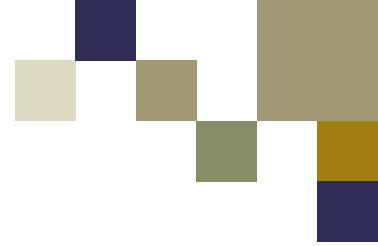


5. Biodiversity and
Ecosystem Health



Biodiversity is defined in the Biodiversity Act (Act No. 10 of 2004) as “the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species and of ecosystems” (Government of South Africa, 2004). Ecosystem is also defined in the Biodiversity Act as “a dynamic complex of animal, plant and micro-organism communities and their non-living environment interacting as a functional unit” (Government of South Africa, 2004).

5. BIODIVERSITY AND ECOSYSTEM HEALTH

Ecosystems include biotic communities (plants, animals, microbes) and abiotic factors (water, temperature, soil type). Ecosystems and their elements provide food, water, fibres, energy, raw materials, industrial chemicals, and medicines. Biodiversity also contributes to economic growth and development such as tourism and the cultivation of indigenous species. International and national research has shown that degradation of ecosystems leads to a reduction in ecosystem services, such as a reduced capacity to generate clean water and a loss of food production due to land degradation (DEAT, 2005). These losses are often felt disproportionately by the urban and rural poor, who are most exposed to the effects of pollution and who rely directly on the natural environment for their livelihoods.

Due to past policies, especially with regard to the former homelands, overcrowding has occurred in these areas resulting in a negative impact on the biodiversity of the region. Unsustainable farming practices, as well as farming in marginal areas and the removal of vegetation contribute to biodiversity loss. About 60% of the grassland biome in the Free State has been irreversibly transformed through development, such as urban settlements, mining, agriculture and industrial facilities. Currently, about 6% of the land surface of South Africa is formally conserved through the system of national and provincial protected areas. The target is to expand this figure to 8% by 2010 (DEAT, 2005). In the Free State, currently 3.4% of the land surface is protected.

Virtually all ecosystems and habitats in South Africa have been modified or transformed by human activities. Three key inter-related threats to biodiversity and ecosystem health

are: habitat removal, invasive alien species and climate change (DEAT, 2005). Invasive alien species are said to pose the second biggest threat to biodiversity after habitat destruction, and as a result they impede sustainable development. Scenario modelling predicts that the country’s biomes are likely to shrink to about 38 - 55% of their current area by 2050 as a result of climate change (DEAT, 2005a). Higher levels of atmospheric carbon and reduced occurrence of frost are expected to encourage tree growth and an expansion of the savanna biome into the grassland biome (see Chapter 7).

While conditions differ for different ecosystems and parts of the country, in general South Africa’s biodiversity and ecosystem health are declining, and climate change is predicted to have a severe impact on biodiversity. Some 34% of South Africa’s terrestrial ecosystems are categorised as threatened, mainly due to loss and degradation of natural habitat, through, for example, cultivation, deforestation, urban and coastal sprawl, mining, and invasion by alien species. 82% of our main river ecosystems are classified as threatened; it is estimated that 50% of our wetlands have already been destroyed; and 36% of freshwater fish are threatened. River ecosystems are under pressure from over-abstraction of water, for a range of uses, including agricultural, industrial and residential. Poor management of land also directly impacts river biodiversity.

Source: DEAT, 2006



5.1 The State of the Free State Ecosystems

5.1.1 Terrestrial Ecosystem

Four biomes occur within the Free State, namely grassland (72% of the province), Nama Karoo (22%), savanna (5.95%) and forest (0.05%) (Figure 5.1).

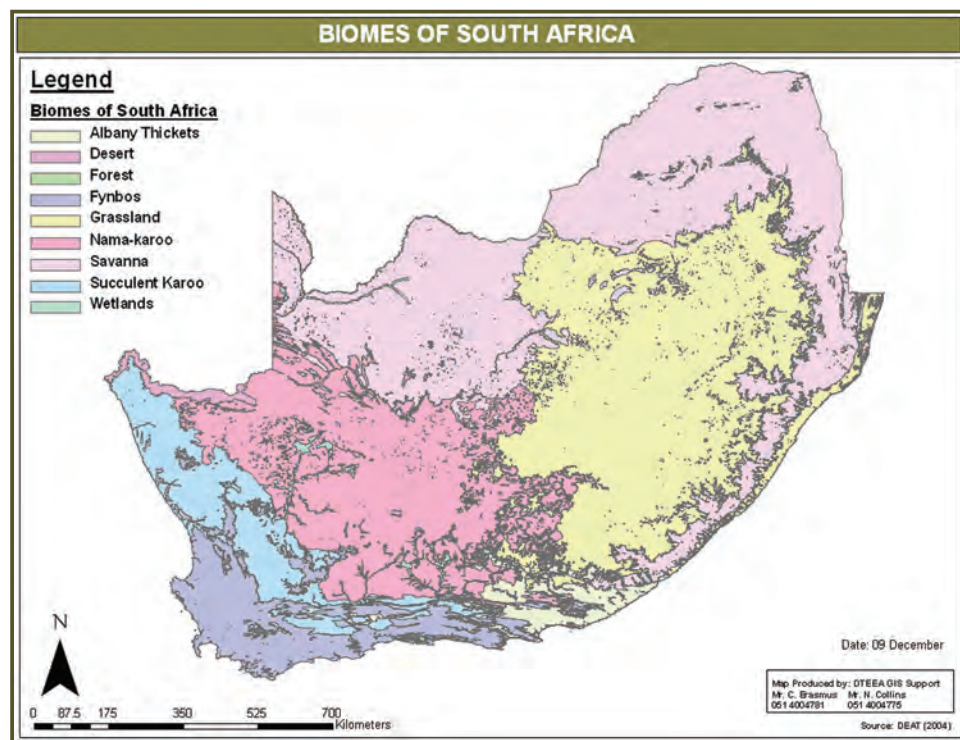


Figure 5.1: Biomes of South Africa

Within these biomes, a total of 37 vegetation units can be found in the Free State (25 in the grassland biome, 5 in the savanna biome, 1 in the Nama Karoo biome, 1 in the forest biome as well as 2 azonal alluvial and 3 inland wetland vegetation types) (Mucina & Rutherford, 2006). Eight grassland vegetation units are restricted to the Free State, namely Xhariep Karroid Grassland, Bloemfontein Dry Grassland, Central Free State Grassland, Winburg Grassy Shrubland, Western Free State Clay Grassland, Eastern Free State Clay Grassland, Frankfort Highveld Grassland and Northern Free State Shrubland (Figure 5.2).

Of the 37 vegetation units, 7 are categorised as “Endangered (E)”, according to the conservation categories proposed by Mucina and Rutherford¹, 6 as “Vulnerable (V)” and 24 as “Least Threatened (LT)” (Table 5.1) (Mucina & Rutherford, 2006).

¹ Indication of the percentage of untransformed surface area remaining. Endangered is when 60% remains, vulnerable when 80% remains and least threatened up to 100%.



Table 5.1: Free State Provincial Nature Reserves

Vegetation Units	Total	Endangered	Vulnerable	Least Threatened
<i>Grassland vegetation units</i>	25	7	5	13
Dry Highveld Grassveld Bioregion	10	3	1	6
Mesic Highveld Grassland Bioregion	10	4	4	2
Drakensberg Grassland Bioregion	4			4
Sub-escarpment Grassland Bioregion	1			1
<i>Savanna vegetation units</i>	5			5
Central Bushveld Bioregion	2			2
Eastern Kalahari Bushveld Bioregion	3			3
Nama Karoo Bioregion	1			1
Forest	1			1
Azonal Alluvial Vegetation	2		1	1
Inland Wetlands	3			3
Free State vegetation units	37	7	6	24

Source: Mucina & Rutherford, 2006

The grasslands in the north western and north eastern areas of the Free State are identified as priority conservation areas in the National Biodiversity Strategy and Action Plan (Figure 5.3) (DEAT, 2005). The current status of protection of the vegetation units is tabulated in Table 5.2.



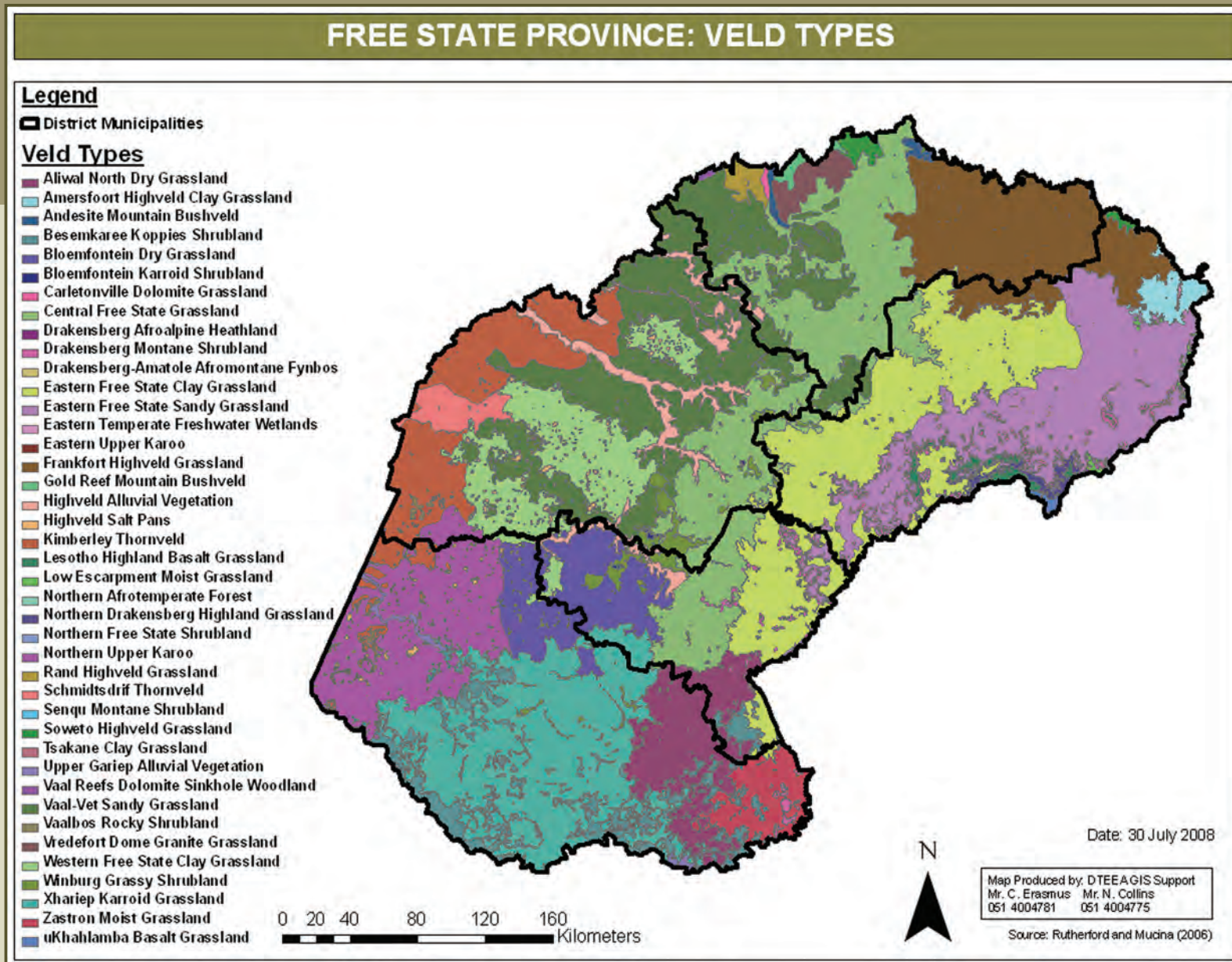


Figure 5.2: Veld types in the Free State

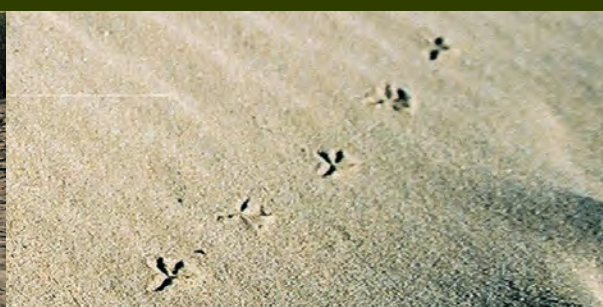
Table 5.2: Conservation status of vegetation units

Biome	Vegetation Unit	Status	% Conserved	% Transformed	Conservation Status	Free State Nature Reserve in which it occurs
Grassland Biome - Dry Highland Grassland Bioregion						
Gh2	Aliwal North Dry Grassland	LT	small	12	Hardly Protected	Caledon Nature Reserve
Gh3	Xhariep Karroid Grassland	LT	2.5	4	Hardly Protected	Gariiep Nature Reserve Tussen-die-Riviere Nature Reserve Kalkfontein Dam Nature Reserve
Gh4	Besemkaree Koppies Shrubland	LT	5	3	Poorly Protected	Tussen-die-Riviere Nature Reserve Gariiep Nature Reserve Caledon Nature Reserve Kalkfontein Dam Nature Reserve
Gh5	Bloemfontein Dry Grassland	E	small	40	Hardly Protected	Soetdoring Nature Reserve
Gh6	Central Free State Grassland	V	small	25	Hardly Protected	Willem Pretorius Nature Reserve Rustfontein Dam Nature Reserve Koppies Dam Nature Reserve
Gh7	Winburg Grassy Shrubland	LT	2	10	Hardly Protected	Willem Pretorius Nature Reserve
Gh8	Bloemfontein Karroid Shrubland		0	10	Not Protected	Willem Pretorius Game Reserve
Gh9	Western Free State Clay Grassland	LT	0	20	Not Protected	
Gh10	Vaal-Vet Sandy Grassland	E	0.3	63	Hardly Protected	Sandveld Nature Reserve Soetdoring Nature Reserve
Gh11	Vredefort Dome Granite Grassland	E	0	80	Not Protected	Vredefort Dome World Heritage Site
Grassland Biome - Mesic Highland Grassland Bioregion						
Gm1	Zastron Moist Grassland	V	0	33	Not Protected	
Gm2	Senqu Montane Shrubland	LT	0	14	Not Protected	
Gm3	Eastern Free State Clay Grassland	E	small	75	Hardly Protected	Willem Pretorius Nature Reserve
Gm4	Eastern Free State Sandy Grassland	E	2	50	Hardly Protected	Owaqwa National Park Golden Gate National Park Sterkfontein Dam Nature Reserve

Biome	Vegetation Unit	Status	% Conserved	% Transformed	Conservation Status	Free State Nature Reserve in which it occurs
Gm5	Basotho Montane Shrubland	V	2		Hardly Protected	Qwaqwa National Park Golden Gate National Park Sterkfontein Dam Nature Reserve
Gm6	Frankfort Highveld Grassland	V	0	>33	Not Protected	
Gm7	Northern Free State Shrubland	LT	0	-	Not Protected	
Gm8	Soweto Highveld Grassland	E	little	50	Hardly Protected	
Gm11	Rand Highveld Grassland	E	1	-	Hardly Protected	
Gm13	Amersfoort Highveld Clay Grassland	V	0	25	Not Protected	
Grassland Biome - Drakensberg Grassland Bioregion						
Gd5	Northern Drakensberg Highland Grassland	LT	38	7	Well Protected	Sterkfontein Dam Nature Reserve Golden Gate National Park Qwaqwa National Park
Gd6	Drakensberg-Amathole Afromontane Fynbos	LT	>50	-	Well Protected	Golden Gate National Park Qwaqwa National Park
Gd7	uKhahlambo Basalt Grassland	LT	75	-	Well Protected	
Gd8	Lesotho Highland Basalt Grassland	LT	1	10	Hardly Protected	Golden Gate National Park
Grassland Biome - Sub-Escarpment Grassland Bioregion						
Gs3	Low Escarpment Moist Grassland	LT	2	6	Hardly Protected	Sterkfontein Dam Nature Reserve
Savanna Biome - Central Bushveld Bioregion						
Svcb9	Gold Reef Mountain Bushveld	LT	22	15	Well Protected	
Svcb11	Andesite Mountain Bushveld	LT	7	15	Poorly Protected	

Biome	Vegetation Unit	Status	% Conserved	% Transformed	Conservation Status	Free State Nature Reserve in which it occurs
Savanna Biome - Eastern Kalahari Bushveld						
Svk4	Kimberley Thornveld	LT	2	18	Hardly Protected	Sandveld Nature Reserve
Svk5	Vaalbos Rocky Shrubland	LT	<2	2	Hardly protected	
Svk6	Schmidtsdrif Thornveld	LT	2	13	Hardly protected	
Nama Karoo Biome - Upper Karoo Bioregion						
Nku3	Northern Upper Karoo	LT	0	4	Not Protected	
Azonal And Intrazonal Forest						
Foz2	Northern Afrotropical Forest	LT	30	-	Well Protected	
Azonal Alluvial Vegetation						
Aza4	Upper Gariep Alluvial Vegetation	V	3	>20	Hardly Protected	Tussen-die-Riviere Nature Reserve Gariep Nature Reserve
Aza5	Highveld alluvial Vegetation	LT	10	>25	Poorly Protected	Sandveld Nature Reserve Soetdoring Nature Reserve
Inland Wetlands						
Azf3	Eastern Temperate Freshwater Wetlands	-	5	15	Poorly Protected	Seekoivlei Nature Reserve
Azf4	Drakensberg Wetlands	-	>50	3	Well Protected	
Inland Saline Vegetation						
Azi10	Highveld Salt Pans	-	Small portion	4	Hardly Protected	Soetdoring Nature Reserve

Source: Mucina & Rutherford, 2006



There are currently 18 provincial nature reserves occupying a total area of 207,996 hectares, which represents only 1.6% of the Province (Table 5.3). The extent of the provincial nature reserves is currently under review as discrepancies exist between the area of land being managed and the original proclamation notices.

Table 5.3: Free State Provincial Nature Reserves

Nature Reserve	Total Area (Ha)			Managed by
	Water	Land	Total	
Bathurst Nature Reserve	0	154	154	DTEEA (Not formally proclaimed)
Caledon Nature Reserve	1,485	2,219	3,704	DTEEA
Erfenis Dam Nature Reserve	4,171	400	4,571	DTEEA
Ficksburg Nature Reserve	0	134	134	Not Managed as a Nature Reserve
Gariep Nature Reserve	36,000	15,737	51,737	DTEEA
Kalkfontein Dam Nature Reserve	6,319	162	6,481	DTEEA
Karee Nature Reserve	0	10	10	DTEEA – Managed as Provincial Nursery
Koppies Dam Nature Reserve	1,360	4,325	5,685	DTEEA
Maria Moroka Nature Reserve	100	5,490	5,590	DTEEA
QwaQwa Nature Reserve	0	21,285	21,285	DTEEA
Rustfontein Dam Nature Reserve	2,230	5,081	7,311	DTEEA
Sandveld Nature Reserve	22,300	15,523	37,823	DTEEA
Seekoeivlei Nature Reserve	0	4,415	4,415	DTEEA
Soetdoring Nature Reserve	2,056	4,117	6,173	DTEEA
Sterkfontein Dam Nature Reserve	6,940	10,830	17,770	DTEEA
Tussen-die-Riviere Nature Reserve	0	22,800	22,800	DTEEA
Willem Pretorius Game Reserve	2,648	9,443	12,091	DTEEA
Wuras Dam Nature Reserve	40	222	262	DTEEA
Total Area	85,650	124,062	207,996	

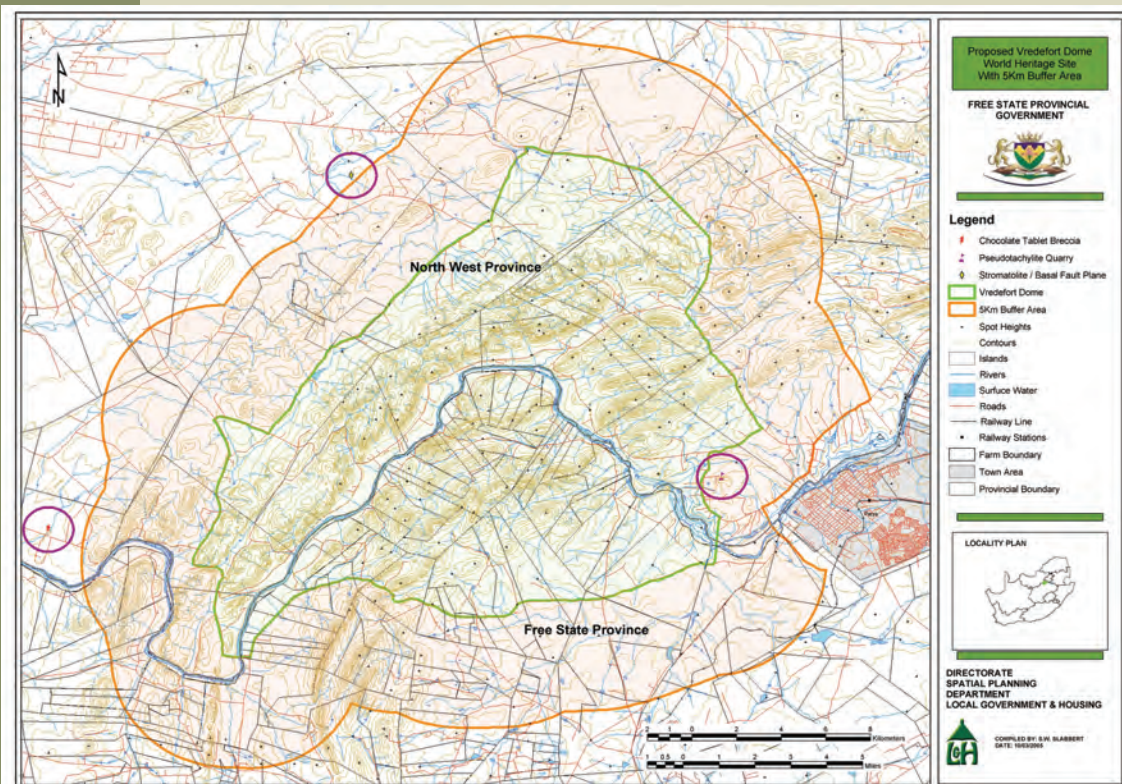
Source: DTEEA Database, 2008

Other areas of conservation significance include the Maloti-Drakensberg Transfrontier Conservation Area, the Vredefort Dome and the high altitude grassland areas from Memel to Van Reenen along the Free State and KwaZulu-Natal provincial border.

The Maloti-Drakensberg Transfrontier Conservation Area is a transboundary initiative in Lesotho and South Africa. 22,800It includes a conservation area and World Heritage Site, which was included on UNESCO's World Heritage List in December 2000. The conserved areas include the Ukhahlamba World Heritage Site, Golden Gate National Park, QwaQwa National Park, Sterkfontein Dam Nature Reserve, and conserved areas within Lesotho.

reserve that was established specifically to protect and conserve the wetlands. In addition, there are generally narrow strips of land around the dams at the reserves that are too small to support a fully functioning ecosystem, including large mammals. Although most of the species present on the provincial reserves are of Least Concern² (based on the Red Data List), some species are listed in higher categories of vulnerability.

² The conservation status of a taxon is considered of Least Concern when it has been evaluated against the IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category



The Vredefort Dome is the oldest and largest clearly visible meteorite impact site in the world (DTEEA, 2008). It was declared as South Africa's seventh World Heritage Site in July 2005. The site also comprises a range of ecosystems covering about 40,000 hectares.

Most of the provincial Nature Reserves are located around state owned dams (Figure 5.4). The land was originally purchased by DWAF, primarily as a precautionary mechanism against flooding, and subsequently transferred to the DTEEA (then the Department of Nature and Environmental Conservation) for development and management. Consequently, the reserves are fragmented areas throughout the province, which were not selected for their importance in regard to biodiversity or cultural heritage. Seekoeivlei Nature Reserve (a Ramsar Site) is the only



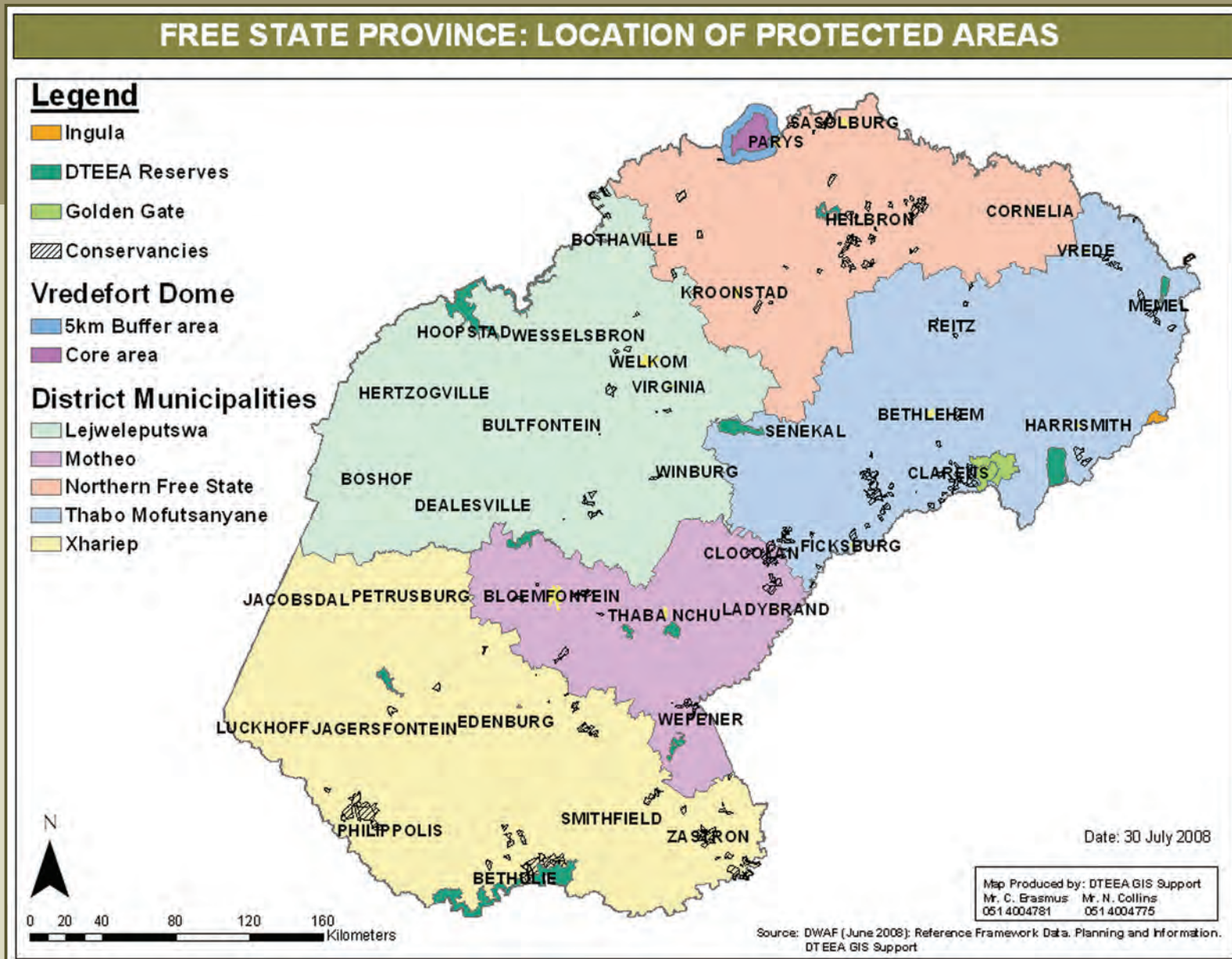


Figure 5.4: Location of Protected Areas in the Free State

In addition to the provincial nature reserves, 253 Private Nature Reserves are located within the Province representing a further 218,840 hectares of protected area (1.76% of the Province). The location of these reserves was dependent upon the willingness of the landowners to have their properties declared as nature reserves. This has resulted in a fragmented network of areas that were not selected for their role in biodiversity conservation. The extent of the private nature reserves is currently being reviewed in order to verify data and update the Protected Area Register.

Land that is owned by other government departments, such as the South African National Defence Force (e.g. military training grounds in and near Bloemfontein, Bethlehem and Wepener) are also protected areas.

The total area of land under formal protection is summarised in Table 5.4.

Table 5.4: Summary of land under formal protection in the Free State

Governing Body	Surface area under protection (hectares)	Agency
National	11,600	SAN Parks
Provincial	207,996	DTEEA
Municipal/Local	7,821	Proclaimed as Private Nature Reserves
Private	218,840	Proclaimed Private Nature Reserves
SANDF	1,187	Vaalbank Private Nature Reserves
Total	447,444 (3.4%)	

Currently, 256 conservancies have been established throughout the Province covering 900,000 hectares. Through this programme, 857 rural rangers and 1,280 urban rangers have been trained in management of conservancies. This includes issues of poaching, protection of indigenous flora and fauna, management of invasive aliens, and management of waterways.

Management plans have been developed for all protected areas. A strategy has been developed by the DTEEA regarding the expansion of the protected areas and ultimately biodiversity conservation (DTEEA, 2007). Three key actions are proposed that will be addressed by the Biodiversity Plan that is currently being developed:

- Establishment of a dedicated unit within the Conservation Directorate at the DTEEA for the support of biodiversity conservation initiatives to extend the protected areas, particularly the private protected areas.

- Verification of the extent of all provincial and private nature reserves.
- Identification and prioritisation of areas of biodiversity significance and their appropriate management.

Braamhoek Pumped Storage Scheme

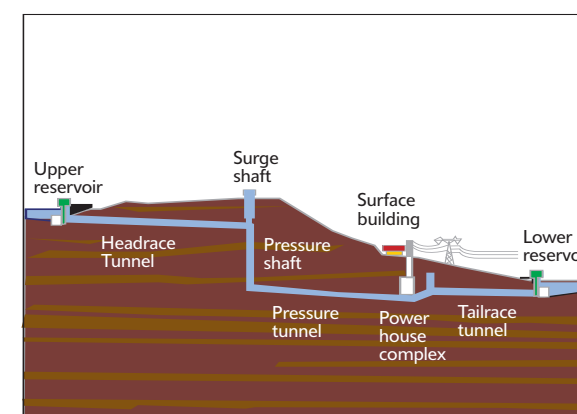


The Ingula Resource Reserve is currently under development. The development of a conservation area of about 8,500 hectares for the protection of threatened wetlands and high altitude grassland was a requirement of the RoD for the Eskom Pumped Storage Scheme at Braamhoek/Ingula. Plants from the Provincial nursery are to be re-introduced into the Ingula Resource Reserve for propagation and annual harvesting by herbalists and traditional healers.

Currently, about 50% of the grassland in the Eastern Free State is transformed with only 2% formally protected.

The grassland biome was identified as a conservation priority in the National Spatial Biodiversity Assessment (DEAT, 2004). The

Grasslands Programme was initiated in January 2008 to conserve the biodiversity and ecosystem of the grassland biome. The target of the programme is to nationally secure 4% of vegetation types within natural areas within 5 years and 22.3% within 20 years.



Schematic Layout of Pumped Storage

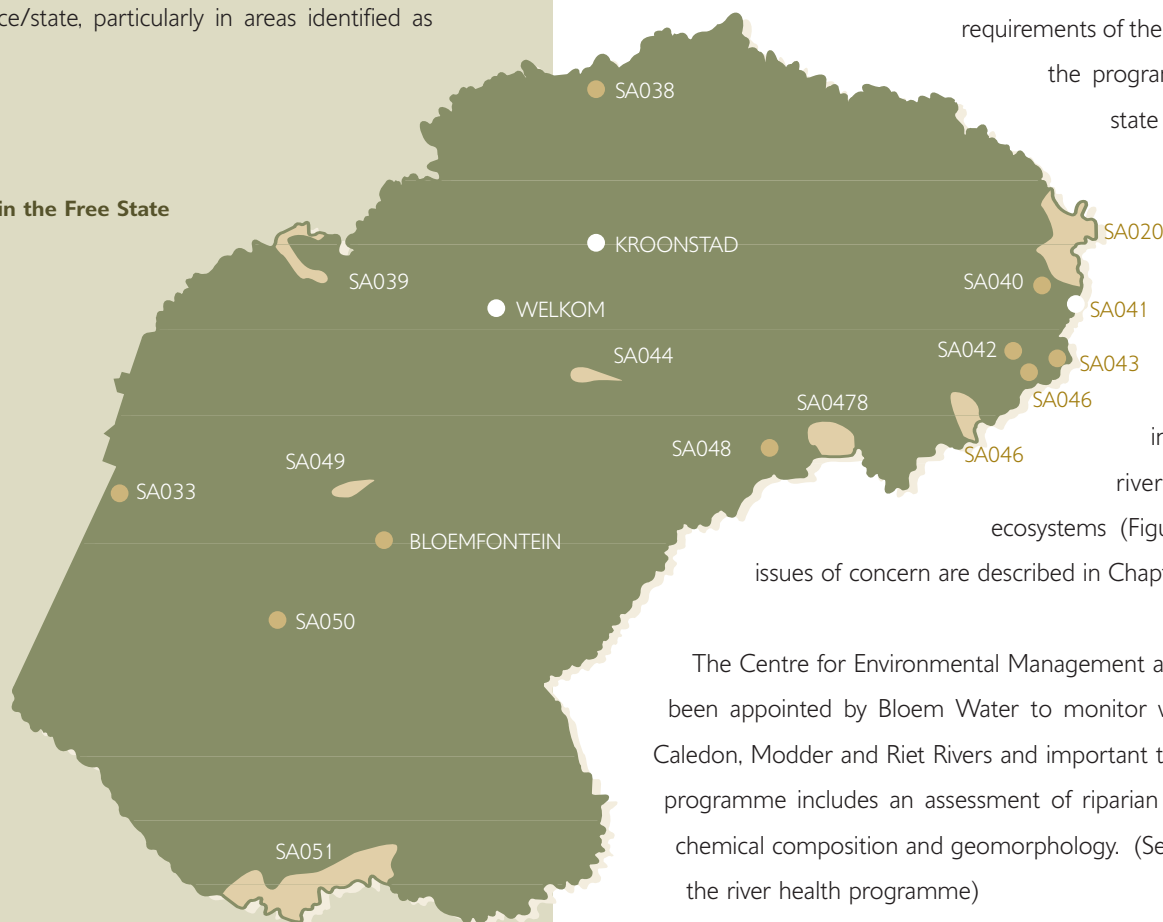
An EMP and SDF have been developed for the Clarens region in the Eastern Free State for the protection of the high altitude flora and fauna.



Many endangered birds are dependent on either grasslands or wetlands, and for some, both. BirdLife South Africa (BLSA) has identified areas important for the survival of species and/or communities and designated them "Important Bird Areas" (IBAs). There are sixteen such IBAs in the Free State (Figure 5.5) (Barnes *et al.*, 1998). Although some of these areas are already protected areas (provincial nature reserves), a number have no protection and rely on the co-operation of private landowners. Expansion of protected areas will require acquisition of land by the province/state, particularly in areas identified as biodiversity "hotspots".

Source: Barnes *et al.*, 1998

Figure 5.5: Important Bird Areas in the Free State



Power lines are a threat to a number of larger bird species due to collisions with the infrastructure and electrocutions. Most of these are Red Data species, e.g. Cape Vulture, Blue Crane, Ludwig's Bustard and Secretary bird. A strategic partnership between Eskom and the Endangered Wildlife Trust was initiated during 1996 to address the problem through an integrated management approach.

5.1.2 Aquatic Ecosystems

Rivers

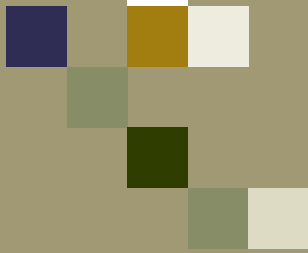
Many of the rivers in the Province have intermittent flow during the dry season with most runoff occurring during the summer rains. Areas of flat gradient within the Province promote the formation of pools and pans.

Five eco-regions have been identified in the Free State as part of the process of classifying the rivers (DWAF, 2004), namely the Ghariep Plateau, Southern Kalahari, Nama Karoo, Highveld and Great Escarpment Mountains.

The River Health Programme was launched by DWAF in 1994 to gather information on the ecological integrity of rivers in South Africa, which is aligned with the requirements of the National Water Act. The objective of the programme is to report on the ecological state of aquatic resources, the trends and any emerging problems.

The overall health assessment of the rivers in the Free State is assessed to be fair to poor (DWAF, 2004), which negatively impacts on the functioning of the rivers and sustainability of the river ecosystems (Figure 5.6). Specific assessments and issues of concern are described in Chapter 6.

The Centre for Environmental Management at the University of the Free State has been appointed by Bloem Water to monitor water quality and ecosystems in the Caledon, Modder and Riet Rivers and important tributaries. The biological monitoring programme includes an assessment of riparian vegetation, algae, invertebrates, fish, chemical composition and geomorphology. (See chapter 6 for more information on the river health programme)



● Aquatic macro-invertebrates (SASS index) reflect the short term condition of the river system. Any change in the composition of the invertebrate community indicates a change in the river health. The presence and abundance of algae, as measured by chlorophyll-a concentrations, measure the trophic status of the river. Growth of aquatic plants and algae is stimulated by nutrients (nitrogen and phosphorus) in the water. The abundance and diversity fish (Fish Response Assessment Index (FRAI)) reflect the longer-term health of the river. River health is classified from Class A (unmodified or approximates natural conditions) to Class E (seriously modified).

The results of the assessment of the health of the Caledon, Riet and Modder Rivers in 2005 and 2007 are tabulated in Table 5.5. The key stressors on the rivers are summarised in Table 5.6.



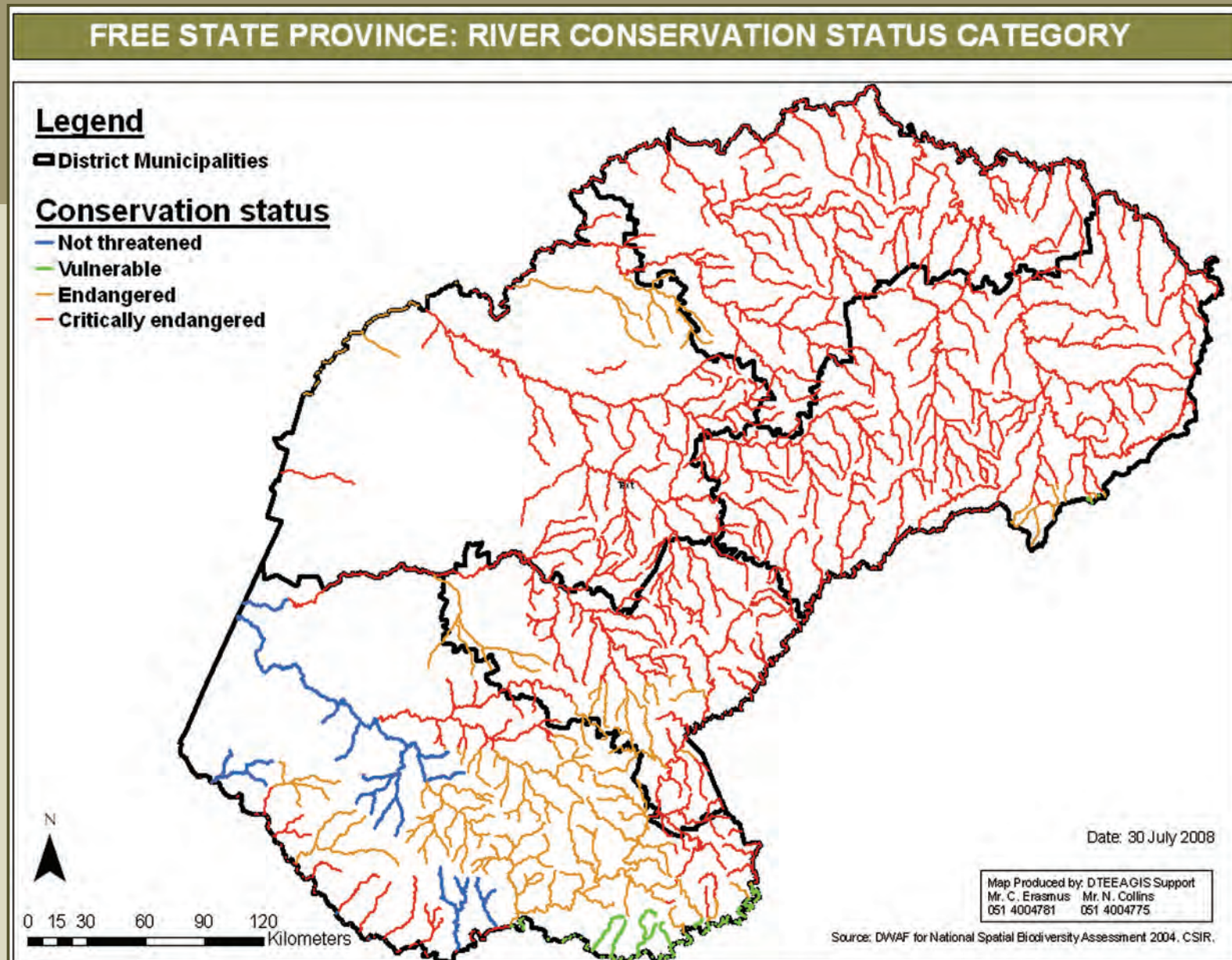


Figure 5.6: River conservation status

Table 5.5: Results of selected indicators of river health for the Caledon, Riet and Modder Rivers for 2005 and 2007

River Section	2005						2007					
	TDS (mg/l)	Dissolved Inorganic P (µg/l)	Chloro-phyll- <i>a</i> (µg/l)	FRAI %	FRAI Class	SASS5	TDS (mg/l)	Dissolved Inorganic P (µg/l)	Chloro-phyll- <i>a</i> (µg/l)	FRAI %	FRAI Class	SASS5
Caledon	126	285	17			No data	218	36	7			No data
Riet	358	267	21			No data	326	99	18			No data
Upper Modder	126	342	30	66.8	C	No data	218	52	104	55.4	D	No data
Upper Middle Modder	299	465	34	64.7	C	Very poor	370	558	59	62.8	C	Fair
Lower Middle Modder	706	7,212	68	61.2	C	Very poor	606	9,945	56	40.9	D/E	Fair/Poor
Lower Modder	426	323	37	56.7	D	Very poor	425	61	22	49.1	D	Very poor

Source: Seaman et al., 2008

Table 5.6: Ecological stressors on river water ecosystems in the Caledon, Modder and Riet Rivers

River Section	Ecological Stressors				
	Geomorphology	Riparian Vegetation Index	Physical/Chemical and Algae	South African Scoring	Fish Assemblage Integrity Index
Caledon	Upstream erosion from sandstone derived soils Uncovered banks Flooding as a result of damming Construction of dam Trampling of banks by domestic animals	Sedimentation has led to loss of natural habitat Construction of Welbedacht Dam resulted in removal of natural vegetation	High concentration of suspended material resulted in high turbidity, poor underwater light conditions, and low algal growth	Water quality deterioration and habitat destruction as a result of Welbedacht Dam, as well as siltation of river downstream led to low SASS5 scores	

River Section	Ecological Stressors				
	Geomorphology	Riparian Vegetation Index	Physical/Chemical and Algae	South African Scoring	Fish Assemblage Integrity Index
Upper Modder River	Transfer of water from Novo transfer scheme could cause further damage to channel	Encroachment of reeds, as well as the building of the Rustfontein Dam has led to loss of natural habitat	Increased nutrient concentrations stimulated algal growth		Presence of weirs restrict movement
Middle Modder River	Construction of dams High flow as a result of dams Trampling of river banks by domestic animals	Presence of dams and weirs has resulted in deterioration in natural habitat, such as encroachment of reeds Cattle farming and road construction	High with nutrients levels renders river section into a eutrophic-hypertrophic state	Water quality deterioration (sewage effluent, urban runoff), high nutrient levels with increase in algae Presence of weirs and dams Loss of SIC biotope as a result of releases from Rustfontein Dam	Presence of weirs and dams
Lower Modder River	Construction of dam Trampling by domestic animals causes bank erosion	Encroachment of reeds and presence of exotic trees Cattle grazing and trampling of river banks	Relatively high salinity, phosphates and enhanced algal growth	Water quality deterioration probably as a result of agricultural practices Regulation of flow (weirs and Krugersdrift Dam) results in no flow or standing water and no SIC biotope Additional flow from Orange River	Presence of weirs and dams Low flow and deteriorating water quality
Riet River	Trampling by domestic animals causes bank erosion	Encroachment of reeds as well as presence of exotic trees	Increased algal growth as a result of retention of water by aquatic vegetation		

Source: Seaman et al., 2008

Wetlands

Within the Free State, 18,735 wetlands have been mapped that are estimated to cover about 2,129 km² (about 1.7% of the total surface area of the province) although considering the level of accuracy of the technology this may be underestimated (<http://bgis.sanbi.org/WaterManagement/Nationalwetlands/index.asp>). Limited information is available on the status of the wetlands. The current South African wetland classification system (Ewart-Smith et al., 2006) classifies wetlands at a landscape level only although a biological classification system is being developed.



A wide range of wetland types occur in the Free State, which contribute towards the overall biological diversity of the Province including the range of species that these support. Several of the Red Data species occurring in the Free State are wetland dependant. In addition, many other species are found in wetland habitats only and some plant species provide habitat for Red Data species, such as the White-winged Flufftail that is closely associated with *Carex* sedges (Barnes, 1998). The pan belt from Welkom to the Northern Cape border is important in sustaining birdlife in dry seasons (Geldenhuys, 1982). Most of the Provincial nature reserves are associated with State dams, but the management of the outflow from these (and thus their levels) by the national Department of Water Affairs and Forestry is done without consulting the Free State DTEEA.

Although the diversity of plant species within individual wetlands (alpha diversity) is relatively low, diversity amongst wetlands (beta diversity) is high (Burgoyne et al., 2000, Eckhardt et al., 1993 and Perkins et al., 2000). Consequently, in order to conserve the biodiversity of wetlands, a range of wetland types needs to be conserved. For example, depression type wetlands (pans), which are typical of the western Free State (although they do occur across the entire province), provide habitat to a variety of bird species, some of which are listed Red Data species, e.g. the Greater and Lesser Flamingos. However, as a consequence of the irregular and sporadic rainfall that characterises the Province, the specific ecological conditions required by the variety of bird life may only be present at some of the pans. Acquisition of only certain pans for the conservation of water birds will therefore be of limited value (Geldenhuys, 1982). Conservation action should therefore instead be directed towards the elimination of detrimental factors affecting these habitats to ensure that they are present and healthy over the entire range of their natural distribution.

5.2 The Status of Species

The Free State supports a range of biodiversity, including a number of Red Data species (IUCN, 2007), which are species that are at risk of extinction (Table 5.7).

The main threats impacting on terrestrial biodiversity include the loss of habitat through land transformation and climate change, as well as pollution. Traditional hunting using packs of dogs has also been identified to be one significant impact on small mammals and bird diversity. This is particularly prevalent in the rural areas and in the QwaQwa National Park. Law enforcement officials annually destroy about 150 such dogs (DTEEA database).

Table 5.7: Summary of terrestrial biodiversity in the Free State

Biodiversity	No. Species (iii)	Endemic	Critically Endangered	Endangered	Vulnerable	Near Threatened
Mammals ⁽ⁱ⁾	97 ^(vii)	2	1	4	7	9
Birds	459 ^(viii)		3	3	24	22
Amphibians ^(v)	27	0	0	0	0	1
Reptiles ^(v)	93	0	0	0	2	4
Plants ⁽ⁱⁱ⁾	3,001	675 ^(iv)			3	1
Arachnids (not Acari)	300+				2	

Key: Critically Endangered - faces an extremely high risk of extinction in the wild
 Endangered - faces a very high risk of extinction in the wild
 Vulnerable - faces a high risk of extinction in the wild
 Near-threatened - close to qualifying for "Vulnerable", or likely to become so in near future

Source: i) Friedmann & Daly, 2004 v) Bates, 1996
 ii) Golding, 2002 vi) Bates, 2004
 iii) DEAT, 2005b vii) Skinner & Chimimba, 2005
 iv) DEAT, 2004 viii) Colahan, 1995

5.2.1 Mammals

Red Data species of mammals in the Free State are tabulated in Table 5.8. Two Red Data species are endemic to South Africa, namely the White-tailed Rat and the Slogget's Ice Rat. Two sub-species of Black Rhino are found in the Free State. *Diceros bicornis bicornis*, which is Critically Endangered, is found in the western Free State while *Diceros bicornis minor*, which is categorised as Vulnerable, is found in the eastern Free State. The habitat of the reserves in the Free State is not optimal to support the Black Rhino. Currently, only male Black Rhinos have been introduced to two of the bigger provincial reserves, the Sandveld Nature Reserve and Tussen-die-Riviere Nature Reserve, to test the suitability of the vegetation to support this species. As the results appear to be satisfactory, should female Black Rhino be available, these will also be introduced to these two reserves. However, only a small number of Black Rhino can be supported.

Due to over-exploitation, the Oribi antelope is now endangered. A small population has been introduced into the Koppies Dam Nature Reserve. However, the population has not increased as anticipated. A number of reasons for this low population growth have been identified, including the territorial behaviour of the Oribi that live in family groups. Family groups from source areas should not be mixed and groups should be released only in open grassland habitat. In addition, areas need to be burnt during the winter months to provide an early flush of green vegetation for the animals.

Guideline figures have been developed for the carrying capacity for each mammal species in each provincial reserve. Aerial surveys are conducted on all reserves annually to determine species population sizes. This information is used to decide how many animals should be removed. Removal takes place every second year. DTEEA participates in exchange



programmes with other provinces to introduce a wider gene pool, particularly for species present in low numbers.

Records over the past two decades have indicated the presence of Servals throughout the Free State (National Museum records; Herrmann *et al.*, 2008). Previously, Servals were only found in the eastern and northern parts of South Africa. In the Free State, sightings of Serval have now been made close to rivers or dams,



suggesting that Servals use waterways as corridors to penetrate otherwise unsuitable habitat in drier areas.

Impact of Caracal and Black Jackal

The issues with regard to the impact of caracal and black jackal on the total biodiversity of the area are probably the most urgent but most neglected conservation issue in Southern Africa.

Caracal and Black-backed Jackal occur in the same areas as small stock farms, where predation is on the increase. As a counter mechanism, some farmers have resorted to uncontrolled blanket-control and poisoning practices that threaten biodiversity in the area. Such non-selective control, however, may poison non-target animals and through compensatory breeding and immigration lead to an increase in Caracal and Black-backed Jackal numbers (Avenant & Du Plessis, 2008).

Studies in the West Coast National Park have indicated that Caracal prey on small stock when natural prey densities were low and that females with young selected larger prey when they have young (Avenant & Nel, 1997, 1998, 2002). Non-territorial Caracal were found to be the most likely ones that scavenge on unnatural prey. This implies that good farming practices (i.e. those that also take into account previous scientific findings) can be used effectively to decrease depredation on small stock. The Canis-Caracal Programme has been initiated by researchers from the University of the Free State and the National Museum, Bloemfontein, to address the Caracal and Black-backed Jackal problem in southern Africa. It proposes the management of Caracal to "limit" stock loss, rather than hunting them to "stop" stock loss. Ensuring a higher diversity of small mammals and securing dominant, territorial Caracal individuals or Black-backed Jackal pairs over a large area may help to curb stock losses. Small mammals will be monitored to assess the influence of various predator control and farming practices on ecosystem structure and functioning (see Avenant, 2000, 2003, 2005, Avenant & Cavallini, 2007, Avenant *et al.*, 2008, Avenant & Du Plessis, 2008).



Figure 5.8: Mammal species in the Free State listed on the IUCN Red Data List

Species	Status	Reserves where most likely to occur
Black Rhino <i>Diceros bicornis bicornis</i>	Critically Endangered	
Hartmann's Zebra <i>Equus zebra hartmannae</i>	Endangered	
Oribi <i>Ourebia ourebi</i>	Endangered	Koppies Dam, Sterkfontein
White-tailed Rat <i>Mystromys albicaudatus</i>	Endangered	Koppies Dam, Erfenis Dam, Willem Pretorius, Soetdoring, Sandveld, Maria Maroka, Rustfontein, Bathurst, Kalkfontein, Wuras Dam, Caledon, Tussen-die-Riviere, Gariep
Tsessebe <i>Damaliscus lunatus lunatus</i>	Endangered	Koppies Dam, Erfenis Dam, Sandveld
Black Rhino <i>Diceros bicornis minor</i>	Vulnerable	Sandveld, Tussen die Riviere
Bontebok <i>Damaliscus pygargus pygargus</i>	Vulnerable	
Cape Mountain Zebra <i>Equus zebra zebra</i>	Vulnerable	Gariep
De Winton's long-eared bat <i>Laephotis wintoni</i>	Vulnerable	Sterkfontein
Roan <i>Hippotragus equines</i>	Vulnerable	Willem Pretorius, Sandveld, Seekoeivlei
Sable <i>Hippotragus niger niger</i>	Vulnerable	Koppies Dam, Willem Pretorius, Sandveld
Cheetah <i>Acinonyx jubatus</i>	Vulnerable	
Brown Hyaena <i>Parahyanena brunnea</i>	Near- threatened	Willem Pretorius, Soetdoring, Maria Maroka, Rustfontein, Bathurst, Kalkfontein, Wuras Dam, Caledon, Tussen-die-Riviere, Gariep
Dent's Horseshoe Bat <i>Rhinolophus denti</i>	Near- threatened	
Geoffroy's Horseshoe Bat <i>Rhinolophus clivosus</i>	Near- threatened	Maria Maroka, Sterkfontein, Tussen-die-Riviere, Gariep
Lesueur's Wing-gland Bat <i>Cistugo lesueuri</i>	Near- threatened	Sterkfontein
Schreiber's Long-fingered Bat <i>Miniopterus schreibersi</i>	Near- threatened	Sterkfontein
Serval <i>Leptailurus serval</i>	Near- threatened	Willem Pretorius, Soetdoring, Caledon, Sterkfontein, Seekoeivlei
South African Hedgehog <i>Atelerix frontalis</i>	Near- threatened	Koppies Dam, Erfenis Dam, Willem Pretorius, Soetdoring, Sandveld, Maria Maroka, Rustfontein, Bathurst, Kalkfontein, Wuras Dam, Caledon, Sterkfontein, Seekoeivlei, Tussen-die-Riviere, Gariep
Spotted Necked Otter <i>Lutra macuicollis</i>	Near- threatened	Koppies Dam, Erfenis Dam, Willem Pretorius, Caledon, Seekoeivlei
Temminck's Hairy Bat <i>Myotis tricolor</i>	Near- threatened	Willem Pretorius, Sterkfontein
Sloggett's rat/ Ice rat	Near- threatened	

Source: Friedmann & Daly, 2004

5.2.2 Birds

Fifty-two species of birds in the South African Red Data list (Barnes, 2000) have been recorded in the Free State in recent years (Table 5.9) (DTEEA, unpublished), although some of these must be regarded as just vagrants to the Province. There are 26 species that are dependent either on grasslands, wetlands, or both habitats, and which are currently inadequately conserved in protected areas. Two of the species (the Lesser Kestrel and Black-winged Pratincole) are non-breeding migrants from the Palaearctic, and significant numbers of these birds spend the austral summer in the Free State. As a signatory to the Bonn Convention on migratory species, South Africa is obliged to conserve these species.

Currently, most conservation work involving birds is of a monitoring nature, and mostly linked to national projects run by the Animal Demography Unit, Department of Zoology, University of Cape Town. The longest running of these is the Co-ordinated Waterbird Counts (CWAC) project (<http://cwac.adu.org.za/>) which includes surveys of most of the State dams in the Free State. This project was initiated in 1992 by the then Ramsar Working Group of the Department of Environmental Affairs and Tourism in part-fulfilment of South Africa's commitment to the Ramsar Convention. One report has been published so far, namely Taylor *et al.*, 1999.

The Co-ordinated Avifaunal Roadcounts (CAR) project has been running for 10 years in the Free State. The distance covered in survey routes in the Free State represent about 40% of the total distance covered in South Africa (http://web.uct.ac.za/depts/stats/adu/p_car.htm). The main aim of this project is the monitoring of over 20 species of large terrestrial birds, most of which are Red Data species. One report has been published, for the period 1993-2001 (Young *et al.*, 2003). Continuation of the project nationally is threatened by the difficulty in accessing funding.

In addition to participating in the CAR and CWAC programmes, the DTEEA also supports the Birds in Reserves Project, (http://web.uct.ac.za/depts/stats/adu/p_birp.htm), involving surveys of birds within protected areas (of varying status), in an attempt to determine how well these contribute to the "conservation status" of the avifauna.

A project was launched in 2007 by the Animal Demography Unit, the Southern African Bird Atlas Project 2 (SABAP2) (<http://sabap2.adu.org.za/index.php>). This project is a follow-up

from the first Southern African Bird Atlas Project (SABAP1), which took place from 1987-1991. The project has been designed to build on the successes of SABAP1 and make a greater contribution to biodiversity planning and conservation in southern Africa. It is anticipated that the project will provide insights into the effects of climate change on bird distribution patterns. SABAP2 is scheduled to continue until the end of 2009, with a possible extension to 2011. Some members of the Free State DTEEA and BirdLife Free State are currently involved with this project in the Free State.



Table 5.9: Red Data bird species which have been recorded in the Free State in recent years (since 1990)

Species	Status	Habitat
Rudd's Lark <i>Heteromira fra ruddi</i>	Critically Endangered	Short upland grassland
White-winged Flufftail <i>Sarothrura ayresi</i>	Critically Endangered	Upland marshes
Wattled Crane <i>Bugera nus carunculatus</i>	Critically Endangered	Upland marshes and dams
Bearded Vulture <i>Gypaetus barbatus</i>	Endangered	High altitude grassland; nests on cliffs
Botha's Lark <i>Spizocorys fringillaris</i>	Endangered	Heavily-grazed upland grassland
Saddle-billed Stork <i>Ephippiorhynchus senegalensis</i>	Endangered	Dams, pans
African Finfoot <i>Podica senegalensis</i>	Vulnerable	Well-vegetated rivers
African Grass Owl <i>Tyto capensis</i>	Vulnerable	Grassland, marshes
African Marsh-Harrier <i>Circus ranivorus</i>	Vulnerable	Marshland, flooded grassland
African White-backed Vulture <i>Gyps africanus</i>	Vulnerable	Savanna, grassland, karoo
Bateleur <i>Terathopius ecaudatus</i>	Vulnerable	Savanna, grassland, karoo
Blue Crane <i>Anthropoides paradisea</i>	Vulnerable	Karoo, grassland
Cape Vulture <i>Gyps coprotheres</i>	Vulnerable	Grassland, karoo, savanna; cliff nester
Corn Crake <i>Crex crex</i>	Vulnerable	Grassland, vleis
Grass Owl <i>Tyto capensis</i>	Vulnerable	Grassland, marshes
Grey Crowned Crane <i>Balearica regulorum</i>	Vulnerable	Marshes, dams, grassland
Kori Bustard <i>Ardeotis kori</i>	Vulnerable	Savanna, grassland, karoo
Lappet-faced Vulture <i>Torgos tracheliotus</i>	Vulnerable	Savanna, grassland, karoo
Lesser Kestrel <i>Falco naumanni</i>	Vulnerable	Grassland, karoo; roosts in large trees
Ludwig's Bustard <i>Neotis ludwigii</i>	Vulnerable	Karoo, grassland
Martial Eagle <i>Polemaetus bellicosus</i>	Vulnerable	Savanna, grassland, karoo
Pink-backed Pelican <i>Pelecanus rufescens</i>	Vulnerable	Large waterbodies
Southern Bald Ibis <i>Geronticus calvus</i>	Vulnerable	Grassland; nests on cliffs
Southern Ground-Hornbill <i>Bucorvus leadbeateri</i>	Vulnerable	Upland grassland
Stanley's Bustard <i>Neotis denhami</i>	Vulnerable	Grassland
Striped Flufftail <i>Sarothrura affinis</i>	Vulnerable	Upland grassland
Tawny Eagle <i>Aquila rapax</i>	Vulnerable	Savanna, grassland, karoo
White-backed Night-Heron <i>Gorsachius leuconotus</i>	Vulnerable	Well-vegetated rivers
White-bellied Korhaan <i>Eupodotis cafra</i>	Vulnerable	Grassland
Yellow-breasted Pipit <i>Hemimacronyx chloris</i>	Vulnerable	Upland grassland
Black Harrier <i>Circus mauru</i>	Near-threatened	Grassland, karoo

Species	Status	Habitat
Black Stork <i>Ciconia nigra</i>	Near-threatened	Dams, pans; nests on cliffs
Black-winged Lapwing <i>Vanellus melanopterus</i>	Near-threatened	Upland grassland
Black-winged Pratincole <i>Glareola nordmanni</i>	Near-threatened	Grassland, shores of wetlands
Blue Korhaan <i>Eupodotis caerulescens</i>	Near-threatened	Grassland, karoo
Bush Blackcap <i>Lioptilus nigricapillus</i>	Near-threatened	Montane forest
Caspian Tern <i>Hydroprogne caspia</i>	Near-threatened	Dams
Chestnut-banded Plover <i>Charadrius pallidus</i>	Near-threatened	Pans, dams
Great White Pelican <i>Pelecanus onocrotalus</i>	Near-threatened	Large waterbodies
Greater Flamingo <i>Phoenicopterus ruber</i>	Near-threatened	Dams, pans
Greater Painted-Snipe <i>Rostratula benghalensis</i>	Near-threatened	Vleis, dams, pans
Half-collared Kingfisher <i>Alcedo semitorquata</i>	Near-threatened	Wooded streams
Lanner Falcon <i>Falco biarmicus</i>	Near-threatened	Savanna, grassland, karoo
Lesser Flamingo <i>Phoeniconaias minor</i>	Near-threatened	Dams, pans
Marabou Stork <i>Leptoptilus crumeniferus</i>	Near-threatened	Savanna, grassland
Melodious Lark <i>Mirafra chiniana</i>	Near-threatened	Grassland
Pallid Harrier <i>Circus macrourus</i>	Near-threatened	Grassland, karoo
Peregrine Falcon <i>Falco peregrinus</i>	Near-threatened	Various, near high cliffs
Red-billed Oxpecker <i>Buphagus erythrorhynchus</i>	Near-threatened	Savanna
Secretary bird <i>Sagittarius serpentarius</i>	Near-threatened	Grassland, karoo, savanna
Short-clawed Lark <i>Mirafra chuana</i>	Near-threatened	Savanna
Yellow-billed Stork <i>Mycteria ibis</i>	Near-threatened	Dams, pans

Source: Barnes, 2000



As part of an international initiative, ornithologists from the National Museum, Bloemfontein initiated a ringing project on the migratory Barn Swallow (*Hirundo rustica*) during February 1998 in Bloemfontein assisted by qualified ringers from BirdLife Free State (a branch of BirdLife South Africa) (<http://www.nasmus.co.za/ornithol/Swallows/intro.html>). Barn Swallow populations in the European breeding areas have recently shown significant declines, possibly due to the loss of feeding habitat and reduced supply of insect food, through changes in farming practices. The international ringing project aims to investigate population dynamics, as well as to establish the effects of varying environmental conditions on Barn Swallows along migration routes and in key non-breeding area. The importance of Bloemfontein as an area supporting Barn Swallows from a significant area of this species' European breeding range is indicated by the capture and release of individual swallows ringed in at least 14 European countries. As such, Bloemfontein represents an important core research area for the study of this flagship long-distance migrant.

The large scale irrigation of land for agricultural purposes and in particular the production of wheat in winter (when natural grass seeds are in short supply) has resulted in the widespread presence of Red-billed Quelea in large numbers that have a significant impact on crop yields (due to consumption of seeds). This species has been declared an agricultural pest and eradication programmes have been implemented in an attempt to control populations. The use of poisons and controlled explosions to kill the Red-billed Queleas may however also kill non-target species and negatively impact on the environment. Movements of this species in southern Africa appear to be controlled by rain fronts and the abundance in the Free State shows large annual fluctuations.

5.2.3 Reptiles and Amphibians

Within the Free State there are six species of reptiles and one species of amphibian that are on the IUCN Red Data list. Two species of reptiles are categorised as Vulnerable, namely the Sungazer (*Cordylus giganteus*) and Breyer's Long-tailed Seps (*Tetradactylus breyeri*).

The habitat of the Sungazer is open grassland in the prime crop farming areas of the northern and north-eastern Free State and a small part of the adjacent southern Mpumalanga. As these areas are constantly being ploughed, the subterranean burrows of these lizards are destroyed. In addition, economic activities and infrastructure development, such as industries, mining and housing, have contributed to loss of habitat. The pet and muti trades also result in depletion of populations (Van Wyk 1988). Other threats include



fumigation of mammal burrows for control of species like mongooses and Suricates, and secondary poisoning of food supply due to crop spraying and poisoning of grass-eating termites (Van Wyk 1988). Twenty years ago, it was estimated that as much as 50% of arable land in the range of the Sungazer was under cultivation (Van Wyk 1988). It is likely that the successful re-colonisation of old fields will take a long time, and will depend on re-establishment of grassland and the availability of insects and other arthropods, such as millipedes that form the diet of this lizard.

In the years 1989 to 1991, hundreds of Sungazers were removed from Tshiame east of Harrismith when this area was developed for industry and housing, and translocated to Wolhuterskop and Loch Athlone Nature Reserves in Bethlehem, Sterkfontein Dam Nature Reserve and Golden Gate Highlands National Park (Williams 1990; Groenewald 1992). However, these relocations were of limited success and there have been no reports of any long-term monitoring over the past 18 years.

The grassland habitat of the Breyer's Long-tailed Seps is also in prime cropland, although distribution of the species is fragmented (Bates, 1996). In the Free State it has been recorded from only two sites in the north-east of the province. Availability of habitat is threatened by fires and overgrazing. As for the Sungazer, farmers should be encouraged to leave corridors of natural vegetation between croplands so that disturbed colonies are not cut off or left with little suitable cover and food supply.

Four species of reptiles and one species of amphibian are categorised as near-threatened. In the Free State, Lang's Crag Lizard (*Pseudocordylus langi*) is restricted to the rim of the escarpment and its summit in the vicinity of Mont-aux-Sources and Nemahadi Pass in QwaQwa and the Spiny Crag Lizard (*Pseudocordylus spinosus*) is found nearby along the Sentinel trail (Bates, 2005). Both species are largely protected by their relatively inhospitable habitat and rupicolous (living on or amongst rocks) nature although they may be easily collected and exploited for the pet trade.

Although the widespread Giant Bullfrog (*Pyxicephalus adspersus*) is not known to be severely threatened in the Free State, economic activity and pollution are of concern in some areas. This may lead to the disappearance of water bodies (pans, marshes and dams, as well as open grassland which becomes a temporary pan in the rainy season), which are needed for breeding.



In the Free State, the Striped Harlequin Snake (*Homoroselaps dorsalis*) is restricted to the central-northern parts. Its habitat is threatened by agricultural activity, especially crop farming. This species may shelter in old termite mounds that are destroyed when grassland is ploughed.

No monitoring programmes are being undertaken at this time on any amphibians or reptiles in the Free State. Consequently, no specific information is available with respect to changes in population numbers or disappearance of species from particular areas. A survey should be undertaken to determine the current distribution of Sungazers and Breyer's Long-tailed Seps in the Free State, starting with the farms at which De Waal (De Waal, 1978) recorded them. Sight records, photographs and reports from farmers can be used in such an evaluation.

5.2.4 Freshwater Species

Aquatic habitats are impacted by overgrazing, invasive alien species, informal settlements, urban development and industrial and agricultural pollution. Riparian activities (alluvial mining, impoundments, cultivation) also threaten aquatic habitats and associated biodiversity.

Free State Rivers host a number of commercially as well as recreationally important target species. The indigenous target species include the Orange Vaal



Largemouth Yellowfish, Orange Vaal Smallmouth Yellowfish, Moggel fish, Orange River Mudfish and Sharptooth Catfish. The Vaal-Orange largemouth yellowfish is the only fish species listed in the IUCN Red Data List.

Fishery resources, specifically the Moggel fish and Orange River Mudfish are regarded as a substantial protein source and are targeted by subsistence and commercial sectors. A hatchery has been established by the DTEEA at Gariiep that focuses on breeding barbell fish, the Orange River mudfish, mullet and yellowfish.

The Free State is one of the most popular angling destinations in the country. Fishing hotspots include the Vaal Barrage (largemouth Bass), Koppies Dam (carp and yellowfish), Sterkfontein Dam (yellowfish), Bloemhof Dam (yellowfish) and Riet River (Orange Vaal largemouth yellowfish). Catch and release practices to limit impacts on sensitive target species, as well as bag constraints on specific fish like Orange Vaal

largemouth and smallmouth yellowfish, are commonplace amongst angling clubs. Quotas for harvesting of fishery resources have been set for the dams of the Free State. Permits have been granted to both commercial and artisanal operators. Fish quotas are issued for Bloemhof Dam (200 tonnes), Kalkfontein Dam (50 tonnes), Gariiep Dam (200 tonnes) and Erfenis Dam (15 tonnes). Commercial fishing permits are issued for periods of five years. However, a review of the commercial fishing industry and issuing of permits is needed.

5.2.5 Arachnids

Although no Red Data list has been compiled for Arachnida, three family groups are vulnerable in the Free State, namely the Trapdoor spider (*Ctenizidae*), the Purse Web spider (*Atypidae*) and the Baboon spider (*Theraphosidae*).



The main threat to Arachnids is crop spraying and the use of poisons in gardens. The ordinary Garden spider (*Argiope australis*) is rarely seen now. The Arachnids of the Free State is still largely unknown, as little work has so far been done on these animals in this Province. A national survey, the South African National Survey of Arachnids, is presently being conducted.

5.2.6 Acarology

Work is ongoing at the National Museum to classify the species of soil mites. Mites play an important role in decomposition of organic material that contributes to soil fertility and also remediation of the ecosystem following burning of the vegetation. Agricultural practices impact on their viability. Their presence of soil mites is an indicator of the quality of soil although a comparative study of baseline conditions has not yet been undertaken.

5.2.7 Butterflies

The Southern African Butterfly Conservation Assessment, launched in May 2007, is a four-year conservation project aimed



at determining the distribution and conservation priorities of all butterfly species in the Southern African region, especially those threatened with extinction (<http://sabca.adu.org.za/about.html>). The Free State DTEEA has given permission for fieldworkers involved in this project to collect in Provincial nature reserves.



5.2.8 Plants



Conservation of grasslands habitats is important for the protection of the listed Red Data plants species. Plants in the Free State that are on the IUCN Red Data list are tabulated in Table 5.10. Information on plant species and their distribution in the Free State is however limited.

Table 5.10: Plant species in the Free State listed on the IUCN Red Data List

Species	Status
<i>Argyrobium velutinum</i>	Endangered
<i>Delosperma macellum</i>	Endangered
<i>Argyrobium campicola</i>	Vulnerable
<i>Brachystelma dimorphum</i>	Vulnerable
<i>Encephalartos ghellinckii</i>	Vulnerable
<i>Helichrysum haygarthii</i>	Vulnerable
<i>Hermannia cordifolia</i>	Vulnerable
<i>Hypoxis uniflorata</i>	Vulnerable
<i>Kniphofia ensifolia</i>	Vulnerable
<i>Brachystelma glenense</i>	Near threatened
<i>Gladiolus robertsoniae</i>	Near threatened
<i>Kniphofia typhoides</i>	Near threatened
<i>Neohenricia sibbettii</i>	Near threatened



Source: Golding, 2002

5.3 Invasive Alien Species



An alien species is defined as “a species that is not an indigenous species; or an indigenous species that is translocated or intended to be translocated outside its natural distribution range through human intervention” (National Environmental Management: Biodiversity Act, No. 10 of 2004).

Increasing mobility of people between provinces, nationally, as well as internationally, leads to the potential spread of species not indigenous to the Province, thereby impacting negatively on species composition and ecosystem functioning. The alien plant invasion potential is relatively high throughout the Free State (Figure 5.7). Based on climate change scenarios, an increasing trend in the prevalence of alien plant species is envisaged.

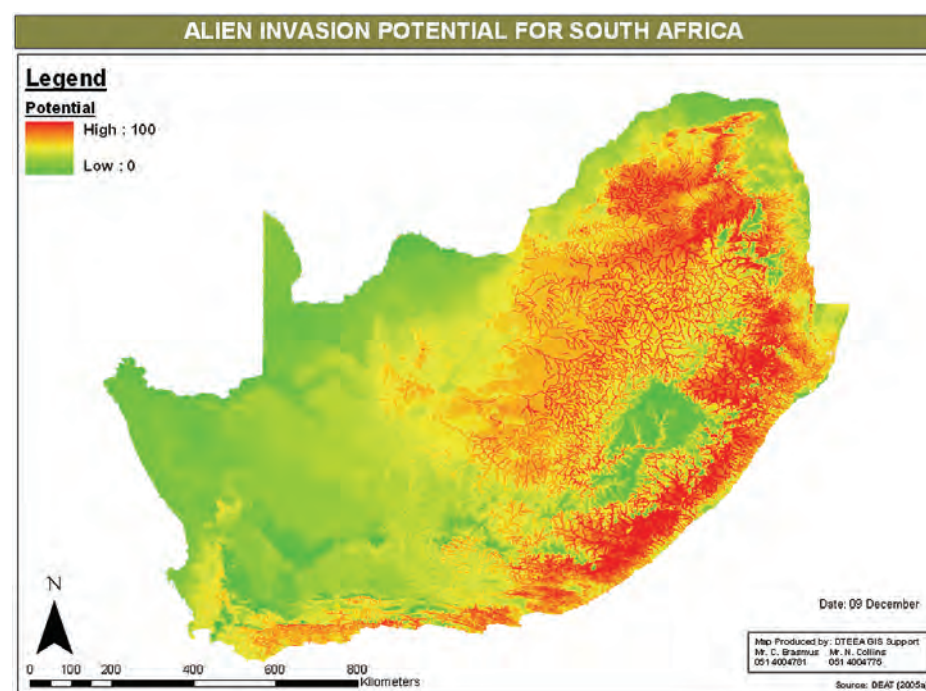


Figure 5.7: Alien invasion potential



Invading alien plants not only displace indigenous plants but also use more water than indigenous trees and plants. It is estimated that alien invasive plants reduce the national mean annual runoff by about 3,300 million m³, (6.7% of the national runoff). (<http://www.dwaf.gov.za/wfw/default.asp>). A study on the economic value of streamflow loss due to invasions of black wattle in South Africa estimated a net present cost of R14 billion (DEAT, 2005a). In addition, alien plants generally grow in dense stands that burn more aggressively than indigenous vegetation and damage the soil which is more easily washed into waterways following the first rains.

The Working for Water (WfW) programme, launched in 1995 and administered through the Department of Water Affairs and Forestry, is aimed at controlling invasive alien plants. The cost nationally of this programme is estimated at R600 million a year over 20 years. In the 2002/03 financial year, R21.6 million was spent on eradicating mainly Mesquite in the Free State (mainly the central and western regions) and the Northern Cape. Other invasive plants include the fire thorn, a common garden plant that was planted along the N1 and has now become a problem in the eastern parts of the province, as well the black wattle in the same region. It is estimated that if the invasive alien plants are not controlled the problem controlled the number of plants throughout South Africa will double within 15 years. (<http://www.dwaf.gov.za/wfw/default.asp>)

Inter Basin Transfer Schemes, such as the Malibamatso to Ash River, have impacted on the genetic integrity of fish species through the introduction of species from historically isolated populations. Isolation of migratory species, upstream from dam or weir walls where the connectivity is separated and gene movement occurs only in a downstream direction, will result in a depletion of genetic diversity and lessening of the viability of the population. None of the dams or weirs in the Free State has any fishways to maintain up and downstream connectivity although this has been proposed for incorporation on the Ash River.

Exotic fish species found in the provincial rivers include rainbow trout, brown trout, largemouth bass, carp and grass carp. Since 2000, no invasive alien species may be legally stocked in the rivers.

The growing establishment of private game reserves has led to the loss of genetic integrity of South Africa's endemic species as a result of hybridisation. More specifically, hybridisation has occurred between the Blesbok and Bontebok and the Black and Blue Wildebeest. In the past, hybridisation between Red



Red Hartebeest/Tsessebe hybrid

Hartebeest and Tsessebe was forced in the Koppies Dam Nature Reserve. The offspring are now kept at the Rustfontein Dam to determine whether they are fertile. The recommendation to game farmers will be to separate the two species, which was the previous policy of Transvaal Nature Conservation.



Black Wildebeest/Blue Wildebeest hybrid

Hybridised offspring of Blesbok and the Bontebok and the Black and Blue Wildebeest are difficult to identify. A photographic method is used to determine if the Bontebok are pure. Research by geneticists to develop reliable genetic tests to determine pure and hybrid animals is ongoing.



Blesbok/Bontebok hybrid

Box 5.2 Orange Vaal River Yellowfish

Conservation and Management

Association

The development of a large recreational fishery based on invasive alien species including trout, bass and carp had a detrimental impact on local indigenous fish populations (Woodford *et al.*, 2005). In response, the Orange Vaal River Yellowfish Conservation and Management Association (OVRycMA) was established in 1996. Two indigenous indicator species were chosen for a sustainable replacement fishery, namely the Orange Vaal largemouth yellowfish (listed as Near-threatened due to habitat destruction, illegal netting and overexploitation) and the Orange Vaal Smallmouth Yellowfish. The goal of the Association was threefold:

- (1) Develop yellowfish as a catch-and-release-only fishery;
- (2) Assist land owners and interested stakeholders with marketing yellowfish catch-and-release and general conservation; and
- (3) Educate the public about OVRycMA goals and increase support through a network of interested local and national citizens.

To date, this project has successfully managed over 700 km of river frontage. The fisheries are valued at R1.2 billion which is higher than the value of the alien species fisheries (De Villiers 2007).

Source: Granek *et al.*, 2008

Records from the National Museum in Bloemfontein indicate that the Greater canerat has infiltrated the Free State Province since the mid-1980s and that its distribution range may already cover about 45% of the total area of this Province (Van der Merwe & Avenant, 2004). It is believed that an increase in dammed rivers and potential food sources (e.g. new cultivated areas, especially irrigated crops close to natural water courses) may enable this species to expand and colonise new areas. Canerats may exacerbate the poor state of these ecosystems, thereby degrading habitat integrity even further. Their importance as an invader species in the Free State with regard to conservation is however unclear although the canerats will use and reduce the habitat that was used by indigenous species.

The domesticated cat has cross bred with the African Wildcat to such an extent that the integrity of this species in South Africa is threatened.

Five bird species are alien to the Free State:

- Common Mynahs (*Acridotheres tristis*) are the most invasive and are found primarily in the urban and peri-urban areas in the central and northern areas of the province, although there are indications that this species is spreading westwards and southwards. Although the impact (noise and pollution) of this species on human settlements is well recognised, there is little proven evidence of impact on indigenous species.
- Common Starlings (*Sturnus vulgaris*) are found in the southern, central, eastern and northern Free State in both urban and the rural areas, where they probably compete with indigenous species.
- House Sparrows (*Passer domesticus*) are distributed widely throughout the Free State, being concentrated in urban areas and around rural homesteads. This species does not pose a significant threat to indigenous bird species.
- Ornamental waterfowl, particularly the Mallard Duck (*Anas platyrhynchos*), which poses the greatest threat to genetic integrity due to hybridisation with indigenous species, mainly the Yellow-billed Duck (*Anas undulate*). Although free-flying Mallards are not often seen in the Free State, suspected Mallard/Yellow-billed Duck hybrids have recently been shot by hunters near Bloemhof Dam (Free State DTEEA, unpublished).
- Feral pigeons that are confined to urban areas and create a nuisance through fouling of buildings.





5.4 Trade in Biodiversity Resources

It is estimated that more than 80% of South Africans rely on indigenous medicinal plants for their health care (DST, 2006). Nationally, the trade in medicinal plants is estimated to be worth between R500 million and

R2.3 billion although the mass that is harvested is not known (Zietsman personal communication, 2008). However, the current demand for numerous plant species exceeds supply and the combination of high demand; intensive harvesting of indigenous plant stocks and lack of major resource management and plant production has resulted in a scarcity of numerous indigenous medicinal plants and accelerated the increasing trend of several plant species, becoming extinct outside of protected areas (DST, 2006).



Almost every species in the Province has a traditional use. The most frequently used medicinal plants are slow-growing trees, bulbous and tuberous plants, with bark or underground parts being the most widely utilised (Zschocke *et al.*, 2002). The Free State Province has 69 plant species of medicinal value,

11 of which are listed in the IUCN Red Data list (Van Wyk *et al.*, 2002). However, with the current rate of extraction, plants that are not listed or protected, risk becoming extinct.

Species of particular importance include Climbing potato, Pigs Ear, Wild Pear and Pineapple Flower. Areas of concern include the Eastern Free State on the border with Lesotho, the habitat of numerous bulbous indigenous plants.

There are currently 2,500 traditional healers who have permits to remove certain protected plants for their own use in the Free State. Permits are issued only to members of Traditional Healers Organisations for a period of three years. One permit condition is that only five plants per species per month may be removed and that no

trading may take place. No animals may be removed from the environment for muti purposes. DTEEA runs workshops every two years for Traditional Healers, together with scientists from the National Museum and the Department of Health.

The biggest problem however is not the traditional healers, but the commercial traders that sell the plants to the traditional healers in cities and who are not concerned about the consequences of their exploitation on the sustainability of the resource. Illegal trade and collection of plant species by commercial traders is based on specific targeted groups, with cycads and succulent groups being the most sought-after groups. There is also a market for the aardvark, otters, sungazers and tortoises.

The formal and informal curio trade industry is based on the uncontrolled utilisation of natural resources, particularly plant resources. This threat is particularly prevalent in the eastern Free State region. Due to limited available habitat, the Resurrection Plant, Cheese-wood and Wild Rhubarb are under threat (Winterbach, 1993). With the central location of the Free State, it is often used as a thoroughfare or trading route for traders and smugglers of various products.

Despite the extension of electricity to households in the Province (Chapter 8), 20% of households continue to use wood for cooking purposes (Stats SA, 2007). The utilisation of forest resources for firewood, timber and various other uses has increased. *Acacia erioloba*, a protected species, is being utilised illegally for commercial purposes and is sold as fuelwood in towns. This is a threat to the African White-backed Vulture (which nests in large acacias) populations still occurring in the north western Free State.

The rural poor are heavily reliant on natural resources for fuelwood, which is exacerbating the problem of deforestation. This is particularly apparent in the northwest region of the Province, where there is a shortage of fuelwood resulting in *Acacia karroo* being felled. The uncontrolled cutting of proteas for fuelwood in the QwaQwa National Park impacts on those birds that use the trees as feeding and nesting sites, such as Gurney's Sugarbird. Removal of dead and fallen trees has a detrimental effect on smaller mammals, such as dormice, that use old hollow trees for breeding, nesting and hibernating, and shrews and other small rodents that use fallen trees as their habitat. Dead trees, or dead branches in living trees are also important for some species of birds, particularly as nest sites for hole-nesting species, and the removal of these in Provincial nature reserves is controlled.

5.5 Responding to Biodiversity Loss

The National Biodiversity Strategy and Action Plan (DEAT, 2005) has been developed in response to the signing and ratifying of the Convention on Biological Diversity, in 1995. This provides the framework within which Provincial programmes are to be developed. The GIS currently under development by DTEEA will assist in more effectively managing the biodiversity of the Province (Chapter 3).

Currently, the DTEEA is in the process of developing two policies: i) for the Import, Export and Translocation of Game, with specific reference to exotic species and ii) for the transformation of the game industry.



Permitting and compliance is monitored by the DTEEA. During 2007, a total of 4,800 permits were issued of which 250 were in accordance with CITES requirements. CITES (Convention on International Trade in Endangered Species) was ratified in 1975 and aims to prevent the sale of endangered species through appropriate control measures and monitoring. Other issues addressed during 2007 include:

- Removal and release of 210 different animals that were kept illegally.
- Evidence provided for 49 court cases.
- 22 people arrested for the illegal possession and trade in rhino horn, cycads and abalone.
- Rhino horn to the value of R1.5 million, 12 tonnes of abalone and 12 endangered Cape Parrots were confiscated.

5.6 Conclusions

Historically, establishment of protected areas has been on an ad-hoc basis and generally the location has been based on land that has been made available around dams. Rivers in particular are poorly conserved and are subject to a range of impacts. Current conservation programmes may therefore not adequately include a representative sample of all ecosystems. In addition, the impacts from changes made to biodiversity and ecosystems may not be immediately identified but may only be apparent in the longer-term. A cautious approach to any change is therefore recommended and should be guided by appropriate information.

It is essential that planning frameworks at the three spheres of government must take biodiversity into consideration and be integrated into social and economic development. Strengthening of the information management system at a Provincial level through the establishment of the GIS as a planning tool will enable informed decisions to be made.

To effectively plan and implement an integrated approach to the management of biodiversity requires an effective institutional capacity at all levels of government. This includes appropriate financial and human resources (in sufficient numbers and with appropriate skills) and the correct tools to continually monitor and manage information, its evaluation and application. Due cognisance should be given to pending climate change which is predicted to have significant impacts in the Province.

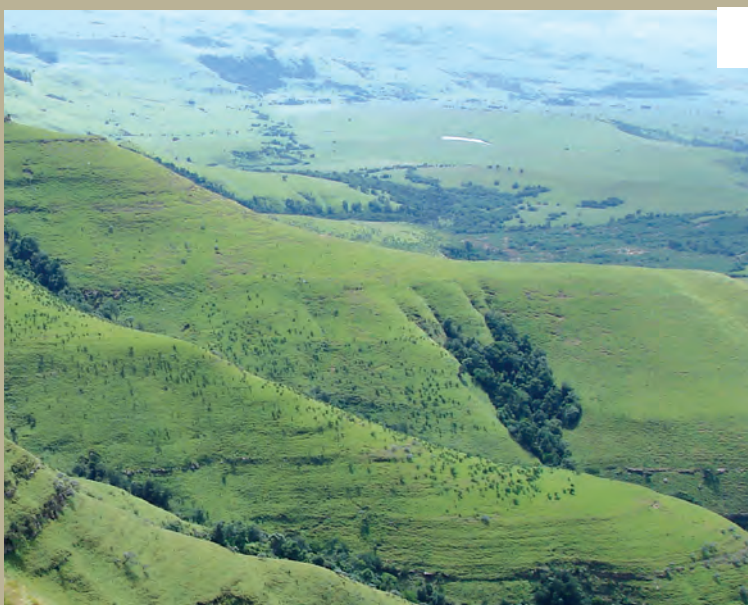
With a focus on socio-economic development within the Province, the role of biodiversity in strengthening the tourism potential must be assessed and addressed accordingly.

5.7 Actions

The following actions are proposed to address identified issues of concern. Timeframes and responsibilities have been allocated to the proposed actions.

Issue	Action	Timeframe	Responsibility
Planning: Inadequate planning impacts on the management of conservation areas and protection of biodiversity and ecosystems. Issues of biodiversity need to be incorporated into planning frameworks at provincial and local government.	Establish conservation areas needed to protect various ecosystems through the Conservation Plan and develop and implement action plan	2008 – 2012	Municipalities Researchers DTEEA
	Ensure that biodiversity issues identified within provincial and municipal planning frameworks	2008 – 2010	Municipalities DTEEA
	Develop and implement biodiversity management plan for private reserves	2008 – 2010	Private sector Researchers DTEEA
	Increased awareness of the role of biodiversity in socio-economic development and available management tools	2008 -2010	DoA Lead department - DTEEA
	Ensure possible impacts of climate change are addressed within planning frameworks	2008 – 2012	Researchers Municipalities DTEEA
	Develop and implement a tool to assess terrestrial ecosystem integrity to inform planning and decision making	2008 – 2012	Researchers DTEEA
	Update the departmental database with a land-use cover – and vegetation map	2008 - 2009	GIS specialists DTEEA
<i>Aquatic ecosystems:</i> The overall assessment of river health in the Province is fair to poor. Wetland health is also negatively impacted by detrimental factors. Management of aquatic systems needs to be optimised.	Integrated approach to the management of catchments to improve water quality and ecosystems	2008 – 2010	DTEEA Municipalities Researchers Lead department - DWAF
	Establish current status of wetlands, rehabilitation requirements and management options	2010 – 2011	DTEEA Researchers
	Identify priority wetlands for protection of biodiversity	2008 - 2009	DTEEA

Issue	Action	Timeframe	Responsibility
<i>Invasive alien species control:</i> Invasive alien species displace indigenous species and impact on the genetic integrity of species. Alien invasive plants are responsible for a reduction in water runoff.	Integrated approach to removal of invasive alien vegetation	2008 – 2012	DoA DWAF Lead department - DTEEA
	Strategy developed to manage the introduction and re-introduction of large mammal species in the Province	2008 – 2010	Researchers DTEEA
	Strategy developed to promote genetic integrity of species in the Province	2008 – 2009	DTEEA
<i>Trade in biodiversity resources:</i> High demand and intensive harvesting of indigenous plants is accelerating the extinction of species outside of protected areas.	Establish measures to mitigate the large scale harvesting of indigenous species	2008 -2010	Researchers DTEEA
	Strengthen programmes to minimise harvesting of indigenous vegetation for fuelwood	2008 – 2012	DoA DTEEA Lead department - DWAF
<i>Problem animal species:</i> The negative impacts of problem species to be identified and addressed	Identify and implement priority research and action plans	2009 - 2010	Researchers DTEEA Farmers Users Associations Lead department - DoA



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