardi	X			
A. gilli	X			
Barbus andrewi	X			
B. anoplus			X	
B. calidus	X			
B. capensis		X		
B. erubescens	X			
B. serra		X		
Galaxias zebratus		X		
Pseudobarbus afer		X		
P. asper		X		
P. burchelli	X			
P. burgi	X			
P. phlegethon	X			
P. tenuis		X		
Labeo seeberi		X		
L. umbratus				X
Sandelia capensis		X		
TOTALS	8	8	1	1

Table 3: Origin, reasons for introduction and impact of the 19 alien freshwater fish species in the Western Cape Province (*denotes invader species).

Species	Common name	Origin	Why introduced	Predator or competitor	Level of impact
*Barbus aeneus**	Smallmouth yellowfish	Southern Africa	Angling	Both	Localised – medium in Gourits system
Carassius auratus	Goldfish	Asia	Ornamental	Mainly C	Urban – low
*Clarias gariepinus**	Sharptooth catfish	Africa	Angling	Both	Widespread – high
*Cyprinus carpio**	Carp	Asia	Angling	Mainly C	Widespread – high
*Gambusia affinis**	Mosquitofish	N. America	Mosquito control	Both	Localised – medium
*Lepomis macrochirus**	Bluegill	N. America	Angling fodder fish	Both	Widespread – high
*Micropterus dolomieu**	Smallmouth bass	N. America	Angling	Mainly P	Widespread – very high
*M. punctulatus**	Spotted bass	N. America	Angling	Mainly P	Localised – high
*M. salmoides**	Largemouth bass	N. America	Angling	Mainly P	Widespread – high
*Oncorhynchus mykiss**	Rainbow trout	N. America	Angling	Both	Localised in some mountain areas – medium to high
*Oreochromis mossambicus**	Mozambique tilapia	Southern Africa	Angling	Mainly C	Widespread – medium
O. aureus	Israeli tilapia	Israel	Angling	Mainly C	Very localised – low
*Tilapia sparrmanii**	Banded tilapia	Southern Africa	Fodder fish	Mainly C	Widespread – medium
Perca fluviatilis	Perch	Europe	Angling	Mainly P	Very localised - low
*Salmo trutta**	Brown trout	Europe	Angling	Mainly P	In a few mountain streams – medium
*Tinca tinca**	Tench	Europe	Angling	Mainly C	Localised in Breede System – low

Table 4. Contribution of formal conservation areas in the Western Cape Province towards conserving freshwater fish diversity.

Conservation area	No species	% species	No IUCN species	% IUCN species
Western Cape Province	18	100	15	100
Western Cape Nature Conservation Board reserves	16	89	13	87
S.A. National Parks	2	11	1	6
Local authority nature reserves	5	28	3	20

Table 5. Contribution of formal conservation areas in the Western Cape Province towards freshwater fish conservation at the species level.

Species	No. national parks in which recorded	No. W.C.N.C.B. nature reserves recorded in	No. local authority reserves recorded in
Austroglanis barnardi			
A. gilli		2	
Barbus andrewi		4	1
B. anoplus		6	
B. calidus		2	
B. capensis		3	
B. erubescens			
B. serra		2	
Pseudobarbus afer	1	6	
P. asper		7	
P. burchelli		5	3
P. burgi		2	
P. phlegethon		1	
P. tenuis		2	
Galaxias zebratus	3	12	3
Labeo seeberi		2	
L. umbratus		4	
Sandelia capensis		16	5

nature reserves) and Cape galaxias (Table 5).

Table 5 shows that S.A. National parks within the W.C.P. make a negligible contribution to the conservation of indigenous fishes here (two species recorded) compared to the moderate contribution of local authority nature reserves (four species) and substantial contribution of provincial nature reserves (PNR's)(16 of the 18 species recorded). Of concern are the few records we have in conservation areas of several highly threatened species, for example the fiery redfin *Pseudobarbus phlegethon* (one PNR) and Clanwilliam rock catlet *Austroglanis gilli* (two PNR's).

Few, if any, of the formally protected areas within the W.C.P. were designed to conserve representative and functional riverine ecosystems and their fishes. Skelton *et al.* (1995) identified attributes that a formal conservation area requires to be effective for conserving riverine fishes.These are discussed in more detail in the recommendations section at the end of this report. Regarding W.C.P. freshwater fishes, the following deficiencies in the existing reserve system were noted:

- Only a small proportion of indigenous fish distribution records are within reserves.

- In several cases, W.C.P. indigenous fishes share reserve habitat with predatory invasive alien fishes such as black bass and rainbow trout.
- Existing manpower, funding and knowledge make eradication of alien species extremely difficult.
- Highly threatened species such as Clanwilliam sandfish *Labeo seeberi* and Twee River redfin are poorly conserved.

There is an almost total bias towards conserving montane areas and their associated headwater river zones due to the proclamation in the 1970s of Mountain Catchment Areas to conserve water supply to the province. The middle and lower reaches of rivers, where endangered species such as Clanwilliam sandfish, sawfin and whitefish occur, are highly impacted and poorly conserved.

DATA QUALITY: The majority of fish distribution records are based on point data, hence data quality is good to excellent. Distribution maps for each species revealed few records that were outside the known distribution range for each species. The main criticism is that several systems have been poorly sampled, especially smaller coastal systems. In addition, some point data is old (over 20 years) and, with the continual invasion of introduced species, often is misleading in terms of current distribution range as the indigenous species previously recorded may now no longer be present.

Critical habitats

The critical habitats for indigenous fish species include the full range of habitats utilised during the life history stages of the 18 species. All species are primarily river dwellers with only Cape Galaxias and Cape kurper occurring occasionally in natural lakes and wetlands. Riverine habitats of importance thus include rapids, riffles, pools and backwaters in each freshwater zone of the river. For effective conservation, ecologically healthy habitats must be present in the mountain stream, foothill, transitional and lower zones of the river.

Due to mostly unsustainable and inappropriate agricultural development across the W.C.P., mainly in the lowlands where soils and gradients are most suitable for intensive agriculture, most transitional and lower river zones have been extensively degraded and are also dominated by introduced invasive alien fish and plant species. The chances of full recovery of many of these rivers are minimal. In contrast, many mountain stream and foothill zones in the mountain catchment areas, are still relatively pristine and are free of alien fish and plants. This is where the majority of existing fish diversity still occurs and where most of the Western Cape Nature Conservation Board's future conservation efforts will be targeted.

River areas of critical importance to the conservation of W.C.P. freshwater fishes were mapped at the 1:50 000 scale. The key considerations were biodiversity hotspots, river areas of critical importance to the conservation of a threatened species or unique population of a species and adopting a catchment approach when identifying the boundaries to critical areas. The most important areas are shown in Figure 1 and are listed in Appendix 2. The map shows that critical habitats and areas are situated across the W.C.P. in both mountainous and lowland areas.

Threats

The IUCN World Conservation Strategy (IUCN 1980, in

Table 6. Main threats to freshwater fishes of the Western Cape Province.

Type of threat	Impact on fish or ecosystem
Instream dams	Barrier to upstream migration, alteration of flow patterns and water chemistry downstream of dam, refuge for alien invasive fishes during floods
Bulldozing of rivers	Localised destruction of instream and riparian habitat, reduces habitat diversity and quality, increased turbidities and sedimentation
Unsustainable water abstraction	Rivers pumped dry or flow severely reduced during dry season resulting in major loss of habitat during peak times of recruitment
Excessive use of pesticides and herbicides	Poorly studied but rivers with good habitat adjacent to large orchards appear to be devoid of fishes (*e.g.* Suurvlei River, Cederberg)
Excessive use of fertilizers	Eutrophication and mineralization of W.C.P. rivers which are characteristically oligotrophic and acidic in nature
Alien invasive fishes	Elimination or severe reduction of indigenous fish populations through predation, competition or habitat alteration
Alien invasive plants	Invade catchment, riparian and instream areas reducing water yield and stream flow (*e.g.* pines *Pinus* spp.), out-competing and eliminating indigenous flora (*e.g.* black wattle *Acacia mearnsii*), altering nutrient cycles (*e.g. A. mearnsii*) and reducing light and oxygen penetration to surface waters (*e.g.* water hyacinth *Eichhornia crassipes*)
Lack of education and awareness	Local communities and anglers are often unaware of local indigenous fishes and their importance. This can be overcome through effective environmental education programmes

Skelton 1987) recognises six broad categories of threats to the survival of vertebrates of which two (habitat destruction or degradation and the impacts of introduced species) have had severe impacts on W.C.P. freshwater fishes. Threats to South African fishes and rivers are discussed in detail by Bruton and Van As (1986), Skelton (1987) and Davies and Day (1998). A summary of the impacts of these threats on W.C.P. freshwater fishes is presented in Table 6 with threats to each fish species presented in Appendix 1.

Effectiveness of current conservation management

Current conservation management in the W.C.P. of freshwater ecosystems and their fishes cannot be regarded as effective. Inadequate capacity and funding from statutory sources is the major cause for this situation. These inadequacies affect operational capabilities at the W.C.N.C.B. in the following ways:

- inability to undertake regular survey work;
- inability to undertake priority research projects;
- inability to purchase land to conserve freshwater aquatic systems, particularly hot spots;
- inability to undertake or implement species or habitat recovery plans;
- poor communication and co-operation with riparian land-owners and angling clubs;
- insufficient public awareness campaigns; and
- a poor enforcement capability.

The major constraints to the effective conservation management of indigenous freshwater fishes are discussed in detail below:

INVASIVE ALIEN FRESHWATER FISHES: The impact of invasive alien fishes in the W.C.P. is possibly the greatest constraint to the effective conservation of its indigenous freshwater fishes. This is because fishes such as carp, rainbow trout and smallmouth bass are widespread in and dominate the ichthyofauna of many rivers of the province (Figure 2). Experience has shown that once a fish species has established itself it becomes almost impossible to eradicate as biological control agents are not available and poisons such as Rotenone cannot be safely administered throughout a system. Projects to eradicate alien fishes from small sensitive tributaries are, however, feasible and urgently required.

MANPOWER: Critical capacity shortages have emerged at conservation authorities since 1990 due to severance packages being offered by the state to reduce the size of the public service and vacated posts not being filled due to budgetary constraints. In 1994, the W.C.N.C.B. had eight scientists and technicians in their aquatic section – presently there are two. These statistics of inadequate manpower are alarming, given the high percentage of endemic fishes, their imperilled conservation status and the rich and unique diversity of aquatic invertebrates in the W.C.P. Clearly, freshwater systems cannot be effectively managed without sufficient and appropriate expertise.

FUNDING*:* Funding for nature conservation in the W.C.P., and elsewhere in South Africa, have been progressively reduced in real terms since 1990. Funding constraints have prevented the filling of posts and have restricted the number of fish surveys undertaken due to budget cuts in mileage and other incidental costs. This has adversely affected monitoring and research on fishes. River systems that were monitored every two to three five to seven year intervals. This is unacceptable given the rapid slide of several species towards extinction. Some of the smaller systems that may contain genetically distinct populations of fishes have not been surveyed for more than a decade.

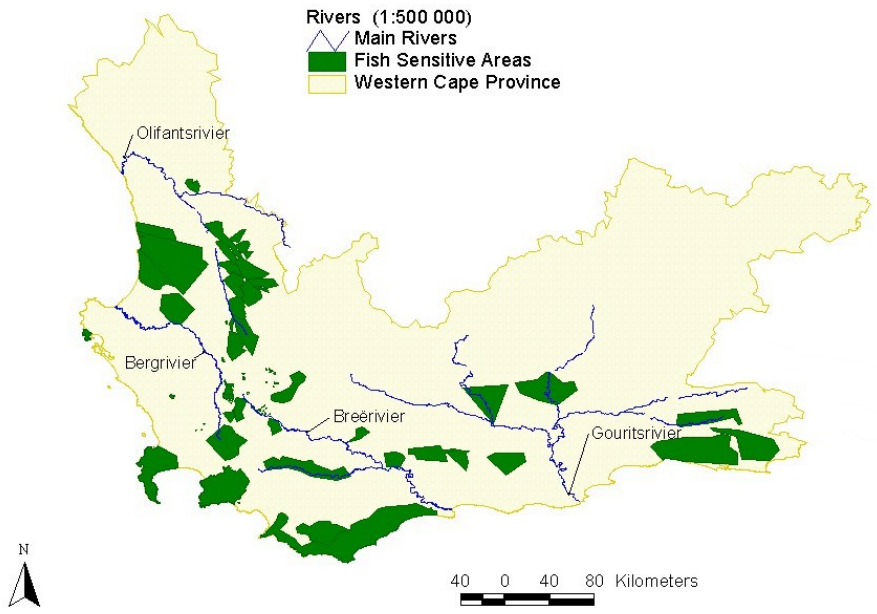

Figure 1. River areas regarded as very important for freshwater fish conservation in the Western Cape Province.

A number of research projects have been recently completed or are being undertaken which are providing valuable insights into the biology and population genetics of several threatened species. These projects have been financially supported by the Western Cape Nature Conservation Board 's contract research programme and World Wide Fund for Nature – South Africa (WWF-SA). The W.C.N.C.B. contract research programme funds outside researchers to do collaborative research on projects identified by scientists within the department. This programme has been successful but is dependent on internal funding for its operation.

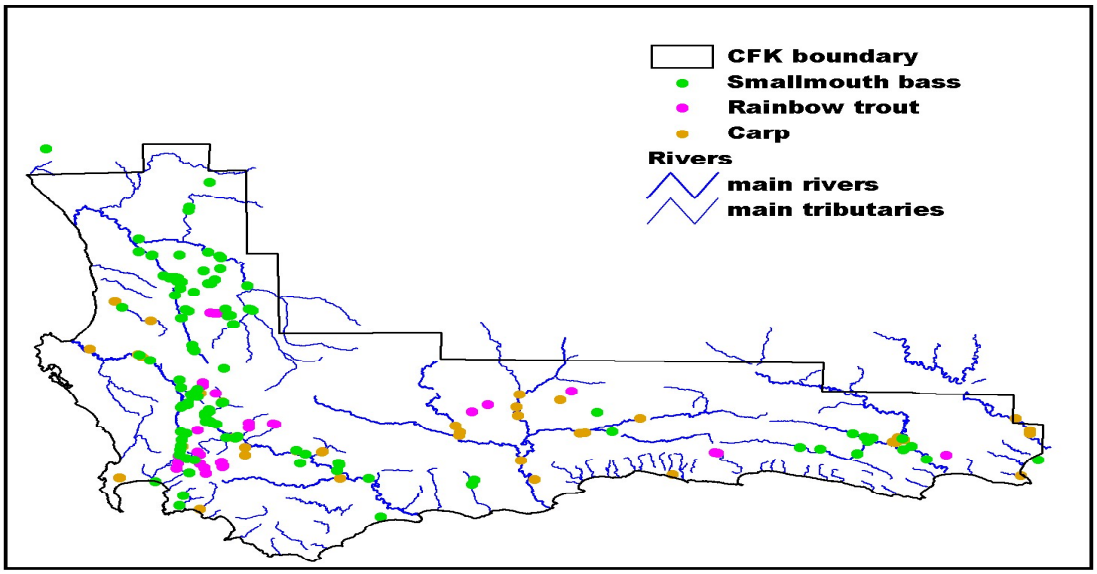

Figure 2. Distribution of smallmouth black bass, carp and rainbow trout in the Western Cape Province.

This important work is now in jeopardy as a 34% funding cut on contract research programmes was made in 1998.

INADEQUATE RESERVE NETWORK: Fish distribution maps generated during this analysis show that the vast majority of records fall outside formally conserved areas. Rivers are generally poorly conserved and especially so in their middle and lower reaches. The main reasons for this are threefold: (i) their value for irrigation purposes gave riparian land a premium value; (ii) freshwater fishes are not as visible and charismatic as large mammal species; and (iii) there are difficulties associated with conserving a longitudinal ecosystem such as a river.

LACK OF PUBLIC AWARENESS: The two most important public groups involved in freshwater fish utilisation and management in the W.C.P. are farmers (especially riparian landowners) and anglers. Farmers own catchment areas, river banks and beds and use surface or ground water for irrigation. Their actions can have a major influence on river processes and biotic diversity.

The previous government did little in terms of legislative development to promote sustainable utilisation of aquatic resources culminating in a landowner philosophy of resource ownership rather than custodianship of resources. Few landowners have an understanding of river functioning and the ecological needs of rivers and thus at present are unable to contribute to conserving rivers and indigenous fishes. Rivers are regularly bulldozed for flood control purposes and to create weirs. Similarly, some highly sensitive tributaries have abstraction points that remove the entire surface flow of the river during summer. The ecological impacts of such practices appear to be of little concern to many farmers as their focus is on production and making a profit. Farm dams are often stocked with fish without nature conservation permits, resulting in the further spread of invasive species such as bass, trout and sharptooth catfish *Clarias gariepinus*.

The attitude and activities of many freshwater anglers is also of concern. The W.C.P. has few indigenous freshwater fishes of angling value and the three species that are so regarded are not easily accessible to the general public. Hence alien species are targeted and, being popular and accessible, are the ones that are stocked into new waters. Few stockings are legal (i.e. undertaken with the approval of conservation authorities) resulting in the

continual spread of harmful invasive species into new habitats. In the majority of cases, anglers stock fish without being aware of the legislative requirements and the ecological consequences but some anglers stock fish without permits fully aware of the illegality of their actions.

LEGISLATIVE DEFICIENCIES: Key legislation affecting the conservation of W.C.P. fishes and associated ecosystem is the Water Act of 1998, Section 21 Regulations (Listed Activities requiring impact assessments) of the Environmental Conservation Act of 1989, Nature Conservation Ordinance 19 of 1974 and guideline documents within Western Cape Nature Conservation Boards "Aquatic Research Programme 1990".

The Water Act regulates the use of water (*e.g.* abstractions, construction of dams, inter-basin water transfers) and its discharge into the natural environment. The ecological needs of the water resource (*e.g.* river, aquifer and lake) are recognised and catered for. The "Environmental Reserve" enjoys the only right to water usage and comprises the ecological needs of the resource provider and basic human needs. However, to effectively implement and enforce the new Act, significant increases in capacity and funding are necessary. Without this, the Act will look good on paper but will mean little in terms of more sustained use of our water resources.

The Section 21 Regulations ensure that impact assessments are undertaken and permits issued for a range of proposed activities (*e.g.* bulldozing of rivers, construction of farm dams and aquaculture) prior to their implementation. This Act is administered by the Western Cape's Department of Environmental and Cultural Affairs and Sport (DECAS). This Department has seen significant strengthening of its capacity since 1999 enabling it to now regulate listed activities more effectively.

The Nature Conservation Ordinance 19 of 1974 controls, by means of a permit system, the transport of aquatic biota between inland waters, the import or export of biota into the Province and the capture of indigenous aquatic biota. W.C.N.C.B. also has a series of guideline or "policy" documents within its 1990 Aquatic Research Programme that are used to guide fish stockings of various alien species. However, these laws are largely ineffective at controlling the illegal stocking of fishes into farm dams and rivers and the importation of fishes and aquatic plants from other provinces. The main reason for the deficiency is a lack of law enforcement capacity at the W.C.N.C.B. and the huge difficulty experienced wordwide in monitoring the movement of live fishes across national and provincial boundaries.

Other relevent legislation includes the Convention on Biodiversity, CITES, the S.A. White Paper on Biodiversity Conservation, Mountain Catchment Areas Act, Conservation of Agricultural Resources Act and the National Environmental Management Act.

Utilisation

The rivers of the W.C.P. are critically important to the economic development of the region. This is because many areas, especially the south-western Cape region, have hot dry summers when agricultural production of most crops (*e.g.* deciduous fruits and grapes) reach their peak. Rivers are also heavily utilised to supply water to farms, towns and industries. Winter water is stored in farm and larger irrigation dams while the small summer base flows may be entirely utilised.

The indigenous fishes, in contrast, are poorly utilised for recreational or subsistence purposes. There are two reasons for this.

(i) The W.C.P. only has four large species of potential angling or food value. Species such as Clanwilliam yellowfish *Barbus capensis*, sawfin *Barbus serra* and whitefish *Barbus andrewi* were historically popular with anglers (see Scott 1982), and to an extent with subsistence fishermen and farm workers.

(ii) Since the 1960s, alien invasive fishes such as smallmouth bass began to dominate the ichthyofauna of the larger rivers. The result has been that potential indigenous angling species are now difficult to locate and often restricted to relatively inaccessible areas.

However, increasing numbers of landowners and anglers are becoming aware of the value of W.C.P. fishes and the contribution they can make to conserving these fishes. Applications and enquiries are regularly received about stocking farm dams and garden ponds with indigenous fishes in preference to alien species. The Federation of South African Flyfishers (FOSAF), an organisation historically concerned with promoting flyfishing for trout, established a yellowfish working group in 1997. Their main aim was to promote environmentally responsible angling for "yellowfishes" (including sawfin and whitefish) and sustainable use of their habitat. The angling ethic of "catch and release" is gaining momentum for these indigenous fishes and is mandatory in terms of Nature Conservation Ordinance 19 of 1974.

A further area of growth is underwater diving trails for W.C.P. freshwater fishes. Many perennial fynbos streams are clear, warm and slow flowing in summer which are ideal conditions for diving. A marketing drive will be necessary to encourage the large numbers of divers who visit the sea to extend their interests to freshwater habitats.

Alien fishes such as carp, rainbow trout and smallmouth bass are relatively widespread and abundant in most large rivers and associated dams of the W.C.P. and are hence popular with anglers. They form the basis of a significant socio-economic recreational fishery.

Economic incentives for conservation

The economic incentives to conserve W.C.P. freshwater fishes are not immediately obvious as they do not presently form the basis of a significant recreational fishery or eco-tourism industry. However, they have considerable economic potential provided that:

- innovative marketing projects are developed to promote awareness of their ecological and recreational value;
- increasing utilisation by anglers and divers leads to the development of associated tourism infrastructure (*e.g.* chalets, day tickets for anglers or divers); and
- financial incentives, which are presently lacking, should be investigated to reward land-owners who conserve fish habitat in sensitive areas, or at least utilise such habitat sustainably.

Trends in conservation ethic

The approach of the provincial conservation authority towards freshwater fish conservation has changed dramatically this past century. The initial focus on freshwater fishes in the W.C.P. was towards utilisation for food and angling purposes. In the late 1800s, colonists interested in angling realised that many Cape streams lacked suitable angling and eating fishes. Only the Berg, Breede and Olifants River Systems have indigenous fish species of angling value (*e.g.* Clanwilliam yellowfish, sawfin and whitefish) but these species were then regarded as inferior to better known European (*e.g.* carp) and North American species (*e.g.* rainbow trout).

Consequently, rainbow trout, brown trout *Salmo trutta* and carp amongst others were introduced prior to 1900, by government biologists for mass production at the Jonkershoek hatchery, stationed outside Stellenbosch. These introductions, despite early setbacks, were highly successful, allowing the stocking of the three species into suitable rivers not only within the W.C.P. but throughout South Africa (Hey 1995).

Interestingly, the potential negative impacts of alien species was appreciated soon afterwards when warnings from Canada and within South Africa about the carp's ability to mass reproduce and degrade habitat, resulted in carp culture being terminated at Jonkershoek in 1921 (Hey 1995).

The earliest forerunner of the W.C.N.C.B, the Department of Inland Fisheries, was established in 1943 to develop the inland fisheries of the then Cape Province to their full potential (Hey 1995). What this meant was the introduction of further alien fish species of angling and eating value (*e.g.* Mozambique tilapia *Oreochromis mossambicus*) or as a fodder fish (*e.g.* bluegill *Lepomis macrochirus*, banded tilapia *Tilapia sparrmani*) for the basses. The largemouth and smallmouth bass had been introduced in the 1930s into the W.C.P. for mass production at Jonkershoek. The mass distribution of these fishes was enhanced by a campaign entitled "Fish for food from farm dams", vigorously promoted by the Inland Fisheries Department (Hey 1995). Various other tilapias from across Africa (*e.g.* Israeli tilapia *Oreochromis aureus* and Nile tilapia *O. niloticus*) were imported for trials at Jonkershoek and distribution to suitable farms for stocking with largemouth bass (Hey 1995). Fish were also imported for mosquito control such as the mosquitofish *Gambusia affinis* (Hey 1995).

The growth in environmental awareness and interest in nature conservation resulted in the Department of Nature Conservation of the Cape Provincial Administration being established in 1952. This new department incorporated the old Inland Fisheries Department which was renamed the Inland Fisheries Division. Despite a new name, the Department maintained the same focus at its Inland Fisheries Division and significantly increased its staff complement to 19 scientific and technical staff by 1969. Amazingly, inland fisheries activities now included the production of ornamental fish and plants at Jonkershoek (Hey 1995).

In the 1940s and 1950s, some staff at the Inland Fisheries Division and more conservation-orientated anglers had become aware of the severe impact of smallmouth bass in the Berg and Olifants River systems, yet the Department continued to produce black bass at Jonkershoek until 1980. The only logic for this continuation was probably public pressure for continued alien fish stocking and an inability to make a paradigm shift away from alien fish production by the departments top management of the time.

The situation with regard to river and land management was equally disturbing, with laws designed to maximise agricultural production without serious recognition to environmental sustainability. The previous Water Act did not recognise the natural environment as a user of water and had provisions which allowed dams to be built without compensatory releases or allowed perennial rivers to be pumped dry. Rivers were regularly bulldozed for flood control purposes since crops could be planted up to the riparian zone of the river.

The production of South Africa's first Red Data Book for fishes (Skelton 1977) was a key development in provoking a paradigm shift in attitudes towards the alien fish debate amongst freshwater fish conservationists across South Africa. The W.C.P. led the way with Dr Kas Hamman and other young conservation scientists within the Cape Province's Department of Nature Conservation challenging existing attitudes of its top management towards freshwater fish conservation in the province. This challenge was ultimately successful with the termination of alien fish production in 1986. It should be noted that the Department had established the Clanwilliam Yellowfish Station outside Clanwilliam in 1977 because of the plight of this and other threatened indigenous Olifants River fishes. Yet, ironically, the Department continued to produce and distribute bass from Jonkerhoek (DNC 1979).

Until the mid 1980s basses, trouts and tilapias were also stocked across the province without consideration as to whether the receiving system or area was sensitive or not. This operational policy resulted in today's wide distribution of these species in natural waters across the W.C.P.

The situation and focus in 2001 at the W.C.N.C.B. towards freshwater fish conservation is very different from that of 1970 and earlier. The positives are that the Board actually does modern nature conservation work now with its goal of effectively conserving the natural biological diversity and ecosystem processess of the W.C.P. No alien fish species are produced by the W.C.N.C.B. with this function taken over by the private sector. There is a permit system which allows the introduction of fish species into areas where they are naturally or legally resident. Environmental impact assessments have to be undertaken for applications to introduce fish species into new areas. We generally oppose such applications.

Excitingly, anglers and rural land-owners are increasingly willing to stock indigenous fishes in preference to basses and trouts and support river and indigenous fish rehabilitation projects. The Cape Piscatorial Society has since 1990 had a very cordial and mutually productive relationship with the W.C.N.C.B. and regularly financially supports conservation projects. After many years of apparent hostility between organised bass fishing and the W.C.N.C.B. Peninsula Bassmasters in 2000 presented the W.C.N.C.B. with a cheque of R10 000 for indigenous fish conservation in the Olifants River System. Of more national significance, has been the emergence of the National Yellowfish Working Group under the auspices of the Federation of South African Flyfishers (FOSAF) to promote yellowfish fishing and conservation across South Africa. Significantly, FOSAF was established in the mid 1980s to protect the interests of the trout fishing fraternity when the Department of Nature Conservation stopped producing trout and removed protective legislation for trout from its Ordinance.

The major focus currently with respect to river and wetland conservation is catchment and habitat protection and rehabilitation as well as ensuring that applicable legislation (*e.g.* Water Act, Impact Assessment Regulations) is enforced by the relevent authorities. The Fynbos Working for Water Programme, a massive government funded poverty relief programme, is managed by the W.C.N.C.B. and has played a pivotal role in catchment and river rehabilitation in the W.C.P. (Impson and Hamman 2000).

The negatives are a huge decrease in real terms in funding and capacity allocated to freshwater fish and river conservation work since 1970. Whereas the Inland Fisheries Division had 15 scientific and technical staff based at Jonkershoek in 1969, and a significant proportion of the Department's budget, today the W.C.N.C.B. has two scientists to conserve the rivers and freshwater fishes of the W.C.P. This decrease has been caused by continual reductions in real terms in budgets allocated by the provincial government to the W.C.N.C.B. and its forerunners in nature conservation since 1990. It is highly ironic that there is less funding and manpower now when we are doing our work as it should be done compared to 30 years ago when nature conservation produced and protected alien fish species!

This critical constraint is fortunately likely to be addressed and overcome when the C.A.P.E. Action Plan is implemented between 2001 to 2005.

Conservation research and actions

Current research on W.C.P. freshwater fishes and actions taken to conserve species and associated habitats are shown in Table 7. This table shows that active research is being undertaken in the fields of population genetics, distribution and general biological studies *e.g. Austroglanis* (Bills 1998), whitefish (Impson and Bloomer 1998/1999), Clanwilliam redfin *Barbus calidus* (Nthimo 1997, Swartz 1999), Twee River redfin (Marriott 1997), Cape galaxias (Waters and Cambray 1997), Berg River redfin (Bloomer and Impson 2000), fiery redfin *Pseudobarbus phlegethon* (Swartz 1999) and yellowfish (Naran 1997). The *Austroglanis* study has now developed into a broader PhD by Roger Bills study mainly focused on the phylogenetics of the family.

Table 7 reveals that few active conservation projects are being undertaken despite their urgent need. The main reasons have already been discussed and are due to critical capacity and funding constraints within the nature conservation agencies. The main activities involve monitoring, environmental education (including land-owner awareness) and collaboration with external research organisations. However, this is done on an *ad hoc* basis.

There is an urgent need to empower the aquatic scientific sections of the nature conservation authorities, so that pro-active work that focusses on the critical conservation issues becomes the operational focus, rather than a strategy that is never realised. Past focusses on single species conservation (*e.g.* Clanwilliam yellowfish) and on promoting alien fishes prior to the 1980s (see Hey 1995) prevented the W.C.N.C.B. from attaining its true conservation objectives. The focus nowadays on ecosystem conservation and the conservation of aquatic biodiversity including genetic diversity is a welcome change and is being addressed within the limits of Board's capacities.

Status of knowledge

The successful outcome of a biodiversity analysis such as this one is dependent on a good overall knowledge of the freshwater ichthyofauna at a community, species and population level. Our knowledge of the distribution of W.C.P. species is regarded as good while knowledge of the biology and ecology of most species is still unsatisfactory (Table 8).

Some species and systems (especially the smaller systems) have been under-sampled. A recent detailed survey of the tributaries of the Olifants River system by one of the authors (Roger Bills) is the type of monitoring required in future. Greater funding and institutional capacity is required to ensure that our knowledge of species distributions remains updated and accurate.

Capacity and funding limitations are the primary reasons for the poor knowledge of the biology and ecology of most species. This is of particular concern for those poorly studied species that appear to be at greatest risk (*e.g.* Berg River redfin, Clanwilliam sandfish and whitefish). Without a good understanding of the life history requirements of these species, it is impossible to develop and implement effective species and habitat recovery plans.

Recent genetic studies (*e.g.* Waters and Cambray 1997, Impson and Bloomer 1998/1999, Bloomer and Impson 2000, Swartz 1999) have revealed that several species consist of distinct populations and in the case of the Cape galaxias these may represent a species complex (Waters and Cambray 1997). This aspect of biodiversity conservation for W.C.P. fishes needs urgent attention and may show that the region is home to a far greater freshwater fish diversity with greater endemicity than is presently acknowledged.

Table 7. Recent and current research and conservation management programmes for freshwater fishes of the Western Cape

Species	Current research	Current conservation actions
Austroglanis barnardi	Systematic and biology study	Detailed surveys of Olifants tributaries
A. gilli	Systematic and biology study	Detailed surveys of Olifants tributaries
Barbus andrewi	Genetics, systematics	Stocking of farm dams. Yellowfish Working Group angler awareness
B. anoplus	Conservation genetics	Detailed surveys in Olifants System
B. calidus	Biology, conservation genetics	Detailed surveys of Olifants tributaries, translocation into Bushmanskloof Private Game Reserve (BPGR)
B. capensis	Systematics of yellowfish, water releases from dam to study effect on spawning behaviour (Cambray*et al*.. 1997 and King *et al.*1998). Conservation genetics	Detailed surveys in Olifants tributaries, controlled water releases from Clanwilliam dam to trigger spawning. Stocking of farm dams. Yellowfish Working Group angler awareness
B. erubescens	Marriott's 1997 thesis is presently being published (2 papers), genetics	Detailed biological and ecological study, yet recommendations have not been addressed
B. pallidus	Bloomer and Fouche (genetics work)	
B. serra	Ecology, genetics, systematics	Detailed surveys in Olifants tributaries, stocking of farm dams. Yellowfish Working Group angler awareness
Pseudobarbus afer	series of life history papers by Cambray (e.g. Cambray 1994) and workers. Conservation genetics	
P. asper	as for *P. afer*	
P. burchelli	Conservation genetics	
P. burgi	Conservation genetics	Detailed survey of Berg River System.
P. phlegethon	Conservation genetics	Detailed surveys of Olifants tributaries
P. tenuis	Conservation genetics	
Galaxias zebratus	life history and populations genetics	Small stone weir erected on Krom River to prevent bass moving upstream. Cambray recommended conservation of 2 small populations in Gamtoos/Kouga and Krom Rivers
Labeo seeberi		Detailed survey of Olifants River System
L. umbratus		
Sandelia capensis	Conservation genetics	

Recommendations for future conservation

The indigenous freshwater fishes of the Western Cape Province are probably the most threatened and endemic component of its biota, yet have been largely neglected to date in strategies and decisions to conserve the region. This is because most of the species are small, have little in the way of charismatic features, have no immediate economic value, are "out of sight" (i.e. underwater), coupled with the difficulties associated with conserving river systems. Several of these unique fishes face extinction in the near future, should this neglect continue and capacity inadequacies within organisations involved in river and fish conservation in the W.C.P. not be addressed.

The key recommendations to be addressed to improve the conservation status of these fishes comprise the following.

- Develop a reserve network that includes key aquatic systems for fish conservation (see Figure 2). According to Skelton *et al.* (1995) the following aspects are important: (i) ideally a reserve should encompass the entire catchment of the affected area; (ii) the reserve must secure the minimum water quantity and quality requirements of the entire biotic community of the aquatic ecosystem; (iii) natural hydrological cycles must be maintained, (iv) high impact alien predators such as bass and trout must be eradicated and (v) reserves placed higher in the catchment will be better protected and easier to manage than downstream reserves.
- Capacity inadequacies within Western Cape Nature Conservation must be addressed without further delay. Staff complements need to be strengthened with suitably qualified people and linkages need to be strengthened with research institutes and universities.
- A dedicated funding base for freshwater fish conservation and associated ecosystems within the W.C.P. is required to allow urgent research projects and field surveys to proceed. Little is still known about the biology and ecology of several highly threatened species This could be administered by an organisation such as WWF-SA and managed by a dedicated working group.

  It is essential that voucher specimens are collected during studies and lodged in recognised museums for long-term curation. Most of the distribution records that form the basis of this study are from museum records.

Table 8. State of knowledge of Western Cape Province freshwater fishes.

Species	Conservation status	Rating of confidence in recommended status	Rating of present knowledge of distribution	Knowledge gaps
Austroglanis barnardi	EN	90%	90%	Breeding, feeding biology, phylogenetics
A. gilli	VU	90%	90%	As for *A. barnardi*
Barbus andrewi	VU	90%	70%	Present distributions, biology and ecology
B. anoplus	NL	80% (if species complex-reassess)	60%	Taxonomy, genetics, distribution
B. calidus	EN	80%	95%	Biology
B. capensis	VU	80%	70% (lower Olifants unknown)	Genetics, mainstream distribution
B. erubescens	CR	95%	100%	Captive rearing projects
B. serra	EN	90%	70%	Genetics, biology, mainstream distribution
Pseudobarbus afer	VU	80%	50%	Genetics, taxonomy, distribution
P. asper	VU	80%	50%	Genetics, taxonomy, distribution
P. burchelli	EN	90%	80%	Genetics, taxonomy, distribution
P. burgi	CR	95%	90 %	Biology, detailed surveys, taxonomy
P. phlegethon	EN	95%	95%	Breeding and feeding biology, taxonomy
P. tenuis	EN	80%	50%	Genetics, distribution
Galaxias zebratus	LR (nt)	80% (if species complex-reassess)	40%	Taxonomy, genetics, distribution
Labeo seeberi	CR	60%	50%	Distributions, population estimates, biology
L. umbratus	NL	80%	50%	Genetics, distribution
Sandelia capensis	NL	50%	40%	Genetics, taxonomy, distribution

- River rehabilitation projects, specifically involving alien fish removal from critical fish conservation areas, are urgently required. Sufficient funding and collaborative projects with the Department of Water Affairs and Forestry are needed to erect barrier weirs in sensitive tributaries followed by eradication of alien fish above these weirs.
- Law enforcement has been neglected resulting in little control over the movement of live fish between inland waters and habitat damage to rivers by activities such as bulldozing. Capacity in this area needs immediate strengthening together with a greater will to act against offenders.
- Environmental education and public awareness needs specific attention to change the way in which land-owners, anglers and the broader public view rivers and our indigenous fishes. A sense of custodianship of natural resources must be developed together with innovative methods of promoting the resource value of indigenous fishes.

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Appendices

Appendix 1: Conservation status of and threats to freshwater fishes of the Western Cape Province.

Species	Current Iucn Status (Baillie and Groombridge 1996)	Major Threats (AF=Alien Fishes, AP= Alien Plants, B=River Bulldozing, WA=Water Abstraction, W=Weirs)	Remarks And Recommendations
Austroglanis barnardi	CR (B1,2bcd)	B, WA, W	Endemic to Olifants system – only in Noordhoeks, Thee and Hex rivers, not formally conserved.
A. gilli	VU (A1ce,B1,2c)	B, WA, W	Endemic to Olifants system in several systems on both Olifants and Doring sub-catchments. Some populations very small and may be disconnected, some within conserved areas.
Barbus andrewi	VU (A1cde)	AF, AP, B, WA and W	Endemic to Berg and Breede systems, surveys and other actions urgently needed.
B. anoplus	NL	AF, WA and W	In Olifants, Groot, Gourits and Swartkops systems. Genetic studies by Engelbrecht have shown that isolated populations can be distinct. Genetic studies of W.C.P. populations needed. Some populations highly threatened. Some populations within conserved areas.
B. calidus	EN (B1,2ac)	AF, AP, B, WA	Endemic to Olifants system in several systems, some populations within conserved areas.
B. capensis	VU (A1ce)	AF, AP, B, WA and W	Endemic and widespread in Olifants system, some populations fragmented and some within conserved areas.
B. erubescens	CR (B2ae,3a,E)	AF, WA and W	Endemic to Twee River of Olifants system where it is fragmented by various impacts. Not formally conserved. Urgent conservation measures required. The most threatened freshwater fish of the W.C.P.
B. serra	EN (B1,2abde,C1)	AF, AP, B, WA and W	Endemic to Olifants, occuring in mainstream and several tributaries, mainstream surveys urgently required, some populations within conserved areas.
Pseudobarbus afer	LR (nt)	AF, AP, B, WA and W	Widespread in S. Cape coastal streams to Sundays system. Isolated populations are probably genetically distinct. Some populations are highly threatened; some populations within conserved areas.
P. asper	VU (A1ce)	AF, AP, B, WA and W	Several populations in the Gourits system and the Groot River of the Gamtoos system. These populations may be distinct and some are threatened. Some populations within conserved areas.
P. burchelli	EN (A1ce,2ce,C1)	AF, AP, B, WA and W	Several fragmented populations in Breede system, also in Duiwenhoeks and adjacent systems. The Duiwenhoks is expected to be genetically distinct, some populations within conserved areas.
P. burgi	CR (A1ce, B1,2abce,3acd)	AF, AP, B, WA and W	Several fragmented populations in the Berg system and also in the Verlorenvlei system (a distinct population) and Langvlei from where they may have become extinct. Re-introduction into Eerste River must be investigated. A few populations within conserved areas.
P. phlegethon	EN (B1,2ac)	AF, AP, B, WA and W	Several fragmented populations in the Olifants/Doring system with genetic studies showing that the Driehoeks population (Doring system) is a distinct subspecies. This species appears more abundant on lower portions of Olifants River tributaries making them susceptible to agricultural impacts and invasion by alien fish. Some populations are within reserves.
P. tenuis	EN (A1ce,2ce,C1)	AF, AP, B, WA and W	In the Gourits and Keurbooms systems as well as E. Cape systems within the C.F.K.. Each isolated population may be genetically distinct. Some populations conserved.
Galaxias zebratus	LR (nt)	AF	Widespread from Olifants to Gamtoos systems from coast to mountains, possible Gondwana relic, may be a species complex, more genetic and taxonomic analysis required. Some populations highly threatened and some conserved.
Labeo seeberi	CR (A1ace)	AF, AP, B, WA and W	Endemic and once widespread in Olifants system, now highly fragmented and only 3 recruiting populations known in the Oorlogskloof, Gifberg (nursery site) and Biedou rivers. Distribution surveys (especially mainstreams) and biological study urgently needed. Oorlogskloof population in nature reserve.
L. umbratus	NL	AF, WA and W	In the Gourits, Gamtoos and Sundays system of the C.F.K., also in Orange/Vaal system. C.F.K. populations may be genetically distinct from the Orange/ Vaal population.
Sandelia capensis	NL	AF and WA	Widespread distribution from Verlorenvlei system to Port Elizabeth. Likely that isolated populations may be genetically distinct. Some populations within conserved areas.

Appendix 2: Critical areas including biodiversity hotspots for the conservation of primary freshwater fishes of the Western Cape Province

Olifants River system:

1. Twee system. *B. erubescens* is endemic to the system, and is probably the nearest to extinction of South African freshwater fish species. *G. zebratus* is also present and this population may prove to be genetically distinct from other populations within the system. The subsystem is impacted by agricultural developments and introduced fishes such as *B. capensis*, *L. macrochirus*, *O. mykiss* and *S. capensis*. The effects of chemical run-off from farms needs to be urgently assessed here as areas of high density farming have low numbers of all species. Within the system *B. erubescens* is fragmented into the Upper Suurvlei, Upper Middeldeur and lower Twee. The only unimpacted and safe section of the system is the Heks River, a small valley tributary of the Middeldeur. **Recommendations**: The Heks River should be considered for purchase and protection with weirs to prevent upstream migration of alien fish species. The remaining Twee system should be made into a conservancy. *B. erubescens* should be stocked into safe sanctuary areas within the system (dams and river sections above natural fish distributions). Actions are urgently required.

2. Rondegat system. This system contains *A. gilli*, *G. zebratus*, *P. phlegethon*, *B. calidus* and *B. capensis*. In a current genetic study, *A. gilli* from the Rondegat have been shown to be genetically distinct from populations elsewhere in the system indicating them as a priority for conservation. The Rondegat is partly within the Cederberg Wilderness Area and "protected" naturally from upstream movement of bass by a natural barrier waterfall. The lower valley is farmed for cattle and citrus and is heavily infested with alien trees such as black wattle (*Acacia mearnsii*). **Recommendations**: A river rehabilitation project is needed involving alien fish and plant removal, weir construction near entrance into Clanwilliam Dam and conservancy involving local farmers (keep cattle out of river).

3. Boontjies-Boskloof systems. Species present in the system are *B. capensis*, *A. gilli*, *B. calidus*, *P. phlegethon* and *G. zebratus*. The Boskloof is "protected" from upstream movement of bass by a large modern off-take weir (for the local municipality and farmers). The upper Boskloof is in the Cederberg Wilderness Area and so is effectively conserved. The lower Boontjies has been invaded by bass for several kilometres. Unfortunately barrier falls low down in the drainage mean that the remaining indigenous fishes are sandwiched into a very short section of river. The upper Boontjies is devoid of fishes but may well harbour endemic invertebrates. **Recommendations**: The Cederberg Wilderness Area should be enlarged to include more of the Boskloof River. Alternatively, river conservancies should be considered for the Boskloof and Boontjies rivers. In the lower Boontjies, there is a series of waterfalls and a series of spectacular pot holes which could be considered as a natural heritage site.

4. Noordhoeks, Thee and Oudste systems. The former two rivers are the only sites where *A. barnardi* occur in pristine habitats. They are also the most diverse rivers with other species represented by *A. gilli*, *B. capensis*, *B. calidus*, *P. phlegethon* and *G. zebratus*, and can be regarded as the two most important in the system. Historically *B. serra* and *L. seeberi* may have also been present but recent surveys have not identified these two species. The upper catchments are pristine but are not protected whereas the lower reaches where *A. barnardi* and *P. phlegethon* are most common, are seriously impacted by bulldozing (to reduce flooding) and water extraction (to the point where the rivers dry up in summer). **Recommendations**: These two rivers should be purchased right down to their confluences with the main Olifants channel. Alternatively, conservancies can be considered but the resident farmers are unlikely to be receptive to this option. Protection from upstream migration of aliens needs to be urgently addressed as bass are present in the lower Thee and *T. sparrmanii* are in the Noordhoeks. Farm dams, irrigation channels and pipes may have aided alien fish movement and need to be critically evaluated to prevent further influxes up these rivers. Lower river habitats need to be rehabilitated, further bulldozing prevented and natural bank fynbos vegetation allowed to regenerate for 20-50m either side of these rivers. Actions are urgently required.

5. Ratels system. Upper reaches no fish, middle reaches *B. capensis*, *B. serra* and *B. calidus* and lower reaches *M. dolomieu* and *L. macrochirus*. A large actively recruiting population of *B. serra* is present which sets it aside as an important area in need of conservation. **Recommendations**: A conservancy should be established as private landowners support conservation. Barriers to bass should be established near the confluence with the Olifants and bass should be eradicated above the barrier by poisoning using rotenone.

6. Tra-Tra system. There is a very short section (less than 1km) near Wuppertal where *B. calidus*, *B. serra* and *A. gilli* are present. Below these there are bass and above the town's water off-take weir is a substantial population of *G. zebratus*. The indigenous fishes are sandwiched into a very short section of river. **Recommendations**: A barrier weir should be constructed at the town of Wuppertal where there is presently a ford/drift. The bass between the town and where the indigenous fish occur could then be poisoned, using rotenone, allowing indigenous fishes to re-colonise this section (another 1km of river habitat) and effectively protect them from further bass encroachment. A conservancy is suggested and this could be a community project as the town and the "swimming pool" (including their indigenous fish) are major tourist attractions.

7. Biedou-Heuningvlei system. The upper catchment and gorge is a superb natural spectacle and includes a Natural Heritage Site (Bushmanskloof Game Reserve). It represents a breeding site for *L. seeberi*, *B. capensis* and *B. serra*. Also present are *A. gilli* and *B. calidus*. The indigenous fish population is found in a short 2km section below gorge. **Recommendations:** A weir should be established near the Biedou/Clanwilliam road and bass and other alien fish eradicated above this. A conservancy is proposed.

8. Driehoeks-Matjies system. One of only two populations of genetically distinct *P. phlegethon* "Doring" occurs here. Also present are *A. gilli*, *B. calidus*, *B. capensis*, *B. serra* and *G. zebratus*. The Cederberg Wilderness Area is at the top of the drainage, private farms in the mid valley and the Matjies River Nature Reserve lower down. A conservancy has been established to conserve the river system. **Recommendations:** The area just

below the Driehoeks farm has large mouth bass (*M. salmoides*) - these have been present for several decades and appear not to have moved either up or down the stream. However, the bass have split populations of *P. phlegethon* and pose a threat to the entire subsystem. They should be considered for removal by heavy fishing pressure (angling and spear fishing) with possible weir construction limiting their expansion. At the Matjies (confluence of the Krom and Driehoeks) there are bass again. Because of the nature of the river in its lower stretches (sandy isolated pools in late summer) it may be possible to eradicate bass here using rotenone poison. The Cederberg Wilderness Area could also be extended.

9. Breekkrans system and adjacent southern tributary. New distributions for *B. calidus*, *P. phlegethon*, *G. zebratus* and *A. gilli* have recently been discovered in this system. The upper reaches are protected from development as it is owned by a mountain club. However, upstream encroachment by bass is a serious threat to the system. **Recommendations:** The Cederberg Wilderness Area should be extended to include more of this catchment and a conservancy should be established. A weir needs to be constructed at the main road near Vogelfontein farm and bass populations poisoned with rotenone in the middle reaches. This would require initial determination of the upper bass limit and downstream populations of indigenous species. As one of only two *P. phlegethon* "Doring" populations this is a key river within the Olifants system.

10. Eselbank system. New site for *B. calidus*, *G. zebratus* and *A. gilli*. Like the nearby Tra-Tra populations, these populations are sandwiched into a short section of river. Smallmouth bass (*M. dolomieu*) have travelled further up this system by irrigation contour furrows. **Recommendations:** The Cederberg Wilderness should be extended and a conservancy established. Bass should be eradicated here.

11. Heks system. The third river to contain *A. barnardi* and *A. gilli*. The mid and lower sections also contain bass but their upper limit has not yet been identified. *A. gilli* are present in the upper catchment and *B. capensis*, *B. calidus*, *B. serra* and *P. phlegethon* may also be present here (further surveys are needed). The upper section of the river is within the Cederberg Wilderness Area. There are two or three farms in this valley (fruit and limited grazing). Lower down at the Heks Farm the river is bulldozed and most of the summer water flow is extracted. **Recommendations:** The Cederberg Wilderness Area should be extended to include most of this system and a conservancy should be established. The upper limit of bass needs to be determined and bass should be eradicated by using weirs, winter flushing and heavy fishing pressure during pre-breeding periods. Rotenone should not be used because of the healthy *Austroglanis* populations.

12. Upper Olifants from source to Keerom. The Visgat gorge is a Natural Heritage Site but none of this section is formally protected. In this stretch of river there are the largest populations of *B. capensis* and *B. serra* within the Olifants system. It is a major breeding site and is the only Olifants mainstream site that is not entirely impacted by bass. Unfortunately there are alien species in this area with brown trout (*S. trutta*) in the river above the natural fish limit (Visgat) through to Boskloof and bass from Boskloof to Keerom. Smaller numbers of one year old yellowfish (Bills 1998) also seem to indicate reduced recruitment in areas where there were bass. The headwater reaches in the Agter-Witzenberg are extensively farmed and heavily dammed but the Olifants River remains reasonably healthy. Rapidly invading black wattles are a cause of concern. **Recommendations:** A conservancy and enlargement of the Groot Winterhoek Wilderness Area is essential. Other proposals include the translocation of juvenile indigenous fish collected in the summer to close-by upper reaches such as those above Visgat and Boskloof River (already under consideration by N.D. Impson) and the selective removal of bass and trout by fishing between Visgat and Keerom. Dams in the area should be cleared of bass to prevent their possibility of entering the upper Olifants river.

13. Jan Dissels-Kliphuis systems. The Jan Dissels has the largest population of *A. gilli* in the entire Olifants system (estimated at over 20,000 individuals by IRB) whereas the Kliphuis system has a possibly distinct population of *B. anoplus*. The Jan Dissels and Rondegat *A. gilli* appear to be genetically different to other populations in the system making them very important for the conservation of this species. Also present in the Jan Dissels is *G. zebratus*. Historically, *B. calidus*, *B. capensis*, *L. seeberi* and *P. phlegethon* were present. Unfortunately, bass have moved up this system with recent surveys not being able to identify their upper limits. Habitat remains excellent and the upper reaches are within the Cederberg Wilderness Area. The lower Jan Dissels is heavily impacted from agro-chemical pollution, the Clanwilliam refuse dump, excessive water off-take and alien weeds such as *E. crassipes*. **Recommendations:** The Cederberg Wilderness Area should be extended and a conservancy established. The construction of low cost weirs is proposed together with the fishing out or winter-flushing of bass down the river. A field experiment aimed at determining the feasibility and success of such actions needs to be implemented. Rotenone should not be considered due to the presence of substantial *A. gilli* populations.

14. Gifberg system. A seasonal tributary stream flowing directly into the Doring river where *L. seeberi* and *B. serra* breed during spring. A short (approximately 1km) section of river delimited by waterfalls (upper preventing all fish movement and lower prevent bass movement). In recent surveys (March 1998) only juveniles were found in stagnant pools. **Recommendations**: The entire catchment should be purchased to establish a reserve. It represents a possible site for collection of juveniles for stocking. Detailed surveys and a biological study on *L. seeberi* are needed

15. Rietkloof system. This is a small tributary stream of the Groot (Doring) system in a pristine valley. In its lower 2km there is a small population of *B. anoplus*. It is one of the few sites we have located with this species and the only one that is unimpacted. The confluence with the mainstream is a fall so it is naturally protected from bass encroachment. **Recommendations:** conservancy or reserve.

Verlorenvlei-Langvlei river systems:

16. The Verlorenvlei system has a large population of *P. burgi* "Verlorenvlei" present throughout the system. This population has been shown by Skelton (1980) and Bloomer and Impson (in press) to be morphologically and genetically distinct from the Berg River populations. It probably represents a new species and

for conservation purposes should be considered separate from *P. burgi*. Although high numbers of fish were recently collected throughout the system, all areas are impacted by agro-pollution (chemicals and sediments) and water extraction. *P. burgi* and other fish were also found to have high levels of bacterial infections (probably due to inferior water quality). **Recommendations:** A conservancy is needed which can link with the estuary which is a RAMSAR site. A Catchment Management Plan is urgently needed to control future water use.

The Langvlei is a coastal system that historically had *P. burgi*, *G. zebratus* and *S. capensis*. These were (and possibly still are) valuable populations as they probably represent the most north-westerly ranges of these species and are probably genetically distinct. The *P. burgi* population should be most similar to its nearest neighbor *P. burgi* "Verlorenvlei". **Recommendations:** Surveys are needed to determine if these populations are extant. Conservancies would probably provide the most effective protection.

Berg River system:

17. Piketberg tributaries of the Berg system. Isolated and most northerly populations of *P. burgi* "burgi" in the Platkloof and Boesmans systems. The former flows through Goedverwacht (a mission town) and has a very healthy population of *P. burgi*. Other species include *G. zebratus* and *S. capensis*. Bass and bluegill (*L. macrochirus*) have invaded the lower reaches of both systems. **Recommendations:** Conservancies involving private landowners and the Goedverwacht community are needed. Alien fish should be eradicated using weirs and poisons. Surveys are urgently needed.

18. Twenty Four-Leeu system. Both *P. burgi*, and *S. capensis* present with *B. andrewi* and *G. zebratus* probably also in the system. The middle and upper rivers are in an almost pristine condition but have been invaded by bass (*Micropterus* spp.) and rainbow trout (*O. mykiss*). **Recommendations:** The Groot Winterhoek Wilderness Area should be extended and conservancies established. Alien fish need to be eradicated and indigenous fish re-established. Surveys are urgently needed.

19. Krom system. Both *P. burgi* and *G. zebratus* recorded while *S. capensis* is probably present. The catchment is heavily farmed and receives water form the Witte River (Breede River system) via an Interbasin Water Transfer (IBT). **Recommendations:** The Limietberg Nature Reserve could be extended and a conservancy established. Barriers to upstream bass invasion should be investigated. Alien plant invasions need control.

20. Upper Berg system (Hugo, Wemmers and upper Berg rivers): *B. andrewi*, *G. zebratus*, *P. burgi* and *S. capensis* have been recorded here. These populations are all under threat from alien fishes and trees. Other impacts include weirs, large instream dams, river bulldozing and an IBT. **Recommendations:** The Limietberg Nature Reserve should be extended and a series of conservancies established. Alien fish should be contolled in the Hugo system and Berg River above the IBT Dam. Alien plant invasion in the catchments and within the riparian zone need to be controlled. Surveys are urgently needed.

Heuningness River system:

22. This system has populations of *P. burchelli*, *G. zebratus* and *S. capensis* that are probably genetically unique. It includes Soetendalsvlei and De Mond estuary. Impacts include instream dams, use of pesticides and fertilizers and alien fish and trees. **Recommendations:** The De Mond Nature Reserve should be expanded to include Soetendalsvlei and a conservancy should be established for the rest of the system. Alien fish and trees should be eradicated where appropriate. Surveys are urgently needed.

Breede River system:

21. Riviersonderend and northern tributaries. Species include *G. zebratus*, *P. burchelli*, *S. capensis* and a few isolated populations of *B. andrewi*. This area is in good to excellent condition but is being increasingly invaded by alien trees and fish. **Recommendations:** The reserve should be extended to include one or more complete tributaries. A conservancy for the Riviersonderend system should be established. Protection of aquatic habitats from alien fish and plant encroachment is necessary. Surveys are urgently needed.

23. Witte system. *B. andrewi*, *G. zebratus*, *P. burchelli* and *S. capensis* are present but are threatened by brown trout (*S. trutta*) and an IBT in the upper reaches and bass and black wattle in the lower reaches. The Steenboks tributary is threatened by resort development. Much of the system is conserved in the Limietberg Nature Reserve. **Recommendations:** The reserve should be extended to the confluence of the Witte and Breede rivers and/or a conservancy should be established. Alien fish and trees should be eradicated from the lower Witte system.

24. Sanddrif-Hex system. *B. andrewi*, *G. zebratus*, *P. burchelli* and *S. capensis* are present but are threatened by rainbow trout, alien trees, bulldozing of riverbeds and a large instream dam. **Recommendations:** A part of the Waterval Nature Reserve should be extended to include the Sandrif system and a conservancy should be established on the Hex system. The control of alien trees within the riparian zone should continue. Surveys urgently needed.

25. Brandvlei Dam. A very large population of the vulnerable *B. andrewi* is present. Potential threats include the illegal introduction of sport fishes for angling purposes, resort development and pollution from land-based sources. **Recommendations:** A conservancy should be established and ongoing monitoring is required.

26. Kogmanskloof-Kingna system. *G. zebratus*, *P. burchelli* and *S. capensis* are present but are threatened by alien fish and trees, water abstraction and pesticide and fertilizer use. **Recommendations:** A conservancy should be established. Surveys urgently needed.

27. Leeu-Klip system. *G. zebratus*, *P. burchelli* and *S. capensis* are present but are threatened by alien fish and trees, water abstraction and pesticide and fertilizer use. **Recommendations:** The Marloth Nature Reserve should be extended and a conservancy established. The feasibility of eradicating alien fishes should be investigated. Surveys are urgently required.

28. Buffeljags-Tradouw systems. *B. andrewi, G. zebratus, P. burchelli* and *S. capensis* are present in this highly acidic blackwater system but are threatened by bass, bluegill, alien trees and the Buffeljags Dam. **Recommendations:** The Grootvaderbosch Nature Reserve should be extended and a conservancy established for the system. Genetic studies are necessary as some of these populations may be distinct. The system needs rehabilitation work involving alien fish and tree eradication. Surveys are urgently needed.

Duiwenhoeks (29) and Goukou River (30) systems:

29 and 30. *G. zebratus, P. burchelli* and *S. capensis* are present in these highly acidic blackwater systems but are threatened by bass, bluegill, alien trees and water abstraction. Due to their isolated nature these populations may be genetically distinct. **Recommendations:** The Grootvadersbosch Nature Reserve should be extended and a conservancy for each system established which could extend to their respective estuaries which are in good condition. These systems should be rehabilitated by alien tree eradication and alien fish removal from their upper and middle reaches. Surveys are urgently required.

Gourits River system:

31. Groot system. This system is species rich with *B. anoplus, G. zebratus, L. umbratus, P. asper, P. tenuis* and *S. capensis* present. All these populations may show significant genetic differences with populations on the eastern side of the system and in other systems. The system is impacted by several species of alien fishes, alien trees, water extraction and pesticide and fertiliser use. **Recommendations:** The Towerkop Nature Reserve should be extended and a conservancy established. Surveys are urgently required.

32. Gamka-Seweweekspoort-Nel systems. These systems are also species rich with *B. anoplus, G. zebratus, L. umbratus, P. asper, P. tenuis* and *S. capensis* present. All these populations may show significant genetic differences with populations in other systems. The system is impacted by several species of alien fishes, alien trees, water extraction and pesticide and fertiliser use. **Recommendations:** The Towerkop and Swartberg Nature reserves should be extended and a conservancy established. Surveys are urgently required.

33. Kammanassie system. This system is also species rich with *B. anoplus, G. zebratus, L. umbratus, P. asper, P. tenuis* and *S. capensis* present. All these populations may show significant genetic differences with populations on the western side of the system and in other systems. The system is impacted by several species of alien fishes, alien trees, water extraction and pesticide and fertiliser use. **Recommendations:** The Kammanassie Nature Reserve should be extended and a conservancy established. Surveys are urgently required.

Southern Cape coastal systems between George and Knysna:

34. Isolated coastal systems here may each harbor genetically distinct populations of *G. zebratus, P. afer* and *S. capensis*. Impacts in general include alien fishes and trees, water extraction and weirs. **Recommendations:** The Goukamma Nature Reserve should be extended and individual conservancies established for the key systems. Alien trees should be eradicated, especially from riparian areas. Surveys and genetic studies are necessary.

Keurbooms-Bietou River system:

35. This system is also species rich with *G. zebratus, P. afer, P. tenuis* and *S.capensis* present. All these populations may show significant genetic differences with other populations in other systems. The system is impacted by several species of alien fishes, alien trees, water extraction and pesticide and fertiliser use. **Recommendations:** The Keurbooms Nature Reserve should be extended and a conservancy established. Surveys are urgently required.

Executive Summary

The freshwater fish database of the Western Cape Nature Conservation Board (WCNCB) was analysed with the aid of a Geographic Information System to generate species distributions on a series of maps. The maps were used to identify river areas with high diversities of indigenous freshwater fishes or containing highly threatened fish species. These river areas were called critical fish conservation areas and were compared with the Western Cape Province's existing network of formal conservation areas to determine how effectively freshwater fishes are being conserved. A desk-top analysis was then used to summarise existing knowledge and to highlight relevant issues which require urgent attention to ensure the future conservation of these fishes and their associated ecosystems. The chapter is similar to the report submitted by the authors to the Cape Action Plan for the Environment for conservation planning for the Cape Floral Kingdom (CFK).

Key Findings

- The Cape Action Plan for the CFK identified indigenous freshwater fishes as a priority group for conservation because 16 of the 19 species are endemic with all endemics listed as threatened. Significantly, eight of these 16 endemic are only found in the WCP with the remaining endemic species being near endemics to the WCP.
- The eighteen indigenous freshwater fishes of the WCP form a distinct "Cape" component of the ichthyofauna of Africa, with both Gondwanan relicts (*e.g.* Cape Galaxias *Galaxias zebratus*) and largely endemic genera (*e.g. Pseudobarbus*).
- Fifteen of the 18 species are listed as threatened with an alarming nine of these either critically endangered or endangered.
- The primary threats have been the impact of invasive alien fish species and habitat degradation by unsustainable agricultural development.
- 35 river areas of critical conservation importance to freshwater fishes were identified with the majority in the Olifants River System.
- The existing reserve network, especially provincial nature reserves, make a substantial contribution towards freshwater fish conservation. However, several highly threatened species (*e.g.* Twee River redfin *Barbus erubescens*) are not conserved and fishes in reserve areas frequently share reserve habitat with highly predatory invasive alien fish species such as smallmouth blackbass *Micropterus dolomieu*.
- Recent genetic studies on several populations of the same apparent species (*e.g.* Berg River redfin *Pseudobarbus burgi*) have indicated that there are possibly cryptic species involved and hence the numbers of species and levels of endemicity are likely to increase.
- The WCNCB is presently poorly equipped to conserve freshwater fishes and associated habitats. Manpower (two scientists) and operational budgets for this task are way below critical minimum requirements (three scientists and two conservators).
- Invasive alien fishes are still increasing their distribution ranges in WCP inland waters due to illegal stockings by the public. The continual spread of the sharptooth catfish *Clarias gariepinus* is cause for special alarm.
- Public awareness of freshwater fish conservation needs is growing, with especially organised angling (Cape Piscatorial Society, Federation of South African Flyfishers, Peninsula Bassmasters) and some conservation minded land-owners supporting conservation projects and protecting indigenous fishes. Educational displays and material at the Two Oceans Aquarium at the Cape River Ecosystem Display ensure that a significant component of the public have become aware of the plight of these fishes.
- The Fynbos Working for Water Project, managed by the WCNCB in the WCP, is making a significant contribution to river rehabilitation by clearing invasive alien trees from catchment and riparian areas.

Conservation Implications

The present status of the indigenous freshwater fishes of the WCP and hence CFK looks depressing. If the existing resources to conserve them are not improved, their conservation status will further deteriorate with species such as the Twee River redfin likely to become extinct within the next 20 years.

However, CAPE is likely to turn the tide as significant resources are expected to be mobilised between 2001 to 2005 to improve conservation of the rivers and associated fauna of the WCP. A CAPE Action Plan project entitled "A river runs through it" has been accorded priority status for implementation and with a budget of nearly R10 million should address several inhibitory factors that presently exist.

State of Biodiversity: Western Cape Province, South Africa Amphibians and Reptiles

Ernst H.W. Baard and Atherton L. de Villiers
Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

Introduction

The six floristic biomes in the Western Cape Province (W.C.P.), namely the Fynbos, Afromontane Forest, Thicket, Grassland, Nama and Succulent Karoo Biomes (Low and Rebelo, 1996), are not only diverse with regard to the variety of plant species and communities occurring there, but also contain a wide diversity of animal species, biogeographical zones, landscapes and natural features, both within the terrestrial and aquatic (freshwater and marine) context. In addition to the topographical diversity of the Cape Fold Mountains, the coastal zone and lowlands, and their transition into surrounding habitats, the W.C.P. experiences a wide climatic diversity too. These features have resulted in an extensive and complex diversity of habitat types which partly explain the rich biological diversity within the W.C.P. Past climatic changes on a global scale have also influenced ecological systems and processes within the W.C.P. to the extent where it is believed that vicariant speciation processes and events during global climatic changes have resulted in evolutionary driving forces that have had significant impacts on the biodiversity within the biogeographical boundaries of the W.C.P. (Vrba, 1985).

The Cape Floral Kingdom (C.F.K.), comprising the Fynbos, Succulent Karoo, Thicket and Afromontane Biomes (Cowling and Richardson, 1995), and largely contained within the W.C.P., is considered one of six floral kingdoms in the world, and together with the remainder of the Succulent Karoo Biome, stretching up the western half of the country, are recognised as two of the 25 global biodiversity "hotspots" (Myers, Mittermeier, Mittermeier, Da Fonseca and Kent, 2000). This places a significant responsibility on the relevant conservation authorities mandated to protect, conserve and manage this natural heritage.

The amphibians and reptiles of the W.C.P. are recognised as a truly diverse group with a relatively high number of endemic species. Referring to the greater number of non-tropical endemic forms, Poynton (1964) describes a distinct "Cape Fauna", represented by the unique assemblage of amphibians (mostly endemic) occurring in the southwestern region of the country. Poynton (*op. cit.*) also mentions the coincidence of the Cape amphibian fauna with the fynbos region. The W.C.P. reptile fauna is also highly varied and comprises taxa unique to this region, including some of South Africa's rarest and most threatened (Branch, 1988a; 1998).

South African herpetology is still very much in its *alpha* phase (see further on), since distribution surveys and taxonomic research continuously turn up new taxonomic entities. For example, 83 new reptile species were described in the 10 years after the first South African reptile field guide was published in 1988 (Branch, 1998). This is especially due to improved molecular techniques which are useful for identifying biological diversity (and indicating cryptic taxa = "taxa within taxa"). Within roughly the last 10 years herpetological research in South Africa has provided valuable information on the general taxonomy, distribution, and ecological and physiological aspects of reptiles and amphibians, whereas herpetofaunal conservation efforts have mainly been targeted at threatened species and broader conservation issues.

The conservation of W.C.P. biodiversity is primarily concentrated in the mountainous areas where the past establishment of nature reserves, state forests and other conservation areas, as well as the declaration of mountain catchment areas, has resulted in the establishment of a reserve system biased largely towards montane habitats. However, mountains contain a rich biodiversity including refugio for biogeographically related phenomena such as melanism and relict poulations. Furthermore, it is easier to conserve, since human influences, such as urban and agricultural development (two of the main culprits in the loss of biodiversity), are limited by the sheer ruggedness and hostility of the terrain. In contrast, the rate of biodiversity loss in the coastal zone and lowlands is high, since the conservation of biodiversity in these regions is patchy and fragmented, and often seriously compromised due to development pressure and general habitat degradation in these areas.

The aim of this chapter is to discuss the conservation status of amphibian and reptile diversity in the W.C.P.; and to make recommendations towards conservation actions and/or measures required for effective conservation of this largely unique fauna. Various issues of threat and constraint will be discussed, and legislative shortcomings and effectiveness of conservation measures will be highlighted.

Methods

This chapter is partly based on the information obtained from analysing data from a biodiversity database for the C.F.K. and W.C.P.; an analysis which formed the basis of a review report of the amphibians and reptiles of the C.F.K. as indicators of centres of biodiversity, sensitive

habitats and sites of special interest (Baard, Branch, Channing, De Villiers, Le Roux and Mouton, 1999). This process formed part of the Cape Action Plan for the Environment (C.A.P.E.) – a strategic planning exercise to establish a comprehensive long-term conservation strategy for the C.F.K. (Cowling, Pressey, Lombard, Heijnis, Richardson and Cole, 1999; Ashwell and Younge, 2000).

The biodiversity database was compiled and is maintained by the Scientific Services Division of the Western Cape Nature Conservation Board (W.C.N.C.B.) and comprises herpetological data from the various museum and institutional sources as listed in the Acknowledgements, as well as from the Western Cape Nature Conservation Board itself. This was useful in compiling a checklist of amphibians and reptiles known to occur in the W.C.P. (Appendix 1).

During the analysis of the data, it became apparent that the bulk of information on the occurrence of the herpetofauna in W.C.P. statutory conservation areas comprises unconfirmed records. As a result, the authors considered it potentially misleading to include this information for biogeographic analytical purposes in this chapter, and the level of accuracy for those analyses included has therefore been specified. This aspect is, however, receiving attention for future revisions of this chapter. Furthermore, because marine herpetofauna (sea turtles and snakes) are only vagrants to the W.C.P. shores, the authors do not consider them part of the indigenous herpetofauna of the province, and have excluded them from the biogeographical analysis of W.C.P. biodiversity.

In addition to the above analyses, specific habitats and/or sites and areas known to be sensitive and/or vulnerable to disturbance and habitat degradation, or which are known to support a diverse herpetofauna, and which were identified and mapped at the 1:50 000 scale by Baard *et al.* (1999) were incorporated for the sake of completeness.

Amphibian and Reptile Statistics

Data quality

Before presenting results on the state of herpetological biodiversity in the W.C.P., it is important to discuss the quality of the data used to compile this report. For very obvious reasons, the outcome of any data analysis is only as good (and complete) as the quality of data. Numerous inaccuracies were encountered with museum data collation and curation *e.g.* outdated taxonomy, missing specimens, vague locality descriptions, misplaced localities, and obvious misidentifications or specimen labelling mistakes. Besides correcting as many of the inaccuracies as possible, it still remains uncertain as to what level specimens in museums have been accurately identified and labelled. The authors therefore, largely assumed that accurate identifications were made and that specimens carry correct and accurate labels.

As mentioned above, there is a paucity of confirmed herpetological records from statutory conservation areas in the W.C.P. (see Siegfried 1989). Although some have been surveyed thoroughly (*e.g.* Burger, 1993; Branch and Braack, 1989), others remain without proper, confirmed records. This aspect is currently being addressed by the Western Cape Nature Conservation Board by means of a biodiversity information management system which would ensure a system of systematic baseline data collection facilities and opportunities, and should result in numerous, useful and accurate records being logged with the current database system. This includes a formal protocol for data collection, routing, co-ordination, vetting and capture.

Another aspect regarding data qualty, is the matter of the so-called "confirmed absence" of taxa from certain geographical areas. In other words, does a lack of records from a particular area mean that a particular taxon does not occur there, or does it simply mean that it has not yet been recorded from there? Bearing in mind the fact that one could, however, with a reasonable amount of certainty and accuracy, "predict" the absence of certain taxa, especially specialised endemics, from certain areas (*e.g.* crag lizards are generally known to be absent from low-lying coastal fynbos communities, and geometric tortoises and micro frogs absent from montane habitats), it could be useful to perform a spatial analysis to model and map the confirmed absence of certain taxa to aid in the interpretation of the geographical distribution of taxa. This aspect, however, is not addressed in this chapter.

Because South Africa is still very much in its *alpha* phase of herpetological inventory, the W.C.P. biodiversity database is unlikely to be complete within the near future, but it remains important to increase our knowledge about the distribution and conservation status of taxa (especially population status figures). At the time of writing this chapter, however, the authors considered the 13 754 reptile and 6 595 amphibian records currently contained in the database to reflect a reasonably accurate and acceptable state of herpetological distribution information within the W.C.P.

With further emphasis on herpetological inventories and taxonomic research in South Africa, specifically in the W.C.P., pending better funding, our knowledge about the taxonomic status of many taxa will improve, hopefully to the point one day where descriptions of new taxa will reach a plateau. Additionally, with regard to determining the conservation status of taxa, it is important that monitoring be undertaken on the population status of threatened and/or endemic taxa in particular.

Amphibians

Amphibians play a major role in complex aquatic and terrestrial ecosystems where on the one hand, they serve as food for many other organisms, while in turn, they consume vast quantities of insects and other invertebrates, many of these which are often considered pests by humans. Amphibians are further good indicators of environmental health since they live in such close proximity to especially aquatic habitats.

Besides frogs and toads (generally, only referred to as “frogs”), no other kinds of amphibian, for example caecilians (worm-like amphibians), salamanders or newts (four-legged amphibians with tails) occur naturally in the W.C.P. The W.C.P. has a fair diversity of frogs, with 44 of 109 (40%) species known to occur in South Africa, Lesotho and Swaziland, occurring here (Figure 1). However, the W.C.P. boasts 22 species (50%) which are endemic to the region, occurring nowhere else. This number is considered unusually high and reflects the past

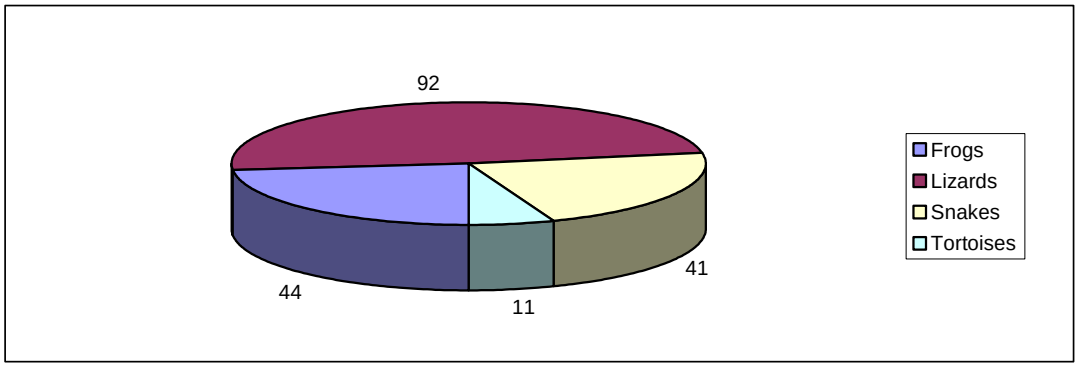

Figure 1. Number of Western Cape Province amphibians and reptiles.

biogeographical history of the region, which included climate and habitat changes, and other events that shaped the landscape and acted as environmental prompts for evolutionary change. Many of these endemic species are habitat specialists and occur in habitats which are by nature unique and often highly susceptible to environmental pressure and change. In certain cases, and under certain conditions, these habitats, together with their inhabitants, may experience undue environmental pressure leading to deterioration in habitat quality and possibly eventual local extinction.

There appear to be no established non-indigenous (alien) frog species in the W.C.P., but it needs to be noted that small populations of the painted reed frog *Hyperolius marmoratus*, a species indigenous to the East Coast, including the eastern parts of the W.C.P., have been recorded from the Cape Flats, Cape Town. However, the extent of invasion has yet to be established. It is thought that these frogs have either been deliberately released there, or they arrived with shipments of fruit and/or vegetables from the eastern regions where they occur naturally.

The distribution of frogs in the W.C.P. is by no means uniform and certain areas contain more species than others. Typically, the arid regions of the W.C.P. do not support many species of frogs, although the species occurring there are opportunistic breeders and large congegrations may flock to breeding pools during the breeding season, usually heralded by seasonal rains. The Cape Fold Mountains and surrounding foothills, especially the Kogelberg region, are known to support healthy populations of numerous frog species, and one area in particular, the Betty's Bay coastal wetlands and seepage fynbos, is known to support at least eleven frog genera (with 16 species). In general, the western and southern lowlands between the sea and mountains contain many natural and semi-natural wetlands and waterbodies which play host to frogs from this region. It is unfortunately also in this region where natural habitat destruction in favour of agricultural development has claimed a large proportion of natural frog habitat. However, artificial waterbodies, such as farm dams, provide suitable habitat for some common, non-specialist species, such as the common platanna, Cape river frog, and clicking stream frog. Additionally, the deep sandy areas of the coastal zone provide habitat for other species such as the burrowing Cape sand frog and various species of rain frogs.

With regard to their conservation status, most of the 44 frog species occurring in the W.C.P. are considered in Red List (Red Data Book) terms to be secure or of least concern. This majority comprises most of the common, wide-spread and generalist species such as the common platanna *Xenopus laevis*, the Cape river frog *Afrana fuscigula*, raucous toad *Bufo rangeri*, the clicking stream frog *Strongylopus grayii* and the common caco *Cacosternum boettgeri*. The current IUCN Red List (IUCN, 2000) lists six W.C.P. frogs as threatened (see Appendix 1), while the most recent South African Reptile and Amphibian Red Data Book (Branch, 1988a) also lists six W.C.P. frogs as threatened. Following a recent evaluation of the national conservation status of South African, Lesotho and Swaziland frogs (Harrison, Burger, Minter, De Villiers, Baard, Scott, Bishop and Ellis, 2001), new IUCN categories of threat (IUCN, 2001) were assigned to those species facing threats within their natural habitats.

Two W.C.P. species namely the micro frog *Microbatrachella capensis* and the Table Mountain ghost frog *Heleophryne rosei* were assigned to the "Critically Endangered" category, while the Cape platanna *Xenopus gilli* and the western leopard toad *Bufo pantherinus* were assigned to the "Endangered" category. These four species are considered in particular need of conservation attention and if current threats do not stop or continue operating without mitigation, they may face extinction.

Two more species, namely the Cape caco *Cacosternum capense* and the Cape mountain toadlet *Capensibufo rosei* are considered "Vulnerable" to environmental pressure and therefore their conservation status needs to be monitored. Six other species are considered as "Near Threatened" which means that if threatening processes continue to operate without mitigation, they may yet move into higher categories of threat. Two species, categorised as Data Deficient, require further information on their status, and field studies need to be conducted to gain a better understanding of their status. Figure 2 represents an analysis of W.C.P. frog endemism, indicating so-called "hotspots" of endemism, while Figure 3 details the current

conservation status of frogs in the W.C.P. (based on Harrison, *et al*., 2001).

Virtually no trade in W.C.P. frogs takes place, except for the annual export quota assigned to suppliers of the common platanna *Xenopus laevis* for biomedical research purposes. Many local, national and international medical and other scientific research laboratories make use of the common platanna as a laboratory animal. The Convention

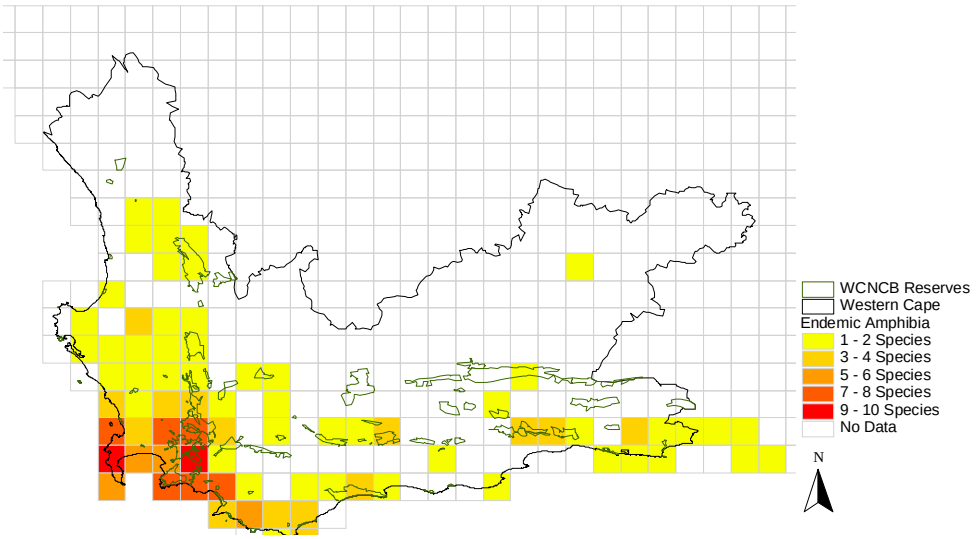

Figure 2. Degree of Western Cape Province frog endemism per quarter degree grid square.

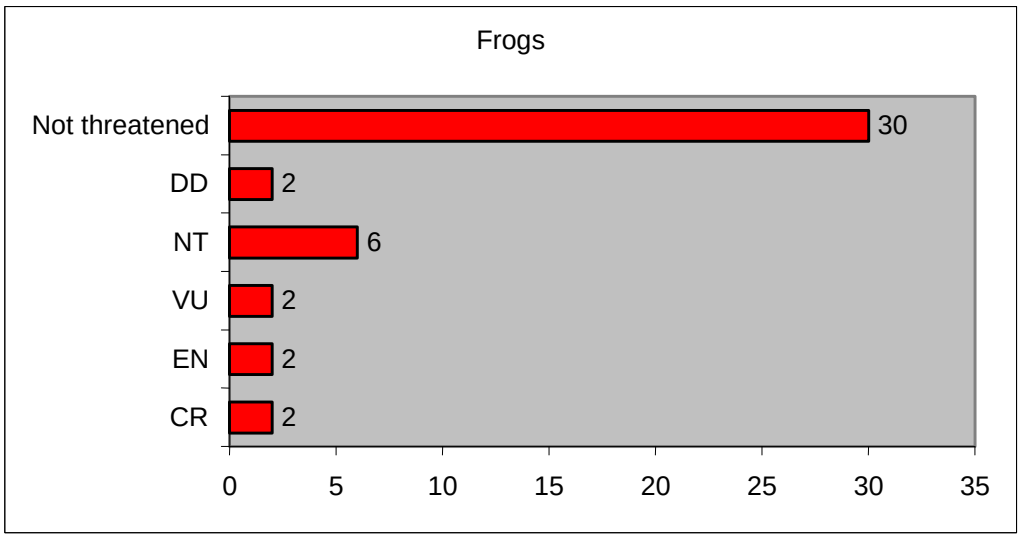

Figure 3. Conservation status of the indigenous frogs of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

on the International Trade in Wild Species of Fauna and Flora (CITES) regulates trade in, amongst other, amphibians and reptiles. Currently, no W.C.P. frogs are listed by CITES. Three species, namely the Cape platanna, micro frog and Cape caco are classified as "Endangered Wild Animals" (Schedule 1) according to the Nature Conservation Ordinance (No. 19 of 1974). All other frogs of the W.C.P., are classified as "Protected Wild Animals" (Schedule 2) according to the above ordinance.

In summary therefore, general W.C.P. frog endemicty is relatively high at 50% (Table 1), while 36% are considered to be at some conservation risk. Five percent are Critically Endangered, 5% Endangered, 5% Vulnerable and 14% Near Threatened (Figure 3). The status of two species (5%) is considered Data Deficient, and one species (2%), the sand toad *Bufo angusticeps*, is considered to be of Least Concern. There is, however, no reason to be complacent, and monitoring activities and field studies, even on the non-threatened frogs, must be initiated and current studies continued.

non-indigenous reptiles, the flower pot snake *Ramphotyphlops braminus* and the North American red-eared terrapin *Trachemys scripta elegans* are found here as well.

The W.C.P. contains a total of 145 (41% of the South African total) reptile species, and this total comprises 92 (63% of the W.C.P. total) lizard, 41 (28%) snake and 11 (8%) terrestrial tortoise and 1 (1%) freshwater terrapin species (Figure 1). One non-indigenous snake species, namely the flowerpot snake *Ramphotyphlops braminus* from Australasia has colonised many oceanic islands and most continents, including southern Africa where small populations have been found in a few coastal cities, *e.g.* Cape Town and Durban (Branch, 1998). The extent of its invasion is, however, unknown.

Lizards

The 92 lizard species of the W.C.P. are represented by a wide variety which includes the legless lizards, the skinks, the common lizards, the girdled lizards, the agamas, the chamaeleons, the leguaan, and the largest group, namely the geckos. The remarkable variety of environments in the

Table 1. Number of indigenous Western Cape Province amphibians and reptiles, with number and percentage of endemic taxa.

	No. of taxa	No. endemic taxa (%)
Frogs	44	22 (50%)
Lizards	92	17 (18%)
Snakes	41	2 (9%)
Tortoises	11	2 (18%)
TOTAL	188	43 (23%)

Reptiles

Reptiles are found in a great variety of habitats around the world, and they are represented on land, in freshwater habitats and even the marine environment. As with amphibians, they also play an important role in terrestrial and aquatic ecosystems in that they not only fall prey to a variety of predators such as other reptiles, birds, mammals and even some invertebrates, but also consume vast amounts of invertebrate prey, while the larger reptiles such as crocodiles and pythons, may even take medium to large mammals. Unfortunately, some reptiles, especially snakes, do not have a good public image and often have to suffer at the hands of uninformed and prejudiced humans.

Branch (1998) states that southern Africa perhaps has the highest reptile diversity on mainland Africa, and that the lizard fauna is by far the richest and most diverse. This is particularly the case among the geckos, skinks and girdled lizards. South Africa is host to 350 species of reptile (approximately 5.4% of the world total of 6500+ species). These comprise 213 lizards, 9 worm lizards, 105 snakes, 13 terrestrial tortoises, 5 freshwater terrapins, 2 breeding species of sea turtle and 1 crocodile (Branch, 1998). Two

W.C.P. is reflected in the occupation by lizards of habitats ranging from the coastal belt to mountain peaks, and from some of the wettest regions of the province to the most arid interior. Past biogeographical events, acting as evolutionary driving forces, as well as the topographic diversity of landscapes in the W.C.P., has led to an exceptional diversification in the lizard fauna of the region and this is well-reflected by the gecko and girdled lizard families. Seventeen lizard species (18%) are endemic to the W.C.P. and include five geckos, two dwarf chamaeleons, two crag lizards, three girdled lizards, one mountain lizard and four burrowing skinks (Table 1). represents the situation regarding the centres of reptile endemism in the W.C.P.

The conservation status of the W.C.P. lizards is considered stable and only seven species (8%) are currently listed on the 2000 IUCN Red List of Threatened Species (IUCN, 2000). Three species, namely Kasner's burrowing skink *Scelotes kasneri*, the armadillo lizard *Cordylus cataphractus* and McLachlan's girdled lizard *Cordylus maclachlani* are considered "Vulnerable". Four other species namely Gronovi's burrowing skink *Scelotes*

gronovii, the Namaqua plated lizard *Gerrhosaurus typicus*, the Hawequa fat-tailed gecko *Afroedura hawequensis* and the small-scaled leaf-toed gecko *Goggia microlepidota* are considered "Lower Risk/near threatened" (Figure 5). The most recent South African Red Data Book for Reptiles and Amphibians (Branch, 1988a) lists eight lizards as

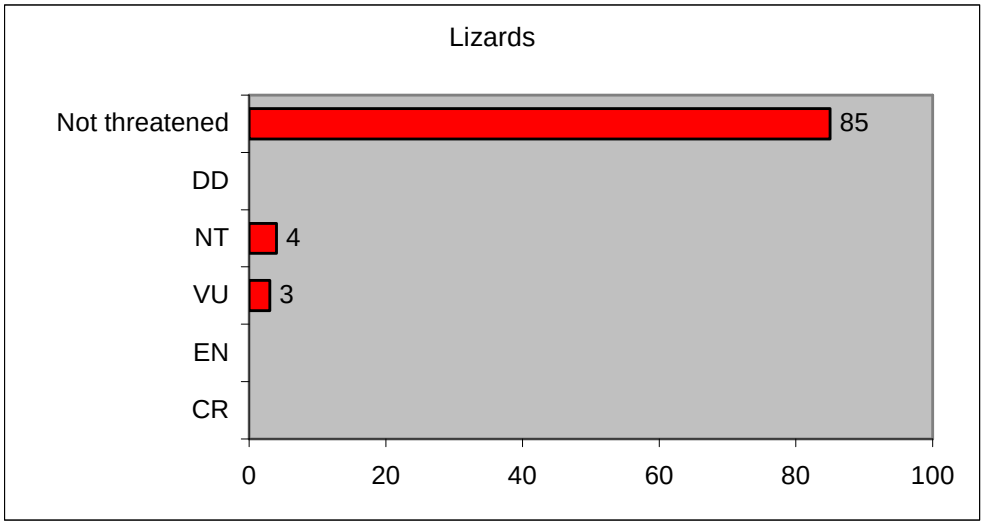

Figure 5. Conservation status of the indigenous lizards of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

threatened. Baard *et al.* (1999) reviewed the status of the W.C.P. lizards and made recommendations towards proposed IUCN categories for a number of species (see section on recommended conservation measures). These recommended categories should, however, be reviewed in terms of the latest IUCN Red List categories as reviewed and published by the IUCN (2001).

Members of the five genera *Cordylus* (girdled lizards), *Pseudocordylus* (crag lizards), *Bradypodion* (dwarf chamaeleons), *Chamaeleo* (greater chamaeleons) and *Varanus* (leguaans) are listed on CITES Schedule 2 due to their popularity as pets and the necessity to control trade in these species. Finally, all lizards in the Western Cape are classified Protected Wild Animals (Schedule 2) by the Nature Conservation Ordinance (No. 19 of 1974). Habitat degradation and destruction, popularity in the pet trade and restricted distribution ranges are the most important issues regarding the conservation status of the W.C.P. lizards. The recommendations of Baard *et al.* (1999) regarding proposed IUCN listings for W.C.P. lizards, snakes and tortoises are detailed in the section on recommended conservation actions.

Snakes

Forty one species of snake occur in the W.C.P. As with frogs and lizards, snakes also occupy a diversity of habitats and environments and may be found from the coastal dune belt, through the lowlands and into the mountains where the fortunate hiker may catch a glimpse of a rinkhals or berg adder. Surprisingly, only two snake species (9%), namely the Cape sand snake *Psammophis leightoni leightoni* and the southern adder *Bitis armata* are endemic to the W.C.P. (Table 1).

Three species (7%), Fisk's house snake *Lamprophis fiskii* ("Vulnerable"), the yellow-bellied house snake *Lamprophis fuscus* ("Lower Risk/near threatened") and the Namaqua dwarf adder *Bitis schneideri* ("Vulnerable") are listed in the 2000 IUCN Red List of Threatened Species (Figure 6), mainly due, in the former two cases, to their rarity, and in the third case, its relative habitat specificity – coastal sand dunes – and the threat of habitat destruction. Baard *et al.* (1999), however, did not consider these three taxa currently threatened and therefore these taxa do not appear in the section on recommended conservation measures. The recommended categories for the Cape sand snake and southern adder should, however, be reviewed in terms of the latest IUCN Red List categories as reviewed and published by IUCN (2001). The southern adder, a recently recognised species (Branch, 1999), and the Cape sand snake are considered particularly threatened by urban and coastal development in their restricted distribution ranges in the coastal lowlands of the southwestern Cape (Baard, *et al.*, 1999).

Apart from the above species, the South African Red Data Book for Reptiles and Amphibians (Branch, 1988a) lists two more snake species, namely the Cape sand snake and the western black spitting cobra *Naja nigricollis woodi* as "Vulnerable" (mainly due to habitat destruction on the Cape Flats and surrounding area) and "Rare" (this is a naturally rare species) respectively.

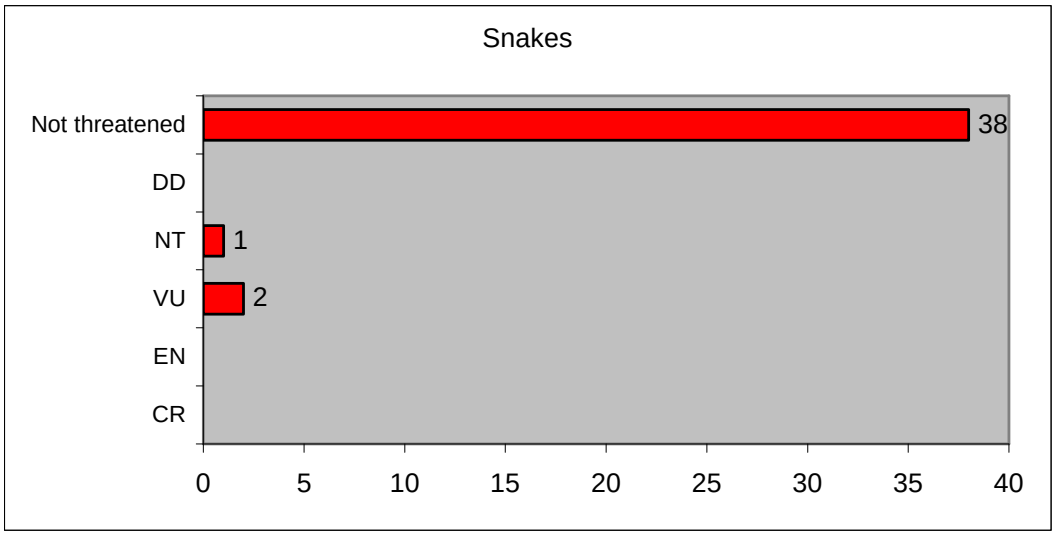

Figure 6. Conservation status of the indigenous snakes of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Defidient.

No snakes are listed by the CITES convention and the following non-venomous snake genera, namely *Lycodonomorphus*, *Lamprophis*, *Lycophidion*, *Mehelya*, *Duberria*, *Dasypeltis*, *Pseudaspis*, *Philothamnus* and *Prosymna* are classified as Protected Wild Animals by the Nature Conservation Ordinance (No. 19 of 1974). Venomous snakes are protected by virtue of them being wild animals, and the fact that nobody may hunt, kill or capture any wild animal without permission or using prohibited hunting methods.

Tortoises and Terrapins

The W.C.P. boasts the highest diversity of terrestrial chelonians or tortoises in the world. Nowhere else will one find such a diversity of species in such a relatively small region. Bearing in mind that worldwide there are 40 recognised species of terrestrial tortoise – family Testudinidae - (Iverson, 1992), then the eight species (11 taxa when subspecies are included) found here comprise almost a quarter of the world total (Table 1). Not only can one find one of the world's largest tortoises here, but also the smallest, and one of the rarest. Surprisingly, only one freshwater terrapin, namely the widespread and common Cape or helmeted terrapin *Pelomedusa subrufa* is found here.

The 11 terrestrial tortoises (including subspecies) found in the W.C.P. comprise the leopard tortoise, angulate tortoise, the padlopers or parrot-beaked tortoises, the tent tortoises and the geometric tortoise. Two of the species (18%), namely the southern speckled padloper *Homopus signatus cafer* and the geometric tortoise *Psammobates geometricus* are endemic to the region (Table 1). Figure 4 represents reptile endemism in the W.C.P. The above two taxa are also listed in both the 2000 IUCN Red List of Threatened Species (IUCN, 2000) as "Lower Risk/near threatened" and "Endangered" respectively (Figure 7), as well as the South African Red Data Book for Reptiles and Amphibians (Branch, 1988a) as "Restricted" and "Endangered" respectively.

All the tortoises of the W.C.P., as well as the Cape terrapin, are listed as Protected Wild Animals (Schedule 2) by the Nature Conservation Ordinance (No. 19 of 1974), except for the geometric tortoise which is classified as an Endangered Wild Animal (Schedule 1). Furthermore, due to their popularity as pets, all terrestrial tortoise genera and the associated species, namely *Geochelone*, *Chersina*, *Psammobates* and *Homopus* are listed on Appendix 2 of CITES, except for the geometric tortoise which is listed in Appendix 1.

The conservation status of all tortoises and the Cape terrapin is considered stable, except for that of the geometric tortoise, a habitat specialist which inhabits only the West Coast and inland renosterveld of the southwestern Cape (Greig and Burdett, 1976; Baard, 1989; Branch, 1998). It is considered "Endangered" as a result of the loss of more than 90% of its favoured habitat.

Most tortoise species are represented in statutory conservation areas (Branch, Benn and Lombard, 1995) and the recent trend in establishing conservancies, which incorporate more and more natural habitat into a more formal structure, is enhancing tortoise conservation in the W.C.P. Unfortunately, habitat destruction in especially the Cape lowlands West of the Cape Fold Mountains and the Overberg region to the southeast, has led to substantial and irreversible loss of lowland habitat formerly inhabitated by healthy tortoise populations.

Tortoises are fairly evenly distributed in the W.C.P. and it is only in the Cape Fold Mountains where one does not really find any tortoises. Angulate tortoises, for example, inhabit the West and South Coast regions, while also occurring in the arid interior, for example, the Tanqua Karoo. Interestingly, padloper tortoise species (*Homopus*) replace each other as one moves from West to East; first along the coast (*H. areolatus*), and from Namaqualand

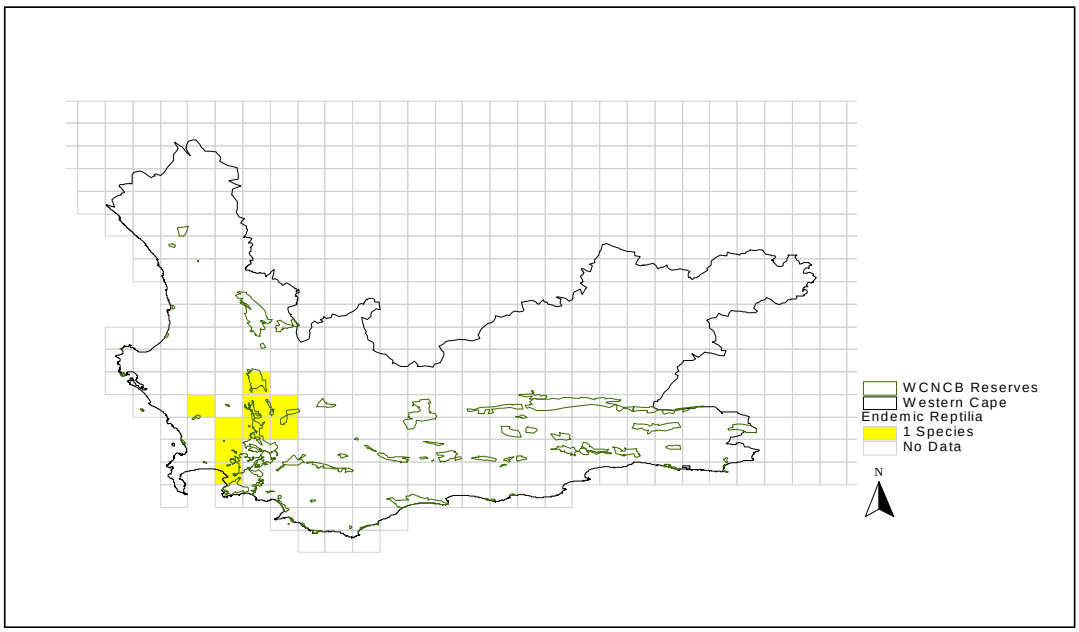

Figure 4. Degree of Western Cape Province reptile endemism per quarter degree grid square.

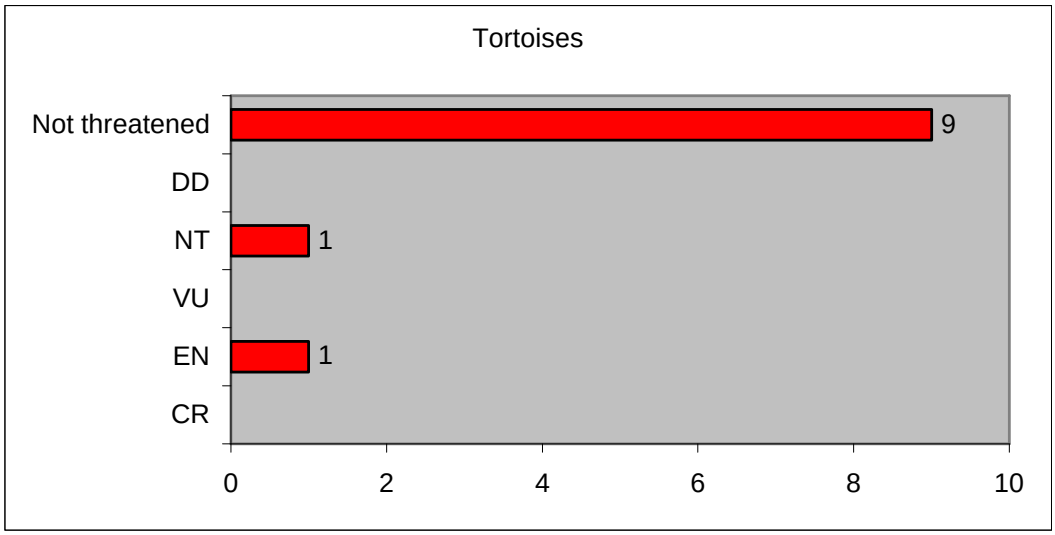

Figure 7. Conservation status of the indigenous tortoises of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

(*H. signatus*) eastwards through the Roggeveld and Nuweveld Mountains (*H. boulengeri*) and onto the escarpment (*H. femoralis*) towards the Great Karoo and Eastern Cape Province. While the geometric tortoise *P. geometricus* is found only in the Boland (Swartland southwards to the Hottentots Holland basin, Breede River Valley and Ceres Valley), the three tent tortoise subspecies, namely *P. tentorius trimeni, P. t. verroxii* and

P. t. tentorius inhabit the more arid regions of the Karoo and Namaqualand. Leopard tortoises *Geochelone pardalis* do not occur naturally in the winter rainfall region and their distribution in the W.C.P. is confined more to the Karoo regions. It is, therefore, quite possible to encounter up to five tortoise species within an approximately 100 km radius in certain parts of the W.C.P. and adjacent regions. Two such regions are the Sutherland-Middelpos area and the Karoo National Park at Beaufort West (Greig and Burdett, 1976).

In summary, the W.C.P. has 145 reptile species, with 92 (63%) lizards, 41 (28%) snakes, 11 (8%) terrestrial tortoises and one (1%) freshwater terrapin. Seventeen (18%) lizards, two (9%) snakes and two (18%) tortoises are endemic to the region, and seven (8%) lizards, three (7%) snakes and two (18%) tortoises are considered threatened and are internationally listed as such (IUCN, 2000). In comparsion with the frogs, general reptile endemicity is low at approximately 15%, and whereas 36% of all frogs are considered at conservation risk, this figure is much lower for reptiles at 8%.

Critical Habitats

It is clear from the analysis of the conservation status of the herpetofauna of the C.F.K. (Baard, *et al.*, 1999) that there are a number of herpetological taxa which are either endemic to certain landscapes and habitat elements within the W.C.P. or which are habitat specialists and by definition, have very specific (narrow) habitat requirements. This habitat specialization and the concomitant conservation status of those taxa and habitats are important indicators of the following critical habitat components in need of special conservation attention and/or management.

Perennial mountain stream habitats

Ghost frogs (*Heleophryne* spp.) are closely associated with mountain kloof habitats and clear, perennial streams, and although adults may be found away from the streams, they prefer the wet, moss- and fern-covered slopes usually present in shaded kloofs. Since their tadpoles take more than a year to metamorphose, they are adapted to and require perennial water to carry them through the dry periods. In the Cape Fold Mountains, these kloof habitats also harbour special kloof forest vegetation specially adapted to these conditions.

Should conservation management practices or the uncontrolled invasion by non-indigenous vegetation in mountain habitats lead to the reduction or cessation of perennial run-off, the possibility exists that ghost frogs in general, and the Table Mountain ghost frog in particular, will be negatively affected. There is very good reason to believe that the latter species, confined to a handful of perennial streams draining Table Mountain, will disappear should their habitat be altered or otherwise be tampered with. Habitat deterioration in the form of pollution, erosion of stream habitats, invasion by non-indigenous vegetation and damming of streams will have a definite and significantly negative impact on this species.

It is also reasonable to believe that global climate change, especially as predicted for the western half of southern Africa, could have a severe negative impact on perennial stream habitats in the Cape Fold Mountains, mainly because of the predicted extensive reduction in precipitation and run-off (Midgley, *et al.*, 2001). The impact of reduced perennial run-off in the mountains will almost inevitably lead to perennial streams drying up during the dry season and reducing breeding opportunities for adults and survival of tadpoles.

Montane wetland habitats (seeps, sponges, etc*.)*

One of the most important functions of the maintenance of healthy ecological systems and processes in the Cape Fold Mountains, is the constant supply of clean and potable water and life-support systems to the associated human communities. However, not only is this an important function for sustaining human life, but also to sustain healthy montane habitats supporting the biodiversity restricted to these areas. Montane wetland habitats play an important role in absorbing, filtering and releasing water, as well as providing micro-habitats for a variety of plants, invertebrates and lower vertebrates, especially frogs and toads. These seepage and sponge areas provide a home to numerous taxa, many of them endemic to these habitats and found nowhere else.

Poor management of mountain catchments, unchecked infestation of these habitats by invasive non-indigenous plants and poor fire regime management will result in the deterioration and eventual alteration of these very sensitive habitats which are prone to disturbance. Another real threat in a water-poor future scenario is the bulk abstraction of water from aquifers underlying these montane habitats. If not abstracted in a sustainable manner, the risk exists that these ecosystems could be driven beyond their ability to recover, and eventually ecosystem collapse could result. The impact of global climate change on these montane wetland habitats (see above) is potentially severe and could lead to further ecosystem and process deterioration.

Coastal, acidic blackwater lakelets

Two endangered amphibians, namely the micro frog and the Cape platanna are indicator species for the very peculiar coastal, acidic blackwater lakelets, found on the Cape Peninsula and in the coastal zone from the Cape Flats through Cape Hangklip and Betty's Bay to Cape Agulhas. These lakelets are formed through the drainage of Table Mountain sandstone and the leaching of polyphenols and tannins from coastal fynbos plant communities into soils, from where the decomposition process releases phenolic units in the form of humic, fulvic and hymetomelanic acids and humin (Picker and De Villiers, 1988; 1989). These dark-pigmented substances are then transported into vleis, sponges and seepages where the water take up the characteristic deep amber colour. Due to the components leaching into these, often temporary, waterbodies, these lakelets are characteristically acidic (pH 5-6.6; Picker and De Villiers, 1989).

The main threat to the continued existence of this unique habitat type, and indeed two of the most endangered amphibians in the W.C.P. (and South Africa) (De Villiers, 1988a; Picker and De Villiers, 1988), is the modification of the water quality through poor land management practices and destruction of these lakelets through

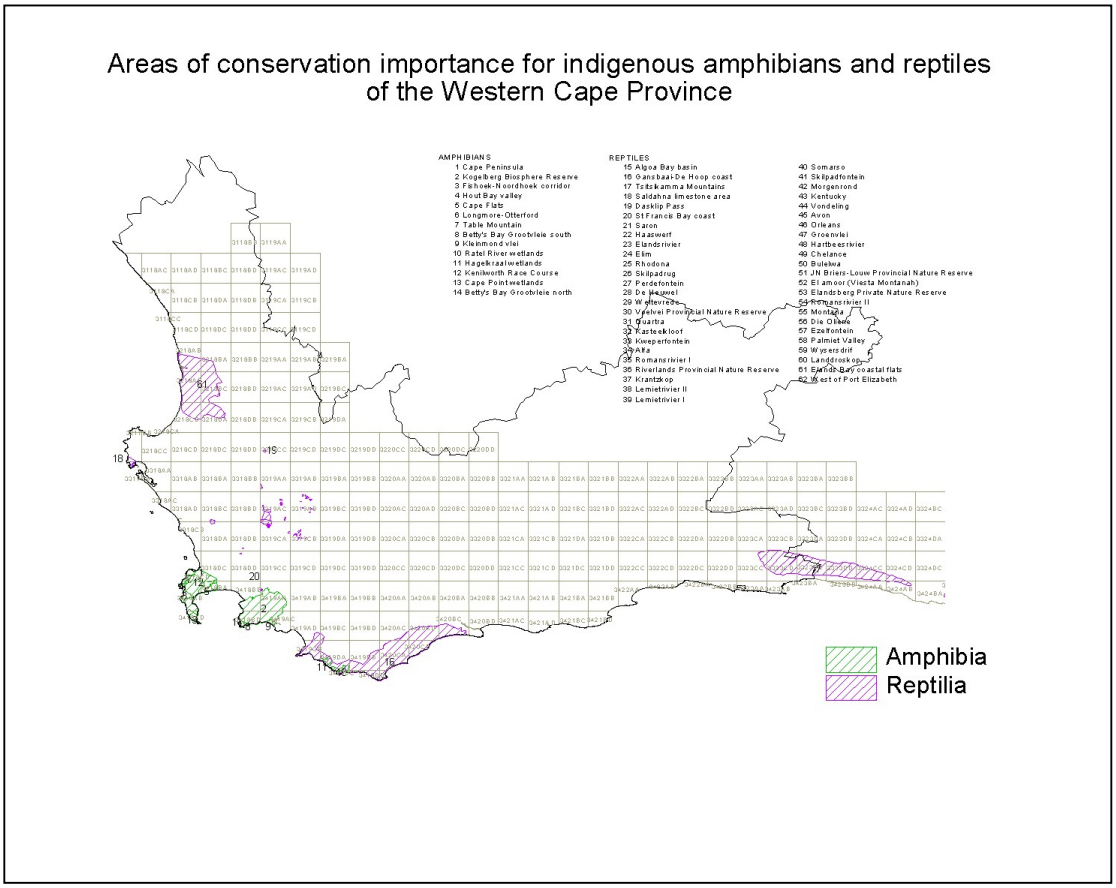

Figure 8. Map indicating areas of conservation importance for amphibians and reptiles in the Western Cape Province.

landscape modification by coastal, urban and agricultural development. Further, the uncontrolled spread of non-indigenous invasive vegetation has also led to the modification and destruction of many of these sites, and consequently threatens the continued existence of both the Cape platanna and micro frog. An added threat to the existence of the Cape platanna is the successful invasion of these modified habitats by the closely-related and much more tolerant common platanna *Xenopus laevis*, and the subsequent competion and hybridization with *X. gilli* (Picker 1985).

Other aquatic and terrestrial habitats/areas important to Western Cape amphibians and reptiles

The following regions/areas within the W.C.P. have been identified as biodiverse, sensitive or threatened (see Baard, *et al.* 1999 and Figure 8):

- **Coastal lowlands from Lambert's Bay and Graafwater, southwards towards the Driefonteinberg** (see Figure 8 – Eland's Bay coastal flats):

  These coastal lowlands, including the coastal region from Lambert's Bay to Eland's Bay contain a number of amphibian and reptile taxa which are considered good indicators of a unique West Coast herpetological species assemblage, and which may be at considerable conservation risk mainly due to coastal development pressure (habitat destruction) and, potentially, the reptile trade. Additionally, poor land use management and unsustainable agricultural practices may result in general habitat deterioration for numerous taxa. The conservation of these taxa should be catered for in coastal development structure plans, and representative examples of their distribution ranges should, where possible, be incorporated into statutory, or at least private conservation areas.

- **Greater Saldanha region and limestone coastal fynbos** (see Figure 8 – Saldanha limestone region)**:**

  This area is important because it contains a number of reptile species which are at considerable conservation risk. The endemic, restricted and possibly endangered southern dwarf adder, *Bitis armata*, occurs in the area (Branch, 1999). The coastal limestone plant communities are at risk too, and development pressure is building in this general area, especially pressure to mine the general area for lime. Furthermore, from an evolutionary viewpoint, it contains a scientifically important "contact zone" between two lizard species, namely the black girdled lizard *Cordylus niger* and the Cape girdled lizard *Cordylus cordylus*, the former a relict, melanistic

taxon, occurring only there and on the Cape Peninsula. This contact zone, situated to the Northwest of Saldanha and East of Jacob's Bay is threatened by habitat disturbance and coastal development. Its inclusion in a statutory conservation area is of scientific and conservation importance. The conservation of these taxa should be catered for in coastal development structure plans, and representative examples of their distributions should, where possible, be incorporated into statutory conservation areas.

- **Cape Peninsula** (see Figure 8)**:**

  The Cape Peninsula with its topographically and biologically diverse landscape contains numerous reptile and amphibian taxa, some of which are threatened and endangered. The endangered Cape platanna and Table Mountain ghost frog both occur there, as well as a relict population of the endangered micro frog at the Kenilworth Racetrack and the southern-most, isolated population of the black girdled lizard, *Cordylus niger*, a melanistic relict taxon. The continued existence of suitable habitats in the new Cape Peninsula National Park, especially that of the threatened taxa, is important to the survival of these, and many other taxa. Conservation management practices should be aimed at the optimum maintenance of healthy montane and lowland ecosystems and processes, while natural corridors for the movement of larger animals, for example birds and mammals, and important invertebrates such as pollinators should be maintained.

- **Cape Point Nature Reserve (as incorporated into the Cape Peninsula National Park)** (see Figure 8):

  This reserve contains critical habitat of the endangered Cape platanna. The continued existence of these blackwater lakelets (see above), and proper management of the surrounding landscape to prevent eutrophication, infestation by invasive alien plants, *etc*. is very important, because the invasion by the common platanna of these habitats is largely prevented by the "healthy" state of these lakelets.

- **Fish Hoek/Noordhoek corridor, Hout Bay Valley and Cape Flats** (see Figure 8):

  These areas are important for the continued existence of healthy amphibian breeding habitats, especially for the western leopard toad. Its breeding habitats are threatened by habitat degradation and destruction, mainly through urban development throughout the identified region, as well as river course canalization especially through urban areas. It is currently unknown what effect air- and water-borne pollutants have on the quality of water bodies where these animals are known to breed, but suffice it to say that, in general, amphibian breeding success is very much dependent on good quality and healthy habitats. Because these animals undertake mass migrations to and from the breeding sites, many also succumb to road traffic or die in urban swimming pools. Adequate buffer zones around breeding sites and corridors connecting individual wetlands are important requirements for the conservation of this species. Representative examples of its range should be included into statutory conservation areas such as the Cape Peninsula National Park.

- **Kenilworth Race Course wetlands** (see Figure 8)**:**

  These wetlands contain a good representative example of the amphibians of the Cape Flats region - an area which has largely been disturbed and converted beyond rehabilitation. This site contains a population of the endangered micro frog - the last surviving population on the Cape Flats. The continued existence of these wetlands is considered important, and statutory arrangements for its inclusion into a conservation area, such as the Cape Peninsula National Park, are recommended. Its management by a statutory conservation agency, such as South African National Parks or the Western Cape Nature Conservation Board needs to be more explicit.

- **Remaining West Coast Renosterveld isolates** (see Figure 8):

  As much as possible of the remaining isolated patches of West Coast and inland renosterveld in the Swartland region, as well as those in the Worcester-Tulbagh and Ceres valleys, known to support numerous endemic and threatened plant taxa, as well as the endangered geometric tortoise *Psammobates geometricus* and vulnerable Cape caco *Cacosternum capense*, should be targeted for inclusion into either statutory or private conservation areas (including conservancies in the latter case). It is imperative that this lowland habitat type be actively targeted for conservation due to the increasing rate of habitat deterioration and habitat loss.

  The recent Cape Action Plan for the Environment identified core projects targeted at identifying the remaining important and irreplaceable lowland habitats, as well as initiating conservation measures (including incentives for the conservation of these habitats) (Ashwell and Younge, 2000). These projects should be supported not only by statutory conservation agencies, but also local government and private landowners. Without the support of the latter, as well as innovative strategies to conserve these sites, it is virtually impossible to secure enough land to ensure the survival of many taxa. The consolidation or enhanced protected status for these sites remains the only hope for securing these sites and its important biodiversity.

- **Top of Dasklip Pass** (see Figure 8)**:**

  This site contains an isolated population of Oelofsen's girdled lizard, a melanistic, montane relict lizard taxon which appears at risk due to a restricted distribution range, possible commercial value and easy road access. Extension of the current statutory conservation area is proposed, *i.e.* expansion of the Groot Winterhoek conservation area to include the Dasklip Pass.

- **Greater Landdroskop area, Hottentots Holland Mountains** (see Figure 8)**:**

This area is of high scientific importance because it contains melanistic animal (both vertebrate and invertebrate) taxa which are important indicators of changing climates, *etc*. A recently-described crag lizard species from there, *Pseudocordylus nebulosus*, (Mouton and Van Wyk, 1995) appears at risk due to its very restricted range (<5 km^2), as well as its scientific and possible commercial value. The region also hosts undescribed and endemic new species of dwarf chameleons and moss frogs. Although this area is already included in the Hottentots Holland Nature Reserve, it should be flagged for further conservation attention, *e.g.* specific conservation measures, due to the relative easy access, for example via the current hiking trail system.

- **Kogelberg Biosphere Reserve (including the Kleinmond/Betty's Bay/Pringle Bay areas)** (see Figure 8):

  The proclaimed Kogelberg Biosphere Reserve incorporates a diverse amphibian fauna, some of which are endemic to the C.F.K.. This feature should add more impetus to the conservation of biodiversity in this region. The Kleinmond/Betty's Bay/Pringle Bay area (see Figure 8) is a wetland area situated on the border of the Biosphere Reserve. This is known as a site with a high amphibian diversity, mainly because of wetland habitats associated with the mountains close to the coast. Amongst others, the endangered micro frog *Microbatrachella capensis* and Cape platanna *Xenopus gilli* are found there. Numerous other frog genera, *e.g. Afrana, Strongylopus, Cacosternum, Tomopterna* are known to inhabit the vast wetland system. All wetlands in this area, plus all the sites at which endangered frogs are found, should be included in either statutory or private conservation areas or targeted for more formal conservation arrangements. Where possible and practical, the majority of sites where the above two endangered taxa are found are to be included in a statutory conservation area, especially those sites to the east of Kleinmond which are on private properties (zoned for agriculture) and critically threatened (*e.g.* sand-mining, wildflower industry). It is also important to note that the site at Betty's Bay, preliminarily identified as a proposed "frog nature reserve" in the Hangklip/Kleinmond Municipality's structure plan, should be proclaimed as a statutory conservation area.

- **Ratel River Estate and Hagelkraal wetlands** (see Figure 8)**:**

  These wetlands incorporate important habitats for numerous amphibian genera and also contain the two above-mentioned endangered frogs (the micro frog and Cape platanna). The endemic, restricted and possibly endangered southern adder, *Bitis armata*, also occurs in the area (Branch, 1999). Maintaining the continued healthy state of these wetlands and the surrounding landscape (clearing of alien vegetation, *etc*.) is important. Furthermore, they are situated adjacent to existing conservation areas and represent natural extensions of the latter. The incorporation of these areas into current statutory conservation areas, *e.g.* Walker Bay conservation area, is strongly recommended.

- **Limestone fynbos habitats between Gansbaai and Infanta, including De Hoop Nature Reserve** (see Figure 8):

  This area has been identified as including important coastal habitats for the endemic, restricted and possibly threatened southern dwarf adder, *Bitis armata* (Branch, 1999). Although it is apparently extinct on the Cape Flats, the limestone, calcrete and coastal fynbos habitats along the southwestern Cape coastline support isolated populations of this taxon. More samples of the habitats where this taxon occurs should be included within statutory and private conservation areas. The clearing of non-indigenous invasive vegetation to enhance the natural biodiversity of this region should be continued and remains a priority.

Threats to Herpetological Biodiversity

From the analysis by Baard, *et al.* (1999) it is clearly evident that habitat degradation and destruction are the most important aspects threatening the continued survival of many taxa. Habitat conservation strategies are therefore crucially important to target those sites, habitats and ecosystems in need of protection and mitigation against habitat disturbance and degradation.

Another important aspect linked to habitat disturbance is the influence of invasive non-indigenous vegetation. Unchecked invasion by many non-indigenous plant species, especially the inconspicuous grasses and herbs, has a detrimental effect on habitat status. In this regard monocultures of non-indigenous grasses and herbs, and dense stands of invasive non-indigenous trees have led to a number of taxa becoming threatened.

Related to non-indigenous vegetation infestation is the alteration of water tables and the reduction of run-off. The construction of dams and roads, water abstraction schemes, the damming of streams and alteration of drainage lines also all contribute to a lowering of the water table and reduction in run-off. Together these have serious implications for, in particular, taxa dependent on sensitive wetland habitats.

Fire frequency and extent are two aspects which remain important to a number of W.C.P. reptiles and amphibians because of both the direct and indirect impact it has on populations. For example, in isolated and fragmented lowland renosterveld habitats, wildfires have the potential of wiping out viable populations of taxa such as the endangered geometric tortoise and some endangered plants. Besides lowering populations to a critical threshold of survival (direct impact), populations may be unable to recover because of lower recruitment and inadequate corridors to facilitate recolonisation. Following fire, habitat disturbance such as overgrazing, and trampling may further detrimentally affect the habitat status in an indirect way. Fire in mountain areas also has the potential to alter habitats crucial to the survival of certain montane species. If not managed correctly, fires could change vegetation cover in the medium to long term, which in turn may affect run-off and destroy seepage,

sponge and other damp areas which may be important to the survival of taxa dependent on these habitats. Even in larger areas, the lack of megaherbivores often prevents a mosaic from becoming established and uniform stands of similar aged vegetation then potentially develop as fuel for huge extensive fires.

The utilization of components of the W.C.P. herpetofauna for commercial purposes (specifically the international pet trade) is a very real threat because of the relatively high number of endemic and attractive taxa found there. As collectors' items, geometric tortoises, Oelofsen's girdled lizards, dwarf crag lizards, armadillo lizards, dwarf adders (*Bitis* spp), including the berg adder and adders of the *Bitis cornuta* complex, and many others could, for example, be targeted to supply an ever-increasing demand world-wide. More and more international attention is being turned to South Africa because of the dwindling supply from countries which have been over-exploited. For example, 627 718 wild-caught ball pythons *Python regius* and 10 039 wild-caught pancake tortoises *Malacochersus tornieri* were imported into the USA from Africa during 1983-1995 (Hoover, 1998). Except in certain justified cases (*e.g.* the common platanna for biological research purposes), the commercial exploitation of W.C.P. herpetofauna should only be allowed under very special conditions, because the unsustainable use of this resource could affect ecosystem integrity in the long term.

Urban, rural, coastal and agricultural development in the southwestern Cape has resulted in the current precarious state in which the Cape platanna, micro frog and western leopard toad find themselves. As a result, the natural breeding habitats of these species have been altered and/or destroyed at an alarming rate during the past 100 years and breeding populations of these three species are barely surviving in the last remaining wetlands and other waterbodies in the greater Cape Metropolitan Area, Cape Peninsula and adjacent coastal areas towards Cape Agulhas. The micro frog and Cape platanna for example survive in remnant, specialist habitats (acidic, blackwater lakelets), the western leopard toad depends on permanent waterbodies or waterbodies that retain water deep into the summer months for breeding, while the Table Mountain ghost frog is a habitat specialist with a naturally restricted range which survives in only six perennial mountain streams draining the southern and eastern slopes of the Table Mountain complex. These four species are under undue pressure in the form of encroachment by invasive, non-indigenous vegetation, enrichment of waterbodies, altered drainage patterns, erosion and general habitat deterioration.

While as yet there is no evidence of major declines in amphibian populations in the Western Cape (bearing in mind that not all species are being monitored), cognisance should be taken of the global decline in populations of many frogs on the South and North American, Eurasian and Australasian continents (Beebee, 1997). Also, the projected impact of accelerating global climate change on particularly the western half of South Africa, and specifically the Cape Floral Kingdom, is predicted to be quite severe (Midgley, Rutherford and Bond, 2001), and it is believed that this phenomenon could potentially be responsible for the ultimate local extinction of at least some of the highly specialised and threatened frogs and reptiles. In this regard, species occurring along the West Coast of the Western and Northern Cape Provinces especially appear to be at risk. This threat may also affect and disrupt frog breeding strategies in this region since it is predicted that the winter rainfall region will experience less, as well as more aseasonal rain. This means that seasonal rainfall patterns could change and ultimately be responsible for the total disruption of breeding for those species not able to cope with this change. It is of concern that the predictions indicate that this phenomenon may already be happening, or may happen within the next 30 to 50 years.

Apart from habitat deterioration and destruction, threats and threatening processes such as too frequent burning of natural habitats, encroachment by invasive alien vegetation, overgrazing, trampling and erosion of natural veld all threaten natural tortoise populations. Finally, the practice of tortoise consumption for food by humans and the illegal trafficking of tortoises for the international pet market, in other words, consumptive utilization, is further threatening the tortoises of the W.C.P., and conservation legislation and law enforcement should target this group for protection. On a positive note, however, many people and communities in the W.C.P. are committed to tortoise conservation, and caring and sympathetic private land owners, rehabilitation centres and other committed groups are contributing much time and resources to the protection of natural habitats and populations in general.

Effectiveness of Current Conservation

In general, the following constraints towards the conservation of W.C.P. herpetological biodiversity have been identified:

- **Lack of resources, both in human capacity and financial**: Currently, only two conservation herpetologists are formally employed by the Western Cape Nature Conservation Board which hampers conservation actions and attention to threatened taxa in the W.C.P.
- **Lack of uniform, national guiding principles, policies and legislation towards herpetological conservation**: Up till 2000, a lack of national guidelines towards the utilization and conservation of reptiles and amphibians has resulted in inconsistent policies being applied by provincial conservation agencies, and has in certain cases facilitated the illegal trade, especially in reptiles. This has not been the case in the W.C.P. where a policy towards the utilization and conservation of herpetofauna is in place.
- **Lack of implementation of international conservation legislation and Conventions:** In the W.C.P., CITES legislation regarding herpetofauna is applied, but inconsistencies in policy and the general lack of herpetological expertise in other provinces, hampers a uniform approach to the implementation of international conservation legislation, particularly with regard to herpetofauna.
- **Lack of conservation law enforcement capacity, especially at ports of import and export**: Because of other priorities, law enforcement effort and

attention have not always been focused at curbing the illegal trade in reptiles and amphibians. Lack of capacity and trained staff, especially at ports of entry and export, has allowed shipments of, for example, illegal reptiles into and out of South Africa, and the W.C.P.

- **Fragmented (and outdated) provincial conservation legislation**: As a result of somewhat outdated provincial conservation legislation, the application of regulations is difficult and lacking in certain cases. This has lead to cases where traders in illegal reptiles have made use of loop-holes in legislation in order to either export or import specimens for trade purposes.

- **Lack of institutional capacity (mainly financial) to procure conservation land**: The procurement of land for the conservation of critical habitats and/or taxa in need of conservation attention is a very important issue in securing the long term future of threatened taxa. Due to the poor financial position in which provincial conservation agencies such as the Western Cape Nature Conservation Board find themselves, it is unfortunately not always possible to buy land for conservation. However, non-governmental agencies, such as WWF-SA have played a major role in procuring important pieces of private property for conservation, including sites important for reptile and amphibian conservation. For example, the purchase of large stretches of natural habitats in order to either consolidate or expand statutory conservation areas, indirectly has benefited herpetofauna conservation. There has also recently been a major effort by private landowners to set aside land for conservation – efforts that should be commended and supported by statutory conservation agencies.

- **Lack of environmental education with regard to herpetological issues**: Unfortunately, due to the lack of mainly financial and human capacity, education towards an awareness and appreciation of reptiles and amphibians and their roles in nature has not always been addressed. The “public image” of these animals is not always high enough to warrant special attention. However, people almost aways find educational material on reptiles and amphibians very useful and a concerted effort towards enhancing public awareness about them should be made.

- **Lack of incentives for private land owners to conserve threatened habitats**: While it is true that the private landowner can play a crucially important role in securing land for the long term conservation of our reptiles and amphibians, there are very few, if any, current incentives to conserve private properties. It is really only the landowner who can afford to set aside land for conservation without any financial return, who contributes in a very important way. The Cape Action Plan for the Environment has identified the development of a set of incentives (financial, *etc*.) for private landowners as one of the critically important issues in securing more land for conservation.

- **Lack of staff to monitor illegal activities both in- and outside conservation areas**: Many illegal activities in- and outside conservation areas escape the attention of the W.C.P. conservation authority because there is a general lack of staff to monitor these activities. Measures should be taken to step up law enforcement activities, specifically regarding the illegal collection of reptiles and amphibians.

- **Lack of a representative network of conservation area**s: Current conservation of the W.C.P. herpetological resource is unintentionally biased towards montane species included in the vast statutory mountain catchment areas and nature reserves. For example, statistics on the percentage vegetation types conserved in the W.C.P. indicate that >20% of mountain fynbos in the province is contained in statutory conservation areas, but that only 0.46% and 0.56% of West Coast renosterveld and sand plain fynbos, respectively, is conserved. These great imbalances are specifically evident in the lowlands of the W.C.P., and a concerted effort should be made towards the inclusion of more representative samples of lowland habitats and vegetation types into an optimally designed reserve system. Many important sites, sensitive habitats, *etc.* fall outside the current conservation area network, because of the historic bias towards mountain catchment management and protection. This should be addressed by incorporating proper reserve selection algorithms and reserve design principles into conservation planning exercises to include important biodiversity elements in a representative conservation area network.

In summary, conservation legislation appears to be effective in curbing the illegal trade in and utilization of herpetofauna on the one hand, but a lack of enforcement capacity and other aspects on the other hand, is seriously hampering effective conservation in the broader sense. Conservation legislation needs to be revised in order to become more practical and "user-friendly", not only in an effort to control the sustainable utilization of herpetofauna, but also to stimulate interest and improve the transfer of information about these animals. A combination of clear policy, effective law enforcement, proper reserve design and high private landowner interest will contribute substantially to the effective conservation of this natural resource.

Utilization of Herpetological Diversity

The utilization of herpetofauna in the W.C.P. is relatively limited. All reptiles and amphibians, except for the venomous snake genera, in the Western, Northern and Eastern Cape Provinces are classified as either Endangered or Protected Wild Animals by the Nature Conservation Ordinance (No. 19 of 1974). Venomous snakes, however, are protected by the fact that no wild animal may be collected, transported, *etc*. without valid permits.

The utilization of herpetofauna may be categorised as follows: a) the collection of animals mainly for scientific and educational purposes by universities, museums and other institutions, b) the possession thereof (and trade

therein) for private purposes (mainly to keep as pets), and c) the use of herpetofauna by traditional healers for medicinal purposes.

In the Western Cape Province, policy and legislation towards the utilization of herpetofauna for scientific and educational purposes regulate the collection, possession, transportation and export of reptiles and amphibians. Valid permits are required for the above activities. Tortoises such as the angulate and leopard tortoises are the most popular species kept as pets by members of the public, with snakes generally the next most popular as pets. Lizards, frogs and toads appear to be far less popular. However, one abundant and wide-spread frog species, the common platanna, *Xenopus laevis*, is extensively utilized for biological research, both locally and internationally. Annual quotas for wild-collected specimens (from man-made impoundments only) are awarded to a limited number of commercial suppliers of these animals.

The limited herpetological expertise in the neighbouring Northern and Eastern Cape provincial conservation authorities is disturbing, but Western Cape conservation herpetologists are consulted from time to time for recommendations concerning permit applications, policy advice and legislation. Valid permits from Western, Northern and Eastern Cape conservation authorities are required to keep any of the above in captivity, and regulations control aspects such as cage sizes.

There is unfortunately very little information available regarding the use of reptiles and amphibians in traditional medicinal practices in the W.C.P. Items such as python and leguaan skin and fat, leguaan claws, dried chameleons, *etc*. regularly appear in traditional healers' catalogues, but there are no quantifying data available for the W.C.P. as yet. This has the potential to become a significant threat to the conservation status of at least some of the rarer taxa. It is also unknown to what extent the so-called "bushmeat trade" has an impact on the W.C.P. herpetofauna. The Western Cape Nature Conservation Board has representation on the Cape Traditional Healers' Association forum and attempts to stay abreast of developments in this field. According to information received, it is believed that TRAFFIC South and East Africa has initiated a study towards the utilization of, amongst others, reptiles and amphibians by traditional healers.

The W.C.P. herpetofauna is also utilized in a non-consumptive manner, for example by members of the public hiking on mountain trails, private landowners, and an increasing number of public facilities such as restaurants, wineries, guest houses, guest farms, mainly in terms of publicity, *etc*. More and more people realise that frogs and toads, tortoises, lizards and snakes can act as drawcards to the increasing ecotourism industry that South Africa, and especially the W.C.P., is experiencing. Loubser, Mouton and Nel (2001) investigated the "ecotourism potential" of herpetofauna in the Namaqua National Park, the implications and spin-offs for conservation, as well as the potential impact (positive and/or negative) of a better public awareness on the status of these animals.

Economic Incentives to Conserve Herpetofauna

There are currently few economic incentives to conserve amphibians and reptiles in the W.C.P. The current trend is to provide eco-tourism facilities within a reasonable travelling distance from Cape Town, the main tourism hub in the province, to which visitors to the W.C.P., preferably international ones, can travel, and observe large mammals, including the "Big Five", namely lion, buffalo, elephant, leopard and rhino. Not many tourists are interested in herpetofauna in general, judging by the apparent low demand for this activity. Therefore, unless the landowner can derive tangible benefits from the conservation of good and healthy amphibian and reptile habitats, and can generate an interest from a tourism point of view (perhaps a "specialist tourist" is the answer in this case), herpetological conservation will become only a by-product of other conservation initiatives. However, one example where herpetofauna is successfully used, amongst others, as a conservation drawcard, is at the Elandsberg Private Nature Reserve near Hermon, where eco-tourism activities are combined to include field visits to view one of the most endangered terrestrial tortoises in the world, namely the geometric tortoise.

Trends in Herpetological Conservation Ethic

This section highlights the basic work that has been done to raise both the general profile and the conservation awareness of amphibians and reptiles in the W.C.P., describes certain examples of attitudes and awareness towards herpetofauna, and then describes briefly the organisations, institutions and major roleplayers involved in the conservation of W.C.P. herpetofauna.

Early works by prominent herpetologists F.W. FitzSimons, and his son, V.F.M. FitzSimons, on the snakes (FitzSimons, 1912) and lizards (FitzSimons, 1943) of South Africa, Loveridge and Williams' treatment of the tortoises and terrapins of Africa (Loveridge and Williams, 1957) and the monograph on South African toads and frogs by Poynton (1964) were milestones in scientifically describing the reptile and amphibian fanua of South Africa and the W.C.P., but it was perhaps the more popular publications (including the first fieldguide to the reptiles) that created a better public awareness about these animals (Rose, 1925; 1950; 1962; Passmore and Carruthers, 1979; Branch, 1988b; Boycott and Bourquin, 1988).

During the 1950s, shiploads of tortoises, mainly angulate tortoises, left Cape Town for Europe to be sold by their thousands as pets (Anonymous, 1950a, 1950b). The sad fact is that most of these tortoises usually did not survive their first winter abroad, and very high mortality rates were reported. Also, during the 1960s and early 1970s, many South African and Cape reptiles and amphibians were exported to the USA as pets or as biological material, with very little if any, control over the situation. It was during the 1970s, after public concern was expressed, that authorities realised that this practice was not in the best interest of the W.C.P. herpetofauna in general and stopped the uncontrolled export of these taxa. Amongst other conservation legislation development, this eventually culminated in the proclamation of the then Cape Nature Conservation Ordinance and Regulations (No. 19 of 1974) which provided blanket protection to the amphibians and reptiles of the then Cape Province.

Unfortunately, many uninformed people still regard reptiles and amphibians as not worth protecting and show very little regard to their role in nature. For example, the old practice of collecting bags full of tortoises from the wild and roasting them alive on the open fire for a meal is apparently still continued to this day, albeit much less often, and recent reports confirmed that not only do poor, farm labourer families, living very much a subsistence lifestyle still practice this, but also more affluent private landowners along the northern West Coast of the W.C.P.

The period from 1971 to 1982 saw the appointment by the then Cape Department of Nature Conservation of the first conservation herpetologist and assistants, as well as a major effort to collect as much baseline information as possible on the Cape herpetofauna. This created a much better understanding and awareness of the Cape herpetofauna, and the conservation plight of many specialised and threatened taxa was publicised (see for example Greig and Burdett, 1976; Greig, Boycott and De Villiers, 1979).

During the mid-eighties and nineties, herpetological expertise was expanded with research and monitoring efforts concentrated on some rare and threatened taxa (Baard, 1989, 1990, 1993; De Villiers, 1997), and policy development continued. In addition, a large number of public lectures on W.C.P. herpetofauna were delivered by Cape Nature Conservation herpetologists, scientific papers were read at symposia, and several scientific, semi-scientific and popular articles published on the subject.

It is currently believed that the conservation ethic towards amphibians and reptiles in the W.C.P. has improved, but that there is room for still further improvement. For example, surprise is still quite often expressed at the importance of herpetofaunal conservation measures in mitigating against the potential impact on natural populations of various developments, and blatant disregard for the conservation and management of healthy natural habitats for reptiles and amphibians is still experienced. Furthermore, despite the dissemination of information to the contrary (arguably, there is room for improvement here as well), there are still certain sectors of society that erroneously believe frogs, toads and lizards are poisonous to man and that they should be killed on sight, and that snakes, regardless of whether venomous or not, should be killed, *e.g.* the deliberate killing of all snakes ("The only good snake is a dead snake") or the deliberate driving over of snakes on roads by some drivers.

Roleplayers involved in the conservation of W.C.P. herpetofauna fall into three major categories, namely, governmental, para-statal and private.

Firstly, conservation can be achieved at first, second or third tier level government. The national Department of Environmental Affairs and Tourism is primarily responsible for the conservation of biodiversity in South Africa. By signing the Convention on Biodiversity and the CITES convention, the South African Government has pledged itself to biodiversity conservation and control of trade in biota. Certain powers and responsibilities have been devolved to provincial and local governments. National policy guidelines towards the utilization of the South African herpetological resource are currently being drafted through a consultation process. As a national, statutory conservation body, South African National Parks also contributes to herpetological conservation through the *in situ* conservation of habitats and biota within the W.C.P. political boundary.

At secondary government level, the provincial nature conservation authorities take responsibility for conservation within their provincial borders. This involves the conservation of biodiversity both in- and outside statutory conservation areas. This also includes regulating the control over the utilization of biodiversity. Furthermore, provincial authorities also take the responsibility as the delegated CITES Management Authority, and where capacity exists, the Scientific Authority as well. At local government level, the provincial government has the option of delegating certain powers and responsibilities to District Municipalities, Local Substructures, and/or Local Municipalities. The law enforcement sections of these authorities usually take responsibility for the enforcement of environmental legislation and regulations, for example within the City of Cape Town municipality, or West Coast District Municipality.

Parastatal organisations such as museums and universities have an important role to play in herpetofaunal conservation in that inventories and research undertaken by them, may yield information necessary to compile effective conservation strategies and action plans, the implementation of which, resides mainly with conservation authorities. Taxonomic research may, for example, identify a new taxon with a very restricted range and narrow habitat requirements. This information has to be incorporated into strategies aimed at alleviating the conservation plight of the taxon in question. Non-governmental organisations (such as wildlife societies, and TRAFFIC) also have an important role to play in a so-called "watchdog" capacity, pointing out environmentally sensitive sites and issues, mustering support for conservation in general, and ensuring that issues such as accountability, equitability, *etc.* are addressed.

The conservation of land in private ownership can be somewhat difficult to achieve. First one needs an interested and dedicated private individual whose conservation ethic is strong enough to drive any effort towards the conservation of a natural element(s) on his/her property. Secondly, the property (for example in the case of a production unit such as a farm) should be able to function viably despite the fact that part of the farm has been zoned as a conservation area, and thirdly, the landowner should be able to derive a tangible benefit from conserving part of his/her farm (for example in the form of a tax incentive). In other words, the landowner should be able to afford not to utilise the conservation area on his property for production of crops or stock. This has proven difficult in many cases and has in all probability been one of the main factors contributing to the fragmentation of especially lowland habitats in the W.C.P.

Conservation Research and Actions

The following organisations and academic institutions are currently involved in herpetological research and/or conservation activities in the W.C.P.:

- Western Cape Nature Conservation Board (biodiversity inventories and monitoring of threatened taxa, conservation policy, planning and management, as well as law enforcement)
- University of Cape Town (terrestrial tortoise systematics and genetics, frog atlassing)
- University of Stellenbosch (mainly frog and lizard systematics, physiology, ecology and behaviour)
- University of the Western Cape (frog systematics and taxonomy, terrestrial tortoise systematics, ecology and physiology, freshwater terrapin breeding biology)
- Villanova University, USA (gecko systematics and phylogeny, general herpetofaunal biogeography)
- Port Elizabeth Museum (biodiversity inventories, herpetological systematics and biogeography)
- Various natural history museums providing curation facilities for W.C.P. herpetological specimens

Private landowners who own property within the political boundaries of the W.C.P. possess a large proportion of the remaining natural habitats. By protecting and managing natural habitats on their properties carefully and correctly, interested private landowners can make a tremendous contribution towards the conservation of W.C.P. biodiversity, and herpetodiversity in particular. *In situ* habitat conservation is the single most important aspect in securing the survival of many taxa. The establishment of numerous conservancies, many adjacent to statutory conservation areas, also creates larger "safe" habitats important to many of these species.

Apart from national parks which are proclaimed at central government level, the provincial government is the statutory body in the W.C.P. which is responsible for the proclamation of statutory nature conservation areas. The provincial authority may further assist in (and encourage) the proclamation of private and local nature reserves on private and local authority properties, respectively.

In the Western Cape Province, the four taxa currently recognised as endangered, are found in protected areas, for example the micro frog (one local authority nature reserve), Cape platanna (Cape of Good Hope Nature Reserve, incorporated into the Cape Peninsula National Park), Table Mountain ghost frog (Cape Peninsula National Park) and geometric tortoise (four provincial and two private nature reserves).

Herpetologists of the Western Cape Nature Conservation Board have been and still are involved in research and conservation efforts targeted mostly towards threatened W.C.P. taxa. Monitoring of frog and reptile population status continues, but unfortunately a lack of capacity is hampering the effectiveness of some efforts. However, meaningful contributions have been made in the following cases:

- distribution and biogeography of terrestrial tortoises (Greig and Burdett, 1976)
- distribution and systematics of stream and ghost frogs (Greig, Boycott and De Villiers, 1979; Boycott, 1982)
- description of new species (Channing and Boycott, 1989; Boycott, De Villiers and Scott, 2002)
- monitoring of geometric tortoise population status (mostly unpublished data)
- research into the biology and conservation status of the geometric tortoise (Baard, 1989a; 1989b; 1990; 1993; 1995a; 1995b; 1997; Baard and Mouton, 1993, Gardner, Baard and Le Roux, 1999)
- general identification and husbandry of tortoises in captivity (Baard and De Villiers, 1994)
- conservation status of W.C.P. herpetofauna (Baard, 1989a; Baard, Branch, Channing, De Villiers, Le Roux and Mouton, 1999)
- endangered frog monitoring (Boycott and De Villiers, 1986; Picker and De Villiers 1989; De Villiers, 1997)
- contributed species accounts for the 1988 revision of the South African Red Data Book – Reptiles and Amphibians (De Villiers, 1988a, 1988b, 1988c, Picker and De Villiers, 1988; Baard, 1988a, 1988b, 1988c)
- major contributions to, and review and co-authorship of the 2000 Conservation Assessment and Management Plan for Southern African Frogs (Harrison, *et al.*, 2001)
- major contributions to and regional representation of the South African Frog Atlas Project and Red Data Book revision for frogs (De Villiers – regional representative and author of seven species accounts)
- membership of IUCN Tortoise and Freshwater Turtle Specialist Group (Baard), as well as the Declining Amphibian Population Task Force (De Villiers)

Status of Herpetological Knowledge

Numerous earlier natural scientists such as Karl von Linne, George Boulenger, Thomas Bell, Andrew Smith, John Hewitt and Vivian FitzSimons, to name but a few, have been instrumental in establishing South African herpetology as an independent science, and many of their names are reflected in the diversity of current scientific names of South African reptiles and amphibians. While space unfortunately does not allow for a full treatment of the state of our herpetological knowledge prior to 1900, the reader is referred to Adler (1989) for a comprehensive overview of these early workers. This section will attempt briefly to highlight our state of herpetological knowledge for the W.C.P. for the period approximately 1900 to 2000, but inevitably cannot cite every study or herpetological treatment published during this time.

The first real treatment of the snakes of this region was by FitzSimons (1912) who contributed significantly to snake taxonomy, life history and aspects of snake bite treatment. Early scientists at the University of Stellenbosch concentrated on life history aspects of some of our endemic frogs (De Villiers, 1929; 1934), and research was conducted into the breeding habits and early development and anatomy of the micro frog, Cape sand toad and Cape caco. In the 1920s and 1930s, John Hewitt contributed a

major proportion of our knowledge on lizards and tortoises of this region (taxonomy, life history, etc.), and with the publication of the first full treatment of lizards of South Africa by FitzSimons (1943), herpetological knowledge for this region was fairly good. While most of the knowledge was published in more scientific journals, early W.C.P. communities did not have much access to this literature. Therefore, the books by for example Rose (1925; 1950; 1962) contributed much to the general public knowledge on reptiles and amphibians and popularised these animals.

FitzSimons (1962) published a full taxonomic treatment of snakes of South Africa, which was followed up by two revisions by Broadley (1983; 1990). Loveridge and Williams (1957) were responsible for the first comprehensive text on African tortoises and turtles, which included new and revised taxonomic and life history information on the tortoises of the W.C.P. Following a comprehensive survey of the terrestrial tortoises of the former (pre-1994) Cape Province, Greig and Burdett (1976) presented valuable distribution and taxonomic data for this group. The first comprehensive taxonomic treatment of South African (and W.C.P.) frogs was by Poynton (1964), followed by a more popular text by Passmore and Carruthers (1979). South Africa's first Red Data Book for Reptiles and Amphibians was edited by McLachlan (1978).

The 1980s saw exponential growth in an interest in herpetology in South Africa, and as a result, much information on W.C.P. herpetofauna was made available. Branch (1981) published a taxonomic revision of the lizards of the former Cape Province; a publication which he followed up with South Africa's first popular field guide to the snakes and other reptiles (Branch 1988b). At that time a revision of the Red Data Book was considered appropriate and Branch (1988a) also edited the second South African Red Data Book for Reptiles and Amphibians. This is unfortunately still the only, most recent Red Data Book for herpetofauna in South Africa, and yet another revision is urgently required. During the same year the first field guide on South African tortoises by Boycott and Bourquin (1988) was published.

The period 1988 to 1998 was very productive from a herpetological, but particularly reptile, point of view, since exciting new insights were gained into lizard systematics, ecology, physiology, behaviour and general herpetological biology and biogeography of regions such as the Western, Northern and Eastern Cape Provinces through the work of Broadley, Bauer, Branch, Mouton, Channing, Flemming, Van Wyk, Burger, and many other co-workers. In 1993, the Herpetological Association of Africa held its third symposium, including the *FitzSimons Commemorative Symposium: South African Lizards - 50 years of progress* to celebrate progress on this front, as well as to commission a complete taxonomic review of FitzSimons' Lizards of South Africa (1943) – see Van Wyk (1997). This review process is still in progress.

Branch (1998) published a second edition of his first field guide, and to illustrate the success of the recent field work and research, stated that, in the 10 years between the two field guides, amazingly a total of 83 new reptile species was discovered and described, translating into the discovery, on average, of a new reptile species every 44 days! The year 1995 also saw the launch of the first ever South African Frog Atlas Project which aims at atlassing frogs over the whole of South Africa, Lesotho and Swaziland (Harrison and Burger, 1998). This was preceded by the publication of a revision of South African frogs (Passmore and Carruthers, 1995), also with numerous additional species. The University of the Western Cape launched a comprehensive research programme into the biology and conservation of W.C.P. land tortoises in 1998, in collaboration with the Western Cape Nature Conservation Board to assist conservation agencies in conserving healthy tortoise populations.

Boycott and Bourquin (2000) published a fully updated and revised second edition of their book on South African tortoises. During July 2000, an international *Conservation Assessment and Management Plan* workshop was held to revise the conservation status of the frogs of South Africa (Harrison, *et al.*, 2001). The South African Frog Atlas is to be published in 2003, which will include an amphibian Red Data Book too. Channing (2001) published a comprehensive review of the amphibians of Central and southern Africa which updates the taxonomy and natural history of this group. This is a significant contribution to knowledge on South African, and particularly the Western Cape's frogs.

The above should, however, not in any way distract from the research, field studies, monitoring, *etc.* being conducted on W.C.P. reptiles and amphibians by numerous students, scientists, universities, museums, zoological institutions, conservation agencies, as well as the contribution that is made by the private keepers and breeders of herpetofauna. Very often one tends to forget that information gained through either keeping, breeding, studying and/or observing reptiles and amphibians can contribute significantly to our general knowledge of these "small, mostly harmless yet essential animals" (Branch, 1998). The state of knowledge on W.C.P. reptiles and amphibians is considered good, but the recent and continuous discovery and description of new taxa suggests that there is still a long way to go.

Recommendations towards the Conservation of Herpetofauna

The following section contains information on those amphibian and reptile species of the W.C.P. which are in urgent need of conservation action. Recommendations towards improving the conservation status of some taxa considered to be at risk in the W.C.P. are made and it is suggested that the conservation authority should develop, in consultation with experts in the field, action plans and/or conservation strategies to enhance current efforts towards conserving the herpetodiversity of the W.C.P.

Amphibians

Scientific name/ Common name	Main reason(s) for poor conservation status	Current IUCN category (IUCN, 2000)	Proposed IUCN Category (Harrison, *et al.*, 2001)	Recommendations
Heleophryne rosei Table Mountain Ghost Frog	Habitat degradation and destruction mainly through damming of some streams, alien vegetation, reduced stream flow, kloof erosion	VU; A1ce, 2ce, B1, 2abc, D2	CR B1ab(ii,iii,v) B2ab(ii,iii,v)	Critically threatened taxon, restricted distribution of about 8 km^2, occurs in <10 perennial streams on Table Mountain, Cape Peninsula National Park, habitat specialist, isolated distribution. **All sites** to be included in conservation action plan. (Genus *Heleophryne* indicator of pristine, perennial mountain streams)
Microbatrachella capensis Micro frog	Lowland habitat degradation and destruction through eutrophication and spread of alien vegetation, urban and agricultural development, sand mining practices. Also, reduced water tables through road building, damming, etc.	EN; A1ce, 2ce, B2abc, 3b	CR B2ab(i,ii,iii,iv,v)	Endangered taxon, indicator of threatened acidic blackwater lakelets in coastal belt - critical habitat. Protected only in Kleinmond NR. **All sites** to be included in conservation action plan
Xenopus gilli Cape Platanna	Lowland habitat degradation and destruction through eutrophication and spread of alien vegetation, urban and agricultural development, as well as hybridisation with *X. laevis*. Also, reduced water tables through road building, damming, etc.	VU; A1ce, 2ce, B1, 2abc, 3b	EN B1ab(i,ii,iii,iv,v) B2ab(i,ii,iii,iv,v)	Endangered taxon, indicator of threatened acidic blackwater lakelets in coastal belt - critical habitat, genetically threatened by related taxon. Protected only in Cape Point NR. **All sites** to be included in conservation action plan
Bufo pantherinus Western Leopard Toad	Habitat degradation and destruction mainly through urban development throughout its range	Not listed (taxon recently described)	EN B1ab(ii,iii,iv,v) B2ab(ii,iii,iv,v)	Endangered. Restricted range. Threatened by urban development, especially in the Fish Hoek/Noordhoek corridor, the Hout Bay valley and on the Cape Flats. Adequate buffer zones around, and "connectiveness" of, breeding localities are important aspects to be considered. Taxon undertakes mass migritations to breeding sites, and many succumb to road traffic.
Cacosternum capense Cape Caco	Lowland habitat degradation and destruction mainly though agricultural development, however, can be relatively common in sub-optimal habitat such as wheatfields. Changing and more intensive farming practices may for example threaten in medium to long term	LR, nt	VU B1ab(i,ii,iii,iv,v) B2ab(i,ii,iii,iv,v)	Enigmatic taxon - habitat (mainly renosterveld) threatened by development, agriculture, etc. but able to survive in cultivated lands where most of the known localities are situated. Status needs to be closely monitored
Capensibufo rosei Cape Mountain Toadlet	Habitat degradation due to the spread of alien invasive vegetation, afforestation and general habitat modification	LR; nt	VU B1ab(ii,iii,iv) B2ab(ii,iii,iv)	Restricted distribution. Indicator of mountain sponges and seeps, especially on mountain plateaus. Little or no data on status
Arthroleptella drewsii Drewes' Moss Frog	Habitat degradation due to the spread of alien invasive vegetation, afforestation and general habitat modification		NT	Recently-elevated cryptic species, little or no data on status, but restricted distribution. Ensure proper continued conservation management of habitat
Arthroleptella lightfooti Lightfoot's Moss Frog	Habitat degradation due to the spread of alien invasive vegetation, afforestation and general habitat modification		NT	Little or no data on status, but restricted distribution. Ensure proper continued conservation management of habitat
Arthroleptella landdrosia Landdros Moss Frog	Currently, good habitat quality maintained through conservation area management		NT	Endemic taxon with restricted range. Ensure proper continued conservation management of habitat
Breviceps gibbosus Cape Rain Frog	Habitat degradation and destruction, however, can be common in sub-optimal habitat such as residential areas	VU; A2c	NT	Enigmatic taxon – habitat (renosterveld-covered hills and mountain foothills) threatened by development, agriculture, etc. but able to survive in urban areas.
Poyntonia paludicola Mountain Marsh Frog	Habitat degradation due to the spread of alien invasive vegetation, afforestation and general habitat modification		NT	Recently described taxon, restricted distribution, little or no data on status. Indicator of mountain sponges and seeps

Reptiles

Scientific name/ Common name	Main reason(s) for poor conservation status	Current IUCN category (IUCN, 2000)	Proposed IUCN Category (Baard, *et al., 1999)*	Recommendations
Psammobates geometricus Geometric Tortoise	Lowland habitat degradation and destruction mainly through urban and agricultural expansion, alien vegetation infestation, overgrazing, trampling, too frequent fires, poor land use management	EN; A1ac, B1, 2c	EN; A1ac, B1, 2c	Endangered taxon. Indicator of good quality lowland fynbos (renosterveld endemic) habitats, habitat specialist. Habitat loss >90%. Long-lived, slow-maturing taxon. Vulnerable to poor land use management. **All sites** must be included in conservation action plan
Homopus signatus cafer Southern Speckled Padloper	Habitat degradation due to poor land use management. May become locally threatened. Pet trade threatens too	LR, nt	DD	Southern subspecies restricted in range and indigenous to fynbos. Little is known about its conservation status. Due to small adult size and attractiveness, it features on the pet trade wish list. Listed as Restricted in 1988 SA Red Data Book
Cordylus aridus Dwarf Karoo Girdled Lizard	May become locally threatened due to scientific value and easy access for pet trade		EN; B1	Endangered taxon. Known from only two localities, within isolated range (>90% of range in Western Cape and CFR). **All sites to be included** in conservation action plan
Cordylus minor Dwarf Girdled Lizard	May become locally threatened due to scientific value and easy access for pet trade		EN; B1	Endangered taxon, known from only two main localities within isolated range (>90% of range in Western Cape and CFR). **All sites to be included** in conservation action plan
Cordylus cataphractus Armadillo Lizard	Pet trade	VU; A2d	VU; A2d	Due to its gregarious nature (big family groups), vulnerable to over-exploitation for pet trade. Otherwise relatively widespread and abundant
Pseudocordylus nebulosus Dwarf Crag Lizard	Taxon vulnerable to exploitation, habitat change and poor conservation management practices		VU; D2	Recently-described specialist taxon known from a single area (<5 km^2) in Hottentots-Holland Mountains. Concern about vulnerability to exploitation by collectors for scientific and commercial value, as well as habitat change, because found only in reasonably specific habitat on N slopes of Landdroskop. **Whole range** to be included in conservation action plan
Scelotes gronovii Gronovi's Dwarf Burrowing Skink	Habitat destruction and degradation along West Coast due to extensive coastal development	LR, nt	VU; A2c	Good indicator of unique West Coast herpetological species assemblage. **Limestone coastal fynbos in greater Saldanha region** to be included
Scelotes kasneri Kasner's Dwarf Burrowing Skink	Habitat destruction and degradation along West Coast due to extensive coastal development	VU, A2c	VU; A2c	Good indicator of unique West Coast herpetological species assemblage. **Limestone coastal fynbos in greater Saldanha region** to be included
Cordylus mclachlani McLachlan's Girdled Lizard	Restricted range	VU, A2d		
Cordylus macropholis Large-scaled Girdled Lizard	Habitat destruction and degradation along West Coast due to extensive coastal development		LR; nt	Relatively "narrow" (restricted) range along West Coast, habitat specialist, good indicator of unique, endemic West Coast herpetological faunal assemblage, vulnerable to over-collection and habitat degradation
Cordylus niger Black Gridled Lizard	Habitat destruction due to general development, especially in the greater Saldanha region		LR; nt	Taxon at lower risk but may become locally threatened due to expanding development. Two isolated populations, *i.e.* Cape Peninsula and greater Saldanha region. Latter especially threatened by development. Restricted range. Melanistic, relict taxon of high scientific value
Cordylus oelofseni Oelofsen's Girdled Lizard	No specific threats due to hostile (to man) habitat, but one population may become locally threatened through over-exploitation and easy access		LR; lc	Melanistic, relict taxon of high scientific value. **Dasklip Pass population** may become locally threatened by exploitation for pet market
Psammophis leightoni leightoni Cape Sand Snake	Habitat destruction and degradation due to urban and agricultural development through most of its restricted range		LR; nt	Most of its distribution range is under great development pressure
Bitis armata Southern Adder	Lowland habitat degradation and destruction through development, alien vegetation, sand mining and coastal development, with anecdotal reports of specific collection for pet trade which may intensify now that species is recognised		LR; nt	Recently described taxon. Restricted range. Little known about its conservation status. Indicator of sensitive coastal habitats. Existing populations appear restricted to calcrete fynbos habitats at Langebaan and from Gansbaai to De Hoop Nature Reserve. Species now apparently extinct from much of Cape Flats region (W.R. Branch, pers. comm.).

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APPENDIX I Western Cape Province Herpetological Checklist

	English Name	IUCN Red List 2000	Proposed IUCN Category	CITES Appendix	SA Red Data Book 1988	Oordinance Schedule
AMPHIBIANS						
Xenopus gilli	Cape platanna	Vulnerable	Endangered		Endangered	1
Xenopus laevis laevis	Common platanna					2
Heleophryne purcelli	Cape ghost frog					2
Heleophryne regis	Southern ghost frog					2
Heleophryne rosei	Table Mountain ghost frog	Vulnerable	Critically Endangered		Endangered	2
Bufo angusticeps	Sand toad		Least Concern			2
Bufo gariepensis gariepensis	Karoo toad					2
Bufo pantherinus	Western leopard toad		Endangered			2
Bufo rangeri	Raucous toad					2
Bufo vertebralis	Southern pygmy toad					2
Capensibufo rosei	Cape mountain toad	Lower Risk/near threatened	Vulnerable		Restricted	2
Capensibufo tradouwi	Tradouw mountain toad					2
Breviceps acutirostris	Strawberry rain frog					2
Breviceps fuscus	Pplain rain frog					2
Breviceps gibbosus	Cape rain frog	Vulnerable	Near Threatened		Vulnerable	2
Breviceps montanus	Cape mountain rain frog					2
Breviceps namaquensis	Namaqua rain frog					2
Breviceps rosei	Sand rain frog					2
Arthroleptella lightfooti	Cape moss frog		Near Threatened			2
Arthroleptella bicolor	Riviersonderend moss frog					2
Arthroleptella drewesii	Kleinrivier mountain moss frog		Near Threatened			2
Arthroleptella villiersi	Hottentots Holland moss frog					2
Arthroleptella landdrosia	Landdros moss frog		Near Threatened			
Cacosternum boettgeri	Common caco					2
Cacosternum capense	Cape caco	Lower Risk/near threatened	Vulnerable		Restricted	1
Cacosternum karooicum	Karoo Caco					
Cacosternum namaquense	Namaqua caco					2
Cacosternum nanum nanum	Bronze caco					2
Microbatrachella capensis	Micro frog	Endangered	Critically Endangered		Endangered	1
Poyntonia paludicola	Marsh frog		Near Threatened			2
Pyxicephalus adspersus	Bullfrog		Near Threatened			2

Appendix 1 (*continued)*

	English Name	IUCN Red List 2000	Proposed IUCN Category	CITES Appendix	SA Red Data Book 1988	Oordinance Schedule
Afrana angolensis	Common river frog					2
Afrana fuscigula	Cape river frog					2
Afrana vandijki	Van Dijk's river frog		Data Deficient			2
Strongylopus bonaespei	Banded stream frog					2
Strongylopus fasciatus fasciatus	Striped stream frog					2
Strongylopus grayii grayii	Clicking stream frog					2
Tomopterna delalandii	Cape sand frog					2
Tomopterna tandyi	Tandy's sand frog					
Afrixalus knysnae	Knysna leaf-folding frog		Data Deficient			2
Hyperolius horstockii	Arum lily frog					2
Hyperolius marmoratus verrucosus	Painted reed frog					2
Kassina senegalensis	Bubbling kassina					2
Semnodactylus wealii	Rattling frog					2
LIZARDS						
Acontias lineatus grayi	Striped legless skink					2
Acontias lineatus lineatus	Striped legless skink					2
Acontias litoralis	Coastal legless skink					2
Acontias meleagris meleagris	Cape legless skink					2
Typhlosaurus caecus	Cuvier's blind legless skink					2
Scelotes bipes	Silvery dwarf burrowing skink					2
Scelotes caffer	Cape dwarf burrowing skink					2
Scelotes gronovii	Gronovi's dwarf burrowing skink	Lower Risk/near threatened			Restricted	2
Scelotes kasneri	Kasner's dwarf burrowing skink	Vulnerable			Restricted	2
Scelotes sexlineatus	Striped dwarf burrowing skink					2
Mabuya capensis	Cape skink					2
Mabuya homalocephala	Red-sided skink					2
Mabuya occidentalis	Western three-striped skink					2
Mabuya sulcata sulcata	Koppie skink					2
Mabuya variegata variegata	Variegated skink					2
Australolacerta australis	Southern rock lizard				Restricted	2
Meroles ctenodactylus	Smith's desert lizard					2
Meroles knoxii	Knox's desert lizard					2
Meroles suborbitalis	Spotted desert lizard					2
Nucras lalandii	Delalande's sandveld lizard					2

Appendix 1 (*continued)*

	English Name	IUCN Red List 2000	Proposed IUCN Category	CITES Appendix	SA Red Data Book 1988	Oordinance Schedule
Nucras livida	Karoo sandveld lizard					2
Nucras tessellata	Striped sandveld lizard					2
Pedioplanis burchelli	Burchell's sand lizard					2
Pedioplanis laticeps	Cape sand lizard					2
Pedioplanis lineoocellata pulchella	Spotted sand lizard					2
Pedioplanis namaquensis	Namaqua sand lizard					2
Tropidosaura gularis	Cape mountain lizard					2
Tropidosaura montana montana	Common mountain lizard					2
Cordylosaurus subtessellatus	Dwarf plated lizard					2
Gerrhosaurus flavigularis	Yellow-throated plated lizard					2
Gerrhosaurus typicus	Namaqua plated lizard	Lower Risk/near threatened			Rare	2
Tetradactylus seps	Short-legged seps					2
Tetradactylus tetradactylus	Common long-tailed seps					2
Chamaesaura anguina anguina	Cape grass lizard					2
Cordylus aridus	Dwarf Karoo Girdled Lizard			2		2
Cordylus cataphractus	Armadillo girdled lizard	Vulnerable		2	Vulnerable	2
Cordylus coeruleopunctatus	Blue-spotted girdled lizard			2		2
Cordylus cordylus	Cape girdled lizard			2		2
Cordylus macropholis	Large-scaled girdled lizard			2		2
Cordylus mclachlani	McLachlan's girdled lizard	Vulnerable		2	Restricted	2
Cordylus minor	Dwarf girdled lizard			2		2
Cordylus niger	Black girdled lizard			2		2
Cordylus oelofseni	Oelofsen's Girdled Lizard			2		2
Cordylus polyzonus	Karoo girdled lizard			2		2
Pseudocordylus capensis	Graceful crag lizard			2		2
Pseudocordylus microlepidotus microlepidotus	Cape crag lizard			2		2
Pseudocordylus microlepidotus namaquensis	Cape crag lizard			2		2
Pseudocordylus nebulosus	Dwarf Crag Lizard	Vulnerable		2		2
Agama aculeata aculeata	Ground agama					2
Agama atra atra	Southern rock agama					2
Agama atra knobeli	Southern rock agama					2
Agama hispida	Spiny agama					2
Bradypodion damaranum	Knysna dwarf chameleon			2		2

Appendix 1 (*continued)*

	English Name	IUCN Red List 2000	Proposed IUCN Category	CITES Appendix	SA Red Data Book 1988	Oordinance Schedule
Bradypodion gutturale	Robertson dwarf chameleon			2		2
Bradypodion karrooicum	Karoo dwarf chameleon			2		2
Bradypodion occidentale	Namaqua dwarf chameleon			2		2
Bradypodion pumilum	Cape dwarf chameleon			2		2
Chamaeleo namaquensis	Namaqua chameleon			2		2
Afroedura hawequensis	Hawequa flat gecko	Lower Risk/near threatened			Restricted	2
Chondrodactylus angulifer angulifer	Giant ground gecko					2
Pachydactylus austeni	Austen's gecko					2
Pachydactylus bibronii	Bibron's gecko					2
Pachydactylus capensis	Cape gecko					2
Pachydactylus geitje	Ocellated gecko					2
Pachydactylus kladaroderma	Thin-skinned Thick-toed Gecko					2
Pachydactylus labialis	Western Cape gecko					2
Pachydactylus maculatus	Spotted gecko					2
Pachydactylus mariquensis mariquensis	Marico gecko					2
Pachydactylus oculatus	Golden spotted gecko					2
Pachydactylus rugosus formosus	Rough gecko					2
Pachydactylus serval purcelli	Western spotted thick-toed gecko					2
Pachydactylus weberi	Weber's gecko					2
Goggia braacki	Braack's Dwarf Leaf-toed Gecko					2
Goggia hewitti	Hewitt's Dwarf Leaf-toed Gecko					2
Goggia hexapora	Cedarberg Dwarf Leaf-toed Gecko					2
Goggia lineata	Striped dwarf leaf-toed gecko					2
Goggia microlepidota	Small-scaled dwarf leaf-toed gecko	Lower Risk/near threatened			Restricted	2
Goggia rupicola	Namaqualand dwarf leaf-toed gecko					2
Afrogecko porphyreus	Marbled leaf-toed gecko					2
Afrogecko swartbergensis	Swartberg African leaf-toed gecko					2
Ptenopus garrulus maculatus	Common barking gecko					2

Appendix 1 (*continued)*

	English Name	IUCN Red List 2000	Proposed IUCN Category	CITES Appendix	SA Red Data Book 1988	Oordinance Schedule
Varanus albigularis	Rock or white-throated monitor			2		2
SNAKES						
Ramphotyphlops braminus	Flower-pot snake					
Rhinotyphlops lalandei	Delalande's blind snake					
Leptotyphlops nigricans	Black thread snake					
Leptotyphlops gracilior	Slender thread snake					
Lycodonomorphus rufulus	Common brown water snake					2
Lamprophis aurora	Aurora house snake					2
Lamprophis fiskii	Fisk's house snake	Vulnerable			Rare	2
Lamprophis fuliginosus	Brown house snake					2
Lamprophis fuscus	Yellow-bellied house snake	Lower Risk/near threatened			Rare	2
Lamprophis guttatus	Spotted house snake					2
Lamprophis inornatus	Olive house snake					2
Lycophidion capense capense	Cape wolf snake					2
Duberria lutrix lutrix	Common slug eater					2
Pseudaspis cana	Mole snake					2
Amplorhinus multimaculatus	Many-spotted snake					
Prosymna sundevallii sundevallii	Southern shovel-snout snake					2
Dipsina multimaculata	Dwarf beaked snake					
Psammophylax rhombeatus rhombeatus	Spottedskaapsteker					
Psammophis notostictus	Whip snake					
Psammophis leightoni leightoni	Cape sand snake	Vulnerable			Vulnerable	
Psammophis leightoni namibensis	Namib sand snake					
Psammophis crucifer	Cross-marked grass snake					
Philothamnus hoplogaster	Green water snake					2
Philothamnus natalensis occidentalis	Eastern green snake					2
Dasypeltis scabra	Common egg eater					2
Crotaphopeltis hotamboeia	Herald snake					
Telescopus beetzii	Namib tiger snake					
Dispholidus typus typus	Boomslang					
Homoroselaps lacteus	Spotted harlequin snake					
Aspidelaps lubricus lubricus	Coral snake					
Naja nivea	Cape cobra					
Naja nigricollis woodi	Black spitting cobra				Rare	

Appendix 1 (*continued)*

	English Name	IUCN Red List 2000	Proposed IUCN Category	CITES Appendix	SA Red Data Book 1988	Oordinance Schedule
Hemachatus haemachatus	Rinkhals					
Causus rhombeatus	Common night adder					
Bitis arietans arietans	Puff adder					
Bitis atropos	Berg adder					
Bitis caudalis	Horned adder					
Bitis cornuta	Many-horned adder					
Bitis rubida	Red Adder					
Bitis armata	Southern Adder					
Bitis schneideri	Namaqua dwarf adder	Vulnerable			Vulnerable	

CHELONIANS					
Pelomedusa subrufa	Marsh terrapin				2
Geochelone pardalis	Leopard tortoise		2		2
Chersina angulata	Angulate tortoise		2		2
Homopus areolatus	Parrot-beaked tortoise		2		2
Homopus boulengeri	Karoo Boulenger's padloper		2		2
Homopus femoralis	Greater padloper		2		2
Homopus signatus signatus	Namaqua speckled padloper	Lower Risk/near threatened	2		2
Homopus signatus cafer	Southern speckled padloper	Lower Risk/near threatened	2	Restricted	2
Psammobates geometricus	Geometric tortoise	Endangered	1	Endangered	1
Psammobates tentorius tentorius	Tent tortoise		2		2
Psammobates tentorius trimeni	Namaqua tent tortoise		2		2
Psammobates tentorius verroxii	Bushmanland tent tortoise		2		2

Checklist prepared by Baard, De Villiers and Turner (February 2002)

State of Biodiversity: Western Cape Province 2000
Avifauna

Kevin A. Shaw
Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

Introduction

The province has six broad avifaunal habitats namely mountain and lowland Fynbos, Karoo, afromontane forests, coastal strip and inland waters. Individually these habitats do not have as diverse a bird life as the more northern habitats such as the savanna. The diversity of habitats within the province do, however, provide for fairly rich bird diversity. Four hundred and fifty two bird species were recorded for the province during the South African Bird Atlas Project representing fifty percent of the bird species occurring in southern Africa.

There are no birds endemic to the Western Cape Province. There are, however, six species that are endemic to the Fynbos Biome, which extends outside the province. These species are therefore classified as near endemic species (more than 70% of the population occurs within the province).

A large percentage of the protected areas occur in the mountainous areas of the Western Cape. The ruggedness of the areas has limited development outside of protected areas and these are still in a fairly pristine state. Bird diversity is, however, not very high in these areas. In contrast to this, very little protection is given to the lowland and coastal habitats where a larger number of bird species occurs. Most of the lowland has been transformed into agricultural land and the coastal habitats are under constant threat from development. A large number of species occurring in this habitat have experienced a decline in population numbers.

The major threat to birds is loss of habitat. This is especially so with regards to coastal and wetland birds, specifically pallustrine wetland birds. The problem is complicated slightly in that a number of species (some of which are threatened species) have adapted to human-altered environments and their numbers are increasing. As these environments can, however, change these increases may be short-term unless the species can again adapt to new changes.

This chapter aims to describe the state of avifauna biodiversity of the Western Cape Province. It addresses certain issues concerning the avifauna, but in order to produce a concise chapter on the state of biodiversity only the most relevant information was included.

Methods

The majority of the information contained in this report emanated from the analysis of data accumulated during the South African Bird Atlas Project. The data were obtained from the Avian Demography Unit of the Department of Statistical Sciences at the University of Cape Town and placed into a database compiled by the Scientific Services Division of the Western Cape Nature Conservation Board. Historical records that were stored in a database at Jonkershoek were also added to that obtained from the South African Bird Atlas Project. Furthermore a literature survey was carried out to obtain additional information on each species and added to the database. Analyses of the data were carried out using a geographical information system package (Arcview Ver.3.1) in combination with a database package (MS Access).

The nomenclature used in this report follows that used by the authors of The Atlas of Southern African Birds (Harrison *et al.*, 1997), the publication that emanated from the South African Bird Atlas Project. The splitting and lumping of species or the finding of new species subsequent to the Atlas have therefore not been taken into account.

Avifaunal Statistics

The South African Bird Atlas Project recorded a total of 454 bird species in the Western Cape Province. Most of the data were collected between 1987 – 1991 (Harrison *et al.*, 1997). There are however two exotic species that were not recorded during this period, the House Crow and the Peafowl. The total number of exotic species recorded for the province, including the latter two species, is 10; the other eight species are the Indian Myna, Chukar Partridge, Mute Swan, Mallard Duck, Chaffinch, Feral Pigeon, House Sparrow, and European Starling. A further 100 species are either vagrants to the Western Cape or the southern limits of their distribution range extend just into the province. If one excludes these species and considers the fact that 686 species were recorded for South Africa during the Atlas period, then the Western Cape Province supports 50% of South Africa's bird life (344 species). Table 1 is an analysis illustrating the breeding and resident status of the birds of the Western Cape.

Twenty-five of the 33 bird species endemic to South Africa, Lesotho and Swaziland occur in the Western Cape Province. There are, however, no true endemic bird species to the

province but six of the 25 species can be classified as near endemic (up to 70% of the distribution range occurring within the province). These are the Cape Rockjumper, Victorin's Warbler, Protea Canary, Cape Sugarbird, Cape Siskin and the Orangebreasted Sunbird. All six species are endemic to the Cape Floristic Kingdom, the boundaries of which extend just outside the Western Cape *Provincial* boundary. Figure 1 shows a breakdown of endemism and Figure 2 that of indigenous classes.

Using species lists of reserves together with surveys carried out by field staff for the Avian Demography Unit's "Birds in Reserves Project (BIRP), it was possible to determine how many species were recorded in protected areas within the province. Of the 454 species (including the eight provincially extinct species, see below) recorded in the province 346 species were recorded in protected areas (Figure 3). Figure 4 shows that a large percentage of those species not recorded in protected areas are vagrant, pelagic and exotic species. As new data concerning the presence of species within reserves are being collected continually (the BIRP Project is still operating) these statistics will change as more information is gathered.

Table 1. Analysis of the birds of the Western Cape.

	No. of species	% of total
Total number of species (including exotics)	354	
Species that breed within the province	294	83
Species that do not breed within the province	60	17
Resident[1] birds	273	77
Migratory[2] birds	81	23
Migratory birds	81	
Species that breed within the province	26	32
Species that do not breed within the province	55	68

1. Resident refers to those bird species that remain within the province throughout the year
2. Migratory birds are those species that leave their summer habitats and migrate to the province either to breed or to visit. Also included are the 18 pelagic species that utilise the continental shelf as feeding grounds but breed on islands in the Atlantic Ocean

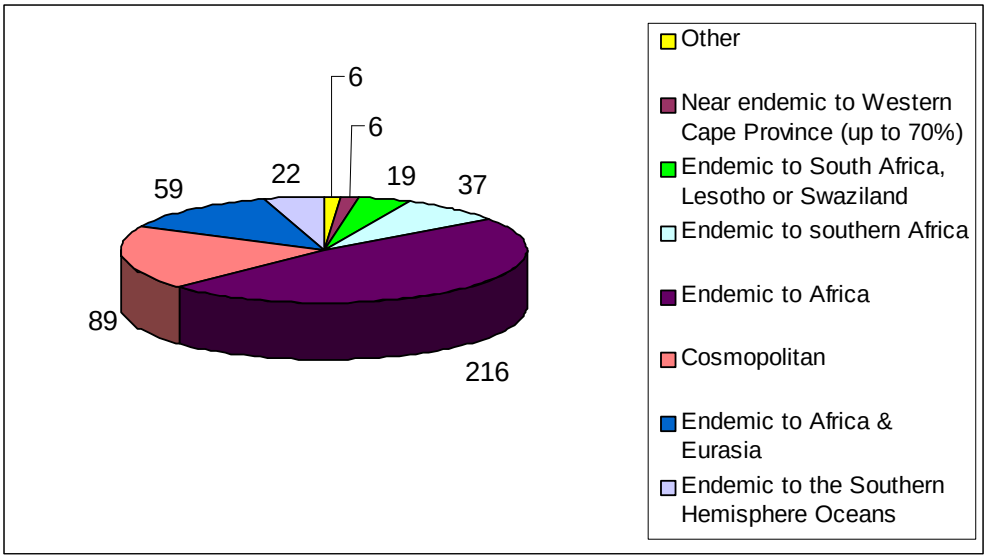

Figure 1. Number of bird species occurring within the Province according to endemic categories. Other refers to those species not falling into any of the categories and include species such as the Manx and Little Shearwater.

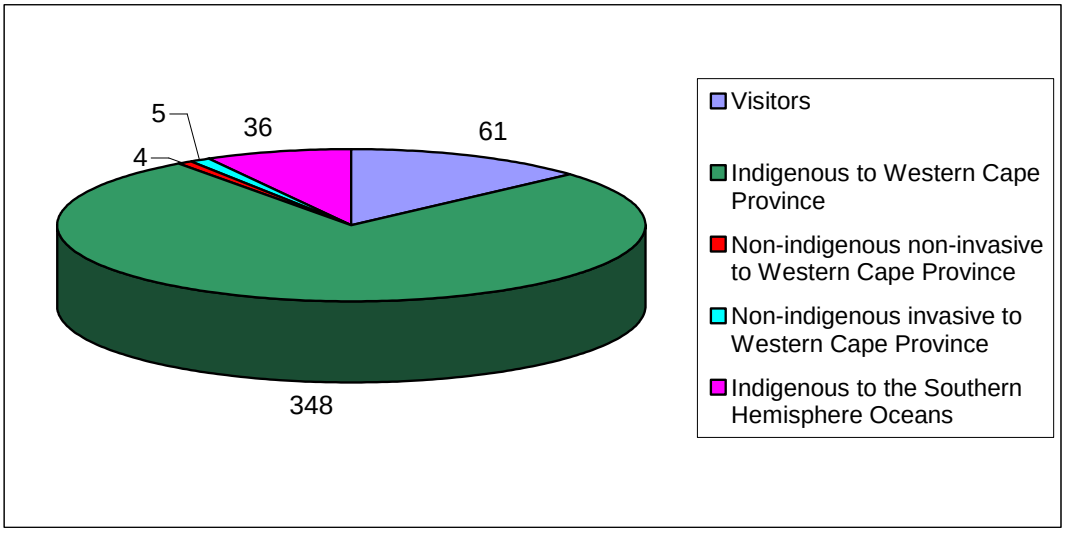

Figure 2. Number of bird species occurring within the Province according to indigenous categories. Visitors refer to those species that do not regularly occur within the Province (Bateleur and Tawny Eagles) or those species that have small resident populations due to possible early range expansions and/or cage bird escapees (Whitefaced Whistling Duck).

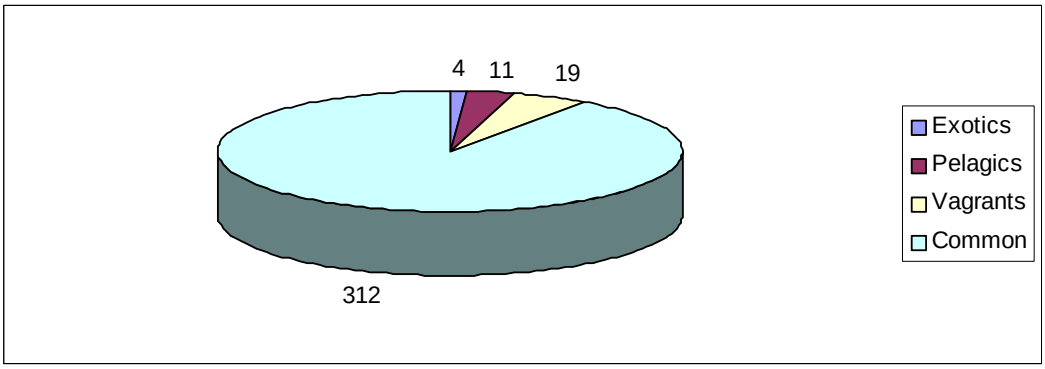

Figure 3. Number and class of bird species occurring within protected areas.

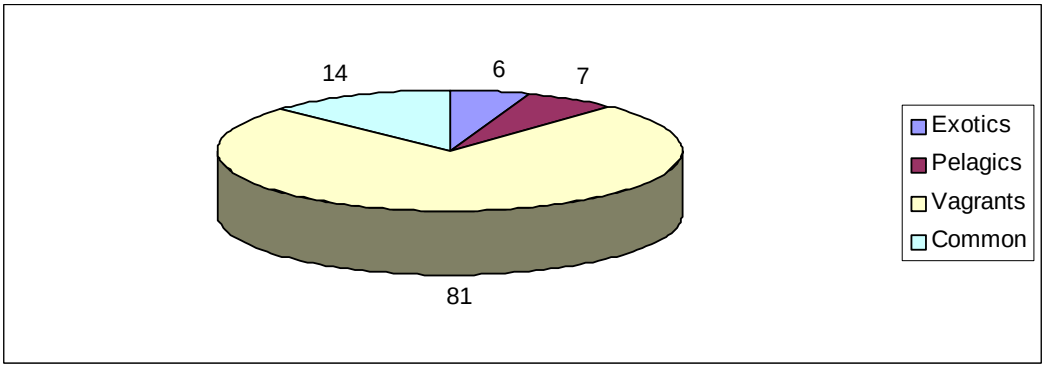

Figure 4. Number and class of species not occurring within protected areas.

Fifty-three of the species recorded in the Western Cape Province are listed in the latest Red Data Book of Birds (Barnes 2000). Figure 5 illustrates the number of nationally threatened species according to their proposed IUCN Categories. A further eight species are known to have become extinct within the province. They are the Bittern, Bald Ibis, Bearded, Egyptian and Lappetfaced Vultures, Cape Parrot, Wattled Crane and Scops Owl.

Ninety-three bird species recorded within the province are listed in the three Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Convention). The only species listed under Appendix 1 is the Peregrine Falcon, which is also the only Appendix I listed bird species for South Africa. The species listed in the three CITES appendices are indicated in Appendix I of this chapter.

Data from the South African Bird Atlas Project were used to create a map (Figure 6) showing species richness per quarter degree square (the standard area used to collect data in the project). Unfortunately Figure 6 illustrates the effect of sampling rather than species richness. This fact is illustrated more clearly when comparing Figure 6 with the map produced in the Atlas of Southern African Birds (Harrison, *et al.*, 1997) of the number of atlas cards submitted per quarter degree square. The high concentration of birders and subsequently the high number of submitted atlas cards for example for the Cape Town area would have a biased effect on Figure 6 compared to quarter degree squares in rural areas far from

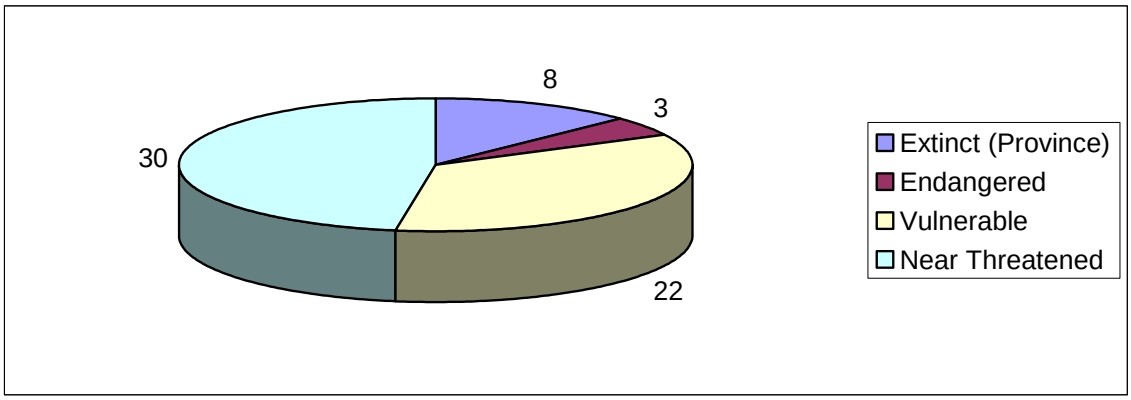

Figure 5. Number and classification of threatened species occurring in the Western Cape Province.

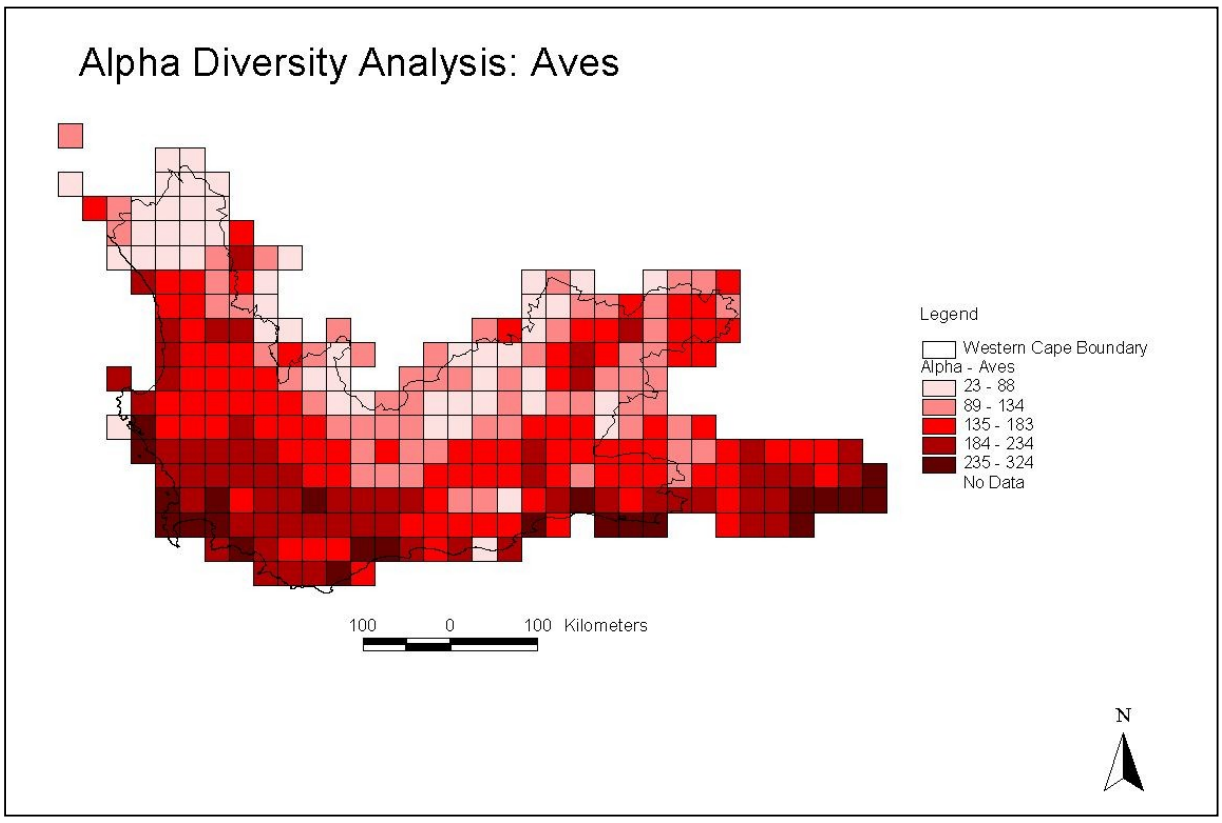

Figure 6. Map showing the number of species recorded per quarter degree square.

Cape Town.

Data quality

The data used emanated from the South African Bird Atlas Project and are accurate in terms of the date, species and quarter degree square. This was a huge project involving the help of many amateur ornithologists, carrying out surveys per quarter degree square. The coverage was not uniform as some squares, notably those close to the major urban centres, were surveyed more frequently than those in the rural areas. This however did not affect any of the analyses made in this chapter.

Critical Habitats

Shaw (1995) carried out an analysis of the Avifauna of the Western Cape Province in order to evaluate the conservation status of these bird species. Each species was scored according to a set of categories (five biological and six non-biological) and the species were ranked according to their total scores. In this analysis 26 species were proposed as high priority species for conservation while 36 species were proposed as intermediate priority species for conservation (Table 2).

The province has six major avifaunal habitat types, Karoo, mountain fynbos, lowland fynbos, forest, coastal (defined as a 1km broad strip along the coast of the province), and inland water (Figure 7). Adjacent to the province is another important habitat; the open ocean. Shaw (1995) using the species identified in Table 2 and assigning them to the habitats they inhabit, was able to identify habitats of conservation importance to the avifauna within the Western Cape (Table 3).

The last column of Table 3 clearly shows that the habitat with the highest conservation priority is the open ocean. Currently the conservation of this habitat, as well as the organisms dependent on it falls, within the jurisdiction of the Directorate Marine and Coastal Management of the Department of Environment Affairs and Tourism. The provincial mainland has three further avifaunal habitats of concern namely, inland water, the coastal and the forest habitat. Considering the number of dams that have been built within the province it is surprising to see that inland water species are a conservation priority. This is especially so when these dams have been responsible for the increase of a number of waterfowl species within the province (Froneman 1997). The wetland species occurring in both the lists of high and intermediate priority species are, however, pallustrine wetland species that have specific habitat requirements not always supplied by man-made impoundments. Furthermore these species have never occurred in great numbers due to the limited amount of habitat. The increasing pressures on our coasts by developers and tourists have impacted heavily on the bird species that rely on the coastal habitat. The forests have also suffered in the past from man-made disturbances such as logging and development. The forests today are patchy and widely dispersed. The birds of the other three habitat types, lowland, and mountain fynbos and Karoo, have adapted fairly well to the man-converted landscapes or disturbances.

Threats to Avifauna Biodiversity

Six broad categories of threats to the survival of vertebrate species are recognized by the IUCN's World Conservation

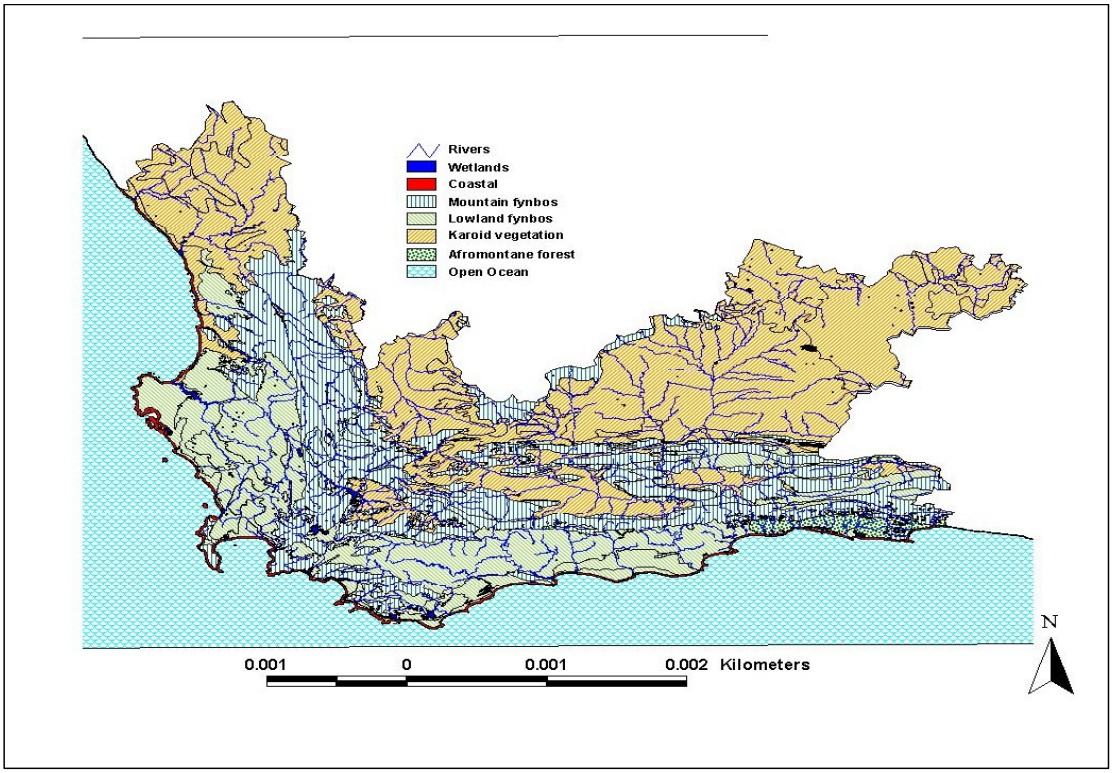

Figure 7. Map of the avifaunal habitat units of the Province.

Strategy. They are habitat destruction or degradation; overexploitation; impacts of introduced species; food supply that has been contaminated or is not available; persecution to protect crops or livestock and incidental capture or destruction.

A. Habitat destruction or degradation

The destruction or degradation of habitat is the most important threat to the birds of the Western Cape and has resulted in the decline of certain species in all seven habitat types (open ocean habitat included) identified in the province. Pollution, especially oil pollution, is the most serious cause of habitat degradation in the Open Ocean (Rand, 1970). In the absence of onshore winds, oil spills along the South African coast are pushed out to sea by the Coriolis force. Pelagic birds are contaminated with oil when roosting on the water. Birds occurring in the narrow coastal habitat on the other hand are more severely affected by oil pollution since many of the spills occur in this habitat or move into it. These species also have to contend with high human pressure in the form of development and disturbances.

The principal large-scale disturbance factors of forests are exploitation and clearing, grazing, and fire. The forested area in the George/ Knysna area is the only forest that has been intensively utilised for timber almost continuously since its discovery by early European settlers in 1750 (Geldenhuys, 1991). The selective nature of the exploitation has affected the species composition and age structure of the forests. Those forests in public ownership, however, are at present in an advanced stage of recovery from timber exploitation in the nineteenth and early twentieth centuries (Geldenhuys and Macdevette, 1989). Historically forest margins were subjected to fires originating in adjacent vegetation types. The severe exploitation of forests created high debris loads and exposed forests to the drying effects of the wind, thereby increasing the damage to forests by fires. It was only in 1900 that control measures were implemented to prevent further damage to forests by either natural or human induced fires (Geldenhuys, 1991). Commercial plantations of exotic trees, which are still an important part of the economy of the area, replaced large sections of the indigenous forests and also serve as a source from where exotic trees can infest into the indigenous forests. Despite the large-scale disturbance to this habitat, the only documented proof of the decline of a forest species is that of the Crowned Eagle (Steyn, 1989) and the locally extinct Cape Parrot (Wirminghaus *et al.*, 1999). It is almost certain that numbers of other forest dependant species like the Knysna Lourie and Narina Trogon also declined due to habitat loss.The area of inland water habitat has increased due to the construction of dams, especially farm dams. Berg *et al.* (1994) state that there are more than 4000 farm dams in the Western Cape with a combined storage capacity in excess of 120 million m^3. The increase in area of this habitat has resulted in an increase in only certain waterfowl species, as these artificial habitats do not cater for all waterfowl. In certain cases "special" habitats are flooded because of these artificial impoundments and habitat is lost, at least temporarily, to certain waterfowl species. Furthermore the change in water levels in these impoundments due to seasonal removal for irrigation purposes has been known to affect species such as the African Jacana and the Whiskered Tern (Urban *et al.*, 1986). Natural wetlands have been destroyed through the process of drainage for agricultural lands, indiscriminate burning and grazing, excessive input of nutrients from agricultural lands, and the invasion of wetlands by exotic invasive plant species. The loss of these natural wetlands, especially pallustrine wetlands, has affected species like Baillon's Crake, and African Rail.

Although agriculture (crops and extensive pastoralism) is the single most important threat to the Karoo habitat, invasive alien plants, mining operations and to a limited degree urbanisation all contribute to the degradation of this habitat. Populations of species commonly found in the Karoo like the Martial Eagle, Secretary Bird, Ludwig's, Kori and Stanley's Bustards have all declined (Brown *et al.* 1982, Brooke 1984, Urban *et al.* 1986, Hockey *et al.*, 1989). Although the reasons for these declines are due to a combination of factors, the most common factor is that of habitat loss and degradation.

The rugged terrain of the area covered by mountain fynbos has restricted the anthropogenic disturbances to this habitat. The disturbances that do occur include agriculture (e.g. deciduous fruits and grapes along the lower slopes; grazing, although the vegetation is unsuitable, is practiced in the eastern areas), commercial plantations, and holiday and tourist facilities. Habitat loss has resulted in the decline of two species, the Striped Flufftail and the Blackrumped Buttonquail. Both species occur in rank vegetation on moist south facing slopes, which has been destroyed due to injudicious burning practices in the past (Hockey *et al.*, 1989).

Of the seven habitat types lowland fynbos has suffered the most due to habit loss and alteration. This was due to the grain-farming boom in the early 1920s, which lead to large areas of renosterveld, being cleared. Jarman (1986) estimates that over 90% of coastal renosterveld had been destroyed. Strandveld, another lowland fynbos vegetation component, is also under threat, particularly from urban development, mostly holiday resorts along the coast (Jarman 1986, Fraser and Machoun, 1988). Furthermore, advanced technology in the agricultural sphere, namely the centre pivot irrigation systems, has made farming more viable in these coastal areas, placing further pressure on this environment (Heydenrich, 1993). Species that have suffered a decline due to this habitat loss include the Grass and Marsh Owl, Stanley's Bustard and Secretarybird (Steyn, 1989, Brooke, 1984).

B. Overexploitation

The overexploitation of a species or its derivatives has resulted in the decline of a number of species. Brooke (1984) states that the reason for the decline of bustard species in South Africa is due to hunting pressure on a slow breeding species. It is also well known that African Penguin eggs were collected in large numbers for food and incubating eggs were destroyed to ensure fresh ones for collection on the next visit precipitated the population decline in the early 1900s. The annual egg crop for the period 1900-1930 exceeded 450 000 eggs from Dassen Island alone (Frost *et al.* 1976). The scraping and subsequent removal of guano on a regular basis did not only cause a disturbance, but resulted in a diminished quality of breeding habitat for island breeding species, especially the African Penguin.

Fortunately many of these cases of overexploitation are activities that occurred in the past and have since ceased to exist. Most of the bird species occurring in the Western Cape are protected according to the Nature Conservation Ordinance (No. 19 of 1974). Furthermore hunting of birds is controlled by the proclamations promulgated under the Ordinance on an annual basis, which stipulate the species that may be hunted, the season in which the species may be hunted as well as the bag limit.

C. Impact of introduced species

Species are introduced into an area either for aesthetic reasons, as food, for hunting, to control pests or by accident. Introductions may result in competition with indigenous species, hybridisation with indigenous species, introduction of

diseases and pests, agricultural damage, higher levels of predation or alteration of habitat (Long 1981). The Western Cape has it share of introduced species, both faunal and floral, which affect the avifauna of the province in some way. The species that has the potential to become a huge problem is the Mallard Duck. It is closely related to some of the indigenous waterfowl and does in fact produce fertile hybrid offspring when hybridised with the Yellowbilled Duck. Furthermore the Mallard Duck is an invasive species and has adapted well to many of the areas where it was introduced (Long 1981).

Table 2. List of high and intermediate conservation priority bird species occurring within the Western Cape Province as proposed by Shaw 1994.

High Priority	
African Penguin	*Spheniscus demersus*
White Pelican	*Pelecanus onocrotalus*
Cape Gannet	*Morus capensis*
Bank Cormorant	*Phalacrocorax neglectus*
Crowned Cormorant	*Phalacrocorax coronatus*
White Stork	*Ciconia ciconia*
Black Stork	*Ciconia nigra*
Greater Flamingo	*Phoenicopterus ruber*
Lesser Flamingo	*Phoeniconaias minor*
Secretary Bird	*Sagittarius serpentarius*
Cape Vulture	*Gyps coprotheres*
Martial Eagle	*Polemaetus bellicosus*
Crowned Eagle	*Stephanoaetus coronatus*
Blackrumped Buttonquail	*Turnix hottentotta*
Baillon's Crake	*Porzana pusilla*
Kori Bustard	*Ardeotis kori*
Stanley's Bustard	*Neotis denhami*
Ludwig's Bustard	*Neotis ludwigii*
African Black Oystercatcher	*Haematopus moquini*
Caspian Tern	*Hydroprogne caspia*
Antarctic Tern	*Sterna vittata*
Damara Tern	*Sterna balaenarum*
Knysna Lourie	*Tauraco corythaix*
Grass Owl	*Tyto capensis*
Marsh Owl	*Asio capensis*
Cape Eagle Owl	*Bubo capensis*
Intermediate priority	
Cape Cormorant	*Phalacrocorax capensis*
Little Bittern	*Ixobrychus minutus*
Little Sparrowhawk	*Accipiter minullus*
Pale Chanting Goshawk	*Melierax canorus*
Peregrine Falcon	*Falco peregrinus*
Cape Francolin	*Francolinus capensis*
Blue Crane	*Anthropoides paradiseus*
Striped Flufftail	*Sarothrura affinis*
African Jacana	*Actophilornis africanus*
Painted Snipe	*Rostratula benghalensis*
Chestnutbanded Plover	*Charadrius pallidus*
Turnstone	*Arenaria interpres*
Knot	*Calidris canutus*
Ruff	*Philomachus pugnax*
Ethiopian Snipe	*Gallinago nigripennis*
Curlew	*Numenius arquata*
Common Tern	*Sterna hirundo*

Fortunately in the Western Cape the species is mostly restricted to urban wetlands, but sightings of the species in rural wetlands are increasing. Increased competition (for food and nest sites) from this species is possibly the reason why there are so few native species occurring on wetlands where the Mallard has gained a foothold. Unfortunately control of the Mallard Duck is inhibited by ignorance of the damage this species is capable of and the popularity of the species as a pet.

evidence of interspecific competition between these two introduced species and indigenous congeners. The European Starling is reported to cause damage to orchards (Feare 1984) and table grapes (Jarvis and Heÿl 1989) and in the case of table grapes causing a loss of up to seven tons per hectare (McVeigh 1991).

Birds are not only affected by introduced species of the same taxa but also of other taxa as well. Hockey (1983) showed

Table 2. *(Continued)*

High Priority	
Redbilled Woodhoopoe	*Phoeniculus purpureus*
Scalythroated Honeyguide	*Indicator variegatus*
Knysna Woodpecker	*Campethera notata*
Cape Bulbul	*Pycnonotus capensis*
Starred Robin	*Pogonocichla stellata*
Cape Rockjumper	*Chaetops frenatus*
Knysna Warbler	*Bradypterus sylvaticus*
Victorin's Warbler	*Bradypterus victorini*
Bleating Warbler	*Camaroptera brachyura*
Namaqua Warbler	*Phragmacia substriata*
Cape Sugarbird	*Promerops cafer*
Orangebreasted Sunbird	*Nectarinia violacea*
Cape Siskin	*Pseudochloroptila totta*
Protea Canary	*Serinus leucopterus*

Two species, the European Starling and the House Sparrow, were introduced into South Africa in the 1800s. Both species spread rapidly from their introduced sites, the House Sparrow spreading throughout southern Africa as well as into Malawi and Zambia (Brooke 1997) and the European Starling extending its range throughout the province into adjacent provinces as well as into Namibia and Lesotho (Craig 1997). They are both found in settled habitats and there is very little

that a causeway built between Marcus Island and the mainland on the west coast of the province enabled predators to access the island. During the 1979-80 breeding season, 10 African Black Oystercatchers (8% of the Island breeding population) were killed. Similarly the large number of rats *Rattus norvegicus* found on Bird Island near Lambert's Bay is also due to a causeway linking the island to the mainland. These

Table 3. Analysis of the avifauna of the Western Cape Province according to habitat.

Habitat type	Habitat area expressed as (%) of total area	Number of species in habitat	Number of species of conservation importance[1]	Species of importance expressed as a percentage of the number of species in habitat
Karoo	57.8	153	10	6.5
Mountain fynbos	22.4	138	7	5.1
Lowland fynbos	17.9	172	13	7.6
Forest	1.8	53	9	17
Coastal	0.07	78	20	25.6
Inland water	<1[2]	81	13	16
Open ocean		21	18	85.7

1. The data were obtained from Shaw (1995) unpublished M.Sc Project
2. Due to the large number of dams (many of them not documented) and rivers it was not possible to determine this area. The area is, however, estimated to be less than one percent of the total area of the province.

rats eat the eggs and chicks of nesting birds on the island.

Exotic vegetation may provide habitat for a species that otherwise may not occur in the area. Range expansion in the Hadeda Ibis (Macdonald, Richardson and Powrie 1986), Pied Barbet (Macdonald 1986) and Masked Weaver (Macdonald 1990) has occurred partly or mostly because of the spread of alien trees.

D. Loss or contamination of food supply

The loss of food supply has been demonstrated to be a threat to many pelagic and coastal seabirds. Crawford and Shelton (1978) showed that the overexploitation of pilchards also lead to a decline in guano hence numbers of Cape Cormorants at various colonies along the Namibian Coast. Crawford and Shelton (1981) state that the overexploitation of pilchards in the 1950s and 1960s reduced the supply of food to breeding African Penguins which subsequently led to a lower reproductive success. Hockey (1983) suggests that the eastern distribution of the African Black Oystercatcher may be limited by the overexploitation of inter-tidal invertebrate resources by humans, both for food and as bait.

Chemical contamination of food supplies not only causes problems for the bird ingesting the contaminant, but can have long lasting effects. Studies have shown that contaminants can cause eggshell thinning and reduced breeding success in a number of birds of prey. The most well known studies are those of the effects of DDT on Peregrine Falcon in America. On the African continent studies on the African Fish Eagle (Davies and Randall 1989) and the African Goshawk (Hartley and Douthwaite 1994) for example, have resulted in similar findings. Another example is the large scale spraying of the brown locust that has affected many bird species preying on them. A look at early distribution ranges of species like the smaller kestrels that occurred in the brown locust areas compared to distribution records today indicate clearly the affect these spraying operations have had.

E. Persecution to protect livestock or crops

The predominate agricultural practices occurring within the province include small grain, fruits, vegetable, fodder crop, small-stock, dairy, beef, and ostrich farms. Bird damage occurs mostly in the small grain, fruit, and small stock and ostrich industries. The greatest damage occurs in the wheatfields of the Overberg and the Swartland by Egyptian Geese, Spurwinged Geese and periodically by small granivorous passerines (predominantly the Red Bishop). The latter species are controlled using mistnets, while shooting and scaring devices are used against the two geese species. Frugivorous birds and sometimes insectivorous birds are responsible for crop damage to especially the table and wine grape industry. These birds are controlled mostly using mistnets but a variety of scaring methods is also used. Unfortunately due to poor permit returns it is not possible to determine the number of birds that are killed during these operations.

Although large raptors do on occasion take very young lambs the biggest problem in stock farming are birds (especially Blue Cranes) taking food from small-stock and Ostrich food troughs. Fortunately various inexpensive non-lethal methods have been devised, most of them by the farming community, to prevent the birds from accessing the food troughs.

Regrettably poison is used illegally on occasions, but in most cases it is the farm labourer using the poison to obtain birds for food. There are, however, a few cases of landowners using poison to control predators. It is very seldom that only the target species are killed and in just about all cases investigated non-target species were also killed.

F. Incidental capture or destruction

Incidental capture or destruction occurs as a consequence of some kind of human activity. Often these affects are not realised as there is very little if any physical evidence. African Black Oystercatchers feed predominantly in the inter-tidal zone. During the breeding season when movement is restricted due to territory size and dependent chicks, disturbance in the form of human presence restricts the available time for foraging. Breeding success can be severely influenced depending on the duration and the intensity of the disturbance. Unfortunately the summer school holiday period and the breeding season of the Oystercatcher coincide and disturbance does have a severe affect on the species (Summers and Cooper 1977).

Infrastructures associated with humans often have an impact on a number of bird species. Collisions with especially powerlines and sometimes fences cause the highest mortality in Blue Cranes, this despite the under reporting of collision incidences. Large raptors using electricity poles as perches are often electrocuted when they touch the live wires while taking off or landing. ESKOM, the main supplier of electricity, is addressing these problems by fitting mitigation measures and altering the design of the poles to make them more bird-friendly. Reports are received on a periodic basis of birds drowning in water troughs and reservoirs, but casualties are not nearly as high as other parts of the country.

Effectiveness of Current Conservation

The effectiveness of conservation within the Western Cape Province is influenced by, the lack of resources, the lack of uniform policies and legislation, the lack of implementation of international conservation legislation and Conventions, outdated provincial legislation, poor communication between role players, lack of competent law enforcement officers and inefficient reserve network. A study by TRAFFIC East/Southern Africa on the trade of southern African indigenous birds where the effectiveness of South Africa's legislation was investigated came up with similar findings (Patterson 2001a).

Lack of resources, both human and financial: South Africa, specifically the Western Cape Province is fortunate to have two avian orientated institutions; the Percy Fitzpatrick Institute of African Ornithology and the Avian Demography Unit, both situated at the University of Cape Town. The Percy Fitzpatrick Institute concentrates on the ecology and biology of birds while the Avian Demography Unit specialises in bird population, especially bird population dynamics. Both these institutions are dependent on outside funding to carry out research projects. There is also a research component within the Directorate Marine and Coastal Management of the Department of Environment Affairs and Tourism that specialises in research on seabirds. The Western Cape Nature Conservation Board is the institution that is primarily responsible for the conservation of the avifauna of the Western Cape. Regrettably a shortage of funds and human resources does hamper the efficient conservation of birds and associated habitats. Fortunately there are a large number of bird enthusiasts that belong to the various bird clubs situated throughout the province. These enthusiasts can be enlisted in a variety of projects and in fact have been enlisted in a number of the Avian Demography Unit's initiatives, the South African Bird Atlas Project been the most well known.

Lack of uniform, national-guiding principles, polices and legislation: There are currently nine provinces within South Africa, each with its own legislation and policies. In many cases the legislation and policy differ, resulting in ineffective conservation strategies. Furthermore there are no national guiding principles and policies that address these discrepancies.

Lack of implementation of international conservation legislation and Conventions: South Africa is signatory to at least six major international conventions concerning the protection of the environment. Despite being signatories for a number of years (e.g. the Ramsar Convention was signed in 1975) some of the conventions have not been ratified (i.e. incorporated into South African legislation). Convention affairs are dealt with at national level and very little information is filtered down to the provincial conservation authorities who are the implementing agents of the convention.

Outdated provincial legislation: The current Nature Conservation Ordinance was promulgated in 1974. Despite a few changes that have been made to the Ordinance since then and a number of attempts to rewrite the Ordinance, it remains virtually unchanged. The Ordinance is still based largely on fisheries, hunting and the proclamation of protected areas, which were the original objectives of Nature Conservation during the early years. An investigation into the contents of the Ordinance needs to be undertaken to determine how relevant some of the legislation is and other issues like the protection of species outside reserves needs to be addressed.

Poor communication between role players: Currently, communication between the various role players takes place on an *ad hoc* basis. This has, improved slightly from the past situation with the advent of email. Taking into consideration the number of role players involved (conservationists, researchers and bird clubs), it would make sense to have a formal forum where bird conservation can be discussed and directed.

Lack of competent law enforcement officers: There is a large amount of legislative information that needs to be learnt (see the list of legislation below) and it is understandable why only those law enforcement officers that work directly with conservation issues make an effort to master the legislation. Furthermore there are 9702 species of birds in the world (Sibley and Monroe 1990, Sibley and Monroe 1993) of which a large percentage can be found in the cage-bird industry. Custom officials at the various points of entry into and exit out of the country within the province do not receive training in the identification of species. There is, however an identification manual available for CITES species (Anon 1994), and recently one has been developed by TRAFFIC East/Southern Africa for the commonly traded South African indigenous birds (Patterson 2001b).

The following legislation is applicable to avifaunal conservation:

International Conventions
Convention on wetlands of international importance especially as waterfowl habitat (Ramsar Convention)
Convention on international trade in Endangered Species (CITES Convention)
Convention on Migratory Species (Bonn Convention)
Convention on Biodiversity

National Legislation
Environmental Conservation Act
Environmental Management Act
Water Act
Forest Act
Seals and Seabird Act
Sea Shore Act
South African White paper on Biodiversity Convention
Mountain Catchment Areas Act
Sea Fisheries Act
Resource Conservation Act
Performing Animals Act
Animal Protection Act
Animal Diseases Act

Provincial Legislation
Provincial Conservation Ordinance
Hunting regulations
Land Use Planning Ordinance
Avifaunal Conservation Policies
Local Authority and *Municipal legislation*
Relevant legislation within the Municipal bylaws and local authority regulations

Inefficient reserve network: The current formal reserve network does not adequately protect all avifaunal species. In many cases the formal reserve network, no matter how extensive, will not be able to support viable populations of certain species. These species are usually large birds that require large areas and coastal birds that are restricted to a narrow region along the coast of the province. Other methods are needed to conserve these species and one method that has been used successfully is to get private landowners interested in the conservation of the targeted species. This has worked well with the Blue Crane in the Overberg and the sentiment is expanding to the Swartland, where the numbers of this species are increasing. The Cape Vulture is another good example where cooperation between private landowners and conservationists has benefited a species. Other conservation initiatives like conservancies and biosphere reserves are finding favour within the province, as landowners become more conservation orientated. Over the last few years a large number of conservancies have been established as well as two biosphere reserves. Furthermore 26 Important Bird Areas (IBA's) have been identified in the Western Cape, some of which are existing national and provincial reserves, but others are privately owned areas (Barnes 1998).

Utilization of Avifauna Diversity

Throughout history birds have been used, either sustainably or unsustainably for consumption or ornamentation. Watson (1991) studying bird fossils at Swartkrans has determined that an association between hominids and birds in South Africa has existed from at least one million years ago. Today birds are still being used, legally or illegally, often in large numbers and with economic yields that make them important as a natural resource. Most illegal utilisation is restricted to the cage-bird industry and the utilisation of birds as a food source by impoverished communities. Legal utilisation is predominantly Ostrich farming, hunting, and the cage bird industry.

Ostrich farming: Five subspecies of Ostrich are recognised, of which one *Struthio camelus syriacus* of Saudi Arabia is now accepted as extinct (del Hoyo 1992). The other four subspecies occur in Africa. *S. c. australis*, the subspecies occurring in southern Africa only occurs naturally in certain nature reserves. Brown, Urban and Newman (1982) state that the only pure wild birds are found in Namibia and the northern parts of its original range. Outside the reserves the species is farmed intensively for its meat, leather and feathers. During the infancy of the Ostrich industry birds were brought in from Somalia (subspecies *S. c. molybdophanes*) to "improve" the genetic stock. It is not known whether genetic contamination

as a result of these introductions has been restricted to the Ostrich farming industry or if it occurs in the "wild" populations. Furthermore the movement of Ostriches in South Africa was undertaken on such a scale that the chances of finding genetically unique populations within the subspecies are remote. The Ostrich is now treated as a domesticated bird and permits are not required for transport or keeping in captivity, as is the case with other indigenous birds. Conservation officials only concern themselves with birds occurring within reserves, while the Department of Agriculture is responsible for the Ostrich farming industry. Ostriches are known to cause damage to natural vegetation through excessive trampling. This is a concern as Ostrich farming is expanding into other areas within the province - most notably near Bredasdorp and along the West Coast.

Hunting: Wing shooting, although adequate opportunities exist, is not as popular in the Western Cape as it is in other parts of the country. Birds that may be hunted are listed on the hunting proclamations, which are issued on an annual basis and stipulate hunting season and bag limits for each species.

Another method of hunting is falconry. The numbers of active falconers are, however, few and therefore this form of hunting has a minimal impact on the avifaunal populations in the province. The same regulations with regards to the hunting season and bag limits also apply to this hunting fraternity.

Cage bird trade: A thriving cage bird trade business exists within the Western Cape Province. Although a number of indigenous species may be found in captivity it is predominantly exotic species that are utilised. A possible reason for the preference for exotic birds is the stringent control measures with regards to keeping and trading with indigenous species. There are a number of cage bird associations within the province some of which cater for specific species or groups like the Western Province Show Budgie Association, Western Province Wild Bird Society and the Western Province Waterfowl Breeders Association while others like the Western Province Bird Breeders Association are more general. A concern that conservationists have is the affect of escaped birds on the local bird populations. Past and recent experience has shown that many of the established populations of exotic birds in the world originated from escaped cage birds. In the Western Cape the most well known example is the Mallard Duck. This species is a threat to indigenous waterfowl, especially closely related species like the Yellowbilled Duck.

Economic Incentives to Conserve Avifauna

Bird watching: The number of field guides available to birders today compared to a few decades ago when there were only one or two, gives an indication of how the interest in birds has grown over the last few decades. Turpie and Ryan (1999) carried out a survey to determine how much birdwatchers are worth in South Africa. From the survey they estimated that at least one in very 2300 South African are birders, which is a lot less than the United States (one in every 255 citizens). Respondents to the survey indicated that they spent on average 30 days per year birding of which about two thirds are overnight trips. A large percentage (83%) of this period is spent within South Africa. Due to the high diversity of birds and the large number of parks, the savanna biome was the most preferred destination. Roughly 35 –55% of a person's birding time was spent in protected areas and there was a clear message from the respondents that they would like to walk in these parks without being threatened by animals. Furthermore it is estimated that between 750 to 1500 international birders visit South Africa each year spending on average R12000 (excluding airfares to reach South Africa) per three-week trip. South Africa is classified as a good birding destination due to the high number of endemic birds, large total diversity and excellent field guides and birding information. Conservatively it is estimated that local birders spend about R70-130 million a year (liberal estimates can push this figure to about R300 million), while visiting birders may contribute another R10 – 25 million. A further R90 –200 million can be added to the latter total for non-birders visiting bird related attractions. In conclusion it is estimated that birding contributes about 0,03% of the Gross Domestic Product, which is about the same as the total income generated by the South African National Parks.

Hunting: According to individuals in the business (Dr P.J. Viljoen pers.com), wing shooting is currently experiencing an increasing trend. Unfortunately no surveys have been undertaken to support this statement. The increase in the membership of the National Wing Shooters Association between 1994 (50 members) and 2001 (1200 members) can, however be used to support this theory (Dr P.J. Viljoen pers.com). South Africans generally have an abhorrence to associations and the numbers of hunters will be far higher than the aforementioned figures. One of the reasons for the increase in the interest in the sport is the price of hunting mammalian game in the country, which has been increasing over the last few years. Using ammunition sales and an estimate of the number of shots/bird it was estimated that 500 000 birds were hunted countrywide in 1994 (Dr P.J. Viljoen pers.com). A potential therefore exists that this activity could have economic benefits. Another unknown factor is how much of a financial contribution the visiting hunter makes. This is difficult as the majority of the hunters visit the country primarily to hunt mammalian game, but will also do a bit of wing shooting on the side. Furthermore many provinces stipulate that there can only be two hunters per professional hunter and it is the opinion of those in the industry that to make wing shooting viable there should be at least four hunters per professional hunter. Should professional hunters accompany more than two hunters and the indications are that they do, they only indicate the prescribed number giving slightly skewed figutres.

Trends in Avifauna Conservation Ethic

Conservation: The first positive step to protect wildlife in South Africa was Act No 42 of 1899, which was known as the Protection of Birds Act. It enabled a local authority to petition the Governor to issue proclamations prohibiting the killing of birds within that authority's jurisdiction. The Act was amended in 1911 to include the protection of bird's eggs. Unfortunately only a few authorities applied for the implementation of this act. The protection of fauna and flora was delegated to the provinces with the Act of Union in 1911. Within the Cape Province various pieces of legislation were promulgated to protect certain species of rare birds, and later capture or collection of eggs was permissible under permit. The promulgation of the Wildlife Protection Ordinance in 1950 was a major turning point. The ordinance consolidated existing legislation and introduced a number of new protective measures, the most important being the listing of protected animals. In 1952 the Cape Department of Nature Conservation came into being. Thereafter regulations with regard to which species were allowed to be kept in captivity, who was allowed to keep indigenous wildlife, as well as the minimum cage sizes required, were promulgated. Furthermore the Department bought various parcels of land to carry out research on the breeding and management of wildlife. The first piece of land was obtained in 1952 on the

banks of the Eerste River near the Jonkershoek Fish Hatchery. Amongst other wildlife, this station was designed to house waterfowl in order to study their breeding and other habits. In 1956 the De Hoop farm was bought with the object of breeding antelope and gamebirds. The gamebird breeding never materialised and De Hoop later became a nature reserve rather than a research station. In 1960 the property Assegaaibosch was obtained opposite the Jonkershoek Fish hatchery. Large pens were erected in which waterfowl (e.g. Cape Teal and Cape Shoveller) were raised for study purposes and to be released back into the wild. In 1965 aviaries were constructed so that research on the breeding of rare birds could be done. Only two species were introduced to these aviaries, the Cape Parrot and the Knysna Lourie. Many waterfowl were reintroduced into the wild from these breeding programmes. In the 1960s Mute Swans were even introduced to Groenvlei, but they only survived because of the protection they received from predators/humans and the extra food that was provided. The numbers declined quite quickly once these protection measures stopped and only a single individual was recorded in the area in 1982 (Boshoff *et al.* 1991).

A number of properties were obtained specifically to protect birds. The most best known and one of the first bird sanctuaries in the country was Rondevlei, established in 1952 by the local authority of Cape Town. The province obtained Rocherpan Nature Reserve in 1968 to afford protection to waterfowl. In 1970 a bird sanctuary on the Seekoei River was established, which unfortunately was not successful due to developments at the estuary mouth, which disrupted the river ecosystem.

The trend in later years has moved from the captive breeding and release of birds and the procurement of land to protect avifauna species, to looking at other more holistic ways of protecting birds. The prioritising of species for conservation action was one of the first steps. Monitoring projects were established for those prioritised species that were at that stage not being monitored. Threats to the species are evaluated and where possible mitigation measures are implemented to reduce threats. Furthermore as a number of the prioritised species have been large species occurring predominantly on private property a number of awareness campaigns have been initiated to inform landowners of the plight of these birds. The inherent economic value of a particular species as an ecotourism asset is also sometimes used as an incentive to convince landowners to protect species. The newly opened Blue Crane route in the Caledon area is a good example of how a community can benefit from a single species.

Research: Literature from the early years indicates that research was confined to observations on the basic ecology of birds. This included amongst others, aspects such as preferred habitat, food, breeding biology, and distribution. Over the years technology has become more advanced enabling researchers to undertake more detailed studies. One of the major developments was the computer and later on the personal computer. Computers have enabled researchers to store large data sets, analyse data quickly and efficiently and carry out analysis that was not possible by hand. Other technological advancements included the development of radio transmitters and later on satellite transmitters. These are a tremendous help in recording movement patterns. Later development of these transmitters included reducing the size, enabling transmitters to be used on smaller birds and fitting them with solar panels resulting in a longer lifetime. Advancements in the field of genetics have allowed taxonomists to answer the many questions that have remained unanswered for many years. Currently there are several projects underway in this field to try aimed at resolving taxonomic issues within certain groups of birds. Research into avifauna was elevated substantially in 1959 when the Percy Fitzpatrick Institute of African Ornithology was established and again in 1991 when the Avian Demography Unit was established (both within the ambit of the University of Cape Town). Both institutions have been instrumental in setting the trends of avifaunal research not only within South Africa, but in Africa as a whole.

Conservation Research and Actions

There are numerous organizations, both national and international, involved in avifaunal research and actions within the Western Cape Province. Listed below are some of these organisations:

- W.C.N.C.B. (monitoring threatened taxa, inventories, policy and planning, law enforcement, problem control)
- Municipal conservation departments (monitoring threatened taxa, eradication of pest species)
- University of Cape Town - Avian Demography Unit (bird populations especially bird population dynamics)
- University of Cape Town - Percy Fitzpatrick Institute of African Ornithology (ecology and biology of birds)
- University of Cape Town – Zoology Department (feeding studies)
- University of Pretoria – Genetics Department (taxonomy)

Other institutes carrying out research include:

- University of Washington – Zoology Department and the Burke Museum of Natural History (taxonomy of warblers)
- Vogelwarte Radolfzell Research Institute of Max Planck – Germany and Belgische Natuur- en Vogelreservaten – BNVR – Birdlife Belgium (White Stork migration routes)
- Cornell University – Psychology and Neurobiology Department (relating neuroanatomy to learning in African warblers)
- Paris VI University – Laboratoire d' Geologie (carotenoids, sexual selection and oxidation stress in birds)
- University of the Western Cape (affects of human disturbance on birds)
- The Open University – Department of Biological Sciences (life history and reproductive behaviour of Bokmakieries)

Status of Avifaunal Knowledge

Ornithology in South Africa is perhaps more fortunate than other taxa in that it is a field of study that has an early history plus it is a field that has gained popularity amongst the general public. The number of bird clubs (± 34 bird clubs registered with Birdlife South Africa), some with a huge membership, (e.g. Cape Bird Club with ± 3000 members) within the country illustrates how popular ornithology has become. This huge force of dedicated observers has been used to gather information for a number of projects over the years. Using amateur ornithologists, although providing unique opportunities, does pose some problems. The biggest problem is that of data accuracy and various scrutiny systems such as the Rarities Committee have been implemented to corroborate

these observations. Different avenues are also available to the amateur to publish sightings, most notably the newsletters of the various bird clubs, and recently on the few bird list servers.

Species distribution data are available from the South African Bird Atlas Project coordinated by the Avian Demography Unit. This was a monumental task and was based on the observations of countless bird enthusiasts who sampled quarter degree squares over a five-year period. These data were used for most of the analysis for this chapter. The atlas survey should be repeated as birds are highly mobile and readily adapt to man altered environments and these changes need to be monitored. Species ranges are constantly changing in response to these changes and it is only through repeating a project such as this at regular intervals that a better understanding is obtained of these changes.

The current compilation of the seventh edition of Roberts' Birds of Southern Africa, has shown a number of gaps in the knowledge of the biology and ecology of certain species, some of which are very common. This needs to be followed up and these species targeted in national projects such as the Nest Record Card Scheme, which collects information on basic breeding biology of birds.

Continual evaluation on the current state of knowledge is required in order to determine future trends in the ornithological field. Congresses, symposia and workshops concerning these issues should be held on a more regular basis and not only at the beginning of a new century as seems to be the current practice.

Recommendations towards the Conservation of Avifauna

Bird mortalities related to anthropogenic causes occur on a regular basis. These include collisions with powerlines and fences, electrocutions and poisoning. Collisions with powerlines and electrocutions are currently receiving attention. Many of the mitigation measures have been developed, and several have even been implemented. The problem lies in the identification of the problem areas, and this can only be done with the help of the landowners and the general public who observe these incidents. The supply company only becomes aware of a problem when the collisions/electrocution cause a disruption in the power supply. Poisons are another major factor causing bird mortalities. As agriculture is practised over a large percentage of the province it inevitably means that there are a lot of herbicides and pesticides in use. In the majority of cases if the agrochemicals are used according to the instructions the effect on the avifauna will be reduced tremendously. The majority of the cases investigated so far have resulted from the misuse of agrochemicals. It is therefore imperative to promote the correct use of these chemicals. An alternative is to use biological control measures in getting rid of pests. Where these "biocontrol" methods are known they should be widely publicised.

Generally bird species that occur in sufficient numbers within the current reserve network are adequately protected. Certain birds, most notably the larger species, are the ones that require attention from conservation. Due to the large territory size required by many of these species, only a few pairs, if any, are protected by the current reserve network. Innovative ideas and methods are required to protect these birds that occur mostly on private agricultural land. The present Cape Vulture and Blue Crane initiatives are examples of such methods. Other initiatives include conservancies and biosphere reserves where conservation is carried out at a landscape level rather than individual species. There are also some of the smaller bird species that are currently not protected by the present reserve network. The Birds in Reserves Project (BIRP) is currently addressing this problem by identifying which species occur and/or breed within protected areas. Bird enthusiasts, conservationists and reserve managers should be encouraged to participate in this project.

There are a number of national projects that are currently in progress. The above mentioned BIRP project is but one of them. Others include the Nest Record Card Scheme (NERCS), the Coordinated Wetland Avifaunal Count (CWAC) and the Coordinated Avifaunal Roadcount (CAR). The more people participating in these projects the bigger the dataset becomes, thus producing more meaningful results.

There are ever increasing reports of human/bird interactions being received. This is possibly due to the increase in the human population together with the certain birds' ability to adapt to human altered environments. While in other parts of the world this aspect is receiving regular attention, unfortunately in South Africa very little work has been done. This makes recommendations difficult and often the complainant takes matters into his or her own hands, very often with dire consequences for the birds.

There are a large number of bird enthusiasts, conservationists and researchers within the province. Currently very little coordination exists between them and some medium of communication, possibly a forum, could enhance avifaunal conservation in the Western Cape.

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Appendix I. List of bird species recorded within the Western Cape Province during the South African Bird Atlas Project together with their respective Breeding and Migratory Status and their IUCN and CITES classification. The list includes those species that are provincially extinct as well as exotics species.

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Struthio camelus	Ostrich	B	R		
Spheniscus demersus	African Penguin	B	R	Vulnerable (A1acde+2bce)	II
Eudyptes chrysocome	Rockhopper Penguin			Near Threatened (A1acde)	
Podiceps cristatus	Great Crested Grebe	B	R		
Podiceps nigricollis	Blacknecked Grebe	B	R		
Tachybaptus ruficollis	Dabchick	B	R		
Diomedea exulans	Wandering Albatross			Vulnerable (A1ad+2b)	
Diomedea cauta	Shy Albatross	N	M	Vulnerable (A2d)	
Diomedea melanophris	Blackbrowed Albatross	N	M	Near Threatened (A1a+2d)	
Diomedea chlororhynchos	Yellownosed Albatross	N	M	Near Threatened (A2d)	
Phoebetria fusca	Darkmantled Sooty Albatross			Near Threatened (A2d)	
Macronectes giganteus	Southern Giant Petrel	N	M	Near Threatened (A1ad)	
Macronectes halli	Northern Giant Petrel	N	M	Near Threatened (A2de)	
Fulmarus glacialoides	Antartic Fulmar				
Thalassoica antarctica	Antartic Petrel				
Daption capense	Pintado Petrel	N	M		
Pterodroma macroptera	Greatwinged Petrel	N	M		
Pterodroma mollis	Softplumaged Petrel	N	M		
Pterodroma lessonii	Whiteheaded Petrel				
Pterodroma incerta	Atlantic Petrel				
Pterodroma brevirostris	Kerguelen Petrel				
Halobaena caerulea	Blue Petrel				
Pachyptila vittata	Broadbilled Prion	N	M		
Pachyptila belcheri	Slenderbilled Prion				
Procellaria aequinoctialis	Whitechinned Petrel	N	M	Near Threatened (A1cde+2cde)	
Calonectris diomedea	Cory's Shearwater	N	M		
Puffinus gravis	Great Shearwater	N	M		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Puffinus carneipes	Fleshfooted Shearwater				
Puffinus griseus	Sooty Shearwater	N	M		
Puffinus puffinus	Manx Shearwater	N	M		
Puffinus assimilis	Little Shearwater	N	M		
Hydrobates pelagicus	European Storm Petrel	N	M		
Oceanodroma leucorhoa	Leach's Storm Petrel	N	M		
Oceanites oceanicus	Wilson's Storm Petrel	N	M		
Phaethon rubricauda	Redtailed Tropic Bird				
Pelecanus onocrotalus	White Pelican	B	R	Near Threatened (A2c)	
Morus capensis	Cape Gannet	B	R	Vulnerable (A2c, B1+3bd, D2)	
Morus serrator	Australian Gannet				
Phalacrocorax carbo	White-breasted Cormorant	B	R		
Phalacrocorax capensis	Cape Cormorant	B	R	Near Threatened (A1a+2bc)	
Phalacrocorax neglectus	Bank Cormorant	B	R	Vulnerable (A1a+2b, C1)	
Phalacrocorax africanus	Reed Cormorant	B	R		
Phalacrocorax coronatus	Crowned Cormorant	B	R	Near Threatened (C1, D1)	
Anhinga melanogaster	Darter	B	R		
Ardea cinerea	Grey Heron	B	R		
Ardea melanocephala	Blackheaded Heron	B	R		
Ardea goliath	Goliath Heron				II
Ardea purpurea	Purple Heron	B	R		
Egretta alba	Great White Egret	B	R		
Egretta garzetta	Little Egret	B	R		III
Egretta intermedia	Yellowbilled Egret	B	M		
Bubulcus ibis	Cattle Egret	B	R		III
Ardeola ralloides	Squacco Heron				
Butorides striatus	Greenbacked Heron				
Nycticorax nycticorax	Blackcrowned Night Heron	B	R		
Gorsachius leuconotus	Whitebacked Night Heron			Vulnerable (A1a+2bc, C1)	

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Ixobrychus minutus	Little Bittern	B	R		
Ixobrychus sturmii	Dwarf Bittern				
Botaurus stellaris	Bittern			Critical Endangered (A1c+2bc)	
Scopus umbretta	Hamerkop	B	R		
Ciconia ciconia	White Stork	B	M		
Ciconia nigra	Black Stork	B	M	Near Threatened (A2c)	II
Ciconia abdimii	Abdim's Stork				
Leptoptilos crumeniferus	Marabou Stork			Near Threatened (A2e)	III
Mycteria ibis	Yellowbilled Stork				
Threskiornis aethiopicus	Sacred Ibis	B	R		III
Geronticus calvus	Bald Ibis			Vulnerable (A2c, C1+2b)	III
Plegadis falcinellus	Glossy Ibis	B	R		
Bostrychia hagedash	Hadeda	B	R		III
Platalea alba	African Spoonbill	B	R		
Phoenicopterus ruber	Greater Flamingo	N	R	Near Threatened (B3abcd)	II
Phoeniconaias minor	Lesser Flamingo	N	R	Near Threatened (A1a+2c)	II
Cygnus olor	Mute Swan	B	R		
Dendrocygna viduata	Whitefaced Duck				III
Dendrocygna bicolor	Fulvous Duck				III
Thalassornis leuconotus	Whitebacked Duck	B	R		
Alopochen aegyptiacus	Egyptian Goose	B	R		III
Tadorna cana	South African Shelduck	B	R		
Anas undulata	Yellowbilled Duck	B	R		
Anas sparsa	African Black Duck	B	R		
Anas capensis	Cape Teal	B	R		III
Anas hottentota	Hottentot Teal	B	R		
Anas erythrorhyncha	Redbilled Teal	B	R		
Anas smithii	Cape Shoveller	B	R		
Netta erythrophthalma	Southern Pochard	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Plectropterus gambensis	Spurwinged Goose	B	R		III
Oxyura maccoa	Maccoa Duck	B	R		
Sagittarius serpentarius	Secretary Bird	B	R	Near Threatened (A1c+2c)	II
Gypaetus barbatus	Bearded Vulture			Endangered (C2b)	II
Neophron percnopterus	Egyptian Vulture			Regionally Extinct	II
Gyps coprotheres	Cape Vulture	B	R	Vulnerable (A1acd+2bcd, C1+2b)	II
Torgos tracheliotos	Lappetfaced Vulture			Vulnerable (C1)	II
Milvus migrans parasitus	Yellowbilled Kite	B	M		II
Elanus caeruleus	Blackshouldered Kite	B	R		II
Aviceda cuculoides	Cuckoo Hawk				II
Pernis apivorus	Honey Buzzard				II
Aquila verreauxii	Black Eagle	B	R		II
Aquila rapax	Tawny Eagle			Vulnerable (A1a+2b, C1)	II
Aquila nipalensis	Steppe Eagle				II
Aquila wahlbergi	Wahlberg's Eagle				II
Hieraaetus pennatus	Booted Eagle	N	M		II
Lophaetus occipitalis	Longcrested Eagle				II
Polemaetus bellicosus	Martial Eagle	B	R	Vulnerable (A1a, C1)	II
Stephanoaetus coronatus	Crowned Eagle	B	R	Near Threatened (A1c+2cd)	II
Circaetus cinereus	Brown Snake Eagle				II
Circaetus pectoralis	Blackbreasted Snake Eagle				II
Gypohierax angolensis	Palmnut Vulture				II
Haliaeetus vocifer	African Fish Eagle	B	R		II
Buteo buteo	Steppe Buzzard	N	M		II
Buteo trizonatus	Forest Buzzard	B	R		II
Buteo rufofuscus	Jackal Buzzard	B	R		II
Accipiter rufiventris	Redbreasted Sparrowhawk	B	R		II
Accipiter minullus	Little Sparrowhawk	B	R		II
Accipiter melanoleucus	Black Sparrowhawk	B	R		II

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Accipiter tachiro	African Goshawk	B	R		II
Micronisus gabar	Gabar Goshawk	B	R		II
Melierax canorus	Pale Chanting Goshawk	B	R		II
Circus ranivorus	African Marsh Harrier	B	R	Vulnerable (A1c+2bc, C1)	II
Circus pygargus	Montagu's Harrier				II
Circus maurus	Black Harrier	B	R	Near Threatened (D1)	II
Polyboroides typus	Gymnogene	B	R		II
Pandion haliaetus	Osprey	B	M		II
Falco peregrinus	Peregrine Falcon	B	R	Near Threatened (C2a)	I
Falco biarmicus	Lanner Falcon	B	R	Near Threatened (A1c+2c)	II
Falco subbuteo	Hobby Falcon	N	M		II
Falco amurensis	Eastern Redfooted Kestrel				II
Falco tinnunculus	Rock Kestrel	B	R		II
Falco rupicoloides	Greater Kestrel	B	R		II
Falco naumanni	Lesser Kestrel	N	M	Vulnerable (A1ace)	II
Alectoris chukar	Chukar partridge	B	R		
Francolinus africanus	Greywing Francolin	B	R		
Francolinus levaillantii	Redwing Francolin	B	R		
Francolinus capensis	Cape Francolin	B	R		
Francolinus afer	Rednecked Francolin	B	R		
Coturnix coturnix	Common Quail	B	R		
Numida meleagris	Helmeted Guineafowl	B	R		
Turnix hottentotta	Blackrumped Buttonquail	B	R	Endangered (C2a)	
Grus carunculatus	Wattled Crane			Critical Endangered (A2c, C1+2a)	II
Anthropoides paradiseus	Blue Crane	B	R	Vulnerable (A1acde+2bc)	II
Balearica regulorum	Crowned Crane			Vulnerable (A1ac+2bc, C1)	II
Rallus caerulescens	African Rail	B	R		
Amaurornis flavirostris	Black Crake	B	R		
Porzana pusilla	Baillon's Crake	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Sarothrura rufa	Redchested Flufftail	B	R		
Sarothrura elegans	Buffspotted Flufftail	B	R		
Sarothrura affinis	Striped Flufftail	B	R	Vulnerable (A1c+2c, C1+2a)	
Porphyrio porphyrio	Purple Gallinule	B	R		
Porphyrula martinica	American Purple Gallinule				
Gallinula chloropus	Moorhen	B	R		
Fulica cristata	Redknobbed Coot	B	R		
Podica senegalensis	African Finfoot			Vulnerable (A2c, C1)	
Ardeotis kori	Kori Bustard	B	R	Vulnerable (C1)	II
Neotis denhami	Stanley's Bustard	B	R	Vulnerable (A1ac+2bc, C1)	II
Neotis ludwigii	Ludwig's Bustard	B	R	Vulnerable (A1a+2b)	II
Eupodotis caerulescens	Blue Korhaan			Near Threatened (A2c)	II
Eupodotis vigorsii	Karoo Korhaan	B	R		II
Eupodotis afra	Southern Black Korhaan	B	R	Vulnerable (A1c+2c, C1)	II
Actophilornis africanus	African Jacana	B	R		
Rostratula benghalensis	Painted Snipe	B	R	Near Threatened (A1c+2c)	
Haematopus ostralegus	European Oystercatcher				
Haematopus moquini	African Black Oystercatcher	B	R	Near Threatened (A1c+2c, C1)	
Charadrius hiaticula	Ringed Plover	N	M		
Charadrius marginatus	Whitefronted Plover	B	R		
Charadrius pallidus	Chestnutbanded Plover	B	R	Near Threatened (B1+3ab)	
Charadrius pecuarius	Kittlitzs's Plover	B	R		
Charadrius tricollaris	Threebanded Plover	B	R		
Charadrius mongolus	Mongolian Plover				
Charadrius leschenaultii	Sand Plover				
Charadrius asiaticus	Caspian Plover				
Pluvialis squatarola	Grey Plover	N	M		
Vanellus coronatus	Crowned Plover	B	R		
Vanellus melanopterus	Blackwinged Plover	B	R	Near Threatened (A2c)	

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Vanellus armatus	Blacksmith Plover	B	R		
Arenaria interpres	Turnstone	N	M		
Xenus cinereus	Terek Sandpiper	N	M		
Actitis hypoleucos	Common Sandpiper	N	M		
Tringa glareola	Wood Sandpiper	N	M		
Tringa totanus	Redshank				
Tringa stagnatilis	Marsh Sandpiper	N	M		
Tringa nebularia	Greenshank	N	M		
Calidris canutus	Knot	N	M		
Calidris ferruginea	Curlew Sandpiper	N	M		
Calidris minuta	Little Stint	N	M		
Calidris ruficollis	Rednecked Stint				
Calidris bairdii	Baird's Sandpiper				
Calidris melanotos	Pectoral Sandpiper				
Calidris alba	Sanderling	N	M		
Limicola falcinellus	Broadbilled Sandpiper				
Philomachus pugnax	Ruff	N	M		
Gallinago nigripennis	Ethiopian Snipe	N	R		
Limosa limosa	Blacktailed Godwit				
Limosa lapponica	Bartailed Godwit	N	M		
Numenius arquata	Curlew	N	M		
Numenius phaeopus	Whimbrel	N	M		
Phalaropus fulicaria	Grey Phalarope				
Phalaropus lobatus	Rednecked Phalarope				
Recurvirostra avosetta	Avocet	B	R		
Himantopus himantopus	Blackwinged Stilt	B	R		
Dromas ardeola	Crab Plover				
Burhinus capensis	Spotted Dikkop	B	R		
Burhinus vermiculatus	Water Dikkop	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Cursorius rufus	Burchell's Courser	N	R		
Cursorius temminckii	Temminck's Courser				
Smutsornis africanus	Doublebanded Courser	N	R		
Glareola pratincola	Redwinged Pratincole			Near Threatened (A1ac+2c)	
Glareola nordmanni	Blackwinged Pratincole			Near Threatened (B2e+3ab)	
Stercorarius parasiticus	Artic Skua	N	M		
Stercorarius longicaudus	Longtailed Skua				
Stercorarius pomarinus	Pomarine Skua				
Catharacta antarctica	Subantarctic Skua	N	M		
Larus dominicanus	Kelp Gull	B	R		
Larus fuscus	Lesser Blackbacked Gull				
Larus cirrocephalus	Greyheaded Gull	B	R		
Larus hartlaubii	Hartlaub's Gull	B	R		
Larus sabini	Sabine's Gull	N	M		
Hydroprogne caspia	Caspian Tern	B	R	Near Threatened (C1)	
Sterna bergii	Swift Tern	B	R		
*Sterna s*and*vicensis*	Sandwich Tern	N	M		
Sterna hirundo	Common Tern	N	M		
Sterna paradisaea	Arctic Tern	N	M		
Sterna vittata	Antarctic Tern	N	M		
Sterna dougallii	Roseate Tern			Endangered (B1+3d, C2a)	
Sterna balaenarum	Damara Tern	B	M	Endangered (A2c, C2a, D1)	
Sterna albifrons	Little Tern	N	M		
Chlidonias niger	Black Tern				
Chlidonias hybridus	Whiskered Tern	B	R		
Chlidonias leucopterus	Whitewinged Tern	N	M		
Pterocles namaqua	Namaqua Sandgrouse	B	R		
Columba livia	Feral Pigeon	B	R		
Columba guinea	Rock Pigeon	B	R		III

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Columba arquatrix	Rameron Pigeon	B	R		
Streptopelia semitorquata	Redeyed Dove	B	R		III
Streptopelia capicola	Cape Turtle Dove	B	R		
Streptopelia senegalensis	Laughing Dove	B	R		III
Oena capensis	Namaqua Dove	B	R		III
Turtur chalcospilos	Greenspotted Dove				
Turtur tympanistria	Tambourine Dove	B	R		III
Aplopelia larvata	Cinnamon Dove	B	R		
Poicephalus robustus	Cape Parrot			Endangered (A1a+2bc, B1+2c, C2a)	II
Tauraco corythaix	Knysna Lourie	B	R		II
Cuculus canorus	European Cuckoo				
Cuculus solitarius	Redchested Cuckoo	B	M		
Cuculus clamosus	Black Cuckoo	B	M		
*Clamator gl*and*arius*	Great Spotted Cuckoo				
Clamator jacobinus	Jacobin Cuckoo	B	M		
Chrysococcyx cupreus	Emerald Cuckoo	B	M		
Chrysococcyx klaas	Klaas's Cuckoo	B	M		
Chrysococcyx caprius	Diederik Cuckoo	B	M		
Centropus burchellii	Burchell's Coucal	B	R		
Tyto alba	Barn Owl	B	R		II
Tyto capensis	Grass Owl	B	R	Vulnerable (A2c, C1)	II
Strix woodfordii	Wood Owl	B	R		II
Asio capensis	Marsh Owl	B	R		II
Otus senegalensis	Scops Owl				II
Bubo capensis	Cape Eagle Owl	B	R		II
Bubo africanus	Spotted Eagle Owl	B	R		II
Bubo lacteus	Giant Eagle Owl				II
Caprimulgus europaeus	European Nightjar				
Caprimulgus pectoralis	Fierynecked Nightjar	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Caprimulgus rufigena	Rufouscheecked Nightjar	B	M		
Caprimulgus tristigma	Freckled Nightjar	B	R		
Apus apus	European Swift	N	M		
Apus barbatus	Black Swift	B	M		
Apus caffer	Whiterumped Swift	B	M		
Apus horus	Horus Swift	B	M		
Apus affinis	Little Swift	B	M		
Apus melba	Alpine Swift	B	M		
Colius striatus	Speckled Mousebird	B	R		
Colius colius	Whitebacked Mousebird	B	R		
Urocolius indicus	Redfaced Mousebird	B	R		
Apaloderma narina	Narina Trogon	B	R		
Ceryle rudis	Pied Kingfisher	B	R		
Megaceryle maxima	Giant Kingfisher	B	R		
Alcedo semitorquata	Halfcollared Kingfisher	B	R	Near Threatened (A1c+2c, B1+2bcde, C1)	
Alcedo cristata	Malachite Kingfisher	B	R		
Halcyon albiventris	Brownhooded Kingfisher	B	R		
Merops apiaster	European Bee-eater	B	M		
Merops persicus	Bluecheecked Bee-eater				
Merops bullockoides	Whitefronted Bee-eater				
Coracias garrulus	European Roller				
Coracias caudata	Lilacbreasted Roller				
Upupa epops	African Hoopoe	B	R		
Phoeniculus purpureus	Redbilled Woodhoopoe	B	R		
Rhinopomastus cyanomelas	Greater Scimitarbill				
Tockus alboterminatus	Crowned Hornbill				
Tricholaema leucomelas	Pied Barbet	B	R		
Pogoniulus pusillus	Redfronted Tinker Barbet				
Trachyphonus vaillantii	Crested Barbet				

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Indicator indicator	Greater Honeyguide	B	R		
Indicator variegatus	Scalythroated Honeyguide	B	R		
Indicator minor	Lesser Honeyguide	B	R		
Prodotiscus regulus	Sharpbilled Honeyguide				
Geocolaptes olivaceus	Ground Woodpecker	B	R		
Campethera notata	Knysna Woodpecker	B	R	Near Threatened (C1)	
Dendropicos fuscescens	Cardinal Woodpecker	B	R		
Mesopicos griseocephalus	Olive Woodpecker	B	R		
Mirafra apiata	Clapper Lark	B	R		
Mirafra sabota	Sabota Lark				
Mirafra curvirostris	Longbilled Lark	B	R		
Mirafra albescens	Karoo Lark	B	R		
Mirafra burra	Red Lark			Vulnerable (B1+2c, C2a)	
Chersomanes albofasciata	Spikeheeled Lark	B	R		
Calandrella cinerea	Redcapped Lark	B	R		
Spizocorys sclateri	Sclater's Lark			Near Threatened (C2a)	
Galerida magnirostris	Thickbilled Lark	B	R		
Eremopterix verticalis	Greybacked Finchlark	B	R		
Eremopterix australis	Blackeared Finchlark	B	R		
Hirundo rustica	European Swallow	N	M		
Hirundo albigularis	Whitethroated Swallow	B	M		
Hirundo dimidiata	Pearlbreasted Swallow	B	M		
Hirundo cucullata	Greater Striped Swallow	B	M		
Hirundo abyssinica	Lesser Striped Swallow	N	M		
Hirundo spilodera	South African Cliff Swallow				
Hirundo fuligula	Rock Martin	B	R		
Delichon urbica	House Martin	N	M		
Riparia riparia	Sand Martin	N	M		
Riparia paludicola	Brownthroated Martin	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Riparia cincta	Banded Martin	B	M		
Psalidoprocne holomelas	Black Saw-wing Swallow	B	M		
Campephaga flava	Black Cuckooshrike	B	R		
Coracina caesia	Grey Cuckooshrike	B	R		
Dicrurus adsimilis	Forktailed Drongo	B	R		
Oriolus oriolus	European Golden Oriole	N	M		
Oriolus larvatus	Blackheaded Oriole	B	R		
Corvus capensis	Black Crow	B	R		
Corvus albus	Pied Crow	B	R		
Corvus splendens	House Crow	B	R		
Corvus albicollis	Whitenecked Raven	B	R		
Parus afer	Southern Grey Tit	B	R		
Anthoscopus minutus	Cape Penduline Tit	B	R		
Pycnonotus capensis	Cape Bulbul	B	R		
Pycnonotus nigricans	Redeyed Bulbul	B	R		
Phyllastrephus terrestris	Terrestrial Bulbul	B	R		
And*ropadus importunus*	Sombre Bulbul	B	R		
Turdus olivaceus	Olive Thrush	B	R		
Monticola rupestris	Cape Rock Thrush	B	R		
Monticola explorator	Sentinel Rock Thrush	B	R		
Monticola brevipes	Short-toed Rock Thrush				
Oenanthe monticola	Mountain Chat	B	R		
Oenanthe pileata	Capped Wheatear	B	R		
Cercomela familiaris	Familiar Chat	B	R		
Cercomela tractrac	Tractrac Chat	B	R		
Cercomela sinuata	Sicklewinged Chat	B	R		
Cercomela schlegelii	Karoo Chat	B	R		
Thamnolaea cinnamomeiventris	Mocking Chat				
Myrmecocichla formicivora	Anteating Chat	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Saxicola torquata	Stonechat	B	R		
Cossypha dichroa	Chorister Robin	B	R		
Cossypha caffra	Cape Robin	B	R		
Pogonocichla stellata	Starred Robin	B	R		
Chaetops frenatus	Cape Rockjumper	B	R		
Erythropygia coryphaeus	Karoo Robin	B	R		
Parisoma subcaeruleum	Titbabbler	B	R		
Parisoma layardi	Layard's Titbabbler	B	R		
Hippolais icterina	Icterine Warbler				
Acrocephalus baeticatus	African Marsh Warbler	B	M		
Acrocephalus schoenobaenus	European Sedge Warbler				
Acrocephalus gracilirostris	Cape Reed Warbler	B	R		
Bradypterus baboecala	African Sedge Warbler	B	R		
Bradypterus sylvaticus	Knysna Warbler	B	R	Vulnerable (B1+2abcd, C2a)	
Bradypterus victorini	Victorin's Warbler	B	R		
Phylloscopus trochilus	Willow Warbler	N	M		
Seicercus ruficapillus	Yellowthroated Warbler	B	R		
Apalis thoracica	Barthroated Apalis	B	R		
Sylvietta rufescens	Longbilled Crombec	B	R		
Eremomela icteropygialis	Yellowbellied Eremomela	B	R		
Eremomela gregalis	Karoo Eremomela	B	R		
Camaroptera brachyura	Bleating Warbler	B	R		
Euryptila subcinnamomea	Cinnamonbreasted Warbler	B	R		
Sphenoeacus afer	Grassbird	B	R		
Cisticola juncidis	Fantailed Cisticola	B	R		
Cisticola aridula	Desert Cisticola				
Cisticola textrix	Cloud Cisticola	B	R		
Cisticola subruficapilla	Greybacked Cisticola	B	R		
Cisticola lais	Wailing Cisticola				

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Cisticola tinniens	Levaillant's Cisticola	B	R		
Cisticola aberrans	Lazy Cisticola				
Cisticola fulvicapilla	Neddicky	B	R		
Prinia hypoxantha	Spotted Prinia	B	R		
Phragmacia substriata	Namaqua Warbler	B	R		
Malcorus pectoralis	Rufouseared Warbler	B	R		
Muscicapa striata	Spotted Flycatcher	N	M		
Muscicapa adusta	Dusky Flycatcher	B	R		
Melaenornis infuscatus	Chat Flycatcher	B	R		
Sigelus silens	Fiscal Flycatcher	B	R		
Batis capensis	Cape Batis	B	R		
Batis pririt	Pririt batis	B	R		
Stenostira scita	Fairy Flycatcher	B	R		
Trochocercus cyanomelas	Bluemantled Flycatcher	B	R		
Terpsiphone viridis	Paradise Flycatcher	B	M		
Motacilla aguimp	African Pied Wagtail	B	R		
Motacilla capensis	Cape Wagtail	B	R		
Motacilla flava	Yellow Wagtail				
Motacilla cinerea	Grey Wagtail				
Anthus cinnamomeus	Grassveld Pipit	B	R		
Anthus similis	Longbilled Pipit	B	R		
Anthus leucophrys	Plainbacked Pipit	B	R		
Anthus vaalensis	Buffy Pipit				
Anthus crenatus	Rock Pipit	B	R		
Macronyx capensis	Orangethroated Longclaw	B	R		
Lanius minor	Lesser Grey Shrike				
Lanius collaris	Fiscal Shrike	B	R		
Lanius collurio	Redbacked Shrike				
Laniarius ferrugineus	Southern Boubou	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Dryoscopus cubla	Puffback	B	R		
Tchagra tchagra	SouthernTchagra	B	R		
Telophorus zeylonus	Bokmakierie	B	R		
Telophorus olivaceus	Olive Bush Shrike	B	R		
Sturnus vulgaris	European Starling	B	R		
Acridotheres tristis	Indian Myna	B	R		
Spreo bicolor	Pied Starling	B	R		
Creatophora cinerea	Wattled Starling	B	R		
Lamprotornis nitens	Cape Glossy Starling	B	R		
Lamprotornis corruscus	Blackbellied Glossy Starling	B	R		
Onychognathus morio	Redwinged Starling	B	R		
Onychognathus nabouroup	Palewinged Starling	B	R		
Promerops cafer	Cape Sugarbird	B	R		
Nectarinia famosa	Malachite Sunbird	B	R		
Nectarinia violacea	Orangebreasted Sunbird	B	R		
Nectarinia chalybea	Lesser Doublecollared Sunbird	B	R		
Nectarinia afra	Greater Doublecollared Sunbird	B	R		
Nectarinia fusca	Dusky Sunbird	B	R		
Nectarinia amethystina	Black Sunbird	B	R		
Zosterops pallidus	Cape White-eye	B	R		
Plocepasser mahali	Whitebrowed Sparrow-Weaver				
Passer domesticus	House Sparrow	B	R		
Passer melanurus	Cape Sparrow	B	R		
Passer diffusus	Greyheaded Sparrow	B	R		III
Petronia superciliaris	Yellowthroated Sparrow				
Sporopipes squamifrons	Scalyfeathered Finch	B	R		
Amblyospiza albifrons	Thickbilled Weaver				III
Ploceus capensis	Cape Weaver	B	R		
Ploceus velatus	Masked Weaver	B	R		

Appendix I. (*Continued)*

ScientificName	English Name	Breeding Status	Migratory Status	IUCN Categories	CITES
Quelea quelea	Redbilled Quelea				
Euplectes orix	Red Bishop	B	R		III
Euplectes afer	Golden Bishop				III
Euplectes capensis	Yellowrumped Widow	B	R		
Lagonosticta rubricata	Bluebilled Firefich				III
Lagonosticta senegala	Redbilled Firefich				III
Estrilda astrild	Common Waxbill	B	R		III
Estrilda melanotis	Swee Waxbill	B	R		
Ortygospiza atricollis	Quail Finch	B	R		III
Amadina erythrocephala	Redheaded Finch				
Vidua macroura	Pintailed Whydah	B	R		III
Fringilla coelebs	Chaffinch	B	R		
Serinus mozambicus	Yelloweyed Canary				III
Serinus atrogularis	Blackthroated Canary	B	R		
Serinus canicollis	Cape Canary	B	R		
Serinus scotops	Forest Canary	B	R		
Pseudochloroptila totta	Cape Siskin	B	R		
Serinus alario	Blackheaded Canary	B	R		
Serinus sulphuratus	Bully Canary	B	R		
Serinus flaviventris	Yellow Canary	B	R		
Serinus albogularis	Whitethroated Canary	B	R		
Serinus leucopterus	Protea Canary	B	R		
Serinus gularis	Streakyheaded Canary	B	R		
Emberiza flaviventris	Goldenbreasted Bunting				
Emberiza capensis	Cape Bunting	B	R		
Emberiza tahapisi	Rock Bunting				
Emberiza impetuani	Larklike Bunting	B	R		
Anas platyrhynchos	Mallard Duck	B	R		
Pavo cristatus	Peafowl	B	R		

Executive summary

Four hundred and sixty two bird species were recorded in the Western Cape during the South African Bird Atlas Project period, which in the Western Cape Province, ran over two consecutive periods, 1982 – 1985 and 1987 - 1991. This includes exotic species, vagrants and species whose southern distribution ranges extend just within the province. Excluding these species and considering that 686 species were recorded for South Africa during the Atlas period, the province actively supports 50% of South Africa's bird life (344 species).

No true endemic bird species can be found within the province. Six species are however classified as near endemic species (up to 70% of the distribution range occurs within the province) placing the responsibility of their protection on the province.

The new Red Data book of the birds of South Africa, Lesotho and Swaziland list 53 threatened species occurring within the province. Furthermore since European settlement eight bird species are known to have become extinct in the province.

Of the six broad categories of threats to the survival of vertebrate species recognised by the IUCN's World Conservation Strategy, the degradation or destruction of habitat is the most important one affecting bird life within the province. This includes threats like oil spills, transforming the landscape for agricultural purposes and coastal development, over exploitation of forest products and alteration of river flows leading to loss of wetland habitat. The other IUCN categories of threat affecting the province's bird life are loss or contamination of food supply, impact of introduced species, overexploitation, incidental capture or destruction and persecution to protect crops and livestock.

Effectiveness of avifauna conservation is affected by, lack of resources (both human and financial), lack of uniform national guiding principles, policies and legislation, lack of implementation of international conservation legislation and conventions, outdated provincial legislation, poor communication between role players, lack of competent law enforcement officers and an insufficient reserve network.

The most well known case of utilisation of an indigenous bird species is that of the Ostrich. Ostrich Farming has developed into a major industry supplying, meat, feathers and leather to a wide range of consumers. While the industry has done a lot of good for the economy of the province it has had severe conservation implications. The only areas where true wild individuals of this particular race occurs are in the northern extremeties of its range. Furthermore ostriches form the Somali race were introduced into the industry to improve genetic strains. Other methods of utilisation include the cage bird industry and wing shooting, both of which are not on the same scale as ostrich farming.

Bird watching has increased tremendously over the last few decades. An average conservative estimate of expenditures by local birders is in the order of between R70 – 130 million a year, but could be as much as R300 million. Visiting birders to South Africa contribute a further R10-25 million a year and a further R90-200 million can be added to the latter total for non-birders visiting bird related attractions. It is estimated that birding contributes about 0,03% of the Gross Domestic Product. Although no detailed surveys have been carried out there are indications that wing shooting can also have an economic benefit, possibly not as large as bird watching, but substantial enough to be considered.

Conservation trends have changed over the years from the initial captive breeding and release *programmes* to the current *programmes* looking at alternative methods to protect bird species other than in protected areas. A number of species are not currently protected in the current reserve network and innovative ideas and measures are required to protect these species.

The field of ornithology is perhaps more fortunate than other taxa in that a large force of amateur ornithologists exists. These people have and are been utilised in a number of projects. Furthermore there are two institutes that concentrate primarily on avifaunal research with a number of other institutions doing avifaunal research on a slightly smaller scale. Unfortunately with so many various organisations and people involved in ornithology, coordination amongst the role players becomes difficult often to the detriment of avifauna conservation.

State of Biodiversity: Western Cape Province, South Africa Mammals

Peter H. Lloyd
Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

Introduction

The Western Cape Province (W.C.P.) of South Africa, one of nine provinces forming the country, is generally regarded in South African terms as being "poor" with respect to the number of its mammals when compared to the other eight provinces. This misconception has its origin in the fact that the Western Cape, essentially a winter rainfall region, lies adjacent to one of the richest spots in the world in terms of mammalian diversity, namely the summer rainfall region of the rest of South Africa. In fact only when compared with the rest of our own country can the Western Cape be regarded as having a "poor" mammofauna in terms of biodiversity. However, some of the other Western Cape vertebrate and many of the invertebrate groups do reflect higher levels of biodiversity, as do the plants; and almost all groups show higher levels of endemism. The misconception regarding mammalian diversity in the Western Cape is partially exacerbated by the relatively low biomass mainly due to the low nutrient status which is fairly characteristic of the fynbos biome.

The historic distribution of the larger mammals within the W.C.P. is probably better documented than that of any other faunal group in South Africa (see Skead, 1980; Skead, 1987; and Rookmaker, 1989) and the role that mammals played in the development of nature conservation in the W.C.P. is well summarized by Hey (1977).

Methods

The relevant literature was consulted to assemble a list of those mammalian species and other taxa that have been recorded from within the present boundaries of the Western Cape Province, which are also known to live under relatively natural conditions, and to exclude those species/taxa which are only known to survive under purely captive conditions such as those prevailing in zoological gardens and similar institutions or those maintained as pets or for purposes of the pet trade.

Two of the most important references used were "Classification of Southern African Mammals" (Meester, Rautenbach, Dippenaar and Baker, 1986) and "The Mammals of the Southern African Subregion (New Edition)" (Skinner and Smithers, 1990). The taxa listed in these two references (with minor modifications to accommodate the latest available information, particularly in the minor instances where these two references differed) were entered into the biodiversity database, incorporating all the known species and subspecies indicated. In the case of the latter it was Meester, *et al.* (1986) which was most heavily relied upon. The result of this exercise was a list of all the mammals known to occur within the southern African subregion (a region defined loosely as that south of a line joining the Kunene and Zambesi Rivers), at currently recognized (warts and all!) subspecific level. For reference purposes typical subspecies (*i.e.* those subspecies whose trinomial is the same as the specific epithet; in other words where the species and subspecies names are the same) were included even if that typical subspecies did not occur within the subregion. For the purposes of this paper, with minor exceptions, only species are discussed.

The next step was to identify from W.C.N.C.B. records, museum records and literature records of the current and historic (recorded recent history) distribution of mammals, those taxa known to occur or to have recently occurred in what is now politically defined as the Western Cape Province. The precision of locality-recording encompasses the full spectrum, from very coarse, to point localities determined to the nearest second in terms of longitude and latitude.

The following step was to identify those taxa that were known to be restricted to this geographic region and those nearly restricted to it, in other words those taxa endemic or nearly endemic to the W.C.P. Because of the relatively unique character of the W.C.P. which encompasses the majority of the Cape Floristic Kingdom (C.F.K.), similar statistics for this region were also identified.

The subsequent step was to identify those mammalian taxa (both from our own records and the published literature) which are considered to be at some level of risk in terms of continued survival, which has culminated in the publication of local and international lists of threatened mammalian taxa (*e.g.* various IUCN Red Lists and various South African Red Data Books), and other categories for purposes of protection, as has also been undertaken for other vertebrate and invertebrate groupings. These threats/risks are well summarized in a variety of publications (see particularly Skinner, Fairall and Bothma, 1977; and Smithers, 1986), as are many of the critical habitats. These are supplemented by W.C.N.C.B. records.

Mammalogical Statistics

Of the approximately (due to taxonomic vagaries and continuing developments in molecular genetic techniques) 340 naturally-occurring species of mammal known from the southern African subregion, ±280 species are recorded for South Africa (*i.e.* 82% of mammals occurring in the Southern African Subregion are also to be found in South Africa) (Meester *et al.*, 1986). For the W.C.P., the number

of naturally-occurring mammalian species recorded is considerably lower at 160 (*i.e.* only 57% of the species occurring in South Africa, also occur in the W.C.P.), hence the commonly heard statement that this province is impoverished with respect to mammals.

To place the mammalian riches of the Western Cape into proper perspective and context it is, therefore, instructive to compare the province to the whole of Western Europe, which is roughly an order of magnitude larger. Both Western Europe and the Western Cape, despite the difference in area, can claim to have been home to ±160 species of mammal in recent history. These range in size from tiny shrews to the largest of whales in both regions. However, whereas species of only nine of the 18 or 19 living mammalian Orders (depending on which references are used; *e.g.* Miller and Levine (1991) recognizing 18 and Orr (1966) recognizing 19) can be encountered in Western Europe (Chinery, 1993), the Western Cape alone has species from 13 or 14 of the 18 or 19 mammalian Orders (again depending on which references are used) still surviving, and this in an area one tenth the size.

Although a small number (probably only 11) of the species in the Western Cape became locally extinct, a large proportion of these locally extinct species have now been re-established. Only one or two species, depending on which references are used, in the Western Cape have become completely extinct. These are the blue antelope, *Hippotragus leucophaeus*, and the quagga, *Equus quagga*; the latter, however, is considered by most modern taxonomists as the southernmost subspecies of the plains zebra, *Equus burchelli*. Similarly the so-called "Cape lion" is simply considered to represent the southernmost ecotype of the lion, *Panthera leo*.

To these 160 species in the Western Cape, can probably be added a further 15 or more species which are not native to the Western Cape (including species both alien to the RSA; and indigenous to the RSA, but not indigenous to the W.C.P.) but which, unfortunately, can be regarded as having become established, to a lesser or greater extent, in the wild. For Western Europe this figure is 23 or more such species. In the W.C.P. this number could potentially increase due to pressure from the game industry to be allowed to bring into the W.C.P. even more species which never occurred here naturally.

Although not in quite the same proportion as the rest of South Africa, the Western Cape also has mammals which are endemic to its boundaries. Six mammal species (<4%) are known to be endemic to both the C.F.K. and the W.C.P. (see Table 1), but many more subspecies are also unique to these regions. A further two mammalian species are known to be endemic to the C.F.K., and near-endemic to the W.C.P. (*Chlorotalpa duthiae* and *Myomyscus verreauxi*), and a further four species are also known to be near-endemic to the province (*Aethomys granti*, *Chrysochloris asiatica*, *Myotis lesueuri*, and *Raphicerus melanotis*). A further 13 species endemic to the country as a whole also occur within the province, meaning that 25 of the species endemic to South Africa are (or were) also Western Cape species (as mentioned earlier at least one of these species is now completely extinct). Of those mammals that became extinct within the boundaries of the province, but which survived elsewhere, only six have yet to be re-established within the province in a truly wild state on formally conserved State land. These are represented by the lion (*Panthera leo)*, the spotted hyaena (*Crocuta crocuta*), African wild dog (*Lycaon pictus*), the black rhinoceros (*Diceros bicornis)*, the hippopotamus (*Hippopotamus amphibius*), and the Cape or African buffalo (*Syncerus caffer*). All of these species are under consideration for reintroduction to suitable areas provided funding for appropriate boundary fencing, or in some cases reserve expansion, can be obtained, for those species where this is necessary. Two of these species are widely expected to have occurred within the province but few or no material records currently appear to exist; these are the African wild dog and the spotted hyaena. Evidence to corroborate their existence or previous occurrence within the province is regarded as a natural history research priority. Similarly, whether or not the riverine rabbit still exists (or ever did) within the boundaries of the Western Cape Province, is part of the subject of a current research project. At present it is generally regarded as part of the Western Cape fauna, as are the two former. Species existing on conserved Western Cape areas in what are

Table 1. Mammalian species which are endemic or near-endemic to the W.C.P.

Species	W.C.P. endemic	C.F.K. endemic	W.C.P. near-endemic
Acomys subspinosus	√	√	
Bathyergus suillus	√	√	
Cryptochloris zyli	√	√	
Hippotragus leucophaeus	√	√	
Myosorex longicaudatus	√	√	
Tatera afra	√	√	
Chlorotalpa duthiae		√	√
Myomyscus verreauxi		√	√
Aethomys granti			√
Chrysochloris asiatica			√
Myotis lesueuri			√
Raphicerus melanotis			√

currently considered to be non-viable numbers include the cheetah, the brown hyaena, and the African elephant.

Two antelope species which became extinct throughout the province but survived elsewhere, have been successfully re-established, namely the eland and the red hartebeest. Several other species which died out in parts of the province have been successfully re-established in several areas from surviving populations elsewhere within the province; these include springbok, bontebok, and Cape mountain zebra. Several areas still exist where further re-establishment of these species can be considered.

Considerable success has been achieved in the conservation efforts aimed at protecting the mammals of the Western Cape, as is evidenced by the fact that several mammals have been accorded improved conservation status by being listed in lower categories of threat in more recent Red Data Books and Red Lists compared with earlier editions. However, many of these mammals, despite being well-represented in many provincial nature reserves and National Parks, are still considered to be under some form of threat (whether this be because their numbers are still below certain threshholds, or because their natural habitat outside conservation areas is extremely limited or degraded). As a result, if we examine those species that are unequivocally still known to occur; those species that are thought probably to occur (without material evidence as yet of their presence); those species that occurred historically and have not yet been reintroduced; and those species which probably occurred historically (but for which unequivocal evidence is currently lacking), we find ourselves looking at a wide range of categories of threat or protection.

The "1994 IUCN Red List" (published in 1993 (Groombridge, 1993)) lists thirty (30) Western Cape species as "Insufficiently Known (K)"; two (2) Western Cape species as "Indeterminate (I)" (implying that they are either rare, vulnerable or endangered but insufficient information exists as to which is the most appropriate); four (4) Western Cape species as "Rare (R)"; seven (7) Western Cape species as "Vulnerable (V)"; six (6) Western Cape species as "Endangered (E)"; and one (1) Western Cape species as "Extinct (EX)" (*i.e.* a total of 50 Western Cape mammalian species in the Red List).

The "South African Red Data Book – Terrestrial Mammals" (Smithers, 1986), by way of comparison, lists two (2) Western Cape species as "Out of Danger (OOD)"; fourteen (14) Western Cape species as "Indeterminate (I)"; eleven (11) Western Cape species as "Rare (R)"; five (5) Western Cape species as "Vulnerable (V)"; two (2) Western Cape species as "Edangered (E)"; and one (1) Western Cape species as "Extinct" (*i.e.* a total of 35 Western Cape mammalian species in the S.A. Red Data Book).

In terms of the "Convention on International Trade in Endangered Species of Fauna and Flora (CITES)", twelve (12) Western Cape species are listed in Appendix I and a further twelve (12) species in Appendix II.

In terms of published IUCN status reports using the recently proposed and revised IUCN threat categories at the time of preparing this report, the only one available to W.C.N.C.B. for mammals was that of East (1999) for antelope. In this report four (4) antelope species occurring naturally in the Western Cape are listed as "Lower Risk (least concern)"; and ten (10) antelope species as "Lower Risk (conservation dependent)". A single (1) antelope subspecies, namely *Damaliscus dorcas dorcas* (the bontebok), is listed as "Vulnerable".

In terms of the Nature Conservation Ordinance of the Western Cape Province (Ordinance No. 19 of 1974; and also still applicable to the Northern Cape Province and the Eastern Cape Province) two categories of special protection are offered to wild animals. Schedule 1 is a list of animals considered to be "Endangered Wild Animals" and Schedule 2 is a list of animals declared to be "Protected Wild Animals". Accounting only for listed species known to occur within the Western Cape Province (and excluding those known from the Northern and Eastern Cape and not known from the Western Cape) 71 species of mammal are considered to be "Protected Wild Animals" in the Western Cape and a further three species are considered to be "Endangered Wild Animals", namely *Acinonyx jubatus* (the cheetah), *Diceros bicornis* (the black rhinoceros), and *Bunolagus monticularis* (the riverine rabbit) plus one subspecies, namely *Equus zebra zebra* (the Cape mountain zebra). This ordinance has recently been amended for the Western Cape Province and is now known as "The Western Cape Nature Conservation Laws Amendment Act, 2000" (Provincial Gazette Extraordinary, 5426 of 17 February 2000).

For the purposes of this document the details for subspecific categories will not be included although they will be available from the database (but not at the same level of accuracy as for species, particularly because of the dynamic nature of taxonomy at this level). However, two exceptions, the bontebok (*Damaliscus dorcas dorcas*) and the Cape mountain zebra (*Equus zebra zebra*), based on the fact that the subspecies in question differ morphologically from their related subspecies to the extent that they have different, colloquially derived, common names, and the fact that both these subspecies have considerable economic value, would seem to be sufficiently important for their inclusion in this report. The statistics for these two subspecies are provided in Table 2.

Table 2. The endemic and conservation status, and legal protection for the Cape mountain zebra and bontebok in the W.C.P.

Scientific Name	Common Name	Endemic to	IUCN	SARDB	CITES	Prop. IUCN	Ordinance
Equus zebra zebra	Cape mountain zebra	Former Cape Prov.	E	Vulnerable	AI	VU	S1
Damaliscus dorcas dorcas	Bontebok	Western Cape Prov.	R	Rare	AII	VU	S2

Data quality

The quality of the data in terms of taxonomic currency at the time of writing reflects the most recent interpretation, including recent genetic evaluations based on modern molecular biological techniques. In terms of the quality of the locality data, these records vary extensively, as previously alluded to, from relatively vague literature records referring to general districts, via discrete quarter degree squares ($1/16^{th}$ degree squares), down to point localities determined in various ways, including geographic positioning system technology.

In terms of the larger to medium-sized mammals, which for the most part are highly mobile, this does not represent much of a problem. However, with the smaller mammals, even in the case of the bats (Order Chiroptera), it is considerably more meaningful to have locality data of greater precision in order to understand their habitat requirements more accurately. For example several of the fossorial small mammals such as the golden moles, or chrysochlorids (Order Insectivora; family Chrysochloridae) and the rodent moles, or mole-rats, or bathyergids (Order Rodentia; family Bathyergidae) are likely to display preferences for specific soil-types; similarly detailed knowledge of different cave-systems could provide clues as to why certain caves are preferentially used by certain species of bats in contrast with other caves utilized by different species of bats.

Unfortunately, in terms of spatial analysis, the data are mostly available at the quarter degree square (QDS) level which is generally not fine enough to allow for ecological interpretation. Furthermore temporal analysis is hampered by crudely recorded dates and times, or the complete lack of temporal information. For those records where point localities (to the nearest second with respect to latitude and longitude) are available, the associated temporal data are usually reliable, but the current number of such records is far too small to allow for meaningful analysis. Precise data for such records therefore remain a priority.

Critical Habitats

If one were to look at a broad category of habitats that are critical for the survival of a large number of mammal species, the first that would come to mind is that of the marine environment. This is an over-simplification, however, since, despite the fact that almost 40 species of mammals (almost 25%) of the Western Cape Province are dependent (or occasionally so) on the coastal waters of the province, they actually represent a group of mammals utilizing, or dependent on, a wide variety of habitats, which in a world of greater exposure to terrestrial habitats tend to be regarded as a single uniform environment. The marine environment is probably as diverse as the terrestrial environment, but because of its lesser exposure to human society, this environment tends to be viewed as one so-called "habitat", whereas in fact it represents many environments. The most critical of these, however, is probably the inshore marine environment directly adjacent to the shore.

A closer examination, therefore, of critical habitats in the W.C.P. in terms of mammals, more or less suggests a tie between mammals associated with the renosterveld lowlands (and particularly the grazing available within them) and mammals associated with rivers (and particularly the associated riparian vegetation) and wetlands. Although both these habitats (lowland and water-associated) are utilized by a wide range of mammalian species, approximately 20 species are (or would be) effectively dependent to a lesser or greater extent on the continued availability of each of these habitats in the Western Cape for their continued survival (or the maintenance of these habitats, for those species which could be re-established).

In the case of the lowland renosterveld, at least five grazing ungulate species were previously dependent on this habitat for their survival within the W.C.P. or the C.F.K.; namely the (extinct) quagga (now considered to be the southernmost subspecies of the plains zebra); the African buffalo (in a small part of the southern lowland renosterveld); the extinct blue antelope; the bontebok (also only in the southern lowland renosterveld); and the red hartebeest which occurred throughout the C.F.K. (probably represented by what is now considered to be an extinct subspecies). The re-establishment, or continued survival of those ungulate taxa which are still extant within their natural habitat, within the C.F.K. depends to a great extent on the conservation of the remaining portions of this extremely threatened and fragmented habitat and to some extent on the success or failure of potential ecological restoration techniques. The presence of these five grazing ungulates in the C.F.K. was thus effectively only possible because of the presence of grass within the lowland renosterveld, which, prior to being ploughed for cultivation, must have come closest to resembling a grassland/savannah habitat within the greater shrub-dominated C.F.K., thereby accommodating species more typical of grassland and savannah habitats elsewhere.

Another large mammal which previously also occupied the lowland renosterveld, amongst other habitats, in the C.F.K. and the W.C.P., was the black rhinoceros, but it could also survive in other habitats. However, this habitat was not only important for larger mammals. The sandier portions of the lowland renosterveld represent important habitats for W.C.P. and C.F.K. endemic species such as the Cape gerbil (*Tatera afra*); the Cape dune molerat (*Bathyergus suillus*); and Van Zyl's golden mole (*Cryptochloris zyli*).

The current state of fragmentation of these remaining lowland habitats and their potential importance in conserving several "charismatic" mammalian species, should, therefore, be seen as a major factor in support of a variety of proposed ecological restoration programmes.

In the case of the riverine habitats and wetlands, there are also at least four species wholly dependent on the good health of these environments in the W.C.P. (and the C.F.K.). The wholly dependent species are the Cape clawless otter (*Aonyx capensis*); the water mongoose (*Atilax paludinosus*); the water rat (*Dasymus incomtus*); and the hippopotamus (*Hippopotamus amphibius*). A fifth species, the riverine rabbit (*Bunolagus monticularis*) is dependent on the alluvial floodplains of a restricted number of non-perennial rivers in the western Karoo for its survival. However, the role of riverine and wetland habitats in extending the range of certain species,

particularly typically forest-adapted species; in acting as corridors between different areas of their preferred or more sustainable habitats; or simply in making the environment considerably more attractive for some species (without knowing the degree of dependency); cannot be underestimated. In the latter case species such as the large-spotted genet (*Genetta tigrina*); the large grey (or Egyptian) mongoose (*Herpestes ichneumon*); the serval (*Felis serval*); the reddish-grey musk shrew (*Crocidura cyanea*); the greater musk shrew (*Crocidura flavescens*); Brant's climbing mouse (*Dendromus mesomelas*); the vlei rat (*Otomys irroratus*); Verreaux's mouse (*Myomyscus verreauxi*); woodland dormouse (*Graphiurus murinus*); and Cape molerat or "blesmol" (*Georychus capensis*) are probably implicated. Species which utilise rivers as extensions of their more typical forest or woodland/savannah habitats, or as corridors between areas of preferred habitat (or both), historically included species such as black rhinoceros (*Diceros bicornis*); elephant (*Loxodonta africana*); African buffalo (*Syncerus caffer*); but still also include animals such as vervet monkey (*Cercopithecus aethiops*); kudu (*Tragelaphus strepsiceros*); leopard (*Panthera pardus*); the lesser woolly bat (*Kerivoula lanosa*) (which may be restricted to riverine habitats); Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*), which uses riverine forest vegetation as an extension of its true forest habitat; and probably the Namib long-eared bat (*Laephotis namibensis*). Many other species probably also benefit from these aquatic habitats and links.

Another critical habitat for a fairly specialized group of mammals, and for many other vertebrates too, but particularly for a wide range of invertebrates, particularly for some of the rarer species in the W.C.P., is the speleological (or cave) environment. In terms of mammals the most important inhabitants of caves (and frequently man-made equivalent excavations) are obviously bats (the Order Chiroptera). Not all insectivorous bats are obligate cave-dwellers, although of the 16 insectivorous and three frugivorous bats recorded from the W.C.P., all but four are known to utilize caves at least some of the time. Of the four bat species known not to utilize caves, two are fruit bats. Of the 14 insectivorous species of bats utilizing caves, six to the best of our knowledge are obligate cave-dwellers. Only one species of fruit bat, namely the Egyptian fruit bat (*Rousettus aegyptiacus*), is closely associated with caves, to the extent that it can effectively also be regarded as an obligate cave-dweller, at least at certain times of the year.

These critically important habitats are generally considered to be in a relatively healthy condition, except for certain caves in close proximity to the larger urban environments. In these disturbed/damaged/transformed caves past losses in the numbers of certain colonial species could have been considerable.

Another habitat under considerable threat, mostly due to residential and recreational development, is that which includes the coastal dunes and their associated sandy areas. By its very nature this environment, at least in patches, is particularly dynamic, even in some of the secondary and tertiary dune thickets. Because of this dynamic nature it is perhaps not surprising that it is not the richest habitat in terms of mammalian biodiversity, yet certain species appear to have become more or less adapted to it. One of the species in this category appears to be Grant's golden mole (*Eremitalpa granti*) on the western coast of the province, whereas another appears to be the Zulu golden mole (*Amblysomus iris*) on the sandy areas of the southern coast of the province. Other species which are frequent inhabitants of this habitat, and other sandy areas, are the Cape dune molerat (*Bathyergus suillus*); the Cape molerat (*Georychus capensis*); and the Cape golden mole (*Chrysochloris asiatica*). Another species which utilizes associated sandy areas, but not the dune areas necessarily, is the Cape gerbil (*Tatera afra*).

Species which utilize the dune vegetation, particularly in areas adjacent or close to coastal forest, are animals such as the blue duiker (*Philantomba monticola*), the bushbuck (*Tragelaphus scriptus*), and the bushpig (*Potamochoerus porcus*), even if these are not necessarily their most preferred habitats. Species which utilize this environment as corridors to areas of more preferred habitat are numerous, but include species such as the leopard (*Panthera pardus*).

Afromontane and coastal forest habitats are naturally fragmented in the W.C.P. but this fragmentation has been exacerbated by considerable utilization in the past. Although the W.C.P. forest environments do not exhibit high levels of mammalian biodiversity (in contrast with many forest habitats elsewhere in the country) there are a few mammalian species and subspecies which are nearly endemic to these forests. The blue duiker (*Philantomba monticola*) and the bushpig (*Potamochoerus porcus*) are species whose major strongholds are within the forests but both species are also found in adjacent thicket or coastal scrub environments. The effects of forest fragmentation on mammalian diversity should therefore be monitored and where possible consolidation should be considered.

Lowland fynbos, whilst also representing a habitat enormously reduced from its original extent, is again a habitat exhibiting low levels of mammalian biodiversity, probably attributable to the low nutrient levels in the soils and the highly unpalateable character of the leaves of most fynbos plants. The reintroduction of the bulk megaherbivores into such habitats could potentially increase their productivity due to nutrient recycling, particularly in terms of making nitrogen-associated nutrients more accessible, and also through their mere presence by producing pathways through otherwise potentially homogeneous stands of fynbos shrubs permitting the development of grass along these paths, which could also play a role in creating more of a vegetation mosaic with respect to age and species composition as a result of acting as minor firebreaks.

The marine environments, particularly inshore, are subject to enormous utilization pressures at present, particularly aimed at coastal fish species, rock lobster and abalone, but with several other species being targeted with lower intensities (including species such as the great white shark). The marine mammal component, however, currently appears to be facing fewer threats than ever before. However, if the pelagic fish stocks were to suffer a major decline, a large number of marine mammals could suffer considerable negative impacts.

The Karooid environments, many of which have been severely modified/transformed due to unsound agricultural practices, are fortunately extensive. As a result many mammal species have been able to persist in viable numbers and with the current interest in the game industry, many species, but most notably the springbok (*Antidorcas marsupialis*), now probably occur in much larger numbers than, say, 30 years ago. Apart from the Karooid river systems alluded to earlier, most mammals in the karoo are still relatively secure.

Because of its extent and protection from development, the least threatened habitat in the W.C.P. is montane fynbos. Despite exhibiting relatively low levels of mammalian biodiversity, for example in comparison with the Karoo, it nevertheless provides valuable sanctuary to a wide range of mammals. These include animals as diverse as rock dassies (*Procavia capensis*) and baboons (*Papio ursinus*), which could be regarded as keystone species, and "top" carnivores such as leopards (*Panthera pardus*), brown hyenas (*Hyaena brunnea*), honey badgers (*Mellivora capensis*).

Threats to Mammalian Biodiversity

Undoubtedly the greatest threat to mammalian biodiversity and indeed biodiversity in general is the continuing loss or irreversible transformation of natural habitat due to agricultural and industrial development, mining, urbanization, and the spread of alien biota. This loss of natural habitat, and the associated fragmentation of what is left, is exacerbated in the case of those specialist mammals with very specific habitat preferences such as the riverine rabbit (Karooid riverine systems), and bontebok (grasslands within the renosterveld). The associated losses in the availability of food, cover, and shelter, combined with the problems caused by declining numbers is thus a real problem for several species, particularly for those which are naturally rare or those which now have restricted distributions as a result of anthropogenic forces.

Another more insidious threat, however, is that of a variety of threats to genetic integrity, particularly in the case of taxa involved in the game industry. Because of the economic value of these traditional "game species" several concessions have been made with respect to some of those species being conditionally permitted to be maintained on properties outside their natural ranges under what are effectively "wild" conditions (see "Policy on the importation and translocation of mammals into and within the Cape Province", Lloyd and Lensing (1990)). Apart from the more obvious genetic implications of hybridization between subspecies (*e.g.* between blesbok (*Damaliscus dorcas phillipsi*) and bontebok (*Damaliscus dorcas dorcas*)), relatively recent developments have indicated that so-called "good" species (as opposed to subspecies) are frequently so genetically similar that compatability between them is of such a nature that interspecific hybridization can lead to the production of fertile hybrids. Classical examples which have been well-documented are those of fertile interspecific hybrids between various species in the genus *Kobus* (which includes the waterbuck, lechwe, kob and puku (Gray, 1972)) and those of the genus *Connochaetes* (with several populations of fertile hybrids between black and blue wildebeest having been recorded recently, including in the scientific literature (Fabricius, van Hensbergen and Zucchini, 1989)).

Another potential threat to mammalian biodiversity is the threat of pathogenic impacts, due to the movement of taxa important to the game industry. The variety of diseases that could be introduced into new areas is potentially large and in the cases of viral, or similar, diseases, in particular, could in some cases have devastating effects, because of the difficulty in both detecting and treating them. This includes diseases which can be transmitted from both wild and domestic mammals (*e.g.* bovine tuberculosis).

A less likely threat, but nevertheless possible, is the ecological effect an introduced taxon could have on a locally resident taxon through competition and partial or complete displacement. This includes the introduction of wild species not indigenous to South Africa into new environments (*e.g.* the Himalayan tahr, *Hemitragus jemlahicus*, on Table Mountain), and the introduction of species indigenous to South Africa into South African and W.C.P. environments which are not part of their natural distribution range (*e.g.* impala, *Aepyceros melampus*, in the southern Cape). The threat is not limited to "alien" animals alone, but includes the threats posed by invasive "alien" vegetation.

The last three threats listed are all impacts caused by the introduction of inappropriate taxa alien to the area of introduction. This serves to illustrate the need for at least a national mammalian translocation policy and preferably one covering all biota. Other threats to mammals include issues such as illegal hunting leading to over-exploitation. Apart from traditional poaching, the bushmeat industry, which has rapidly expanded elsewhere in Africa, is now underway in South Africa as well. A further threat is the persecution of those taxa which opportunistically utilize crops and domestic livestock. Yet another threat is the reintroduction of species into areas which are not sufficiently large to support genetically viable numbers of the species in question.

Chemical and physical pollution of the environment is also an important threat to wildlife in the urbanized terrestrial areas and associated coastal developments. Apart from nuclear waste, the worst and most persistent pollutants are probably those derived from the petrochemical industry. Although not necessarily the most toxic of substances, the pollutants from this industry are transported throughout the planet; over the oceans and across continents. Some of the most insidious pollutants, however, many also derived from the petrochemical industry, are the agrochemicals used as herbicides, pesticides, growth stimulants, reproductive stimulants and inhibitors, *etc.*, which can result in either increased toxicity or increased nutrient status (eutrophication) within local and sometimes distant environments. Other pollutants which can have dire consequences for animals are the artificial sexual hormones used in human society, which mimic their natural equivalents, but often end up in wetland environments and become absorbed by wild animals with varying results. Marine pollution, generally viewed mostly in terms of marine birdlife, can be equally devastating to other forms of wildlife, including mammals

and with the importance of the oceanic trade routes around the tip of Africa, remains a major threat.

Current declining funding for nature conservation poses a further threat to mammalian conservation because of the associated reduction in manpower to advise on conservation problems and to enforce conservation legislation.

Effectiveness of Current Conservation

Although difficult to evaluate because of the limited distributional data, particularly for smaller mammals, and the complications caused by the artificial movement (or translocation) of certain taxa amongst the larger mammals because of the "game" industry, the efficacy of conservation efforts is most dramatically apparent in terms of the success, in numeric terms, of the conservation of many of the ungulates previously considered to be under considerable threat *e.g.* registered pure bontebok numbers now exceed 2 500, and Cape mountain zebras now exceed 1 000 in number.

However, the majority of the conservation areas are inadequate in terms of conserving viable numbers of some of the larger and medium-sized carnivores and more particularly the megaherbivores. Similarly, species with linear distributions along water-courses, particularly the riverine rabbit, are either not conserved at all in formal conservation areas, or are relatively poorly conserved. This also applies to several other mammal species associated with wetlands in general, and river systems in particular, such as otters. This means that for many taxa their conservation still depends to a great extent on the private landowner.

However, in terms of many of the smaller mammals, the fact that many of their larger relatives are adequately conserved numerically and in a sufficient variety of habitats (for those taxa which are not so specialized as to require only one sort of habitat), means that many of these smaller mammals' habitats, frequently consisting of a variety of microhabitats and "microecotones" are fortuitously also conserved. Only those highly specialized habitat specialists, such as the riverine rabbit, are generally, or often, excluded from such conservation measures. Habitat specialists, amongst the smaller mammals, therefore, such as the riverine rabbit, bats in general, especially the cave-dwelling insectivorous taxa, and other specialized taxa, are the targets on which small-mammal conservation efforts should be focused. Similarly, larger mammals with specialized requirements threatened by agriculture and other developments, also represent species to be targeted for further conservation action; *e.g.* hippopotamus.

In summary, the effectiveness of the formally conserved areas in conserving biodiversity is therefore quite considerable for certain taxa, and many of these taxa (particularly traditional game species) are also preserved by private landowners, albeit without many of the selective pressures which they should be exposed to, but there are several taxa for which current formal conserved areas provide little or no conservation value, and it is these taxa that should be the highest priority for conservation action, especially through land purchases; consolidation; expansion; joining and linking of existing conservation areas; and whatever other means that are available. The Cape Action for People and the Environment (C.A.P.E.) will hopefully address some of these issues and is discussed more fully in the section dealing with recommendations.

Apart from the physical conservation effort in the form of protecting appropriate habitat, there are also the legislative and administrative aspects of wildlife conservation. The legislative aspect starts with international conventions to which South Africa is a signatory, some of which have already been incorporated into South African Law. This is followed by national legislation, with a variety of Acts having an impact and effect on mammalian and other wildlife. Each of the nine provinces, presently with concurrent responsibility for nature conservation, has its own (or shared) provincial legislation dealing with issues within its boundaries. Finally local authorities frequently also have bye-laws and regulations. In some instances there are legislative differences between the provinces, and between the provinces and local authorities, which hamper informed decision-making and illustrate the need for more uniformity among the provinces.

Although much of the necessary legislation is in place, some of it is outdated. Furthermore, as alluded to above, there are cases where international conventions have been signed but not yet been ratified because they have not yet been incorporated into national legislation. Similarly certain proposed national legislation has still not been finalized, and this is also partially true of some of the provinces where new ordinances or provincial acts have been proposed but with little progress. Slow progress is being made but this inertia is currently symptomatic of conservation throughout the country which in general suffers from a lack of financial and human resources. This is particularly noticeable with respect to the shortcomings concerning structured monitoring programmes.

Utilization of Mammalian Diversity

The utilization of terrestrial mammals persists as probably the major economically important form of vertebrate utilization with both domestic and wild animals. Whilst in the case of the latter this is also a valid and justifiable economic pursuit, it is not without its environmental risks. Many concessions have been made to the game industry from the conservation authorities' points of view, in order to accommodate this highly-profitable economic activity. These concessions include the right to maintain certain species outside their natural distribution ranges (this includes certain non-indigenous ("alien") taxa (*e.g.* fallow deer, *Cervus dama* and Indian blackbuck, *Antilope cervicapra*) and certain taxa indigenous to the RSA, but outside their natural range) provided that certain minimal conditions are met. Utilization, however, does pose a real and potential threat to biodiversity when this activity or economic pursuit involves the large-scale uncontrolled movement of organisms, and these threats include ecological damage caused by an escaped "alien" organism which has the potential to flourish in its new environment; they include the introduction of pathogens occurring naturally in the animal introduced to the new area, but which are pathogens not previously present in the new environment or on its biota; they include potential

hybridization problems in the cases of a close genetic relationship where a taxon from elsewhere is introduced into an area to which its close relation is endemic, with resultant hybridization producing organisms less well-adapted to either environment; and they include the removal of naturally selective pressures which could have negative effects on their continued evolution.

The game industry effectively has four facets; namely the production of meat; the breeding of rare taxa for profit; the provision of hunting opportunities; and the provision of opportunities for ecotourists to observe wildlife, particularly the larger and rarer species. Each of these facets, unless carefully managed, can result in compromising the ecological, pathogenic and genetic health of other taxa. Associated with the hunting industry are a number of ancillary industries such as the trophy registration industry, the taxidermy industry, parts of the fire-arm industry and the meat/venison industry.

There is, however, another form of mammalian wildlife utilization and that is the requirement by the medical profession for animals on which to undertake humane experimentation. This industry is mostly but not entirely restricted to the utilization of primates, mostly in the form of baboons and vervet monkeys. Harvesting of animals in the wild, however, is now restricted to those animals which can be shown to have caused agricultural damage, and is controlled by a permit system.

In both the above cases (*i.e.* the game industry and the needs of the medical profession) the owner of the property on which these animals occur (game or problem animals) benefits financially, to a greater or lesser extent, through this utilization. Furthermore, in both cases the utilization is maintained at sustainable levels; in the game industry standard animal husbandry practices are largely followed (*i.e.* "living off the interest and preserving the capital") and the small demand by the medical profession also ensures sustainability in the latter case.

There is also a small demand for certain species from the wild by zoological gardens either for research or display, and this is catered for by recognized (soon to be registered) animal dealers. Similarly there is also a small demand for certain wild mammals for research purposes, usually aimed at providing biological information which will be useful for further conservation purposes.

Another form of the utilization of wild animals forms part of the pet trade, whereby certain species representing wild animals which have been bred in captivity are regarded as "recognized pet species" and are exempt from most legislation (*e.g.* squirrel monkeys, *Saimiri sciureus*). Utilization of indigenous species for this trade is discouraged.

Economic Incentives to Conserve Mammals

The economic incentives to conserve certain species of mammals are relatively simple; very high economic returns can be obtained through live sales and trophy-hunting (particularly of the rarer megaherbivores, the larger carnivores, and the rarer traditional game species) and through various ecotourism activities. The game industry, for a variety of reasons, places a particularly high monetary value on taxa which have a particular appeal to certain segments of human society. These include firstly the megaherbivores (*e.g.* >R500 000 for a black rhinoceros; >R100 000 for a buffalo), which because of their rapid numerical declines elsewhere on the continent generate a keen interest from conservation-conscious members of society, often far in excess of their apparent rarity (*e.g.* apart from an interest by specialist collectors, the many even rarer invertebrates attract relatively little interest, other than as dead specimens of a rare "commodity"), and also, to a lesser extent, from the hunting fraternity as potential hunting trophies. Some of the larger carnivores, unfortunately for them, in many areas of private land *only* have appeal as potential hunting trophies, but in the Western Cape there is a greater emphasis on their being used as drawcards for ecotourism. This is probably true throughout South Africa for the lion, for example, but less so for even the leopard, whereas sadly the hyenas and African wild dogs have relatively little general appeal, except for the wealthy tourists. The traditional game species, typically the rarer large antelopes, generate appeal both in terms of aesthetic qualities and hunting.

Generally speaking in terms of the so-called "game industry", therefore, sufficient financial incentives already exist, provided that the provisioners of these income-generating activities have sufficient capital to make the original investment in acquiring these taxa. This presents several problems since because of this limiting factor, many landowners wish to acquire the most sought-after or most readily available taxa, whether they occur naturally (or occurred historically) in the region in which their properties occur or not. This in turn, as mentioned above, raises several other problems in terms of potential ecological, pathogenic, and genetic threats to naturally occurring taxa. Even when these landowners do purchase the appropriate taxa, they often cannot purchase sufficient animals in terms of long-term genetic considerations.

It is our opinion that there are several opportunities to provide a variety of incentives to landowners to maintain appropriate taxa and land-use practices if certain guidelines are followed. It should be borne in mind that private landowners with pristine undeveloped land, *i.e.* land in a natural or unploughed state with little or no alien vegetation, represent a very important group of custodians of biodiversity and if they were to transform this land through ploughing it up or overutilizing it with livestock, biodiversity losses could be enormous, particularly in the W.C.P. lowlands. This fact should be factored into the revenue system by taking into account the value of such property in protecting elements of biodiversity, which are in effect and fact (in terms of the Convention on Biological Diversity) State assets, and implemented as some form of tax incentive.

To achieve such a system would require some sort of quantitative evaluation of land. To start with one could possibly use a points system on a sliding-scale of say 1-5 points for several criteria. For example one could allocate points for a first category based on the degree of infestation by invasive alien plants; a second category based on the size of the property; a third based on the number of indigenous mammal species (or mammalian predators) completely or partially protected by the property; a fourth based on the number of non-indigenous

(alien) mammals on the property; a fifth based on the number of alien, potentially invasive, mammals with regard to ecological invasions, pathogenic invasions, and genetic invasions. Tax rebates on a sliding scale could then be considered; the amounts depending on how many points the properties in question were awarded.

This system could also possibly be developed, by way of example, to allow extra points to be awarded for conserving species not targeted by the game industry, such as small and medium carnivores, rodents, hares, insectivores, bats, hyraxes and primates. Some minor effort would probably be required in estimating population sizes for the larger species, but a simple index would probably suffice.

Trends in Mammalian Conservation Ethics

Historically, the conservation of mammals was essentially the preserve of cultural or political leaders, who set aside areas for "royal" hunts, or at least hunting events for privileged members of the society that then prevailed. Ordinary landowners, however, originally saw little value in wildlife other than as commodities to be eaten or used. Over time, probably associated with socioeconomic advancement, this led to a generally softened approach by landowners towards certain forms of wildlife, particularly those species which represented the occasional source of "biltong" or sport-hunting or which only made occasional depradations on crops. However, this approach was generally not extended to carnivores. The gradual separation of urban and rural life, led to a higher tolerance level for the carnivores in the cities than could be expected from the rural communities, mostly because the urban communities no longer experienced the stock losses that more rural communities still experienced. These stock losses, whether economically significant or not, hindered the development of an holistic conservation ethic. Today the more affluent rural communities, particularly because of more ecologically effective and acceptable control measures can to some extent afford to adopt more conservation/carnivore friendly management practices which have reduced the hunting pressure on indigenous carnivores such as the leopard, but in less affluent communities this is probably less applicable, highlighting the fact that there is still a need for environmental education and innovative problem-solving.

At the opposite extreme from the rural stock farmer and the breeder of rare game taxa, has been the development of the animal rights movement. This grouping has included people with reasonably rational arguments looking for improved wildlife management techniques and the expansion of conservation areas, but also includes those totally opposed to any population management, and those totally opposed to the use of animal protein as a source of food. Clearly the latter have little chance of success in persuading economically depressed societies to change their dietary habits, but could well have an influence on first-world opinions about issues concerning wildlife population management, and more particularly hunting, in such a way that some of the economic objectives of many countries, particularly third-world countries, could be severely compromised *e.g.* elephant culling programmes in national parks; and hunting concessions in Botswana.

A disturbing feature of the inherent economic value of threatened rarer taxa, as alluded to in the opening paragraph of the previous section, has been the major increase in the demand for establishing inappropriate taxa or re-establishing locally extinct taxa. The re-establishment of locally extinct taxa is, in most cases, a laudable objective and only problematic when the historic habitat to which they are being returned has been extensively or completely transformed and/or is too small to accommodate the taxon in question in viable numbers. Table 3 provides a list of all mammalian species considered to be indigenous to the W.C.P. and their conservation status.

The introduction of taxa into the W.C.P. which were never recorded in historic times or which are not known from recent geological periods is, however, problematic for a variety of reasons.

In the first place because of the topographic, climatic, and hence ecological diversity of South Africa, this country is particularly blessed with a fairly spectacular array of mammals (as well as other faunal groups), particularly the ungulates, megaherbivores, and carnivores. Many of these taxa are sought-after either because of their relative rarity, or because of their special "aesthetic" appeal. In parallel with this diversity of mammals, is a vast diversity of pathogens or parasites, and pathogenic vectors (from arthropods, round worms, flat worms, annelids, molluscs, unicellular organisms, bacteria, viruses and lesser groupings). Many of these are essentially endemic to certain regions, but have the potential to become pandemic under certain conditions. Possible climatic change could potentially exacerbate such scenarios. Ill-considered translocation of certain wildlife species could result in some of these pathogens (and parasites) also being transferred to new areas and to species/taxa which have not previously been exposed to them, with potentially disastrous results. It should be a requirement that for all such introductions the environmental impact assessment route should be followed, and that exemption from such a procedure should only be possible with full veterinary, or other agricultural, and conservation approval.

Secondly, some of these taxa introduced to new areas also have the potential to become ecologically invasive or destructive. Although there are probably not many South African taxa which could pose such a threat in the W.C.P., several non-South African taxa do have that potential, particularly animals such as goat-antelopes (such as tahr species), wild species of goat, and wild species of sheep. Apart from such ungulates, other mammalian species adapted to environments similar to those in the Western Cape, especially the montane habitat, from other mammalian orders, also have similar potential *e.g.* rats, mice, rabbits, and cats. Many of our islands provide examples of what enormous damage can be caused.

The third reason for concern is possibly the greatest threat, and that is the fact that many taxa from elsewhere are closely related to taxa which occur naturally in the Western Cape. Recent advances in genetic research have shown that there are often considerable genetic differences between closely related taxa (even within recognized subspecies) from different areas in South Africa, even although no morphological differences are discernible.

Even more disturbing is the fact that apart from the risks involved with hybridization between obviously closely related taxa, there is evidence that fertile hybridization can occur between what are traditionally regarded as good species within the same genus (as has been unequivocally demonstrated between the species in the genera *Connochaetes* and *Kobus*). Still more alarming is the fact that there is now evidence that even intergeneric hybridization can result in the production of fertile hybrids.

These concerns are frequently ignored by those with interests in the game industry, mostly due to ignorance. More disturbing, however, is the fact that many in the game industry who are not ignorant of these facts, are known to have taken advantage of the situation, and it is alleged, with reasonable evidence, that some of these people, have deliberately hybridized taxa in order to provide "new" taxa for the hunting fraternity, even going so far as to produce fertile (*i.e.* self-generating) intergeneric taxa. This, from a conservation perspective, is an entirely unacceptable practice.

Conservation Research and Actions

Historically so-called conservation research concentrated on breeding aesthetically attractive taxa or those taxa traditionally regarded as being sport associated, in order to either re-establish them in the wild, or to place them in those areas where they could be hunted or angled (fished). In terms of mammals this mostly covered a variety of ungulates, mostly indigenous bovids (antelope) and alien cervids (deer).

Subsequent research was initially concentrated on autecological studies of the rarer indigenous ungulates. This developed gradually to include the rarer carnivores and ultimately to all rarer taxa where possible, although there are several taxa occurring in the Western Cape which have not yet been the subject of such projects (*e.g.* the small-spotted cat (*Felis nigripes*); the water rat (*Dasymus incomtus*); and the white-tailed mouse (*Mystromys albicaudatus*). More recently studies have been focused on wider issues and many of these are aimed at studying communities, rather than individual species, in context with their environments, in an effort at understanding ecological processes. Individual specific/subspecific/deme studies are now mostly concentrated on genetic variation and identification.

Ironically enough, although frequently attempted, regular detailed studies on the natural distribution (and the semi-captive distribution of introduced "game" taxa) of mammals have been less than adequate. There are probably a number of reasons to explain this phenomenon (see Lloyd and Millar, 1983). In the first place mammals, particularly the larger ones, are generally the animals most familiar to people and familiarity in this case does lead to "contempt" in a sense, since because people are so familiar with them, they frequently fail to record the localities in which they occur. The mobility and familiarity of certain taxa exacerbates this problem. The lack of familiarity with smaller mammals, however, has also resulted in insufficient information concerning their distribution patterns.

Furthermore because of the diversity of mammals, and the lack of a public sector interested in "mammal-watching" in the same sense that the "bird-watching" community represents, monitoring mammalian distribution is both a time-consuming and expensive pursuit. Declining funding for both conservation organizations and natural history museums has thus also been partially to blame for this paucity.

The most important fields of mammalian research (and action) currently underway include studies on the rarer taxa with specialized habitat requirements, such as the riverine rabbit, and potentially the W.C.P. populations of the laminate vlei rat (*Otomys laminatus*), amongst others. Yet another field of research enjoying considerable attention is the contribution being made to taxonomy by modern molecular biological techniques (a variety of techniques looking at DNA structure). Projects currently targeted for such studies include examining closely related taxa previously identified by more traditional taxonomic techniques in order to confirm these findings, but will hopefully increasingly be focused on taxa with disjunct, or apparently disjunct, distribution ranges (taxa that spring to mind again include *Otomys laminatus*, but would also include, amongst many others, *Otomys saundersiae*, *Mystromys albicaudatus*, *Dasymus incomtus*). Other groups which also require further taxonomic evaluation are the golden-moles (chrysochlorids) and the elephant-shrews (macroscelidids).

Probably the third most important field of mammalian research should also be a continuation of improved problem animal management techniques, which should focus more on solving the true problem, rather than identifying and removing the wild animal which has been incorrectly accused of being the problem.

These three fields are probably the most important avenues to explore still further. Because of its relatively long history in South Africa, mammalogy has been more fortunate than many of the other zoological subdisciplines and much of the groundwork has been done. Apart from the above three fields, the only other important facet is to obtain better information on distribution and habitat requirements, particularly for many of the smaller mammals.

In terms of institutions currently or historically engaged on mammalian research in general, the list is enormous. In brief we will mention the more important overseas institutions which have been involved in mammalian research in the W.C.P., followed by local centres of tertiary education and the specialized natural history centres.

Overseas Institutions which have contributed considerably to mammalogical studies in Africa, including the W.C.P.

American Museum of Natural History
Smithsonian Institution
British Museum (Natural History)
Zoological Society (London)
IUCN Species Survival Commission - various Specialist Groups

American Society of Mammalogists
Zoological Society for the Conservation of Species and Populations (Z.S.C.S.P - Germany)

Local Tertiary Education Institutions which have contributed considerably to mammalogical studies in the W.C.P.

University of the Witwatersrand - Science Faculty
University of Pretoria - Science Faculty; Veterinary Faculty; Agriculture Faculty - especially the Mammal Research Institute and the Eugene Marais Chair of Wildlife Management
University of Cape Town - Science Faculty; Medical Faculty
University of Stellenbosch - Science Faculty; Forestry Faculty; Agriculture Faculty
University of Natal - (both Durban and Pietermaritzburg campuses) - Science Faculty
University of the Western Cape - Science Faculty
University of Port Elizabeth - Science Faculty
Rhodes' University - Science Faculty
Technikon RSA
Cape Technikon
Port Elizabeth Technikon (Saasveld Campus)

Specialized Natural History Centres which have contributed considerably to mammalogical studies in the W.C.P.

Department of Water Affairs and Forestry (D.W.A.F.) - the erstwhile S.A. Forestry Research Institute
Department of Environmental Affairs and Tourism (D.E.A.T.) - Division of Marine and Coastal Management; South African National Parks
Department of Agriculture (National) - various institutes
Provincial Conservation Authorities - especially W.C.N.C.B., but also others
South African Museum
Transvaal Museum
McGregor Museum
Amathole Museum (formerly Kaffrarian Museum)
Albany Museum
Port Elizabeth Museum
Durban Natural History Museum

Status of Mammalian Knowledge

Mammalogy is one of the fields of zoology which has been fortunate enough to have a relatively long history, particularly with respect to distribution records and studies of the megaherbivores and other "traditional game" species and the larger carnivores. These groups, although targeted by early hunters and in many cases almost completely exterminated, at least in certain areas, were the subjects of numerous narratives and many of the earliest studies. Because of their relative rarity, their relatively large size and conspicuous nature, and also simply because of the fact that they were mammals (namely animals with which human-beings, also mammals, can most closely associate) many of these animals also became the subjects of the first autecological studies in the relatively recent subdisciplines of ecology and nature conservation science. The status of knowledge of these groups therefore rivals, and probably exceeds, that acquired in the general field of ornithology, despite not possessing a lay interest group equivalent to the birdwatchers who provide so much information in the field of ornithology. However, the smaller mammals, even many of the more common species, particularly amongst the rodents, have not, until recently, been able to solicit anywhere near as much attention as the larger members of their class. In recent years this has been more adequately addressed and it is probably true to say that today the most poorly understood mammals, apart from marine mammals, would be represented by the rarer small mammals. This is partially because they can be difficult to locate, partially because some of them occupy habitats in remote areas, partially because of the fact that many people are biased against rodents of any sort, including any animals that vaguely resemble rodents.

Despite the fact that some of these smaller mammals are not well documented in terms of their general biology, their ecological requirements, and their distributional limits, it would be fair to say that in general the status of mammalian knowledge can be considered reasonably sound, with considerable attention currently being focused on the rarer taxa. Academic institutions, particularly the Mammal Research Institute and the Transvaal Museum, but including several other universities and other natural history museums, have ensured that these rarer and less well understood taxa are the focus of their research programmes. One of the most important other focal points currently receiving considerable attention is the topic of molecular biological taxonomic techniques, especially those employing a wide range of techniques to analyse and evaluate mitochondrial and nuclear DNA.

Recommendations towards the Conservation of Mammals

The conservation of mammals has had an historical advantage in many respects when compared with early conservation actions with respect to other vertebrates and also with respect to the invertebrates. As alluded to earlier, this is probably the result of mammals being more familiar to human society than the other groups of animals. However this "charitable" attitude displayed towards mammals relative to other faunal elements was never absolute, inasmuch as certain types of mammal (mostly those that were considered to be palatable and which were thus termed "game") received considerable protection (with a few notable exceptions) whereas others were (and in some cases still are) the targets of relentless persecution. The latter include many of the carnivores, especially lions, cheetahs, wild dogs and spotted hyenas (which were all hunted to extinction in the W.C.P.); brown hyenas, with only the occasional straggler being reported in the province; and the leopard, which still survives and which is now protected, but which is still occasionally hunted (normally (?) via the permit system) because of attacks on livestock. Included within this group of persecuted mammals (mostly carnivores), however, are two of our commoner primates, namely the baboon (because of raids on both crops and smaller livestock) and the vervet monkey (mostly because of raids on cereal, vegetable and fruit crops). Although many private ecotourism developments apply to keep some of the more spectacular species on their properties in the

W.C.P. most of these developments are incapable of supporting viable self-sustaining populations, and it is therefore important to ensure the creation of large statutory conservation areas (whether through consolidation of existing reserves and/or purchase of further extensive areas) in order to re-establish viable self-sustaining populations of those species which have either become extinct in the W.C.P. or nearly so and to maintain those species still surviving which are considered to be incompatible with agriculture. This is an achievable goal within the W.C.P. even if only restricted to two or three conservation areas and even if genetic viability cannot be attained without management intervention. Not only would such re-establishments provide an ecotourism attraction to these conservation areas but as management tools they would play an important evolutionary role in maintaining the genetic fitness of the prey species on which they would have to survive. Concomitant with such reintroductions to such extensive conservation areas ("mega-parks") would be the reintroduction of the locally extinct megaherbivores as well, such as elephant, black rhinoceros and hippopotamus, and the other locally extinct herbivores which have not yet been re-established on many of the reserves. In the latter case the species frequently absent are taxa such as Cape mountain zebra, red hartebeest, and eland, all of which can do reasonably well, even in montane habitats. Cape mountain zebras, however, do need hard (rocky) substrates, which is why they were commonly found in montane habitats. All three taxa were historically fairly widespread within the W.C.P. In the case of both the megaherbivores and larger carnivores, as alluded to earlier, population sizes would probably be lower than would be ideally required to maintain genetic fitness and variation, due to genetic drift and other mechanisms eroding genetic variability, but these shortcomings can be managed relatively simply and cheaply through occasional strategic translocations of individuals. The C.A.P.E. programme includes projects aimed at establishing such extensive conservation areas, which could be enhanced through the incorporation of privately owned land in the form of private nature reserves and conservancies, all managed coooperatively.

The smaller carnivores which are also targeted by agricultural communities, are more fortunate in that their densities are generally higher and the likelihood of imminent extinction considerably lower than those of their larger relatives. Nevertheless some of the smaller carnivores in the W.C.P. appear to occur in low densities and thus need additional measures aimed at their protection. Although to some extent extensive conservation areas designed to accommodate self-sustaining populations (albeit probably small) of larger carnivores and megaherbivores, will also fortuitously provide refuge for an enormous suite of smaller organisms, some of the organisms (in this case mammals) will have natural distribution ranges which do not overlap at all, or only overlap partially, with the geographic locations of these extensive areas.

The carnivore species for which additional conservation measures should be considered as priorities are the small-spotted (or black-footed) cat (*Felis nigripes*), the serval (*Felis serval*), and the white-naped (or snake-) weasel (*Poecilogale albinucha*). Apart from identifying those areas, including nature reserves, in which they still survive, the public at large, and more specifically the landowners in areas where these animals tend to be concentrated, should be targeted to lobby for formal statutory conservation areas and/or to establish private initiatives (*e.g.* conservancies; private nature reserves; local authority nature reserves; and sites of conservation significance) highlighting or focusing on what are local natural history assets, and in so doing, re-instil a sense of pride in local natural resources.

Although, it might possibly have come too late, the programme currently aimed at conserving the riverine rabbit represents a good example of such an approach. In this particular case the problem is exacerbated by the fact that the animal in question has a linear distribution in a very restricted type of environment which is under considerable threat of irreversible transformation, namely the alluvial flood plains of certain Karooid river systems. Apart from their inherent fragility and dynamic nature due to flood events, these habitats also represent arable areas for the agricultural communities and, due to the relatively high water tables, also represent "emergency" forage areas for livestock during periods of prolonged drought.

Rivers, and wetlands in general, whether perennial or temporary, represent important habitats for a wide variety of animals. Apart from the obvious dependency on water by truly aquatic organisms such as a multitude of invertebrates, fish, amphibians, water-associated reptiles and birds, there is a wide variety of mammals, other than the riverine rabbit, which to a greater or lesser extent are dependent on these wetlands, and particularly rivers. One immediately thinks of species such as the Cape clawless otter (*Aonyx capensis*), the water mongoose (*Atilax paludinosus*), and the water rat (*Dasymus incomtus*), not that these are necessarily currently faced with major threats, but many others also utilize not only the water but the riparian and associated vegetation for both food and shelter. However, rivers also play an equally important role as ecological corridors along which animals can disperse from one type of terrestrial environment to a different terrestrial environment. The fact that leopards have re-established themselves on De Hoop Nature Reserve is probably a good example of such activity in practice. Leopards were thought to have been eliminated from the reserve about 100 years ago and the nearest surviving animals in recent times have been those occurring on the mountains near Swellendam. The most likely route to have been followed to prevent detection would have been down the Breede River.

The consequence of these dependencies is therefore a need to promote river and wetland conservation at least as vigorously as lowland conservation. Attention should be focused on trying to identify at least three to five rivers currently passing through or lying adjacent to some of our existing reserves, and developing a conservation programme, including restorative ecological techniques where needed, from the catchment area through to the coastal environment. Several such possibilities still exist, but it is important to act now before further development prevents such action. Apart from publicizing the need for such projects, action needs to be initiated by allowing for such projects to be incorporated into general landscape

planning, such as the spatial development frameworks and integrated development plans.

Similarly at least two areas that also require further protection based on the presence of rare or threatened mammals are firstly the marine environment, with a need for further marine protected areas (MPAs), particularly for the cetaceans and, secondly, the forest remnants, which are mostly protected, but highly fragmented and which could probably benefit from consolidation of these fragments into larger units. Not many species of fruit bat occur in the W.C.P. but all of them are dependent on the fruits available in indigenous forests, and there is really only one species, namely the Egyptian fruit bat, which is capable of utilizing other sources of fruit.

In terms of the conservation of the majority of insectivorous bats, all caves (and mines containing bats) should be identified (much has already been done), monitored and the more important of these should be given statutory protection.

Apart from identifying specific geographic locations for conservation purposes, however, there are other actions needed to improve mammalian conservation which include improved legislation, administrative guidelines and minimum standards, particularly associated with the hunting and animal translocation profession. One vital piece of legislation required is a national translocation policy to reduce the risks associated with the introduction of alien taxa into new environments, including taxa indigenous to South Africa translocated to areas outside their natural distribution range. An administrative need is for a formal procedure to register institutions such as zoological gardens, animal dealers, rehabilitation centres, *etc*. and to provide a set of minimum standards for each of these types of institution.

Finally, a formal monitoring programme for all taxa listed in local or international Red Data Books or Red Lists should be established, much akin to the bird and frog atlassing projects that have been so succesful. Tertiary education institutions, natural history museums, conservation authorities and other interested organizations can all play a role in such monitoring, particularly of precise locality data and population sizes. In this way, even species such as the white-tailed mouse, whose ecological requirements are effectively unknown to us currently, might face a brighter future.

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Table 3. Mammalian species of the W.C.P., their common names, and their conservation status.

Taxon	English Name	IUCN Category	SA RDB Category	CITES	Ordinance
Alcelaphus buselaphus	Red hartebeest	Null	Null	Null	Schedule II
Antidorcas marsupialis	Springbuck	Null	Null	Null	Schedule II
Damaliscus dorcas dorcas	Bontebok	Null	Null	Null	Schedule II
Hippotragus leucophaeus	Bluebuck	Null	Extinct	Null	Null
Oreotragus oreotragus	Klipspringer	Null	Null	Null	Schedule II
Oryx gazella	Gemsbok	Null	Null	Null	Schedule II
Pelea capreolus	Grey rhebuck	Null	Null	Null	Schedule II
Philantomba monticola	Blue duiker	Null	Rare	Null	Schedule II
Raphicerus campestris	Steenbok	Null	Null	Null	Schedule II
Raphicerus melanotis	Grysbok	Null	Null	Null	Schedule II
Redunca fulvorufula	Mountain reedbuck	Null	Null	Null	Null
Sylvicapra grimmia	Common duiker	Null	Null	Null	Schedule II
Syncerus caffer	Buffalo	Null	Null	Null	Schedule II
Taurotragus oryx	Eland	Null	Null	Null	Schedule II
Tragelaphus scriptus	Bushbuck	Null	Null	Null	Schedule II
Tragelaphus strepsiceros	Kudu	Null	Null	Null	Schedule II
Hippopotamus amphibius	Hippopotamus	Null	Rare	Appendix II	Schedule II
Phacochoerus aethiopicus	Warthog	Null	Null	Null	Schedule II
Potamochoerus porcus	Bushpig	Null	Null	Null	Null
Canis mesomelas	Black-backed jackal	Null	Null	Null	Null
Lycaon pictus	Wild dog	Endangered	Endangered	Null	Null
Otocyon megalotis	Bat-eared fox	Null	Null	Null	Schedule II
Vulpes chama	Cape fox	Null	Null	Null	Schedule II
Acinonyx jubatus	Cheetah	Vulnerable	Out Of Danger	Appendix I	Schedule I
Felis caracal	Caracal	Null	Null	Appendix II	Null
Felis lybica	African wild cat	Null	Vulnerable	Appendix II	Null
Felis nigripes	Black-footed cat	Null	Rare	Appendix I	Schedule II
Felis serval	Serval	Null	Rare	Appendix II	Schedule II
Panthera leo	Lion	Null	Null	Appendix II	Schedule II
Panthera pardus	Leopard	Null	Rare	Appendix II	Schedule II
Crocuta crocuta	Spotted hyaena	Null	Null	Null	Null
Hyaena brunnea	Brown hyaena	Vulnerable	Rare	Null	Schedule II
Aonyx capensis	Clawless otter	Null	Null	Appendix II	Null
Ictonyx striatus	Striped polecat	Null	Null	Null	Null
Mellivora capensis	Honey badger	Null	Vulnerable	Null	Schedule II
Poecilogale albinucha	Striped weasel	Null	Rare	Null	Schedule II
Arctocephalus pusillus	Cape fur seal	Null	Null	Appendix II	Null
Arctocephalus tropicalis	Subantarctic fur seal	Null	Null	Appendix II	Null
Hydrurga leptonyx	Leopard seal	Null	Null	Null	Null

Table 3. *(Continued)*

Lobodon carcinophagus	Crabeater seal	Null	Null	Null	Null
Mirounga leonina	Southern elephant seal	Null	Null	Appendix II	NULL
Proteles cristatus	Aardwolf	Null	Rare	Null	Schedule II
Atilax paludinosus	Water mongoose	Null	Null	Null	Null
Cynictis penicillata	Yellow mongoose	Null	Null	Null	Null
Galerella pulverulenta	Small grey mongoose	Null	Null	Null	Null
Genetta genetta	Small-spotted genet	Null	Null	Null	Null
Genetta tigrina	Large-spotted genet	Null	Null	Null	Null
Herpestes ichneumon	Large grey mongoose	Null	Null	Null	Null
Suricata suricatta	Suricate	Null	Null	Null	Null
Balaena glacialis	Right whale	Endangered	Null	Null	Null
Caperea marginata	Pygmy right whale	Insufficiently Known	Null	Appendix I	Null
Balaenoptera acutorostrata	Minke whale	Insufficiently Known	Null	Appendix I	Null
Balaenoptera borealis	Sei whale	Vulnerable	Null	Appendix I	Null
Balaenoptera edeni	Bryde's whale	Insufficiently Known	Null	Appendix I	Null
Balaenoptera musculus	Blue whale	Endangered	Null	Appendix I	Null
Balaenoptera physalus	Fin whale	Vulnerable	Null	Appendix I	Null
Cephalorhynchus heavisidii	Heaviside's dolphin	Insufficiently Known	Null	Null	Schedule II
Delphinus delphis	Common dolphin	Insufficiently Known	Null	Null	Schedule II
Feresa attenuata	Pygmy killer whale	Insufficiently Known	Null	Null	Schedule II
Globicephala macrorhynchus	Short-finned pilot whale	Insufficiently Known	Null	Null	Schedule I and Ii
Globicephala melaena	Long-finned pilot whale	Insufficiently Known	Null	Null	Schedule II
Grampus griseus	Risso's dolphin	Insufficiently Known	Null	Null	Schedule II
Lagenorhynchus obscurus	Dusky dolphin	Insufficiently Known	Null	Null	Schedule II
Neophocaena phocaenoides	Finless porpoise	Insufficiently Known	Null	Appendix I	Schedule II
Orcinus orca	Killer whale	Insufficiently Known	Null	Null	Schedule II
Peponocephala electra	Melon-headed whale	Insufficiently Known	Null	Null	Schedule II
Pseudorca crassidens	False killer whale	Insufficiently Known	Null	Null	Schedule II
Sousa plumbea	Humpback dolphin	Insufficiently Known	Null	Appendix I	Schedule II
Stenella attenuata	Spotted dolphin	Insufficiently Known	Null	Null	Schedule II
Stenella coeruleoalba	Striped dolphin	Insufficiently Known	Null	Null	Schedule II
Tursiops aduncus	Indian Ocean bottlenosed dolphin	Null	Null	Null	Schedule II
Tursiops truncatus	Atlantic Ocean bottlenosed dolphin	Insufficiently Known	Null	Null	Schedule II
Megaptera novaeangliae	Humpback whale	Vulnerable	Null	Appendix I	Null
Kogia breviceps	Pygmy sperm whale	Insufficiently Known	Null	Null	Null
Kogia simus	Dwarf sperm whale	Insufficiently Known	Null	Null	Null
Physeter macrocephalus	Sperm whale	Insufficiently Known	Null	Null	Null
Berardius arnuxii	Arnoux's beaked whale	Insufficiently Known	Null	Appendix I	Null
Hyperoodon planifrons	Southern bottlenose whale	Insufficiently Known	Null	Appendix I	Null
Mesoplodon densirostris	Blainville's beaked whale	Insufficiently Known	Null	Null	Null

Table 3. *(Continued)*

Mesoplodon grayi	Gray's beaked whale	Insufficiently Known	Null	Null	Null
Mesoplodon layardii	Layard's beaked whale	Insufficiently Known	Null	Null	Null
Mesoplodon mirus	True's beaked whale	Insufficiently Known	Null	Null	Null
Ziphius cavirostris	Cuvier's beaked whale	Insufficiently Known	Null	Null	Null
Taphozous mauritianus	Mauritian tomb bat	Null	Null	Null	Schedule II
Sauromys petrophilus	Flat-headed free-tailed bat	Null	Null	Null	Schedule II
Tadarida aegyptiaca	Egyptian free-tailed bat	Null	Null	Null	Schedule II
Tadarida ventralis	Giant African free-tailed bat	Null	Indeterminate	Null	Schedule II
Nycteris thebaica	Egyptian slit-faced bat	Null	Null	Null	Schedule II
Epomophorus wahlbergi	Wahlberg's epauletted fruit bat	Null	Null	Null	Null
Rousettus aegyptiacus	Egyptian fruit bat	Null	Null	Null	Null
Rhinolophus capensis	Cape horseshoe bat	Null	Null	Null	Schedule II
Rhinolophus clivosus	Geoffroy's horseshoe bat	Null	Null	Null	Schedule II
Eptesicus capensis	Cape serotine bat	Null	Null	Null	Schedule II
Eptesicus hottentotus	Long-tailed serotine bat	Null	Null	Null	Schedule II
Eptesicus melckorum	Melck's serotine bat	Null	Null	Null	Schedule II
Kerivoula lanosa	Lesser woolly bat	Null	Indeterminate	Null	Schedule II
Laephotis namibensis	Namib long-eared bat	Null	Null	Null	Schedule II
Miniopterus fraterculus	Lesser long-fingered bat	Null	Null	Null	Schedule II
Miniopterus schreibersii	Schreiber's long-fingered bat	Null	Null	Null	Schedule II
Myotis lesueuri	Lesueur's wing-gland bat	Null	Indeterminate	Null	Schedule II
Myotis tricolor	Temminck's hairy bat	Null	Null	Null	Schedule II
Procavia capensis	Rock dassie	Null	Null	Null	Null
Amblysomus hottentotus	Hottentot golden mole	Null	Null	Null	Null
Amblysomus iris	Zulu golden mole	Indeterminate	Indeterminate	Null	Null
Chlorotalpa duthieae	Duthie's golden mole	Rare	Indeterminate	Null	Null
Chlorotalpa sclateri	Sclater's golden mole	Rare	Indeterminate	Null	Null
Chrysochloris asiatica	Cape golden mole	Null	Null	Null	Null
Cryptochloris zyli	Van Zyl's golden mole	Indeterminate	Indeterminate	Null	Null
Eremitalpa granti	Grant's golden mole	Rare	Rare	Null	Null
Crocidura cyanea	Reddish-grey musk shrew	Null	Null	Null	Schedule II
Crocidura flavescens	Greater musk shrew	Null	Null	Null	Schedule II
Myosorex longicaudatus	Long-tailed forest shrew	Insufficiently Known	Indeterminate	Null	Schedule II
Myosorex varius	Forest shrew	Null	Null	Null	Schedule II
Suncus varilla	Lesser dwarf shrew	Null	Null	Null	Schedule II
Bunolagus monticularis	Riverine hare	Endangered	Endangered	Null	Schedule I
Lepus capensis	Cape hare	Null	Null	Null	Null
Lepus saxatilis	Scrub hare	Null	Null	Null	Null
Pronolagus rupestris	Smith's red hare	Null	Null	Null	Null
Elephantulus edwardii	Cape rock elephant-shrew	Null	Null	Null	Schedule II

Table 3. *(Continued)*

Elephantulus rupestris	Smith's rock elephant-shrew	Null	Null	Null	Schedule II
Macroscelides proboscideus	Round-eared elephant-shrew	Null	Null	Null	Schedule II
Equus burchellii	Burchell's zebra	Null	Null	Null	Schedule II
Equus quagga	Quagga	Null	Null	Null	Null
Equus zebra zebra	Cape Mountain zebra	Vulnerable	Null	Appendix I and II	Null
Diceros bicornis	Black rhinoceros	Endangered	Vulnerable	Appendix I	Schedule I
Cercopithecus aethiops	Vervet monkey	Null	Null	Appendix II	Null
Papio ursinus	Chacma baboon	Null	Null	Appendix II	Null
Loxodonta africana	African Elephant	Vulnerable	Out of Danger	Appendix I and II	Schedule II
Bathyergus suillus	Cape dune molerat	Null	Null	Null	Null
Cryptomys hottentotus	Common molerat	Null	Null	Null	Null
Georychus capensis	Cape molerat	Null	Null	Null	Null
Graphiurus murinus	Woodland dormouse	Null	Null	Null	Null
Graphiurus ocularis	Spectacled dormouse	Null	Rare	Null	Null
Hystrix africaeaustralis	Porcupine	Null	Null	Null	Null
Acomys subspinosus	Cape spiny mouse	Null	Null	Null	Null
Aethomys granti	Grant's rock mouse	Null	Indeterminate	Null	Null
Aethomys namaquensis	Namaqua rock mouse	Null	Null	Null	Null
Dasymys incomtus	Water rat	Null	Indeterminate	Null	Null
Dendromus melanotis	Grey climbing mouse	Null	Null	Null	Null
Dendromus mesomelas	Brants's climbing mouse	Null	Null	Null	Null
Dendromus mystacalis	Chestnut climbing mouse	Null	Null	Null	Null
Desmodillus auricularis	Short-tailed gerbil	Null	Null	Null	Null
Gerbillurus paeba	Hairy-footed gerbil	Null	Null	Null	Null
Malacothrix typica	Large-eared mouse	Null	Null	Null	Null
Mastomys coucha	Multimammate mouse	Null	Null	Null	Null
Mastomys natalensis	Natal multimammate mouse	Null	Null	Null	Null
Mus minutoides	Pygmy mouse	Null	Null	Null	Null
Myomyscus verreauxi	Verreaux's mouse	Null	Null	Null	Null
Mystromys albicaudatus	White-tailed rat	Null	Vulnerable	Null	Null
Otomys irroratus	Vlei rat	Null	Null	Null	Null
Otomys laminatus	Laminate vlei rat	Null	Null	Null	Null
Otomys saundersiae	Saunders's vlei rat	Null	Null	Null	Null
Otomys unisulcatus	Bush Karroo rat	Null	Null	Null	Null
Parotomys brantsii	Brants's whistling rat	Null	Null	Null	Null
Petromyscus collinus	Pygmy rock mouse	Null	Indeterminate	Null	Null
Rhabdomys pumilio	Striped mouse	Null	Null	Null	Null
Saccostomus campestris	Pouched mouse	Null	Null	Null	Null
Steatomys krebsii	Krebs's fat mouse	Null	Null	Null	Null
Tatera afra	Cape gerbil	Null	Null	Null	Null
Orycteropus afer	Aardvark	Null	Vulnerable	Null	Schedule II

State of Biodiversity: Western Cape Province, South Africa
Status of Conserved Areas

Annelise le Roux, Peter H. Lloyd, Andrew A.Turner
Scientific Services
Western Cape Nature Conservation Board
Private Bag 5014
STELLENBOSCH
7599

Statutory conservation areas worldwide are established for a variety of reasons, *i.e.* the need to set aside representative examples of natural ecosystems as benchmarks against which the effects of development can be measured. In maintaining these conserved examples of natural ecosystems it is important to recognise not only the biological species naturally occurring here, but also the relationships between these species (the biota) and their physical and climatic environments (the abiotic elements). These complex relationships, which in effect support life consist of a variety of intertwined ecological processes, ranging from pedogenesis to pollination. In conserving these examples of natural ecosystems, it is important to ensure that the processes are also maintained/conserved, so that both biotic species and ecological processes are allowed to evolve under natural conditions, *i.e.* the naturally selective pressures must be allowed to continue to maintain evolutionary processes.

Other reasons for the conservation of such areas include the need to conserve threatened species, to maintain processes beneficial to humans and other biota, to provide areas for recreation and spiritual well being.

The conservation of the environment and our heritage is not only the responsibility of the state, but of every citizen, including private individuals, companies and NGO's. Although it is generally accepted that at least 10% of terrestrial ecosystems should be conserved as protected areas in order to preserve natural ecosystems, the remaining 90% should also be considered for an effective conservation network. Conservation concepts that are inclusive of humans and their activities such as private nature reserves, conservancies and biosphere reserves also aid the achievement of conservation objectives. A greater conservation awareness and ethic in the western Cape has considerably increased the percentage of privately conserved areas in the last few years. With the C.A.P.E., S.KE.P. and S.T.E.P. initiatives, especially the Conservation Partnership Programme, this positive trend should continue.

Statutory conservation areas

Statutory conservation areas proclaimed for biodiversity and water conservation (Appendix I) represent 10.7% of the Western Cape's surface area and include a proposed serial World Heritage Site comprising a composite of eight sites in the Cape Floral Kingdom; four wilderness areas, seven national parks; 79 provincial nature reserves; one contractual provincial nature reserve; 12 island reserves; seven marine reserves; 38 local authority nature reserves and 15 Mountain Catchment Areas (Table 1 and Map 1). A part of the Baviaanskloof Conservation Area (15 320 ha) is also situated in the Western Cape Province, but it is managed by the Eastern Cape Province which contains the greater part of this conservation area (Appendix II).

Some of the statutory conservation areas are owned and managed by the state, whereas those designated as mountain catchment areas (4.4% of the Western Cape) are owned privately and managed jointly by the private landowner and the state. Therefore only 6.4% of statutory conservation areas are actually owned and managed by the state.

Private conservation areas

Privately owned land managed for the conservation of biodiversity represents 7.7% of the surface of the Western Cape and includes 148 private nature reserves, two internationally proclaimed biosphere reserves, 43 conservancies consisting of groups of landowners managing their land with joint conservation goals in mind, and 36 South African Natural Heritage Sites, many of which are also proclaimed as private nature reserves or fall within conservancies (Appendix I; Tables 1and 4 and Map 1).

Note 1: All calculations on percentage conservation areas were based on data and polygons from the reserves database with the aid of the Biodiversity Analysis Toolkit.

Note 2: All spatial data are provided with this report to serve as baseline for subsequent analyses and comparisons.

Note 3: If the percentage area conserved is calculated from the area in hectares from the various appendices, the value will be higher. However, there are a number of instances where different categories of conservation areas overlap. In these cases the calculations only used the higher status (*e.g.* statutory conservation area and not private conservation area, *e.g.* or wilderness area and not mountain catchment area.).

CONSERVATION STATUS OF ECOSYSTEMS

The Western Cape hosts two of six world plant kingdoms, the Cape Floral Kingdom and the Palaeotropical Kingdom (Map 2), and six of the seven biomes found in South Africa (Map 3). Two of these biomes, the Fynbos Biome and the Succulent Karoo Biome, have been identified as biodiversity hotspots by

Table 1. Conservation area types and percentage conserved in the Western Cape.

Conservation area	Area of Western Cape (ha)	Conserved area (ha)	% Conserved
Statutory conservation areas	12 953 800	1 401 640	10.68%
Private conservation areas	12 953 800	1 001 280	7.73%

Conservation International (Mittermeier et al., 1999) (Map 4).

Biomes

Since 78% of the Fynbos Biome and 37% of the Succulent Karoo Biome are located in this province (Map 3), W.C.N.C.B. has a very large responsibility to ensure the conservation of these two biodiversity hotspots. This province also hosts almost one quarter of the Forest Biome of which the largest and most important portion is represented by the Knysna Forest.

Table 2. Percentages of Biomes (Low and Rebelo, 1997) found in the Western Cape with percentages conserved in the Western Cape.

Biome	% of Biome in Western Cape	% of Biome in statutory conservation areas in Western Cape	% of Biome in private conservation areas in Western Cape
Forest	23.03	6.87	2.22
Fynbos	78.00	20.22	9.09
Grassland	0.23	0.00	0.00
Nama Karoo	10.23	1.12	3.97
Savanna	0.00	-	-
Succulent Karoo	37.23	2.10	4.86
Thicket	13.29	9.45	31.34

Vegetation

Most previous determinations of the conservation status of ecosystems were based on the percentage of Acocks Veld Types conserved (Acocks, 1953 and 1975; Cowan, 1987; Edwards, 1974; Rebelo, 1997; Scheepers, 1983; Wahl and Naude, 1994 and 1996). An attempt was made to compare percentage of Acocks Veld Types conserved with previous analyses, but it was unclear as to how those statistics where obtained. Inconsistencies, *e.g.* higher percentages and then lower percentages conserved in previous analyses were probably due to the fact that Mountain Catchment Areas were included or excluded in the calculations. For the State of Biodiversity Report 2002 the percentage of conserved areas were calculated according to the mapped units obtained from the Reserves Database with the Biodiversity Analysis Toolkit to ensure that all future calculations are comparable. We therefore consider the calculations for the State of Biodiversity Report 2002 as the baseline for future comparisons in the Western Cape.

Veld Types

Acocks originally described the Veld Types of South Africa in 1953 and revised it in 1975 (Acocks, 1953 and 1975). It is still used extensively in South Africa to define broad habitat, climate and vegetation units (Map 5). The percentages of Veld Types found in the Western Cape as well as the percentages of the represented Veld Types (VT) in the province conserved is given in Table 3.

Nineteen out of 70 Veld Types are found in the Western Cape with Macchia (VT70), Coastal Renosterbosveld (VT46) and Coastal Macchia (VT47) found almost exclusively in this province. Of these, only Macchia (Fynbos) can be considered statutorily adequately conserved (more than 40%) in the Western Cape and also in South Africa.

Just less than 80% of Knysna Forest (VT4) and Karroid Broken Veld (VT26) is found in this province with 16% of the first conserved statutorily and only 3% of the latter.

About half of the following Veld Types are found in the Western Cape: Succulent Mountain Scrub (Spekboomveld) (VT25), Central Lower Karoo (VT30), Succulent Karoo (VT31), Strandveld of the West Coast (VT34), Danthonia Mountain Veld replaced by Karoo (VT42), Mountain Renosterbosveld (VT43) and False Macchia (VT70). All but the Succulent Mountain Scrub and False Macchia are either not or very inadequately conserved.

Veld Types found predominantly outside the Western Cape, *e.g.* Central Upper Karoo (VT27), Western Mountain Karoo (VT28), Namaqualand Broken Veld (VT33), False Upper Karoo (VT36), False Karroid Broken Veld (VT37) and Karroid Danthonia Mountain Veld (VT60) are also not conserved here except for Central Upper Karoo that is managed as a conservancy.

Vegetation Types

More recently Low and Rebelo (1997) have reclassified the vegetation of South Africa (Map 6). The percentages of Vegetation Units found in the Western Cape as well as the percentages of the represented Vegetation Units (VU) in the province conserved are given in Table 4.

Twenty-one out of 68 Vegetation Units are found in the Western Cape with Great Nama Karoo (VU53), Little Succulent Karoo (VU58), Central Mountain Renosterveld (VU61), West Coast Renosterveld (VU62), Laterite Fynbos (VU66) and Sand Plain Fynbos (VU68) found exclusively or almost exclusively in the Western Cape. Of these only the Little Succulent Karoo (VU58), Central Mountain Renosterveld (VU61) and Limestone Fynbos (VU67) have a statutory conservation status with more than 5% of each Vegetation Unit conserved in the Western Cape and therefore South Africa as a whole.

Vegetation Units with about 80% of their distribution in this province include Dune Thicket (VU4), South and South-west Coast Renosterveld (VU63) and Mountain Fynbos (VU64). Only the South and South-west Coast Renosterveld are not adequately conserved.

About half of the following Vegetation Units areas lie within the Western Cape: Spekboom Succulent Thicket (VU8), Strandveld Succulent Karoo (VU55) and Lowland Succulent Karoo (VU57) with only 4% of the Spekboom Succulent Thicket statutorily conserved.

Table 3. Percentages of Veld Types (Acocks, 1975) found in the Western Cape with percentages conserved in the Western Cape Veld Types in bold indicate important units in the Western Cape not adequately conserved.

Veld Type no and name	% of Veld Type in Western Cape	% of Veld Type in statutory conservation areas in Western Cape	% of Veld Type in private conservation areas in Western Cape
04 Knysna Forest	76.42	10.13	1.46
23 Valley Bushveld	1.51	1.98	4.68
25 Succulent Mountain Scrub (Spekboomveld)	44.01	8.03	9.78
26 Karroid Broken Veld	77.02	3.02	0.74
27 Central Upper Karoo	15.80	0	38.53
28 Western Mountain Karoo	8.67	0	6.45
30 Central Lower Karoo	43.73	0	0.02
31 Succulent Karoo	48.97	0.92	5.00
33 Namaqualand Broken Veld	4.27	0	0
34 Strandveld of West Coast	64.80	2.98	17.56
36 False Upper Karoo	3.09	0	0
37 False Karroid Broken Veld	0.01	0	0
42 Danthonia Mountain Veld replaced by Karoo	45.23	12.75	0
43 Mountain Renosterbosveld	50.38	3.46	2.47
46 Coastal Renosterbosveld	99.92	1.72	8.89
47 Coastal Macchia	99.15	5.83	24.12
60 Karroid Danthonia Mountain Veld	5.573	0	0
69 Macchia (Fynbos)	97.53	38.94	13.82
70 False Macchia	48.28	41.61	2.11

Vegetation Units found predominantly outside the Western Cape are Valley Thicket (VU5), South-eastern Mountain Grassland (VU44), Upper Nama Karoo (VU50), Eastern Mixed Nama Karoo (VU52) and Grassy Fynbos (VU65).

Note 4: Problems with matching the different vegetation layers were identified, but could not be corrected for this report. This is most likely due to the original capturing scales and projections used.

Conclusion

Most of the conserved areas in the Fynbos Biome are in the mountainous areas (Tables 3 and 4). Except for Low and Rebelo's Vegetation Unit 61 (Central Mountain Renosterveld) the vegetation in the mountainous areas are well represented in statutory conserved areas. In contrast, very little is conserved in the lowlands especially Acocks Veld Types 46 (Coastal Renosterbosveld) and 47 (Coastal Macchia) or Low and Rebelo's Vegetation Units 62 (West Coast Renosterveld), 63 (South and South-west Coast Renosterveld), 66 (Laterite Fynbos) and 68 (Sand Plain Fynbos). Intensive conservation investigations into the status of the lowlands and conservation options is being addressed by two C.A.P.E. programmes, the Cape Lowlands Conservation Programme and the Conservation Partnerships programme respectively. These programmes aim to enhance the conservation status of the lowlands in the next five years.

The very low percentage of statutory conservation areas in the Succulent Karoo Biome in the Western Cape demands attention (Tables 3 and 4), especially the two centres of endemism, the Knersvlakte and the Little Karoo. The first phase of S.K.E.P. has identified important conservation areas and it is imperative that efforts should be made to conserve these areas in the next five years.

Although most of the Nama Karoo Biome falls in the Northern Cape, Low and Rebelo's Vegetation Unit 53 (Great Nama Karoo) falls almost entirely in the Western Cape yet the percentage of conserved areas is totally inadequate.

Although overall the Western Cape has 10% of the land surface under statutory conservation, this is skewed towards a higher concentration in the mountainous areas with very little conserved in the lowlands. The lowland areas have also been almost totally transformed by agriculture and human development and demand immediate attention. It is critical that all remaining natural vegetation patches in this area are conserved. This means that the remaining 90% cannot be ignored once the 10% mark is achieved. An effective conservation network is not purely dependent on surface area protected but on many complex interactions that often occur of large geographical extens that are only recently becoming incorporated in conservation planning. This emphasizes the importance of the contribution of private nature reserves, conservancies and biosphere reserves towards sustaining biodiversity.

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Table 4. Percentages of Vegetation Units (Low and Rebelo, 1997) found in the Western Cape with percentages conserved in the Western Cape. Vegetation Units in bold indicate important units in the Western Cape not adequately conserved.

Vegetation Unit no and name	% of Vegetation Unit in Western Cape	% of Vegetation Unit in statutory conservation areas in Western Cape	% of Vegetation Unit in private conservation areas in Western Cape
02 Afromontane Forest	28.23	6.83	2.39
04 Dune Thicket	78.14	13.98	50.00
05 Valley Thicket	0.05	0.00	0.00
08 Spekboom Succulent Thicket	52.38	4.21	10.82
44 South-eastern Mountain Grassland	3.36	0.00	0.00
50 Upper Nama Karoo	8.69	0.00	33.46
52 Eastern Mixed Nama Karoo	4.06	6.14	0.00
53 Great Nama Karoo	92.33	0.75	0.10
54 Central Lower Nama Karoo	28.24	0.37	0.56
55 Strandveld Succulent Karoo	43.01	0.84	8.18
56 Upland Succulent Karoo	10.49	0.00	0.09
57 Lowland Succulent Karoo	51.70	0.94	7.33
58 Little Succulent Karoo	99.76	5.38	2.13
60 Escarpment Mountain Renosterveld	31.69	0.00	0.00
61 Central Mountain Renosterveld	100.00	7.80	7.07
62 West Coast Renosterveld	99.97	0.84	9.77
63 South and South-west Coast Renosterveld	86.63	2.49	5.75
64 Mountain Fynbos	88.02	45.20	7.66
65 Grassy Fynbos	3.23	0.00	0.00
66 Laterite Fynbos	100.00	0.33	1.42
67 Limestone Fynbos	99.76	10.83	5.90
68 Sand Plain Fynbos	99.94	1.26	32.07

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APPENDIX I DESCRIPTIONS CONSERVATION AREA TYPES

STATUTORY CONSERVATION AREAS

World Heritage Sites

World Heritage Sites are "natural properties" (as opposed to "cultural properties") which can be considered for inclusion in the World Heritage list. They have to be evaluated by the IUCN after initial nomination by any given State. This evaluation is then presented to the World Heritage Committee, established under the Convention concerning the Protection of the World Cultural and Natural Heritage, which was adopted by the Member States of UNESCO in 1972, for a (final) decision. The minimum requirements for registration are that they must fulfil at least one of four criteria concerning natural features. Sites nominated should therefore:

i. be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features; or

ii. be outstanding examples representing on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; or

iii. contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance; or

iv. contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Wilderness areas

Wilderness areas are proclaimed under the Forest Act (Act 122 of 1984) and have the highest status of the various conservation categories. Wilderness areas are areas which have scientific and conservation value as natural ecosystems which have been left virtually untouched by development; which have aesthetic worth as landscapes undamaged by development; which offer physical and spiritual recreational opportunities. In addition, such areas should be undeveloped and uninhabited by humans; they should create the impression that only natural forces have shaped them; and they should be large enough, at least 1 000 ha in size, to provide visitors with a feeling of isolation. Wilderness areas, as well as nature reserves proclaimed under the Forest Act, may neither be deproclaimed nor have their boundaries altered, except with the approval of Parliament (from: Report of the Planning Committee of the President's Council on nature conservation in South Africa, 1984). Wilderness areas may only be proclaimed on demarcated State Forest land to which the Forest Act is applicable.

National Parks

The characteristics of a national park are, according to the International Union for the Conservation of Nature and of Natural Resources (IUCN), "relatively large and outstanding examples of natural landscapes in which the fauna and flora endemic to those specific regions are preserved by means of enduring legislation for the inspiration, education, cultural and recreational use of man". The legislation under which national parks in this country fall, is the National Parks Act (Act 57 of 1976) and the body which manages and administers most national parks at present is South African National Parks. According to Notice 449 of 1994 (See Appendix 1) the criteria for selection and management are that: "These areas are managed by either the (then) National Parks Board (now South African National Parks) or a competent nationally recognized authority".

Provincial nature reserves

These nature reserves are established in terms of the Nature and Environmental Conservation Ordinance, 1974 (Ord. 19 of 1974). Western Cape Nature Conservation Board strives to establish and manage reserves which are representative of each ecological region within the Western Cape. Provincial nature reserves, as relatively undisturbed nature areas, contribute to sustaining society by maintaining essential ecological processes and life-support systems; conserving biological diversity; providing spiritual, intellectual, social, economic, recreational and tourism opportunities, while simultaneously taking into account prevailing social and economic factors.

Marine Protected Areas

The Marine Living Resources Act 18 of 1998 (MLRA) seeks to preserve marine biodiversity. The MLRA also recognises the need to protect the marine ecosystem as a whole, including protecting particular species that are not targeted for exploitation. It also articulates the need to apply a precautionary approach to the management and development of marine living resources. With respect to protected area management, the MLRA provides for fisheries management areas, which can be "any area of the South African waters", and marine protected areas. Marine protected areas may be declared for three specific purposes, (a) for the protection of fauna and flora or particular species thereof and the physical features on which they depend; (b) to facilitate fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or (c) to diminish any conflict that may arise from competing uses in the area. Regulations promulgated under the MLRA aim to protect biodiversity by the use of different control measures, such as imposition of closed seasons, species restrictions and areas closed to fishing.

Local authority nature reserves

Local Authorities such as Metropolitan Councils, Regional District Services Councils, Municipalities, *etc.* may establish nature reserves on land which they control or manage. These reserves are proclaimed by the Premier by way of a notice in the Provincial Gazette in accordance with Article 7 of the Nature and Environmental Conservation Ordinance, 1974 (Ordinance 19 of 1974) (Appendix 3). The aim of local nature reserves is to encourage local authorities to protect significant species, ecosystems or physical features of the local environment.

Mountain catchment areas

Mountain catchment areas are set aside under the Mountain Catchment Areas Act 63 of 1970 with several objectives. They include water and soil conservation, and appropriate management of alien invasive vegetation. This act provides for the conservation, use, management and control of land situated in mountain catchment areas. Previously they were declared at the national level but since 1995 and the administration of the Act being assigned to the provinces, this situation has changed. A number of mountain catchment areas also fall within the protected areas. The Act provides for biodiversity protection within mountain catchment areas by different measures. One of these is the establishment of fire protection committees and the preparation of fire protection plans, to ensure that a proper management regime regulates the activity of preparing and maintaining firebreaks within mountain catchment areas. The

National Veld and Forest Fire Act provides that a fire protection committee established under the Mountain Catchment Areas Act may be recognised and registered as a fire protection association ("FPA") under the former Act. The Act also empowers the provincial authority responsible for administering it to prescribe management measures for catchment areas. The competent national or provincial authority may give binding directions to owners and occupiers of land situated within these areas in order to achieve the Act's objectives. The directions may relate among other things to the prevention of soil erosion and the protection of natural vegetation within the area.

PRIVATE CONSERVATION AREAS

Private nature reserves

Private landowners may apply to the Provincial Administration to establish a private nature reserve on their land or on parts of their land (Article 12 of Ordinance 19 of 1974) (Appendix 4). In order to qualify the land needs to be of viable size and should already be managed for conservation purposes. The main advantage for the landowner is the elevated conservation status that is associated with that of a proclaimed nature reserves.

Conservancies[1]

This conservation category is recognised throughout the country, but is not covered by any legislation. A conservancy consists of a group of landowners (normally with neighbouring properties) who jointly manage the land they own in such a way that predetermined objectives can be achieved. The areas have no legal conservation status and are managed and financed by the landowners themselves. Conservancies are, however, registered and recognised by W.C.N.C.B. as a viable conservation initiative.

Natural Heritage Sites

The South African Natural Heritage Programme was launched nationally by the Chief Directorate: Nature Conservation, of what is now the Department of Environment Affairs and Tourism. The purpose of the project is to provide assistance to private or public landowners in preserving natural areas, no matter how small, because of their scientific, aesthetic and/ or cultural value.

Biosphere Reserves

Biosphere Reserves are areas of land or marine ecosystems, incorporating formally conserved land and adjacent areas with compatible landuse and development practices which form part of the international Man and the Biosphere programme (MAB) coordinated by UNESCO, which is the organization which decides whether registration is approved or not.

APPENDIX II PERCENTAGE OF STATUTORY CONSERVATION AREAS IN THE WESTERN CAPE.

Reserve Type	Management Authority		Reserve Name	Area (Ha)	Total Area (Ha)
Wilderness Area	Western Cape Nature Conservation Board	1	Boosmansbos Wilderness Area	15 202.90	116 924.40
		2	Cederberg Wilderness Area	65 618.60	
		3	Doringrivier Wilderness Area	9 519.10	
		4	Grootwinterhoek Wilderness Area	26 583.80	
South African National Parks	South African National Parks Board	1	Bontebok National Park	2 835.50	90 283.22
		2	Cape Peninsula National Park	22 455.50	
		3	Karoo National Park	32 596.70	
		4	Knysna National Park	404.50	
		5	Tsitsikamma National Park (Western Cape Section only)	3 432.32	
		6	West Coast National Park	26 145.80	
		7	Wilderness National Park	2 412.90	
Provincial Nature Reserves	Western Cape Nature Conservation Board	1	Anysberg Nature Reserve	62 770.90	576 756.80
		2	Assegaaibosch Nature Reserve	197.80	
		3	Babilonstoring Nature Reserve	778.40	
		4	Baviaanskloof Wilderness Area	15 319.00	
		5	Ben-Etive Nature Reserve	5 095.20	
		6	Blomboschfontein Nature Reserve	265.20	
		7	Blouberg Nature Reserve	717.70	
		8	Bokkeriviere Nature Reserve	6 952.90	
		9	Botrivier Nature Reserve	273.40	
		10	Broomvlei Nature Reserve	183.50	
		11	De Hoop Nature Reserve	32 289.30	
		12	De Mond Nature Reserve	928.10	
		13	Driftsands Nature Reserve	435.00	
		14	Elandsbaai Nature Reserve	612.90	
		15	Fonteintjiesberg Nature Reserve	3 997.40	
		16	Gamkaberg Nature Reserve	9 592.00	
		17	Gamkapoort Nature Reserve	9 176.50	
		18	Garcia Nature Reserve	6 473.50	
		19	Gatplaats Nature Reserve	53.60	
		20	Geelkrans Provincial Nature Reserve	383.10	
		21	Goukamma Nature Reserve	2 282.90	
		22	Groenberg Nature Reserve	129.10	
		23	Groenefontein Nature Reserve	5 212.50	
		24	Groenlandberg Nature Reserve	5 122.40	
		25	Groot Swartberg Nature Reserve	83 905.60	
		26	Grootwinterhoek Nature Reserve	909.00	
		27	Harmony Flats Nature Reserve	9.60	
		28	Haweqwa Nature Reserve	46 313.20	
		29	Helderberg Nature Reserve	218.40	
		30	Hexberg Nature Reserve	1 679.50	
		31	Hottentots-Holland Nature Reserve	27 037.90	
		32	Houwhoek Nature Reserve	3 257.70	
		33	JN Briers Louw Nature Reserve	28.90	
		34	Kammanassie Nature Reserve	27 057.80	
		35	Kasteelberg Nature Reserve	393.70	
		36	Keurboomsrivier Nature Reserve	909.30	
		37	Kleinjongensfontein Nature Reserve	582.80	
		38	Kogelberg Nature Reserve	19 504.30	
		39	Maanschynkop Nature Reserve	784.80	
		40	Marloth Nature Reserve	11 237.20	
		41	Matjiesrivier Nature Reserve	12 800.40	
		42	Millwood Nature Reserve	4 503.20	
		43	Moedverloren Nature Reserve	7 495.30	
		44	Mt Hebron Nature Reserve	756.70	
		45	Paardeberg Nature Reserve	559.40	
		46	Paardenberg Nature Reserve	1 522.40	
		47	Pearly Beach Nature Reserve	630.80	
		48	Pela Nature Reserve	600.20	

Appendix II *(continued)*

Reserve Type	Management Authority		Reserve Name	Area (Ha)	Total Area (Ha)
		49	Quoin Point Nature Reserve	1 150.40	
		50	Riverlands Nature Reserve	1 111.60	
		51	Riviersonderend Nature Reserve	25 009.60	
		52	Robberg Nature Reserve	191.00	
		53	Rocherpan Nature Reserve	929.20	
		54	Rooiberg Nature Reserve	12 839.20	
		55	Ruitersbos Nature Reserve	17 851.60	
		56	Salmonsdam Nature Reserve	839.80	
		57	Seemeeu Broeikolonie	38.80	
		58	Simonsberg Nature Reserve	463.10	
		59	Soetendalsvlei Nature Reserve	415.10	
		60	Soetfontein Nature Reserve	54.30	
		61	Spioenkop Nature Reserve	1 256.40	
		62	Swartberg East Nature Reserve	18 766.30	
		63	Theewaters Nature Reserve	14 300.10	
		64	Towerkop Nature Reserve	18 991.50	
		65	Twistniet Nature Reserve	1 182.60	
		66	Tygerberg Nature Reserve	3 563.60	
		67	Uilkraalsmond Nature Reserve	805.70	
		68	Voëlklip Nature Reserve	0.50	
		69	Voëlvlei Nature Reserve	861.60	
		70	Vrolijkheid Nature Reserve	1 966.10	
		71	Waenhuiskrans Nature Reserve	266.80	
		72	Walker Bay Nature Reserve	3 588.00	
		73	Warmwaterberg Nature Reserve	2 692.80	
		74	Waterval Nature Reserve	6 834.50	
		75	Witbosrivier Nature Reserve	503.50	
		76	Witfontein Nature Reserve	13 890.80	
		77	Wittebrug Nature Reserve	1 582.70	
		78	Witzenberg Nature Reserve	1 637.00	
		79	Zuurberg Nature Reserve	1 232.20	
Contractual Provincial Nature Reserve	Western Cape Nature Conservation Board		SAS Saldahna Contractual Nature Reserve	932.90	932.90
Island Reserves	Western Cape Nature Conservation Board	1	Bird Island Reserve	3.54	295.34
		2	Dassen Island Reserve	231.20	
		3	Dyer Island Reserve	15.70	
		4	Elephant Rock Island Reserve	0.80	
		5	False Bay Seal Island Reserve	3.00	
		6	Geyser Island Reserve	1.90	
		7	Jacob's Rock Island Reserve	0.50	
		8	Mossel Bay Seal Island Reserve	2.70	
		9	Paternoster Rock Island Reserve	19.10	
		10	Quoin Rock Island Reserve	0.40	
		11	Seal Ledges Island Reserve	0.90	
		12	Vondeling Island Reserve	15.60	
Marine Protected Areas	Western Cape Nature Conservation Board	1	De Hoop Marine Reserve	31 843.00	41 929.60
		2	Dyer & Geyser Island Marine Reserve	232.60	
		3	Goukamma Marine Reserve	2 900.00	
		4	Robberg Marine Reserve	1 897.80	
		5	Rocherpan Marine Reserve	896.30	
		6	West Coast National Park Marine Reserve	4 159.90	
Local Authority Nature Reserve	Various district councils and municipalities	1	Aloeridge	4.20	25 582.40
		2	Bracken	35.10	
		3	Caledon	261.60	
		4	Ceres Mountain Fynbos	6 840.20	
		5	Columbine	267.30	
		6	Dassieshoek	754.50	
		7	Die Fort	114.40	
		8	Durbanville	6.50	

Appendix II *(continued)*

Reserve Type	Management Authority		Reserve Name	Area (Ha)	Total Area (Ha)
		9	Fernkloof	1 379.90	
		10	Greyton	2 069.70	
		11	Heidelberg	3.70	
		12	Helderberg	265.40	
		13	Heuningberg	905.20	
		14	Jan Marais	24.20	
		15	Kalbaskraal	37.10	
		16	Katrivier	79.50	
		17	Kleinmond Coast and Mountain	671.60	
		18	Ladismith-Kleinkaroo	2 771.30	
		19	Mont Rochelle	1 681.20	
		20	Montagu Eeufees	14.70	
		21	Montagu Mountain	1 187.70	
		22	Paardenberg	382.80	
		23	Paarl Mountain	2 038.50	
		24	Pauline Bohnen	374.10	
		25	Pledge	25.30	
		26	Raapenberg	19.60	
		27	Ramskop	66.20	
		28	Rondevlei Bird Sanctuary	135.30	
		29	Rooi-els	5.70	
		30	Skulpiesbaai	100.60	
		31	Touw	1 713.10	
		32	Tygerberg (Bellville)	210.80	
		33	Van Kervel	14.10	
		34	Villiersdorp	530.40	
		35	Werner Frehse	195.60	
		36	Wolfgat	243.50	
		37	Yzerfontein Local Nature Reserve	129.10	
		38	Zandvlei Bird Sanctuary	22.70	
Mountain Catchment Area	Western Cape Nature Conservation Board & Private Landowner	1	Anysberg	6 269.80	619 037.70
		2	Grootswartberg	9 604.20	
		3	Hawequas	51 599.70	
		4	Hottentots-Holland	24 740.90	
		5	Kammanassie	30 290.00	
		6	Klein Swartberg	32 574.00	
		7	Koue Bokkeveld	97 286.10	
		8	Langeberg -Oos/East	41 362.40	
		9	Langeberg -Wes	63 307.20	
		10	Matroosberg	82 268.70	
		11	Riviersonderend	45 278.40	
		12	Rooiberg	12 543.70	
		13	Sederberg	59 405.20	
		14	Swartberg-Oos	10 501.00	
		15	Winterhoek	52 006.40	

APPENDIX III PERSENTAGE OF PRIVATE CONSERVATION AREAS IN THE WESTERN CAPE

Reserve Type	Management Authority		Reservename	Area (Ha)	Total Area (Ha)
Private Nature Reserves	Private Landowners	1	Andrewsfield Private Nature Reserve	983.90	122 398.60
		2	Annet Private Nature Reserve	127.40	
		3	Annex Arch Rock Private Nature Reserve	55.80	
		4	Banghoek Private Nature Reserve	1 034.90	
		5	Basjanskloof Private Nature Reserve	3 787.30	
		6	Bergwater Private Nature Reserve	304.90	
		7	Blaauw Mountain Private Nature Reserve	339.50	
		8	Blomberg Private Nature Reserve	278.40	
		9	Blombos Private Nature Reserve	64.80	
		10	Blydskap Private Nature Reserve	14.40	
		11	Bobbejaanskloof Private Nature Reserve	133.50	
		12	Bojaansklip Private Nature Reserve	212.90	
		13	Boontjiesrivier Private Nature Reserve	73.90	
		14	Botterboom Private Nature Reserve	705.20	
		15	Brackenburn Private Nature Reserve	150.20	
		16	Brandfontein-Rietfontein Private Nature Reserve	5 903.90	
		17	Brian Mansergh Private Nature Reserve	84.40	
		18	Buitenverwachting Private Nature Reserve	241.90	
		19	Camphill Village Private Nature Reserve	16.30	
		20	Cederberg Private Nature Reserve	4 099.20	
		21	Chaynouqua Private Nature Reserve	59.90	
		22	Coppull Private Nature Reserve	91.70	
		23	De Walle Private Nature Reserve	4.70	
		24	Die Duine Private Nature Reserve	774.90	
		25	Die Poort Private Nature Reserve	1 147.60	
		26	Diepklowe Private Nature Reserve	213.80	
		27	Donkins Bay Private Nature Reserve	849.30	
		28	Doornkloof Private Nature Reserve	564.00	
		29	Doorspring Private Nature Reserve	306.30	
		30	Drie Kuilen Private Nature Reserve	3 506.20	
		31	Drooge Riviers Berg Private Nature Reserve	956.00	
		32	Duiwenhoksriviermond Private Nature Reserve	281.10	
		33	Eagle Rock Private Nature Reserve	32.30	
		34	Eagles Rest Private Nature Reserve	19.00	
		35	Eastford Private Nature Reserve	90.50	
		36	Elandsberg Private Nature Reserve	2 766.90	
		37	Elim Private Nature Reserve	1 842.20	
		38	Eyerpoort Private Nature Reserve	3 612.10	
		39	Fairhill Private Nature Reserve	274.50	
		40	Featherbed Private Nature Reserve / SANHP	57.00	
		41	Freshwater Sands Private Nature Reserve	782.50	
		42	Fynbos Ridge Private Nature Reserve	5.60	
		43	Fynbosrand Private Nature Reserve	104.10	
		44	George Private Nature Reserve	36.00	
		45	George Private Nature Reserve (Kleinbaai)	3.70	
		46	Gouriqua_KERNKOR Private Nature Reserve	2 445.30	
		47	Greylands Private Nature Reserve	476.10	
		48	Groenfontein Private Nature Reserve	1 646.20	
		49	Groenkant Private Nature Reserve	140.80	
		50	Groot Hagelkraal Private Nature Reserve	1 321.50	
		51	Groot Paternoster Private Nature Reserve	340.00	
		52	Grootbos Private Nature Reserve	121.40	

Appendix III *(continued)*

Reserve Type	Management Authority		Reservename	Area (Ha)	Total Area (Ha)
		53	Grootdam Private Nature Reserve	178.60	
		54	Grotto Bay Private Nature Reserve	963.90	
		55	Hannes Zaaiman Private Nature Reserve	166.80	
		56	Hans' Gift Private Nature Reserve	73.20	
		57	Hasekraal Private Nature Reserve	1 179.10	
		58	Hebron Private Nature Reserve	14.20	
		59	Hessequa Hills Private Nature Reserve	111.30	
		60	Heunings River Private Nature Reserve	292.80	
		61	Hoek-van-die-Berg Private Nature Reserve	407.00	
		62	Hog Hollow Private Nature Reserve	12.30	
		63	Hopefield Private Nature Reserve	1 721.10	
		64	Inverdoorn Private Nature Reserve	8 991.30	
		65	Jakkalsfontein Private Nature Reserve	1 817.80	
		66	Jan Malherbe Private Nature Reserve	245.00	
		67	Jongensgat Private Nature Reserve	145.00	
		68	Joostenberg Private Nature Reserve	59.60	
		69	Kaaimans Rivier Gorge Private Nature Reserve	12.60	
		70	Kanaland Private Nature Reserve	721.10	
		71	Kanon Private Nature Reserve	42.20	
		72	Kapklip Private Nature Reserve	1 367.90	
		73	Karindal Private Nature Reserve	5.40	
		74	Kiaruna Private Nature Reserve	66.00	
		75	Klein Cedarberg Private Nature Reserve	989.50	
		76	Klein Ezeljagt Private Nature Reserve	153.40	
		77	Klein Houwhoek Private Nature Reserve	1 158.10	
		78	Kleinberg Private Nature Reserve	1 604.60	
		79	Kleinrivier Private Nature Reserve	622.40	
		80	Kleyn Kloof Private Nature Reserve	27.40	
		81	Klipfontein Private Nature Reserve	2 540.30	
		82	Koeberg Private Nature Reserve	1 558.80	
		83	Koopmanskloof Private Nature Reserve	119.70	
		84	Kwelanga Private Nature Reserve	9.30	
		85	Langerug Private Nature Reserve	114.90	
		86	Lanverwagt Private Nature Reserve	8.40	
		87	Matroosberg Private Nature Reserve	0.00	
		88	Mooiplaas Private Nature Reserve	32.90	
		89	Mosselbankfontein Private Nature Reserve	245.40	
		90	Nantekara Private Nature Reserve	5.00	
		91	Ollishof Private Nature Reserve	22.40	
		92	Op -De -Berg Private Nature Reserve	423.30	
		93	Opdrag Private Nature Reserve	0.00	
		94	Orca Private Nature Reserve	72.20	
		95	Ortmansgat Private Nature Reserve	760.80	
		96	Oude Bosch Private Nature Reserve	579.90	
		97	Patrys Kloof Private Nature Reserve	1 637.70	
		98	Pierre-Jeanne Gerber Nr. 2 Private Nature Reserve	25.60	
		99	Pierre Jeanne Gerber Nr. 3 Private Nature Reserve	22.70	
		100	Pierre-Jeanne Gerber Nr. 10 Private Nature Reserve	83.10	
		101	Plettenberg Bay Country Club Private Nature Reserve	67.70	
		102	Quaggas Berg Private Nature Reserve	810.20	
		103	Red Hill Fynbos Private Nature Reserve	841.50	
		104	Renosterkop Private Nature Reserve	1 005.50	
		105	Riebeekriviers Private Nature Reserve	71.80	
		106	Rivendell Private Nature Reserve	24.10	

Appendix III *(continued)*

Reserve Type	Management Authority		Reservename	Area (Ha)	Total Area (Ha)
		107	Riverine Rabbit Private Nature Reserve	1 806.50	
		108	Rondeberg Oord Private Nature Reserve	204.50	
		109	Rondeberg Private Nature Reserve	817.40	
		110	Rooikrans Private Nature Reserve	3 455.50	
		111	Ruvami Private Nature Reserve	422.90	
		112	San Sebastian Private Nature Reserve	457.20	
		113	Sandies Glen Private Nature Reserve	132.20	
		114	Sangebethu Private Nature Reserve	1 882.70	
		115	Sea Farm Private Nature Reserve	259.30	
		116	Sepree River Private Nature Reserve	1 772.10	
		117	Seven Puts Private Nature Reserve	979.10	
		118	Skuilkrans Private Nature Reserve	1 852.70	
		119	Skuilte Private Nature Reserve	15.70	
		120	Soopjeshoogte Private Nature Reserve	801.20	
		121	Southview Private Nature Reserve	3.40	
		122	Stalkrans Private Nature Reserve	77.00	
		123	Steenbokkie Private Nature Reserve	3 492.90	
		124	Steenboksfontein Private Nature Reserve	816.80	
		125	Stilbaai Fynbos Private Nature Reserve	639.10	
		126	Sustersdal Private Nature Reserve	3 128.60	
		127	Swartriet Private Nature Reserve	70.90	
		128	Taayskloof Private Nature Reserve	4 289.40	
		129	Tankwa Private Nature Reserve	1 477.40	
		130	Ten Einde Private Nature Reserve	180.20	
		131	The Gums Private Nature Reserve	22.70	
		132	The Lagoon 2 Private Nature Reserve	39.50	
		133	Vaalkloof Private Nature Reserve	5 480.30	
		134	Vergaderingskop Private Nature Reserve	238.60	
		135	Vogelgat Private Nature Reserve	606.20	
		136	Wadrif Private Nature Reserve	477.40	
		137	Wakkerstroom Private Nature Reserve	1 636.80	
		138	Wargundy Private Nature Reserve	3.40	
		139	Waterfall Private Nature Reserve	140.00	
		140	Waterkop Private Nature Reserve	309.10	
		141	Waterval Private Nature Reserve	248.70	
		142	West Point Private Nature Reserve	100.40	
		143	Westford Bridge Private Nature Reserve	109.30	
		144	Whispering Hills Private Nature Reserve	259.70	
		145	Wiesenhof Wildpark Private Nature Reserve	175.30	
		146	Witdraai Private Nature Reserve	1 053.20	
		147	Zeven Puts Private Nature Reserve	644.20	
		148	Zwartbosch Private Nature Reserve	5 121.70	
Conservancies	Private landowners				
		1	Akkedisberg Conservancy	7 197.80	563 120.50
		2	Badsberg Conservancy	6 329.20	
		3	Benede Bergrivier ConservancyMnr A.A. Melck	31 358.80	
		4	Biedouw Conservamcy	0.30	
		5	Blinkwater Conservancy	646.60	
		6	Blombos Conservancy	2 228.90	
		7	Boggomsbaai Conservancy	80.80	
		8	Bosrivier	1 312.00	
		9	Bottelary Hills Renosterveld Conservancy	662.80	
		10	Cape West Coast Conservancy	8 193.20	
		11	Cedarberg Conservancy	135 131.00	
		12	Danabaai Conservancy	355.00	
		13	Fransmanshoek Conservancy	265.20	
		14	Gounaland Conservancy	641.20	

Appendix III *(continued)*

Reserve Type	Management Authority		Reservename	Area (Ha)	Total Area (Ha)
		15	Gouriqua Conservancy	3 746.00	
		16	Great Brak River Conservancy	2 145.70	
		17	Groenfontein Conservancy	15 025.10	
		18	Groenlandberg Conservancy	22 202.30	
		19	Grootvadersbosch Conservancy	17 548.80	
		20	Hartenbos Heuwels Conservancy	115.50	
		21	Herold Conservancy	4 834.60	
		22	Indalo Conservancy (Boschfontein)	959.70	
		23	Jonkershoek Conservancy	1 644.60	
		24	Kasteelberg Conservancy	8 764.00	
		25	Klein Swartberg Conservancy	14 857.30	
		26	Kleinriviersberg Conservancy	1 860.40	
		27	Kromriver Conservancy	37 198.10	
		28	Lambert's Bay/Strandveld Conservamcy	12 520.20	
		29	Lower Breede River Conservancy	34 063.20	
		30	Midbrak Consevancy	14.20	
		31	Paardenberg Conservancy	9 187.10	
		32	Rooiberg Conservancy	1 211.30	
		33	Sakrivier Conservancy	79 918.60	
		34	Sneeuberg Conservancy	0.10	
		35	St Blaize Conservancy	306.50	
		36	Swartguggens Conservancy	0.00	
		37	The De Draay Conservancy	3 887.20	
		38	The Noetsie Conservancy	11.30	
		39	Theewaters Conservancy	22 306.10	
		40	Voelvlei Conservancy	26 544.30	
		41	Walker Bay Fynbos Conservancy	10 831.20	
		42	Wupperthal Conservancy	36 693.60	
		43	Yserfontein Conservancy	320.70	
South African Natural Heritage Sites	Private Landowners				
		1	9 Divisie HK (Ou 6BKD)	220.60	33 198.40
		2	Altydgedacht	28.90	
		3	Barkai	74.00	
		4	Bo-Boschkloof (A)	140.80	
		5	Bo-Boschkloof (B)	128.90	
		6	Boesmanskloof	5 311.90	
		7	Boontjieskraal	85.50	
		8	Brandfontein Private Nature Reserve	544.60	
		9	Buffelspoort (Kaap)	3 253.60	
		10	Drayton Siding	160.20	
		11	Duthie Reservaat	30.40	
		12	Elandsberg	2 771.50	
		13	Featherbed Nature Reserve	49.00	
		14	Forest Hill	31.90	
		15	Groenfontein Private Nature Reserve	1 646.20	
		16	Groothagelkraal	1 360.30	
		17	Gys Se Kraal	1 081.60	
		18	Klawer Valley	18.60	
		19	Klipheuwel Radiostasie	69.90	
		20	Krabbefontein	87.50	
		21	Muldersvlei	24.50	
		22	Paapekuilfontein	830.20	
		23	Paardenberg-Bewarea	9 155.60	
		24	Perdefontein	58.90	
		25	Plattekloof 430	249.60	
		26	Purgatory Outspan Gedeelte 1	120.20	

Appendix III *(continued)*

Reserve Type	Management Authority		Reservename	Area (Ha)	Total Area (Ha)
		27	Renosterkop Private Nature Reserve	800.10	
		28	Rietvlei	178.30	
		29	Robben Island	479.10	
		30	Sea Farm	90.00	
		31	Silwerboomkloof	23.50	
		32	Somchem	24.80	
		33	Sterboom	71.10	
		34	Tierberg	1 230.70	
		35	Visgat Natural Heritage Site	2 158.60	
		36	Vogelgat Private Nature Reserve	607.30	
Biosphere Reserves	Private landwoners	1	Kogelberg Biosphere Reserve (land and sea)	112 072.70	460 818.10
		2	West Coast Biosphere Reserve (land, lagoon, sea and island)	384 745.40	