

THE SOUTH AFRICAN LEGAL FRAMEWORK FOR THE CONSERVATION OF BIODIVERSITY

ERIK KLEYNHANS ROUWENHORST

B.Sc, M.Sc

Thesis submitted in the fulfilment of the requirements for the
degree Philosophiae Doctor in Geography and Environmental
Studies at North-West University

Promoter
PROF IJ VAN DER WALT

Assistant-Promoter
PROF SS CILLIERS

POTCHEFSTROOM
2007

MET LIEFDE VIR PA EN MA

***Jare en sirkels eindig nooit die begin
en trane in letters gespin;***

***Splinters van die ewige stryd
teen die bloed, sweet en spyt.***

***Begrawe in my bruin smart gesteente
in die seerkry van my gebeente.***

***Soggens versmoor die mis my lugkastele
saans die pienk wolk tussen doringstele;***

***Seisoene en dae vlieg my lewensjare
Kuiken tot hoender, verwaai in herfsblare.***

***Droom oor more en wonder of dit sal wees,
saai dit onrus oor my gees;***

***Toe bel jy eendag in die oggend dou
en eindig die waansin van die grou...***

Erik Rouwenhorst

DECLARATION

I, Erik Kleynhans Rouwenhorst, do hereby declare that, unless specifically indicated to the contrary in this text, this thesis is my own work and has not been submitted to any other university in the fulfilment of the academic requirements of any other degree or qualification.

Due to the large amount of legislation, examination deadlines and the time required for consultation with promoters, the author and promoters uniformly decided that no new relevant legislation after 31/06/2006 were used for evaluation purposes. Evaluation of legislation in this project included those available before such determined date. The author is fully aware of environmental legislation promulgated after such date, but for these practical reasons, this does not fall within the scope of this thesis.

ACKNOWLEDGEMENTS

I would like to extend my sincere gratitude and appreciation to the following individuals and institutions, for their contributions towards this research project.

- My promoter Prof Kobus van der Walt for his commitment and patience in leading this research project. Successful completion of this project would not have been possible without you.
- My assistant promoter Prof Sarel Cilliers for his assistance on aspects relating to biodiversity.
- Prof Willemien du Plessis and Dr Louis Kotze of the Faculty of Law, at North-West University for their assistance.
- Mrs Christine Bronkhorst at the Ferdinand Postma Library (North - West University) who assisted me in obtaining legislation needed in this research project.
- Prof Rina de Beer and Prof Kobus van der Walt for translation of the Afrikaans summary.
- Mrs Shirley Banning for the linguistic editing of this thesis.
- Dr Hannes Strauss for his assistance in writing this information onto compact disc.
- Ms Ananka Loubser for assisting with the printing of this document.
- My family and friends for their love and support.

TABLE OF CONTENTS

	Page
Acknowledgements	i
Table of contents	ii
List of tables	xv
List of figures	xvi
Abstract	xviii
Opsomming	xix

CHAPTER 1 OBJECTIVES AND SCOPE OF STUDY

1.1	Introduction	1
1.2	Biodiversity in South Africa	1
1.3	Concern over biodiversity in South Africa	2
1.3.1	Floral diversity status	2
1.3.2	Faunal diversity status	2
1.4	Aspects that are needed to protect and conserve biodiversity	3
1.5	South African law and the environment	4
1.6	Research question	6
1.7	Objective	6
1.8	Research method	7
1.9	Chapter division	7

CHAPTER 2 BIODIVERSITY IN SOUTH AFRICA

2.1	Introduction	8
2.1.1	Biodiversity in dynamic ecosystems	11
2.2	The importance of biodiversity	14

2.3	Plant and animal biodiversity in South Africa	17
2.3.1	Floral diversity status	22
2.3.2	Faunal diversity status	25
2.3.3	Marine environment status	27
2.4	Threats to plant and animal biodiversity in South Africa	27
2.4.1	Anthropogenic threats to terrestrial and aquatic biodiversity	29
2.4.2	Anthropogenic threats to marine biodiversity	32
2.5	Conservation status	34
2.5.1	Conservation of terrestrial biodiversity	34
2.5.2	Conservation of marine biodiversity	35
2.6	Conclusion	37

CHAPTER 3

REQUIREMENTS TO SUSTAIN BIODIVERSITY

3.1	Introduction	38
3.2	Aspects needed to ensure sustainable biodiversity	38
3.3	The marine environment	33
3.3.1	Marine harvesting, protection, and regulation	40
3.3.1.1	Life in the ocean	40
3.3.1.2	Harvesting	40
3.3.1.3	Stocks in trouble	41
3.3.1.4	Aquaculture	42
3.3.1.5	Improved fishing management	42

3.3.1.6	Whaling	43
3.3.1.7	Corals	43
3.3.1.8	Seagrasses	43
3.3.1.9	Mangroves and estuaries	44
3.3.1.10	Coastal dunes	45
3.3.1.11	Need for regulation, protection and conservation measures	46
3.3.2	Marine pollution	48
3.3.2.1	The scope of marine pollution	48
3.3.2.2	Sources	48
3.3.2.3	Impact of algae	49
3.3.2.4	Toxic substances	49
3.3.2.5	Oil	50
3.3.2.6	Dumping and littering	51
3.3.2.7	Measures to assist in marine pollution control	51
3.3.3	Protection of Antarctica	52
3.3.3.1	Character of continent	52
3.3.3.2	Biodiversity	53
3.3.3.3	Protection	53
3.3.4	Summary: Aspects needed to sustain biodiversity in the marine environment	54
3.4	The terrestrial, atmospheric and fresh water environment	56
3.4.1	Air pollution	56
3.4.1.1	Acid rain	56

3.4.1.2	Impact of acid rain	58
3.4.1.3	Impact on biodiversity	59
3.4.1.4	Regulation	60
3.4.1.5	Global warming	60
3.4.1.6	The ozone layer	62
3.4.1.7	Measures to reduce air pollution	63
3.4.2	Population growth	64
3.4.2.1	Impact of growth	64
3.4.2.2	Impact of mortality	66
3.4.3	Development	66
3.4.3.1	Urbanisation and the environment	66
3.4.3.2	Measures to regulate the negative impact of development	68
3.4.3.3	Mining	69
3.4.4	Land and aquatic pollution control	70
3.4.4.1	Pollution of aquatic resources	70
3.4.4.2	Types of wastes	72
3.4.4.3	General solid wastes and litter (non-hazardous)	73
3.4.4.4	Regulation	74
3.4.4.5	Hazardous substances	76
3.4.4.6	Nuclear wastes	76
3.4.4.7	Heavy metals and persistent organic compounds	77
3.4.4.8	The threat to biodiversity	78
3.4.4.9	Regulation	79

3.4.5	Hydrological cycle integrity	80
3.4.5.1	The scope of water resources	80
3.4.5.2	Use of water	80
3.4.5.3	South Africa and water shortage	81
3.4.5.4	Need for regulation	81
3.4.5.5	Importance of mountain catchment areas	82
3.4.5.6	Regulation and protection	84
3.4.5.7	Regulation in South Africa	84
3.4.5.8	Wetlands	85
3.4.5.9	Threats	86
3.4.5.10	Need for protection and conservation of wetlands	87
3.4.6	Fire regulation	87
3.4.6.1	Scope	87
3.4.6.2	Regulation of fires	89
3.4.7	Summary: Aspects needed to sustain biodiversity in the terrestrial, atmospheric and fresh water environment	89
3.5	The biological environment	92
3.5.1	Terrestrial conservation	92
3.5.1.1	Conservation areas	92
3.5.1.2	Conservation strategies	94
3.5.1.3	Community approach in conservation	95
3.5.1.4	Biodiversity harvesting activities	96
3.5.1.5	Conservation management measures	97
3.5.1.6	Hunting	98

3.5.1.7	Alien and invasive species	99
3.5.1.8	Control of alien and invasive species	100
3.5.1.9	Biodiversity trade	101
3.5.1.10	Control measures	102
3.5.1.11	Migratory species	103
3.5.1.12	Destruction of forest biodiversity	104
3.5.1.13	Logging	104
3.5.1.14	Incentives to save the forests	105
3.5.1.15	Deforestation and the fuelwood crisis	106
3.5.1.16	Solutions	107
3.5.1.17	Deforestation and the timber trade	108
3.5.1.18	Value of timber	109
3.5.1.19	Incentives for protection and conservation	110
3.5.2	Management of agricultural activities	110
3.5.2.1	Impact of agriculture on the environment	110
3.5.2.2	Need for sustainable agricultural practices	112
3.5.2.3	Desertification	113
3.5.2.4	Solutions	115
3.5.2.5	Agricultural products	115
3.5.2.6	Environmental problems with fertilisers and biocides	115
3.5.2.7	Regulation of agricultural activities and products	117
3.5.3	Summary: Aspects needed to sustain biodiversity in the biological environment	118
3.6	Conclusion	120

CHAPTER 4

SOUTH AFRICAN ENVIRONMENTAL FRAMEWORK LEGISLATION

4.1	Introduction	122
4.2	The development and scope of environmental law	122
4.2.1	International environmental law	123
4.3	The Bill of Rights and environmental law	124
4.3.1	Role of Government and administration	124
4.3.2	Functions of national, provincial and local government	126
4.4	Framework legislation	128
4.4.1	National Environmental Management Act 107 of 1998	129
4.4.2	Environment Conservation Act 73 of 1989	149
4.4.3	Convention on Biological Diversity, 1992	155
4.4.4	National Environmental Management: Biodiversity Act 10 of 2004	161
4.4.5	National Environmental Management: Protected Areas Act 57 of 2003	178
4.5	Conclusion	187

CHAPTER 5

SECTORAL LEGISLATION: THE MARINE ENVIRONMENT

5.1	Introduction	191
5.2	The Marine Environment	191
5.2.1	Marine harvesting, protection, and regulation	191
5.2.1.1	The International Convention for the Regulation of Whaling, 1946 (IWC)	191
5.2.1.2	The International Convention for the Conservation of Atlantic Tunas, 1966	192

5.2.1.3	Marine Living Resources Act 18 of 1998	193
5.2.1.4	Sea-Shore Act 21 of 1935	199
5.2.1.5	Sea Birds and Seals Protection Act 46 of 1973	200
5.2.1.6	Sea Fishery Act 12 of 1988	200
5.2.2	Marine pollution	201
5.2.2.1	Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986	201
5.2.2.2	International Convention for the Prevention of Pollution from Ships, 1973	202
5.2.2.3	Protocol of 1978 to the International Convention for the Prevention of Pollution from Ships, 1973	203
5.2.2.4	The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969	204
5.2.2.5	Protocol relating to intervention on the high seas in cases of marine pollution by substances other than oil 1973	205
5.2.2.6	Marine Pollution (Intervention) Act 64 of 1987	205
5.2.2.7	Dumping at Sea Control Act 73 of 1980	205
5.2.2.8	The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol	207
5.2.2.9	Marine Pollution (Control and Civil Liability) Act 6 of 1981	209
5.2.3	Protection of Antarctica	210
5.2.3.1	The Antarctic treaty 1959	210
5.2.3.2	The Protocol on Environmental Protection to the Antarctic Treaty 1991	211
5.2.3.3	The Convention on the Conservation of Antarctic Seals 1959	212
5.2.3.4	The Convention on the Conservation of Antarctic Marine Living Resources 1980	213
5.2.3.5	The Antarctic Treaties Act 60 of 1996	214
5.3	Conclusion	216

CHAPTER 6

SECTORAL LEGISLATION: THE TERRESTRIAL, ATMOSPHERIC AND FRESH WATER ENVIRONMENT

6.1	Introduction	219
6.2	The terrestrial, atmospheric and fresh water environment	220
6.2.1	Air pollution control	220
6.2.1.1	The United Nations Framework Convention on Climate Change, 1992 (UNFCCC)	220
6.2.1.2	The United Nations Convention to Combat Desertification, 1994 (UNCCD)	221
6.2.1.3	The Montreal Protocol on substances that deplete the ozone layer, 1987 (Montreal Protocol)	223
6.2.1.4	The Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997, (The Kyoto Protocol)	224
6.2.1.5	National Environmental Management: Air Quality Act 39 of 2004	226
6.2.2	Hydrological integrity	230
6.2.2.1	The Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1971 (Ramsar Convention)	230
6.2.2.2	National Water Act 36 of 1998	231
6.2.2.3	Mountain Catchment Areas Act 63 of 1970	234
6.2.2.4	Lake Areas Development Act 39 of 1975	235
6.2.3	Regulation of development	235
6.2.3.1	Development Facilitation Act 67 of 1995	236
6.2.3.2	Physical Planning Act 125 of 1991	236
6.2.3.3	Mineral and Petroleum Resources Development Act 28 of 2002	237
6.2.3.4	Petroleum Pipelines Act 60 of 2003	241
6.2.4	Natural heritage	242

6.2.4.1	National Heritage Council Act 11 of 1999	242
6.2.4.2	National Heritage Resources Act 25 of 1999	242
6.2.4.3	The World Heritage Convention, 1972	244
6.2.4.4	World Heritage Convention Act 49 of 1999	244
6.2.5	Land and aquatic pollution control	245
6.2.5.1	Nuclear Energy Act 46 of 1999	245
6.2.5.2	National Nuclear Regulator Act 47 of 1999	247
6.2.5.3	The Stockholm Convention on Persistent Organic Pollutants, 2002 (POPs)	249
6.2.5.4	The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention)	251
6.2.5.5	The Convention on Prior Informed Consent-Rotterdam, 1998 (the Rotterdam Convention)	252
6.2.5.6	Hazardous Substances Act 15 of 1973	253
6.2.5.7	Explosives Act 15 of 2003	255
6.2.6	Fire regulation	256
6.2.6.1	National Veld and Forest Fire Act 101 of 1998	256
6.3	Conclusion	258

CHAPTER 7

SECTORAL LEGISLATION: THE BIOLOGICAL ENVIRONMENT

7.1	Introduction	262
7.2	The biological environment	262
7.2.1	Terrestrial conservation	262
7.2.1.1	The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES)	262
7.2.1.2	The Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)	264

7.2.1.3	National Parks Act 57 of 1976	266
7.2.1.4	Forest Act 122 of 1984	266
7.2.1.5	Management of State Forest Act 128 of 1992	266
7.2.1.6	National Forest Act 84 of 1998	266
7.2.1.7	Fencing Act 31 of 1963	268
7.2.2	Management of agricultural activities	269
7.2.2.1	Agricultural Pest Act 36 of 1983	269
7.2.2.2	Animal Health Act 7 of 2002	270
7.2.2.3	Conservation of Agricultural Resources Act 43 of 1983	271
7.2.2.4	Genetically Modified Organisms Act 15 of 1997	274
7.2.2.5	The Genetically Modified Organisms Amendment Bill 34 of 2005	275
7.3	Conclusion	276

CHAPTER 8 PROVINCIAL LEGISLATION

8.1	Introduction	278
8.2	Eastern Cape	278
8.2.1	Nature Conservation Act (Ciskei) 10 of 1987	278
8.2.2	Nature and Environmental Conservation Ordinance 19 of 1974	280
8.3	Free State	282
8.3.1	Bophuthatswana Nature Conservation Act 3 of 1973	282
8.3.2	Qwaqwa Nature Conservation Act 5 of 1976	283
8.3.3	Protected Areas Act (Bophuthatswana) 24 of 1987	284
8.3.4	Nature Conservation Ordinance 8 of 1969	285

8.4	Gauteng	288
8.4.1	Nature Conservation Ordinance 12 of 1983	288
8.5	KwaZulu-Natal	291
8.5.1	KwaZulu Nature Conservation Act 29 of 1992	291
8.5.2	KwaZulu-Natal Nature Conservation Management Act 9 of 1997	296
8.5.3	KwaZulu-Natal Nature Conservation Management Amendment Act 5 of 1999	296
8.5.4	Nature Conservation Ordinance 15 of 1974	298
8.6	Limpopo	301
8.6.1	Gazankulu Nature Conservation Act 5 of 1975	301
8.6.2	Weeds Act (Venda) 12 of 1983	302
8.6.3	Nature Conservation and National Parks Act (Venda) 20 of 1986	303
8.6.4	Northern Province Tourism and Parks Board Act 8 of 2001	304
8.6.5	Nature Conservation Ordinance 12 of 1983	305
8.7	Mpumalanga	305
8.7.1	Mpumalanga Nature Conservation Act 10 of 1998	305
8.7.2	Mpumalanga Parks Board Act 6 of 1995	308
8.8	Northern Cape	309
8.8.1	Nature and Environmental Conservation Ordinance 19 of 1974	309
8.9	North West	309

8.9.1	Nature and Environmental Conservation Ordinance 19 of 1974	309
8.9.2	Nature Conservation Ordinance 12 of 1983	309
8.10	Western Cape	309
8.10.1	Nature and Environmental Conservation Ordinance 19 of 1974	309
8.11	Conclusion	309

CHAPTER 9 CONCLUSION AND RECOMMENDATIONS

9.1	Conclusion	311
9.2	Recommendations	317
9.3	Strategic recommendations	317
9.3.1	National Interdepartmental Biodiversity Body	317
9.3.2	Integration and fusion of provincial legislation	319
9.3.3	National integration of international commitments	320
9.3.4	The environmental impact assessment agency	321
9.4	Framework legislation recommendations	322
9.5	Sectoral legislation recommendations	325
9.6	Marine environment	325
9.6.1	Marine protection	325
9.6.2	Management of marine pollution	326
9.7	The terrestrial, atmospheric and fresh water environment	326

9.7.1	Atmospheric pollution control	326
9.7.2	Regulation of development	326
9.7.3	Land and aquatic pollution control	327
9.7.4	Hydrological cycle integrity	328
9.7.5	Fire regulation	328
9.8	Biological environment	328
9.8.1	Management of agricultural activities	328
9.9	Provincial legislation recommendations	392
9.9.1	Eastern Cape	392
9.9.2	Free State	330
9.9.3	Gauteng	331
9.9.4	KwaZulu-Natal	331
9.9.5	Limpopo	332
9.9.6	Mpumalanga	332
9.9.7	Northern Cape	332
9.9.8	North West	333
9.9.9	Western Cape	333
10	Conceptual Framework Act on Biodiversity	333
	REFERENCE	336

LIST OF TABLES

Table	Description	Page
Table 1:	Characteristics of early and late succession species and their habitat requirements	13
Table 2:	Terrestrial species richness in South Africa	19

Table 3:	Sizes of various South African biomes expressed in hectares	21
Table 4:	Definitions of vulnerability to extinction	23
Table 5:	Threats to the seven South African biodiversity hotspots	30
Table 6:	Concise generic summary of sustainable biodiversity aspects/criteria in the marine environment	54
Table 7:	Concise generic summary of sustainable biodiversity aspects/criteria in the terrestrial, atmospheric and fresh water environment	89
Table 8:	Concise generic summary of sustainable biodiversity aspects/criteria in the biological environment	118
Table 9:	Schedules 4 and 5 of the Constitution (1996) dealing with environmental matters that relate to biodiversity matters	127
Table 10:	Differences and similarities between provincial legislation.	316

LIST OF FIGURES

Figure	Description	Page
Figure 1:	Schematic diagram of succession of a forest (adapted from Cox, 1997:55).	12
Figure 2:	South African species in comparison to Africa and the rest of the world, expressed in species per 1000 km ² (data from Geach & Peart, 1998).	18
Figure 3:	Percentage endemism for various countries (adapted from Cowling and Hilton-Taylor, 1993:35).	18
Figure 4:	Total number of species for the 9 South African provinces (created by the author using information from South Africa, 1996).	19

Figure 5:	Number of floristic taxa in detailed biodiversity hotspots (data from Van Wyk & Smith, 2001:16).	20
Figure 6:	Percentage endemism in detailed biodiversity hotspots (data from Van Wyk & Smith, 2001:16).	21
Figure 7:	Sizes of various South African biomes expressed in hectares (data from South Africa, 1999a).	22
Figure 8:	Status of floral taxa from 1980-1995 (created by the author using data from Geach & Peart, 1998; South Africa, 1999a).	25
Figure 9:	Status of mammal taxa from 1986-2000 (data collected from Massicot, 2002; Collins, 2001; Deltaenviro, 2002; Feris, 2002; Peter's Homepage, 2002; Klein, 2001; South Africa, 1999a; Smithers, 1986:10; IUCN, 2003).	26
Figure 10:	Percentage conserved area of the seven biodiversity hotspots (data from Maddock & Benn, 2000).	35
Figure 11:	Representation of the structure, functions, and benefits of the formation of the proposed National Interdepartmental Biodiversity Body	319
Figure 12:	Representation of the fusion of provincial legislation	320
Figure 13:	Integration of supported international commitments	321
Figure 14:	Formation of the Environmental Impact Assessment Agency	322
Figure 15:	Contents of a proposed generic conceptual biodiversity act	334

ABSTRACT

South Africa is ranked as one of the most biologically diverse countries in the world. In comparison it has more species of vascular plants, amphibians, reptiles, birds and mammals per 1000 km² than Africa and the rest of the world. Unfortunately, statistics indicate that this biological diversity is becoming increasingly threatened by various anthropocentric activities in South Africa. It can be concluded that South Africa has the highest number of red data species in the world, as well as the second highest number of endemic taxa. The numbers of extinct, endangered, rare, and vulnerable species have increased exponentially over the past 10-15 years. South African legislation provides directives to ensure measures are taken to provide for biodiversity conservation and sustainable use. However, the trends in the conservation status of various South African species have raised the question of whether this legislation can adequately sustain biodiversity for future use.

Biodiversity needs to be preserved for sustainable future use due to the instrumental and intrinsic value it holds for society. Various criteria should be complied with to ensure that biodiversity is sustained for future generations. In this research project a consortium of criteria was identified relevant to ensuring sustainable use of biodiversity and its conservation. These criteria pertain to the marine, terrestrial, atmospheric, fresh water and biological environment and may directly or indirectly reflect on the integrity of biodiversity. This consortium of aspects included marine harvesting, marine protection, marine pollution, air pollution, human population growth, development, land pollution, aquatic pollution, hydrological integrity, fire management, terrestrial protection, and agricultural management. These focus areas included numerous internationally recognised strategic and detailed aspects, and also additional measures relevant to the South African context. South African legislation was evaluated against these aspects to determine its compliance with these issues.

The results concluded that South African legislation makes provision for various strategic aspects that are needed to sustain biodiversity. However, legislation failed to address a few strategic and some important detail aspects, such as the regulation of marine harvesting, marine protection, control over marine pollution, management of human population growth, regulation of development, hydrological integrity, and terrestrial protection. Smaller lacunae were discovered in air pollution control, fire management, land and aquatic pollution control, the management of agricultural activities, fragmented administration of legislation between government spheres, and the effectiveness of provincial legislation to regulate biodiversity protection in all provinces.

The author recommended the formation of the National Interdepartmental Biodiversity Body to ensure integrated management of issues that relate to the environment and biodiversity. Other recommendations include: integration and fusion of provincial legislation to ensure equal protection of biodiversity in all provinces; national integration of international commitments into relevant

statutes; and the formation of the Environmental Impact Assessment Agency to regulate the quality of environmental impact assessments. Detailed recommendations were aimed at improving specific aspects under various environmental acts.

OPSOMMING

Suid-Afrika is 'n land met 'n baie ryk biodiversiteit. Die land het meer spesies vaatplante, amfibië, voëls en soogdiere per 1000 km² as enige ander Afrika-land en selfs enige ander land ter wêreld. Statistiek dui egter daarop dat hierdie biodiversiteit toenemend bedreig word deur 'n verskeidenheid antroposentriese aktiwiteite. Die gevolg daarvan is dat Suid-Afrika die hoogste getal rooi-data spesies in die wêreld het, asook die tweede hoogste getal endemiese taksa. Die hoeveelheid uitgestorwe-, bedreigde-, raar- en kwesbare spesies het die afgelope 10-15 jaar eksponensiëel toegeneem. Suid-Afrikaanse wetgewing maak voorsiening vir stappe om te verseker dat biodiversiteit beskerm word, maar die lae bewaringstatus van verskeie spesies het die vraag laat ontstaan of hierdie wetgewing wel voldoende is om die volhoubaarheid van Suid-Afrika se biodiversiteit te verseker.

Biodiversiteit moet bewaar word vir die toekoms as gevolg van die intrinsieke en instrumentele waarde wat dit inhou vir die gemeenskap. Daar moet egter aan verskeie kriteria voldoen word om te verseker dat biodiversiteit wel volhoubaar beskerm kan word. In hierdie studie is kriteria geïdentifiseer wat relevant is om volhoubare biodiversiteit te verseker. Hierdie kriteria val binne die raamwerk van die mariene-, terrestriële-, en biologiese omgewing, en mag die integriteit van biodiversiteit direk of indirek beïnvloed. Die kriteria sluit die volgende in: ontginning van mariene spesies, mariene beskerming, mariene besoedeling, lugbesoedeling, menslike bevolkingsaanwas, die regulering van ontwikkeling, terrestriële besoedeling, akwatiese besoedeling, hidrologiese integriteit, brandbestuur, grondbewaring en landboubestuur. Hierdie fokusareas sluit 'n verskeidenheid van strategiese en detail kriteria in wat internasionaal erken word, asook kriteria wat meer van toepassing op Suid-Afrika is. Hierdie kriteria is gebruik as 'n basis waarteen Suid-Afrikaanse wetgewing geëvalueer is om sodoende te bepaal of die wetgewing wel toereikend is.

Die resultate het aangetoon dat Suid-Afrikaanse wetgewing wel voorsiening maak vir die meeste van die aspekte wat vereis word vir volhoubare biodiversiteit, maar dat enkele strategiese en detail aspekte in meer besonderhede aangespreek moet word. Hierdie aspekte sluit in die regulering van mariene ontginning, mariene beskerming, kontroliering van mariene besoedeling, bevolkingsaanwas kontrole, regulering van ontwikkeling, hidrologiese integriteit en landelike bewaring. Enkele detail-leemtes m.b.t. lugbesoedelingskontrole, brandbestuur, terrestriële en akwatiese besoedeling, beheer van landbouaktiwiteite, gefragmenteerde administrasie tussen regeringsorgane, asook die effektiwiteit van provinsiale wetgewing om biodiversiteit in alle provinsies te beskerm, is ook geïdentifiseer.

Die instel van 'n Nasionale Interdepartementele Biodiversiteitsliggaam word voorgestel om meer geïntegreerde bestuur van sake betreffende die omgewing en biodiversiteit te verseker. Ander aanbevelings sluit die volgende in: die integrering en samesmelting van provinsiale wetgewing om ewekansige bewaring van biodiversiteit in alle provinsies te verseker, die nasionale integrasie van internasionale verbintenisse (soos konvensies) in relevante wette, en die vorming van 'n omgewingsinvloedbepalings-agentskap om kwaliteitskontrole oor die bepaling van omgewingsinvloed te verbeter. Detail aanbevelings is daarop gemik om spesifieke aspekte onder verskeie omgewingswette te verbeter.

CHAPTER 1

OBJECTIVES AND SCOPE OF STUDY

1.1 Introduction

The extinction of species is not a unique and recent phenomenon but occurred over millions of years during natural selection and evolution. The extinction of species may be a dramatic event, or may be a slow process that can take millions of years to achieve. Over long periods of evolutionary time, it is likely that speciation and extinction may have balanced each other out, and it is suggested that the average speciation rate is 0.5 species per annum compared with the 0.05 species per annum extinction rate. It is estimated that the average bird and mammal species may exist for up to 2 million years. Extinction rates have not been constant throughout evolutionary time, and extinction is often associated with calamitous events in the earth's history. With the ability of humans to use fire and tools, the pressure on the natural ecosystems increased steadily to a point where its impact became apparent (Cox, 1997:45-49).

When considering the present phenomenon in which entire ecosystems are becoming extinct, one has to keep in mind that the extinction of species in the past was only partial. In this process many species did not become extinct and had the potential to provide the necessary genetic information for sustaining ecosystem integrity. In contrast, entire ecosystems are wiped from the face of the earth today, and very little genetic information is left behind to create a natural backup. The period of time available today for species to adapt to the changing environmental conditions are not adequate to allow for sustainable adaptation. Some species will remain alive in the most environmentally unfavourable conditions, but the loss of more sensitive species will create major lacunae in global diversity (Primack, 1993:105-107).

1.2 Biodiversity in South Africa

A simple definition of biodiversity makes provision for the variety of living organisms from terrestrial, marine and aquatic ecosystems. This also includes the ecological complexes of which they are part of and all the diversity between species, within species and ecosystems (Noss, 1990:155).

South Africa falls into the top twelve countries in the world with the highest percentage of endemic species, meaning that such species only occur in small isolated areas and nowhere else (see chapter 2, 2.3). South Africa can be ranked as the country with the second highest number of endemic species in the world. It is only slightly outnumbered by New Zealand (Cowling and Hilton-Taylor, 1993:35). South Africa further harbours 5.8% of the world's mammal species, 8% birds, 4.6% reptiles, 16% marine fish species, 1.3% freshwater fish, 2.1% amphibians, 5.5% invertebrates, and 7.5% vascular plant species (see chapter 2,

2.3.1 and 2.3.2). Areas with high biodiversity in South Africa include the following areas: Wolkberg, Maputaland, Pondoland, Eastern Mountain, Albany, Cape Floristic Kingdom and Succulent Karoo (Cowling and Hilton-Taylor, 1993:31-42; Conservation International, 2002b).

1.3 Concern over biodiversity in South Africa

Certain criteria may be used to describe the conservation status of species (chapter 2, 2.3.1). In terms of such system a species may be:

- *extinct* when it no longer exists,
- *extinct in the wild* when it only survives in cultivation,
- *critically endangered* when it is facing a very high risk of extinction in the wild in the near future,
- *endangered* when it is in danger of extinction,
- *vulnerable* when it is believed that it may become endangered,
- *rare* when it consists of small populations which are not yet vulnerable or endangered,
- *threatened* when endangered/vulnerable/rare,
- *endemic* when restricted to a particular region, and
- *conservation dependent* when it can not be classified in any of the above categories due to lack of information (Primack, 1993:105-107; Collins, 2001:1).

1.3.1 Floral diversity status

Statistics conclude that South Africa has the highest number of threatened plant taxa in the world. The status of approximately 4149 plant species has been assessed, and of these an estimated 3435 are globally threatened (Geach & Peart, 1998:2). A further estimated 2575 species are locally threatened (Cowling and Hilton-Taylor, 1993:31-42; Geach & Peart, 1998).

Species that were common a few years ago are currently seriously threatened. The numbers of some species (*Encephalartos dolomiticus*, *Encephalartos cerinus*) have been reduced to such an extent that reproduction is no longer possible. Statistics further conclude that many plant species will become more threatened in the near future (see chapter 2 for detail discussion) (Geach & Peart, 1998; South Africa, 1999a).

1.3.2 Faunal diversity status

Even though animal diversity is less threatened than plant diversity there is concern over their conservation status in general. The monitoring of faunal diversity is a difficult task due to the fact that animals migrate and are therefore difficult to trace. There is currently very little information available on most South African species. Worse still it is estimated that numerous insect species may

have become extinct even before they had been formally described (Goode, 2001:132).

South Africa harbours 243 mammals and of these an estimated 10.12% are threatened while 10.93% are endemic. Statistics conclude that 11 animal species are currently critically endangered in South Africa. These include species such as: black rhinoceros, pangolin, riverine rabbit, roan antelope, wild dog, coelacanth, Pondoland cannibal snail, Smith's dwarf chameleon, Juliana's golden mole, Van Zyl's golden mole and Visagie's golden mole (Smithers, 1986:10; Klein, 2001; Collins, 2001; South Africa, 1999a; Massicot, 2002; Deltaenviro, 2002; Feris, 2002; Peter's Homepage, 2002; IUCN, 2003).

South Africa harbours an astonishing 23 000 invertebrate species and of these an estimated 4.14% are threatened. Unfortunately the emphasis falls mainly on butterflies, of which South Africa harbours approximately 632 species. Of these 100 species, 2 are endangered, 7 are vulnerable, and 91 are rare (see chapter 2, 2.3.2) (Collins, 2001:1; South Africa, 1999a; Fuggle & Rabie, 1992:252).

1.4 Aspects required to protect and conserve biodiversity

One can almost categorically state that the threat to biodiversity is the result of anthropogenic activities of society. Even if mankind does not inherently want to compromise biodiversity, direct and indirect actions are responsible for the mass extinction of numerous species of plants and animals. Every country in the world has a responsibility to conserve its remaining biodiversity, and to ensure that the integrity of natural systems is sustained for use by future generations. The requirements for conserving biodiversity and ensuring its sustainable utilization rest upon strategic aspects. These aspects have a universal character, even though their importance may not be known at a specific time. It should therefore also be stressed that specific requirements are a concurrent function of society's development level, and change constantly as new research fills the gaps of our scientific uncertainty. It is therefore important to ensure that these aspects are regularly updated to accurately address sustainable biodiversity management (see chapter 3). *Sustainable biodiversity should mean that such diversity should be protected without compromising the integrity and long-term survival thereof.*

Numerous requirements should be complied with to ensure that biodiversity is sustained in a developing country. It is evident that such requirements are divergent and may have a direct or indirect character. *Direct* requirements may include those aspects that relate to direct threats to biodiversity. *Indirect* aspects relate to factors that may impact negatively on the survival of biodiversity or aspects that may prove detrimental at a later stage. It is therefore important to regulate all these requirements to ensure that every level of sustainable biodiversity can be achieved.

The requirements to sustain biodiversity can be classified under various focus areas of the environment. No area should be perceived as more important than any other, because the sum of these aspects interrelate with one another in the natural environment. One specific aspect of a particular focus area might also be essential to sustain the integrity of a natural system in another area (see discussion on holism in chapter 3). One could use the example of terrestrial pollution that may influence biodiversity on land, later in aquatic systems, and ultimately the marine environment. For ease of understanding and evaluation, the author classified these requirements into three separate focus areas that comprise: the marine environment, the terrestrial, atmospheric and fresh water environment, and the biological environment. All these areas interrelate with each other, and should not be seen as separate entities.

The marine environment (chapter 3, see 3.3) includes the territorial waters of South Africa, the adjoining seashore and coastal zone, and features associated therewith. These features include estuaries, sea lakes, lagoons, islands, and river mouths. Aspects that need to be regulated in this framework include:

- Marine harvesting, protection, and regulation
- Marine pollution; and
- Protection of Antarctica.

The terrestrial, atmospheric and fresh water environment (chapter 3, see 3.4) includes the atmosphere, water, and soil. Provision should be made to protect these entities that are necessary to sustain the living world. Aspects that need to be regulated in this framework include:

- Air pollution;
- Population growth;
- Development;
- Land and aquatic pollution control;
- Hydrological cycle integrity; and
- Fire regulation.

The biological environment (also see chapter 3, 3.5) includes aspects that relate to terrestrial protection and conservation of biodiversity. It also includes the regulation of agricultural activities that may have a detrimental impact on the environment. Aspects that need to be regulated in this framework include:

- Terrestrial conservation; and
- Management of agricultural activities.

1.5 South African law and the environment

Concern over environmental degradation has resulted in the promulgation of legislation that contains directives to manage such issues. The objective of

environmental legislation should not only make provision for aspects that pertain to sustainable development, but also to community well being. This is also emphasised by section 24 of the Constitution of the Republic of South Africa, 1996, that states that Government should protect the environment against degradation. This also implicates that biodiversity that forms part of such environment should be protected. Reasonable measures should be used to ensure the protection of the environment in order to enhance sustainable development (see chapter 4, 4.3). Under ideal conditions environmental legislation should make provision for the prevention of: biodiversity loss; disturbance to ecological systems; land degradation; all forms of environmental pollution; landscape disturbance; and over-exploitation of renewable and non-renewable resources. Environmental law should also regulate direct and indirect impacts on the environment, and holistically co-ordinate environmental problems (Glazewski, 2000:9-17).

Legislation that reflects on biodiversity can be divided into framework and sectoral legislation. The Constitution of the Republic of South Africa, 1996, is the most important basis of law in general and also environmental law (especially section 24). All legislation should comply with the principles of the Constitution at all times. Framework environmental legislation pertaining to biodiversity includes the following statutes:

- National Environmental Management Act 107 of 1998;
- Environment Conservation Act 73 of 1989;
- National Environmental Management: Biodiversity Act 10 of 2004;
- National Environmental Management: Protected Areas Act 57 of 2003; and
- Convention on Biological Diversity, 1992.

Conventions and protocols are international instruments that form an important part of legislation due to the fact that it can lead to the promulgation of legislation that is concurrent with the objectives of such commitment. Commitments are however not a form of pertinent legislation, unless the principles thereof have been integrated as part of national legislation.

The Convention on Biodiversity, 1992 (signed by South Africa) led to the promulgation of the Biodiversity Bill and eventually the Biodiversity Act.

Framework legislation forms a basis for sectoral statutes that pertain to the integrity of biodiversity, whether directly or indirectly. Sectoral environmental legislation covers the following aspects: agricultural resources, land development planning, environmental impact assessment, biodiversity, genetic modification, marine systems, protected areas, biological resource use, water management, mining and energy, natural heritage, and pollution control (ETU, 2002). Numerous statutes reflect on the integrity of biodiversity, and a few important statutes include:

- The Agricultural Pest Act 36 of 1983;
- Genetically Modified Organism Act 15 of 1997;
- The Sea Birds and Seals Protection Act 46 of 1973;
- The Marine Living Resources Act 18 of 1998;
- Dumping at Sea Control Act 73 of 1980;
- National Water Act 36 of 1998; and
- Nuclear Regulator Act 47 of 1999.

Provincial legislation (see chapter 8) forms an important part of environmental legislation, and the impact of such legislation in provinces may be of substantial character. Court cases reflect on the way legislation is interpreted and forms an important part of environmental law.

It can therefore be said that environmental legislation aims to protect the integrity and sustainability of biodiversity. It reflects directly or indirectly on the conservation and management of threats to biodiversity. A single act however does not ensure sustainable management and conservation of biodiversity.

1.6 Research question

Does South African environmental legislation adequately provide measures to protect and conserve biodiversity in South Africa?

(Protect *per se* in this thesis means to shield from direct and indirect threats, while conserve means to sustain such resources *in situ* or *ex situ*).

1.7 Objective

Main objective

The main objective of this thesis is to:

- Evaluate South African environmental legislation to determine whether it provides adequate measures to protect and conserve biodiversity in South Africa, and to make recommendations to improve such legislation in the face of protection and conservation of such biological resources.
- Formulate a new concept framework idea that could ensure the protection and conservation of such resources if implemented.

Specific secondary objectives are:

- Determine the state of biodiversity in South Africa through descriptions, statistics and any other specialist information.
- Identify and describe criteria needed to protect biodiversity in South Africa.
- Identify, discuss and evaluate international law and framework environmental legislation relevant to the protection of biodiversity.

- Identify, discuss and evaluate sectoral environmental legislation pertaining to the “marine environment focus area”.
- Identify, discuss and evaluate sectoral environmental legislation pertaining to the “terrestrial, atmospheric and fresh water environment focus area”.
- Identify, discuss and evaluate sectoral environmental legislation pertaining to the “biological environment focus area”.
- Identify, discuss and evaluate provincial environmental legislation pertaining to biodiversity.
- Conclude and recommend on the results obtained.

1.8 Research method

This study was a literature survey of the most important information relevant to the protection of biodiversity. Aspects relating to the protection of biodiversity, and any other aspects relating to the conservation of biological resources were gathered. This information was obtained from various international and national sources such as specialist publications, books, articles and personal communications with biodiversity specialists.

This information was used to compile a biodiversity literature overview, and the information therein was used to evaluate the relevant legislation. The provisions of the legislation were critically and objectively compared with international and national requirements (contained in the biodiversity literature overview) to assess their overall adequacy in protecting biodiversity. Lacunae in such provisions (in comparison to the literature overview) were identified at the end of each act and relevant recommendations regarding such lacunae were presented in chapter 9.

Only sections of various acts that are relevant to biodiversity were discussed in this thesis during the evaluation process.

1.9 Chapter division

In this thesis the following chapters will be discussed in order to provide systematic information and to reach a conclusion. The chapter division will be as follows:

Chapter 1 Objectives and scope of study;
 Chapter 2 Biodiversity in South Africa;
 Chapter 3 Requirements to sustain biodiversity;
 Chapter 4 South African environmental framework legislation;
 Chapter 5 Sectoral legislation: The marine environment;
 Chapter 6 Sectoral legislation: The terrestrial, atmospheric and fresh water environment;
 Chapter 7 Sectoral legislation: The biological environment;
 Chapter 8 Provincial legislation; and
 Chapter 9 Conclusion and recommendations.

CHAPTER 2

BIODIVERSITY IN SOUTH AFRICA

2.1 Introduction

The adaptation of living organisms to present the current biodiversity is a process that has taken almost three billion years to achieve, and has resulted in a large number of genetically unique organisms. None of the species alive today can exist without the interrelation with other organisms. Humans are considered the only species able to change the breadth of its niche with its intellectual capabilities. The large-scale destruction of biodiversity that is seen today is the most dangerous threat to humankind's continued existence (Barthlott & Winiger, 1998:144-147; Eldredge, 1998:1; Hall *et al.*, 1980:167).

Biodiversity *per se* includes animals, plants, fungi, ciliates, flagellates, ameboids, archaeobacteria and bacteria (Hickman *et al.*, 1997:11; Primack, 1993:77-83). Biodiversity also includes all aspects of biological diversity, species richness, ecosystem complexity and genetic variation (UGF, 2002; Hawksworth, 1991:14-16).

Of the 1 413 000 species that have been described globally, the diversity composition is:

- 751 000 insects;
- 248 400 plants;
- 281 000 other animals;
- 1 000 viruses;
- 4 800 bacteria;
- 6 900 fungi; and
- 26 900 algae (Wilson, 1992:10-12).

Cellular life in the form of bacteria evolved about 3.5 billion years ago, and eukaryotic organisms about 2 billion years ago. It is estimated that more species are alive today than in any other time in history, even if certain taxa contained more species in the past. The reason for this increasing richness in species can be contributed to evolutionary processes, and the break-up of continents that created numerous climatic regions. Species richness is correlated with structural complexity. On land, structure is provided by vascular plants, whereas in marine areas corals contribute to the dominating biological structure. Most of the time there is a general correlation between species richness and ecosystem productivity, but some exceptions do occur. Some highly productive systems, such as salt marshes, sea-grass beds, and hot springs, are species-poor. Conversely, plant species richness is extremely high in some unproductive semiarid regions with poor soils. Island communities are generally also poorer in

species than comparable mainland communities of all latitudes. Areas that have been geographically isolated for very long geological times and which have great topographic relief often support a high number of plant and animal species (Meffe & Carroll, 1994:144-150; Primack, 1993:57-60).

Biodiversity involves all the evolutionary and ecological aspects and includes the intraspecific and interspecific patterns in the ecosystem. The endemic taxa represent the uniqueness of a specific ecosystem and are of particular concern to conservation biology. About 1.4 million species have been named and described globally and estimates inform that the total number of species that still need to be described could reach 12.5 million (Hawksworth, 1991:14-16).

Biological diversity includes the entire range of species that can be found on earth. A species is defined as a group of individuals that are morphologically, physiologically or biochemically distinct from other groups. It is generally accepted in taxonomic circles that species can breed among themselves, but not with individuals of other groups. Taxonomists who specialise in the identification of new species most commonly use the biological concept of a species. Evolutionary biologists more often use the biological definition of a species, because it is based on measurable genetic relationships (Primack, 1993:77-83).

Taxonomy is the science of classifying living things according to a binominal nomenclature system. This system was developed in the eighteenth century by the Swedish biologist Carolus Linnaeus. In this system the genus name is always capitalized while the relevant species name is written in a standard manner. The overarching goal of taxonomy is to create a system that reflects the evolutionary characteristics of various organisms. Systematics is the study of diversity in the living world and the grouping of species that makes their identification much easier. Similar species are grouped into a genus, similar genera are grouped into a family, similar families are grouped into an order, similar orders are grouped into a class, similar classes are grouped into a phylum, and finally similar phyla are grouped into a kingdom. Five kingdoms are recognised by modern biologists in the living world and they are: plants, animals, fungi, monerans and protists (Primack, 1993:77-83).

Biochemical similarity reveals that life probably originated about 3.5 billion years ago on earth. Many species originated from an ancestor, and the process in which new species are formed is known as speciation. This process is active today and will probably be the driving force for the origin of species in the future. Populations of living organisms are adapting to changing environmental conditions, and these adaptations may be biological or environmental. When the genetic change that a population has undergone becomes large enough for that population to lose their capability to interbreed with the natural population from which they originated, they are considered to be a new species. The process whereby a species is gradually transformed into another species is called phyletic evolution. Speciation can only occur once the original population is

sexually isolated from the original ancestor. This isolation may be the result of geographical isolation, and therefore speciation is a rapid process on isolated islands, mountains and desolated valleys. The process of adaptive radiation where a species continuously adapts to changing environmental conditions is actively responsible for the biodiversity that exists today. Although speciation may be a tedious process, new variants and species may even arise within just one generation for some plants. Where unequal chromosome divisions are responsible for polyploids to arise, this genetic combination may have unique characteristics, which may enable them to survive and form a new species. Although new species are continuously arising all the time, the rate of extinction is currently almost a thousand times higher than speciation (Primack, 1993:79).

There are several factors that determine the great variety of species. The ultimate explanation involves the evolutionary and biogeographic processes that have determined the patterns of speciation and extinction. Communities of moist and tropical origins appear to have a greater variety of resources, and this is responsible for sustaining a large number of species and allows coexistence. Another factor that provides for the great number of biodiversity is called the intermediate disturbance hypothesis. In the absence of moderate disturbance, certain dominant species will take over the entire ecosystem and exclude other species from the habitat (Cox, 1997:56-60).

Diversity is maximised when moderated disturbance allows for the creation of different microhabitat conditions that favour succession and speciation. The catastrophism hypothesis holds that evolution tends to increase biodiversity by speciation and adaptive radiation continuously over evolutionary time. As a result of rare cataclysmic events that occur from time to time in the earth's history, massive extinctions may take place. These events may include catastrophic asteroid impacts, volcanoes, continental glaciations or changes in sea levels. Equilibrium theories hold that under particular environmental conditions a balance is created between speciation and extinction. The conditions that determine the balance between extinction and speciation include the effectiveness of geographical barriers that isolate portions of ancestral species (Cox, 1997:56-60).

Species interact within biological communities through processes such as competition, predation and mutualism. A characteristic of species is that they occupy distinct trophic levels within communities that represent the way they obtain their energy (see chapter 2, 2.1.1). Various unique feeding relationships of individual species are formed with other species in the food chain. Certain keystone species play an important part in determining the survival of other species in a community, and these may be predators or even inconspicuous species. The loss of keystone species can result in the extinction of numerous other species. This includes microorganisms which play an important part in various ecological processes. Keystone species are largely dependant on

keystone resources in the environment, and conservation of these resources will determine their survival (Primack, 1993:43-51).

All levels of diversity are needed for the continual survival of species and natural communities as well as for the well being of mankind:

- *Genetic diversity* is needed by species in order to maintain reproductive vitality, resistance to disease and the ability to adapt to changing environmental conditions.
- *Species diversity* represents the range of evolutionary and ecological adaptations of species to survive in a particular environment.
- *Community level diversity* represents the collective response of species to various environmental conditions (Woodwell, 1990:4-5).

Conservation biology is the scientific discipline that integrates fundamental aspects of ecology, systematic biology, and wildlife management. The focus of this integration seeks to find methods to preserve, restore, and manage biodiversity (Cox, 1997:12).

2.1.1 Biodiversity in dynamic ecosystems

The existence and interaction of individuals of a species constitutes to a population and these individuals differ in size, age, sex and genotype. The requirements for a species to successfully exist and reproduce depend on the environmental sources and circumstances. These essential living requirements are characterised as the habitat for any given species. Specific conditions that are required by a species are termed as the specific niche for that species, and differ between species. Populations are not distributed uniformly over a geographic area, but consist of semi-isolated patches. These distributions may appear and disappear over time due to relocations and local extinctions, a pattern called meta-population (Cox, 1997:55).

A population tends to increase as a result of immigration and reproduction, and decrease due to emigration and mortality. Effects such as density and competition are called direct density dependent factors, while density independent factors such as weather may also affect the size of a population. The level around which a population fluctuates is called the carrying capacity, and will differ for all species and habitats. The carrying capacity is responsible for population regulation and these factors will maintain the numbers of individuals within a specific range. The populations of various species that interact with each other form the biotic community, which may be truly unique in every ecosystem. The community structure and composition over a landscape reflects the habitat conditions, and is responsible for the dynamic character of a community (Cox, 1997:56).

Communities may also change due to their inherent dynamics and their interaction with changing environmental conditions, a process known as biotic

succession. A piece of disturbed land will be the primary site for the formation of an initial pioneer community that prepares the land for the establishment of other species. Characteristically these pioneers have the inherent ability to survive and reproduce under these situations that are unfavourable for the establishment of other species. These species are therefore responsible for a durative change of the environment (such as soil), so that other species can become established at a later time. If this dynamic process is not disturbed, then primary succession will ultimately lead to secondary succession until a stable climax community is established (Figure 1). Interim disturbances create durative patterns of secondary succession until the entire system emulates towards a climax community stage (Cox, 1997:55-60).

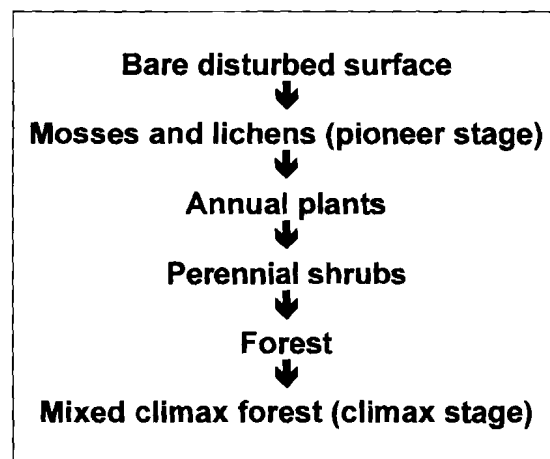


Figure 1: Schematic diagram of succession of a forest (adapted from Cox, 1997:55).

Any community is characterised by the presence of trophic levels, which may be so interconnected that it is difficult to determine the exact level of a species. Producers are the first level of the food chain and are usually the green plants and algae, but may also be chemolithotrophic and lithotrophic bacteria (Atlas, 1997:147).

These plants are able to synthesize organic compounds through the process of photosynthesis and use these for growth and structural support. The herbivores are the second heterotrophic level that utilise these photosynthetic products, and may be any animal ranging from insects to mammals. Carnivores are the third level of this complex energy flow system, and feed on the herbivores on the second level. The top carnivores are the fourth level that feed on the carnivores or even the herbivores, and these may include human beings in many instances. The decomposers feed on the organic matter produced by all organisms and are found at all levels of the energy flow system/trophic levels. Ecosystems have a particular inherent pattern of inertia, stability and resilience that enables them to resist change in the face of disrupting external forces. Ecosystems have the

ability to regulate their internal conditions and adapt to a particular situation in short and long term situations. Resilience is the ability of an ecosystem to recover rapidly after a disrupting activity, to ensure that after some time it has the same stable climax character again. Equilibrium in ecosystems is very short lived and a change may be quite rapid. It is important to keep in mind that factors that increase slight instability in an ecosystem favour high biodiversity formation, which ultimately yield useful materials to humans (Dobson, 1998:243-245).

Table 1: Characteristics of early and late succession species and their habitat requirements

Characteristics	Early succession stage	Late succession stage
Habitat requirements	Generalised	Specialised
Resource requirements	Generalised	Specialised
Behavioural plasticity	High	Low
Genetic plasticity	High	Low
Reproductive potential	High	Low
Impact of disturbance	Often beneficial	Usually detrimental
Exploitation potential	High	Low

Source: Cox (1997:55).

Where major changes occur in the characteristics of dominant species, this can lead to the formation of plant and animal communities that tend to adapt to particular stages in the succession spectrum. Species are classified as early or late succession species, and their requirements and responses will therefore vary with the stage of succession (Table 1). The early succession habits are variable and change with the physical and biotic conditions. In the early succession stage, the habitat requirements are generalised and early pioneers are able to adapt to this disturbed area. The associated resource requirements of these pioneers are also generalised while the behavioural and genetic plasticity may be high. Pioneer species have a high reproductive potential to ensure their successful establishment in a disturbed area. The stability and resilience of various ecosystems need to be taken into account when a particular human activity is planned, in order to manage impacts and keep it to the absolute minimum. The impact of disturbance is said to be mostly beneficial for early succession species, since these species are able to recover rapidly after disturbance. Early succession species have a high exploitation potential, and only excessive harvesting will pose an extinction risk. For late succession species the habitat and resource requirements are specialised, and these species are not able to survive and reproduce in pioneer habitats. These species are also characterised by low behavioural and genetic plasticity, and a low reproductive potential is often present. Disturbing a late succession stage is almost always detrimental and the exploitation potential is therefore low.

There is no stability in even the most pristine natural sites and fluctuation between an imaginary point of equilibrium occurs continuously. Species and communities are in continual movement, and a species at a given point in time will not necessarily be there the next year. A few important aspects regarding biodiversity need to be understood before an effort can be made to conserve it.

- Biodiversity is not stable at any taxonomical level. If an alien plant or animal is introduced into an ecosystem that has been isolated for a very long time, the physical characteristics of the species may change with time to adapt to the new habitat. This also means that speciation of the species may take place after successful adaptation to the specific environment.
- Biodiversity also fluctuates in terms of the number of taxa present at a given time. It is almost impossible to predict the future of a species.
- The number of individuals in a population is subject to dynamic change and chaotic fluctuation. Very little is known about the dynamics of the seed bank, and the long-term state of the population.
- Environmental and habitat fluctuations induce changes in the combinations of species in a given ecosystem.
- Species and their associate groups may appear and disappear at a fast rate, and therefore the combination of plant and animal species in an ecosystem may change from year to year.
- Change may occur rapidly without any visible changes, and the speed and quality of these changes may be chaotic and unforeseeable. Changes may occur due to weather and climatic changes, or the combination of other organisms in the ecosystem.
- The suitability of certain plant species as indicator species may change in certain types of habitats. The number of plant species may be plentiful one year, and may be non-existent the next year due to dynamic habitat changes. The use of permanent species proved to be a more stable method in assessing biodiversity dynamics.
- The population of a group of species changes constantly and should not be seen as a permanent pattern (Barthlott & Winiger, 1998:78-85).

2.2 The importance of biodiversity

The loss of biodiversity affects the poorest of the poor first, the loss of which will threaten the maintenance of ecological process necessary for survival (UGF, 2002). The destruction of biodiversity by one human due to its instrumental value is harmful to society and is immoral. In sharp contrast with this view, the anthropocentric philosophical tradition only values the ethical consideration for human life. All other life forms are merely regarded as entities that should be dominated and utilized by development (Meffe & Carroll, 1994:24-30).

Conservation of biological species is a crisis discipline that is driven by the value of biodiversity, and therefore one should critically determine why we intend to conserve plant and animal diversity. The inherent value of biodiversity in the

biosphere and ecosphere cannot be doubted, and various instrumental values can be linked to its valuable character. The potential of biodiversity to be used for food, medicine, fibre and fuel, needs to be researched more thoroughly. Pollination, nutrient cycling and oxygen production are only a few services that are offered by a rich plant and animal diversity (South Africa, 1996).

Practical scientific knowledge and a genetic library are some of the benefits offered by biological richness. Then after all, the psycho-spiritual satisfaction provides intrinsic value to human life and well being. The value of biodiversity should not only be based on an economic valuation, but also on the ethics of a philosophical character. The Bible recognises the intrinsic value of other species, because God declared them as good. The Judeo-Christian Stewardship Conservation Ethic formulated by Jewish and Christian theologians concurrently supports respect and dignity towards all forms of diversity (Meffe & Carroll, 1994:24-30).

The value of plant and animal diversity may therefore be reflected in the following aspects.

- Life-Support Value
- Economic Value
- Recreational Value
- Scientific Value
- Aesthetic Value
- Genetic-Diversity Value
- Cultural-Symbolization Value
- Character-Building Value (psychological)
- Diversity-Unity Values
- Dialectical Value
- Life Value
- Religious Value (Palmer, 1997:53-57; Cowling and Hilton-Taylor, 1993:12-16; Birdlife SA, 2002).

A basic scale with identified degrees of equality towards nature can be used for possible conflict resolution, and three patterns occur.

- *Extreme Speciesism*. This philosophical view takes precedence of human interest over even the most basic animal interest. It justifies any human activities to be fully ethical. Killing animals for fur would therefore be fully acceptable.
- *Interest Sensitive Speciesism*. Basic human interest takes precedence over basic animal interest, but a peripheral interest does not. This philosophy supports subsistence hunting and killing carnivores when posing a threat to humans.
- *Species Egalitarianism*. Total equality towards humans and all other animals and the killing of animals for food or protection is not allowed. The

use of domestic animals for milk and egg production is allowed, and the relocation of dangerous animals away from humans is advised (Cox, 1997:285-295).

Environmental ethics are divided into various philosophical areas of interest and moral standing. *Primary ethic* involves the aspects and duties that have intrinsic moral character, whereas secondary ethics have instrumental value to people. The modern society is characterised by a *pragmatic utilitarian ethic* and moral standing for humans and some other animals with humanlike traits. This unfortunately means that other species and ecological systems only have secondary moral standing based on their utilitarian value. The *ecocentric ethic* requires that the intrinsic value of species, communities and ecosystems must be judged on a subjective scale. Equality should be based on aspects such as peripheral interest and the immediate and basic interest of the biological component in the ecosphere. *Anthropocentrism* focuses on the value of humanity, the country, community and the family. This philosophical view will therefore not lead to ultimate sustainability of biological diversity. While on the other hand the importance of all plants and animals are supported by the philosophy of *biocentrism*. *Deep ecology* is an ecophilosophy that supports the intrinsic value of all organisms and their conservation. People should therefore emulate to adopt a way of life that respects the unity of humans in the biosphere (Des Jardins, 1993:5-6; Cox, 1997:290).

Various methods have been used to assign a possible monetary or economic value to biological diversity. Values can be divided into direct and indirect values: Direct values are assigned to products harvested by people. Indirect values are assigned to the benefits provided by biodiversity, and therefore the latter does not necessarily mean that the source will be destroyed. Direct values are further divided into consumptive use value and productive use value. Consumptive use value means that the product is used locally. These products can therefore be valued by determining their value if people had to buy them, because they were not available in the wild. Monitoring of these resources is very important since the entire living standard of people depend on them. Productive use value is assigned to products that are harvested in the wild and sold on markets. These wild species have great inherent value, because they are a potential genetic resource that can be used to improve domestic strains. Indirect values are assigned to aspects of biodiversity that provide economic benefits without their destruction during use.

Some non consumptive values include:

- ecosystem productivity;
- protection of soil and water resources;
- interaction of species with commercial crops; and
- regulation of climate (Primack, 1993:201-211).

About 20 species of cereals account for more than 90% of the world's harvest, with only three of them producing 70% of the needed cereal. There are hundreds of plant and animal species that have the inherent potential to heal diseases. The tropical herb *Cataranthus roseus* became known a few years ago, when it proved extremely useful in treating leukaemia. A survey revealed that up to 60% of 11 South African plant families might have anti-cancer properties (Souhami & Tobias, 1998:90; Hall *et al.*, 1980:169).

Of the thousands of species with potential medicinal value, only about 4000 have been described to date. Biodiversity is one of the important reasons for the growth of the pharmaceutical, chemical and agro-industry this century. Biodiversity's genetic potential for biotechnology might even be greater (Barthlott & Winiger, 1998:157-171).

Interest in the instrumental value of South African plants has gained popularity over the past six years. The use of indigenous plants to sustain basic domestic needs is particularly relevant in traditional and poverty stricken communities. Searches for usable biochemical compounds in marine organisms have been undertaken in South Africa. Organisms are screened for compounds that may yield anticancer and industrial applications (Wynberg, 2002; Van Wyk & Gericke, 2000:5).

Biodiversity provides the framework for a growing recreation and ecotourism industry, and provides numerous economic benefits. Ecotourism provides one of the major sources of income in many developing countries and is showing potential for future growth, even in industrialised countries (Meffe & Carroll, 1994:24-36).

Any changes in biodiversity composition in a given area will have significant impacts on the ecosystem, economy and landscape processes.

2.3 Plant and animal biodiversity in South Africa

With a surface area of only 1.2 million square kilometres representing 1% of the world's total surface area, South Africa is ranked as the third most biologically diverse country in the world. Figure 2 indicates that South Africa has more species of vascular plants, amphibians, reptiles, birds and mammals per 1000 km² than Africa and the rest of the world. It is only slightly outnumbered by the world average of vascular plants. This rich biodiversity is a result of the unique climatic conditions and variations in topography. These environmental conditions sustain biomes that include: Karoo, fynbos, forest, grassland and savannah (Collins, 2001; Geach & Peart, 1998; Wynberg, 2002: 233). (For more detail on biomes also see Table 3 and Figure 7).

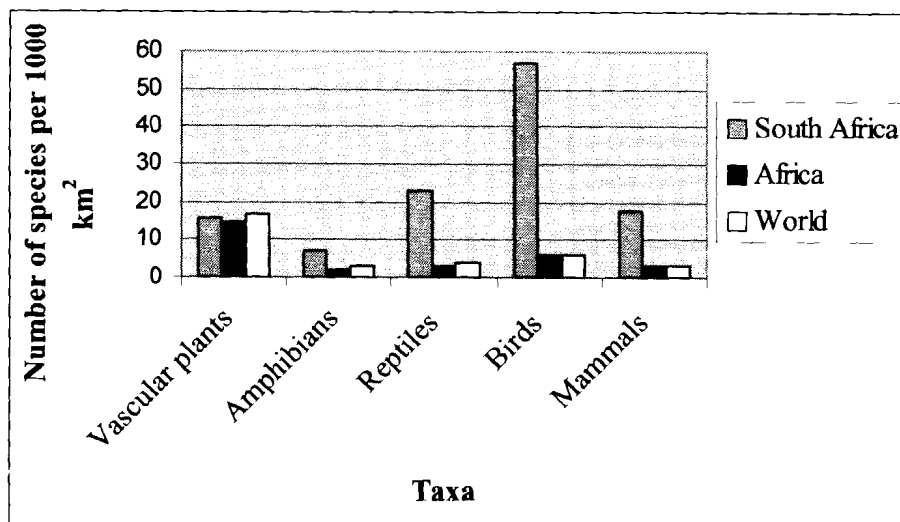


Figure 2: South African species in comparison to Africa and the rest of the world, expressed in species per 1000 km² (data from Geach & Peart, 1998).

South Africa is unique in that it rates in the top twelve countries in the world that have the highest percentage of endemic taxa (Figure 3). The top twelve global endemic rich areas are: New Zealand (82%), South Africa (80%), Australia (80%), New Caledonia (80%), Madagascar (68%), Indonesia (67%), China (56%), Papua New Guinea (55%), Chile (51%), Zaire (29%), Sri Lanka (28%) and Argentina (25%) (Cowling and Hilton-Taylor, 1993:35).

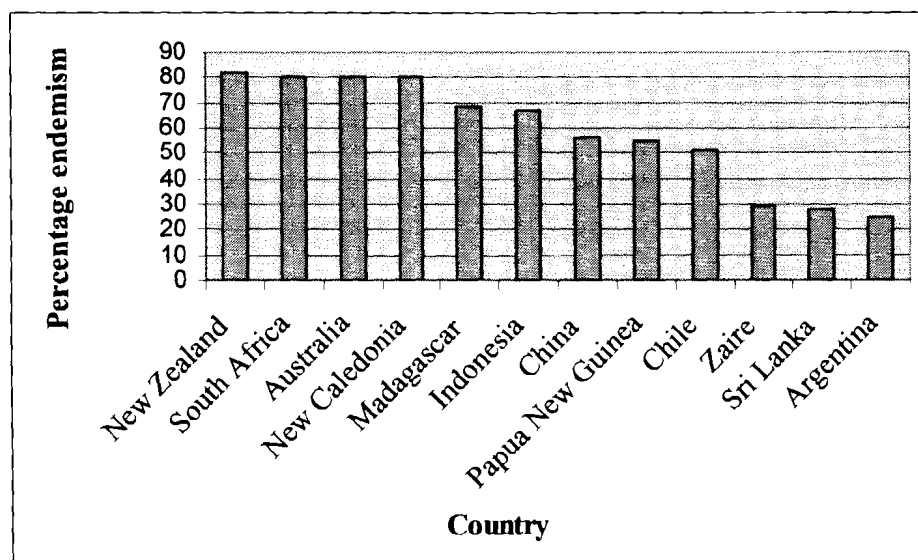


Figure 3: Percentage endemism for various countries (adapted from Cowling and Hilton-Taylor, 1993:35).

South Africa is home to 5.8% of the world's mammal species, 8% birds, 4.6% reptiles, 16% marine fish species, 1.3% freshwater fish, 2.1% amphibians, 5.5% invertebrates, and 7.5% vascular plant species. Total species diversity numbers account for: 227 mammals, 718 birds, 84 amphibians, 286 reptiles, 112 freshwater fish, 2150 marine fish, 77500 invertebrates and 8625 vascular plants (South Africa, 1996). High numbers of taxa occur in the various provinces in South Africa (Table 2 & Figure 4).

Table 2: Terrestrial species richness in South Africa

Province	Biome	Plant	Mammal	Bird	Amphibian	Reptile	Total
Eastern Cape	7	6164	156	384	51	57	6812
Free State	3	2984	93	334	29	47	3487
Gauteng	2	3303	125	326	25	53	3832
KwaZulu-Natal	4	6141	177	462	68	86	6934
Mpumalanga	3	4782	160	464	48	82	5560
North West	2	3025	138	384	27	59	3633
Northern Cape	6	5067	139	302	29	53	5590
Limpopo	3	4236	239	479	44	89	5087
Western Cape	6	8925	153	305	39	52	9474

Source: Adapted from (South Africa, 1996).

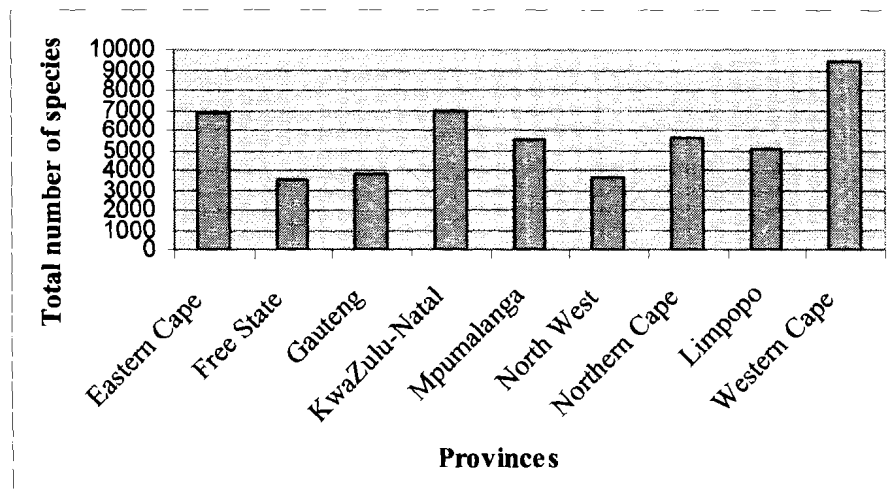


Figure 4: Total number of species for the 9 South African provinces (created by the author using information from South Africa, 1996).

Biodiversity hotspots are encountered in areas with specific environmental characteristics. In South Africa the 7 main hotspots are: Wolkberg, Maputaland, Pondoland, Eastern Mountain, Albany, Cape Floristic Kingdom and Succulent Karoo (Cowling and Hilton-Taylor, 1993:31).

Endemism in these areas ranges from 4% to 68% with an average of 23%, and the Cape Floristic Kingdom with its 6000 endemic species is said to be the most floristic endemic area in the world. The Succulent Karoo is the only semi arid area in the world to be classified as an international biodiversity hotspot. Overall South Africa contains 3.5% of the world's flora on only 0.2% of the world's surface area (Cowling and Hilton-Taylor, 1993:31-42; Conservation International, 2002a).

High levels of endemism are encountered in South Africa. Density of vascular plant endemism is almost concurrent with that of tropical countries. Some isolated areas contain large numbers of species, such as the Drakensberg that has as many as 2045 plant species, with 907 recorded at Cathedral Peak alone (Pearse, 1978:10; Killick, 1990:4; Hall *et al.*, 1980:157).

The seven-biodiversity hotspots can be divided into 18 detailed areas, each with high numbers of species and high percentages of endemism (Figure 5 and 6).

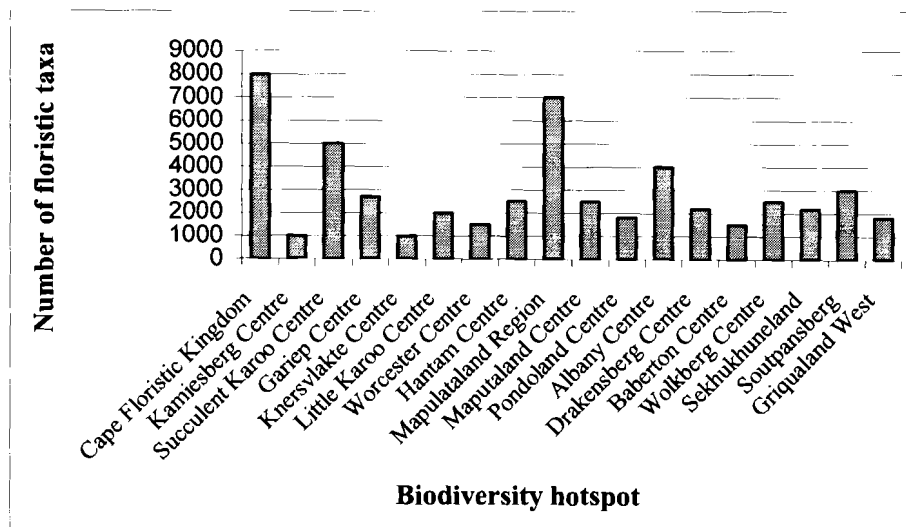


Figure 5: Number of floristic taxa in detailed biodiversity hotspots (data from Van Wyk & Smith, 2001:16).

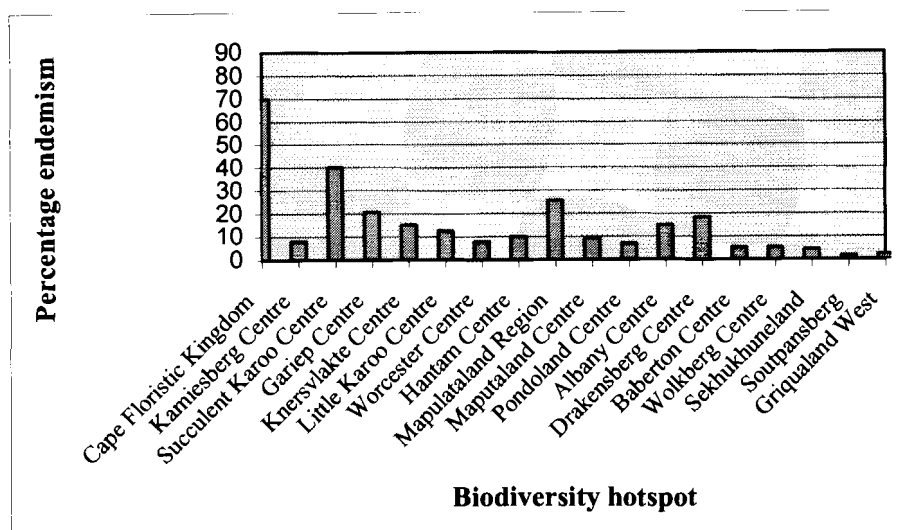


Figure 6: Percentage endemism in detailed biodiversity hotspots (data from Van Wyk & Smith, 2001:16).

Biological aspects of endemism are unique for every South African hotspot. The eastern summer rainfall areas harbour mostly endemic forbs, while endemic shrubs are encountered in all areas, and geophytes and succulents are more common in arid regions. Endemic trees are relatively rare and occur mainly in Pondoland and Maputaland (Cowling and Hilton-Taylor, 1993:31-42).

Biome sizes differ dramatically for various types of biomes in South Africa (Table 3 and Figure 7).

Table 3: Sizes of various South African biomes expressed in hectares

Biome	Size in hectares
Fynbos	6987500
Forest	309000
Nama Karoo	34610700
Succulent Karoo	8190800
Grassland	34536100
Moist Savannah	12669100
Arid Savannah	29617700

Source: Data from (South Africa, 1999a).

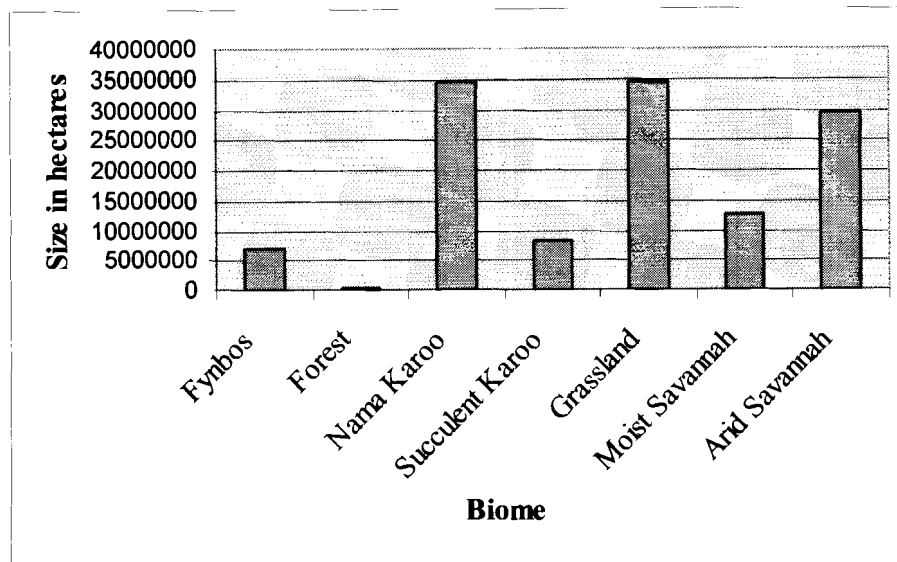


Figure 7: Sizes of various South African biomes expressed in hectares (data from South Africa, 1999a).

Of the seven major biomes found in South Africa, 4 are poorly represented in protected areas and include Succulent Karoo (0.79%), Nama Karoo (0.83%), Grassland (2%) and Moist Savannah (5%). The other three biomes are well represented and include Arid Savannah (12.11%), Fynbos (26.26%) and Forest (77.36%) (Siegfried, 1989).

Low percentages of vegetation types still remain within these biomes, and these are: West Coast Renosterveld (8%), Sand Plain Fynbos (34%), Dry Clay Highveld Grassland (32%), South and Southwest Coast Renosterveld (34%), Short Mistbelt Grassland (35%). Of the 68 vegetation types, 17 are threatened by land use developments (UGF, 2002; NBI, 2000).

2.3.1 Floral diversity status

The conservation status of a plant or animal species is described by a set of international terms (Table 4). These are: extinct, extinct in the wild, critically endangered, endangered, vulnerable, and conservation dependent (Collins, 2001:1; Primack, 1993:105-107).

Table 4: Definitions of vulnerability to extinction

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died.
Extinct in the wild (EW)	A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity, or as a naturalised population well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys are known and/or expected habitat, at appropriate times throughout its historic range, have failed to record an individual.
Critically endangered (CR)	A taxon is Critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	A taxon is Endangered when it is not Critically endangered but is facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	A taxon is Vulnerable when it is not Critically endangered or Endangered but is facing a high risk of extinction in the wild in the medium term future.
Conservation dependent (CD)	Taxa that do not currently qualify as Critically endangered, Endangered or Vulnerable may be classified as Conservation dependent. A taxon must be the focus of a continuing taxon specific or habitat specific conservation programme that directly affects the taxon in question. The cessation of this conservation programme would result in the taxon qualifying for one of the categories above.
Low risk (LR)	A taxon is at Low risk when it has been evaluated and does not qualify in any of the above categories or is data deficient.
Data deficient (DD)	A taxon is Data deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
Not evaluated (NE)	A taxon is Not evaluated when it has not been assessed against the set of criteria.

Source: Primack (1993:105-107).

Thirteen plant families occur only in South Africa, and this plant biodiversity is concentrated in two areas. The Cape Floristic Kingdom and the Succulent Karoo are said to be the richest in plant diversity and endemism in the world. The Cape Floristic Kingdom is said to harbour 65% of Southern Africa's threatened plants. It covers only 4% of Southern Africa, but contains 45% of the area's plant species (Geach & Peart, 1998). Species richness for this area is higher than 8 of the 12 "mega diversity countries" in the world. This endemism is a result of the diverse ecological conditions that occur at the southern tip of the continent (Cowling and Hilton-Taylor, 1993:31-35; Hall *et al.*, 1980:157).

South Africa has the highest number of threatened plant taxa in the world. The conservation status of 4149 plant species has been assessed, and 3435 are globally threatened (Geach & Peart, 1998:2). An estimated 2575 species are locally threatened; 50% occur in the Cape Floristic Region, and 39% occur in the Succulent Karoo. Eighty nine percent of all threatened taxa are endemic to South Africa (Cowling and Hilton-Taylor, 1993:31-42; Geach & Peart, 1998).

More than 20300 angiosperms (flowering plants) occur in South Africa, with 2000 of these threatened plants in the Cape Floristic Kingdom (Collins, 2001:1). The Cape Floristic Kingdom originally covered 74 000 km², but now only 18 000 km² remains. Approximately 14 060 km² of this area is protected and contains 8200 plant species of which 5682 are endemic (Conservation International, 2002a).

Seventeen plant families are threatened in South Africa. Unfortunately the Cape Floristic Kingdom's endemic plant families Penaeaceae, Bruniaceae, and Geissolomaceae contain the largest numbers of threatened species (Hall *et al.*, 1980:161,174). The fynbos vegetation has already lost 36 species, and another 618 species are threatened with extinction (Chapin *et al.*, 1998:1; Red data, 2002).

Some species that were described as common in 1982 are now critically rare. This is the case with *Aloe peglerae* which now rarely occurs in the Magaliesberg (Van Wyk & Smith, 1996:150; Fabian, 1982:46). All South African cycad species are listed as rare, extinct or threatened. One such species is *Encephalartos woodii*, now extinct in the wild, and large specimens sell for up to R 100 000 on auctions (Goode, 2001:121).

Numbers of *Encephalartos dolomiticus* in the Wolkberg have been reduced to less than 25 individuals, and reproduction is now absent. None of the remaining 30 individuals in the small population of the critically endangered *Encephalartos cerinus* is conserved. Since its description in 1996, numbers of *Encephalartos brevifoliolatus* have been reduced to only five plants (Grobelaar, 2002:144). This species may now be on the brink of extinction due to illegal collecting. Approximately seven other cycad species face the same dilemma (Hall *et al.*, 1980:158; Jones, 1993:33-34, 223; Goode, 1993:17,110; Vorster, 1995:49, 77; Osborne, 1993:26).

Statistics indicate that plant taxa will become more threatened in the near future. The numbers of extinct, endangered, vulnerable, and rare species have increased from 1980-1995 as indicated by Figure 8 (Geach & Peart, 1998; South Africa, 1999a).

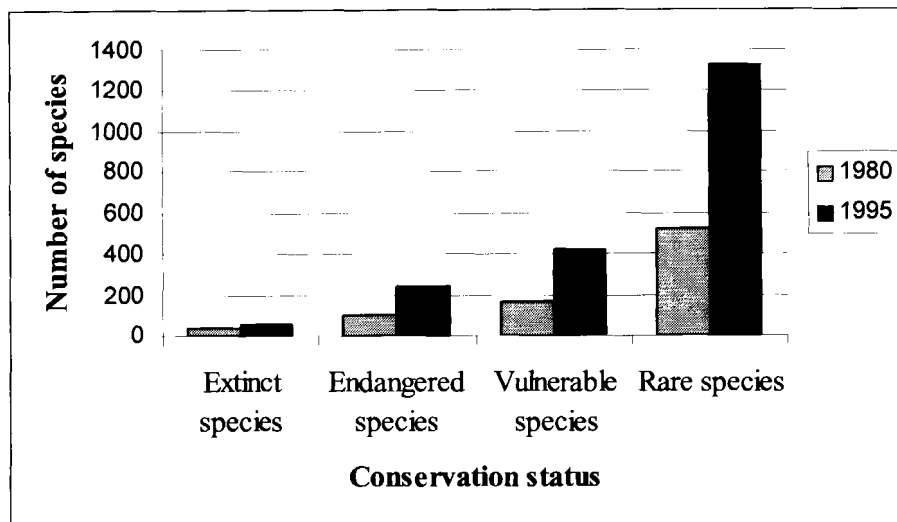


Figure 8: Status of floral taxa from 1980-1995 (created by the author using data from Geach & Peart, 1998; South Africa, 1999a).

2.3.2 Faunal diversity status

Faunal diversity is less threatened than its floral counterpart in South Africa, due to the ability of animals to migrate to more suitable habitats. Monitoring of faunal diversity is difficult for this reason, and little information on most South African species is currently available. The extinction of keystone floral taxa may have led to the simultaneous disappearance of numerous closely associated insect taxa (Goode, 2001:132). Many unknown species may have disappeared before they were formally described. The following discussion provides a strategic scope of the conservation status of mammals from 1986-2000.

South Africa is home to 243 mammals of which 10.12% are threatened and 10.93% are endemic. The latest research indicates that 11 animal species are currently critically endangered in South Africa. A further 28 are vulnerable, eleven of which are endemic. Vulnerable South African animal species include: blue crane, wattled crane, plain mountain adder, Burnup's hunter slug, armadillo girdled lizard, corn crake and Cape rain frog (Feris, 2002). Unfortunately the blue antelope, Eastwood's longtailed seps and the quagga have become extinct (Massicot, 2002; Collins, 2001; Deltaenviro, 2002; Feris, 2002; Peter's Homepage, 2002; Klein, 2001; South Africa, 1999a; Smithers, 1986:10; IUCN, 2003).

As for floral diversity, the numbers of extinct, critically endangered, endangered, and vulnerable mammal species increased during the period 1986 and 2000 as indicated by Figure 9.

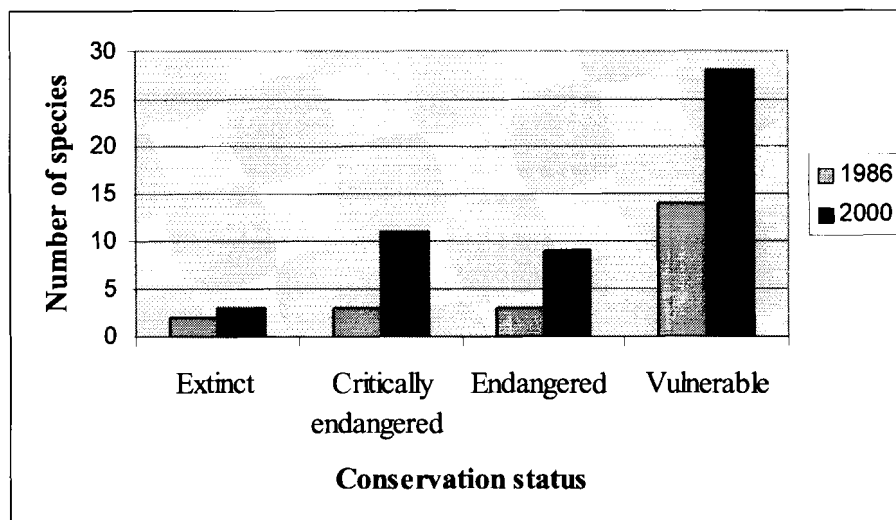


Figure 9: Status of mammal taxa from 1986-2000 (data collected from Massicot, 2002; Collins, 2001; Deltaenviro, 2002; Feris, 2002; Peter's Homepage, 2002; Klein, 2001; South Africa, 1999a; Smithers, 1986:10; IUCN, 2003).

Twenty-six of the 790 bird species are threatened including the jackass penguin, Cape vulture, martial eagle, bateleur and Cape parrot. Five species are endangered namely: the wattled crane, roseate tern, Egyptian vulture, blackrumped buttonquail and blue swallow. Of the 790 species 0.89% are exclusively endemic to South Africa. A further 21 species are vulnerable and 44 are rare (Collins, 2001; Deltaenviro, 2002; South Africa, 1999a; Fuggle & Rabie, 1992:255). Of the 120 wetland associated species recorded, 19 are regarded as rare. Some of these species include: White pelican, Pinkbacked pelican, Rufous-bellied heron, Whitebacked night heron, Little bittern, white stork, Black stork, greater flamingo and the Caspian tern (RAMSAR, 2004).

A total of 299 reptiles and 95 amphibians are found in South Africa. Of the 299 reptiles, 12.04% are threatened and 27.09% are endemic. Of the 95 amphibians 16.84% are threatened and 37.89% are endemic. Indications conclude that 3 species of reptiles are endangered, 13 are vulnerable, and 10 are rare. Amphibians are also under threat with 3 species being endangered, 1 vulnerable, and 2 rare (Collins, 2001; South Africa, 1999a; Fuggle & Rabie, 1992:255).

The latest research indicates that 24 endemic freshwater and estuarine fish species are threatened in South Africa with 7 being endangered, 8 being vulnerable and 9 being rare. From 1977 to 1992 there has been a 79% increase in the number of threatened species. Of the 24 threatened endemic species, 5 are restricted to small and isolated estuarine systems (Fuggle & Rabie, 1992:253-254).

Invertebrates make up the largest part of animal life on earth but unfortunately very little is known about their overall importance. These taxa are sometimes not regarded as an animal, which makes measuring for their conservation difficult. South Africa has approximately 23 000 invertebrate species of which 4.14% are threatened. The only taxonomic groups that seem to draw interest are the butterflies, of which South Africa harbours approximately 632 species. Out of these 100 species, 2 are endangered, 7 are vulnerable, and 91 are rare. The Cape floristic Kingdom alone has 562 terrestrial invertebrate species of which 53 are endemic, 15 are threatened and 2 are critically endangered (Conservation International, 2002). These species are extremely localised and a single development disturbance may be responsible for their total extinction. The use of wetlands for various development projects has been responsible for the rapid decline in butterfly populations (Collins, 2001:1; South Africa, 1999a; Fuggle & Rabie, 1992: 252).

2.3.3 Marine environment status

The South African coastline is bathed by the Atlantic and Indian Ocean. This is an area that encompasses a total length of 3200 kilometres. It is home to almost 10 000 plant and animal species, which accounts for 15% of all global marine taxa. Twelve percent of these are exclusively endemic. The coastline is also home to breeding sites of sea birds, seals and turtles (Geach & Peart, 1998). South Africa has an estimated 2000 marine species (16% of the world total) occur at the coast. The varied coast line further contains an estimated 800 species of seaweeds (Collins, 2001; South Africa, 1999a; Anon., 2002a; Geach & Peart, 1998; Gibbons, 2000:32).

Three marine biogeographic zones can be identified that include: cool temperate west coast, warm temperate south coast and subtropical east coast. Boundaries occur in the regions of Cape Point and the East London/Port St Johns area (Kindersley, 1998:32).

South Africa's major marine ecotypes include: rocky shores, sandy shores, offshore reefs, coral reefs, offshore soft sediment, and estuaries. These are divided into intertidal habitats, offshore reefs, soft sediment benthos and estuaries. Offshore reefs are the habitat of commercially important endemic fish species. Soft sediment benthos are home to exploited species such as hake (*Merluccius sp.*), kingklip (*Genypterus capensis*), and east coast sole (*Austroglossus pectoralis*). Estuaries also support numerous indigenous bird species (Pauw & Durham, 2001).

2.4 Threats to plant and animal biodiversity in South Africa

The extinction of species is not a unique and recent phenomenon but has occurred for millions of years during natural selection and evolution. The extinction of species may be a dramatic event, or may be a slow process that can take millions of years to achieve (Cox, 1997:45-49).

Mass extinction that is seen as the present phenomenon in which entire ecosystems are becoming extinct is a serious global threat to biodiversity. One has to keep in mind that the extinction of species in the past was only partial. In this process many species did not become extinct and had the potential to provide the necessary genetic information to sustain ecosystem integrity. In contrast, entire ecosystems are wiped from the face of the earth today, and very little genetic information is left behind to create a natural backup. The period of time available today for species to adapt to the changing environmental conditions is not adequate to ensure survival (Primack, 1993:105-107).

Extinction may occur because of natural or unnatural activities within ecosystems such as: hunting, introduced predators, introduced alien species, species that were considered a pest, introduced diseases (Eldredge, 1998:ix), trade and collection of species, habitat destruction and fragmentation. Stock grazing in disclosed fenced areas is responsible for serious habitat alteration that is concurrently linked to the extinction of more sensitive species (Barthlott & Winiger, 1998:67).

Not all species have an equal potential to become extinct, and certain inherent characteristics are reasons why some species are more sensitive to extinction than others are. Long-lived species are especially vulnerable to extinction, and additionally keystone species extinction may be responsible for calamitous mass extinctions. Several categories of inherent species characteristics need to be taken into consideration to determine species vulnerability to extinction, and they are:

1. Species with a narrow geographical distribution;
2. Species with only one or a few populations;
3. Species with a small population;
4. Species with low population density;
5. Species that need a large home range;
6. Species with a large body size;
7. Species with low rates of population increase;
8. Species that are not effective dispersers;
9. Species that migrate;
10. Species with little genetic variability;
11. Species with very specialised niche requirements;
12. Species that are found in characteristically stable habitats;
13. Species that tend to form permanent or temporary aggregations;
14. Species that are harvested by people; and
15. Combinations of characteristics (Primack, 1993:99-105; Cox, 1997:47).

While island species are clearly vulnerable to extinction, evidence suggests that mainland species are becoming more vulnerable and the threat of extinction is increasing. Species are becoming extinct at an exponential rate and most of the species lost in the past century disappeared in the last ten years. Most of the

species became extinct because of habitat alteration. The introduction of exotic plant and animals pose a serious threat to extinction of other species with hybridisation being an undesired possibility. In small populations, the survival and reproduction of individuals are strongly influenced by stochastic factors (Dobson, 1998:240).

Demographic stochasticity is the chance variation in mortality and reproduction due to accidents that affect the individuals. Individuals may fail to reproduce in a particular year, or the offspring may all die. Another problem in small and isolated communities is genetic stochasticity. This may lead to the loss of genetic variability due to interbreeding of small isolated populations. Finally, environmental stochasticity or random variation of habitat conditions may have an impact on the survival and mortality rate of small populations. Environmental stochasticity includes small variations that occur under average conditions, but may also include calamitous variations such as fire, earthquakes, earthmoving, urbanisation, and flooding. For small isolated endemic populations such an event may be the final cause of extinction (Dobson, 1998:240-245).

For every species that becomes extinct an average of 30 other species may become more vulnerable to extinction. The sum of biodiversity represents a natural buffer that protects an ecosystem from unstable environmental conditions. A diminishing biological buffer may therefore increase the chances of mass extinction in the future (Hall *et al.*, 1980:161).

2.4.1 Anthropogenic threats to terrestrial and aquatic biodiversity

Anthropogenic impacts are considered the most important threat to biodiversity. These impacts may include direct impacts such as habitat destruction and poaching, or may be the result of indirect consequences such as pollution and climate change. The loss of biodiversity is unique among anthropogenic changes since it is irreversible (Chapin *et al.*, 1998:1).

A study revealed that the 7 biodiversity hotspots in South Africa are threatened by 9 major anthropogenic development activities (Table 5). Using this information one can see that overgrazing, agriculture, and species harvesting were the major threat to 6 of the 7 biodiversity hotspots in South Africa. Alien species and urbanisation were a threat to 4 of the 7 biodiversity hotspots. Forestry was a threat in 3 hotspots, while mining is a threat in at least 2 hotspots. Tourism and incorrect field burning were only a threat in 1 hotspot.

Table 5: Threats to the seven South African biodiversity hotspots

Biodiversity hotspot	Overgrazing	Aliens	Forestry	Agriculture	Urbanization	Species harvesting	Veld burning	Mining	Tourism
Wolkberg	X	X	X						
Maputaland	X	X	X	X	X	X		X	X
Eastern Mountain	X	X	X	X		X			
Pondoland	X			X	X	X	X		
Albany	X			X	X	X			
Succulent Karoo	X			X		X		X	
Cape Floristic Kingdom		X		X	X	X			

Source: Data from (Cowling and Hilton-Taylor, 1993:46; UGF, 2002).

Numerous ecosystems in South Africa have been transformed or modified by human activities (such as Cape Floristic Kingdom, Succulent Karoo, Pondoland, Albany, Eastern Mountain, Wolkberg and Maputaland) (Geach & Peart, 1998:5). Transformation of land for agriculture is a growing problem in the Cape Floristic Kingdom, parts of the Succulent Karoo, Pondoland and Maputaland. Cereals, pastures and agricultural crops have replaced 79% of the renosterveld and 49% of the fynbos vegetation. Large areas of land are irrigated as a result of the construction of dams in the dry succulent Karoo. Although Namaqualand is a marginal agricultural area, 2269 km² are used for dry-land agriculture, which seriously threatens indigenous taxa (Cowling and Hilton-Taylor, 1993:47).

A sample of 70 floristic taxa in the Cape Floristic Kingdom proved that agriculture was responsible for the extinction of one species. Industry was responsible for the loss of at least 8 species, while plant collecting & cut flower picking accounts for 1 species, alien invasive vegetation at least 1 species, and finally fires & genetic factors were responsible for the loss of 5 species. Invasive alien species are able to suppress large numbers of indigenous species. Without proper control it is estimated that Australian species will cause the destruction of the fynbos biome in less than 100 years (Hall *et al.*, 1980:161; Collins, 2002; Hall *et al.*, 1980:157; Geach & Peart, 1998; WCNCB, 2000).

Environmental pollution poses a major threat to biodiversity, and pesticide residues may accumulate in animals over time. Both air and water pollution is

responsible for the reduction of numbers of more sensitive species. This problem is prominent in coastal zones with high industrial activity (UNEP, 2000; Birdlife SA, 2002). All forms of industrial, chemical, and domestic pollution mainly threaten riparian aquatic taxa (Fuggle & Rabie, 1992:254).

Global climate change is a serious potential threat to sensitive ecosystems such as coral reefs and tropical cloud forests, which are the richest in biodiversity. Amphibian populations in Africa are diminishing as a result of global climate changes. In 1998, 10% of the world's coral reefs died as a result of global warming. Evidence indicates that this warming effect may have detrimental consequences on the Cape Floristic Kingdom and the Succulent Karoo (UNEP, 2000).

Invasive plants and forestry are a threat to all 7 hotspots, except for the Succulent Karoo. Ten million hectares (8% of South Africa) have been invaded by 161 species of alien plants (Wynberg, 2002:236). Invasive genera such as *Acacia*, *Hakea*, *Leptospermum*, and *Pinus* already cover large areas of the lowlands and mountainous parts. Alien species also have a negative economical impact on the water supplies of the already water stricken Western Cape Province. Of the 3435 plant species threatened in South Africa, 1900 are threatened by alien vegetation. An increased fire risk is also associated with alien vegetation, and wildflower and ecotourism resources may be compromised in the near future. Control is expensive, but good results were achieved recently with biological control that may prove to be the only sustainable long-term solution (Cowling and Hilton-Taylor, 1993:47; Geach & Peart, 1998; Birdlife SA, 2002; Wynberg, 2002:235,236).

Forestry is a bigger problem than invasive species in the wetter eastern part of South Africa. Grasslands are particularly vulnerable due to the large number of endemic taxa it harbours. Thirty percent of red data species occur in grassland vegetation on the South African highveld that are subjected to forestry (Cowling and Hilton-Taylor, 1993:47).

Overgrazing is a problem in all 7 biodiversity hotspots, except the Cape Floristic Kingdom. Areas degraded by this practice include communally owned land in Maputaland, Pondoland and the Succulent Karoo (Cowling and Hilton-Taylor, 1993:47; Geach & Peart, 1998).

Ninety percent of South Africa can be classified as arid, semi-arid or dry sub humid, and is susceptible to desertification. Land degradation is a serious problem in traditional communal areas. Only 68% of all land is suitable for agriculture and of this only 3% is considered to have high agricultural potential (Geach & Peart, 1998; Birdlife SA, 2002).

Subsistence harvesting of indigenous plant and animal species for medicinal uses is a threat to biodiversity. Approximately 3000 plant species are used as

medicines, with some 350 being used commonly. Numerous slow growing species were collected almost to extinction by traditional healers in Maputaland. There are an estimated 200 000 traditional healers in South Africa. Up to 60% of South Africans consult these healers who are believed to be spiritually empowered. Depending on the part of a plant that is used, many species will become extinct in the future if collection is not managed properly. Commercial harvesting of fynbos and succulents for ornamental trade has resulted in the critical endangerment of species (Cowling and Hilton-Taylor, 1993:47; Van Wyk *et al.*, 1997).

All 35 cycad taxa are extremely endemic in South Africa, to such an extent that many species are restricted to a single forest, gorge or hill. Collectors are willing to pay exorbitant prices for rare species. Unfortunately this has incited the local poverty stricken traditional communities to ignorantly sell large plants to unscrupulous collectors. Most specimens do not survive transplantation and that results in the death of most mature plants (Vorster, 1995: 19-25).

2.4.2 Anthropogenic threats to marine biodiversity

South Africans rely on the ocean for food, recreation, raw materials, mineral extraction and transport (Hewawasam, 2002:2). Different ethics are applied to the ocean than those that are applied to terrestrial systems. Dumping of substances and free harvesting of marine organisms are more often tolerated than the same practices in terrestrial systems (Attwood *et al.*, 2000; Pauw & Durham, 2001). Various industrial and municipal wastes that contain organic and inorganic substances are responsible for pollution at the coast. The result is often toxicity, eutrophication, sediment loading, plastic pollution, and oil pollution (Attwood *et al.*, 2000). Eighty percent of marine and coastal pollution originates on land in the form of municipal, industrial and agricultural wastes and run-off. The pollution is comprised of sewage, waste water, persistent organic pollutants (including pesticides), heavy metals, oils, nutrients and sediments. Marine species are very sensitive to pollution and it is arguably one of the most serious threats to marine biodiversity. Ships that discharge oil and petroleum related substances contribute to this alarming problem (UNEP, 2004). Artificial reefs have been created legally and illegally in South Africa. Although artificial reefs may create a sanctuary for marine species, these artificial materials may result in pollution (Pauw & Durham, 2001).

Changes in temperature due to the greenhouse effect may cause the extinction of marine species (IUCN, 2001). These changes are an indirect effect of air pollution, and the accumulation of greenhouse gases. An increase in ultraviolet radiation due to ozone depleting chemicals may result in the loss of marine species that are sensitive to this type of radiation (Attwood *et al.*, 2000).

Most of South Africa's marine resources including seals, whales, rock lobster, pilchard, hake, kingklip, and linefish, have been overexploited at some time. Between 10% and 64% of stock is annually removed in commercial operations.

In 1997 a total of 519 696 tons of marine species were commercially harvested (South Africa, 1999b). Overexploitation of keystone species may result in the extinction of other marine taxa (South Africa, 1996). Harvesting of marine biodiversity may reduce the numbers of various species through harvesting methods such as seabed trawling that also destroys habitats (UNEP, 2004). The improper management of commercial fishing poses a threat to sustainable marine biodiversity. Commercial and domestic poaching has resulted in the reduction in numbers of taxa (Pauw & Durham, 2001; Anon., 1999).

Scraping and mining of the benthic environment alters habitat requirements and trawlers are often responsible for damage to coral reefs. Mining of diamonds, titanium and fossil fuels disrupts sediments that are associated with the release of heavy metals and oil (Hewawasam, 2002:10). Community structures and gene pools are changed, that compromise sustainable reproduction. Many untargeted marine species are caught in large trawler nets, and bycatch rates fluctuate between ten and seventy percent. The effect of fishing on bycatch species is seldom known because these species are not regulated by quotas (Attwood *et al.*, 2000; South Africa, 1999a).

Mariculture has a negative impact on coastal ecology and is associated with mangrove deforestation, habitat destruction, eutrophication, invasion of introduced species and the spread of disease organisms. The researchers at Saldanha Bay farms have studied the mariculture operation in South Africa intensively. The threats to marine biodiversity by these farms are the removal of phytoplankton from the water that may affect the integrity of indigenous taxa (Attwood *et al.*, 2000; Pauw & Durham, 2001).

Human recreational activities such as diving have already damaged coral reefs in Sodwana Bay. Driving near sensitive zones disturbs breeding patterns of coastal birds like the African black oystercatcher (*Haematopus moquini*). Industrial developments like harbour developments in Saldanha Bay and Richards Bay increase access to areas that were previously not fully accessible to marine harvesting. Species that suffered as a result of alterations to river flow include estuarine pipefish (*Syngnathus watermeyer*), freshwater mullet (*Myxus capensis*), and white steenbras (*Lithognathus lithognathus*). Scientific collecting has threatened populations of coelacanth (*Latimeria chalumnae*), Knysna seahorse (*Hippocanthus capensis*) and pansysshell (*Echinodiscus bisperforatus*) (Pauw & Durham, 2001).

Ships and oilrigs often introduce alien species such as the European mussel (*Mytilus galloprovincialis*) and European shore crab (*Carcinus meanis*) that threatens indigenous taxa. Alien phytoplankton invasions of species such as *Oriococcus anophagefferens* are often associated with mortalities among larger species (Attwood *et al.*, 2000; Pauw & Durham, 2001; Hewawasam, 2002:3). It is evident that natural enemies do not pose a serious risk to extinction of biodiversity when compared to development activities. It is of great importance

that the above information is used to recommend strategies to reduce the anthropogenic impacts on biodiversity.

2.5 Conservation status

Environmental concern arises in periods of environmental crisis, such as the concern over the loss of biodiversity in the eastern part of the North American wilderness during the mid-1800s (Cox, 1997:10-15). The science of conservation biology strives to apply various approaches to prevent the further loss of biodiversity. This new scientific field undertakes research into the effect of human activities on the survival of biodiversity. The results of this research should then be applied to initiate strategies for the conservation of biodiversity (Wilson, 1992:1-5).

2.5.1 Conservation of terrestrial biodiversity

Various methods can be used to conserve biodiversity, but the establishment of protected areas has been shown to be the most effective. The IUCN recommends that 10% of landscapes, ecosystems and biological communities should be protected (IUCN, 2004a).

South Africa's national parks and nature reserves cover 6% of the surface of the country. A total of 422 wilderness areas, national parks and provincial reserves cover 6.7 million hectares. The Kalahari Gemsbok Park and the Kruger National Park alone cover 2% of this conserved area. Approximately 90% of all the birds, mammals, amphibians and reptiles are protected in these areas. Unfortunately only 34% of plants are protected (Collins, 2001; Geach & Pearth, 1998).

Conservation status relevant to the amount of hotspots and endemism is not optimally managed regarding their international status and importance. Unfortunately only 50% of the mountainous area and 3% of the lowlands are conserved in the Cape Floristic Kingdom. The percentages of area conserved for the other hotspots are unfortunately very low (Figure 10). The IUCN recommends that at least 7% (preferably 10%) of land should be protected to ensure long term sustainability of biodiversity.

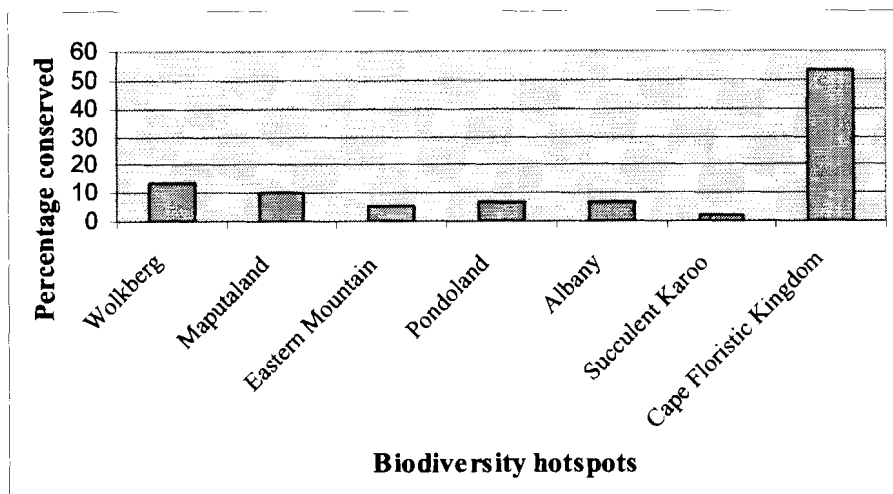


Figure 10: Percentage conserved area of the seven biodiversity hotspots (data from Maddock & Benn, 2000).

Only 12 of the 70 Acock's veld types have more than 10% of their surface area protected. Habitat fragmentation creates islands that are more likely to lose species to extinction than any other areas (Cowling and Hilton-Taylor, 1993:31-42; Geach & Peart, 1998). A small percentage of biomes and vegetation types are conserved in South Africa and include: forest (77.36%), fynbos (26.26%), renosterveld (1.67%), grassland (2%), Nama Karoo (0.83%), succulent Karoo (0.79%), savannah and thicket (4.5%) (South Africa, 1996; South Africa, 1999a).

KwaZulu-Natal has less than 50% of its plants, mammals, birds, amphibians and reptiles conserved in proclaimed protected areas (Goodman, 2002:15, 16). Cape Town is one of the world's top three urban biodiversity spots and Table Mountain alone is home to 1470 fynbos species (Olivier & Olivier, 2001:10). Fortunately the city is participating in a six-part biodiversity conservation project. This includes conservation of open spaces, invasive species management, establishment of ecological corridors, establishment of indigenous vegetation, and capacity building (Mavasa, 2003).

2.5.2 Conservation of marine biodiversity

South Africa has 13 marine protected areas, 11 general restricted areas, 19 fishery sanctuaries, 23 estuarine protected areas and 4 national parks. Marine protected areas collectively cover 17% of the South African coastline, but only 4.9% of the coastline has all forms of exploitation prohibited (Attwood *et al.*, 2000).

Conservation requires that marine biodiversity and habitat types are included in marine protected areas to ensure effective sustainable conservation.

South African marine biogeographic zones are generally poorly protected, except for a small 12 km stretch south of the Langebaan Lagoon. The cool west coast has no marine protected areas that protect representative habitats. A 50 km stretch of coast between the Groen and Spoeg River estuaries is proposed as a national park, and should fulfill west coast protection. The important sandy beach ecosystems of the Eastern Cape are not protected. The southern part of the east coast has no marine protected areas, except for the 5 km Trafalgar Marine Reserve, where short-angling is permitted. The warm temperate south coast and the northern subtropical east coast are however better protected and include most marine taxa (Attwood *et al.*, 2000).

The hard corals that occur only on the northern coast of KwaZulu-Natal are protected in the large St Lucia and Maputaland Reserves. The southern KwaZulu-Natal coastline is the only area where additional offshore reef protection is required. Thirteen trawling-restricted areas that protect soft-sediment benthic communities have been proclaimed. These areas are generally too small and close inshore, or include reefs, which make trawling hazardous, and their conservation function is therefore doubtful (Attwood *et al.*, 2000).

Mixed rock and sand shorelines are protected in the De Hoop, Goukamma, Sardinia Bay, Mkambati, Hluleka, Trafalgar and St Lucia areas. Exposed rocky-shore communities are protected in Cape of Good Hope, Betty's Bay, De Hoop, Tsitsikamma, Robberg and St Lucia marine protected areas. The major sandy-beach ecosystems of the Eastern Cape are not protected. Tsitsikamma is a prominent and effective refuge for deep reef communities. The three eastern Cape 'Wildcoast' marine protected areas extend six nautical miles seaward and include important offshore habitat in a transitional biogeographic zone (Pauw & Durham, 2001; Brouwer, 2002).

South Africa has about 250 estuaries, of which 23 are protected. This protection is regarded as inadequate since most of the protected estuaries are small and insignificant. The protection within an estuary may be limited for example Keurbooms, Gamtoos and Mgeni, or for the protection of birds only such as Orange and Seekoei. The 50 km De Hoop Nature Reserve also includes no substantial estuary, with the exception of the tiny Tsitsikamma estuaries. Fish are not protected from exploitation in any South African estuary (Attwood *et al.*, 2000; Brouwer, 2002).

Some marine birds breed on the mainland and include the endangered Damara tern (*Sterna balaenarum*) and African black oystercatcher (*Haematopus moquini*). Some species are protected in reserves that have a marine and terrestrial component, such as the De Mond and Cape Point Marine Reserve. African penguins breed in two mainland colonies near the high-water mark, one of which falls within the Betty's Bay marine protected area. The St Lucia area protects turtle breeding sites at the north coast (Pauw & Durham, 2001).

The higher marine vertebrate taxa are protected throughout South African waters. Most sea-birds breed on islands only, although they may forage in several marine protected areas. Sea birds are protected on all offshore islands (Attwood *et al.*, 2000).

Sandy beach invertebrates are poorly represented in marine protected areas. On a regional basis, invertebrates are not well represented in marine protected areas on the west coast. Abalone (*Haliotis midae*) is critically depleted in the Western Cape (Pauw & Durham, 2001; Attwood *et al.*, 2000).

Due to the large number of threatened taxa, conservation efforts should be aimed at conserving ecosystems instead of individual species. Focus should also move from isolated protected areas to conservation in all living spaces.

2.6 Conclusion

Biodiversity is needed for the survival of mankind, because it has inherent psycho-spiritual, materialistic and non-consumptive values. Research has indicated that South African biodiversity has the potential to be used in various scientific fields. South Africa has great biological diversity due to the unique climatic conditions that can be found here. All of the nine provinces harbour unique species and biomes that contain thousands of rare and endangered species. A total of 12 biodiversity hotspots can be identified in the Republic that is the home to many endemic species only found in these areas. In the past 15 years the conservation status of various floral species has increased significantly. Faunal species that are dependent on their floral counterparts for survival have disappeared as fast, and some have become extinct. The major threats to terrestrial biodiversity in almost all areas are: overgrazing, alien vegetation, forestry, agriculture, urbanization, species harvesting, mining and tourism. Marine species on the coast are equally threatened by anthropogenic activities. The major threat to these species is pollution, marine mining, marine collection, and global warming. Only small areas of terrestrial and marine environments are protected by legislation as formal conservation areas. Most areas are fragmented and are too small to sustain overall survival of entire ecosystems and species.

CHAPTER 3

REQUIREMENTS TO SUSTAIN BIODIVERSITY

3.1 Introduction

It is evident that the threat to biodiversity is the result of numerous anthropogenic activities in our society. Although mankind does not inherently aim to destroy biodiversity, some direct and indirect actions are responsible for the mass extinction of numerous forms of biodiversity locally and abroad. It should be the responsibility of every country in the world to conserve its remaining biodiversity, and to ensure that the integrity of natural systems is sustained for the future.

Compliance with various aspects is needed to ensure the sustainable use and survival of biodiversity. These criteria are of universal character, but specific requirements may be necessary to protect biodiversity in multicultural and high biodiversity areas such as South Africa. Various requirements relate to the magnitude of society's development level, and these may change constantly. Society may therefore unwittingly undertake an activity today that may in the future prove to have been detrimental to biodiversity. One may use the example of various hazardous substances that are known to affect various biological species in various trophic levels. The negative impact of these substances may only be known years later when it has already damaged biological systems.

The criteria to sustain biodiversity may therefore be concurrently linked to scientific development. It is therefore important to update these issues to ensure that sustainable biodiversity management can be achieved. For this research project sustainable biodiversity *per se* should mean that such diversity should be used in a sustainable manner without compromising its integrity and long-term survival.

3.2 Aspects needed to ensure sustainable biodiversity

Various criteria should be complied with to ensure that biodiversity is sustained in a developing society. These requirements are divergent and may be either direct or indirect. Direct criteria are requirements that are aimed to regulate direct threats to biodiversity. These for example may include the harvesting of species for commercial purposes. Indirect criteria deal with factors that may harm biodiversity in an indirect manner, or at a later stage such as the effect of various chemicals that through the process of bio magnification may prove detrimental to biodiversity. It is necessary to identify and manage all of the requirements to ensure that every level of sustainable biodiversity is achieved.

The criteria to sustain biodiversity may be classified under various environmental focus areas (for practical evaluation purposes that are relevant to this research project). One area should not be considered more important than another,

because all these aspects interrelate with each other in the environment. One can use the example of terrestrial pollution that may influence biodiversity on land, later in aquatic systems, and ultimately the marine environment. These criteria are classified into three separate focus areas (for practical reasons to enhance the evaluation process) namely: the marine environment, the terrestrial, atmospheric and fresh water environment, and the biological environment. All these areas interact with each other, and should not be seen as separate entities in the natural environment.

The environment is not a simplistic system in which every element can be studied on its own and where cause and effect can be calculated like a chemical reaction. The ecosystem is too complex and intricate for this. Our knowledge of the earth is too inadequate to carry on the large scale environmental change and yet still avoid a world wide crisis. The answer must be found in holism that concludes that humankind is equally integrated as part of the environment. Holism teaches us that everything in the Universe (or earth) is attached to everything else in a functional dynamic way. This is as relevant as Einstein's theories on relativity.

As a result of environmental stress on biodiversity resources, the negative impact of numerous anthropocentric activities may manifest in various levels of biological and ecological complexity.

Organism level: physiological and biochemical changes, behavioural changes, fewer or no offspring, genetic defects (mutagenic), birth defects (teratogenic), cancers (carcinogenic) and ultimately death. *Population level:* population increase or decrease, change in age structures (old, young and weak may die), survival of stress resistant types, loss of genetic diversity & adaptability and ultimately extinction. *Ecosystem level:* disruption of energy flow, change in trophic structure and food chains, depletion of nutrients, excessive addition of nutrients, reduction in species diversity, reduction and elimination of habitats, loss of complex food webs, lowered ecological stability and ecosystem collapse (Miller, 1996: 167).

Using the above information one can therefore see the importance of protecting biodiversity. The following discussion identifies and describes aspects that need to be managed properly to ensure sustainable biodiversity in South Africa. A large number of national and internationally recognised aspects were identified that included strategic issues and more detailed aspects. These aspects are particularly relevant to South Africa. These aspects are also generically summarised in three separate tables in this chapter.

3.3 The marine environment

The marine environment (see chapter 9, 9.13–9.18) includes the territorial waters of South Africa, the adjoining seashore and coastal zone, plus features

associated therewith. These features include estuaries, sea lakes, lagoons, islands, and river mouths (see chapter 5).

3.3.1 Marine harvesting, protection, and regulation

3.3.1.1 Life in the ocean

Life exists in even the deepest parts of the ocean and these begin with simple small producers and end with large fishes and whales. The ocean is also viewed as a biome with the largest diversity of life. The deep sea as such is often regarded as a type of semi desert but it is nevertheless very important in stabilizing the world's climate (Hugo, 2004: 80).

The intertidal zone is where the ocean meets the land and may be exposed or submerged at times as the result of the tides. This area is usually stratified with various types of plants and animals that occupy various niches. The pelagic zone includes the waters further from land and basically the open ocean. The flora of the pelagic zone includes surface seaweeds. The fauna may include many species of fish and some mammals such as whales and dolphins. The benthic zone is the area below the pelagic zone but does not include the very deep part of the ocean. The bottom part of this zone consists of sand, silt and dead organisms. Temperatures are generally low as a result of the low light levels. Biodiversity in this zone includes seaweeds, bacteria, fungi, sponges, and fishes. The deep ocean is called the abyssal zone and is very cold (3 °C) highly pressured, rich in oxygen but low in nutritional content. It supports many species of fishes and invertebrates (Hugo, 2004: 80-85; Miller, 1996: 150-154).

Fishing stocks are sustained by plankton that includes microscopic plants and animals and even larger species of up to 20 mm in length. Marine plankton include: picoplankton, nanoplankton, microphytoplankton, microzooplankton, mesoplankton, macroplankton and megaplankton. The integrity and health of plankton will therefore ultimately represent in quality and quantity of stocks (Pillar & Hutchings, 1995: 29).

3.3.1.2 Harvesting

The continents may have been largely hunted out, but the ocean that covers 70% of the world's surface seemed an inexhaustible cornucopia to the rich. However, it is no longer so. Species after species is declining as over fishing becomes chronic throughout most of the world's seas. About 9 000 of the world's 20 000 known species of fish are caught. Only 22 of these are taken in large amounts that exceed 100 000 tons a year. Just 5 groups of species that include herrings, cods, jacks, redfish, and mackerels make up half of the entire annual harvest from the world's seas (Lean & Hinrichsen, 1992: 157).

Three distinct types of fisheries are responsible for the rapid decline in stocks and these include: the use of purse-seine nets to catch small shoaling fish such as pilchard, anchovy and sardines; midwater trawls that catch aggregations of larger fish such as adult horse mackerel and those that use bottom trawls to catch Cape hakes near the sea bed. The length of the purse-seine nets are anything from 350–700 metres and the depth up to 90 metres. The mesh size used to be 32 mm but this was reduced to 13 mm in the 1960s and this has resulted in the capture of some unwanted species. The Purse-seine industry is regulated by quotas, closed seasons, closed areas, limitation on vessels allowed, size of fleet and number of processing plants. Trawl nets are used to catch species on the sea floor or just above the sea floor. The minimum mesh sizes range from 75 mm to 110 mm. The bottom trawl industry is also regulated by closed areas and allowable quotas. Rock lobster traps are also used to catch lobster and the industry is regulated by the allocation of quotas, size limits, gear limitation (no scuba, spearing or trawling), closed areas, closed seasons and number of vessels allowed in an area (Payne & Crawford, 1995: 51-60; Miller, 1996: 580-581).

Trawling poses a significant problem for marine biodiversity due to the large number of bycatch species caught. Trawling nets may stretch for kilometres behind moving trawlers, killing all species that are bound in the nets. In this process numerous untargeted species are also destroyed, including rare species (Hugo, 2004: 255).

Up to 10 tons of unwanted species are discarded for every ton of seafood that is brought to the market. Tragically, much of the catch that is tossed back into the sea is too badly injured by the compression of the net to survive (Cunningham & Saigo, 1997:212). Trawling does not only pose a severe risk to marine biodiversity, but also to seacoast communities who largely depend on domestic harvesting. Numerous marine species on the Alaskan coast are on the brink of extinction due to the effect of commercial trawling activities. This is a clear indication of what may follow in other parts of the world (FMS, 2002; Agencia de Informacao de Mozambique, 2003; Hall-Spencer *et al.*, 2001)

Trawling is responsible for severe damage to the ocean floor and coral reefs (Watling & Elliot, 1998; Royal Society, 2002). It is strongly advised that trawling should be prohibited (Ross, 2003). Trawling has been successfully banned at the Alaskan coast where 274 000 square nautical miles have been declared (9 August 2005) as a protected area (Environment News Service, 2005).

3.3.1.3 Stocks in trouble

The Food and Agriculture Organization of the United Nations estimates that the world's fleets cannot catch more than 100 million tons of the currently exploited species without depleting the stocks. It concluded that the catches increased from 20 million tons in 1950 to 99.5 million tons in 1989, and suggested that

humanity is getting dangerously close the maximum sustainable yield. In fact, this may already been exceeded because this figure does not include the fish taken by almost 8 million local fishermen and this could account to 24 million tons. In 1990 the world's catch fell by 4 million tons, and this is the first major decline in 20 years. The world's marine harvest is taken unequally from the globe and this means that certain areas and species are in more trouble than others (Lean & Hinrichsen, 1992: 157-159).

The USA National Fish and Wildlife Foundation concluded that 14 major fish species have been exploited to such an extent in USA waters, that even if all fishing were stopped, it would take stocks 20 years to recover. Stocks are also in serious trouble in most parts of the European coastline. Catches in the Northwest Pacific that are dominated by Japan are still increasing but will not be able to continue for long. The more fish that is taken from the stocks the greater the eventual crash will be. More than 90% of the world's commercial fisheries are heavily exploited (Lean & Hinrichsen, 1992: 157-159; Miller, 1996: 582-583).

Over fishing is also becoming a problem in Third World countries that sometimes rely on them as the only source of animal protein. Catches have declined in the West Indies and sizes are only a third of what they used to be. Many fishermen in Africa and Asia are now relying on dynamite to kill fish, but in the process large areas of habitat are destroyed as well. In some islands of the Philippines fish are now so scarce that the University of the Philippines in Manila could not find enough specimens to study. The pressure on the world's fisheries will continue to increase because the consumption and trade continue to rise. The world exports on fish and fish products now exceed \$ 15 billion a year (Lean & Hinrichsen, 1992: 160).

3.3.1.4 Aquaculture

Fish farming in ponds and coastal cages offers a practical way of increasing the production of fish and related products. It is a growing industry and produces up to 14 million tons of fish, crustaceans, molluscs and bivalves each year. Unfortunately, fish farms may pose a threat to mangroves which are vital nurseries for wild fish (Lean & Hinrichsen, 1992: 160). Aquaculture can also introduce massive amounts of fish meal into the sea as well as exotic species and diseases (Hugo, 2004: 255).

3.3.1.5 Improved fishing management

The annual global fish harvest can be increased significantly by having better refrigeration at sea to prevent spoilage, and by reducing the by-catch that may amount to up to 20% of the commercial catch (Miller, 1996: 584).

3.3.1.6 Whaling

The Basques were the first people to start whaling systematically. They organized mass hunts since 700 AD and were the world's leading whalers for centuries. They boiled down the blubber into oil, turned the bones into knives and other tools and used the tough and flexible baleen for horsewhips and bows. Eventually the herds disappeared. The Dutch also became involved in whaling and almost cleared the Arctic Ocean east of Greenland. The people of Nantucket first hunted Right whales and then pioneered the exploitation of the Sperm whales. They hunted them for oil and produced \$ 500 000 worth of oil each year. What was once a risky and perilous hunt soon became a mass slaughter. Norway was the first country to dominate it and soon depleted the Northern seas and started to explore the Antarctic. Between 1910 and 1966, almost 330 000 whales of various species were killed. It is estimated that a total of 1.5 million whales were killed between 1925 and 1975 which eventually led to conservation measures (Lean & Hinrichsen, 1992: 160-164; Miller, 1996: 660).

3.3.1.7 Corals

Coral reefs are amongst the oldest and richest living communities of biodiversity on earth. Most are between 5000 and 10 000 years old. The world's 600 000 square kilometres of coral reefs are the marine equivalent of the rainforests. A single part of the Great Barrier Reef may contain up to 300 species of coral and 2000 species of fish. Coral communities may yield valuable medicines such as Didemnin from sea squirts that are effective against viruses and also yield various other anti cancer drugs. Researchers have found a substance in coral that can protect against sunburn. This has great potential since the risk of ultraviolet radiation is ever increasing with the destruction of the ozone layer (Miller, 1996: 150-156).

Most fish species are associated with coral reefs for most of their lives or some part thereof. The reefs further help to calm the sea and protect the shores against storms. When one reef in Sri Lanka was destroyed the shoreline was pushed back almost 300 metres by the unrestrained sea. Yet coral reefs are destroyed at an increasing rate, and of the 109 countries with significant reefs, 93 of those are covered by silt. This is mainly a result of deforestation on land that increases soil erosion. Threats to coral reefs include the negative impact of boats, fishing with dynamite by subsistence farmers, all forms of marine pollution and mining (Lean & Hinrichsen, 1992: 164; Miller, 1996: 150-156).

3.3.1.8 Seagrasses

Seagrasses are underwater meadows that are associated with coral reefs in some areas. They grow close to the shore in shallow water and like mangroves trap sediment and purify water that comes in from rivers. These habitats are also rich in fish and provide nurseries for various species. Five times more fish occurs

on seafloors that are covered with seagrass than on areas that are only covered in mud or sand (Lean & Hinrichsen, 1992: 168).

Unfortunately, this makes them sensitive to pollution and overloading by sediment that may overwhelm them. Dredging and industrial wastes pose a great danger to the survival of these areas. One dredge and fill operation in Florida, which destroyed the seagrass bed, reduced the number of fish species by 80% and cost nearly \$1.5 million in catches (Lean & Hinrichsen, 1992: 168).

3.3.1.9 Mangroves and estuaries

Mangrove forests contain over 2000 species of fish, invertebrates and plants. They are at least as productive as good farmland. Some 55 species of salt tolerant mangrove trees cover 240 000 square kilometres of coastal land throughout the world (Lean & Hinrichsen, 1992: 165).

Shrimp farms often depend on larvae from wild stocks at sea, which disappear as the mangrove forests are being cut down. Mangroves stabilise shore lines and when they disappear the land is left vulnerable to the onset of the sea. They also trap silt and help to filter out pollutants (mangroves and estuaries may also be classified as wetlands, see 3.4.5) (Lean & Hinrichsen, 1992: 165; Beazley, 1993: 30).

Mangroves are threatened all over the world as a result of deforestation for timber, fuelwood, urban development, agricultural land and to create fish ponds for mariculture. They are poisoned by pesticides, silt from erosion and destruction by mining activities. The worst destruction is taking place in Asia where a 5000 square kilometre area of mangrove forest was reduced to 380 square kilometres from 1920 to 1988. More than 2000 square kilometres of Indonesia's mangrove forests are being cut down for the woodchip industry. Nearly the entire north coast of Java is now lined with ponds that are used for mariculture that once harboured numerous species of mangroves (Lean & Hinrichsen, 1992: 165).

Estuaries are formed at the interface between rivers and the sea (and may therefore also include mangroves). Some estuaries are permanently open to the sea, while others may only be open at certain times. The salinity in estuaries will therefore differ from area to area. Lagoons are formed when estuaries are cut off from the sea by a sand bank. Estuaries are dynamic ecosystems that are constantly altered by the tides, waves and river flow. After heavy rains, estuaries may be transformed into rivers that can carry large amounts of mud. Species that live in estuaries have a large spectrum of tolerance due to the constantly changing conditions. Almost 100 species of fish are dependant on estuaries in South Africa and they are mainly detritus feeders that feed in the ocean but take shelter in estuaries (Simpson, 1990: 26-28; Morgan, 1995: 66-67).

South Africa has approximately 340 estuaries along its 3000 km coastline. They are estimated to cover 600 square kilometres of which 400 square kilometres fall within the province of KwaZulu-Natal. Many birds, especially migratory species are also dependant on these systems for survival. Mudflats of the Langebaan is said to have 60 million bacteria per cubic centimetre and is recognised as one of the most ecologically productive areas in the world. These estuaries are important in the juvenile life cycle of penaeid prawns that form an important ecological food link with marine biodiversity. Juvenile fish also use estuaries during a part of their life cycle and later return to the ocean to spawn (Morgan, 1995: 66-67)

Estuaries are prone to siltation due to poor agricultural practices, lowering of river flow due to damming of rivers, building of bridges that may alter tidal action and property development in estuaries (Hugo, 2004: 253). To protect estuaries the following aspects should be taken into account: natural cycles of freshwater input must be maintained; filtering action of these areas must be protected; excessive pollution must be avoided; regulation of catchment areas that provide freshwater to estuaries; avoiding development in estuaries; regulation of soil erosion that deposits large amounts of soil in estuaries; and prohibition of dumping of any substance in estuaries (Heydorn, 1995: 4-11).

Harvesting of any marine taxa in lagoons, sea lakes, and estuaries should be strictly prohibited. These areas are scarce and small along the South African coast, and harbour unique marine diversity (Moore, 1958:399-402). Harvesting in these havens may seriously compromise the natural breeding buffer, since these areas are nurseries for economically important fish. Factors that compromise the natural integrity of estuaries contribute to the depletion of fish stocks (UNEP, 2004; Cunningham & Saigo, 1997:101; Branch & Shackleton, 1988:7, 8).

3.3.1.10 Coastal dunes

Coastal dunes provide an important buffer between the land and the sea and act as a store for sediments. They are closely linked with beaches and there is regular interchange of sediments, nutrients and organisms. Coastal dunes tend to be vegetated with plants that can tolerate salt and strong winds. As dunes become more established over time, other plants will follow and the succession takes place from the land side of the dune (MacPherson, 1990: 85).

Coastal dunes comprise 80% of the 3000 kilometre South African shoreline. They are extremely sensitive to trampling, and loss of vegetation soon results in erosion of the dune system. Removal of sand from dunes by human activities proves extremely detrimental to this sensitive ecosystem. Dunes and shorelines do not recover easily once damaged and events such as mining are detrimental to their survival. Coastal dunes have been mined on the coastal areas of South Africa and rehabilitation is a very expensive process. After the mining process

has been completed the topsoil together with seeds of pioneer plants are placed on the mined dune (MacPherson, 1990: 85).

After 10 years trees such as *Acacia karoo* form canopies under which climax species can become established. It is hoped that after 15 years indigenous animal life would return to the rehabilitated area, but some estimate this could take another 70 years. Some evidence even suggests that once a beach and dune system is degraded or destroyed, it may take up to 119 years to be restored to its original pristine condition (McLachlan & Erasmus, 1983:731; Hugo, 2004: 254-255).

Studies around Durban in areas of disturbed vegetation but not disturbed strata, has indicated that rehabilitation has not occurred over periods of up to 90 years. Any restoration attempts would require a commitment for up to a century in terms of monitoring (Forbes, 1990: 92).

The vegetation cover on sand dunes is very sensitive and easily damaged. Many sea birds such as oystercatchers, terns and plovers breed in the dunes that face the beach. Vehicles can crush the eggs, disturb the birds and threaten the survival of the young chicks. The deep tracks of vehicles can form formidable barriers to small animals such as the leatherback turtle that have to reach the water. This leaves them vulnerable to predators for a longer period of time. In estuarine areas vehicles destroy sensitive salt marsh vegetation that provides habitat to crabs, shrimps, fish and birds. Organisms that live in the intertidal sand such as prawn and worms are also easily destroyed by vehicles (Hugo, 2004: 254)

A very strange occurrence is the mass suicide that occurs from time to time amongst certain populations Lemmings that without warning would migrate to the sea and plunge over the cliffs into the ocean. A similar occurrence is the voluntary swimming of whales and dolphins to the shore. At times they have been returned to the deep ocean by concerned people, without success only to swim to the beach again where they die. These occurrences are linked to offshore military exercises and it is speculated that radar may be affecting these sensitive species (Hugo, 2004: 24).

3.3.1.11 Need for regulation, protection and conservation measures

South Africa's coastal zone faces rapid urbanisation and development due to population growth (Glavovic, 1997:242). Anthropocentric activities on the seashore such as domestic animals, vehicles, boats, camping, and fire making are usually associated with damage to sensitive marine systems (Cunningham & Saigo, 1997:102). Many coastal zone ecologists call for banning or severely restricting the building of seawalls, breakwaters, groins, and jetties. It is believed that these structures cause more damage to biodiversity than protection of coastal zone in the long term (Hugo, 2004: 254; Miller, 1996: 156).

The marine environment needs to be protected from various anthropocentric activities that may directly or indirectly impact negatively on marine biodiversity (Tinley, 1985:264). It is necessary to regulate, and even prohibit certain activities on the seashore in all areas, and not only in certain designated areas. Boats and anthropocentric activities should not be allowed in estuaries, lagoons, and sea lakes. These activities may compromise natural breeding patterns of various marine and coastal species that are habitat specific. Marine organisms are more sensitive to human activities than expected (Lewis, 1964:277).

If certain anthropocentric activities cannot be avoided, environmental impact assessment and/or strategic environmental assessment should be done to determine their potential impact on the environment (Branch & Shackleton, 1988:28, 29). Such a report must be submitted to a competent environmental authority for approval (see 5.2.1 and 9.13). Environmental impact assessment may also prove beneficial to regulate activities that may damage the marine environment (Hauck, 1999:101). (Also see 3.4.3 for more information on EIA).

It has been proposed that the local rural community should be educated/empowered and integrated in a management system to protect marine resources. This strategic "seawatch" should be used to combat the poaching of marine resources (Miller, 1996: 660).

In the marine environment strategic marine impact assessments should be done regularly to determine the state of biodiversity resources in various areas. This assessment should be used as a tool to determine the number of permits granted for all harvested species. This information could also be beneficial when directly linked to the permit fee and the determination of allowable catches. This feedback method will ensure that permits are not granted for harvesting small and threatened marine resources. The fee for different species will therefore vary to avoid over exploitation. Levies should be placed on various fish products to prevent excessive demand of overexploited or endangered species (Miller, 1996: 660).

A relevant Government authority should regulate all forms of harvesting. Funding should be available for methods of ensuring sustainability of marine resources. Commercial and domestic harvesting (including high seas fishing) should be effectively regulated, since domestic harvesting may be just as detrimental as commercial harvesting (Branch & Shackleton, 1988:10, 11; UNEP, 2004). Domestic harvesting may include domestic or recreational harvesting activities. Both types of harvesting are equally detrimental to marine resources, and should therefore be authorised (UNEP, 2004). All forms of harvesting of marine taxa must be monitored and regulated. Any form of fishing that damages the environment should be prohibited (NIMRD, 2003). South Africa notified Japan (February 2002) that it was going to ban their foreign fishing boats in the economic zone (Seafood, 2002).

The establishment of marine protected areas should take priority as a procedure to sustain populations of harvested species in natural areas. Marine protected areas should be sheltered from all kinds of domestic and commercial harvesting (Branch & Shackleton, 1988:9, 47; UNEP, 2002a:188). Such an area must provide a haven for threatened species. The minimum size and number of marine protected areas needed to sustain ecologically functional populations of marine taxa must be determined. It is important to determine the minimum size and the number of marine protected areas in a particular ecological unit to sustain biodiversity. Small areas may not be ecologically viable and be adequate to sustain marine diversity (University of Waterloo, 2004).

Alien species in the marine environment impact negatively on the survival of indigenous species, because these species do not have natural predators in their new environment. Alien species compete with indigenous species for resources, and may eventually take over an entire habitat if not managed properly (MAT, 1997). Ships and oilrigs that act as a temporary transport mechanism introduce many species, and measures to regulate this possible problem may prove beneficial (IUCN, 2004).

An integrated coastal zone strategy is needed to ensure that all environmental concerns are adequately incorporated in coastal zone management (Schneier, 1997:166). The coastal zone should be protected as an integrated unit and provisions should be made to prevent fragmented protection of only certain areas (Rabie, 1997:223).

3.3.2 Marine pollution

3.3.2.1 The scope of marine pollution

The seas have always been the ultimate depository of humanity's wastes. The Mediterranean off the Nile Delta and the waters of the Bosphorus and the canals of Venice have been health hazards for centuries. Pollution has now spread to such an extent that it is threatening to affect all coastlines and the open ocean as well. The enclosed seas that are the most polluted include Russia's Aral Sea that is already classified as effectively dead. The semi enclosed seas like the Mediterranean, the Black Sea and the Baltic are also increasingly polluted. So are the areas where currents are too weak to disperse the contaminants or tend to concentrate them. These include the German Bight and the North Sea. Pollution is also worse in harbours, estuaries and coastal areas than in the open sea (Lean & Hinrichsen, 1992: 173-175).

3.3.2.2 Sources

Most of the pollutants that end up in the sea are either discharged into the ocean directly or are deposited via rivers. Another third is from air pollution fallout and may vary in severity. Another 12% comes from shipping and 10% is deliberately

dumped. Pollution from dumping and offshore installations is usually confined to a local area (Lean & Hinrichsen, 1992: 173-175; Moldan, 1995: 41-48; Miller, 1996: 488).

3.3.2.3 Impact of algae

Algae blooms may be a serious form of pollution in some areas. In 1988 a slick of toxic algae bloom more than 10 metres deep and 10 kilometres wide, spread through the Kattegat and Skagerrak, which separate the coasts of Sweden, Norway and Denmark. It resulted in the death of millions of types of marine biodiversity and was called the "marine Chernobyl". In the same year an algae bloom clogged the northern Adriatic that spread slime over the Italian and Yugoslavian coasts. By 1992, almost 200 blooms of toxic algae were occurring in Japan's Seto Inland Sea every year. (Miller, 1996: 489).

Nitrogen and phosphorus compounds from sewage, fertilisers and some industrial wastes nourish these algae populations that reach explosive populations. The concentration of nitrogen and phosphorous have increase almost 10 fold in some areas as a result of pollution. Up to 75% of sewage from Britain's coastal towns and cities is discharged raw, without treatment into the sea. This is also the case with half of the sewage that is pumped into the Mediterranean. These substances further increase the nutrient levels in these areas that may result in algal blooms. Algae blooms have been responsible for the loss of commercial catches of various species in some areas (Lean & Hinrichsen, 1992: 173; Miller, 1996: 489).

3.3.2.4 Toxic substances

DDT from pesticides and PCBs that are used in glues and electrical appliances are extremely toxic and persistent. Concentrations of these substances have been found in Antarctic penguins, Arctic seals and even rat tail fish that live at a depth of 3000 metres in the abyssal sea. Concentrations have decreased in recent years as a result of stricter environmental legislation in many richer nations, but the problems are ever increasing in the Third World. These two substances account for more than 5% of the chemical contamination of fish (Lean & Hinrichsen, 1992: 175-176).

Toxic substances may alter the survival of organisms at even low concentrations and it is known that only 0.2 ppm of zinc prevents growth in oysters. For copper and mercury, even concentrations as low as 0.01 ppm may prove lethal. Heavy metal pollution such as lead from vehicles and cadmium are becoming a problem worldwide and is responsible for the decrease in numbers of various fish species. Cyanide and biocides are extremely toxic to marine organisms and certain recalcitrant biocides are persistent in the marine environment and affect all levels of the food chain (Moldan, 1995: 41-48).

3.3.2.5 Oil

Every year 4 million tons of oil contaminate the sea. Only about half comes from ships and the rest originates from land pollution. Less than a third of this oil is spilt by accident and more than 1.1 million tons of oil is deliberately discharged into the seas when tankers have to wash out their tanks before taking new cargoes. Crude oil may be lethal to marine biodiversity in concentrations as low as 0.05 ppm (Moldan, 1995: 48).

The worst cases of pollution occur on the main shipping routes. Even low concentrations of oil may be damaging to marine life such as larvae and plankton. Usually large quantities of oil tanker spills are responsible for the death of various forms of biodiversity along the coastline as was seen with the Exxon Valdez in Alaska and the largest Ixtoc blow out at Mexico in 1979. It resulted in the release of 400 000 tons of oil over a 10 month period that polluted the beaches as far away as Texas. Even small spills can do great damage under certain conditions as was the case when 200 tons of oil killed more than 40 000 seabirds in the Wadden Sea in 1969 (Lean & Hinrichsen, 1992: 176).

The Gulf War resulted in the worst spills of oil in history and almost 6 million barrels of crude oil were released into the Gulf. It stretched along the Saudi coast and killed 30 000 seabirds and it could take these salt marches many years to recover (Lean & Hinrichsen, 1992: 176; Miller, 1996: 489-491).

During 1991, 76 illegal oil discharges were reported in South African waters. Oil from the cleaning out of hulls and engines of tankers were responsible for these spills. Harbour activities such as pipeline failures can also occur. In Cape Town in 1998, 150 tons of oil leaked into Table Bay harbour when a pipe that led to an oil storage facility burst (Hugo, 2004: 183).

The Katina P, a 26 year old Greek tanker that carried 66 700 tons of heavy fuel oil from Venezuela to the United Arab Emirates sustained damage to her no 3 tank while in South African water. It resulted in the release of approximately 12 500 tons of oil that covered an area of 120 square kilometres. The oil was still washing up on the shores of the east coast two months later. Apollo Sea, a Chinese carrier was carrying some 2500 tons of fuel oil when it sank off the South African coast in 1994. The first indication that an oil spill had occurred was the oil covered penguins that came ashore on Dassen Island. It resulted in the death of almost 1500 seabirds (Hugo, 2004: 183-184).

It is also suspected that many people change the oil in their cars and discharge the oil into storm water drains. This, together with rain that washes oil from roads in cities contributes to oil pollution in South African waters (Hugo, 2004: 183-184).

3.3.2.6 Dumping and littering

Dumping at sea has done great damage to limited areas but fortunately this is now decreasing as a result of stricter international legislation. Radioactive and industrial wastes have been dumped into the ocean, but fortunately the dumping of radioactive wastes was stopped. About 90% of all dumping results from dredging and some areas may be spoiled by heavy metals and persistent pollutants (Lean & Hinrichsen, 1992: 176).

Dumping of all wastes and toxic substances should preferably be banned (Hohmann, 1992a:139). Dumping should be designated to land sites where such substance can be contained. Dumping of any organic or inorganic substance may lead to the biomagnification of such a substance (Milligan, 2002). This is a process in which mostly non-polar (fat soluble) substances are biomagnified in higher levels in the food chain. The result is the death of many species that form the last level of the food chain, due the accumulation of these toxic substances. Many of these substances are mutagenic and induce spontaneous mutations and carcinogenic growths in marine species (Maritime Safety, 2003; Savitz, 2003).

Every year fishermen discard about 150 000 tons of plastic nets and lines into the ocean. This figure is increased by the irresponsible littering of the sea by countless plastic containers and bands that are tossed overboard. The plastic do not degrade easily and is eaten by some animals with disastrous consequences. Some animals get entangled in the plastic and up to a million seabirds, 100 000 seals whales and dolphins are killed every year as a result of such pollution (Lean & Hinrichsen, 1992: 176).

Almost every blue petre' (*Halobaena caerulea*) contains plastic in its stomach. When plastic accumulates in an animal's stomach, it does not feel hungry and starves to death (Moldan, 1995: 41).

Surveys done locally indicated that about 3500 particles of plastic occur in every square kilometre of the South African coast. Surveys of 50 South African beaches from the Eastern Cape to Cape Town show that in five years plastic pollution has increased by 190%. Researchers are now also finding plastic pollution in Antarctica. Plastic objects found on beaches near urban areas tend to originate from use on land, and mainly include packaging materials. On remote beaches plastic pollution may come from ships. Since plastic is floatable and generally resistant to decomposition it can be easily dispersed over large areas (Hugo, 2004: 189; Moldan, 1995: 41).

3.3.2.7 Measures to assist in marine pollution control

Marine pollution (see chapter 5, 5.2.5 and chapter 9, 9.16 – 9.18) poses a growing threat to the environment, and unfortunately the importance of this problem is not always realised. Unlike pollution on land, marine pollution tends to

spread over a very large area. The fact that these hazardous substances become diluted does not mean that it will not have a negative impact on marine biodiversity (Miller, 1992: 611).

The control and prevention of marine pollution should become strict, and measures must be implemented for its regulation, monitoring and mitigation both here and abroad. The liable party should be responsible for mitigation of any dumped substances (including oil), and the consequences thereof. The person or persons who are responsible for such accidents must immediately report any pollution caused by ships. Inspection of ships should be undertaken regularly to ensure that safety standards are met (Parker, 1975: 235; Hohmann, 1992a:44).

Thermal pollution of seawater by industrial plants has a deleterious effect on marine species, and the necessary precautions should be taken (Nybakken, 1988:487).

Anthropogenic structures should not be abandoned in any area of the marine environment. Such structures may include remnants of ships, oilrigs, or any other structure. Their decomposition may release substances into the marine ecosystems that may damage more sensitive living marine resources. These structures should be removed, recycled (preferably) or be disposed of at relevant disposal sites (Mamaloukas-Frangoulis *et al.*, 2002; Field, 2002).

Mining presents (see also chapter 6, 6.2.13 for detail discussion on mining) another potential threat to the marine environment, due to the physical damage it causes to the sea floor. The release of heavy metal such as arsenic, cadmium and lead (Miller, 1992:183) associated with the mining process may result in the destruction of marine systems and their biodiversity (McLachlan & Erasmus, 1983:719-726). The necessary environmental impact assessment should be undertaken before any mining activities are permitted. Rehabilitation of the marine environment should be undertaken as soon as possible where deemed necessary (Miller, 1992:163).

The following strategies may reduce marine pollution: separate sewage and storm water runoff lines, discouraging of ocean dumping and dredging, protection of sensitive and ecological valuable areas, ecological land use planning to regulate coastal development, double hulls for oil tankers, recycling of oil, improved oil-spill cleanup and secondary treatment of coastal sewage (Miller, 1996: 492).

3.3.3 Protection of Antarctica

3.3.3.1 Character of continent

Antarctica was discovered by the British explorer James Cook in 1774 when he reached a wall of ice past the Antarctic circle. It took another 75 years before the first party set foot on its shores. Since then humankind has derived material

wealth from Antarctica's rich seas and scientific knowledge from its pristine ice and air. There are also probably large mineral and oil reserves that are yet unexplored (Lean & Hinrichsen, 1992: 177).

The continent is almost the size of the USA and is covered by an ice sheet of up to 3 kilometres thick that contains 70% of the planet's fresh water supplies. Only 2% of the continent's surface is free of ice and includes some parts of the coast, the mountain peaks and dry valleys. Almost 90% of the coastline is made up of ice cliffs or shelves that stretch out over the sea. In the winter parts of the ocean freeze and double the size of the continent. The ice sheet helps to power the circulation of the earth's atmosphere and oceans. Antarctica holds great scientific interests in its layers of ice that were compacted over millions of years. These reveal interesting facts about the change of the earth's climate over many thousands of years. Trapped air bubbles of carbon dioxide reveal the levels of air pollution increase over many years (Lean & Hinrichsen, 1992: 177-180).

3.3.3.2 Biodiversity

Most of the biodiversity are confined to microscopic life and the continent's largest land animal is a wingless midge no larger than a centimetre long. The continent's fragile vegetation includes only two flowering plants the Antarctic hair grass (*Deschampsia antarctica*) and Antarctic pearlwort (*Colobenthos subulatus*). The other flora is dominated by mosses and almost 350 species of lichen (Lean & Hinrichsen, 1992: 180).

Biodiversity in the Arctic ocean is much more diverse and includes algae that provide food to vast swarms of krill (shrimp like crustaceans). It is the main source of food to 5 species of migratory whales, 3 species of seal, 20 species of fish, 3 species of squid and various kinds of birds. These predators feed on the different stages of the lifecycle of the krill (Lean & Hinrichsen, 1992: 170).

Most fish contain antifreeze compounds that help them to survive the icy temperatures. During the winter months Weddell seals live permanently under the ice and use sonar to find their food and to locate them back to their breathing holes. The Emperor penguin breeds at the end of summer through the cold winter to ensure that the chicks hatch in spring when food supply is abundant. Since Cook first reported the vast seal colonies, humans have flocked to the Antarctic circle and almost killed all the fur seals. It has taken almost 80 years for their numbers to recover again. Whalers have killed an estimated 99% of the areas Blue whales, 97% of the Humpbacks and 80% of the Fin whales (Lean & Hinrichsen, 1992: 170-180).

3.3.3.3 Protection

Antarctica (see chapter 5, 5.2.9 and chapter 9, 9.13) is not under the jurisdiction of the South African government, but it is of significant value to the Republic. The

territorial waters of South Africa adjoin the Antarctic environment, and any pollution or extinction of species may influence negatively on the Republic. It is therefore important that measures are implemented to ensure that Antarctica is used for scientific and peaceful purposes only (Breach, 2002; BAS, 2002a).

All parties that use Antarctica should guarantee that environmental impact assessments are used where necessary. Dumping of any substances, especially nuclear wastes should be prohibited at all times (Agence France-Presse, 1997).

All countries that use Antarctica should ensure that the environment is properly managed in a sound environmental manner. The harvesting of all Antarctic marine resources should be regulated or prohibited where necessary, and should include the protection of species such as whales (Breach, 2002; BAS, 2002b).

3.3.4 Summary: Aspects needed to sustain biodiversity in the marine environment

The information discussed in chapter 3, 3.3.1 – 3.3.3 is concisely and generically summarised in Table 6 below. Refer to the discussion for more detail.

Table 6: Concise generic summary of sustainable biodiversity aspects/criteria in the marine environment

Aspect needed to sustain marine biodiversity
Marine harvesting, protection, and regulation
Regulation of commercial and domestic fishing by quotas, closed seasons, closed areas, limitation on vessels allowed, size of fleet and number of processing plants (Payne & Crawford, 1995: 51-60; Miller, 1996: 580-581; Lean & Hinrichsen, 1992: 157).
Regulation/prohibition of trawling (Payne & Crawford, 1995: 51-60; Miller, 1996: 580-581; Hugo, 2004: 255; Cunningham & Saigo, 1997:212; Watling & Elliot, 1998; Royal Society, 2002; Ross, 2003; Environment News Service, 2005; FMS, 2002; Agencia de Informacao de Mozambique, 2003; Hall-Spencer <i>et al.</i> , 2001).
Regulation/prohibition of fishing practises that may damage habitat (such as dynamite) (Lean & Hinrichsen, 1992: 160).
Regulation of commercial fish farms, through EIA, management plans to prohibit, regulate and mitigate negative impacts on biodiversity (exotic species, diseases, nutrient enrichment) (Lean & Hinrichsen, 1992: 160; Hugo, 2004: 255; Miller, 1996: 584).
Conservation and protection of whales (Lean & Hinrichsen, 1992: 160-164;

Miller, 1996: 660).
Coral reef and seagrass meadow protection from development, boats, fishing methods and harvesting. Prevention of development, harvesting, destruction and dredging in estuaries and mangroves. Banning or severely restricting the building of seawalls, breakwaters, groins, and jetties (Lean & Hinrichsen, 1992: 164; Miller, 1996: 150-156; Simpson, 1990: 26-28; Morgan, 1995: 66-67; Hugo, 2004: 253; Heydorn, 1995: 4-11; Moore, 1958:399-402; UNEP, 2004; Cunningham & Saigo, 1997: 101; Branch & Shackleton, 1988: 7, 8).
Regulation/restriction of anthropocentric activities on the seashore such as domestic animals, vehicles, boats, camping, and fire making that is usually associated with damage to sensitive marine systems (Glavovic, 1997: 242; Cunningham & Saigo, 1997: 102; Tinley, 1985: 264; Lewis, 1964: 277; Hugo, 2004: 24).
Education of local community regarding marine biodiversity protection and conservation, use of management tools such as EIA, strategic marine assessment to determine allowable catches (Branch & Shackleton, 1988: 28, 29; Hauck, 1999: 101).
Introduction of fish product levies, establishment of marine protected areas, regulation of alien species and integrated coastal management plans to prevent fragmented protection (Miller, 1996: 660; Branch & Shackleton, 1988:10, 11; UNEP, 2004; UNEP, 2004; NIMRD, 2003; Seafood, 2002; UNEP, 2002a:188; University of Waterloo, 2004; MAT, 1997; IUCN, 2004; Schneier, 1997:166; Rabie, 1997:223).
Marine pollution
Regulation/prevention of nutrient pollution, fertiliser and sewage, pesticides and metals from coastal areas and rivers (Lean & Hinrichsen, 1992: 173-175; Moldan, 1995: 41-48; Miller, 1996: 488; Moldan, 1995: 41-48; Maritime Safety, 2003; Savitz, 2003).
Regulation/prevention of abandoned anthropogenic structure dumping in marine environment (Mamaloukas-Frangoulis <i>et al.</i> , 2002; Field, 2002).
Prevention oil pollution (Lean & Hinrichsen, 1992: 176; Miller, 1996: 489-491; Moldan, 1995: 48; Hugo, 2004: 183-184).
Prevention/regulation of dumping (Lean & Hinrichsen, 1992: 176; Hohmann, 1992a:139 Milligan, 2002).
Regulation/prevention/mitigation of mining, use of EIA for activities that may have negative impact (McLachlan & Erasmus, 1983:719-726; Miller, 1992:163).
Prevention/regulation of plastic pollution (Lean & Hinrichsen, 1992: 176; Parker,

1975: 235; Hohmann, 1992a:44; Miller, 1992: 611).
Prevention/regulation of thermal pollution in sea (Nybakken, 1988:487).
Protection of Antarctica
Protection of biodiversity, regulation of fishing, protection of whales, prevention of pollution, prevention of mining, use of EIA where necessary (Lean & Hinrichsen, 1992: 177-180; Agence France-Presse, 1997 Breach, 2002; BAS, 2002b).

Source: Created by the author by using information from 3.3.1 – 3.3.3 in chapter 3.

3.4 The terrestrial, atmospheric and fresh water environment

The terrestrial, atmospheric and fresh water environment (also see chapter 6) includes the atmosphere, fresh water, and soil. Provision should be made to protect these entities that are necessary to sustain the living world. This includes the regulation of development, the management of terrestrial and aquatic pollution, water management and control of fire.

3.4.1 Air pollution

3.4.1.1 Acid rain

Acid rain is mainly caused by sulphur and nitrogen emissions from the burning of fossil fuels such as coal and oil. When these pollutants combine with water vapour, sunlight and oxygen it creates a mixture of diluted sulphuric and nitric acids. In some heavily industrialised areas the hydrochloric gasses in the atmosphere form hydrochloric acid which can also be an ingredient of acid rain (Howe, 1990: 56).

Studies on the wood of coniferous and temperate forests around the world have indicated that these forests have come under great stress in the last 30 years. The trees with the most damage are usually found on the higher slopes that face the prevailing winds. Those shrouded in mists and fog most of the time are the worst affected. Studies found elevated levels of lead, zinc and copper in the forest litter, and in 70% of all the days the mountain is in a cloud of rainwater that is 100 times more acidic than normal rainwater (Lean & Hinrichsen, 1992: 85).

Researchers in Europe and the USA are trying to determine the exact cause of the massive dieback. They say it is the biggest ecological puzzle of the century. The forest death is often accompanied by damage from secondary stress factors such as insects, fungi, frost and snow. The cause is believed to be a noxious combination of airborne pollutants in combination with stress and climatic conditions (Lean & Hinrichsen, 1992: 85).

Although acid rain can be caused by natural processes such as volcanoes, nature's own doses of sulphur and nitrogen are dwarfed by industrial pollution. Natural field and forest fires may also significantly contribute to increased levels of carbon dioxide. This is especially a problem in areas where deforestation is taking place such as poor tropical countries. In southern Africa the problem is particularly problematic during the end of winter. Some sources reveal such air pollution to be as bad as the oil fires during the Persian Gulf war (Safari, 2000). Every year 100 million tons of sulphur oxides are released across the globe, with Europe and North America accounting for 37 millions tons. More than 90% of all the deposited sulphur is man made, and the OECD countries contribute 37 million tons of nitrogen oxides each year (Miller, 1996: 436).

Urban air contains a frightening mix of pollutants including sulphur and nitrogen dioxide mainly from power plants, industries and incinerators. Urban air may also contain reactive hydrocarbons (from petrochemical plants, refineries and vehicles), carbon monoxide (mostly from vehicles), heavy metals (from vehicles and industries) and organic compounds (mostly from chemical industries). These primary chemicals may combine in the atmosphere to form even more toxic secondary contaminants. Oxides of sulphur and nitrogen mix with sunlight and oxygen to form acid rain, and ozone and photochemical oxidants are formed when hydrocarbons react with nitrogen oxides and oxygen in the presence of sunlight (Lean & Hinrichsen, 1992: 89-92; Miller, 1996: 432-434).

Mining also represents a problem to air pollution in certain areas and may contribute to acid rain. Problem gasses include sulphur dioxide, nitrogen dioxide, nitrogen oxide, carbon monoxide and ozone. Solid substances like dust, smoke, sulphates, metallic carbonates and metallic salts that are also becoming a serious problem (Hugo, 2004: 174-175; Simpson, 1990: 25-26).

Sulphur concentrations in the centre of Beijing are more than four times the World Health Organisation's guidelines. The city Benxi on the North Korean border is perhaps one of the world's most polluted cities and its 420 factories contribute to air pollution by pumping 213 000 tons of smoke and dust into the atmosphere every year. A few years ago the city of a few million people simply vanished from satellite photos as a result of the severe air pollution (Lean & Hinrichsen, 1992: 89-92; Miller, 1996: 432-434).

Domestic consumption of coal in South Africa's urban areas also contributes significantly to air pollution and acid rain. Combustion from coal stoves in township areas pours 50 000 tons of sulphur dioxide into the atmosphere. Nitrogen oxide that is released from cars during fuel combustion is also an increasing problem that increases acid rain (Howe, 1990: 56).

3.4.1.2 Impact of acid rain

European and North American temperate forests are under threat from *Waldsterben*, German for forest death (Diab, 1990: 55). *Waldsterben* was first reported in the West of Germany in the early 1970s, but little notice was taken. By 1982 the Government became alarmed when it found that 8% of its forests were damaged. In 1983 that figure increased to 38% and by 1984 to 50%. By 1985, a staggering 52% of the country's forests showed symptoms of decline and in 1986, it was estimated that almost 31 million hectares of coniferous and broadleaved forests were affected in 19 European countries, and the WWF estimates that 50 million hectares is currently affected (Lean & Hinrichsen, 1992: 85).

Coniferous forests along the spine of the Appalachian mountains from Georgia to New England are in decline with similar dieback symptoms, and 60% of the high elevation red spruce in the states of New York, Vermont, and New Hampshire have already perished. It is estimated that 78% of the Ponderosa and Jeffery pines of the San Bernadino Forest in California are ill, and the sugar maples of the south-eastern Canada are also affected. There are alarming signs of damage to the Third World's temperate forests as well, and 90% of China's Sichuan province that was once covered in pines is now bare (Lean & Hinrichsen, 1992: 85-87).

Another study concluded that it costs Europe and Russia \$29 billion each year as a result of the loss of timber, tourism and manufactured goods, and it is expected that these losses will continue in the future if nothing is done about the problem (Lean & Hinrichsen, 1992: 85-87).

Acid rain was first described in 1872 by an English chemist and remains one of the industrialised world's most intractable problems. What has taken humankind centuries to build, and nature millennia to evolve is being degraded and destroyed in a matter of a few years (Lean & Hinrichsen, 1992: 85-87).

Rainfall is naturally acidic with a pH of around 5.6, but man's pollution routinely increases this acidity up to 100 times the level compared to developing countries. Research has indicated that the average pH values of rain water in central Europe are 4.3 or below. According to the OECD the polluted areas of Scandinavia, Japan, central Europe and North America have annual pH levels that may fall as low as 3.5 in some areas (Miller, 1996: 436).

Each year Norway experiences some rainfall that is as acidic as lemon juice, and precipitation as acidic as vinegar has fallen on Kane, Pennsylvania. Rain with a pH value almost the equivalent of battery acid has once fallen on Wheeling in West Virginia. The impact of acid rain may be reduced in areas that have alkaline soils such as the Midwest USA and Southeast England. Glacial soils and those composed of granite are less likely to buffer the affect of acid rain and these

sensitive areas are the hardest hit by the acid deposition (Lean & Hinrichsen, 1992: 86-88; Miller, 1996: 436).

It has been estimated that in the north eastern parts of the USA, 65% of all acid rain is caused by sulphuric acid, 30% by nitric acid and 5% due to hydrochloric acid. It is also believed that acid rain is one of the contributing factors of forest death in the USA and Europe. The former East Germany has the highest per capita sulphur dioxide emissions in the world, and Poland and Romania are among the most polluted countries in the world. China is the world's third largest emitter of sulphur dioxide and has growing problems in its southern provinces with acid rain (Miller, 1996: 436).

Thousands of lakes in the USA including at least 10% in the Adirondack mountains are too acidic to support fish. More than 300 lakes in Canada's Ontario province are estimated to have pH levels lower than 5 which is a level where most aquatic biodiversity dies. Trout and Salmon no longer reproduce in the nine acidic rivers of New Scotia. Nearly 25% of Sweden's 90 000 lakes are acidified to some extent and 4000 of them are so acidic that they are unable to sustain most aquatic biodiversity. Authorities in Norway say that 80% of all of its lakes and streams are technically dead, an area of almost 13 000 square kilometres (Miller, 1996: 436; Lean & Hinrichsen, 1992: 85).

Air pollution is a relatively serious problem in South Africa. A number of measures have been introduced during recent years to control it. Smoke pollution in Bloemfontein, Boksburg, Cape Town, Kroonstad and Pretoria exceeds limits set down by the World Health Organisation. This is particularly a problem during the winter months when atmospheric inversions and calm periods prevent circulation of polluted air. Emissions of carbon dioxide on the eastern Highveld are estimated to be 124 million tons per year and almost 95% of this originates from coal fired power stations (Diab, 1990: 54).

In South Africa much of the air pollution originates from the same industrial sources of acid rain. Escom and Iscor are responsible for the release of one million tons of sulphur dioxide each year. Emissions from 8 power stations on the eastern Highveld rank together with Eastern Germany as the worst in the world. Industrial air pollution that originates in Cape Town is causing acid rain in the Hex River Valley. Acid rain on the Drakensberg is also alarmingly on the increase and is posing a threat to the vegetation of the Drakensberg (Howe, 1990: 56).

3.4.1.3 Impact on biodiversity

Acid rain itself does not kill biodiversity and fish, but sensitive species may die as a result of lethal chemistry of acid waters. Acid water dissolves various metals that do not regularly occur in such high levels in clean water, and the levels of mercury, lead, zinc, aluminium, and manganese are increased exponentially in these waters. Aluminium toxicity peaks at pH 5 and it clogs the gills of fishes that

cause them to suffocate. Species like salmon, trout, minnow and arctic char succumb to these lethal chemical combinations (Lean & Hinrichsen, 1992: 88).

Research also indicates that the acidity of forest soil has increased almost 10 fold in the past 50 years across Europe and North America. Acid rain leaches crucial elements like potassium, calcium and magnesium from soil that are needed by vegetation to survive. Low concentrations of these elements may render vegetation more susceptible to environmental stress such as pollutants and climatic variations (Lean & Hinrichsen, 1992: 88).

Ozone may damage vegetation and crops and is one of the main ingredients of urban smog. This poor air quality is not just directly responsible for poor health in people, but also in animals, and may eventually affect all forms of biodiversity in these air polluted areas (Lean & Hinrichsen, 1992: 89-92; Miller, 1996: 432-434).

3.4.1.4 Regulation

Los Angeles introduced pioneering regulations to combat photochemical smog in the 1960s and 1970s and which were copied worldwide. It required that all cars had to be equipped with catalytic converters to reduce pollution. But its cleanup programme stagnated in the 1980s while the number of vehicles that contributed to the problem increased by 70%. In 1988, southern Californians breathed air that exceeded health standards for 232 days of the year, and on 75 of these days the air pollution was so bad that school children were advised to stay indoors (Miller, 1996: 433; Lean & Hinrichsen, 1992: 92).

In 1989, stringent new regulations came into place that has cut the increasing air pollution drastically. These measures regulate vehicles in certain areas and force companies to cut down on the vehicles that are used, and by introducing more working from home. This plan also clamps down on lawnmower emissions, drycleaners, bakeries and domestic barbeques. The use of unleaded fuel and reduction in the sulphur dioxide emissions is also part of this policy. Regulations on traffic in the city centre in numerous international cities and the use of fines for trespassing in such areas during certain times has also decreased air pollution in these areas (Miller, 1996: 433; Lean & Hinrichsen, 1992: 92).

3.4.1.5 Global warming

Scientists now broadly agree the greenhouse effect is bringing the greatest and most dramatic climatic change to the globe that civilisation has ever witnessed, and it is believed that it will have enormous consequences for all life on earth. Carbon dioxide amongst many other greenhouse gasses act like a glass in a greenhouse by letting the sun's rays through but trapping some of the heat that is radiated back to space (Diab, 1990: 53).

Without the natural levels of carbon dioxide in the atmosphere the natural temperatures on earth would be almost 30 °C colder. This effect was predicted in 1896 by the Swedish chemist Svante Arrhenius when he said the earth would get warmer as a result of the burning of fossil fuels. In 1800 the gas was still at its pre industrial level of 280 parts per million, and by the time Arrhenius issued his warning it has already increased to about 300 ppm. It has already topped the 350 ppm and is still growing rapidly, and every year some 24 billion tons are released into the atmosphere. This amount is increasing by 750 million tons each year. Most of it originates from the burning of fossil fuel (Lean & Hinrichsen, 1992: 93-96; Miller, 1996: 305-310).

The destruction of forests world wide ensures that the absorption rates are also decreased and the decomposition of wood also releases more carbon dioxide. Other greenhouse gasses also contribute to the growing problem of global warming and these include methane and nitrous oxide, both are also given off by fossil fuel combustion. Nitrous oxide is also given off by certain fertilisers and methane by rice paddies and ruminants like cattle. The carbon dioxide level is expected to increase to 560 ppm by the year 2030. Over the last century the world has warmed by between 0.3 °C and 0.6 °C and it is consistent with the increase in greenhouse gasses. It is estimated that the world will be 1.3 °C warmer by the year 2020 and up to 3 °C warmer by 2070 (Lean & Hinrichsen, 1992: 93-96; Miller, 1996: 305-310).

This does not seem to have such a great effect, but apparently small changes have dramatic effects. An increase of only 2 °C will increase temperatures seen 125 000 years ago, and a rise of 3 °C will make the world hotter than it has been in the past 2 million years. Past changes like these took thousand of years to achieve and species had time to adapt to the changing climate. The greenhouse effect threatens to produce these in just a few decades (Miller, 1996: 308-313).

This change is also expected to change the sea levels as a result of the melting snow in mountain areas and the poles. This could have a detrimental impact on the existence of certain islands such as the Maldives, Cocos Islands, Tuvalu, Tokelau, Kiribati, Marshall and Line Islands. Even countries like Bangladesh may be threatened by rising sea levels and it is expected that 18% of Bangladesh may be under water by 2018 and this could rise to 34% by 2100 (Lean & Hinrichsen, 1992: 93-96; Miller, 1996: 308-313).

It is estimated that a 1 meter rise in sea level could make 200 million people homeless, and this would place higher strain on further development and natural resources. The changing climate and weather patterns will also affect the quality and quantity of harvests and food production globally. It is expected that colder countries will be able to cope better with the warmer climate and may see increased food production. But warmer countries may suffer from frequent droughts that could severely compromise populations (Lean & Hinrichsen, 1992: 93-96; Miller, 1996: 308-313).

This change in climate will also affect wildlife and it is believed that with a rise of 1 °C, plant species will have to move 90 kilometres towards the poles to survive. Many will not be able to spread fast enough to survive the rapid changes. It is also expected that the change in the polar areas will be the greatest and that the Arctic tundra will disappear altogether (Lean & Hinrichsen, 1992: 93-96; Miller, 1996: 308-313).

Global warming from the greenhouse effect is now inevitable and the only solution would be to try and manage the process as effective as possible. Carbon dioxide levels can be best reduced by conserving energy, halting deforestation and planting more trees. These measures need a good degree of cooperation since acting alone will make almost no difference to global emissions. Unfortunately the Third World relies heavily on the burning of fossil fuels since it is poverty stricken. Richer countries are slow to react because of the possible compromise that greenhouse gas reductions may have on the integrity of industries and therefore economical growth (Lean & Hinrichsen, 1992: 96).

3.4.1.6 The ozone layer

Ozone is a form of oxygen with 3 atoms instead of the normal 2, less than one part per million of this blue tinged gas is poisonous to humans. Near ground level it is a pollutant that helps form photochemical smog and acid rain, but far overhead in the stratosphere it forms a lifesaving ozone layer. Ozone is the only gas in the atmosphere that can screen out the lethal ultraviolet rays of the sun. It is spread so finely throughout the stratosphere, yet if it were not for this fragile filter, ultraviolet radiation would kill all terrestrial life. A small amount gets through doing enough damage to warn against the weakening ozone layer (Morgan, 1995: 132-133; Miller, 1996: 317-322).

Ultraviolet increases the risk of skin cancer, suppresses the immune system and damages all types of plants and animals. In 1992 there were reports of blindness in fish, rabbits and sheep in southern Chile the populated area the nearest to Antarctica where the hole in the ozone layer was originally discovered. Fisheries and marine resources seem to be more vulnerable to ultraviolet light that is able to penetrate water by much as 20 metres in clear conditions. Plankton that drifts on the surface of the sea is particularly vulnerable to this type of radiation. Plankton also forms the most important part of the marine food chain and absorbs almost 50% of the world's carbon dioxide emissions. Depleting them could upset the balance of life and speed up global warming (Lean & Hinrichsen, 1992: 97-99; Diab, 1990: 33-35; Morgan, 1995: 132-133; Miller, 1996: 317-322).

The greatest danger to the ozone layer comes from chlorofluorocarbons (CFCs) that are outstandingly useful and versatile chemicals that were long seen as miracle substances. Inert and immensely stable, neither flammable nor poisonous, easy to store and cheap to produce they seemed to be designed for the modern world. They were first developed as coolants and played and

important role in refrigeration and air conditioning. They were also introduced as aerosol propellants during the Second World War to spray insecticides in the fight against malaria. They were also used to blow up foams that were used in various applications (Miller, 1996: 318).

Unfortunately this stability that makes them so useful allows them to attack the ozone layer. They drift upwards and take about 8 years to reach the stratosphere and once there, they can survive for almost a century. As they break down under intense ultraviolet radiation they release chlorine that reacts with ozone and converts it to ordinary oxygen. The chlorine acts as a catalyst and does not undergo permanent change, so every CFC molecule lives on to destroy thousands of molecules of ozone (Lean & Hinrichsen, 1992: 97-98; Morgan, 1995: 132-133; Miller, 1996: 318).

Damage to the ozone layer has also been increasing in the Northern Hemisphere where most of the world's population lives. Between 1979 and 1990 the amount of ozone above the 30 to 50 degrees northern latitude has decreased by 8% and was twice as much as scientists initially estimated. It will be a long time before the ozone returns. It is estimated that it could take a century for the ozone layer to return to its original state (Lean & Hinrichsen, 1992: 100; Diab, 1990:33).

3.4.1.7 Measures to reduce air pollution

Air pollution (see chapter 6, 6.2.1) may cause direct or indirect problems in the environment, and is often responsible for an increase in temperature, acid rain (Marini-Bettolo, 1989:170) and ultraviolet radiation (UNEP, 2002a:124; Hohmann, 1992a:540).

Measures should be implemented to ensure that where possible all aspects of air pollution are prevented, reduced, and mitigated. Air pollution control areas can be beneficial in regulating the presence of air pollution in certain areas. Control measures should manage various types of air pollution including different types of domestic and industrial air pollution (Hohmann, 1992c:1675, 1689).

Vehicles that pollute the environment with black smoke should be prohibited in all areas. Catalytic converters in city areas may prove beneficial (Hohmann, 1992c:1675, 1689) (see chapter 9, 9.8; 9.9; 9.11 and 9.12). In urban areas the presence of air pollution by domestic burning may greatly increase the presence of acid rain. Urban coal and wood fires should be prohibited, and fire making for recreational purposes should be designated to special areas. This aspect is regulated effectively in more densely populated areas in Europe (Cunningham and Saigo, 1997:499; UNEP, 2002a:250). In South Africa smoke due to domestic activities in some rural areas may become more problematic during the winter season, creating numerous environmental problems (Crothers, 1998:141).

International cooperation between countries should be implemented since air pollution is a global problem. Public awareness and education are important tools to proactively increase environmental awareness. Regulation of fires will also improve the regulation of greenhouse gases, which should be given more attention here and abroad. The control of ozone depleting gases is important since these substances are responsible for increased ultraviolet radiation. Directives should be implemented to protect the stratospheric ozone layer (Hohmann, 1992a:73; Hohmann, 1992c:1691).

Domestic and industrial equipment used for burning various substances should be regulated (Warren & Goldsmith, 1974:27; UNEP, 2002a:212-217).

Air pollution can be reduced by the implementation of the following strategies:

- The establishment of air quality standards such as specification of pollution reducing equipment and the determination of standards for emissions;
- Land use zoning, which implies that certain areas have to be set aside for higher pollution than others;
- Dispersion strategies to reduce pollution in certain local areas by employing methods to increase dispersion of pollutants;
- Residual taxes that places financial strain on heavy polluters of the environment; and
- Economic incentives that are aimed to reduce pollution to more desired levels (Preston-Whyte, 1990: 46-47; Miller, 1996: 445-448).

3.4.2 Population growth

3.4.2.1 Impact of growth

Although fertility rates are dropping, the momentum of population growth is responsible for the fact that almost 3 billion people will be added to the planet within the new 25 years, but it could also be as high as 4 billion according to some estimates. Within the next 10 years it is estimated that the number of people that will be born in the Third World may be up to 900 million, which is 24% in total, whereas the population growth will only be an estimated 5% or 56 million people in industrialised countries (Miller, 1996: 246-247).

This population explosion began in the West around the middle of the 17th century, but before that the increase in human population was only increasing at a slow rate from about 150 million at the time of Christ, to somewhere around 500 million. Then the rate dramatically increased since 1850 when there were about 1.2 billion people and the growth rate continued to increase. The reason was not because people had more babies, but rather that they lived longer, had better food supplies and health care improved. Eventually the birth rate in industrialised countries were stabilised when people became more prosperous

and educated and the birth rate was almost equal to the mortality rate (Miller, 1996: 246-247).

Counties like Austria, Belgium and Italy have already achieved zero population growth, while the population in Hungary and Germany is actually declining. Third World countries have not come to that point yet and are fuelling the world's growth in numbers. During the first half of the 1990s Africa's population has increased by 3% a year, the highest regional growth rate that the world has ever seen. The average woman in the Middle East and Africa bears between six and eight children while the equivalent in industrialized counties bears one or two (Morgan, 1995: 116-117).

The results of uncontrolled population growth is only too evident: mounting unemployment, spreading slums and squatter camps, lack of access to education, poor health care, impaired water services and sanitation, and lack of family planning services. Poverty therefore deepens and more people are pushed to the edge of survival and this raises the need for increased development (Lean & Hinrichsen, 1992: 17-20; Morgan, 1995: 116-117).

Even though China is using incentives and strict legislation to reduce its birth rate, its still growing population has an enormous environmental impact. As a result of overpopulation most of its water, air and land are seriously polluted. Soil erosion as a result of this population explosion is causing serious environmental degradation (Miller, 1996: 246-247).

Development (also see 3.4.3) poses one of the greatest risks to biodiversity and proactive measures must be used to anticipate its impact on the environment (Hohmann, 1992a:92). Although development is the direct threat to biodiversity one should realise that this process is driven by population growth (Swanson and Johnston, 1999: 53).

With increasing population growth comes pressure on natural resources and biodiversity. All anthropocentric developments are indirectly driven by the need for food, shelter, transport, recreation, and medicines. The loss of biodiversity by development may eventually be responsible for a human population crash in the future. Population growth is successfully controlled in China. It is therefore wise to regulate population growth for the sake of mankind and biodiversity (Cunningham & Saigo, 1997:148,149; Miller, 1992:196, 218).

The role of women is very crucial in regulating the population of the world and education seems to be the most important aspect. Literate women with secondary school education are much more likely to take advantage of family planning and maternal and child health care facilities than illiterate women with little or no education. Poorly educated women in Brazil, for instance, have on average six children and those with secondary education only two. Between 1960 and 1985, Costa Rica achieved a 53% decline, and 70% of its women use

contraceptives despite little effort to spread family planning. The reason seems to be that it has a good record in promoting health and education and tackling poverty (Lean & Hinrichsen, 1992: 17-20).

Population growth control is a sensitive issue and should be approached with caution. However, it may prove beneficial if governments could create incentives to encourage people to have smaller families (Miller, 1996: 239-246, 588).

3.4.2.2 Impact of mortality

The projections indicate that the HIV/AIDS exponential growth rate is almost doubling every year and there is under reporting due to the reluctance of individuals to report the full extent of the disease. Generally the pandemic is a big threat to public health because there is no cure or vaccine and infection almost invariably lead to death. The median incubation period may be as long as ten years. It is believed that 25% of all South Africans are infected with this virus and the number of infected persons seems to double every 14 months (Hugo, 2004: 97).

In South Africa one can expect mortality to rise significantly due to the high HIV/AIDS infection rate (Dorrington *et al.*, 2003). This does not only pose a social problem, but also an environmental one. Municipal areas are already running out of space, and new burial sites pose a threat to the environment and biodiversity (Environ, 2003).

3.4.3 Development

3.4.3.1 Urbanisation and the environment

The earth is witnessing an urban revolution, as people worldwide are moving into towns and cities. In 1800 only some 50 million people lived in urban areas, and by 1985 this number had risen to 2 billion which presents an increase from 5% to 45% in just under 200 years. It is estimated that by the year 2010 more people will live in towns and cities than in the countryside (Lean & Hinrichsen, 1992: 21).

The urban revolution is mainly taking part in the Third World where it is the hardest to accommodate it. It took London 130 years to go from 1 million to 8 million, whereas Mexico City zoomed from 1 million to 20 million in less than 50 years. Between 1950 and 1985 the number of city dwellers has grown more than twice as fast in the Third World as in industrialised countries. During this period the urban population in the developed world increased from 477 million to 838 million, less than double but it quadrupled in the developing counties from 286 million to 1.14 billion (Lean & Hinrichsen, 1992: 21-24).

In the Third World, towns and cities are increasing by an average of 3.6% per year, and every year they must absorb 80 million more people. Transport,

communication, health and sanitation systems are likely to break down as these mega-cities grow. Alexandria's sewage system built for a million people now struggles to carry the waste of 4 million people. About a third of the people in the Third World's cities now live in desperately overcrowded slums and squatter settlements. Many are unemployed, uneducated, undernourished and chronically sick. In Bombay and Rio de Janeiro, over 3 million people are squeezed into slums and shanty towns, while 60% of the entire population of Bogota and Kinshasa and almost 80% of the people of Addis Ababa live in slums. These areas have a negative impact on the environment and biological resources (Lean & Hinrichsen, 1992: 21-24; Miller, 1996: 251-261).

Development will always cause some kind of degradation to the environment and the amount of development that must be limited for the sake of environmental conservation will always be a controversial issue. One such example is the Maluthi giellemientjie (*Pseudo-barbus quathlambae*) that is threatened by the R 4 billion Lesotho Highland Water Scheme (Hugo, 2004: 166-167).

The main reason plants and animals become extinct are as result of the direct destruction of habitats. The Western Cape Nature Conservation Board is concerned at the large-scale developments like holiday resorts, golf courses, golf estates and polo estates taking place along the southern Cape coast and has called for urgent political intervention at the highest level. Golf courses and golf estates take up large areas of land and mostly lead to significant habitat loss and fragmentation Fynbos needs fire for optimal regeneration and seedling recruitment (also see 3.4.6 for comprehensive discussion on the role of fire on biodiversity). When fynbos vegetation becomes fragmented by developments such as houses, buildings and various kinds of infrastructure, it becomes almost impossible to burn the fynbos patches under optimal conditions, because houses or infrastructure could be destroyed (Independent Online, 2004).

The fact that most of the Cape renosterveld has been used for agriculture has led to the near extinction of the geometric tortoise (*Psammobates geometricus*). The Strand municipality has recently created a special nature reserve consisting of renosterbos (*Elytropappus rhinocerotis*) to provide a habitat for the tortoise (Hugo, 2004: 166-167).

Various plant species have already been saved from extinction by cultivation in botanical gardens and includes species such as *Protea aristata* which was grown from seed for the first time in 1969 in Kirstenbosch. This plant is now cultivated in gardens and elsewhere, and even though it is extremely rare in its natural habitat it cannot be considered as endangered. Even though many species can be saved by *ex situ* conservation measures, it still does not provide a sustainable solution, because the interaction of various plants and animals in a habitat can be very specific. Certain insect species may be responsible for the fertilisation of certain plants, such as orchids (Hugo, 2004: 166-167).

The endangered Cape vulture needs carcasses that have been killed by wild animals and predators. These animals fragment the bones into pieces that can be swallowed by the vultures. Bones are needed for calcium that ensures strong bones and wings. As a result of the killing of wild animals and predators these animals are no longer around to fragment the carcasses. This has resulted in wing fractures in vultures that have resulted in the decrease in their numbers (Hugo, 2004: 166-167).

The loss of one species may therefore result in the loss of other species that are dependent on them for their survival. Some species are so specific in their requirements that they cannot be kept in cultivation. Too much emphasis is therefore placed on the conservation of individual species, without emphasis on the conservation and protection of entire ecosystems and habitats. Over the last 350 years, South Africa has lost 46% dry forests, 62% grasslands, 50% mangroves and 90% renosterveld (Hugo, 2004: 166-167).

3.4.3.2 Measures to regulate the negative impact of development

Many cities can be improved by designing them in harmony with the environment. Curitiba in Brazil is one of the world's eco-cities with a population of almost 2 million. The city officials have given neighbourhoods over 1.5 million trees to plant. No tree may be cut down in the city without a permit, and for every tree that is cut down, 2 must be planted. Many streets in the city centre have been designed only to be used by pedestrians and no cars are allowed. Almost 70% of the cities residents commute on a daily basis by busses, and only high rise buildings that consist mainly of stores are allowed on the bus roots to ensure that space are used effectively. The city recycles up to 70% of its wastes and it is considered to be a world leader (Miller, 1996: 270).

Development (see chapters 4 and 6) physically destroys large parts of natural vegetation that sustains biodiversity (Kain, 1981:106; Hohmann, 1992a:85). The establishment of limited development areas should take biodiversity hotspots into consideration, since these areas may be more sensitive to the loss of species than other areas. Development and environmental management should be integrated to ensure environmental liability and mitigation. The establishment of green belts in cities will help to preserve indigenous vegetation and biodiversity (Hodge and Gilson, 2003; Miller, 1996: 269).

Strategic environmental impact assessment should be used to guide the compilation of development plans. A permit system should be used to regulate activities in limited development and controlled areas (DBP, 2000). In these areas there should be equality towards all groups of the population, and no person should be exempted from any directives. Lower socio economic income groups are often responsible for higher degradation of the environment with overgrazing, deforestation, and erosion being common. This is evident in third world countries such Africa and South America (St Andrew's University, 2000).

Environmental degradation is becoming a problem where unregulated practises are not managed. Domestic activities on farms should be monitored, due to their detrimental impact on the environment. These unregulated domestic activities may prove more detrimental than regulated urban settlements (Scherr, 1999; Caldwell, 1999:182).

Environmental impact assessment (see chapter 4) should be used for various anthropocentric development activities in general. All activities that could have a detrimental impact on the environment should be subjected to environmental impact assessment (Tait *et al.*, 1988:14; Hohmann, 1992a:67). Biodiversity overview is a useful procedure that can be used to assess the credibility of the environmental impact assessment report (Brooke, 1998).

Environmental impact assessment (including scoping) should be submitted to an independent authority that does not have a stake in the benefits of the particular activity. An authority cannot formulate an unbiased opinion when it receives benefit from such activity. Environmental impact assessment should be an independent process executed by a competent impact assessor. This impact assessor should have an adequate academic background, and any person not having the minimum qualifications should not undertake environmental impact assessment (Wathern, 1988:143-158). The list of activities (see chapter 4, 4.4.2) that are subjected to environmental impact assessment should be comprehensive and represent significant activities, as well as those that are particularly relevant to South Africa (South Africa, 2002a:1-2).

The following activities should be subjected to environmental impact assessment: Substantial changes in land use, new land development, forestry, rural development projects, commercial water use, construction of dams or impoundments, drainage projects, all major infrastructures, construction of roads, all industrial plants, power plants, mining, waste management, sewage treatment plants, facilities involving explosives, nuclear installation, holiday resorts, cultivation of declared alien species, release of genetically altered organisms, biological pest control, concentration of livestock, atmospheric pollution processes, harbours, cableways, communication structures, racing tracks, facilities involved with hazardous substances, construction of channels (Wathern, 1988:275; UNECE, 2001; Canada, 2003; Hohmann, 1992a:354, 403).

3.4.3.3 Mining

Mining waste is extensive in South Africa. The diversity of wastes that originate from mining operations is more limited than that of municipal and industrial sources, but the volume is usually greater. Mining wastes are concentrated in the area where production takes place. It may consist of mine dumps such as in the case of gold mining, or as material that covers the ore bearing layers that must first be removed. In the case of open cast mining, one ton of copper ore may yield as much as one ton waste. Gold mining may yield up to 200 000 tons of

waste for every ton of gold that is produced. Mining waste is usually not combustible except in the case of low grade coal (Hugo, 2004: 166-167).

Gold mining is responsible for the pollution of water that emanates from slimes dams and other mine workings. The result is often water that is extremely acidic as a result of the chemical reaction of water, oxygen and iron pyrite. Water may also contain cyanide substances that may be difficult to neutralise. Contaminated water has already caused the destruction of aquatic ecosystems in the Vaal River and its tributaries. Coal mining has also resulted in the pollution of water by various salts and acid. Sulphur dioxide that emanate from coal dumps also increases the amount of air pollution locally and the increase of acid rain (Ridl, 1990: 77-80).

Mining is also responsible for the removal of vegetation that results in the loss of habitat for numerous species. This has an ultimate detrimental impact on the functioning of various ecosystems (Ridl, 1990: 77-80).

Before any mining activity is undertaken an independent authority that does not have a stake in the mining activity should grant authorisation. Environmental impact assessment should be undertaken to determine the expected impact the activity may have on the environment (Hannan, 2002:7-10).

A management plan must be compiled wherein provision is made for rehabilitation of the post-mining environment. Rehabilitation should be undertaken to the satisfaction of an independent authority. This management plan should be a prerequisite before authorisation of any mining or prospecting activity is undertaken. Provision should also be made to ensure that financial provision is made to implement rehabilitation plans (Hannan, 2002:7-10).

Closure of marginal mines should not be postponed unnecessarily, and should be enforced as soon as a mine becomes marginal. It may be beneficial to introduce measures to implement this process as soon as possible, without any unreasonable compromises to the social, political and economic frameworks. Rehabilitation cannot be implemented if a mine continues to operate marginally. This is especially relevant in the case where mining takes place on the surface (copper mines, granite mining etc.). This will further postpone rehabilitation and hence influence negatively on the environment and biodiversity (Hannan, 2002:7-10).

3.4.4 Land and aquatic pollution control

3.4.4.1 Pollution of aquatic resources

Everywhere, it seems surface waters are being polluted at an increasing rate by various municipal, industrial and agricultural wastes. Even in industrialised countries where stringent environmental legislation and policies have been

implemented, the problem is ever increasing. The world is currently producing about 2300 cubic kilometres of wastewater a year (Lean & Hinrichsen, 1992: 61).

The industrialised OECD countries have had some success with the controlling of pollution at point sources, but diffuse pollution is still creating a big problem. Only about 60% of the total population of the 21 OECD countries have effective sewage treatment plants. The coverage ranges from nearly 100% in Sweden and Denmark to less than 1% in Turkey, 11% in Portugal and 39% in Japan (Morgan, 1995: 134).

The Rhine is one of the most polluted rivers in the world, but as a result of improved domestic and industrial water treatment processes levels of pollution are slowly decreasing. Today fish are returning to parts of the river, after being absent for many decades due to the high levels of organic and inorganic pollutants in the river. The Rhine is however still a very polluted river and mainly as a result of the presence of salts that are being washed into it from mining and agricultural activities. It has also suffered greatly from the spills of chemicals in the past that has impacted negatively on the ecology of the river (Lean & Hinrichsen, 1992: 61; Morgan, 1995: 134-135).

Water quality is also being degraded, and the river Vistula in Poland is a good example, since it is so polluted with industrial and municipal wastes that its water is unusable, even for industrial applications along its 1068 kilometre length. The industrialised countries have dumped billions of tons of pollutants into their rivers, estuaries, coastal waters and aquifers (Lean & Hinrichsen, 1992: 57).

In China 41 large cities use polluted groundwater. Research has indicated that 24 000 wells out of 124 000 samples in the USA are contaminated with nitrates from chemical fertilisers from farmlands (Lean & Hinrichsen, 1992: 57).

In North America there has been some improvement in the past few years, due to more stringent control on industrial polluters, and oxygen levels in rivers and streams have improved considerably. Lakes are becoming eutrophic due to the effect of build up of fertilizers and animal wastes. Since the 1950s, concentrations of phosphates and nitrates in freshwater rivers and lakes throughout Europe and North America have increased significantly. Nutrients from fertilizers and animal wastes were found to be the main pollutant of nearly 60% of all polluted lakes surveyed in the USA and various lakes in Europe (Lean & Hinrichsen, 1992: 61-65).

India's rivers are little more than open sewers that carry industrial and domestic pollutants from the land to the sea. About 70% of the country's water resources are polluted and only 217 of the 3119 cities have complete sewage treatment systems. The Ganges is a sacred river to the Hindus and one of the most celebrated rivers in the world, but almost 600 of its 2525 kilometres are dangerously polluted with human and animal wastes. Only 12 of its 132 industrial

plants that pump water directly into the river have adequate treatment plants in working order. Many of the cities like Varanasi have no sewage treatment plants at all. The Government of India has allocated \$195 million to a 5 year cleanup programme. This is an effort to bring the biodiversity in the river back to live by upgrading and building sewage treatment plants. The unsound use of pesticide and fertilisers will also be addressed by this programme (Lean & Hinrichsen, 1992: 65).

3.4.4.2 Types of wastes

A broad spectrum of wastes is produced in South Africa and is detrimental to biodiversity. These wastes react chemically in the environment and disposal of various types of wastes should be executed in the relevant manner. Different disposal procedures and control measures should therefore apply to each category (Lombard, 1990: 75).

The following substances may be problematic: colorants, fixed particles, oil, grease, organic substances, pesticides, trace metals, cyanide, chemical residues, acids, alkalis, nitrogen, phosphorus, detergents, pathogens, salts and radioactive substances (Hugo, 2004: 140-141).

These diffuse sources include the following: agricultural fertilisers and pesticides, heavy metals, oils, hydrocarbons, garbage, chemicals from road de-icing, organic wastes from animals and dust. These sources are difficult to regulate and are creating problems. In the urban environment, street surfaces are also a collection area for emission products such as zinc, cadmium, asbestos, copper, oil and hydrocarbons (Lean & Hinrichsen, 1992: 61-65; Simpson, 1990: 25-26).

One of the major sources of pollutants is leaks from underground storage tanks that contain substances such as petrol and other chemicals. Seepage from landfill sites is an increasing problem that is often difficult to firstly identify, and secondly to regulate (Rawlins, 1990: 20).

The result of such pollution is massive destruction of aquatic biodiversity. The combination of nitrates and pesticides for example creates a potent carcinogenic mixture that is detrimental to numerous animals and people. The urban run-off of water from the streets of Florida has accounted to more than 85% of all heavy metals that are now found in its adjacent rivers and swamps. It is often seen that even though stringent measures are in place to regulate pollution, economic growth and industrial protection are still prioritised (Lean & Hinrichsen, 1992: 61-65).

Sewage releases large quantities of organic material that is used by bacteria during aerobic decomposition thereof. Large amounts of carbon dioxide are released while oxygen supplies are exhausted. Ammonia and hydrogen sulphide together with large quantities of nitrates and phosphates are released. In severe

cases of sewage pollution in rivers, most aquatic plant and animal life is killed. The release of phosphates and nitrates may be responsible for algal blooms which further comprises aquatic biodiversity (Hugo, 2004: 179-181).

Industrial wastes may prove even more detrimental and may contain toxic organic and inorganic substances. Heavy metals may accumulate in the food chain and be responsible for the death of animals and plants. Some forms of organic substances are extremely persistent and include pesticides such as DDT and BHC. Cyanide is often used in various industrial processes and is extremely toxic to plants and animals. Fish are usually the first organisms that are negatively affected by this organic substance (Hugo, 2004: 182).

Thermal pollution in aquatic riparian systems is often overlooked, but may be detrimental to various forms of aquatic biodiversity (Marini-Betòllo, 1989:248). Thermal pollution is the addition of hot water to a natural body of water. This hot water is usually derived from cooling installations, particularly in the case of nuclear power plants. Certain species that are less tolerant of temperature variations may be negatively influenced by such temperature variations. The amount of dissolved oxygen is also reduced when the water is heated. Thermal pollution may be reduced by using and wasting less energy, limiting the released amount of heated water, discharging water away from ecological sensitive areas, use of cooling towers to cool water and use of buffer zones such as ponds for initial cooling of heated water (Hugo, 2004: 183; Miller, 1996: 488).

3.4.4.3 General solid wastes and litter (non-hazardous)

One of the most serious problems facing municipalities and other authorities is the disposal of solid wastes. Rapidly growing quantities of garbage from cities pose threats to the environment. In developing countries less than 10% of urban wastes are treated and only a small proportion of such treatment meets acceptable standards. Unsustainable consumption, particularly in industrialized countries is increasing the amount and varieties of waste and quantities could increase five fold by the year 2025 (Hugo, 2004: 185-186).

The best way to cope with wastes is through a waste prevention approach that is focused on changes in lifestyles and in production and consumption patterns. Three types of waste can be recognised. *Biodegradable wastes* such as kitchen refuse that may take a few months to naturally break down. *Combustible wastes* such as plastic, rubber and artificial fibres. When these materials are exposed to the ultraviolet rays of the sun, they take 10 to 30 years to breakdown. However, when they are buried such as in the case of municipal rubbish dumps their lifetime is practically infinite. Paper and other biodegradable wastes decompose extremely slow under anaerobic conditions without oxygen newspapers dug up after 40 years still prove readable and even food may be fully intact after 10 years. *Non combustible wastes* include metal objects, building rubble and mining wastes. These break down by oxidation processes and mechanical weathering.

Aluminium tins may take 100 years to break down, while building rubble and mining wastes may take thousands of years (Hugo, 2004: 185-186; Miller, 1996: 542-543, 546).

Approximately 95% of all waste in South Africa is dumped on land and 1.3 million tons of packaging material and container waste are discarded annually. These include: glass (270 000 tons), plastic (190 000 tons), tin plate (150 000 tons) and paper (650 000 tons). Approximately 200 000 tons of litter are strewn annually in South Africa, and clearing this costs more than R 100 million per year. Only 30% of wastes are recycled in South Africa in comparison with 50% in Germany and Japan (Hugo, 2004: 186).

South African homes generate 350 000 tons of waste paper every year of which only 9% is recovered for recycling. There are no real incentives to encourage waste producers to adopt cleaner production processes and to minimize waste generation. Each ton of waste paper that is recycled saves 17 pine trees and 3 cubic metres of landfill space. It also results in less air, water and terrestrial pollution that are the end product in the paper manufacturing process. Taiwan recycles up to 98% of wastepaper, Denmark 97% and the United Kingdom 60% (Hugo, 2004: 261; Miller, 1996: 542).

There is a widespread belief that plastic pollution is more detrimental to the environment than paper pollutants. When all the facts are taken into account, plastic may actually be substantially less destructive to the environment than paper. Research has indicated that almost 2.5 times more energy is required to produce paper than the same mass of plastic. Between 50% and 500% more air pollutants such as sulphur dioxide, nitrogen oxide, hydrocarbons, carbon monoxide, dust and waste is produced during the manufacturing of paper. Paper is also not necessarily more biodegradable than plastic and when buried it may remain in tact for many years. Demand for paper also increases the need for exotic plantations that destroy the habitat of biodiversity and impact negatively on the mountain catchment areas, and ultimately hydrological integrity (Hugo, 2004: 189-191).

3.4.4.4 Regulation

Accumulation of wastes (see chapter 9, 9.5 – 9.7) and toxic substances on land and in aquatic water sources on land, pose a threat to terrestrial, aquatic, and eventually marine biodiversity (Hohmann, 1992b:907). Measures should be implemented to ensure adequate disposal of wastes, and the management thereof. Classification of wastes according to their characteristics is necessary to ensure sound disposal of more hazardous substances (Stein, 1997:252).

Solutions for the increasing waste problem include:

- The production of less waste that means that unnecessary packaging materials must be reduced or eliminated;
- The recycling of materials such as plastic, glass, metals and rubber;
- Combustion of certain wastes to produce electricity instead of using coal and other sources;
- Composting of organic material to produce compost as soil conditioner and fertilizer, and even the production of biogas as a by product of such degradation; and
- Manufacturing processes should be redesigned in such a manner to eliminate the use of harmful chemicals. Better construction of products will ensure that they are reusable (Hugo, 2004: 189-191; Miller, 1996: 529-531, 537).

The following economical and political strategies have been suggested: taxing the use of virgin resources, eliminating taxes on recycled products, subsidies for waste recycling initiatives, direct paying by consumers for types of wastes that are collected, encouraging Government purchase of recycled products to increase demand and lower prices, the use of landfills only as a last option for products that can not be reused, recycled, incinerated or composted and the requirement of eco-labels on all products to indicate environmental sustainability (Miller, 1996: 541).

Compulsory use of environmentally degradable products, packing materials, or any other object should be implemented. This will enhance their natural decomposition and ensure they don't accumulate in the environment and pose a threat to living resources (Narayan and Pettigrew, 1999). Together with this the use of unnecessary plastic or paper packaging materials should be minimised (Miller, 1992: 538,539).

Waste sites should be monitored regularly to ensure that these areas do not pose a threat to the environment (Cunningham & Saigo, 1997:565). The following methods may prove beneficial in the management of landfills: the monitoring of aquifers near landfills to ensure that no leaking is taking place, the installation of leak detection systems for the storing of hazardous substances, banning of disposal of hazardous wastes in deep injection wells and storing of hazardous substances above ground to ensure detection of leakages (Miller, 1996: 494-495).

Fines for littering is extremely high in Singapore and even littering any area with something as small as a cigarette bud may result in a big fine. These strict measures have resulted in almost no littering in public areas. Littering should also not only be prohibited in public areas, but also in private areas such as smallholdings and farms (Hugo, 2004: 186).

3.4.4.5 Hazardous substances

Hazardous waste is an inorganic or organic element or compound that, because of toxicological, physical, chemical or persistency properties, may exercise detrimental acute or chronic impacts on human health or the environment.

3.4.4.6 Nuclear wastes

Scientists activated the first nuclear reactor at the University of Chicago in 1942 and were able to produce the first self sustaining nuclear reaction showing that humanity would be able to harness atomic energy (Lean & Hinrichsen, 1992: 120).

The first nuclear power plant was opened in 1956 at Cumbria in the Northwest of England. By the end of 1990s there were 420 commercial nuclear power plants in 25 countries that produced 17% of the world's power. They dominated the power supply in a few countries such as France, Belgium, and almost 50% in South Korea, Sweden and Hungary (Lean & Hinrichsen, 1992: 120).

Nuclear wastes pose a far greater threat to the environment than most regular domestic and industrial wastes. These substances are mutagenic and induce mutations and lethal carcinogenic growths in living organisms. In case of an accidental leak or explosion, these materials may persist in the environment for thousands of years. Mutagenic substances can alter genetic biodiversity at all levels. Nuclear material may destroy large numbers of biodiversity, if not strictly regulated (Miller, 1996: 390).

Nuclear power produces intense radioactive wastes that may persist in the environment for thousands of years. No country in the world has yet determined how to dispose of the most dangerous waste, 10% by volume but 99% containing radioactive levels. At present it is being stored and cooled while industries are working out what to do with it. France, Germany and the USA are the most optimistic countries and hope to begin with disposal programs by the year 2010. Meanwhile most countries find it hard to deal with even less virulent wastes and the UK had to abandon many proposals and still has not yet evolved a publicly acceptable strategy for its disposal (Lean & Hinrichsen, 1992: 122; Morgan, 1995: 90-91; Miller, 1996: 388-389).

On April 26, 1986, operators at the Chernobyl plant thought to be one of the best managed plants in the USSR made a mistake when carrying out a test on one of its reactors. In an attempt to correct it, they deliberately overrode a series of safety systems designed to prevent an accident. The reactor's power surged several hundred fold in a second and two huge explosions blasted the 1000 ton lid of the reactor and lit a fire that blazed for 10 days. In the process huge quantities of radioactive materials were released into the environment. It is estimated that at least 6000 people may have already died as a result of the

accident and this could eventually reach 40 000 in time to come. Wildlife was also severely affected as result of the radioactive materials that accumulated in the environment and the food chain (Lean & Hinrichsen, 1992: 122).

South Africa has reasonable large uranium resources that are mainly connected with the gold mining industry. It only has one nuclear plant with an output of 1800 MW situated at Koeberg. The nuclear waste from the nuclear reactor is stored underground at Vaalputs in the Northern Cape in an area that is sparsely populated, has a dry climate and is geologically stable (Hugo, 2004: 140-141).

The South African Government has approved of a pebble bed modular reactor to be erected at a cost of R 2.5 billion. Although this is extremely expensive it seems to be necessary to provide in the growing energy needs. South Africa has no other option but to rely on the use of more nuclear energy in the future, since the existing pollution from fossil fuels can not be tolerated indefinitely. With the necessary precautions nuclear energy could be used to a large extent to supply in the energy needs of the country (Hugo, 2004: 140-141).

3.4.4.7 Heavy metals and persistent organic compounds

In Europe, North America and beyond, hazardous waste dumps have displaced communities, fouled air, poisoned surface and ground water, contaminated soils, and adversely affected the environment. The USA generates roughly 240 million tons of hazardous waste every year, and 70% of this originates from the chemical industry. The worldwide total is hard to estimate but the OECD estimates it to be 338 million tons. Many products and chemical compounds have not been tested for their potential effects on the environment and it is a daunting task. There are over 70 000 chemicals in trade each year, and almost a thousand are added to this number annually. Half are classified as hazardous or potentially hazardous, but unfortunately little information is available. The United States National Academy of Sciences sampled 100 chemicals at random and ran computer tests on them to determine if any toxicological data were available. They found only 10% of all pesticides were analyzed, 2% of cosmetic ingredients, 18% of drugs and 5% of food additives. For years most hazardous wastes were dumped in landfills, ponds, buried, left at roads and pumped into rivers and the sea (Lean & Hinrichsen, 1992: 101-103).

In the Netherlands about 4000 waste sites have been identified and at least 1000 of them need immediate clean up as they pose an imminent threat to the environment. Before reunification West Germany had to clean up at least 15 000 of its abandoned waste sites. The total cost could add up to \$30 billion and it could take up to 20 years to complete this task. French authorities have identified 450 abandoned waste dumps of which 80 need immediate clean up. A 1990 study by Friends of the Earth disclosed various areas that were posing a serious risk to the environment, but little was done. Poland generates roughly 30 million tons of hazardous waste each year, and 66% of this is dumped in unregulated

sites. The USA holds the record for abandoned hazardous waste dumps and it is estimated that 10 000 sites need immediate attention, and cleaning them up could cost around \$100 billion and take up to 50 years to complete (Lean & Hinrichsen, 1992: 101).

The amount of waste shipped from Western to Eastern Europe is estimated to be between 200 000 and 300 000 tons a year. Most countries still put most of their toxic wastes into holes in the ground. The UK relies on mixing hazardous wastes with domestic rubbish in hundreds of landfill sites with varying degrees of concentrations. However, this is believed to be a time bomb that has yet to explode (Miller, 1996: 544).

Denmark has one of the most sophisticated systems for the disposal of hazardous wastes. All industrial wastes are collected and sent to Kommunekemi plant in Nyborg where substances are sorted according to their hazardous potential. Non toxic substances are buried and hazardous wastes are incinerated or turned into non toxic substances. The energy that is released during the incineration process is used to provide central heating in the town. Similar systems are used in Bavaria, Sweden, Finland and South Korea (Lean & Hinrichsen, 1992: 101-104; Miller, 1996: 544-555).

The Minimata Bay disaster in Japan where over 400 people died after eating fish poisoned with mercury that originated from a local factory was the first report of the impact improper discharge of hazardous waste could have (Lean & Hinrichsen, 1992: 101-103; Miller, 1996: 546, 550).

Rich nations often try to dump their hazardous substances in Third World countries where legislation is usually less strict or even non existent. In 1987 and 1988, five shiploads of Italian toxic waste were dumped in Koko, a little Nigerian port. Ten thousand barrels of assorted poisons were piled in the yard of an unsuspecting farmer and later began leaking. Eventually after Nigeria seized two other Italian ships the Italian Government took away the wastes. It also tried unsuccessfully to export them to the UK but without any success and had to take them back to Italy. But some northern firms still try to dump toxic wastes in the Third World. By the late 1980s some 100 000 shipments, totalling over 2 million tons of hazardous waste were being transported across national frontiers into Western Europe (Miller, 1996: 544-555).

3.4.4.8 The threat to biodiversity

Hazardous substances include organic and inorganic substances. Organic substances are relatively safer than inorganic substances due to their ability to be ecologically degraded. Certain organic substances such as DDT are extremely recalcitrant, even to microbial degradation. They are also oil soluble and biomagnified repeatedly in the food chain, and may therefore persist in the environment for many years. DDT and numerous other stable organic

compounds are mutagenic and induce carcinogenic growths in amphibians (Dasman, 1972:162; McDonald & Kay, 1988:156; NPWRC, 2002).

Environmental mutagens, such as polycyclic aromatic hydrocarbons and heterocyclic amines are known to bind to nucleotides and result in the formation of DNA adducts. Some DNA adducts are fixed as mutations through replication of DNA. Reactive oxygen substances that may be generated by pollutants also induce the formation of DNA adducts (Sato and Aoki, 2003).

Some classes include: polycyclic aromatic hydrocarbons; aromatic amines; aminoazo compounds; n-nitroso compounds; alkylating agents; aliphatic halogenated hydrocarbons; inorganic metals and minerals; and some naturally occurring substances (EHS, 2002).

The following classes of substances require priority consideration: arsenic, mercury, cadmium, thallium, beryllium, chromium, lead, antimony, phenolic compounds, cyanide, organohallogenated compounds, chlorinated solvents, organic solvents, biocides, tar residues, pharmaceutical products, peroxides, chlorates, azides, ethers, chemical laboratory materials, asbestos, selenium, tellurium, metal carbonyls, polycyclic aromatic hydrocarbons, soluble copper compounds, certain acids, certain basis and organochlorines (Lean & Hinrichsen, 1992: 102).

3.4.4.9 Regulation

Hazardous wastes (see chapter 6, 6.2.15 and chapter 9, 9.6) need to be strictly regulated to ensure that these substances are not released into the environment. The possible impact of hazardous substances needs to be assessed before permission is granted for their use (Marini-Betòllo, 1989:568; Hohmann, 1992a:73).

Inorganic substances are generally less environmentally friendly, and many metals will remain in the environment for thousands of years. Metals can be incorporated into the structure of organic substances, and after degradation the metal ion will be released once again (Marini-Betòllo, 1989:247). Heavy metals such as lead/mercury/uranium may systematically intoxicate many terrestrial and aquatic species (Miller, 1992:556-570).

The only problem with incineration of certain substances (such as batteries) is that the ash may contain toxic heavy metals such as cadmium, lead, mercury, arsenic, beryllium, zinc and copper which may contribute to air, water and eventually marine pollution (Miller, 1996: 544-555).

One of the best solutions to hazardous wastes is still to prevent or reduce the production thereof or to recycle such wastes. Japan recycles more than 50% of its hazardous wastes (Lean & Hinrichsen, 1992: 104).

3.4.5 Hydrological cycle integrity

3.4.5.1 The scope of water resources

The study of freshwater ecosystems is known as limnology and can be divided into two groups. Lentic communities include large stagnant bodies of water such as dams, lakes and wetlands, whereas lotic communities include running water such as rivers. There is no sharp division between the two but rather a gradual transition (Hugo, 2004: 24).

Although 70% of the earth's surface is covered by water, less than 3% of the water is fresh and more than three quarters of that is frozen mainly at the poles. The remaining fresh water lies underground and only 0.001% of all the water on earth is available to terrestrial life that includes people. More than 123 000 cubic metres of freshwater fall on land each year as rain and snow which is enough to flood all the continents 80 centimetres deep, and therefore in theory more than enough to meet foreseeable needs (Lean & Hinrichsen, 1992).

Most of Africa and the Middle East, the western part of the USA, parts of Mexico, Chile, Argentina and most of Australia suffer severe water shortages. Opposed to this, a country like Iceland gets enough rain and snow to provide every person with 674 600 cubic metres of freshwater every year. About 2 billion people in 80 countries around the world live in areas with chronic water shortages and as human and animal populations grow the crisis will get worse. Changes in the in global climate as a result of the greenhouse effect are likely to cause great disruption in the rainfall patterns as the earth heats up. It is predicted that the entire part of the western USA will have to cut its current water use by up to 70% in the near future (Lean & Hinrichsen, 1992: 57; Miller, 1996: 453-456).

Groundwater is also unequally distributed and only relative small quantities can be commercially used. The Ogallala aquifer which lies under 8 of the states of the Great Plains in the USA, is being so depleted that the water tables are falling by up to a metre a year. A quarter of all of the USA irrigated cropland is only kept watered at the cost of depleting groundwater supplies and some areas have already been abandoned. The same is happening to Bangkok, where the water table has plunged 25 metres since the late 1950s, and in China 50 cities are threatened by shortages as the water table beneath Beijing is sinking by up to 2 metres a year. A third of its wells are thought to be waterless (Lean & Hinrichsen, 1992: 57; Miller, 1996:455).

3.4.5.2 Use of water

Only about 5% of worldwide consumption of water is used for domestic purposes, while 75% is used for irrigation and the remaining 20% for industrial and mining purposes. In developed countries as a whole, 40% of the water is consumed for industrial purposes and in the eastern parts of Europe as much as

80% is used in factories and power plants. In India for example 93% of all water is used for irrigation of crops (Miller, 1996: 458; Lean & Hinrichsen, 1992: 60).

3.4.5.3 South Africa and water shortage

South Africa is considered to be a dry country as more than 60% of the country has a rainfall of less than 750 mm per annum. Water is a serious limiting factor in the future economic development of our country. South Africa also has management problems regarding our water resources especially in our catchment areas (Weaver, 1990: 13).

South Africa is currently utilizing 50% of all available water resources and by the year 2010 it is estimated that this figure will increase to 67%. Gauteng is already using far more water than what is available in the area. There are three main consumers of water in South Africa and these are agriculture, industries and domestic. Almost 67% of water in South Africa is used for irrigation purposes. Certain crops need more water than others, such as maize in comparison with sugar cane. If irrigation takes place in drier climates such as the Northern Cape even more water will be needed to compensate for the water loss during evaporation. Salination of soil may also become a problem in drier areas that are heavily irrigated (Hugo, 2004: 152-153).

Erosion problems are persistent in many catchment areas and have resulted in the rapid runoff, and many rivers that used to be perennial are now filled with silt and sand. The result is that the biodiversity in these rivers have greatly diminished. The problem is more severe in certain areas such as the former Transkei where a hydroelectric facility in the Mbashe River was filled with sediment in its first year after completion. Many rivers like the Levubu, Great Letaba, Olifants, and Crocodile have changed from perennial streams to intermittent streams. The reasons for this include increased abstraction for agricultural activities, siltation as a result of overgrazing, and increased forestation with alien pine plantations (Hugo, 2004: 151-152).

3.4.5.4 Need for regulation

Charging realistic prices for water would encourage the conservation and effective use of this resource. Water is usually heavily subsidised particularly for irrigation purposes and farmers usually pay 10% of their costs back to the relevant authority. In California farmers have paid back only 5% of their costs over the past 40 years, and unfortunately this has led to the irrigation of inappropriate crops with 30% of all the water used. The wiser use of water resources and a proper pricing strategy is needed to deal with the water crisis which will become an increasing global problem (Lean & Hinrichsen, 1992: 60).

Hydrological cycle (see chapter 6, 6.2.2) integrity is important for the conservation of aquatic taxa, and also to sustain terrestrial biodiversity in times of

drought. The hydrological integrity may be quantitatively and qualitatively compromised by various anthropocentric developments. Pollution arising from terrestrial and atmospheric resources may alter the quality of the water source and make it inhospitable for the survival of aquatic biodiversity (as discussed earlier) (Wilber, 1969:3).

Activities that reduce or stop stream flow may be responsible for the death of various aquatic and terrestrial species. The impact of stream reduction activities may be even more severe in times of periodic drought. It is therefore important to ensure measures are taken to conserve water and prevent all forms of pollution, and to mitigate cases of pollution. Commercial water use and domestic water use in rural areas and farms should be monitored to ensure sustainable use. Water quality monitoring should be undertaken on as many as possible water resources at different intervals. Measures to prevent mitigate, and monitor desertification should be implemented to sustain hydrological integrity (Robinson, 1993:184-210).

3.4.5.5 Importance of mountain catchment areas

The world's mountain ranges are amongst the most critical areas in the world and are being devastated by continuous assault from human activities. In tropical developing countries alone, an area that comprises 160 million hectares of upland watersheds have been seriously degraded in the past 30 years. At least 2 billion people depend on the stability of these uplands. When these areas are healthy they perform an important role in the regulation of water supplies by absorbing rain and releasing them to percolate into groundwater that flow down rivers. They therefore help to regulate the climate and the aquatic habitat that provides a habitat for various kinds of biodiversity that is found nowhere else. Vegetation cover such as indigenous trees also helps to bind the soil and prevent erosion and ultimately desertification (Lean & Hinrichsen, 1992: 77).

All over the world mountain catchment areas and their associated biodiversity have been destroyed by logging companies and poor subsistence farmers. In developed countries they have often been destroyed by *Waldsterben* or forest death syndrome that is triggered by pollution and has swept across large parts of Europe and some areas of North America (see 3.4.1) (Lean & Hinrichsen, 1992: 77-80).

Half the trees on the Alps are dying of *Waldsterben* that is caused by pollution that is brought in by winds from across Europe and rises from the exhausts of vehicles that increasingly throng the area. Roads through the Alps now carry 20% of all passengers and 25% of all goods carried into the European community. The holiday makers that use the almost 40 000 ski runs in the mountains add to the erosion and avalanches and landslides are increasing. Nearly 60 plant species have disappeared from France's Haute Savoie region so

far in the past century, and more than half of Europe's threatened species occur in this mountainous area (Lean & Hinrichsen, 1992: 77).

The once fertile Ethiopian highland where 70% of the county's people lived used to support agricultural societies for thousands of year, but is now synonymous with disaster. Every year at least a billion tons of topsoil is washed away, and already 20 000 square kilometres of land have been degraded in such a way that they can no longer sustain any agricultural activities. Within 20 years the situation will be worse and it is expected that 100 000 square kilometres of former fertile arable land will be rendered completely useless (Lean & Hinrichsen, 1992: 77-80).

Another good example is the Andes in Ecuador and Peru where the erosion problem is aggravated by tropical storms. Half of the land has now been stripped of trees and more than 15 tons of soil is now being lost per hectare per year, and in severe cases up to 200 tons may be lost. Forty years ago most of the Central American Isthmus was covered in forest, but now only a few areas remain. As a result of this the Pacific side of the Isthmus is now being eroded away by erosion. The Panama canal is silting up with soil stripped from the local watersheds and big ships may not be able to use it in the future (Lean & Hinrichsen, 1992: 77-79).

China's Yellow river (Huang He) flows 3 to 10 metres above the surrounding land as it approaches the sea, and over the years it has carried so much silt that this has raised the channel. More than a billion tons of soil is carried down the river every year, half of it scoured from the already badly eroded Loess Plateau in its middle reaches. Some 430 000 square kilometres of the plateau have been reduced to bared hillsides with huge erosion scars. In this part of its course the river consists of equal parts of water and sediment and is officially classified as liquid mud (Lean & Hinrichsen, 1992: 77-79).

The destruction of the Himalayas affects the largest number of people and over the last 40 years at least 40% of its forest has been cut down. By 1992, China had cut and taken away \$54 billion worth of timber from Tibet since occupation, while Nepal's mountains have lost at least half their trees in the last 40 years. Between 40 and 70 tons of soil is stripped from its surface per hectare per year. People must now watch the mountain day and night during the monsoon for landslides and tragically often entire villages are buried (Lean & Hinrichsen, 1992: 77-79).

The Himalayas are the youngest mountain range on earth and its youth makes it particularly prone to erosion. Even if they remained forested they would still be losing soil and the ferocious monsoon would cause floods downstream. But deforestation has escalated the problem immensely. In the past the Himalayas were covered by trees and Bangladesh suffered severe flooding twice a century. By the 1970s floods were occurring every four years and the pace of deconstruction continued into the 1980s with a series of devastation disasters. A

severe flood in 1988 flooded almost 85% of the country. India's flood prone area increased from 25 million hectares in the 1960s to 60 million in the 1980s. Even worse is that the water supplies are drying up, and in Uttar Pradesh 70 000 villages are short with water. It is believed that deforestation is responsible for this phenomena that has increased in the past 20 years (Lean & Hinrichsen, 1992: 76-80).

3.4.5.6 Regulation and protection

There is however hope for the Himalayas, and that is the small mountain kingdom of Bhutan which proudly proclaims itself as the last green patch left in the mountains. Here the hills are still covered by magnificent forests and the rivers run clear for most of the year. The country remained isolated by deliberate policy for centuries, and only began to open up to the rest of the world in the late 1960s (Lean & Hinrichsen, 1992: 76-80).

When it realised what happened to its neighbours, the Government became determined not to develop in the same way and adopted a strict conservation policy. It stipulated that 60% of the country should remain under forest and this was not a small target, since 35% of the country is above the tree line. In 1979 it stopped private contractors from cutting timber and national production fell by 87% in two years. Felling by shifting cultivators was also banned, although with less success and a tree planting program was launched to increase the forest area. Another law was introduced to cut the population of goats by 80%, since these are considered to be one of the great destroyers of land. They are now restricted to stalls where they create little damage (Lean & Hinrichsen, 1992: 76-80).

The Government also gave villages private forests to manage on their own. This initiative of privately owned forests inspired the locals to sustain their forests. When the Government in Nepal started to nationalise the forest the cycle of destruction began, and in an attempt to save the forests again the Government started to give the forests back again. They also paid the locals to plant trees in deforested areas again, and some areas are cultivated with grass to provide food for their cattle. The Government hopes that this initiative will spread worldwide, but at least 100 million hectares of mountain forest need to be planted to save the world's watersheds (Lean & Hinrichsen, 1992: 76-80).

3.4.5.7 Regulation in South Africa

Mountain catchment areas (see chapter 6, 6.2.3) should receive special attention since these areas generally sustain the hydrological integrity of riparian systems (DWA, 1986:20). Exotic forestry activities should be severely restricted in mountain catchment areas, due to the fact that these exotic trees use excessive amounts of water. Exotic forestry in mountain catchments also destroys

biodiversity because these large areas form “green deserts” that do not sustain any biodiversity (Robinson, 1993:211-221; Goode, 2001:161).

Commercial forest plantations have already destroyed the habitat of many indigenous species. The climatic conditions in some mountain areas in South Africa are ideal for the establishment of pine and eucalyptus plantations. Approximately 90 million trees are being planted each year. Due to lack of concern for the environment, trees used to be planted even in watercourses and had a devastating effect on rivers and streams. The area of plantations currently represents 1.5 million hectares and most of these occur in high rainfall areas. Some trees such as *Eucaplyptus* species may absorb up to 250 litres of water per day (Hugo, 2004: 259).

Commercial logging also results in negative impacts on soil and an increase in soil erosion because heavy trucks and vehicles are moved on dirt roads. After felling the soil is left bare and may be prone to erosion. Pollution through fertiliser use is also a huge problem and should not be allowed by plane but only directly by hand (Hugo, 2004: 259).

3.4.5.8 Wetlands

Contrary to popular opinion, wetlands are not wastelands and they provide critical habitat for thousands of species of plants and animals. Wetlands include swamps, bogs, marches, peatlands, deltas, fens, estuaries and tidal flats all over the world, and cover 6% of the world's surface from tundra to tropics (Beazley, 1993: 12).

Coastal wetlands that include estuaries, salt marches and tidal flats provide vital spawning and nursery areas for fish and shellfish. Two thirds of the fish caught in the world hatched in tidal zones. In the mid 1970s the yield of fish and shellfish dependant on wetlands was valued at over \$700 million (also see 3.3.1). A sub tropical salt march may be twice as productive as a tropical rain forest and a reed march may produce four of five times as much plant matter per area than the most fertile grassland. Wetlands also sustain large numbers of animals such as reptiles, insects, crustaceans, birds, mammals and amphibians (Beazley, 1993: 12, 34).

The Wadden Sea that borders parts of Germany, Denmark and the Netherlands would produce far less marine life if it were not for the vast stretches of fertile salt marches and tidal flats. The Lower Mekong Basin provides nearly half of the 500 000 tons of fish that are harvested every year. Inland wetlands that are connected to lakes and rivers also provide food and income to many people (Beazley, 1993: 108).

The river swamps of Georgia in the southern USA are farmed for fish. Over 25 000 poor villagers living around Lake Chilwa on the Malawi-Mozambique border

derive most of their protein and income from the rich fishery concentrated around the edges of the lake. The Niger Delta in Mali is also the source of income and livelihood for the people that live on the border of the 20 000 square kilometres of wetland. It provides 100 000 tons of fish a year and is grazed by 2.5 million cattle and sheep in the dry season. Lake Titicaca in the Andes is a source of aquatic plants that are used to feed cattle and it also provides 6000 tons of fish annually (Lean & Hinrichsen, 1992: 153).

Many cultures in southern Africa has adapted to and benefited from wetlands that are used for grazing, harvestable resources such as reeds and subsistence fishing (Begg, 1990: 23).

Wetlands are likely to occur in the catchment of all river systems in South Africa, but their form and abundance vary considerably. South African wetlands that are on the southern tip of the continent host a number of endemic bird species. These include the Cape shoveller (*Anas smithii*). A number of paleo-arctic migrants visit southern African wetlands during the summer and some come as far as the Taimyr Peninsula in Siberia. South African wetlands may also contain some species that usually occur in the tropics, such as the pink-backed pelican (*Pelecanus rufescens*), Rufous-bellied heron (*Butorides rufiventris*), dwarf bittern (*Ixobrychus sturmi*), open billed stork (*Anastomus lamelligerus*) and the pygmy goose (*Nettapus auritus*) (Hugo, 2004: 80-81).

Wetlands have the remarkable ability to filter a wide variety of pollutants and that make them very useful as filters for sewage treatment. They are estimated to be worth \$ 123 000 per hectare, since this is the cost to replace their functions with regular treatment plants. Hungary has long used their peat bogs as natural filters for the treatment of wastewater from sewage plants. Aquatic species such as water hyacinth may remove 75% of lead from wastewater during a 24 hour period. They are therefore very useful in removing heavy metals and excess nutrients from water. Wetlands are also useful in regulating stream flow, shore protection in coastal areas, reducing erosion and thereby stabilising constant hydrological flow (Lean & Hinrichsen, 1992: 153; Begg, 1990: 21; Beazley, 1993: 22).

3.4.5.9 Threats

Wetlands are threatened and retreating all around the globe as a result of human activities such as land reclamation for agricultural and industrial activities and development. Almost 50% of all wetlands in the world have already been destroyed (Beazley, 1993: 45).

Wetlands are also used as garbage dumps and are poisoned by pollution. The USA alone has already lost half of its wetlands as a result of agriculture activities. Some areas such as Iowa have lost 99% of its marshes to arable land. Florida's Everglades have been drained to such an extent that only 10% of the 2.4 million

birds that used them a hundred years ago are still left today. Up to 66% of Eastern Europe's wetlands have already disappeared or are so saturated with pollutants that they are unable to sustain any biodiversity. Western Europe has lost nearly all of its natural wetlands (Miller, 1996: 160-162).

Most of Africa's wetlands are threatened by development projects such as the Maga Dam on the Logone river in Cameroon. The dam has prevented the wetlands from being flooded that have severely impacted on their biological diversity and sustainable agricultural potential. Botswana's Okavango Swamp is the world's largest inland delta but is threatened by irrigation schemes and cattle ranching projects (Lean & Hinrichsen, 1992: 154-156; Beazley, 1993: 44-48; Miller, 1996: 160-162).

3.4.5.10 Need for protection and conservation of wetlands

Wetlands often sustain unique and interesting forms of biodiversity, and conservation of these areas should be encouraged (Williams, 1990:321; Richardson, 1998:205; Cunningham & Saigo, 1997:103). Due to their rarity in South Africa, development activities should be restricted or prohibited in these small areas that are already threatened as a result of their small size and uniqueness. No person should be allowed to alter the mouth of a lake, river, lagoon, estuary or any similar hydrological structure. All lake areas should be protected from detrimental development or recreational activities (Marini-Betòllo, 1989:243-251). Such activities change the natural character of these systems that may in time prove to be detrimental to the survival of particular riparian species.

A meaningful way to conserve wetlands is to provide rewards to the public for the conservation thereof (also see 3.5.1 that focuses on the community approach in conservation). Research has indicated that where substantial benefit can be acclaimed from the conservation of a particular resource, it leads society to become involved. Conservation efforts such as tax exemptions, servitude agreements and subsidies will complement the current regulatory approach to wetland conservation (Begg, 1990: 24).

Conservation measures should ensure that all wetlands are protected and that any development in a wetland is fully regulated or preferably prohibited (Cunningham & Saigo, 1997:88,335).

3.4.6 Fire

3.4.6.1 Scope

As a selection mechanism, fire has a pronounced impact on the ecosystem and it reduces dead and dry organic matter to soluble elements thereby stimulating new growth. Considerable amounts of nitrogen may be lost unless the

combustion produces white ash that may contain some nitrogen. Plants that are resistant to fire are usually characterised by underground stems, and buds that are dormant during the fire season. These fire tolerant species are also often intolerant of shade and require full sunlight and usually fire to stimulate the germination of seeds (Hugo, 2004: 24).

Fire may even be responsible for the release of seeds or stimulate the formation of flowers and reproductive structures. Numerous *Acacia* species need the presence of fire to activate the germination process. Species like *Cyrtanthus* (bulbous plant) needs fire to stimulate successful flowering and without its presence these species quickly disappear from the habitat (Hugo, 2004: 24).

Encephalartos lanatus (a cycad) will only produce cones after the presence of field fires, and this mechanism has been used by cycad collectors to stimulate cone formation in cultivation (Jones, 1993: 202).

Fire may protect grasslands habitats from the invasion of woody plants and trees and ensure a fine balance between woodlands and grass in savannah areas. The dynamics of this aspect will therefore also eventually impact on faunal diversity that is dependent on various types of vegetation for survival. Because of the destructiveness of fire in some localities, the other extreme has also occurred, namely the exclusion of fire. Such exclusion may have a deleterious effect on the ecosystem. During exclusion periods the amount of dry organic material accumulates and when fire occurs after such a period of absence the fires may be hotter and more destructive (Miller, 1996: 617).

The effective use of fire as a sustainability tool may increase the productivity of various areas such as grasslands and may enhance wildlife habitats. Fires that are started out of season may be tremendously destructive to ecosystems. Plants that may be thousands of years old may be irreparably damaged within a few hours. This is especially the case with crown fires where the leaves and branches of large trees may be destroyed. In contrast, surface fires only burn away dry grass and shrubs and are not responsible for the major loss of nutrients (Hugo, 2004: 24; Miller, 1996: 617).

Unfortunately fire is also a threat to the last remaining populations of the Clanwilliam cedars in the Cedarberg mountains in the Cape. These trees are now on the brink of extinction. In 1805 a traveller reported a stand of trees 24 miles long and 2 miles wide in the area. Today one is more likely to see skeletons of dead trees than live ones. These trees need fire to reproduce successfully and seed geminate readily after fire. As a result of increasing fires in the area, the saplings do not reach maturity before the next fire occurs. These trees need long periods without fire, but the area is now regularly burned to increase the grazing capacity of the land (Hugo, 2004: 169).

3.4.6.2 Regulation of fires

Fire can therefore have a positive and negative impact on biodiversity, since it is an environmental factor that enhances balance between various species (Fuggle & Rabie, 1992:214). If burning is not scientifically managed it may be responsible for the loss of certain biodiversity. Burning of any natural areas should take place in the season when it naturally occurs, and this will depend on the location of the specific area. Regulation of veld burning should be prioritised in areas that are prone to veld fires (Cunningham & Saigo, 1997:306).

Firebreaks should be used to protect areas that should not be burned in a particular year or season. The size of firebreaks should be closely monitored, since some persons tend to burn an entire mountain area repeatedly every year (Anon., 2004). This practice may damage the ecology and biodiversity of these areas over the long term. Consecutive burning of all areas should be managed and monitored to ensure its original ecology is sustained (see chapter 6, 6.2.17).

3.4.7 Summary: Aspects needed to sustain biodiversity in the terrestrial, atmospheric and fresh water environment

The information discussed in 3.4.1 – 3.4.6 are concisely and generically summarised in Table 7 below. Refer to the discussion for more detail.

Table 7: Concise generic summary of sustainable biodiversity aspects/criteria in the terrestrial, atmospheric and fresh water environment

Aspect needed to sustain biodiversity in the terrestrial, atmospheric and fresh water environment
Air pollution control
Reduction of industrial levels of gasses that may cause air pollution and acid rain (Howe, 1990: 56; Miller, 1996: 436; Lean & Hinrichsen, 1992: 85).
Catalytic converters for vehicles in cities, regulation/prohibition of domestic urban fires (especially coal fires) (Miller, 1996: 433; Lean & Hinrichsen, 1992: 92).
Reduction of greenhouse gasses from domestic and industrial sources (Lean & Hinrichsen, 1992: 93-96; Miller, 1996: 305-310).
Banning of ozone destroying substances (Lean & Hinrichsen, 1992: 97-99; Diab, 1990: 33-35; Morgan, 1995: 132-133; Miller, 1996: 317-322).

International incentives to regulate and reduce all forms of air pollution (Hohmann, 1992a:73; Hohmann, 1992c:1691; Warren & Goldsmith, 1974:27; UNEP, 2002a:212-217).
Establishment of economic incentives and taxes to regulate air pollution (Preston-Whyte, 1990: 46-47; Miller, 1996: 445-448).
Regulation of development
Incentives to control population growth (economic, education and even legislation) (Cunningham & Saigo, 1997:148,149; Miller, 1992:196, 218; Hohmann, 1992a: 92; Swanson and Johnston, 1999: 53).
Effect of increased HIV mortality on environment and biodiversity and need for alternative environmentally sound burial options (Hugo, 2004: 97; Dorrington <i>et al.</i> , 2003; Environ, 2003).
Limited development areas and greenbelts (Kain, 1981:106; Hohmann, 1992a:85; Hodge and Gilson, 2003; Miller, 1996: 269).
Use of management plans such as EIA amongst other, to regulate, prohibit, mitigate and rehabilitate activities that may have a negative impact on the environment and biodiversity. There is especially a need to regulate activities in remote farm and communal areas (Hugo, 2004: 166-167; St Andrew's University, 2000; Scherr, 1999; Caldwell, 1999:182; Tait <i>et al.</i> , 1988:14; Hohmann, 1992a:67; Brooke, 1998).
Comprehensiveness of activities that are subjected to EIA (Wathern, 1988:275; UNECE, 2001; Canada, 2003; Hohmann, 1992a:354, 403).
Regulation, prohibition (where needed), mitigation and rehabilitation of mining activities through selected management plans and environmental impact assessment techniques (Hugo, 2004: 166-167; Ridl, 1990: 77-80; Hannan, 2002:7-10).
Land and aquatic pollution control
Regulation of domestic and industrial effluent (quality and quantity) including nitrates and phosphates (Lean & Hinrichsen, 1992: 61-65).
Disposal sites for terrestrial wastes according to the inherent characteristics thereof (Hohmann, 1992b:907; Stein, 1997:252).
Effective treatment of sewage (Hugo, 2004: 179-181).
Prevention of release of persistent organic or inorganic chemicals into aquatic systems (Hugo, 2004: 182).
Management of thermal pollution of aquatic resources (Marini-Betòllo, 1989:248; Hugo, 2004: 183; Miller, 1996: 488).

Initiatives to recycle and reuse materials and to minimise waste production. Prevention of unsound waste disposal and littering (Hugo, 2004: 189-191; Miller, 1996: 529-531, 537; Narayan and Pettigrew, 1999; Cunningham & Saigo, 1997:565).
Monitoring of waste sites to reduce, eliminate and mitigate environmental pollution (Cunningham & Saigo, 1997:565; Hugo, 2004: 186; Miller, 1996: 494-495).
Regulation of manufacturing, use and disposal of nuclear substances (Lean & Hinrichsen, 1992: 122; Morgan, 1995: 90-91; Miller, 1996: 388-389; Hugo, 2004: 140-141).
Regulation on the manufacturing, use and disposal of hazardous substances. Prohibition is especially relevant in the case of persistent organic or inorganic pollutants (Rawlins, 1990: 20; Lean & Hinrichsen, 1992: 101-103; Miller, 1996: 546, 550; Marini-Betòllo, 1989:568; Hohmann, 1992a:73; Dasman, 1972:162; McDonald & Kay, 1988:156; NPWRC, 2002; Sato and Aoki, 2003; Miller, 1992:556-570).
Hydrological integrity
Regulation on the industrial, domestic and agricultural consumption of water, including consumption reduction strategies. Management of all surface and groundwater resources (Lean & Hinrichsen, 1992: 57; Miller, 1996:455; Hugo, 2004: 24; Wilber, 1969:3).
Regulation of stream flow reduction activities (domestic, agriculture, industrial) (Robinson, 1993:184-210).
Measures to conserve and protect mountain catchment areas from development such as agriculture, industries, urbanisation and measures to combat and mitigate erosion (Lean & Hinrichsen, 1992: 76-80; DWA, 1986:20).
Regulation and restriction of exotic forestry in mountain catchment areas (Robinson, 1993:211-221; Goode, 2001:161).
Prohibition of exotic forestry in water resources or immediate vicinity (Hugo, 2004: 259).
Protection of wetlands, regulation and mitigation of development (such as urbanisation and industries), agriculture and forestry in wetlands. Where possible these activities should be prevented from taking place. Economic incentives should be used to stimulate their public protection and conservation (Beazley, 1993: 44-48; Miller, 1996: 160-162; Begg, 1990: 21; Lean & Hinrichsen, 1992: 153; Williams, 1990:321 Richardson, 1998:205 Cunningham & Saigo, 1997:103;

Marini-Betòllo, 1989:243-251).
Fire regulation
Regulation of natural fires by paying attention to season, repeated occurrence, exclusion and size of area to be burnt (including the use of fire breaks) (Cunningham & Saigo, 1997:306 Fuggle & Rabie, 1992:214; Hugo, 2004: 169; Jones, 1993: 202; Miller, 1996: 617).

Source: Created by the author by using information from 3.4.1 – 3.4.6 in chapter 3.

3.5 The biological environment

The biological environment includes aspects that relate to the conservation of terrestrial and aquatic (also see chapter 3, 3.4.5) biodiversity. It also includes the regulation of agricultural activities that can have a detrimental impact on the environment.

3.5.1 Terrestrial conservation

3.5.1.1 Conservation areas

About 5% of the world's land surface is now covered by nature reserves, national parks and wildlife sanctuaries. Thousands of years ago hunter gatherer societies in India gave special protection to patches of forests and hundreds of these sacred groves still remain. Kings and princes also protected various royal hunting grounds. William the Conqueror set up one of the earliest, the New Forest in southern England in 1079. Yellowstone was the world's first national park and was created in 1872 as a pleasure ground for the American people. Some of the earliest Canadian national parks were set up by railways companies around scenic parts of the country to lure tourists onto their trains (Lean & Hinrichsen, 1992: 137).

Most of the time the areas were created in parts that were unsuitable for agriculture. The national parks of England and Wales for example were set up in beautiful, but poor high ground. In Zambia most protected areas are set up in areas that are infected with Tsetse fly, and big game is still abundant in these areas (Lean & Hinrichsen, 1992: 137).

Over the last decades the protection has been more systematic and countries try to protect the full range of their resources. Many countries set out to protect species that are threatened by extinction or where endemic biodiversity is high. Brazil has put its highest priority on protecting 30 areas to cover endemic species or birds, plants and lizards. The world's conservation areas contain those areas

that are closed to the public as well as areas where sustainable forestry and use of other natural resources are taking place. These areas may be small from 1200 hectare coral islands to the 70 million hectare Greenland National Park. But the numbers are still short of what is needed to protect the world's genetic resources and a doubling in the size of protected areas is recommended. Some 100 areas are currently internationally recognised as World Heritage Sites and have attributes of international importance (Morgan, 1995: 140-141).

Some parks only exist on paper and are designated in areas already set aside for intensive agriculture and forestry projects, and many have been severely damaged by human activities. By 1989 there were 90 entries on an official list of threatened protected areas in the world. It has been indicated that almost every protected area in the world is currently under threat to some extent as a result of development pressures and bad management (Lean & Hinrichsen, 1992: 137-140; Morgan, 1995: 140-141).

Local people sometimes blame protected areas for harbouring pests such as certain animals that may kill their cattle and elephants that may damage their crops. The Sundarbans is the world's biggest mangrove forest and stretches for nearly 6000 square kilometres across the delta of the Ganges, Brahmaputra and Meghna rivers, and was established to save the Royal Bengal Tiger. It also protects the coasts of India and Bangladesh against the cyclones that sweep up the Bay of Bengal. It also provides spawning grounds for fish and shellfish. The people are however not allowed to collect honey and wood from the forests because they stand a chance to be killed by the tigers (Lean & Hinrichsen, 1992: 137-140).

In New Guinea protected areas have been established on tribal lands and are managed by these local communities. They are encouraged to use the forests profitably but without destroying it. Butterfly farming proved to be very successful in Papua New Guinea and has now spread to other areas as well. Zambia's Kafue Flat wetlands have been threatened by poaching of local antelope, overgrazing and hydroelectric dams. The Government has now involved the local people with the help of WWF to manage these areas on a sustainable manner and to sell the antelope to trophy hunters. The number of antelope has since increased greatly. Mainland Africa's richest forest, Korup in Cameroon now has a national park surrounded by a buffer zone. Small scale hunting, fish farming and forestry are encouraged in this area that helps to protect the integrity of the park. These concentric biosphere reserves are aimed to strike a balance between protection and human use of natural resources (Lean & Hinrichsen, 1992: 137-140).

The western portion of New Guinea contains some of the world's most spectacular wetlands and the Government in association with various international agencies have produced a programme to set up protected

biospheres where people can protect and utilise their natural resources in a sustainable manner (Lean & Hinrichsen, 1992: 144).

South Africa already has 4 biosphere reserves that include Kogelberg (90 000 hectares), Cape Wild Coast (376 900 hectares), Waterberg (140 000 hectares) and Kruger to Canyons (3.3 million hectares) (Hugo, 2004: 213-214).

3.5.1.2 Conservation strategies

Major conservation efforts have been concerned with the saving of species such as whales and elephants and in this way have been able to achieve considerable success. The ban on ivory trade implemented by CITES has resulted in the survival of the African elephant that faced extinction within 20 years (also see **biodiversity trade**). There have also been successes in saving of various kinds of habitats and the successful establishment of protected areas in Bhutan has saved its country's forests from destruction by deforestation activities. It has also established Bhutan's first national park to ensure that its wildlife is protected (Lean & Hinrichsen, 1992: 144).

Conservation areas have many benefits besides simply conserving nature, and they protect wild species which could provide future crops, medicines or industrial raw materials. They can also generate tourism, prevent erosion, conserve water and stabilise local climates. They provide shelter for birds and control pests in the surrounding farmland and contribute to the natural balance of the entire area (Lean & Hinrichsen, 1992: 137-140).

Conservation areas may be directed to conserve and protect various environmental attributes in different types of areas. *Sustainable use* areas are areas that are managed to ensure the long term protection and maintenance of its biological diversity, while providing a sustainable flow of natural products. *Protected land and seascapes* include areas that are a harmonious intervention of people and nature that may contain unique patterns of human settlement. *Habitat and wildlife management areas* are areas that are subject to human intervention based on research into specific requirements of species such as nesting, feeding and survival. *National monuments* may include features of outstanding scientific, educational or inspirational value. *National parks and equivalent areas* contain a natural area that is protected for its ecological diversity and exclude exploitation or intensive occupation thereof. *Scientific reserves and wilderness areas* are areas that are protected in their original and pristine condition (Hugo, 2004: 214-217).

Ramsar sites (also see discussion under 3.4.5) are established for the international acknowledgment and protection of wetlands and their biodiversity. South Africa currently has 16 Ramsar sites, but just because an area is not included, does not mean it is less important (Hugo, 2004: 214).

Natural heritage sites are assigned to certain areas to ensure the protection of areas and features that require conservation management. This concept gives the public a chance to participate in conservation efforts and a chance to safeguard the country's natural ecosystems, biological communities and individual species. These areas may be large or small and may be privately or publicly owned. Registration of these sites reduces the chances that they are unwittingly degraded or destroyed. These areas are usually characterised by any of the following attributes: stands of special plant communities, good examples of aquatic habitats, sensitive catchment areas, habitats of threatened species or any other outstanding natural feature. The programme is entirely voluntary and may be cancelled at any time. There are currently 307 sites, covering 384 646 hectares, under this type of management (Hugo, 2004: 217).

Conservancies are areas of private land that are established to protect various forms of plants and animals. KwaZulu-Natal has registered more than 200 of these areas that involve more than 3000 land owners. The objective of such an area is to conserve biodiversity while ensuring sustainable agriculture. There are already 400 of these areas in South Africa, with most of them featuring in KwaZulu-Natal where it ensures the protection of at least 10% of the province's area (Hugo, 2004: 214-217).

Conservation measures may also include the establishment of gene banks, botanical gardens, and zoos when biodiversity cannot be conserved *in situ* (Miller, 1996: 655).

3.5.1.3 Community approach in conservation

In recent times we have come to realize that in spite of all the preceding arguments, the potential value of biodiversity cannot be regulated as to a set of natural laws alone. The attitudes and perception of people are the ultimate determining factor in natural resources management. In South Africa there now seems to be an emphasis towards public participation and decision making. It is now generally accepted that the public must decide what is best for them and what is not. There is also a shift in the process of resources allocation so that the interested and affected parties are involved from the beginning of any project. Previously most decisions were based on the strategy of the relevant authority whether it was economically viable or not (Hugo, 2004: 238).

Broad public participation in policy development is essential in achieving sustainable development. Government should acknowledge the role of indigenous people and their knowledge in the formulation of policies that assist in the sustainable use of biodiversity. Women in traditional communities should be allowed to use their knowledge to manage the sustainable use of biodiversity. The youth should be informed about the importance of natural resources and sustainable biodiversity utilization from an early age and should be given early responsibility regarding the management of their environment (Hugo, 2004: 238).

Unfortunately the community approach has one large inherent drawback. Most people do not have the technological knowledge to decide what is best for them and very often these choices are determined by cultural heritage, selfish ideals and their perception of the environment and its potential value. Unfortunately the main motivation factor is normally personal and short term gain. In South Africa the best example of this is the traditional values that are associated with the number of cattle owned by a farmer. Quantity has always been regarded as more important than quality. This has had a detrimental impact on the environment. For people to make informed decisions it is necessary that Government should provide them with relevant information on the environment and development projects. This includes information on products and activities that may have a significant impact on the environment (Hugo, 2004: 238-239).

No conservation area can survive unless it is at least tolerated by the local people, and protected areas are now increasingly designed to win the support of the local community. This ensures that the local community gets involved in the sustainable management of these protected areas and their associated biodiversity (Lean & Hinrichsen, 1992: 137-140).

Environmental education of farm labourers form part of the conservancy initiative and community wellbeing and conservation is encouraged. The concept also focuses on control of alien vegetation and the regulation of indiscriminate hunting and poisoning of game. Conservancies may also form part of urban, marine or township areas that are managed according to a set of environmental principles (Hugo, 2004: 214-217).

Conservation projects will however fail without fundamental change in attitudes of the general public and this drives the need for educational programmes to initiate this concept. In Germany children are taught about wildlife through the *Artenschutzkoffer* which contains examples of wildlife products and audiovisual material. In certain African countries children also receive education programmes that are designed to focus attention on the natural environment and the human impact on their natural resources (Lean & Hinrichsen, 1992: 144).

3.5.1.4 Biodiversity harvesting activities

Research has indicated that traditional *muthi* markets have resulted in the extinction of plant species in certain parts of South Africa (McKean, 2002). Almost 50% (2107 tonnes) of medicinal plant material traded annually in KwaZulu-Natal is harvested from the forest biome. In addition to the already overexploited communal forest areas, forest areas on private land with limited past commercial harvest are the only areas potentially available for medicinal plant harvest. Existing forest resources cannot meet this demand. It is a matter of time before communal and private forest areas are overexploited and increased pressure will be exerted on forests under formal protection. It has already been reported that gatherers have used chain saws to remove *Ocotea bullata* trees

from Karkloof (conservation area in KwaZulu-Natal) to strip bark for the medicinal plant trade (KZN Wildlife, 2000).

According to recent research the value of the medicinal plant trade in KwaZulu-Natal alone is conservatively estimated at R 62 million per annum (KZN Wildlife, 2000). The harvesting of indigenous biodiversity for sale on *muthi* markets should be better regulated, to ensure the protection of various threatened indigenous species. These customs are a major threat to many species that are already on the brink of extinction. *Siphonochilus aethiopicus* and *Warburgia salutaris* are only two species which have been overexploited to the brink of extinction in the wild in KwaZulu-Natal (KZN Wildlife, 2000, CEROI, 2000).

Community forestry should be managed on a sustainable and scientific manner to ensure that species are not compromised by the execution thereof. The community or public approach should be emphasised, especially in poor rural communities to ensure that conservation of biodiversity is integrated and sustainable.

3.5.1.5 Conservation management measures

Development is the main reason for the destruction of biodiversity in most areas, and protected areas need to be set aside where biodiversity cannot be adequately protected (GRAIN, 2004; Hohmann, 1992a:92). These areas may be protected areas, wilderness areas, or national parks. Existing parks need to be managed in such a manner that development activities do not interfere with the biodiversity that it protects (Hohmann, 1992b:1019) (see chapter 9, 9.2 – 9.4).

Areas that harbour biodiversity of significant uniqueness or importance should be managed for conservation purposes and Government should assist the owner of such land with sustainable conservation directives. Efforts should be undertaken by conservation authorities to restock rare and endangered species *in situ* (Hohmann, 1992c:1508). Suitable habitats should be identified for the establishment of such species. It is recommended that at least 10% of each biome should be protected to ensure effective conservation of such natural system. The IUCN recommends that at least 7% of all land should be conserved (Hohmann, 1992a:211) (see chapter 4, 4.4.4 and 4.4.5).

In addition to habitat loss, an increasing amount of the planet's remaining wildlife habitat is being fragmented into vulnerable patches by roads, fences, agricultural land and towns. Any habitat that is surrounded by a different type of habitat is in effect a habitat island for most of the species that live there. Most national parks and other protected areas are habitat islands, many of them are surrounded by potentially damaging logging, mining and industrial activities. Habitat fragmentation causes a variety of problems for wildlife. The decrease in a sustainable population size for many species in a boundary area makes them

more vulnerable to predators. Many areas are too small to support the minimum size that is needed for some species to reproduce (Miller, 1996: 646).

The minimum size and number of parks for each functional ecological unit needs to be determined. Ecological protected areas should have a minimum size to ensure that it can sustain the particular biodiversity of interest. Small isolated areas cannot sustain all species that are ecologically important, and this may eventually result in the extinction of certain species (Cunningham & Saigo, 1997:285,289,326; Fuggle & Rabie, 1992:271-272; Brooks *et al.*, 2002:212).

Fencing of parks restricts genetic exchange of information that may lead to the genetic isolation and deterioration of the genetic pool for larger animals. Certain so called non-lethal electrical fencing may even result in the death of animals such as hedgehogs that are often killed by live wires that are near ground level (Van der Walt, 2006). Genetic isolation prevents species from adapting to a wide range of environmental circumstances and diseases. These taxa may be more prone to extinction and may completely disappear from these isolated areas (University of Waterloo, 2004). Genetic information exchanges between larger restricted animal taxa should be prioritised in smaller conservation areas (Miller, 1996: 646).

Experiments in the Brazilian rainforest indicated that isolated patches of rainforest deteriorate within months. Even an area that protects up to 10% of an area, eventually lose half their species in time. Twelve nature reserves have been set up in the mountains of Western China to protect the Giant panda. More than half of the world's surviving population of this species live in these reserves, and their numbers are estimated to be around 1100 animals. But these fragmented areas are surrounded by cultivated land and the Pandas will ultimately not be able to survive in these isolated patches unless they are linked by special corridors. This will allow the animals to move to new areas to mate and to look for food in times of shortages (Lean & Hinrichsen, 1992: 137).

3.5.1.6 Hunting

Hunting can be classified as subsistence hunting, commercial hunting and sport hunting. Subsistence hunters usually kill animals for food and livelihood. Legal commercial hunting kills surplus animals that are kept on properly managed game farms. This practise has resulted in the increase of numbers of many species such as springbok and blesbok. Illegal hunting may involve the killing of animals for sale such as rhino for their horns and elephants for ivory and has resulted in the massive decline in numbers of these species. Sport hunting is where animals are not hunted for food or profit, but for the joy of the hunter. Some groups point out that certain animals such as elephants form strong social bonds and that hunting cruelly break these up. Where sport hunting is managed in a sound environmental way, it may be a sustainable tool to conserve many species (Hugo, 2004: 154-155).

South Africa hosts 4 000 professional hunters from abroad whilst there are approximately 50 000 local hunters. This creates more than R350 million in foreign exchange each year. In the USA a tax is placed on hunting goods and the proceeds are allocated to wildlife management. This fund has raised over 2 billion dollars in the last 40 years (Hugo, 2004: 154-155).

Some of the greatest game reserves in Africa have been in Zimbabwe. These wildlife areas are now the scene of slaughter. In the Save Valley alone most of its 1200 elephants and black rhinos have been killed. Game rangers discovered 1089 dead animals from snares that equals almost 49 kilometres of wire. The snares strangle and starve the animals until they die. Poachers are also using packs of dogs to run the animals down (Hugo, 2004: 164).

Many farmers kill animals like jackals indiscriminately, and in some areas packs of dogs are ruthlessly used to hunt them down. Oranjejag, a hunting organization in the Free State that are subsidized by the provincial Department of Nature Conservation killed 262 caracals, 1628 black backed jackals, 2358 Cape foxes and 177 African wild cats. It is plainly impossible that these had all been causing problems for farmers. In fact, it is well known that the Cape fox and wild cats live mainly on mice, birds and insects. It would therefore seem that these animals are killed without making distinction between those that may kill sheep and those that do not. Individual animals may also cause more problems than other and the aim should be to eliminate the individuals that are causing trouble. A knowledgeable farmer will know which species killed sheep and technology is available to kill individual species that are causing problems (Hugo, 2004: 164).

Wild animals should be used in a sustainable manner and no person should hunt any species for personal instrumental value to such an extent, that it leads to the extinction of a species (Robinson, 1993:265; Hohmann, 1992c:1551).

3.5.1.7 Alien and invasive species

Invasive alien species may cause significant financial losses each year. These species may use 7% of water resources, have a negative impact on agricultural resources, increase the likelihood of flooding and bushfires, cause erosion and siltation of dams and estuaries and lead to the extinction of indigenous biodiversity and undermine the natural functioning of ecosystems (Hugo, 2004: 106).

The introduction of alien species such as rabbits, cats, dogs and rats into habitats where they do not naturally occur is considered to be the most destructive alteration in the world (Cunningham & Saigo, 1997:281; Hohmann, 1992b:1025; Morgan, 1995:139). Invasive alien animals may be detrimental to the survival of indigenous biodiversity. Some invader animals in South Africa include: brown rat, house rat, grey squirrel, European sparrow, European

starling, Indian minna, gold fish, mirror carp and flower pot snake (Hugo, 2004: 110).

The effect of external influences on sensitive species may only become known some years later. In 1949 five cats (*Felis catus*) were brought to the Marion Island weather station as pets. Within 28 years the population increased to 3400. Due to the absence of predators on this Island the birds were an easy prey to the cats. They killed approximately 450 000 birds, especially of the species *Pelecanoides urinatrix* and this had an influence on the entire food cycle of the island. The *Chatharacta antarctica* a predator species was severely inhibited in its feeding habits and turned to penguins as a source of food. The loss of so many birds resulted in the decrease in the amount of guano that impacted negatively on the vegetation of the island. Apart from this the loss of birds also had an impact on the populations of macro invertebrates and insects that eventually compromised all biodiversity on the island (Hugo, 2004: 33-34).

The European house sparrow (*Passer domesticus*) essentially a bird of towns and settlements was introduced to Durban earlier this century. By 1968 it had spread to Namibia and it has also forced the less aggressive Cape sparrow (*Passer melanurus*) out of its habitat. The Indian minna (*Acridotheres tristis*) was introduced in the same way to Durban from India. It is also an aggressive bird and has already taken over most of the habitats of other indigenous birds, especially in towns and gardens (Hugo, 2004: 105).

3.5.1.8 Control of alien and invasive species

Alien invaders are difficult to control, and in the case of vegetation various methods can be used, such as chemical, mechanical and biological control methods. This is the case with the water hyacinth (*Eichhornia crassipes*) that covered vast areas of the Vaal River and the Hartebeespoort Dam. Biological control methods have been successfully used to control the numbers of long leaf wattle, hakea, prickly pear and Kariba weed. These methods are usually characterised by the introduction of insects to the target alien plant that occur in the natural habitat where the target species originated (Hugo, 2004: 24).

The Plant Protection Research Institute in Pretoria has developed a seed attacking insect which seems to be the long term solution to the black wattle. The problem with many invader plants such as wattle is that they also produce large numbers of seeds (up to 20 00 per square metre) that may remain viable for 50 years. To combat alien invasive plants successfully one must understand the factors that may increase the extent thereof. These include climate, soil type, grazing and fire. Fire may be a useful tool to aid in the eradication of fire sensitive alien species in fire resistant indigenous communities (Hugo, 2004: 24).

Alien species must be categorised in various classes depending on the threat they pose to the environment. Both plant and animal species that may threaten

indigenous species should be categorised in this way. This categorisation should make provision to include domestic animals that pose a threat to biodiversity. The owner of land on which invasive alien vegetation occurs, must clear such vegetation within a time limit determined by government. Various domestic animals such as cats, hunting dogs, and goats have a greater impact on the environment than other species (Cunningham & Saigo, 1997:88).

Hunting dogs may result in the extinction of various indigenous animals that are not adapted to cope with the presence of this predator (WRI, 2001). The regulation of hunting dogs may prove beneficial to the conservation of some endangered antelope. Other domestic animals that pose a threat to natural systems should be regulated by a permit system. Irrespective of species or location in the Republic, no alien vegetation should be allowed in any riparian system. Most alien vegetation competes very successfully with indigenous riparian vegetation, and may totally dislodge any natural vegetation (RHP, 2003). (See chapter 4, 4.4.4 and chapter 7, 7.2.8).

3.5.1.9 Biodiversity trade

The international trade in biodiversity is big business and is worth \$5 billion every year worldwide. Most of this trade is legal, but it is estimated that a third of it is unlawful and involves various rare and seriously threatened species. This trade is believed to be one of the reasons that numerous species have become seriously endangered and are on the brink of extinction. Millions of animals are captured every year and shipped to supply the demand in pet trade. Typically a single year will see 50 000 primates, 70 000 tusks of ivory, 4 million live birds, 10 million reptile skins, 350 tropical fish and 1 million orchids. These products are amongst the most expensive in the world and may include: \$13 000 /pound for rhino horn, \$100 000 for leopard coat, \$ 40 000 for certain parrots, and \$ 15 000 for a certain rare cacti species (Lean & Hinrichsen, 1992: 145-148).

The major markets are in the USA, Japan and Europe, and the USA market is estimated to be worth \$250 million each year and it is outdistanced by an illegal trade worth \$300 million. Japan is regarded as the biggest market for illegal wildlife products while Europe is also a major market for exotic birds, reptile skins, monkeys and small cats. The major exporters are South America, Africa, East Asia and the USA. In South America the main exporters are Bolivia, Argentina, Brazil, Peru, and Guyana. The main exporters in Africa include Senegal, Tanzania, Congo, Sudan and South Africa. Much of this illegal trade relies on a handful of countries which act as conduits. Until 1989, ivory from up to 30 000 poached elephants passed through Burundi on its way to the United Arab Emirates where permits were issued (Lean & Hinrichsen, 1992: 145).

The Emirates represents one of the most important centres in the world for the illegal wildlife trade. In Latin America, French Guiana, Bolivia and Paraguay act as middlemen for the illegal movement of up to 150 000 parrots each year to pet

shops. Taiwan offers a passage for poached and smuggled elephant tusks and rhino horn from Africa (Lean & Hinrichsen, 1992: 145-148).

Worldwide some 622 species of plants and animals face extinction as a result of the trade and another 26 300 species are endangered. Black rhino numbers have been cut by 95% in the previous decade as a result of the trading. Meanwhile the numbers of African elephants have decreased by 50% since 1980 as a result of the trade in ivory. Between 60% and 80% of all captured animals that are destined for trade each year are killed in transit. Customs at Madrid airport recently found 1500 dead baby crocodiles in a batch of 2000 (Lean & Hinrichsen, 1992: 146).

As species become extinct or their populations dwindle the balance in nature is severely upset. The loss of a species can disrupt the food chain and result in the increase or decrease of other species. The malaria upsurge in Asia was caused by the over harvesting of bullfrogs that eat the mosquitoes that carry the disease. Every year more than 200 million Asian bullfrogs are killed to provide frog's legs for the trade (Lean & Hinrichsen, 1992: 146).

Captive breeding programmes have been set up to try and increase the numbers of certain threatened species. Common marmosets are bred in the UK and Germany, while over 8000 monkeys are born in the USA each year. There are captive breeding centres for lovebirds in Holland, Belgium, and South Africa. There are also at least 10 crocodile ranching operations around the world. But these are not enough to save the threatened species (Lean & Hinrichsen, 1992: 148).

3.5.1.10 Control measures

Stricter control measures are still needed nationally and internationally to curb the trade further. It is also important to address the demand of consumer countries since this fuels the trade, but this is a difficult task in the poverty stricken Third World. As with ivory trade, poaching dies down, and if people refuse to buy these endangered species, the trade would eventually die down (Lean & Hinrichsen, 1992: 148).

All rare species should be specially protected and measures should be implemented to ensure they receive adequate attention. Trade in all rare species should be managed through a permit system that registers all necessary details of the trader (see chapter 9, 9.3) (Hugo, 2004: 24). The trade in elephants is regulated by the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (1973) and the ban in ivory trade by this Convention has secured the short-term survival of the species (Miller, 1992:417) (see chapter 9, 9.3).

Due to their rarity, certain critically threatened species have very high monetary values. Some species may only exist as single colonies in isolated areas, this is the case with many cycad species such as *Encephalartos dyerianus* that is restricted to a single hill in Mpumalanga and a rare orchid *Holothrix majubensis* that is only found on Majuba Mountain in KwaZulu Natal (Scott-Shaw, 1999: 136).

3.5.1.11 Migratory species

Many kinds of animals migrate and include birds, fish, mammals, reptiles, butterflies and moths. These species are forced to migrate to find food and a suitable year round climate, while other species like salmon migrate to spawn. Giant sea turtles, whales, caribou, wildebeests, Arctic foxes, some frogs and salamanders have regular migration patterns. Cod, mackerel, and pilchard, move to warmer oceans when it gets cold in winter, and head back again in spring. Migrating species achieve extraordinary feats of navigation and stamina, and salmon find their way back through the open sea, rivers and lakes to spawn in the streams where they hatched before (Lean & Hinrichsen, 1992: 152).

European and American eels spawn together in the Sargasso Sea and then go their separate ways. One travels 5000 kilometres over three years to Europe, while the other reaches North America after 1600 kilometres. Millions of Monarch butterflies flock south from North America each year and Painted Ladies develop in North Africa and travel to Europe every spring. Birds, which build up fat before their journeys and some even double their body size, hold the long distance records (Lean & Hinrichsen, 1992: 152).

The tiny Northern waterthrush journeys over 4000 kilometres from New York State to Venezuela. Peregrine falcons have been known to travel up to 16 000 kilometres from North America to South America. The Arctic tern breeds in Britain in summer (as far north as the Arctic Circle) and then migrates to the Antarctic. They must travel up to 35 000 kilometres annually to achieve this. Migratory birds use many different routes during their north-south migration routes, but some 15 are considered major routes. Europe also has four major over the Mediterranean to Africa and there are also three major Asian migration routes (Lean & Hinrichsen, 1992: 152).

Many migratory species such as birds are threatened by various global problems. Birds are good environmental indicators that reflect the health of natural ecosystems and therefore give early warnings of harmful changes in the environment. Scientists estimate that almost 1000 bird species are threatened with extinction and human threats pose the greatest threat to their survival. The draining of marshes, wetlands and estuaries for agricultural and industrial use has deprived numerous species from breeding, resting and feeding places (Lean & Hinrichsen, 1992: 152).

Pesticides in the environment such as DDT and Dieldrin which accumulate in the environment and the bodies of birds have been the cause of decreasing numbers. Oil spills worldwide are also responsible for the death of many birds as was seen with the Exxon Valdez in Alaska that caused the death of 33 000 mainly migratory birds. Poor countries are responsible for the killing of up to 150 million migratory birds used to feed the poor (Lean & Hinrichsen, 1992: 152).

3.5.1.12 Destruction of forest biodiversity

Over the past five decades a tragedy of untold proportions have been unfolding in the world's forests, especially tropical and subtropical forests. These unique ecosystems, the richest and oldest on earth are being destroyed at unprecedented rates. Only about 50% of the mature forest that once graced the planet still stands, and the latest estimates show that up to 800 million hectares of the original 1.6 billion hectares have been felled. The Food and Agriculture Organization of the United States estimates that 11.4 million hectares of tropical forests are felled each year. This rate has increased up to 20 million hectares in the past ten years as indicated by satellite images (Lean & Hinrichsen, 1992: 65-67).

Many other countries such as Indonesia, Thailand, Malaysia, Bangladesh, China, Sri Lanka, Laos, Nigeria, Liberia, Guinea and Ghana have already lost large parts of their rain forests. Eighty percent of the forests of the Philippine have already been destroyed. Central America only has 40% of its original forests left, while half of 24.3 million hectares of Brazilian state Rondonia have been destroyed in recent years (Lean & Hinrichsen, 1992: 65-67).

These figures indicate areas that have been completely cleared for other purposes such as agriculture but also include severely degraded areas. Individual countries showed and even more rapid increase in the rate of destruction. In Myanmar there was a more than six fold increase from 105 000 hectares in 1980 to 677 000 in 1990, and in India there has been a ten fold difference in a period of ten years where the number increased from 147 000 hectares to 1.5 million hectares (Lean & Hinrichsen, 1992: 65-67).

Barbados replaced forests for the production of sugarcane and in Malaysia forests are disappearing at the rate of 225 000 hectares a year to make place for rubber and oil plantations (Lean & Hinrichsen, 1992: 65-67; Miller, 1996: 277-280).

3.5.1.13 Logging

Indiscriminate logging mainly for agricultural activities is thought to be the main reason for the increased rate of destruction of forests. This is often a three stage process. Logging companies carve out concessions and bulldoze access roads into pristine forests to extract timber. Peasant families follow the roads into the

jungle in a desperate search for livelihood, and they clear and burn the forests further to use the land to grow crops. They use the ashes for fertiliser, but after four crops, impoverished soil and insect pests force them off the land and they move on to repeat the cycle in another area. Some seed the plots with grasses and sell these to cattle farmers and thereby completes the final phase of destruction. Most of Central America's forests have been destroyed to produce cheap beef, and in this process two trees are destroyed to produce one hamburger (Miller, 1996: 277-280).

There are several root causes of the pressures that result in the unsustainable use of forests: inappropriate Government policies that value the clearing of forests more than protecting them; governments acting as weak landlords over forests; lack of skills to manage the forests; forest using businesses that use the profit for political gains and overpopulation of forest areas and poverty (Lean & Hinrichsen, 1992: 68).

The soil in most forests is very poor and has evolved in the millions of years to sustain the kinds of biodiversity that are found in them. The stripping away of forests and vegetation often result in the formation of eroded soils and the increase in desertification. A single storm may remove 185 tons of soil from one treeless hectare of land, and after the rains subsided the soil is baked into a lifeless medium that is unable to support any biodiversity (Lean & Hinrichsen, 1992: 65).

3.5.1.14 Incentives to save the forests

These forests regulate water flow and protect watersheds for farmers who grow food for over a billion people. They also regulate the climate and produce oxygen, provide timber and fuelwood, are home to indigenous people and contain possible genetic resources (Morgan, 1995: 136).

Fortunately Brazil has been able to reduce this figure in the past ten years since 1980 where the figure went down from 3.5 million to 1.3 million hectares. This is partly due to international pressure and a change in government. Brazil ended subsidies for deforestation, clamped down on illegal felling, and established new reserves (Lean & Hinrichsen, 1992: 65; Holmberg *et al.*, 1991:16-19).

Saving the forests are one of the main concerns of international organizations and governments. Many initiatives have been launched to combat this problem, but no plan will succeed if its only goal is to save the forests. Most Third World countries are in deep financial debt and will have no interest in saving the forests if there is no financial gain in such option. Recent studies have shown that traditional non destructive uses of forests such as harvesting fruit, oils and medicinal plants, and practising agro-forestry achieve higher returns than slash and burn agriculture and cattle ranching (Lean & Hinrichsen, 1992: 68).

Studies showed that in the Peruvian Andes the use of such areas for sustainable forestry yielded seven times more income in a period of 50 years. The Lacandon Maya Indians and Chiapas of Mexico practise a highly efficient form of traditional forestry that uses a multi layered cropping system that permits them to cultivate 75 crop species on a single hectare plot for up to seven years. With skilled husbandry of the forest's resources, one Lacandon farmer will be able to clear no more than 10 hectares of forest in a lifetime. Yanesha Indians in Peru's tropical forests along the border with Brazil are now managing their forests by cutting trees in narrow strips leaving wide areas of forests intact that allows them to re-colonize the cleared land (Lean & Hinrichsen, 1992: 68).

Many other peoples including the Chagga of Mount Kilimanjaro and the Lua of Thailand practise similar systems of agro-forestry almost anywhere in their forests. It is a much more productive system that allows farmers to use their forests sustainable instead of destroying it and then have to move on. It abates the land hunger which forces people to move into the forests to look for livelihood, and instead focuses on a more harmonious way of using their biological resources (Lean & Hinrichsen, 1992: 68).

Sustainable forestry may include the following aspects: establishment of large forest estates; establishment of long term forest ownership; policies that focus on value of forest instead of single forest products; introducing sustainable forestry activities; and ensuring rights of forest communities (Holmberg *et al.*, 1991: 16-18).

3.5.1.15 Deforestation and the fuelwood crisis

Two billion people are caught in the "poor man's energy crisis" that escalates in the shortage of wood for fuel and heating. Nearly half of humanity has not yet entered the age of fossil fuels and depends on wood for warmth, light and cooking. But as trees are cut down the fuelwood is becoming increasingly scarce in even large parts of sub Saharan Africa, the Middle East and Asia. Fuelwood accounts for a large proportion of all energy consumption in many developing countries. More than 90% of energy in countries such as Burkina Faso, Tanzania, Nepal and Ethiopia comes from wood. It even supplies more than 80% of oil rich Nigeria's needs and many other countries get half of three quarters of their energy from wood. Even in countries with large industrial sectors which use a great deal of fossil fuels, fuelwood dominates the life of the country people, and wood accounts for only a third of India's total energy consumption, but together with dung and crop wastes meets over 90% of rural dweller's energy needs (Lean & Hinrichsen, 1992: 73).

Already 100 million people in the Third World cannot get sufficient fuelwood to meet their energy needs, and almost 1.3 billion people are consuming fuelwood resources faster than they can be replenished. On average consumption outpaces supply by 30% in sub Saharan Africa as a whole, by 70% in Sudan and

India, 150% in Ethiopia and 200% in Niger. If this trend continues it is speculated that within the near future almost a billion people will be faced by chronic supplies of fuelwood. Usually there is not alternative available to these poor people and alternative fuels cost even more than can be afforded. Even in wood rich areas like the Amazon some towns are already feeling the energy pinch. In Manaus, Brazil for example the majority of the poorer residents depend on charcoal to prepare their meals (Lean & Hinrichsen, 1992: 73).

The fuelwood crisis has been attributed to the over exploitation of forests and woodlands by the rural poor as human numbers and energy needs increase. Yet the roots of this problem are more intricate such as rampant logging in combination with animal foraging and slash and burn cultivation. A study found that one of the threats to deforestation was not necessarily the rural collection of fuelwood, but rather the conversion of forests to charcoal to serve the needs of city dwellers. Even though charcoal is lighter than wood, and is preferred above wood due to cheaper transportation costs, the process of producing charcoal consumes almost 50% of the energy of the original wood. So each town dweller therefore uses twice as much wood as people in the country that sticks to original wood (Lean & Hinrichsen, 1992: 73-76).

In several areas the fuelwood crisis has hit the agricultural productivity especially where dry areas have been deforested to make way for arable land. Once the fuelwood becomes scarce the people have to burn animal dung or crop residues to cook their meals. The burning of dung means that the potential use thereof as fertiliser will reduce the agricultural output. Worldwide over 800 million people have resorted to these fuels and in Asia and Africa at least 400 tons of animal dung is burned each year. If this natural fertiliser has been used on croplands instead, an extra 20 million tons of grain could have been produced. In Nepal the use of dung has cut crop production by up to 15% (Lean & Hinrichsen, 1992: 76).

3.5.1.16 Solutions

The World Bank estimates that the fuelwood crisis can be overcome with the planting of 55 million hectares of fast growing trees. But simply planting more trees is not the solution to the problem, since the introduction of certain fast growing aliens may pose a threat to indigenous biodiversity and the choice of such species need to be carefully decided. It is also recommended that the use of more efficient stoves should be implemented to ensure that more energy can be derived from wood (Lean & Hinrichsen, 1992: 76).

The use of a classic fire can only effectively utilise about 6% of the energy of the burning wood. The materials for using these newly developed stoves are not that expensive and can be locally relatively cheap. A good example is the Lorena stove from Guatemala which cuts fuelwood consumption by 50%. It is made from mud and sand and is fitted with a simple metal damper and pipe and costs the equivalent of \$5 and with proper maintenance will last for years. The World

Bank estimates that this stove can reduce fuelwood consumption by 25% if used globally (Lean & Hinrichsen, 1992: 76).

If environmental degradation is to be halted an alternative energy supply must be made available. The demand for fuelwood must be reduced through more efficient usage and substitution with other fuels and electricity (Oxenham & Eberhard, 1990: 61-62).

3.5.1.17 Deforestation and the timber trade

Most attention is now focused on the destruction of the tropical rainforests but many temperate forests are also destroyed. Half the wildwood that once covered almost 80% of Britain was cleared by the time the Anglo-Saxons took over England, and half of what was left vanished before the Normans came. Only 1.5% of it now remains and most of this is threatened. Almost 80% of the forests that originally covered Europe were cut down during the late Middle Ages and now only fragments are left in Poland's Bialoweiza National Park. And within a century of independence 75% of the forest in the USA has been felled and less than 5% of its original woodlands now remain (Miller, 1996: 296).

Nowadays, temperate forest is usually replanted instead of being completely cleared. But these new plantations bear little resemblance to the rich ecologically diverse forests that were cut down, and they usually consist of fragmented stands of just one or two species. Temperate rain forests worldwide are far rarer than their more famous tropical counterparts, covering only about 3% of their area. The biggest one stretched unbroken from Alaska to California along the Northwest American Pacific Coast, and may be the most productive ecosystem in the world. It grows more than 10 times the plant matter than the tropical rain forests, and is home to the tallest trees on earth of up to 100 metres tall. Unfortunately, 80% of the richest areas of the Tongass forest in the Alaska panhandle are scheduled for clear felling and more than 90% of the forest in the lower 48 states has already been cut down (Miller, 1996: 300).

Environmentalists believe that the important parts of the Canadian section of the forest will be gone in 15 years, although the Government and industry dispute this. Only 91 large watersheds on Vancouver Island have not been logged yet, but only 1 of them is protected. By 1988, almost 22 100 square kilometres of land in Alberta have been given over to logging. It is much the same story in Scandinavia that is often hailed as the model for modern forestry (Miller, 1996: 301).

Nearly 60% of Sweden is wooded, and the area is actually increasing. But almost all of it is new and relatively sterile plantations and only 30 000 square kilometres of original old growth remains, and national law forces landowners to cut it down. Two thirds of Finland is under forest but only 3% of it is old growth and logging began in 1992 in some of the last remaining remnants. Virtually no old growth is

left in Norway at all, and hundreds of species including the lynx, bear, wolverine, and many kinds of birds are now seriously threatened. The reindeer forage on lichens in established mature forests and are also under threat because the new forest lacks them. Almost all of the woodland in the lower areas in Chile has been cleared and Japanese logging firms have started to cut down the magnificent southern beech forest of the Magellan Straits (Miller, 1996: 294-301).

Natural forests cover a mere 0.25% of South Africa. The indigenous forests occur mostly in the high rainfall areas of the Drakensberg, Soutpansberg, the coast and southern Cape. The existing forests are shrinking for various reasons that include the penetration with exotic species and agriculture. The demand for commercial logs is expected to increase by 2.5% per annum. It is estimated that the timber industry will have to double the existing forest areas of 1.13 million hectares by the year 2010 to meet in the demand. This will inevitably place indigenous forest under greater pressure. Apart from the fact that these forests are the habitat of rare plants and animals, they are also important catchment areas. Various species such as Clanwilliam cedar, blue duiker and the samango monkey will become extremely endangered in future (Hugo, 2004: 168-169).

3.5.1.18 Value of timber

Timber is one of the five most valuable exports from Third World countries and the demand for timber is growing worldwide, because rich countries are importing 16 times more timber than they did in the 1950s (Lean & Hinrichsen, 1992: 73).

The World Bank estimated ten years ago that more than 66% of the countries that now export tropical timber will have run out of wood by the year 2000. Latin America exports are expected to grow as the Southeast Asian forests are increasingly destroyed, and experts predict that Asia's share of exports could drop to a little as 10% in the near future (Lean & Hinrichsen, 1992: 73).

Present methods of exploitation are wasteful and will result in the destruction of the world's forests. Hardwoods are in demand because they have a relatively uniform structure and the large tree dimensions make it possible to obtain large planks of good quality. Much of the woodwork in Western homes originates in the tropics and everything from window frames to furniture and veneer radio, stereo and TV sets (Lean & Hinrichsen, 1992: 73).

In heavy construction, tropical hardwoods are used in railway sleepers, harbour pilings, wharves, jetties and railing waterways. Hardwoods are also turned into humble pulp and one Japanese company is transforming a rich rainforest in Papua New Guinea into packaging for cameras, calculators and other electrical goods (Lean & Hinrichsen, 1992: 73; Miller, 1996: 283-286).

Logging has already almost resulted in the extinction of some trees such as *Fromarsia* a leguminous tree from Africa that is widely used in veneers. It has

entered the timber market only 40 years ago, and has been so exploited that it is very difficult to find a living tree. These trees are relatively scarce in pristine forest and only 2 or 3 large trees will occur in one hectare. In the process of cutting down these trees the heavy machinery damages the adjacent trees and pushes down trees to make roads to get to the trees.

3.5.1.19 Incentives for protection and conservation

Outrage at the devastation caused by the unrestrained logging has led to calls for developed countries to boycott tropical timber and this has put pressure on the timber companies to improve their operation. The German building ministry has announced a ban and 15% of all Britons said they will not buy any tropical wood products. Many experts believe however that the boycotts might be counterproductive in the long run since they would drive down the price of timber which might force exporters to clear fell forests for pulp that would accelerate the destruction of forests. This could also increase the pressure on equally valuable temperate forests (Lean & Hinrichsen, 1992: 72-73; Miller, 1996: 286-292).

The best option would be for already exporting countries to grow valuable trees in special plantations in areas that have already been cleared by logging. Zambia has already established enough plantations to meet its need for timber for the next decade. Only 2% of exports come from managed plantations, because it may take up to 30 years to establish a mature tree. Exporting countries might be encouraged to look better after their forests if they got better value for them, and they would get up to five times more revenue for a tree if they processed the timber themselves, rather than exporting the raw logs. It would also be more economical to harvest all the other potentially valuable trees that are damaged in the logging process, and a country like Malaysia has already developed a market for them (Lean & Hinrichsen, 1992: 72-73; Miller, 1996: 286-292).

Getting better value from forests would ultimately reduce their rate of destruction. It is estimated that the need for tropical hardwoods could exceed supply by some 400 million cubic metres by the year 2000, and by 3 billion by the year 2025. Controlling unplanned deforestation, allowing previously logged forest to regenerate, protection in national parks, establishment of plantations and setting up sustainable management programmes would conserve the remaining forests and ensure the survival of the timber trade (Lean & Hinrichsen, 1992: 72-73; Miller, 1996: 286-292).

3.5.2 Management of agricultural activities

3.5.2.1 Impact of agriculture on the environment

For almost four decades after the Second World War, food production steadily outpaced demand. The Green Revolution helped boost grain production in the Third World, while amazing technological advances improved the yields in

developed countries. But unfortunately a Billion people are still hungry and there are signs that the long agricultural boom may be ending soon (Lean & Hinrichsen, 1992: 25-28).

Grain production provides about half of the world's calories and increased from 700 million tons to 1.8 billion tons in 1986. It grew by almost 3% a year and outstripped population growth. Similarly the production of meat, milk and fish also rose by 2% annually between 1965 and 1986, while the harvest of vegetables, pulses and fruit grew by 2.5% a year. This growth rate can be attributed to the development of new genetic varieties, the increased use of chemical fertilisers, and the rise in pesticide applications (Lean & Hinrichsen, 1992: 25).

All developed areas including Asia and Western Europe has increased their food production to cope with their growing populations, and these countries now produce almost 30% more food than can be used for their own consumption. Africa has also increased its food production but as a result of its population increase it still produces 27% less food than what is needed for sustainable consumption. Every year 11 million children under the age of five die of hunger or hunger related diseases. Those who are able to survive their ordeal may never reach their potential, because of impaired brain development (Lean & Hinrichsen, 1992: 25-28).

One study followed malnourished children under 5 years of age, for 17 years of their life and came to the conclusion that their capacity for work was 30% lower than those of the same class and same villages who had enough to eat (Lean & Hinrichsen, 1992: 25-28).

After four decades of agricultural growth the global harvest began to falter in the second half of the 1980s. The per capita grain production which grew from 246 kilograms between 1950 and 1984 fell back to 296 kilograms by 1988, a level where it has been in the mid 1970s. In 1988 for the first time in history the United States produced less grain than was needed for its own people, and in four years between 1987 and 1992 the world as a whole failed to produce enough to satisfy demand. The bad weather was blamed for the part of the slump and drought hit India in 1987 and the USA, Canada and China in 1988. These countries are also the world's largest producers. In 1992 the most serious drought of all gripped southern Africa and harvest fell by more than half in the eight countries in the region (Miller, 1996: 568-569).

Scientist speculated that the greenhouse effect was to blame for causing harvests to fail. Increased radiation as a result of the decreasing ozone layers is also thought to have had an impact on the production. Other problems for poor harvests include overuse of land that may result in soil erosion and desertification. It is estimated that every year the world's farmers loose 26 billion metric tons of top soil. At one stage in the 1970s, American farmers lost 6 cubic

metres of soil for every ton of grain that was produced (Lean & Hinrichsen, 1992: 24-28; Miller, 1996: 568-569).

3.5.2.2 Need for sustainable agricultural practices

The loss of arable land therefore results in the need for more land that goes together with the destruction of natural vegetation and ultimately biodiversity. Agricultural activities (see chapter 7, 7.2.8) can completely alter and destroy the natural environment if not managed properly (Hohmann, 1992a:87). The most important impact agricultural activities have on land is the destruction of natural vegetation that supports indigenous species. All land and agricultural resources should be protected from degradation by unsound agricultural activities (Fuggie & Rabie, 1992:191-203).

The application of land use zoning schemes should be utilized to direct sustainable agricultural development (Cloke & Park, 1985:427). Cultivation on slopes that are prone to soil erosion and degradation must be managed by scientific directives to prevent donga formation. In the case of land degradation and soil erosion the owner of such land must take the necessary measures towards rehabilitation (Smith, 1958:69-83; Troeh *et al.*, 1980:395; Cunningham & Saigo, 1997:232).

Overgrazing occurs when too many animals graze for too long and exceed the grazing capacity of the grassland area. It lowers the productivity of the vegetation and changes the type and number of plants in an area. Overgrazing is also caused more often during periods of drought. About 47% of the total land on Earth is suitable for grazing only. The most noticeable impact of humans on these areas is the almost complete replacement of the indigenous animals by domestic species (Hugo, 2004: 114-115).

Poor management of these herds lead to overgrazing, trampling, poor vegetation cover, erosion and environmental degradation. Where overgrazing is severe, wind erosion can further cause extensive damage. Topography can also be changed on micro scale by the provision of artificial drinking places that cause the formation of cattle paths. These paths may lead to the formation of gullies. Cattle that graze on steep slopes play an important part in the formation of soil creep and small terraces. It is estimated that 60% of all topsoil loss in the USA is the direct result of livestock grazing (Hugo, 2004: 114-115; Miller, 1996: 567, 623).

Various technical measures may be used to improve agricultural capacity and reduce environmental degradation. The organic matter of soil should be increased to improve water infiltration, reduce run off and stabilise the nutrient value of the soil. Bare soil should also where possible be covered with vegetation to stabilise it and reduce the possibility of erosion. Appropriate crops must be used in areas that are suitable for their cultivation and crop rotation may improve

general yields of crops. The use of manure should be recommended since this is a sustainable agricultural practise that will also increase soil fertility over the long term. Increased use of stall feeding may prove beneficial in areas that are sensitive to soil erosion and compaction. Rangeland areas that are eroded should be reseeded to stabilise them, and rotational grazing to protect grazing land should be used where possible to protect the integrity of grazing areas (Hugo, 2004: 257-258; Holmberg *et al.*, 1991: 14-15; Miller, 1996: 524).

The large scale destruction of indigenous bush should only be allowed on the authorisation of a competent authority. Bush encroachment should not be seen as a similar problem to invasive alien vegetation. Encroachment by indigenous species is often an environmental indication of unsound agricultural or grazing activities, and should be managed scientifically (Dasman, 1972:255). Natural vegetation should be protected from any activities that could compromise its integrity, such as overgrazing (Cunningham & Saigo, 1997:308).

3.5.2.3 Desertification

The world's deserts are spreading and extending over more and more land, and this process is threatening about one third of the world's land surface and the lives of approximately 850 million people. These areas may include hot desserts and wastelands of the Middle East and the sea of sand of parts of the Sahara. Even the Antarctic is often called a frozen desert because it only gets a few millimetres of rain a year. Desserts may therefore be high and cold, hot and sandy or rocky and impassable. But deserts all have one thing in common and that is their poor soils and harsh climates that make animal husbandry and agriculture impossible without massive imports of water, fertilizer and labour (Lean & Hinrichsen, 1992: 53).

The main causes of desertification are: over cultivation of poor soils, over grazing by sheep, goats, cattle and camels, excessive cutting of fuelwood, deforestation especially on upland and watersheds and inappropriate agricultural practises that may lead to salination and alkalization of agricultural land. People have been creating desserts since the beginning of settled agriculture almost 10 000 years ago. Nearly the whole of Mesopotamia, a once fertile crescent lying between the Tigris and Euphrates rivers is actually not desert. Yet 400 years ago it was the cradle of civilization and the area supported tens of thousands of people. Centuries of over use combined with poor irrigation techniques sterilized the land that resulted in the collapse of the civilisation (Miller, 1996: 516).

UNEP estimates that some 3.3 billion hectares of the world's rangeland, cropland and irrigated land that is an area about the size of North America and South America combined, is under assault by desertification. Desertification has affected the livelihoods of 1.2 billion people worldwide and in 1992 the Food and Agriculture Organization of the United Nations warned that the world's soils were degrading so fast that in little more than 30 years it might no longer be able to

feed its growing populations (Lean & Hinrichsen, 1992: 54; Miller, 1996: 516-521).

Over the last half century some 65 million hectares of Africa, south of the Sahara have been turned to desert. In Mali, the desert has spread 350 kilometres south in just 20 years, and in Sudan it has advanced 100 kilometres in about 17 years. Almost 78 million people now have to cope with severely degraded land. Africa has particularly fragile soils, and almost 80% of them have inherent limitations on their fertility and generally speaking low organic matter and clay which may erode easily. The harsh climate that includes long periods of drought, intersperse with rains makes the continent even more susceptible to desertification. Traditionally African farmers were able to live with irregular rains and poor soils when they rotated their crops and rested their most vulnerable land for up to 20 years (Lean & Hinrichsen, 1992: 56).

The carrying capacity of the land is coming under increasing pressure. A study found that some parts of Africa were already unable to support the demands placed upon them for fuelwood and agriculture. Farmers have been forced onto marginal land by the increasing population and the decreasing rainfall. During these periods of drought the farmers are forced to clear more new land for agriculture and this process speeds up the process of desertification. Some parts of Ethiopia's highlands used to be rich and fertile and they supported farmers for centuries. Since 1900 more than 90% of the country's forests in the highlands have been cleared which resulted in the erosion and loss of topsoil. Already 20 000 square kilometres of land have been lost and is no longer arable (Lean & Hinrichsen, 1992: 56).

Despite four decades of various attempts to conserve soil in South Africa, annual losses as a result of erosion are estimated at 400 million tons. This is about 3 tons per hectare. This represents enough soil to cover 173 farms of 10 000 hectares with a layer of 150 mm soil. Soil erosion has already destroyed 25% of South Africa's original fertile soil reserves. The same situation exists in Lesotho where soil conservation plans have been drawn up as early as 1870 without any real success. Soil erosion, mainly as a result of over grazing is currently one of the most important problems in Lesotho (Hugo, 2004: 173).

In South Africa desertification has affected 250 000 hectares, and 55% of the country is in danger of becoming desert. The encroachment of the Karoo as a result of overgrazing in areas of low rainfall is also of great concern. Calculations done in the 1950s concluded that the Karoo veld is moving eastwards at a rate of 1.6 kilometres per year. Large parts of the Limpopo province bushveld are also in the process of becoming desert as a result of overgrazing. If conditions do not improve, South Africa will soon follow the same path as some parts of Africa (Hugo, 2004: 170-172).

3.5.2.4 Solutions

Solutions to the ever increasing problem of soil erosion in South Africa may include several strategies. The community, especially the local rural community should be educated on the negative effects of soil erosion. They should also be given the opportunity to become involved in projects to reduce, prevent and mitigate soil erosion. In this way, possible conflicts between science and culture can be minimised or avoided. Farmers must be educated on agricultural methods to conserve soil and reduce the possibility of erosion (Garland, 1990: 72).

Qualified officers, preferably from the local community must be appointed to manage soil conservation projects and education, and the necessary funds must be provided by Government for the implementation of these projects. Farmers must be subsidised to undertake soil conservation projects on their land, and must only be paid after successful implementation of such plan (Garland, 1990: 72).

3.5.2.5 Agricultural products

Tremendous increases in the use of fertilisers and biocides have helped bring great rises in the cereal, vegetable and fruit yields over the past four decades. In most areas crop yields are now exclusively dependent on heavy doses of these agrochemicals. World fertiliser use rose from 14 million tons in 1950, to 143 million tons in 1989, and the per capita use rose from 5 kilograms in 1959, to 26 kilograms in 1984. By the late 1980s the world used on average 91 kilograms of fertiliser for every hectare of cropland, a third more than 20 years before. This rise in fertiliser use was also noticed in Third World countries. Due to the unsound management of soil and the loss of micronutrients the average yields have decreased in the past few years. Pesticide use multiplied 32 fold between 1950 and 1986, with global sales nearing \$16 billion in 1985. By 1989 the Third World accounted for one quarter of all pesticide use (Lean & Hinrichsen, 1992: 105; Miller, 1996: 591).

3.5.2.6 Environmental problems with fertilisers and biocides

Behind the impressive growth lurks mounting environmental damage from the misuse and overuse. Nitrates are seeping into the groundwater and in the USA, research has indicated that 8000 wells have been so polluted by nitrates that they are unusable. In Hungary, some 700 small settlements around the country containing 300 000 people have water piped in from neighbouring areas because their own wells are too polluted to use (Lean & Hinrichsen, 1992: 105).

Nitrate pollution is also becoming a problem in Argentina, Brazil and Korea. It often takes decades for nitrates to work their way down through the ground to reach the groundwater, so the problem will worsen as the recent heavy use of fertilisers will only become clear later. Meanwhile fertiliser run off from farm land

pollutes rivers, lakes and the sea where they cause algal blooms in various areas. These toxic blooms are responsible for the death of millions of fish and other forms of aquatic biodiversity (Lean & Hinrichsen, 1992: 105; Morgan, 1995: 124-125).

Heavy biocide (pesticide) use has even had a greater effect where regulations that govern their sound use are often non-existent. These biocides include insecticides, herbicides, fungicides, nematocides and rodenticides. Little is known about the possible negative impact various pesticides have on the environment and biodiversity. The improper use of pesticides costs the USA nearly \$1 billion in losses to agriculture, livestock and wildlife. Some industrialised countries have prohibited the use of some pesticides due to the negative environmental impact they have, but yet they still continue to export them to some Third World countries (Lean & Hinrichsen, 1992: 108).

Volatile pesticides that are applied by tractor or plane may evaporate and drift hundreds of kilometres without getting diluted. In some areas these may condense with clouds on escarpments and cause damage to vegetation. This has been seen in KwaZulu-Natal and it is advised that hormone herbicides are better controlled or their use suspended (Laing, 1990: 41-44).

Pesticides may have the following disadvantages. They affect non-target organisms such as honeybees. Predators that feed on the target organisms may also be affected and when their numbers decrease the target organisms may be benefited. Certain persistent pesticides may accumulate in the food chain and affect other animals and even people. Biomagnification of pesticides results in the death of organisms that are last in the food chain. Populations of birds of prey have decreased as a result of the lethal effect of pesticides that accumulate in the food chain. Pesticides that leach out of the ground may pollute water sources. Target organisms may build up resistance against pesticides that mean that stronger pesticides will have to be used in the future (Hugo, 2004: 24; Morgan, 1995: 125; Miller, 1996: 594-596).

Many pesticides are becoming useless as more and more species develop immunity against them. Fifty years ago, only 7 insects were known to be resistant against pesticides, but this number has increased to more than 500. Twenty years ago, there were no plant pathogens that were resistant to pesticides, but today more than 100 appear to be immune. As pests become resistant to various herbicides, more and more chemicals need to be used that will have a negative impact on the environment. Before the advent of agricultural chemicals about 30% of the world's harvests were lost to pests and weeds. Now, after the vast expansion in pesticide and herbicide use over the last decade, the proportion of crop lost is about the same (Lean & Hinrichsen, 1992: 107).

Many first generation pesticides may be used to deter pests domestically and even commercially. These substances and methods may be naturally derived

from plants or animals or include environmentally friendly methods of pest control. The following pests can be controlled by the use of the following substances: ants (cayenne pepper, mint leaves, boric acid); mosquitoes (planting basil, use of vinegar on skin); cockroaches (sprinkling of boric acid in certain areas in house); flies (planting basil and tansy, using fly paper and traps); flies (essential oils and repellent soaps); and garden pests (spray with solution of tobacco in warm water, garlic, hot pepper and soap mixtures) (Miller, 1996: 592-593).

According to the Environmental Protection Agency, 92% of all U.S. households use one or more pesticides. The average home owner applies two to six times more pesticide per hectares than farmers do (Miller, 1996: 592-593).

3.5.2.7 Regulation of agricultural activities and products

Possible alternative solutions to agrochemical pollution may include:

- Target specific pesticides;
- Reduce longevity of pesticides;
- Prevent water contamination;
- Use of alternative agricultural systems to minimise the use of chemicals. This may include methods such as times of planting to minimise infestation. (Also see discussion on integrated pest management);
- Development of genetic strains that are fairly resistant to pests;
- Better use of natural enemies;
- Use of bio-pesticides;
- Using of insect control hormones;
- Establishment of an independent body to monitor agrochemical use, such as the USA's Environmental Protection Agency, opposed to the current Government authority which currently handles the situation and that may result in conflict;
- Testing of air, water and soil for agrochemical pollution;
- Development of pro active registration process for use of pesticides;
- Control of the end-user of agrochemicals;
- Safe disposal for pesticide containers; and
- Education of farmers and their workers and registration of agrochemical applicators (Laing, 1990: 44-45; Miller, 1996: 601-605; Hugo, 2004: 24; Morgan, 1995: 125).

Integrated pest management offers new hope to this problem by using a variety of ways to control pests. These include natural predators, crop rotation and the use of resistant varieties. It aims to reduce the numbers of pests instead of eliminating them, and the use of pesticides only as a last resort. This kind of management can therefore increase yields and keep the use of pesticides to a minimum (Lean & Hinrichsen, 1992: 106-108).

Cotton yields rose in China's Jiangsu province after IPM was used to cut the use of pesticides by 90%, and cotton grower's profit went up in southern Texas after an almost 88% decrease in insecticide spraying. In 1987, the USA Government concluded that IPM has increased farmer's profits in 15 states by a total of \$579 million per year. Apple growers using IPM in New York State were making \$528 more per hectare, and almond growers in California were getting \$769 more per hectare than the farmers who used traditional pesticides. Integrated Pest Management is however not very popular and still resisted by the larger part of the agricultural community. Consumers are however part of a current movement where support for organic produce is growing and are prepared to pay for it. Although organic farmers are still the minority, their numbers have fortunately grown considerably in the past few years (Lean & Hinrichsen, 1992: 106-108).

Agricultural research in various aspects of agriculture will ensure that agricultural development is encouraged together with sound environmental strategies. Research or scientific experiments that produce genetically altered organisms should ensure that these organisms are not released into the environment without the necessary precautions (IUCN, 2000a: 83).

Release of any genetically altered organism or any organism that is used for biological pest control should be subjected to environmental impact assessment conducted by specialists. The use of any animal tissues for scientific experiments must be carefully regulated to ensure products are not created that can harm natural biodiversity (UNEP, 2002a:126,136).

3.5.3 Summary: Aspects needed to sustain biodiversity in the biological environment

The information discussed in chapter 3, 3.5.1 – 3.5.2 are concisely and generically summarised in Table 8 below. Refer to the discussion for more detail.

Table 8: Concise generic summary of sustainable biodiversity aspects/criteria in the biological environment

Aspect needed to sustain biodiversity in the biological environment
Terrestrial conservation
Establishment of various types of conservation areas to ensure <i>in situ</i> protection and conservation. Sustainable management strategies should be used in these areas (Hugo, 2004: 214-217; Lean & Hinrichsen, 1992: 137-140; Morgan, 1995: 140-141; GRAIN, 2004; Hohmann, 1992a: 92; Hohmann, 1992b:1019).
Establishment of <i>ex situ</i> conservation strategies such as botanical gardens, zoos and gene banks (Miller, 1996: 655).
Public participation and education on conservation strategies (Lean & Hinrichsen, 1992: 144).

Regulation on the trade of threatened and endangered species (Lean & Hinrichsen, 1992: 144).
<i>In situ</i> restocking programmes for threatened and endangered species (Hohmann, 1992c:1508).
Initiatives to overcome habitat fragmentation (Miller, 1996: 646; Cunningham & Saigo, 1997: 285,289,326; Fuggle & Rabie, 1992: 271-272; Brooks <i>et al.</i> , 2002: 212; University of Waterloo, 2004; Miller, 1996: 646; Lean & Hinrichsen, 1992: 137; Van der Walt, 2006).
Regulation of hunting, promotion of sustainable hunting and regulation of hunting methods such as dogs and snares (Hugo, 2004: 154-155; Robinson, 1993:265; Hohmann, 1992c:1551).
Measures to regulate invasive alien species (cats, dogs, goats, rabbits, birds and various species of plants). Special measures should apply to invasive plants in rivers and wetlands (Hugo, 2004: 33-34; Cunningham & Saigo, 1997: 88, 281; Hohmann, 1992b:1025; Morgan, 1995:139; WRI, 2001; RHP, 2003).
Conservation and protection initiatives for migratory species (Lean & Hinrichsen, 1992: 152).
Protection and conservation measures for forests biodiversity and the sustainable use thereof by the public and poor communities (Morgan, 1995: 136; Lean & Hinrichsen, 1992: 65; Holmberg <i>et al.</i> , 1991:16-19; Oxenham & Eberhard, 1990: 61-62).
Regulation of public biodiversity harvesting activities (including <i>muthi</i> markets) to ensure sustainable use thereof (McKean, 2002; KZN Wildlife, 2000; CEROI, 2000).
Public participation and community approach in conservation strategies that include education on the sustainable use of biodiversity resources (Hugo, 2004: 238-239).
Management of agricultural activities
Strategies for sustainable agricultural activities (including sustainable grazing practises) and also erosion prevention and mitigation measures (Hohmann, 1992a:87; Fuggle & Rabie, 1992: 191-203; Cloke & Park, 1985: 427; Smith, 1958: 69-83; Troeh <i>et al.</i> , 1980:395; Cunningham & Saigo, 1997:232; Hugo, 2004: 114-115; Miller, 1996: 567, 623; Dasman, 1972: 255).
Community involvement and education on soil erosion (Lean & Hinrichsen, 1992: 54; Miller, 1996: 516-521; Hugo, 2004: 170-172).
Strategies for the prevention and mitigation of desertification (Garland, 1990: 72).
Strategies to minimise the use of fertilisers to reduce environmental pollution (Lean & Hinrichsen, 1992: 105; Miller, 1996: 591; Morgan, 1995: 124-125).

Regulation on use of commercial and domestic biocides with strict measures for persistent biocides (Laing, 1990: 41-44 Hugo, 2004: 24; Morgan, 1995: 125; Miller, 1996: 594-596; Lean & Hinrichsen, 1992: 107).
Strategies for the registration, monitoring (through independent body) and effective disposal of (left over) pesticides/empty containers (Laing, 1990: 44-45; Miller, 1996: 601-605; MG, 2004).
Regulation on the release of genetically altered organisms (IUCN, 2000a: 83 UNEP, 2002a:126,136).

Source: Created by the author by using information from 3.5.1 – 3.5.2 of chapter three.

3.6 Conclusion

Various aspects are needed to sustain biodiversity, and these may pertain to direct and indirect factors. Direct aspects may include such things as conservation, species introductory programs and propagation initiatives. Indirect issues may relate to aspects such as control of pollution that indirectly influences survival and integrity of many species. These aspects must regulate various aspects in the marine environment, the terrestrial, atmospheric and fresh water environment, and the biological environment to ensure overall survival of biodiversity. In the marine environment harvesting of all marine species should be regulated through various policies and legislative measures. Such measures should effectively ensure the survival of all the species involved. Marine pollution poses a severe indirect threat to most sensitive species, and all activities that contribute to this problem should be eliminated or regulated. Antarctica harbours many economically important species to the Republic and measures should be implemented to ensure the integrity of the Antarctic environment. In the terrestrial, atmospheric and fresh water environment air pollution should be prevented or mitigated where possible, since it may contribute to acid rain, which is detrimental to most species and ecosystems. Human population growth poses an indirect threat to biodiversity and is mainly responsible for urbanization that destroys habitats. Development should therefore be regulated by strict measures and environmental impact assessments should be made to determine the impact of all development activities on biodiversity. Land and aquatic pollution poses a threat to most species and ecosystems, and hazardous substances and radioactive substances are especially detrimental to biodiversity. The use of hazardous substances needs to be eliminated or strictly regulated. The conservation and sustenance of water resources is important to ensure the survival of aquatic biodiversity in an already drought stricken country. Fire is an important ecological part of many South African biomes, but its use must be

regulated to prevent negative ecological changes. Terrestrial conservation is a major aspect that is important in the direct protection of species and associated ecosystems. Adequate areas should be established and managed to ensure the survival of species and systems. Trade in endangered species should be managed according to conservation status of such species. Measures to ban trade in certain species should be implemented where needed. Agriculture is an important economical aspect in South Africa, but may pose a severe threat to species and systems when not regulated effectively. These activities should be controlled through effective measures that encourage economic growth while ensuring justifiable protection to biodiversity.

CHAPTER 4

SOUTH AFRICAN FRAMEWORK ENVIRONMENTAL LEGISLATION

4.1 Introduction

Worldwide concern over environmental degradation is growing considerably as well as in South Africa (Agenbach, 1999:4). The past decade has seen the promulgation of stricter environmental legislation, and complementary administrative procedures (Glazewski, 2000:161). The promulgation of environmental legislation is based on the philosophy of sustainable development. Sustainable development *per se* requires that negative environmental impacts are reduced or eliminated, without compromising maximal economical and social growth (South Africa, 2000:11; Elkington, 1999:73). Sustainable development should take place in such a manner to ensure the survival and sustainability of biodiversity.

The aim of this chapter is to discuss framework environmental legislation in South Africa that creates the basis of environmental legislation. Such legislation should therefore also provide a framework that assists in the protection of biodiversity.

The following framework legislation is discussed in this chapter:

- Constitution of Republic of South Africa;
- National Environmental Management Act 107 of 1998;
- Environment Conservation Act 73 of 1989;
- Convention of Biological Diversity, 1992 (also international law);
- National Environmental Management: Biodiversity Act 10 of 2004; and
- National Environmental Management: Protected Areas Act 57 of 2003.

4.2 The development and scope of environmental law

The forerunner in environmental legislation was the promulgation of the National Environmental Policy Act (NEPA) in the USA. This Act was responsible for the promulgation of stricter environmental legislation, globally and in South Africa (Glazewski, 2000:161).

Environmental law *per se* is a branch of law that regulates direct and indirect impacts on the environment, and holistically co-ordinates environmental problems (Kidd, 1997:6). The environment includes the sum of biophysical, economical, social, and political factors, their interrelationship, and inundation with one another (South Africa, 1992:5). Environmental law originated from several sources such as the Constitution, sectoral legislation, court decisions, custom law, common law, indigenous law, international law (Du Plessis,

2000:47), religious legal systems, and influences of authors (Kleyn & Viljoen, 1996:49-50).

Environmental legislation (all acts, court decisions and supported international commitments) should under ideal conditions protect the integrity and sustainability of biodiversity. These statutes may reflect directly or indirectly on the conservation and management of threats to biodiversity. A single act will therefore not ensure sustainable management and conservation of biodiversity.

Environmental legislation is sectoral and covers the following areas: agricultural resources, land development planning, environmental impact assessment, biodiversity, genetic modification, marine systems, protected areas, biological resource use, water management, mining, energy, natural heritage and pollution control (ETU, 2002).

Environmental legislation amongst others should make provision for the prevention of disturbance to ecological systems, biodiversity loss, land degradation, all forms of environmental pollution, landscape disturbance, and over exploitation of renewable and non-renewable resources (Glazewski, 2000:9-17; Hohmann, 1992a:213).

4.2.1 International environmental law

International law governs the relationships between countries. International environmental commitments manage cross-boundary problems and provide a framework for political and scientific co-operation (Agenbach, 1999:5). In section 231(1) - (5) of the Constitution provision is made for cooperation and ratification of international commitments. According to this section commitments become part of national legislation, once it is enacted as legislation. Section 25 of the National Environmental Management Act 107 of 1998 makes provision for the incorporation of international environmental instruments. The Minister may make a recommendation to Cabinet and Parliament pertaining to the accession and ratification of an international environmental instrument (Glazewski, 2000:45).

Government can be bound to international commitments in the three different ways. When a commitment is signed the State is under an obligation of good faith to refrain from acts that do not comply with the objects of such a commitment. The legal effect is however, influenced by whether a commitment is subject to ratification, acceptance or approval. The State is bound to a commitment when it is stipulated that signing of such a commitment has binding force. Ratification is the formal declaration of the State to be bound to a commitment. When the State has not signed a commitment it can only accede (or adhere) to a commitment, and cannot ratify such a commitment (Agenbach, 1999:6).

4.3 The Bill of Rights and environmental law

The environmental clause in the Bill of Rights, chapter 2 of the Constitution states:

24. *“Everyone has the right-*

*(a) to an environment that is not harmful to their health or well-being; and
(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-*

*(i) prevent pollution and ecological degradation;
(ii) promote conservation; and
(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.”*

The first part of this clause focuses on the importance of a healthy environment to people, and ensures that such an environment does not have a negative impact on the health and well-being of people. In the second part of this clause the focus moves to the protection of the environment. The goal of protecting the environment is to ensure that it will be of benefit to future generations. Protection of the environment is enforced through legislative measures. These measures should ensure the prevention of pollution that may harm people and biodiversity. Measures should also ensure that ecological degradation is prevented. Ecological degradation can be seen as degradation of all biodiversity, people and their interrelationship with each other in the physical environment. Measures should therefore guarantee that these entities are not compromised. This clause further ensures that conservation is promoted. Finally it ensures that social and economical development is guaranteed without compromising ecological integrity. One can therefore conclude that it promotes sustainable development, ensuring that people and biodiversity are equally included in a sustainable framework.

4.3.1 Role of Government and administration

The same principles that apply to the administration, implementation and enforcement of laws in general apply to environmental laws. The Constitution and the passing of other laws have influenced the way in which laws are administered in South Africa. The reason for this can be traced back to the formation of the nine provinces after 1994, and the different approach to powers as well as changes to provincial and local Government structures (Glazewski, 2000:127).

The most important aspect to consider when discussing the administration of environmental law is to realise the importance of the Constitution that creates the

basic framework for legislative, executive and judicial branches of Government (Glazewski, 2000:127).

The Bill of Rights also includes other important sections that are relevant to the environment. These include the property section (section 25), as well as the access to information section (section 32). The Constitution is also important in environmental law since it sets the framework for the administration of environmental laws by national, provincial and local spheres of government. Sustainable development is the driving force behind environmental norms and standards. The powers of national, provincial and local spheres of Government are important in the administration of these laws. The following important chapters of the Constitution (1996) relate to the administration of environmental law:

- Chapter 3 that emphasizes the notion of cooperative governance;
- Chapter 4 that deals with Parliament;
- Chapter 5 that describes the President and National Executive;
- Chapter 6 that deals with the nine provinces; and
- Chapter 7 that deals with Local Government (Glazewski, 2000:128).

Chapter 3 is very important as it makes provision for the resolution of intergovernmental disputes. It ensures that all spheres of Government exercise the powers and functions in a manner that does not encroach on the geographic and functional and institutional integrity of Government in other spheres. Cooperative governance and the resolution of intergovernmental disputes are also discussed in the National Environmental Management Act 107 of 1998. Chapter 3 of this Act makes provision for the compilation of environmental management plans and environmental implementation plans by both national Government departments and provinces to ensure coordination between national spheres of Government, and between national, provincial and local spheres of Government (Glazewski, 2000:127-139).

The nine provinces of South Africa have provincial environmental nature conservation departments. These are unique for every province since they may be a combination of different departments congregated together. The following departments are concerned with the administration of legislation pertaining to the environment and specifically to biodiversity.

Eastern Cape – Department of Economic Affairs, Environment and Tourism;
Free State – Department of Environmental Affairs and Tourism;
Gauteng – Department of Agriculture, Conservation and Environmental Affairs;
KwaZulu-Natal – Department of Traditional and Environmental Affairs;
Mpumalanga – Department of Environmental Affairs and Tourism;
Northern Cape – Department of Agriculture, Nature Conservation and Land Reform, Department of Health and Welfare and Environmental Affairs;
Limpopo – Department of Agriculture, Land and Environment

North West Province – Department of Tourism and Environmental Conservation; and
Western Cape – Department of Environment, Culture and Sport (Glazewski, 2000:127-139).

Some provinces have created statutory Boards that have been given certain environmental functions. For example the Province of KwaZulu-Natal that has the KwaZulu-Natal Nature Conservation Board. Some former self-governing and independent states such as Transkei, Venda, Bophuthatswana and Ciskei no longer exist as legal entities. Many of their statutes and proclamations still apply (see chapter 8). The Environment Conservation Act Extension Act 100 of 1996 as well as the Environmental Laws Rationalisation Act 51 of 1997 extended the application of certain South African legislation to these so-called states (Glazewski, 2000:131).

4.3.2 Functions of national, provincial and local Government

South Africa is not a unitary state, which means that provincial and local Government are not responsible for the enforcement of another sphere's duties, or to impose a duty on, another sphere of Government. An important question arises on when a national sphere can impose laws on provincial and local spheres and when provincial spheres can impose legislation on local spheres. These are later discussed under Schedules 4 and 5 of the Constitution.

The Constitution provides that the national parliament may pass legislation on any matter that has been referred to in Schedule 4, but not Schedule 5, unless it is a matter in which parliament can specifically intervene. One can therefore say that national parliament has exclusive legislative competence to matters that are not specifically assigned to provincial spheres. The Constitution further requires that national legislation must define the various types of municipalities that may be established under the different categories of the municipalities that have been described in the Constitution (Glazewski, 2000:132).

Section 104 of the Constitution makes provision for the competence of provincial spheres. It allows provinces to pass legislation with regard to Schedule 4 and 5 (Table 9), but also to any other matter that it has been assigned to by national legislation. National parliament may therefore assign any of its legislative powers to any other sphere of Government. The provinces therefore exercise concurrent competence with National Government regarding the items that are discussed under Schedule 4, and enjoy exclusive competence in regard to the aspects listed in Schedule 5. National Government may intervene within functional areas listed in Schedule 5 when it is necessary for reasons of environmental concern. An example includes the maintenance of national standards and when it is in the interests of the other provinces or the entire Republic (Glazewski, 2000:127-133).

Schedules 4 and 5 of the Constitution (Table 9) include: "Functional Areas of Concurrent National and Provincial Legislative Competence" and "Functional Areas of Exclusive Provincial Legislative Competence". Both schedules are also divided into Part A and B to deal with local authority competences (Glazewski, 2000:137).

Table 9: Schedules 4 and 5 of the Constitution (1996) dealing with environmental matters that relate to biodiversity matters

Schedule 4		Schedule 5	
Part A	Part B	Part A	Part B
	Air pollution	Provincial cultural matters	
Environment	Municipal health services	Provincial roads and traffic	
Administration of indigenous forest	Municipal public works		Beaches and amusement facilities
Agriculture	Storm water management		Billboards
Health matters	Trading regulations		Control of public nuisances
Cultural matters	Water and sanitation services		Noise pollution
Nature conservation, excluding national parks, national botanical gardens and marine resources			Refuse removal, refuse dumps, and solid waste disposal
Pollution control			
Soil conservation			
Tourism and trade			

Source: Adapted from (Glazewski, 2000:138)

Section 146 of the Constitution further provides that national legislation will prevail over provincial legislation when in the interest of protecting the environment. National legislation will also prevail over provincial legislation when it establishes uniform norms and standards, frameworks and a national policy.

Section 99 provides that a Cabinet member may assign any power or function to a member of the Provincial Executive Council or a Member of the Municipal Council. Section 155 requires provincial Government to establish municipalities in its province and to support the development of such local Government capacities.

Chapter 7 of the Constitution states that every municipality has the right to govern the local Government affairs of its community that are subjected to national and provincial legislation as provided for in the Constitution. It further ensures that the national Government may not compromise a Municipality's right to perform its functions. Section 152 of the Constitution provides that local Government promotes a safe and healthy environment. The Constitution stipulates that municipalities have the authority to administer matters listed under Part B of Schedules 4 and 5 (Table 9). Municipalities also have the power to administrate any matter that has been assigned to it by national or provincial legislation. Finally, the Constitution makes provision for the definition of three categories of municipalities. These are:

- category A municipalities that have exclusive authority in its area;
- category B municipalities that have shared responsibility with a category C municipality; and
- category C municipalities that has authority in an area that includes more than one municipality (Glazewski, 2000:127-139).

4.4 Framework legislation

Framework legislation forms the basis of environmental law, and legislation pertaining to biodiversity. The provisions of these acts are not more important than those of other sectoral legislation, but these create a framework for the promulgation and interpretation of other acts. Within framework legislation norms can be established to guide the formulation of sectoral legislation. Such framework acts therefore form an integral part in the integrity and stability of a holistic composition of legislation that should sustain biodiversity.

The following acts are relevant to framework environmental legislation and biodiversity in particular: the Constitution (as set out above); the National Environmental Management Act 107 of 1998; the Environment Conservation Act 73 of 1989; the Convention of Biological Diversity, 1992 (also international law) that has been signed by the Republic (and therefore forms part of this strategic framework); the National Environmental Management: Biodiversity Act 10 of 2004; and the National Environmental Management: Protected Areas Act 57 of 2003.

(In this Act, and throughout this thesis, sections are discussed thematically and not necessarily in chronological order).

4.4.1 National Environmental Management Act 107 of 1998

Objective

This Act makes provision for aspects that relate to environmental management. It includes sustainable development principles, the establishment of a National Environmental Advisory Forum and Committee for Environmental Coordination, conflict management, fair decision-making, integrated environmental management, compliance, enforcement, management of environmental hazards and the implementation of Environmental Management Cooperation Agreements.

This Act is regarded as a landmark statute in environmental affairs in South Africa. It is the first umbrella national legislation that strives to establish an integrated environmental framework to coordinate diverse and fragmented sectors of South Africa. It places the environment within the process of constitutional transformation. It recognises international principles and practices (Bray, 1999:1).

Principles

Section 2 provides for a list of sustainable development principles. The principles discussed in this section apply throughout the Republic to the actions of all organs of State pertaining to the environment. These principles also apply alongside all other appropriate and relevant considerations. This includes the State's responsibility to respect, protect, promote and fulfil the social and economic rights. The overall objective of these principles is to:

- serve as the general framework within which environmental management plans can be initiated and implemented;
- provide guidelines to which all organs of state must exercise all functions when taking any decision in terms of this Act concerning the protection of the environment;
- serve as principles to which a conciliator should make recommendations; and
- guide the interpretation, administration and implementation of this Act, but also other legislation that is relevant to the management or protection of the environment.

These principles further require that environmental management must place people and their needs at the forefront of its concern. It is also important to realise that the same principles must serve the areas of physical, psychological, developmental, cultural and social interests equitably. In conclusion one can say that development must therefore be socially, environmentally and economically sustainable.

To ensure that development is sustainable, the following aspects should be complied with:

- Disturbance to ecosystems and loss of biological diversity must be avoided or alternatively be minimised and remedied;
- Pollution and degradation of the environment should be avoided or minimised and remedied;
- Waste must be avoided, minimised, reused or recycled and where possible be disposed of in a responsible manner;
- The use of renewable resources and the ecosystems should not be allowed to exceed the level beyond which their integrity is jeopardised;
- The cautious approach should be applied, which takes into account the limits of our current knowledge that may be relevant to the consequences of decisions and actions we may take;
- Negative impacts on the environment should be prevented, minimised or remedied;
- The environmental impacts of activities must be assessed and evaluated and decisions must reflect the nature of such assessments;
- Any person responsible for environmental damage, degradation or pollution will be responsible to remedy, and prevent any further, such impacts on the environment;
- Sensitive, vulnerable, highly dynamic or stressed ecosystems must receive special attention.

Government departments are therefore obliged to take biodiversity into account whenever decisions are made that may affect the environment. One can use the example when establishing protected areas and housing projects.

Housing and the environment

Government Notice 621 of 16 March 2001 makes provision for an environmental implementation plan that has been promulgated by the Department of Housing. This notice describes the environmental impact that housing has on the environment. The National Environmental Management Act requires that national and provincial departments who exercise functions that may affect the environment (schedule 1 of this Act) prepare such a plan and regularly monitor it. National and provincial departments that exercise functions that impact on the management of the environment (schedule 2) must prepare an Environmental Management Plan. The Department of Housing is listed in Schedule 1, and is therefore required to prepare an Environmental Implementation Plan. It describes that housing may have a negative impact on the environment and that these projects may result in the loss of topsoil and pollution of the environment. Informal settlements may impact drastically on highly sensitive ecosystems such as mountain slopes, streams and estuaries.

Since development may have a negative impact on biodiversity, compliance with the above notice is important in ensuring that the value of biodiversity is assessed in areas that may be subjected to urban development.

Administrative bodies

Section 3 makes provision for the establishment of a National Environmental Advisory Forum. The objects of the Forum are to inform the Minister on views of stakeholders regarding the provisions of Section 2 of this Act. Such a Forum should also advise the Minister on any matter concerning environmental management as well as the achievement of objectives and priorities for environmental governance.

Such a forum should under ideal conditions advise the Minister on issues that pertain to biodiversity and the management thereof.

Committee

Section 7 makes provision for the establishment of the Committee for Environmental Coordination. The object of the Committee is to promote the integration and coordination of environmental functions by the relevant organs of state, and to promote the provisions of environmental implementation and management plans. The committee has the following functions:

- To scrutinise, report and make recommendations on the environmental implementation plans;
- To investigate and make recommendations that are relevant to the functions between organs of state or any other law affecting the environment;
- To investigate and recommend on mechanisms in each province, after consulting with the Member of the Executive Council, to designate a single point in the province for the receipt of applications for authorisations, licences and similar permissions;
- To initiate harmonisation of the environmental functions of all relevant national departments and spheres of government; and
- To advise the Minister on guidelines for the preparation of environmental management plans and environmental implementation plans.

This is an important aspect since such recommendations and plans may influence the integrity of biodiversity.

Section 8 makes provision for the composition of the committee. The Committee may request persons to assist it in the execution of its functions or invite persons to attend its meetings and to assist it in carrying out its functions.

This is an important aspect since the input of specialists is needed to ensure an effective and integrated plan can be compiled. Various specialists may ensure the efficiency of such a plan.

Section 10 ensures that the Committee presents an annual report on its activities to the Minister. These may include various environmental management plans in which biodiversity aspects have been dealt with.

Management plans

Section 11 makes provision for environmental implementation and management plans. Every national department and province must prepare an environmental implementation plan at least every 4 years.

Notices

Government Notice 920 of 15 September 2000 makes provision for a Consolidated Environmental Implementation and Management Plan. Its main purpose is to “coordinate and harmonise the environmental policies, plans and programmes” in order to minimise duplication and promote consistency in fulfilling functions with other organs of state.

These plans are important since they may contain information pertaining to the integrity and management of biodiversity.

Government Notice 659 of 17 May 2002 makes provision for a First Edition Environmental Implementation Plan by the National Department of Agriculture. It includes a list of directorates that are responsible for the regulation of activities pertaining to the environment.

The following are included: Directorate Farmer Settlement and Development; Directorate Agricultural Land Resource Management; Directorate Agricultural Water Use Management; Directorate Genetic Resources; Directorate Veterinary Services; Directorate Plant Health and Quality; and Directorate Agricultural Production Inputs. These have various general functions, but are directly or indirectly relevant to biodiversity.

The function of the Directorate Farmer Settlement and Development is to ensure sustainable agriculture for various regions and that these activities do not cause environmental degradation, as well as to ensure the protection of agricultural resource. He or she should ensure that environmental impact assessments are carried out when relevant. The Directorate Agricultural Land Resource Management should regulate: environmental management and auditing; eradication of invader plants; and ensure sustainable use of natural resources. The Directorate Agricultural Water Use Management should ensure the conservation of water resources and soil, and should ensure that environmental impact assessments are carried out where needed.

The Directorate Genetic Resources is responsible for the regulation of genetically altered organisms and to ensure that such resources do not have a

negative impact on the environment. The Directorate Veterinary Services is responsible for the management of animal health and veterinary diseases. The Directorate Plant Health and Quality should manage import control, quarantine management; and export control as well as to ensure that adequate measures are taken when any exotic species or invasive plant species are released that may become invasive. The function of the Directorate Agricultural Production Inputs is to advise on registration of fertilizers, farm feeds, agricultural remedies, stock remedies, sterilizing plants and pest control officers. He or she should also be responsible for the disposal of obsolete pesticides, empty pesticide containers, and the phasing out of methyl bromide.

Section 12 defines the purpose of environmental implementation plans and environmental management plans. These plans should coordinate and harmonise environmental policies, plans, programmes and decisions.

Notice under section 12

Government Notice Regulation 552 of 27 May 2002 defines an Environmental Management Plan as developed for the Department of Labour. Such plan should make provision for the sustainable protection of the environment. It also supports environmental rights in terms of Section 24 of the Constitution of the Republic of South Africa.

Section 13 and 14 defines the contents of environmental implementation plans. According to the Section environmental implementation plans should include the following aspects:

- a description of policies, plans and programmes relevant to the environment;
- measures to assist the relevant national department or province to comply with the policies, plans and programmes as determined by the provisions of this Act;
- recommendations to ensure the objectives and plans for the implementation of the procedures and regulations are met.
- a description of the functions of the relevant department suitable to the environment;
- a description of environmental norms and standards;
- a description of policies, plans and programmes that are designed to ensure compliance with aspects relating to the provisions of this Act;
- a description of priorities concerning compliance to the Department's policies by any other person or party;
- a description of the extent of compliance;
- a description of measures to ensure cooperation with other national or Government departments; and
- proposals for the promotion of the objectives and plans.

These plans are important since they may contain information pertaining to biodiversity.

Section 15 makes provision for submission, scrutiny and adoption of environmental implementation plans and environmental management plans.

Section 16 makes provision for compliance with environmental implementation plans and environmental management plans. Every organ of state must use every power it may have in accordance with the environmental implementation plan or the environmental management plan to ensure compliance with these plans. (If biodiversity is referred to in these plans, it could ensure a powerful mechanism to protect biodiversity).

Notices

Government Notice 249 of 16 February 2001 makes provision for measures to ensure the operation of Environmental Implementation Plans and Environmental Management Plans under section 15 (1). The defence policy on the environment makes provision for the protection of species and habitats, and the conservation of biodiversity and natural resources.

Government Notice 435 of 23 February 2001 makes provision for the publication of Environmental Management Plan under section 15(2) (b) of this Act (see also sectoral legislation chapter 6, 6.2.13, on mining activities). The National Environmental Management Act 107 of 1998 requires that national and provincial departments listed in Schedules 1 and 2 of this Act prepare Environmental Implementation Plans and Environmental Management Plans within one year of the promulgation of this Act.

This regulation further requires that Environmental Management Plans comply with the polluter pays principle, waste minimisation as well as the relevant standards of environmental impact management. This regulation includes a list of international conventions that regulate various mining activities described in the environmental management plans (international agreements are discussed separately in sectoral legislation chapters). Requirements for authorisation to mine or prospect are summarised in this regulation (discussed under later chapters). It also contains other national legislation, provincial ordinances and local bylaws that may be applicable mining and/or other energy related matters.

Government Notice 435 also ensures compliance and performance monitoring of the policies, programmes and legislative requirements of the Department of Minerals and Energy Affairs. Such monitoring should be in concurrence with the principles of the National Environmental Management Act.

Environmental impacts

Government Notice 246 of 14 November 1997 sets out a description of environmental impacts that can be expected to occur with the undertaking of certain military activities by the Department of Defence. Negative environmental impacts such as wastes can be expected when forces are deployed in a certain area. These may result in water, soil, and atmospheric pollution and localised damage to natural vegetation may occur. In the absence of necessary mitigation and rehabilitation measures the impact of such activities may increase over time. The Department of Defence has created a system that seeks to provide an overarching framework to ensure that its activities comply with the principles of the relevant National Environmental Management Act principles in section 2 of this Act.

Integrated environmental management and EIA

Section 23 makes provision for general objectives to promote the application of environmental management tools to ensure effective integrated environmental management.

Legislation pertaining to EIA is also found under the Environment Conservation Act (4.4.2), but has been replaced by the following relevant regulations under this Act.

Section 24 makes provision for measures to manage activities that may have a negative impact on the environment. This section has been amended by the National Environmental Management Amendment Act 8 of 2004.

To ensure that the objectives of this Act are met, activities requiring authorisation because they may significantly affect the environment, must be assessed prior to their implementation. The relevant Government authority is responsible for granting permission for such activity. The Minister may after consultation with the member of the executive council:

- identify activities that need authorisation from the Minister or relevant Government authority before being undertaken;
- identify geographical areas where certain activities may not be undertaken without authorisation from the Minister;
- make regulation in respect to such authorisations;
- identify existing activities which must be evaluated, assessed and reported; and
- compile information and maps that specify the attributes of the environment to be taken into account when considering any activity that needs authorisation.

The following aspects are taken into consideration during environmental impact assessment:

- investigation into possible impact on environment;
- alternative development options;
- mitigation options;
- public participation between affected and interested parties;
- use of effective assessment methods;
- coordination between various Government organs;
- determination of report requirements;
- effective administration; and
- issues that relate to provincial and national borders.

Notice 657 of 16 May 2006 also provides general administrative guidelines for the undertaking of the public participation process during the EIA process.

Sections 24A-24I make provision for:

- listing of activities and geographical areas;
- identification of a competent authority;
- conditions for the authorisation of activities;
- penalties for the unlawful undertaking of listed activities;
- provisions for the establishment of registration authorities (a group of impact assessors may apply to the MEC to form a registration authority); and
- the appointment of independent specialists to review environmental impact assessment reports when needed.

This section is especially relevant to biodiversity that may be affected by certain development activities. The use of environmental impact assessment may prove useful in determining the impact these activities may have on biodiversity.

Notice under section 24

Notice 12 of 14 January 2005, under section 24 of the National Environmental Management Act makes provision for aspects that relate to environmental impact assessment. This Notice consists of 40 regulations (sections that are called regulations) and the relevant regulations will be discussed here. It *should not* be confused with the separate *sections* of the particular Act.

Regulation 3 defines the general responsibilities of the applicant (for EIA) and it ensures that such applicant is responsible for:

- appointment of independent environmental impact assessor;
- provide the impact assessor and relevant authority with all information regarding the proposed activity;
- costs relating to EIA;
- appointing a competent impact assessor; and

- ensure adequate public participation.

Regulation 4 makes provision for the general responsibilities of environmental impact assessors and include:

- competency to undertake EIA;
- undertaking of objective work;
- having no financial interest in the activity;
- undertaking public participation; and
- provision of all information to competent authority.

The competent authority may remove the impact assessor from any project when it comes to the attention of the authority that such applicant may gain benefit from such activity.

Regulation 5 makes provision for public participation. Regulation 6 defines the responsibilities of the competent authority and these include:

- appointment of competent officers to evaluate assessment reports;
- evaluating these reports within a reasonable time frame;
- assisting the applicant with any information needed to successfully undertake the EIA process; and
- proposing alternatives and mitigation options regarding the proposed activity.

Regulation 7 makes provision for measures that regulate the authorisation of activities. It requires the undertaking of a screening process during the application process for the undertaking of category I activities. It further requires the undertaking of scoping and environmental impact assessment during the application for category II activities. Regulation 8 ensures that the competent authority may request an applicant to undertake any activity in regard to the submission of reports.

Regulation 9 defines the objectives of the screening report and these include descriptions of: activity; environment; public participation; environmental impacts and mitigation measures. Regulation 10 provides the competent authority with the authority to accept the application, reject such application or require the applicant for additional information regarding the proposed activity. Regulation 11 makes provision for the compilation of a scoping report and the following aspects are required:

- description of the proposed activity;
- expected impacts;
- alternative options or activities;
- public participation; and
- need for specialist input.

Regulation 12 provides that the competent authority may accept or reject the undertaking of proposed activity or require an environmental impact assessment. Regulation 13 defines the contents of the environmental impact report and these are:

- a complete description of the proposed activity;
- detailed discussion of expected impacts;
- alternative options or activities;
- full undertaking of public participation; and
- discussions of specialist reports.

Regulation 14 defines the objectives of the specialist report and these include:

- qualifications and competency of specialist;
- purpose and scope of report;
- methodology;
- gaps in knowledge;
- findings and potential implications;
- mitigation measures; and
- public participation.

Regulation 17 provides that the competent authority may refuse or grant authorisation for the undertaking of such proposed activity.

Regulation 18 describes the guidelines for the issuing of environmental considerations and these are:

- section 24 of the Constitution;
- principles of this Act;
- objectives of environmental policies;
- other relevant legislation;
- objectives of international instruments;
- possibility of environmental pollution and degradation;
- cumulative impacts; and
- Mitigation and rehabilitation possibilities.

Regulation 21 ensures that the competent authority may request any additional mitigation measures or other measures when granting authority to undertake such proposed activity.

Regulation 22 identifies category I activities that require screening and these include the following:

*“(1) The construction of new facilities or infrastructure, including associated structures or infrastructure, for –
(a) the manufacturing, storage, testing or disposal of explosives including*

ammunition, but excluding licensed retail outlets and the legal end use of such explosives;

(b) the storage of more than 1 000 tons of ore;

(c) the storage of more than 250 tons of coal;

(d) hospitality and recreational purposes, including resorts, lodges, hotels and other tourism or hospitality facilities where -

(i) more than 20 guests can be accommodated overnight;

(ii) there are more than 10 guest units;

(iii) the facility will cover an area in excess of 1 hectare; or

(iv) there is no connection to a municipal sewerage system;

(e) golfing activities including -

(i) driving ranges; or

(ii) golf courses covering less than 10 hectares;

(f) sport and associated recreation activities where -

(i) the facility will have a capacity to hold more than 8 000 people; or

(ii) the facility will cover an area in excess of 3 hectares;

(g) the slaughter of animals and the processing of animal products and by-products with a product throughput in excess of 10 000 kilogram per year;

(h) the concentration of animals for the purpose of commercial production in densities that exceed -

(i) 20 square metres per unit of cattle and more than 500 units per year,

(ii) 8 square meters per unit of sheep and more than 1 000 units per year;

(iii) 8 square metres per unit of pigs and more than 250 units per year excluding piglets that are not yet weaned;

(iv) 30 square metres per unit of crocodiles at any level of production, excluding crocodiles younger than 6 months;

(v) 3 square metres per unit of poultry and more than 250 units at any time, excluding chicks younger than 20 days;

(vi) 3 square metre per unit of rabbit at and more than 250 units at any time; or

(vii) 100 square metres per unit of ostriches and more than 50 units per year;

(i) commercial aquaculture production including mariculture and algae farms with a product throughput of more than 10 000 kilograms per year;

(j) agri-industrial purposes outside areas zoned for industrial purposes and that cover an area of more than 1 000 square metres;

(k) the bulk transportation of sewage and water in pipelines or channels with -

(i) an internal diameter of 0,36 metres or more; or

(ii) a maximum peak throughput of 120 litres or more per second;

(l) the production of clay bricks and clay or ceramic tiles;

(m) the transmission and distribution of above ground electricity with a capacity of less than 120 kilovolt, but more than 20 kilovolt;

(n) any purpose in the one in a hundred year flood line of a river or stream, or within

30 metres from the bank of a river or stream where the flood line is unknown, including -

(i) canals;

(ii) channels;

- (iii) bridges;
- (iv) dams; and
- (v) weirs;
- (o) the off-stream storage of water, including dams and reservoirs, with a capacity of 80 000 cubic metres or more;
- (p) the recycling, handling, temporary storage or treatment of waste with a daily throughput capacity in excess of 10 cubic metres;
- (q) the cremation of human or animal tissue;
- (r) horseracing;
- (s) polo and polo-cross;
- (t) the landing, parking and maintenance of aircraft including -
 - (i) helicopter landing pads;
 - (ii) structures for equipment and aircraft storage;
 - (iii) structures for maintenance and repair;
 - (iv) structures for fuelling and fuel storage; and
 - (v) structures for air cargo handling; or
- (u) the outdoor racing of motor powered vehicles including -
 - (i) motorcars;
 - (ii) trucks;
 - (iii) motorcycles;
 - (iv) boats; and
 - (v) jet skis.
- (2) Construction or earth moving activities in the sea and extending for a distance of 100 metres inland of the high-water mark of the sea, including the construction of –
 - (a) small harbour facilities for commercial and recreational vessels or craft;
 - (b) facilities associated with the arrival and departure of vessels and the handling of cargo;
 - (c) facilities for the storage of material and the maintenance of vessels;
 - (d) fixed or floating jetties and slipways;
 - (e) piers;
 - (f) breakwater structures;
 - (g) tidal pools; or
 - (h) buildings.
- (3) The prevention of the free movement of sand, including erosion and accretion, by means of planting vegetation, placing synthetic material on dunes and exposed sand surfaces for a distance of 100 metres inland of the high-water mark of the sea.
- (4) The dredging, excavation, removal or moving of soil, sand or rock exceeding 5 cubic metres from a river, tidal lagoon, tidal river, floodplain or wetland.
- (5) The removal or damaging of natural vegetation for a distance of 100 metres inland of the high-water mark of the sea.
- (6) The excavation, moving, removal, depositing or compacting of soil, sand, rock or rubble covering an area exceeding 10 square metres for a distance of 100 metres inland of the high-water mark of the sea.

- (7) Filling stations or any other facility for the underground storage of petrol, diesel or paraffin.*
- (8) The above ground storage, including temporary storage, of petrol, diesel or paraffin in containers with a combined capacity of more than 30 cubic metres at any one location or site.*
- (9) Borrow pits, other than borrow pits identified in regulation 23.*
- (10) The manufacture of charcoal and coke.*
- (11) The establishment of cemeteries.*
- (12) The decommissioning of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of more than 10 hectares.*
- (13) The abstraction of groundwater at a volume where any general authorisation granted in terms of the National Water Act, 198 (Act No. 36 of 1998) for groundwater is to be exceeded or the borehole is within 100 metres of another user, spring, wetland, surface water body or river.*
- (14) The transformation or removal of indigenous vegetation in excess of 3 hectares.*
- (15) The planting of tree plantations or the expansion of existing plantations, but excluding community woodlots smaller than 3 hectares.*
- (16) The construction of masts and towers, including those used for telecommunication, broadcasting or radio transmission, where the height of the mast or tower structure as measured from its base is higher than 15 metres;*
- (17) The transformation of undeveloped land to –*
 - (a) establish infill development covering an area of 5 hectares or more; or*
 - (b) establish residential, mixed use, retail, commercial, industrial or institutional use with a structure footprint of 1 hectare or more where such development does not constitute infill.*
- (18) Phased development activities where any one phase of a development activity may be below a threshold in these regulations but a combination of the phases will exceed the threshold.*
- (19) The subdivision of land into portions smaller than 5 hectares.*
- (20) The development of a new facility or the transformation of an existing facility for the conducting of manufacturing processes, warehousing, bottling, packaging, or storage, which occupies an area in excess of 1000 square metres outside an existing area zoned for industrial purposes.*
- (21) The transformation of public open space or a protected area to another use.*
- (22) The release of genetically modified organisms into the environment in instances where it is required by the Genetically Modified Organisms Act, 1997 (Act No. 15 of 1997) or the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).*
- (23) The use of any organism for biological control.*
- (24) The decommissioning of mining, quarrying, prospecting or other mineral extraction operations that commenced before 1991.*

(25) The decommissioning of existing facilities or infrastructure, other than facilities or infrastructure that commenced under an environmental authorisation issued in terms of these regulations, for -

- (a) electricity generation;*
- (b) nuclear reactors and storage of nuclear fuel;*
- (c) industrial activities where the facility or the land on which it is located is contaminated or has the potential to be contaminated by any material which may place a restriction on the potential to re-use the site for a different purpose;*
- (d) the disposal of waste;*
- (e) the treatment of effluent, wastewater and sewage with an annual throughput capacity of more than 15 000 cubic metres;*
- (f) the recycling, handling, temporary storage or treatment of waste with a daily throughput capacity of more than 10 cubic metres; or*
- (g) the cremation of human or animal tissue;*

(26) The recommissioning or use of facilities or infrastructure, after a period of two years from closure, or temporary closure, excluding facilities or infrastructure that commenced under an environmental authorisation issued in terms of these regulations, for -

- (a) electricity generation;*
- (b) nuclear reactors and nuclear fuel storage; or*
- (c) facilities for any industrial process or activity, which requires a new permit or license in terms of legislation governing the release of emissions, pollution, effluent or waste to air, water or soil;*

(27) The expansion or upgrading of existing facilities for any industrial process or activity, which requires an amendment of an existing permit or license or a new permit or license in terms of legislation governing the release of emissions, pollution, effluent or waste to air, water or soil"

Regulation 22 further makes provision for the identification of geographical areas by a competent authority to manage certain activities in a specified way.

Regulation 23 identifies category II activities that require environmental impact assessment and these include the following in terms of regulation 23:

"(1) The construction of new facilities or infrastructure, including associated structures or infrastructure, for -

- (a) the generation of electricity where –*
 - (i) the electricity output is 10 megawatt or more; or*
 - (ii) the facility covers an area in excess of 1 hectare;*
- (b) nuclear reaction including the production, enrichment, processing, reprocessing, storage or disposal of nuclear fuels, radioactive products and waste;*
- (c) any industrial process or activity, which requires a permit or license in terms of legislation governing the release of emissions, pollution, effluent or waste to air, water or soil;*

- (d) the use, recycling, handling, treatment, storage or final disposal of hazardous wastes;
- (e) the extraction or processing of natural gas including gas from landfill sites;
- (f) the bulk transportation of dangerous goods using pipelines, funiculars and conveyors with a daily throughput capacity in excess of 50 tons or 50 cubic metres;
- (g) the landing, parking and maintenance of aircraft excluding unpaved landing strips shorter than 1,4 kilometres in length and helicopter landing facilities and stops used exclusively by emergency services, but including -
 - (i) airports;
 - (ii) runways;
 - (iii) waterways; or
 - (iv) structures for engine testing;
- (h) coastal marinas and harbours;
- (i) the transmission and distribution of above ground electricity with a capacity of 120 kilovolt or more;
- (j) marine telecommunication infrastructure;
- (k) the transfer of more than 20 000 cubic metres of water between water catchments or impoundments per day;
- (l) the final disposal of general waste covering an area in excess of 100 square metres or 200 cubic metres of airspace;
- (m) the treatment of effluent, wastewater and sewage with an annual throughput capacity of more than 15 000 cubic metres;
- (n) the incineration, burning, evaporation, thermal treatment, roasting or heat sterilisation of waste or effluent;
- (o) the microbial deactivation, chemical sterilisation or non-thermal treatment of waste or effluent;
- (p) rail transportation, excluding railway lines and sidings in industrial areas and underground railway lines in mines, but including -
 - (i) railway lines;
 - (ii) stations; and
 - (iii) shunting yards; or
- (q) golfing activities including -
 - (i) golf courses covering 10 hectares or more; and
 - (ii) golf estates that comprise of golf courses of any size and residential housing.
- (2) Any new development activity where the total area of the site is in excess of 20 hectares.
- (3) The extraction of peat.
- (4) The route determination and construction of roads and associated infrastructure where –
 - (a) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998);
 - (b) it is a road administered by a provincial authority;
 - (c) the road reserve is wider than 30 metres; or

(d) the road is designed to carry a high volume of traffic of more than 700 vehicles per lane per day with an equivalent standard axle (80 kilo Newton) pavement class of 3 or more.

(5) The construction of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of more than 10 hectares.

(6) The mining, quarrying, prospecting, extraction or production, including associated structures and the extension of existing operations, of -

(a) ferrous and base metals;

(b) precious metals;

(c) coal;

(d) diamonds;

(e) heavy minerals;

(f) asbestos;

(g) industrial minerals;

(h) gemstones;

(i) clay;

(j) silica; or

(k) dimension stone.

(7) In accordance with the provisions of section 24(2)(c) of the Act, an MEC may exclude activities listed under (1)(p), (1)(q), (2) and (4), as appropriate, where –

(a) an area which is managed by any authority for which an environmental management framework that makes provision for the proper management of the activities to be managed in terms of the environmental management framework has been approved by the competent authority; or

(b) an area is not sensitive to certain activities due to its nature or zoning as identified by the competent authority”

Regulation 24 makes provision for the identification of geographical areas in which specified activities require environmental authorization. These areas may include areas that may contain specific forms of biodiversity that need protection. These activities include the following in terms of regulation 24 (2):

“(2) Activities listed that may be specified by an MEC as requiring environmental authorisation in a geographic area include –

(a) the construction of new facilities or infrastructure or the upgrade or expansion of existing facilities or infrastructure, including associated structures, for –

(i) the manufacture of cement bricks and products;

(ii) vehicular transport, including tracks, where natural vegetation in excess of 250 square metres must be removed, or material to construct a road must be imported from a borrow pit;

(iii) marinas and the launching of watercraft on inland waters;

(iv) above ground cableways and funiculars;

(v) landing and take-off of aircraft;

(vi) driving of 4x4 vehicles;

- (vii) the generation of water pressure by means of elevated water pressure tanks with a combined capacity of 10 000 litres or more;*
- (viii) the treatment or disposal of effluent, wastewater and sewage with a yearly throughput capacity of more than 100 cubic metres;*
- (ix) advertisements as defined in classes 1(a), 1(b), 1(c), 1(d), 2(g), 3(a), 3(b), 3(k), 4(b) and 5(a) of the South African Manual for Outdoor Advertising Control;*
- (x) resorts, lodges, hotels and other tourism or hospitality facilities;*
- (xi) camping and picnicking where the site covers an area in excess of 500 square metres;*
- (xii) sporting activities with a capacity to hold more than 1 000 spectators, or covering an area in excess of 1 hectare; or*
- (xiii) the abstraction of water directly from natural sources, including streams and aquifers, where the daily extraction will exceed 10 000 litres per day or more than 50% of the flow volume of a stream;*
- (b) the construction of masts, towers and poles, including those used for telecommunication, broadcasting or radio transmission where the height of the mast, tower or pole structure as measured from its base is higher than 7 metres;*
- (c) the new or initial fitment of telecommunication or radio reflector or antenna dishes with a diameter in excess of 3 metres and other types of antennas with dimensions of which any part falls outside a box of 3 metres long, 0,4 metres wide and 0,4 metres deep, whether fitted to a pole, mast, tower, building or any other existing structure;*
- (d) the establishment of new or the extension of existing cultivated agricultural fields in excess of 500 square metres;*
- (e) the transformation or removal of indigenous vegetation in excess of 500 square metres;*
- (f) the development or redevelopment of areas for the purposes of residential, mixed, commercial, retail, industrial, agri-industrial, institutional and educational use"*

Court case

This discussion is relevant to EIA and was previously referred to under the Environment Conservation Act.

In *Myburgh Park Langebaan (Pty) Ltd v Langebaan Municipality and Others* 2001 (4) SA 1144 (C) a property developer applied for amendment of the zoning conditions of the area he intended to develop. A dispute regarding the legal prerequisite for development of land falling within a protected natural environment ensued. The property developer applied for *declarator* to determine whether written authorisation in terms of section 22(1) of the Environment Conservation Act should be a prerequisite for the proposed development of land. The applicant had installed bulk services in the area to be developed, and the court determined that in doing so the applicant acted *bona fide* upon authority of permits and approvals granted at the time. The area in question could be zoned

as sub divisional area and not open space. The court therefore concluded that the development application did not require written authorisation in terms of section 22(1) of Environment Conservation Act.

Development should not take place without any written permission from the relevant authority. In this case such activity may have impacted negatively on biodiversity.

Environmental management frameworks

Regulation 25 makes provision for the objectives of environmental management frameworks and these are:

- the making of informed decisions in certain geographical areas regarding the undertaking of specified activities;
- identification of environmental and conservation principles;
- consideration of environmental attributes when making strategic environmental decisions; and
- facilitate cooperative governance relating to environmental management.

Regulation 26 makes provision for the compilation of environmental management frameworks with the objective to harmonize development in regard to environmental resources and attributes. Regulation 27 ensures that such a plan should include all the relevant environmental parameters for specific areas to guide development on a sustainable level.

Regulations 28-40 make provision for measures that relate to administration of this regulation.

Notice 657 of 16 May 2006 makes provision for the compilation of environmental management frameworks. Emphasis is also placed on the potential value of biodiversity in such an area and its conservation potential.

Environmental instruments

Section 25 makes provision for the Incorporation of international environmental instruments. The Minister may make a recommendation to Cabinet and Parliament pertaining to the accession and ratification of an international environmental instrument. When the Republic is party to an international environmental instrument the Minister may publish the provisions of the international environmental instrument in the *Gazette* and may amend or add to such instruments where necessary. The Minister may introduce legislation to Parliament or make any regulations necessary to give effect to an international environmental instrument to which the Republic is a party. Section 27 ensures that these provisions apply to any international environmental instrument which to the Republic is party to.

Any instrument that may protect biodiversity may prove beneficial in ensuring the sustainability of biodiversity in the Republic.

Remediation of environmental damage

Section 28 makes provision for remediation of environmental damage. Every person who is responsible for any significant pollution or degradation of the environment must take measures to prevent such pollution or degradation. When such a responsible person cannot stop such pollution or degradation to the environment, he or she must minimise or rectify any such impacts on the environment. A relevant Government authority may request such responsible person or party to assess the impact of such activities on the environment and report on them. Such a person may be instructed to take certain measures within a determined time frame, and continue with such measures within a reasonable date. Section 30 makes provision for the control of emergency incidents.

It is important to manage such incidents as soon as possible to minimise the effect on biodiversity.

Environmental management inspectors and enforcement

Section 20 makes provision for investigation. The Minister may appoint persons to assist him or her in the evaluation of a matter relating to the protection of the environment by obtaining information relevant to such evaluation.

Section 31H identifies and discusses the general powers of environmental management inspectors. Section 31I makes provision for the seizure of items by an environmental management inspector. When a threatened, protected, or alien species is seized under the provisions of this section, the environmental management inspector may request any person importing such specimen to provide the necessary legal documentation and permits. In the case of a threatened or protected species to be exported the person responsible for such action should provide the necessary export permit and other legal documentation. Section 34E makes provision for the treatment of seized living specimens. While criminal proceedings are taking place all confiscated living specimens must be placed in a rescue centre that can properly care for it.

Section 31J makes provision for powers to stop, enter and search vehicles, vessels and aircraft. Section 31K makes provision for routine inspections, and allows an environmental management inspector the power to inspect any object without a warrant. Section 31L makes provision for the power to issue compliance notices by environmental management inspector when any person has not complied with a provision of legislation over which such inspector has authority on or any condition of a permit or authorization. Section 31O makes provision for Powers of South African Police Service members. A member of the South African Police Service has all the powers of an environmental management inspector in terms of enforcement of this Act. Section 34A as

amended by the National Environmental Management Amendment Act 46 of 2003 ensures that living seized specimens are sent to rehabilitation centers to ensure their survival. Section 34C makes provision for the cancellation of permits. A court that convicts a person of an offence under this Act or any specific environmental management Act, can cancel a permit.

The above sections may affect biodiversity because these are relevant to the way in which biodiversity may be protected.

Section 44 makes provision for aspects that should be considered in the promulgation of regulations in general. The Minister may make regulation regarding:

- the prohibition, restriction or control of any activity that may have a detrimental impact on the environment;
- respect to different activities, provinces, geographical areas and owners or classes of owners of land; and
- directives that ensure that certain offences under this Act constitute criminal offences and prescribe penalties for such offences.

Notice under section 44 Vehicles in the coastal zone

Government Notice 1399 of 21 December 2001 makes provision for the Control of vehicles in the coastal zone. No person may use a vehicle in the coastal zone, unless such person has been authorised to do so. Use without a permit is only allowed on public roads, private land, mining activities, harbour activities, emergency use, or use by officials. The Director General may designate areas for recreational use by vehicles, and activities in such areas should not cause harm to the environment. Such declaration should only be allowed after adequate consultation and after the relevant environmental impact assessment has been undertaken. It also provides conditions under which the Department of Environmental Affairs and Tourism or any other relevant authority may grant any person permission to use a vehicle in the coastal zone. Provision is also made for conditions under which boats may be launched from launching sites in the area. An applicant who wants to use a vehicle in the coastal zone should undertake an environmental impact assessment. The applicant or a qualified person may undertake such assessment. Officers that evaluate applications should have the necessary expertise to make an effective decision. The authority may stipulate any additional conditions of compliance before authorisation is granted. A record of decision should note all relevant details regarding the issuing of authorisation. Any person who contravenes any provision of these regulations will be guilty of an offence and liable for conviction and a fine of up to R10 000 or imprisonment for up to two years. A person may also be liable for both a fine and imprisonment.

(In this Act, and throughout this thesis, amounts for fines are indicated when mentioned by the particular act. Some acts do not mention amounts for fines).

Section 47 ensures that environmental management inspectors enforce the provisions of this Act. Notice 1424 of 12 August 2005 makes provision for qualification criteria and training of environmental management inspectors as determined by the relevant authority.

Bylaws

Section 46 makes provision for the promulgation of model environmental management bylaws. The Minister may make model bylaws for the management of environmental impacts within the jurisdiction of a municipality.

Aspects not covered by this Act

- *Increased population growth that is ultimately the indirect cause of uncontrolled development poses a threat to natural resources and ultimately to biodiversity (also see 3.4.2.1 and Table 7).*
- *Measures to regulate the disposal of corpses in the face of the high HIV/AIDS mortality rate. Due to the impact of this disease on the human population, an exponential increase in deaths can be expected in the next 10 to 15 years. Informal and formal graveyards cover large areas of land, and compromise soil structures, destroying the pristine character of the area. All plants are usually destroyed in these areas as a result of the excavation process. Associated fauna will also ultimately disappear from the area (also see 3.4.2.2 and Table 7).*

4.4.2 Environment Conservation Act 73 of 1989

General objectives

This Act makes provision for general measures to protect the environment. It includes classification and establishment of protected areas, regulation of waste and littering and the establishment of limited development.

Certain parts of this Act have been repealed by environmental legislation. The Biodiversity Act and National Environmental Management Act repealed various parts of this Act. (See also chapter 4, 4.4.4).

Classification of protected areas

Government Notice 449 of 9 May 1994 makes provision for a general policy on classification of terrestrial and marine protected areas under section 2 of this Act. It makes provision for the classification of 5 types of protected areas that include: scientific reserves and wilderness areas; national parks and equivalent reserves; natural monuments and areas of cultural significance; habitat and wildlife management areas; protected land or seascapes; and sustainable use areas. (Also discussed in the Protected Areas Act, see 4.4.5).

Scientific reserves can be defined as area of land or sea that have outstanding ecological or biodiversity of such value that these should be preserved for the chief purpose of scientific research. These reserves in essence should therefore maintain essential ecological processes; preserve biological diversity in an undisturbed state to ensure that representative examples of the natural environment are available for scientific study, environmental monitoring, and education. Such reserves should also ensure the maintenance of genetic resources in a dynamic and evolutionary state that should be allowed to evolve naturally over time. Research activities in these reserves should be undertaken in such a manner that they do not cause harm to biodiversity or the integrity of natural systems. Public access should therefore be limited to scientific research activities.

Wilderness areas on the other hand are large undisturbed pieces of land that contain their natural integrity and are mainly in an undisturbed state. Such areas may contain examples of natural undisturbed beauty and should be used for research, environmental monitoring, and education. Such an area and its genetic resources should be allowed to evolve naturally in an undisturbed state through time. Wilderness areas should serve human and spiritual welfare and such areas must be sufficiently sized to achieve such objectives. Human influences that impact on such area should be kept to a minimum or totally eliminated to allow the area to evolve naturally in time. Access to these areas should be controlled while mechanical access should not be permitted at any point.

National parks are relatively large areas that have unique and outstanding components of biodiversity or several ecosystems that should be protected for future generations. Exploitation and occupation of the area should be prohibited in order to provide a spiritual, scientific, educational, recreational and cultural experience for visitors. The objective of such national parks should be to ensure that the area will continue to exist in a natural state that contains representative samples of physiographic regions, biotic communities, genetic resources, and species and to ensure the continued existence of ecological stability and diversity. These areas include: national parks, provincial nature reserves, and indigenous state forests. (It is also regulated by the National Parks Act 57 of 1976 that was repealed by the Protected Areas Act).

Natural monuments *per se* include a natural feature that holds unique and outstanding scientific, scenic or spiritual value. The objective of these should be to protect outstanding natural features and places as a result of their special interest, unique or representative characteristics and to use same for interpretation, education, research and public appreciation. These areas may include: national monuments, monuments, botanical gardens, zoological gardens, natural heritage sites, and sites of conservational significance.

Habitat and wildlife management areas are areas that may be subjected to human intervention. Such intervention is based on research that may relate to

the requirements of specific species for nesting, feeding and survival. Such a management area should maintain sustainable plant and animal populations but should also protect rare and threatened species. Overall it should provide for natural conditions that are necessary to protect significant species, groups of species, biotic communities, or physical features of the environment. Other objectives may include scientific research, environmental monitoring, educational use and sustainable resource management. Such areas may include: provincial nature reserves, local nature reserves, private nature reserves, and conservancies.

Protected landscapes or seascapes are a product of the harmonious interaction of people and nature. These areas are often scenically attractive or aesthetically unique patterns of human settlement. Traditional practices associated with agriculture, grazing or fishing may be present in the area. The main objective of such an area should be to maintain significant areas characteristic of the harmonious interaction of nature and humans.

Sustainable use areas are predominantly natural and should be managed in a manner that ensures the long-term protection and maintenance of its biological diversity. In this respect it should also provide a sustainable flow of natural products. The overarching objectives of such areas should be to protect and maintain the biological diversity and other natural values of the area while providing benefits to ensure the welfare and development of the local community. A sustainable use area may include mountain catchment areas.

Declaration of protected areas

(Sections 16-18 are repealed by the Protected Areas Act). (See 4.4.5).

Waste and littering

Sections 19 and 19A make provision for measures to prohibit littering. No person may discard, dump or leave any litter on any land or water surface to which the public has access. A relevant authority should make provision for the placement of an appropriate container specifically designated for such purposes.

Section 20 and provisions under the Environment Conservation Amendment Act 50 of 2003 provide for waste management directives. No person may establish or operate any disposal site without a permit issued by the Minister of Water Affairs and Forestry. Such Minister may lay down guidelines for the operation of such facility. No person shall discard waste or dispose of it in any manner other than in a disposal site for which a permit has been issued, or in a manner or facility that has been subjected to the conditions prescribed by the Minister.

Section 24 makes provision for measures for the promulgation of regulations on waste management and these may pertain to:

- the manner in which an application for a permit will be submitted;
- statistics on the quantity and types of waste produced;
- the classification of different types of waste and the management of such wastes;
- methods for the reduction of wastes;
- utilization of waste by recovery, recycling or processing;
- the location, planning and design of disposal sites;
- the supply of information to the public regarding effective waste disposal;
- control over the import and export of wastes; and
- any matter regarding effective disposal of waste relevant to the protection of the environment.

Section 24 has been amended by the Environment Conservation Amendment Act and provides that the Minister may promulgate regulations concerning the prohibition, control, sale, distribution, import or export of products that may have a negative impact on the environment or human welfare.

***Government Notice Regulation 543 of 9 May 2002 under section 24
Plastic bags***

Government Notice Regulation 543 of 9 May 2002, makes provision for Regulations under section 24 of the Environment Conservation Act that pertains to the use of certain plastic bags. The reasons for the promulgation of such regulations are discussed under the explanatory memorandum of the regulation. According to this note the collection and disposal of plastic bags is a growing waste problem in South Africa. The use of plastic bags has increased significantly in recent years. Under this regulation the manufacturing, trade and commercial distribution of bags made of plastic in the Republic with a wall thickness of less than 80 micrometres is prohibited. Plastic bags with a wall thickness of between 30 and 80 micrometres may be manufactured, traded and commercially distributed provided they do not carry printing marks, except where required by law. Bread bags with a wall thickness of between 25 and 80 micrometres may be manufactured, traded and commercially distributed if they do not (unless required by law) carry printing, painting or marks of any kind. The prohibition will not apply to shrinklene and flimsy bread bags made of plastic film. Any person who contravenes this Regulation will be guilty of an offence and liable for conviction or a fine.

***Government Notice Regulation 1196 of 8 July 1994 under section 24
Disposal site permit***

Government Notice Regulation 1196 of 8 July 1994 provides for directives that pertain to the application of a disposal site permit. Any person who wants to establish or operate a disposal site must apply for a permit by submitting a completed form in accordance with the directives under this regulation, to the Regional Director of the Department of Water Affairs and Forestry who has

authority in the area where such site will be located. An applicant may appeal against a decision issued by the Minister of Water Affairs and Forestry in the prescribed manner. The grounds for appeal should be fully furnished by the applicant.

Notice under section 20
Types of wastes

Government Notice 1986 of 24 August 1990 provides for the identification of matter as waste. Waste is herein identified as an undesirable by-product, emission, or residue, whether that includes any matter, gas, liquid or solid, or any combination thereof that originates from any area.

The following are not identified as waste under the provisions of this regulation:

- water used for industrial purposes or any effluent;
- any matter discharged into a septic tank produced (see National Water Act 36 of 1998, 6.2.2.2);
- any radioactive substance (see National Nuclear Regulator Act 47 of 1999, 6.2.5.2);
- any minerals, tailings, waste-rock or slimes produced by mining activities (see Mineral and Petroleum Resources Development Act 28 of 2002); and
- ash produced by electricity generated activities (see National Environmental Management Act 107 of 1998, 4.4.1 and Environment Conservation Act 73 of 1989, 4.4.2).

Regulation of development activities
Environmental impact assessment

Legislation pertaining to EIA is found under the previously discussed National Environmental Management Act (4.4.1). See section 24 of the particular Act and relevant notices and regulations discussed under this section.

Sections 21 and 22 have been repealed by regulations under section 24 of the National Environmental Management Act.

Limited development areas

Section 23 makes provision for the establishment of limited development areas. A competent authority may declare any area a limited development area. No person may commence any development where prohibition exists in a limited development area without the written authorisation of a relevant competent authority.

Section 27 makes provision for the promulgation of regulations regarding limited development areas. A competent authority may make regulations in limited development areas concerning:

- the nature of restrictions and development activities in limited development areas;
- the procedures to be followed in undertaking such restrictions in any limited development area; and
- the repair of damage caused to the environment by any restricted activities in a limited development area.

Noise vibration and shock

Section 25 makes provision for measures that relate to the promulgation of regulations regarding noise, vibration and shock.

Administration of Act and Offences

Section 28 makes provision for general regulatory powers. The functions under this Act may assign duties to any provincial administration or any local authority. The regulations under this Act may also make provision for measures relating to the qualifications, powers and duties of officers enforcing the provisions of this Act. Such powers may include the seizure of any book, document, vehicle or any other object necessary in the execution of the provisions of this Act. Any officer, local authority or Government institution may take steps to cease such activities. Any person who contravenes or fails to comply with any provision of this Act will be guilty of an offence and liable for conviction and a fine not exceeding R100 000 or imprisonment for a period of up to 10 years or to both.

Government Notice Regulation 494 of 2 June 2006 makes provision for the qualification criteria and minimum training that environmental officers must comply with to ensure effective administration of this Act. Notice 345 of 8 April 2005 ensures that environmental officers are identified by identity cards when enforcing the principles of this Act and other relevant environmental legislation.

Section 28A makes provision to exempt certain persons, local authorities and Government institutions from application of certain provisions.

Section 29 makes provisions for offences and penalties.

Power of authority

Section 31 provides for the power of the Minister and competent authority in the case of a default by the local authority. If any local authority fails to comply with its duties, the competent authority may take over the functions of such local authority.

Section 31A provides for the Powers of the Minister, competent authority, local authority or Government institution where the environment is damaged, endangered or detrimentally affected.

Court case under section 31A

In *Evans and Others v Llandudno/Hout Bay Transitional Metropolitan Substructure and Another* 2001 (2) SA 342 (C) a written direction in terms of section 31A of the Environment Conservation Act (73 of 1989) to cease activity that results in pollution or damage to the environment or to take steps to eliminate, reduce or prevent, damage to the environment, the court determined that certain conditions should apply. This includes that any person liable for the elimination or remedy of environmental damage must be given adequate notice and be afforded consultation before being made to take any such steps. Persons accountable to such directives and actions must be allowed adequate time to: make representations; appear at a hearing or enquiry; and to effectively prepare their own case.

Aspects not covered by this Act

- *Inspection in domestic communal land communities and farms to ensure unsound environmental impacts are monitored and managed. Measures should be implemented to ensure that these inaccessible areas are managed and monitored in terms of strict legislation. No person should be allowed to undertake any activities that may have a detrimental impact on the environment (also see 2.4.1, 3.4.3 and 3.4.4 as well as Table 7).*
- *Improved use of environmentally degradable products, packaging materials or any other object. The general policy under this Act encourages recycling and sustainable use, but does not mandate that biodegradable products be used. Where possible, biodegradable product use should be mandated by legislation. Toxic products should be banned under all circumstances (also see 3.4.4 and Table 7).*
- *Improved regulation on the excessive use of unnecessary plastic or paper packaging materials (excepting regulatory bag regulations). All products should be assessed to determine whether the producer does not manufacture unnecessary packaging material that may have a negative impact on the environment (also see 3.4.4 and Table 7).*
- *Improved regulation of littering in private areas. Section 19 only regulates littering in public places. This can create problems on private land, farms, and communal land and needs to be managed and monitored (also see 3.4.4 and Table 7).*

4.4.3 Convention on Biological Diversity, 1992

Introduction

The Convention on Biological Diversity, 1992 forms the basis of the Biodiversity Act, 2003 (see 4.4.4).

The Convention on Biological Diversity provides for international cooperation that is relevant to the conservation of biodiversity and its sustainable use (CBD, 2003). It was signed in June 1993, and ratified by South Africa on 2 November 1995 (South Africa, 2003a). Government Notice 1095 of 28 July 1997, contains the provisions of the *White Paper on the Conservation and Sustainable use of South Africa's Biological Diversity* and also includes the provisions of the Convention on Biological Diversity. The Convention makes provision for the conservation of biodiversity or biological resources. The preamble to this Convention provides principles that contracting parties to the Convention on Biological Diversity should aspire to.

Principles

The principles are:

- that the conservation of biological diversity rests upon the belief that such resources are ecological, and genetic.
- biological diversity is needed for the evolution and maintenance of all ecosystems;
- the conservation of biological resources is a common concern to all humankind;
- all countries have rights over their biological resources;
- all governments have a responsibility to ensure that the biodiversity under their control is utilised in a sustainable manner;
- humanity should realise that anthropogenic activities pose a threat to the integrity and survival of biodiversity;
- scientific information should be used to manage biodiversity resources effectively;
- the causes for biodiversity loss should be prevented;
- biodiversity should preferably be conserved *in situ* while all measures should be implemented to remedy viable genetic resources;
- *ex situ* measures in the country of origin should only be used when *in situ* conservation measures have failed;
- that traditional biodiversity uses should be encouraged while bioprospecting should ensure equal benefit sharing;
- women should be included in biodiversity conservation measures;
- the promotion of international, national and local cooperation between governments, Government organs and private individuals or parties;
- financial and scientific technologies should be used in the conservation of biodiversity;
- special conditions should apply to least developed countries;
- recognition that poverty alleviation is the first priority of least developed countries;
- sustainable biodiversity utilisation is the fundamental principle of sustainable development;

- conservation efforts relevant to biodiversity should be used to improve relations among nations; and
- sustainable biodiversity utilisation will determine the destiny of future generations.

Objectives

Article 1 of the Convention makes provision for a concise definition regarding the objectives of the Convention. The objectives of this Convention pertain to the conservation of biological diversity and the sustainable use of its components.

Rights

According to article 3, countries of the world have the sovereign right to exploit their own genetic resources relevant to their own environmental policies. They have the responsibility of ensuring that activities under their jurisdiction do not have a detrimental impact on the environment.

The Contracting parties to this Convention should comply with its provisions within the limits of its own national jurisdiction. It also ensures that such jurisdiction applies to processes and activities that are carried out under its jurisdiction or control, irrespective of where the effects of such activities may occur (article 4).

Management of biodiversity

Article 5 contains directives to promote international cooperation between countries that are parties to this Convention on issues that relate to biodiversity.

Each contracting party to the Convention must develop strategies to ensure the conservation and sustainable use of biodiversity. Such parties may also adapt programs that *inter alia* reflect on the provisions of the Convention. Contracting parties should also integrate the conservation and sustainable use of biological diversity into relevant sectoral programs (article 6).

Article 7 mandates all contracting parties to implement measures that relate to the identification and monitoring of aspects that relate to *ex situ* conservation, *in situ* conservation and sustainable use of components of biodiversity. These parties should:

- identify components of biodiversity that are important for conservation and sustainable use;
- monitor such components of biodiversity;
- identify processes and activities that may have a negative impact on such biological diversity; and
- maintain and organise such data obtained from such monitoring processes.

The provisions of this Convention will not affect the rights of any contracting party from any international agreement except where such obligations instigate serious threats to biological diversity. It also ensures that contracting parties implement this Convention in accordance with the marine environment concurrently with the rights of countries that relate to the law of the sea (article 22).

Conservation

Article 8 makes provision for *in situ* conservation measures and includes procedures that contracting parties should implement to ensure such objectives are achieved. These provisions include:

- establishment of protected areas to conserve biodiversity;
- determine criteria for the selection and establishment of protected areas;
- regulate all biological resources to ensure sustainable utilisation;
- promote conservation of natural systems and viable populations in their natural surroundings;
- promote sustainable development adjacent to protected areas;
- restore degraded ecosystems and recover threatened species;
- regulate the release of genetically modified organisms;
- prevent introduction of alien species and eradicate present problematic alien species;
- conserve indigenous community practices relevant to the conservation of biological resources;
- develop legislation to ensure protection of threatened species;
- regulate any identified activities that may have a detrimental impact on the environment and biological resources; and
- provide financial support for developing countries to encourage *in situ* conservation measures.

Contracting parties to the Convention must implement directives for *ex situ* conservation to complement *in situ* conservation measures. These measures include (article 9):

- adoption of *ex situ* conservation measures (preferable in country of origin) for the protection of biological resources;
- establishment and maintenance of institutions to ensure such conservation measures and to undertake research on such biological resources;
- implementation of measures for the rehabilitation of threatened species and introduction into their natural habitats;
- management of the collection of biological resources from *in situ* habitats for the purpose of *ex situ* conservation, and to ensure that such collection does not compromise the integrity of such biological resources in any way; and

- provide financial support for developing countries to ensure the establishment of *ex situ* conservation measures.

Sustainable use of biodiversity

Article 10 makes provision for the directives aimed at ensuring sustainable use of biological resources

Article 11 provides that every contracting Party should adopt economically and socially sound measures to ensure the conservation and sustainable use of biological diversity.

Education

Article 12 provides for research and training programs to be implemented by contracting parties to this Convention. These measures should include:

- programs for the identification, conservation and sustainable use of biological diversity;
- the application of research which contributes to the conservation and sustainable use of biological diversity; and
- the use of scientific advances in biological diversity and research that may result in the development of methods for conservation and sustainable use of biological resources.

Provision is made for public education and awareness regarding issues that relate to biodiversity. Contracting parties should also ensure that they cooperate with one another on measures that relate to public education on issues pertinent to biodiversity (article 13).

Environmental impact assessment

Article 14 deals with environmental impact assessment and measures to minimise the impact of activities that have a detrimental effect on both the environment and biological resources. These measures should include the following:

- environmental impact assessment on activities that may have a detrimental effect on biodiversity, including measures for public participation;
- that impacts arising from such activities are taken into account and considered;
- disclosure of information to other contracting parties regarding activities that may have an international impact on biological resources;
- in the case of activities that pose an imminent international danger to biological resources, notifying all contracting parties who may be affected

- by such activity, and to make provision for measures to mitigate such impact; and
- implementation of national emergency arrangements to ensure that emergency situations posing a threat to biodiversity are managed effectively.

Genetic resources

Article 15 deals with the regulation of access to genetic resources. It makes provision for every country to have sovereign rights to regulate their access to genetic resources within the framework of their national legislative framework. Every contracting party should implement measures regarding conditions for access to genetic resources that may be used by other parties. Such measures should not be in conflict with the principles of the Convention. The genetic resources provided by a contracting party are only those from countries of origin of such resources or by parties that have legal access to such resources in accordance with the principles of this Convention. Access should be on consent of both parties and on conditions that are concurrent to the provisions of the Convention.

Technology and information

Provision is made for access to technology and transfer of such technology. Contractual parties to this Convention should endorse the use of technology that may promote the principles of this Convention (article 16). The use of technology should ensure sustainable utilisation of biodiversity and should not compromise the integrity of such biological resources. The use of such technology should take place in a fair manner pertinent to the necessary property rights.

Article 19 makes provision for the management of biotechnology and the distribution of its benefits. Parties to the Convention should encourage the use of biotechnology through legislative and policy measures, and any undertaking of research on such biotechnology by a contracting party using such modified organisms, should be disclosed to the contracting party to whom such organisms are to be introduced.

Article 17 makes provision for directives that relate to the exchange of information. These include measures that contracting parties should take to promote the public exchange of information relevant to the conservation and sustainable use of biodiversity. Such information may pertain to technical, scientific, socio-economic research and training and programs.

Cooperation and financial resources

The contracting parties should promote international technical and scientific cooperation relevant to conservation and sustainable use of biological diversity

(article 18). Such cooperation may result in the development of national policies that support the provisions of this Convention. The contracting parties should in accordance with national legislation and policies, encourage methods for the development and use of technologies that may include indigenous and traditional technologies.

Article 20 makes provision for financial resources. Each party should undertake to provide, according to its capabilities, financial support to achieve the objectives of this Convention. Contracting parties to this Convention should contribute financially on a voluntary basis to developing countries, to ensure that those countries achieve the objectives of this Convention. Consideration should also be given to the most environmentally vulnerable countries including those with arid zones, coastal areas, and mountainous areas.

Consulting bodies

Article 25 makes provision for the establishment of a subsidiary body on scientific, technical and technological advice. This subsidiary body should provide contracting parties with advice regarding:

- scientific and technical aspects relative to biodiversity;
- the effect that measures under this Convention have on the status of biological diversity;
- advise parties on new technologies that should be used to conserve and sustain biodiversity; and
- advise on scientific programs pertaining to biodiversity.

4.4.4 National Environmental Management: Biodiversity Act 10 of 2004

Objective

This Act is concerned with the management of biodiversity in South Africa. The following aspects are covered: establishment of a National Biodiversity Institute, a national biodiversity framework, bioregional plans, biodiversity management plans, protection and trade of threatened/protected species, control of alien and invasive species, regulation of bioprospecting, and conditions regarding the issue of permits (South Africa, 2003a:1-30).

This Act describes the overarching objective of its objective to create a framework on biodiversity legislation. Biodiversity in South Africa is managed by fragmented and incomplete legislation that rests at provincial level and only in some areas at a national level. This absence of national legislation creates problems that compromise the sustainable use of biological resources. To ensure compliance with Section 24 of the Constitution of the Republic of South Africa, national legislation is required to regulate the sustainable use of biological resources and this Act makes provision for measures that lead to the

consolidation of different parts of legislation pertaining to the integrity of biodiversity legislation. This is especially relevant to aspects of coordination of international obligations and the distribution of benefits derived from indigenous biological resources. This Act therefore makes provision for the management of indigenous biodiversity.

This Act makes further provision for sectoral integration at a national level and it strives to prevent duplication that exists in various national Government departments. One such example is the concept of multiple competent authorities for the same function. These provide the framework for cross-sectoral devolution of regulatory functions while retaining existing sectoral regulatory functions. A second example is the integrated permit system that allows existing permits to be issued by competent authorities. These comply with the requirements of this Act instead of providing additional expletive authorization for the same purpose. It thirdly provides for integrated sectoral conservation as a national objective, such as species protection without compromising sectoral activities such as species listing.

Objectives of this Act

This Act further establishes a framework for application of its provisions in relation to the National Environmental Management Act and other legislation and relevant multilateral environmental agreements pertaining to biodiversity and environmental issues. The following is a short discussion of the general scope of this Act.

South African National Biodiversity Institute

Provision is made for the establishment of the South African National Biodiversity Institute that replaces the National Botanical Institute. It ensures that criteria are established for the selection and appointment of a governing board to enforce the provisions of this Act and further defines the functions and powers of such board. It also regulates general administrative issues and financial aspects.

Sustainable use of biodiversity

This Act establishes a framework to ensure conservation and sustainable use of biological diversity within a broader framework of planning pertaining to general sustainable development. It ensures the development, monitoring and review of a national biodiversity framework that forms the National Biodiversity Strategy and Action Plan and further supports the overarching principles of the Convention on Biological Diversity. The creation of bioregional conservation plans places conservation in the context of climatic and geographical characteristics that will ensure a more effective approach.

Threatened and protected species

It makes provisions for the protection of threatened and protected species as well as threatened ecosystems under international agreements. It also regulates their national or international conservation status and provides for measures that regulate trade of such species or components of ecosystems. It ensures the establishment of a scientific authority to regulate various aspects that relate to the conservation of protected and threatened species.

Alien and invasive species

It further ensures the management of alien and invasive species by the control of their introduction and spread, and also through eradication measures in areas where such species are already established. It places a responsibility on persons who are responsible for duty and care relating to alien and invasive species, or on whose land such species may occur. It further establishes obligations for the control and eradication of invasive species and ensures that plans are created for the control, eradication, and status reporting of such species.

Bioprospecting

This Act aims to regulate bioprospecting of genetic material derived from indigenous biological resources. It also ensures fair and equitable sharing of benefits arising from bioprospecting of genetic material derived from indigenous biological resources. These provisions require that bioprospecting permit holders must enter into benefit sharing agreements with holders of rights to the indigenous resources. It also provides for the protection of indigenous biological resources through listing of such species. Finally, it provides for the establishment of a bioprospecting trust that ensures the distribution of all fees.

Permit system

This Act regulates activities relating to components of biodiversity by means of a permit system. Activities that are regulated by permits are those that include threatened, protected, alien, and invasive species. Such permitting system is fully integrated with other permitting systems at national level and provincial level to avoid duplication of such authorization.

Administration

This Act provides for the regulation of administrative issues that pertain to the implementation of the Act to enable the Minister to make regulations regarding certain sections of the Act. These include promulgation of regulations; national norms and standards; protection and utilization of species and ecosystems; implementation of international agreements; alien and invasive species management; bioprospecting and permits. It also ensures that the Minister

follows a consultative and public participation process in exercising powers under the Act.

This Act makes provision for the creation of penalties for offences.

Co-operative governance

This Act uses a number of instruments to ensure cooperative governance as discussed in sections 41(2) of the Constitution of the Republic of South Africa. It describes the role of the Department of Environmental Affairs and Tourism as the lead agent in exercising Government's custodianship of biodiversity and ensures effective powers to enforce the provisions of this Act.

Relevant sections

Management and conservation of biodiversity

Section 2 of this Act makes provision for measures that relate to the conservation of biological diversity within the framework of the National Environmental Management Act. These provisions must ensure compliance with the following important principles:

- The management and conservation of biodiversity;
- The effective use of biological resources in a sustainable manner;
- That bioprospecting of genetic resources to be managed in a fair manner and that benefits arising from such fall within the framework of democracy;
- That international agreements relating to biodiversity which the Republic has ratified are implemented within the framework of this Act;
- To foster cooperative governance within the provisions of this Act; and
- To ensure the formation of the South African National Biodiversity Institute to ensure compliance with the provisions of this Act.

Section 3 makes provision for measures to ensure that the State is the trusteeship of biodiversity. The State must fulfill its rights contained in Section 24 of the Constitution of the Republic of South Africa, and should therefore through its organs implement legislation on the conservation of biodiversity. It should thus ensure the management, conservation and sustainable use of the Republic's biodiversity. The state must implement the directives of this Act to achieve said sustainable use of these resources.

Section 4 makes provision for the application of this Act. The provisions of this Act apply to the territorial waters, the economic zone and the continental shelf. It also ensures that the national, provincial and local spheres of Government are binding by the provisions of this Act.

International agreements

Section 5 makes provision for the application of international agreements or instruments. It therefore ensures that this Act gives effect to all ratified international instruments pertaining to the conservation of biodiversity to which South Africa is a party.

Application of other legislation

Section 6 makes provision for the application of other legislation pertaining to the conservation of biodiversity. The objectives of this Act make provision to ensure that the principles thereof are integrated with those of the National Environmental Management Act. Any conflict that arises as a result of the implementation of this Act should be resolved through the provisions of the National Environmental Management Act as provided for the chapter 4 of that Act.

Section 7 of this Act makes provision for the National Environmental Management Principles. It ensures that the provisions of this Act are guided by the principles provided in section 2 of the National Environmental Management Act.

Section 8 makes provision for measures to resolve conflict with other legislation.

Section 9 makes provision for the establishment of norms and standards. The minister may issue norms and standards for the achievement of objectives under this Act. These norms and standards may pertain to:

- the management and conservation of biodiversity and its components in the Republic;
- the restriction of certain activities that may have a detrimental impact on biodiversity in South Africa; and
- Indicators to measure the progress and compliance with such norms and standards.

Biodiversity institute

Section 10 makes provision for the establishment of the South African National Biodiversity Institute that is a juristic person. Section 11 makes provision for the objectives of the institute, and these are:

- Monitoring and reporting on the status of biodiversity, threatened species, protected species, threatened ecosystems, invasive and alien species;
- to act as an advisory body on matters that relate to biodiversity, organs of state or any other biodiversity stakeholders;
- the management of all national botanical gardens;

- the establishment and management of herbaria or dead animal collections;
- the establishment of facilities for horticultural display, research and environmental education;
- the establishment, maintenance, protection, and preservation of collections of plants, animals and microorganisms in appropriate enclosures;
- to collect, generate, process, coordinate and disseminate information regarding the sustainable use of biodiversity and its components;
- to manage accessibility by the public to national botanical gardens herbaria and other places under the control of the Institute, and to provide plants, information and other services to the public;
- to promote research in the field of indigenous biodiversity and the sustainable use of such indigenous resources;
- to coordinate and implement programs that relate to the sustainable use of indigenous biodiversity resources;
- to manage programs that relate to the rehabilitation of ecosystems;
- to involve civil society in programs that relate to the sustainable use of biodiversity;
- to assist the Minister in his or her duties when necessary, such as in the declaration of protected areas; and
- to advise the Minister on information relating to provisions of this Act, international instruments, bioregional planning, and sustainable biodiversity use.

Section 12 makes provision for general powers of the South African National Biodiversity Institute.

Section 14 makes provision for measures concerning the qualifications of the members of the board.

Botanical gardens

Section 33 makes provision for the declaration of botanical gardens. The Minister may declare any piece of state land a national botanical garden or part of an existing national botanical garden.

Power of Minister

Section 35 makes provision for measures concerning the Minister's supervisory powers.

Biodiversity planning and monitoring

Section 37 describes the purpose of sections 38-49 of this Act pertaining to biodiversity planning and monitoring. According to this section the purpose is to:

- provide for integrated and coordinated biodiversity planning;
- provide for monitoring and conservation status of various components of the Republic's biodiversity; and
- to promote biodiversity research.

Section 38 makes provision for the establishment of a national biodiversity framework. It provides for:

- the adoption of a national biodiversity framework after the commencement of this section;
- measures to ensure the monitoring of the implementation of such a framework;
- review of such a framework at least every 5 years; and
- measures to ensure the necessary amendment to such a framework.

Section 39 makes provision for the contents of such a framework. Such a framework must make provision for:

- integrated coordinated biodiversity management by all governmental and non governmental organisations, persons and parties;
- consistency with the principles of this Act, the principles of the National Environmental Management Act, and the provisions of internationally ratified environmental instruments;
- the identification of priority conservation and protected areas in the Republic; and
- measures for cooperation in Southern Africa on issues that are relevant to biodiversity.

The national biodiversity framework may determine norms and standards for provincial and municipal environmental conservation plans.

Bioregional plans

Section 40 makes provision for the definition and establishment of bioregions and bioregional plans. The Minister or the member of the executive council of the Department of Environmental Affairs and Tourism may identify a geographic region as a bioregion if such region contains special ecosystems or landforms. He/she may publish a plan to ensure the conservation and sustainable use of biodiversity in such bioregion.

Section 41 defines the contents of such a bioregional plan. This plan should contain:

- provisions for the effective management of biodiversity or the components of biodiversity within such a region;
- provision for monitoring for such plan;
- the principles of any internationally ratified environmental instrument.

Section 42 makes provision for review and amendment of bioregional plans. The Minister and the member of the executive council must review a bioregional plan every 5 years to assess the compliance of such plan and the compliance of the principles determined in such a plan.

Section 43 makes provision for biodiversity management plans. Any person or party may submit a draft biodiversity management plan to the Minister. Such draft biodiversity management plan may pertain to:

- any ecosystem that needs special protection;
- an indigenous species that needs protection; and
- a migratory species relevant to any international environmental instrument that is supported by the Republic.

Before any draft biodiversity management plan is approved, the Minister must allocate a suitable party or person to ensure that the directives of such a plan are implemented.

Section 44 and 45 define the contents of biodiversity management plans. According to these sections such a plan should ensure the long-term survival of any particular species or components of biodiversity *in situ*.

Section 46 makes provision for review and amendment of biodiversity management plans. The Minister must review a biodiversity management plan every 5 years to assess the compliance of such plan with the principles determined therein. The Minister may amend a biodiversity management plan on his/her own initiative or on request by any person or party.

Consultation

Section 47 makes provision for measures that support consultation. Before a biodiversity framework, biodiversity management plan, or bioregional plan is adopted or implemented the Minister must ensure that consultation with all relevant persons or parties has transpired.

Section 63 and 99 makes provision for consultation that relates to the provisions of this Act.

Section 48 makes provision for measures to ensure coordination and alignment of biodiversity plans. A biodiversity framework, a biodiversity management plan, and a bioregional plan must not be in conflict with:

- any environmental implementation or management plan as discussed in the provisions of the National Environmental Management Act;
- any integrated development plans adopted by municipalities under the Municipal Systems Act 32 of 2000;

- any spatial development frameworks in terms of legislation regulating land use management, land development and spatial planning; and
- any other plan prepared in terms of provincial and national legislation.

Section 100 makes provision for public participation regarding the objectives of this Act.

Monitoring

Section 49 makes provision for measures to ensure monitoring. The Minister may establish monitoring mechanisms to determine:

- the conservation status of various biodiversity components of the Republic; and
- any negative trends that may affect the conservation status of such components.

The Minister may appoint any person, party or organ of state to monitor the conservation status of any components of biodiversity. The Minister must use such information to report annually to the parliament, and make such information available to the public.

Research

Section 50 makes provision for research pertaining to the integrity of biodiversity. The Minister must promote research conducted by any person or institution that is relevant to biodiversity conservation, sustainable use, and protection of indigenous biological resources. This research in biodiversity conservation may relate to:

- conservation status of various components of biodiversity;
- trends affecting the status of biodiversity;
- processes that may interfere with the conservation of biodiversity;
- the assessment of strategies for biodiversity conservation;
- the determination of biodiversity conservation priorities; and
- the sustainable use, protection and conservation of indigenous biological resources.

Protected species and ecosystems

Section 51 provides for information on threatened and protected ecosystems and species. The purpose is to provide for the protection of ecosystems and species that may be under threat, and also to ensure compliance with the principles of international environmental instruments that are supported by the Republic. It also ensures the protection of specimens that may be affected by international trade, and the utilization of biodiversity in an ecologically sustainable way.

Section 52 makes provision for measures that relate to ecosystems threatened or in need of national protection. The Minister or the member of the executive council of the Department of Environmental Affairs and Tourism may publish a notice to include ecosystems that need protection, these being:

- critically endangered ecosystems such as those that have undergone severe degradation of ecological structure function or composition as a result of anthropogenic activities and that are at high risk of irreversible transformation;
- endangered ecosystems that have undergone degradation of ecological structure, function or composition but are not critically endangered ecosystems;
- vulnerable ecosystems that have a high risk of undergoing degradation of ecological structure and but are not critically endangered; and
- protected ecosystems that are ecosystems of conservational value or national importance and require protection.

Section 53 makes provision for threatening processes to listed ecosystems. The Minister may identify any activity that poses a threat to a listed ecosystem. This section further ensures that such a threatening process be regarded as a specified activity under section 24(2)(b) of the National Environmental Management Act. It also provides that a listed ecosystem be regarded as an area identified for the purpose of section 24 of that Act.

Section 54 includes plans that should be taken into account in the protection of listed ecosystems.

Section 55 ensure that t.e Minister or the member of the executive council for Environmental Affairs in any relevant province may amend or repeal any notice published by him/her regarding the listing of threatened ecosystems.

Section 56 makes provision for the listing of species that are threatened or in need of national protection. It ensures the publication of a list relevant to:

- critically endangered species that include indigenous species facing extremely high risk of extinction in the wild in the immediate future;
- endangered species indigenous and facing a high risk of extinction in the wild in the near future, although they are not a critically endangered species;
- vulnerable species that face extremely high risk of extinction in the wild in the medium-term future, although they are not critically endangered or endangered ; and
- protected species which are of such high conservational value or national importance that they require national protection, although they are not listed as critically endangered, endangered, or vulnerable.

The Minister must review the contents of this list at least every 5 years.

Management of restricted activities

Section 57 makes provision for the management of restricted activities involving listed threatened or protected species. Restricted activities include those that may compromise the survival of threatened or protected species.

A person may only undertake a restricted activity after authorization has been granted in the form of a permit issued by a competent authority. The Minister may prohibit any activity posing a threat to any threatened species. This section does not apply to any listed species that is transported through the Republic from any area outside the Republic. In such case the transit of such specimen must take place under the control of an environmental management inspector.

Scientific authority

Section 60 and 61 make provision for the establishment of a scientific authority to regulate the trade of threatened and protected species.

The scientific authority may also advise the Minister on the following aspects:

- the registration of ranching operations, nurseries, and captive breeding operations;
- whether such facility complies with the standards to undertake such breeding operation;
- the choice of such a rescue center for the disposal of forfeited specimens;
- publish or amend notices regarding protected or threatened species and the undertaking of restricted activities;
- the nomenclature of species; and
- any other matter pertaining to biodiversity.

The scientific authority must base its advice on information obtained from specialists, and consult all private persons or governmental organizations regularly.

Section 62 provides that the scientific authority publish any annual non-detrimental findings on trade in specimens of listed threatened or protected species in accordance with an international agreement on international trade of threatened or protected species.

Alien and invasive species

Section 64 describes measures to control alien and invasive species. The objectives are:

- to prevent the introduction and spread of alien and invasive species into ecosystems where they do not belong;
- to minimize the effect of alien and invasive species and to prevent their harmful effect on indigenous biodiversity; and

- to eradicate alien and invasive species from ecosystems where they may cause damage to the indigenous components of biodiversity.

Section 65 prevents any person or party from carrying out a restricted activity in regard to any specimen of an alien or invasive species. A restricted activity may only be carried out on authorization in the form of a permit from the competent authority. A permit will only be issued after full assessment of the possible effect that such restricted activity may have on indigenous biodiversity or components thereof.

Section 66 makes provision for exemption regarding restricted activities that pertain to biodiversity. The Minister may exempt certain alien species from the provisions of this Act, where any person may conduct any restricted activity relevant to such exempted species without authorization.

Section 67 makes provision for the full prohibition of restricted activities that are relevant to certain alien or invasive species. The Minister may issue a list of alien and invasive species for which no permit may be issued. No person may carry out any restricted activity on any such species under any circumstances. The Minister must ensure that this list is frequently reviewed and amended when necessary. Section 68 provides that the Minister may publish or amend any list regarding any alien or invasive species.

Section 69 makes provision for measures relating to the duty and care of such alien species. Any person or party having received authorization to conduct any restricted activity concerning an alien or invasive species must comply with the conditions under which such authorization has been issued. Such person should take all the necessary steps to prevent or minimize the negative impact of such activity on indigenous biodiversity. Failure to comply with such conditions will result in the relevant authority requesting such person to remedy any harm that has been caused to biodiversity as a consequence of such non-compliance, and may specify directives to ensure such action is taken.

Section 70 makes provision for the management of invasive species. The Minister and the member of the executive council may publish a national or provincial list of invasive species. The Minister and the member of the executive council must regularly review and amend such list. The member of the executive council may amend a provincial list in concurrence with the Minister. Section 71 provides that no person may carry out a restricted activity on such invasive species. A person will only be allowed to conduct a restricted activity on any invasive species after a full assessment of its impact on indigenous biodiversity. Section 73 relates to the duty and care regarding invasive species. A person who has been authorized to conduct any restricted activity relating to a listed invasive species must ensure that he/she complies with the conditions of such authorization. Care must also be taken to ensure that the negative impact on biodiversity is eliminated or minimized.

Section 74 ensures that any person failing to take steps on the management of invasive species may be held liable for any damage sustained to indigenous biodiversity. A competent authority may request such person to pay for all damages inflicted as a result of such non-compliance. He/she may be requested to remedy the effect of such damage when such species occurs on his/her land, and may be requested by the competent authority to implement directives against such non-compliance.

Section 75 makes provision for measures necessary to eradicate and control listed invasive species. Control and eradication of listed invasive species must take place in an appropriate manner and should not cause damage to the environment or indigenous biodiversity. The methods used to control and eradicate a listed invasive species must be directed at the offspring, propagating material and re-growth of such invasive species. Such methods should prevent such species from producing offspring, forming seed, regenerating or re-establishing in nature in any manner. The Minister must ensure effective management of programs aimed to eradicate, control or manage invasive species.

Section 76 makes provision for invasive species control plans for organs of State. The management authority of a protected area must incorporate into its management plan an invasive species control and eradication strategy. All organs of state must prepare an invasive species monitoring, control, and eradication plan for land under their control as part of environmental plans under the provisions of the National Environmental Management Act and other relevant legislation. The invasive species monitoring, control and eradication plans of municipalities must be part of integrated development plans. The Institute may be requested by the Minister to assist municipalities in their duties.

Section 77 makes provision for invasive species status reports. The management authority of a protected area must regularly submit reports to the Minister or member of the executive council on the status of listed species that occur in the area. The report should provide:

- an elaborate list of the invasive species occurring in the area;
- a description of the parts of the area that are invaded by such alien species;
- an assessment on the extent of such infestation; and
- a report on the efficiency of previously utilized control measures.

Section 78 makes provision for the regulation on the release of genetically modified organisms.

Bioprospecting

Section 80 explains control measures relating to bioprospecting, access and benefit sharing.

Section 81 and 82 make provision for measures to manage the use of indigenous biological resources for the purpose of bioprospecting. No person may engage in any activity pertaining to bioprospecting without the necessary authorization from a competent authority. Such a permit may only be issued when a community has given consent to the use of such indigenous biological resources for the purpose of bioprospecting. This includes that such community must accept the terms and conditions relating to bioprospecting and any benefits that may arise from such activity.

Section 83 and 84 make provision for benefit sharing agreements. Such agreement should have the following characteristics, and must:

- determine the type of biological resources to be used in such bioprospecting;
- identify the area from which such resources are to be collected;
- describe the quantities of material to be collected;
- name all parties involved in such agreement;
- determine the magnitude to which such resources will be exploited;
- explain the way in which the community giving consent to such bioprospecting will benefit from the proposed commercialization of such biological resources; and
- ensure that the Minister approves of such agreement, and periodically review the contents thereof.

Sections 85 and 86 make provision for the establishment of a Bioprospecting Trust Fund.

Section 87 describes the objectives relating to the issue of permits. These permits are needed for various aspects pertaining to:

- listed protected and threatened species;
- listed alien and invasive species;
- any activities that regulate terms of a permit;
- bioprospecting of indigenous biological resources; and
- the export of indigenous biological resources for the purpose of research or bioprospecting.

Sections 88-90 make provision for conditions regarding the issue of permits and may include risk assessment procedures regarding the undertaking of certain restricted activities.

Section 102 makes provision for the regulation of existing biodiversity prospecting activities. Any person already conducting bioprospecting activities should continue with such activities whilst appropriate benefits sharing agreements are pending.

Export of biological resources

Section 81 regulates the export of listed indigenous biological resources. No person may export any indigenous biological resources from South Africa with the purpose of bioprospecting without the necessary authorization. A permit to undertake such bioprospecting may only be issued once the community with access to such biological resources has given consent to such activity.

Authorization

Section 88 includes directives necessary for the application of permits. It further controls the issue of permits that regulate:

- restricted activities regarding threatened, protected, alien and invasive species;
- activities that are regulated by notice concerning restricted activities on threatened and protected species;
- bioprospecting relative to indigenous biological resources;
- the export of indigenous biological resources for the purposes of bioprospecting or research.

Section 89 makes provision for risk assessment and expert advice. The issuing authority may request the applicant to make provision for specialist assessment and advice before issuing such authorization.

Section 90 ensures that permits comply with the following specifications:

- the purpose for which such permit is issued;
- the period for which such permit will remain valid;
- conditions for the issuing of such permit; and
- the form that such permit must be in and any relevant particulars;

Section 91 makes provision for measures that are required for permits regarding alien and invasive species. The issuing of a permit relating to a restricted activity pertaining to alien or invasive species must comply with the following aspects:

- that all steps have been taken by the applicant to assess the possible negative impact such activity may have on indigenous biodiversity;
- guarantee that such alien species will have no negative impact on indigenous biodiversity and does not have an invasive character;

- that the benefits regarding such activity are higher than the costs of remedying such impact; and
- adequate measures have been taken by the applicant to prevent the escape of such species.

Section 92 makes provision for integrated permits. The competent authorities that have power over a restricted activity may jointly issue a permit to authorize such restricted activity. Such authority may issue one permit jointly authorizing such restricted activity instead of issuing 2 separate authorizations. An integrated permit may only be issued after compliance with any legislation pertaining to such authorization. The permit must also specify provisions in terms of which it has been issued and the authorities who have issued it.

Section 93 makes provision for the cancellation of permits. The issuing authority may cancel any permit if such permit was issued under false representations provided by the applicant, or if such applicant failed to comply with any condition regarding such permit. Such conditions may pertain to a permit provision, conditions set under the provisions of this Act, or any foreign law that governs such permit system.

Appeal and regulations

Section 94 makes provision for appeal. Any person may appeal against a decision taken by a competent authority on a permit application, or the cancellation of such permit.

Section 97 makes provision for the administration of this Act, including guiding principles for the promulgation of regulations. The Minister may promulgate regulations that relate to:

- the designation of organs of State that may issue authorization for restricted activities;
- the facilitation, enforcement and implementation of restricted activities related to threatened and protected species;
- compliance with the provisions for any supported international environmental instruments that relate to trade in threatened and protected species;
- measures to minimize threats to threatened and protected species;
- minimization of the threats to ecosystems;
- the sustainable use of indigenous biodiversity or components thereof.
- the designation of organs of state to be authorizing authorities in terms of restricted activities;
- the designation of organs of state to be authorities enforcing the provisions of this Act;
- the prescription of compulsory conditions regarding permits;

- the assessment of risks associated with undertaking restricted activities relevant to alien and invasive species;
- the control and eradication of invasive species;
- the requirements and criteria for benefit sharing agreements and material transfer agreements;
- conditions for the issuing of permits;
- procedures for permit application and payment of fees associated with such permits;
- the powers of permit issuing authorities relevant to the authorization of the undertaking restricted activities;
- circumstances in which applications may be approved or refused;
- the conditions on which permits may be issued;
- methods to enforce compliance with the conditions of permits; and
- the validity period of permits.

Offences and penalties

Regulations made in terms of section 101 ensure that any person who contravenes or fails to comply with any provisions of this Act will be guilty of an offence. When such person is found guilty of such an offence he/she may be liable to: imprisonment of up to five years; an appropriate fine; or to both a fine and imprisonment.

Section 102 makes provision for the creation of penalties appropriate to offences under section 101 of this Act. A person convicted of an offence under section 101 is liable to a fine or imprisonment for a period of up to five years or to both a fine and imprisonment. A fine may not exceed the amount determined in the Adjustment of Fines Act 101 of 1991 or three times the commercial value of the object in respect of which the offence was committed.

Aspects not covered by this Act

- *Establishment of zoos and the management thereof on state land. This Act only provides for the establishment of botanical gardens and not zoos (also see 3.5.1.2 and Table 8).*
- *Regulation on trade and use of certain indigenous wood since unregulated trade in indigenous wood may result in the destruction of indigenous forest (also see 2.4.1, 3.5.1.12 – 3.5.1.19 and Table 8).*
- *Improved regulation of muthi markets. This Act makes adequate provision for the (medical and scientific) utilisation of various indigenous species. It allows fair advantages for traditional communities in regard to such prospecting. Muthi markets are difficult, if not impossible to regulate, and impact negatively on the integrity of numerous species. Government incentives such as a permit system, limited markets and/or limited to certain areas and/or species may already prove to be beneficial (also see 2.4.1, 3.5.1.4 and Table 8).*

- *Bioprospecting activities should preferably not harvest commercially from the habitat as mentioned under this Act. Ex situ cultivation techniques should be used for the propagation of commercially important species. Bioprospecting should preferably be subject to environmental impact assessment if such activities cannot be prevented (also see 2.4.1, 3.5.1.4 and Table 8).*

4.4.5 National Environmental Management: Protected Areas Act 57 of 2003

Introduction

This Act, (as amended by the National Environmental Management: Protected Areas Amendment Act 31 of 2004), makes provision for measures to ensure the protection and conservation of ecologically viable areas in the Republic. Such areas should represent South Africa's biodiversity and natural landscapes. It further makes provision for the establishment of a national register that includes all national, provincial and local protected areas, and the management of those areas in accordance with national norms and standards. It covers matters that relate to intergovernmental cooperation and public consultation on matters pertaining to protected areas, and any other matter regarding protected areas.

The Protected Areas Act repeals the objectives of the National Parks Act 57 of 1967 in that many sections were previously outdated and in conflict with the Constitution of the Republic of South Africa. This Act seeks to make provision for a system of protected areas that is a concurrent function of the new constitutional and legal order. It further makes provision for policies and programs of Government. This Act also considers the importance of benefits to the community. The Act makes provision for the establishment of a representative system of protected areas that are covering the ecological integrity of the Republic. It makes provision for the sustained use of biodiversity to ensure that such resources will be available to future generations. This Act should be interpreted within the framework of the National Environmental Management Act and the Biodiversity Act that makes provision for important principles that should be integrated with the objectives of this Act.

This Act ensures that the State guards the protected areas in South Africa so that that these areas are conserved for future utilization. It creates a framework within the National Environmental Management Act and should be integrated with the Biodiversity Act. Provision is made for the establishment of various types of protected areas that include: special nature reserves, nature reserves, national parks, and protected areas. This Act also recognizes other types of protected areas that include: (World Heritage Convention Act) world heritage sites; (National Forest Act) specially protected forest areas, forest nature reserves, forest wilderness areas; (Mountain Catchment Areas Act) mountain catchment areas; and (Marine Living Resources Act) marine protected areas. All these protected areas should be recorded in a register, and the objectives of such

areas should be included. It also makes provision for measures that relate to consultation and the need for concurrence with the relevant Cabinet members.

Objectives

Section 2 defines the overarching objectives of this Act. These objectives are:

- the declaration of protected areas within the framework and principles of a national framework, that includes the objectives of the National Environmental Management Act;
- to ensure cooperative governance in regard to protected areas;
- to ensure the continued existence of National parks;
- to provide a national system for the protection of biodiversity in South Africa;
- to ensure protected areas on state land and private land and communal land; and
- to ensure sustainable development of protected areas for the benefit of people in a manner that would not compromise the integrity of such areas.

Section 3 ensures that the State is the trustee of protected areas.

Interpretation and conflict resolution

Section 5 makes provision for the application of the National Environmental Management Act. It ensures that this Act is integrated with the principles of the National Environmental Management Act and that it is read with the applicable provisions of that Act. Chapter 4 of the National Environmental Management Act should be used to resolve conflict arising as a result of implementation of the provisions of this Act. Section 6 ensures that the Biodiversity Act applies to protected areas under this Act. Section 7 makes provision for measures that resolve conflict with other legislation.

Provincial legislation

Section 8 makes provision for the status of provincial legislation on provincial and local protected areas. This Act will not affect the implementation of provincial legislation that relates to provincial and local protected areas.

Protected areas

Section 9 makes provision for the classification of various types of protected areas in South Africa. The systems of protected areas include the following protected area types:

- special nature reserves, nature reserves (such as wilderness areas), and protected environments;
- world heritage sites;

- national parks;
- specially protected forest areas, forest nature reserves, and forest wilderness areas;
- marine protected areas; and
- mountain catchment areas.

Section 14 ensures that chapter 1, 2 and section 48 of this Act applies to marine protected areas.

Section 17 defines the purpose of protected areas. The objectives of these areas are:

- to protect ecologically viable areas, landscapes and biodiversity forming part of South Africa's landscapes and seascapes and to ensure these areas are included as part of protected areas;
- the preservation of all viable ecological areas;
- to conserve indigenous biodiversity in such areas;
- to protect all types of ecosystems, habitats, and species that represent part of South Africa's biodiversity;
- to protect threatened and rare species;
- to protect vulnerable and sensitive areas;
- to promote sustainable development in the framework of biodiversity and uses associated therewith;
- to balance development and the integrity of biodiversity; and
- to remedy and restore degraded ecosystems and species associated therewith.

Section 18 makes provision for the establishment of special nature reserves. The Minister may declare any area a special nature reserve, or part of such a special nature reserve. The purpose of a special nature reserve is:

- conservation of highly sensitive and outstanding ecosystems or species, and to include unique geological or physiological features; and
- for the primary use of scientific research and environmental monitoring.

Section 23 makes provision for the declaration of nature reserves. The purpose of a nature reserve is:

- to supplement the consortium of national parks in South Africa;
- to protect areas that have significant natural features, species, habitats or biological communities;
- to protect specific areas of scientific interest; and
- make provision for the long-term protection and conservation of indigenous biodiversity.

These areas must be registered in terms of section 10 of this Act. This register must contain the following information:

- a list of all protected areas;
- indication of the kind of protected area in each case; and
- any other information determined by the Minister.

Provision is also made for provincial protected areas (section 12). Any area that was categorized as reserved or protected by provincial legislation before this Act came into effect, must be declared as a protected area under the provisions of this Act.

Section 13 also ensures that these provisions apply to world heritage sites as determined by the World Heritage Convention Act 49 of 1999.

Section 15 makes provision for specially protected forest areas, forest nature reserves and forest wilderness areas. Sections 1-15 and 48 apply to protected forest areas, forest wilderness areas, forest nature reserves and national parks. The other provisions do not apply to these areas but if such areas have been declared a special nature reserve or nature reserve or include such area, it must be managed in a manner that complies with the provisions of this Act. Section 16 ensures that sections 1-15 also apply to mountain catchment areas and national parks.

Section 20 makes provision for the establishment of national parks to protect biodiversity that may be of interest, and to use such an area in a sustainable manner.

Section 21 makes provision for withdrawal of declaration or exclusion of part of a national park. Section 22 provides that the designation of a national park as a wilderness area.

Section 23 makes provision for the declaration of a nature reserve and the following characteristics are taken into consideration: biodiversity value, scientific value, natural flow of products, and traditional use of products. Section 24 makes provision for the withdrawal of declaration or exclusion of part of nature reserve

Section 25 provides that the Minister or the member of the executive council may designate any area as a specific type of nature reserve.

Section 26 makes provision for measures to designate a nature reserve as a wilderness area, and such designation may only be made by the Minister or the member of the executive council. Such declaration should only be issued to:

- protect the natural environmental and biodiversity in an area;
- provide opportunities for solitude; and
- control access to such area and to ensure that such access does not constitute mechanical means.

Section 28 makes provision for the declaration of protected environments. A protected environment as defined by the memorandum on the objectives under the Protected Areas Act has the following objectives:

- to act as a buffer zone to absorb negative environmental impacts adjacent to national parks or nature reserves;
- to provide additional protection of ecosystems outside national parks or nature reserves;
- to protect areas that are sensitive to development; and
- to limit land use in an area that may be included in a national park or nature reserve.

A declaration of a private area as a protected environment may only take place after consultation with the relevant owners of such land. No area that is a nature reserve or special nature reserve may be declared a protected environment. A declaration of an area to be a protected environment for the purposes of controlling development and change in land use in such area is only valid for 3 years. An area ceases to be a protected environment if such area is declared a nature reserve. Section 29 provides that the Minister or member of the executive council may withdraw the declaration of any area as a protected environment. Section 30 provides that the member of the executive council must report to the Minister on any provincial declarations of protected environments.

Consultation and management

Section 31 makes provision for consultation by the Minister.

Section 33 makes provision for public participation.

Section 38 makes provision for the establishment of management authorities and provision should be made to ensure that these authorities are competent in the management of protected areas.

Section 39 makes provision for the preparation of a management plan.

Section 41 makes provision for the objectives of a management plan. A management plan for a particular declared area should contain the following information:

- the terms and conditions regarding such biodiversity management plan;
- the coordinated policy framework;
- performance and control criteria that may be prescribed; and
- a program for the implementation of such a plan.

Section 42 makes provision for the co-management of a protected area. The management authority may enter into agreement with any person or party regarding the co-management of any declared area. Such agreement may also make provision for the control of any anthropogenic activities in such an area. Such co-management may not lead to the fragmentation or duplication of management functions.

Performance indicators

Section 43 makes provision for the establishment of performance indicators in areas that have been nationally declared for conservation and protection purposes. The management authority of an area must manage an area against the set off performance indicators established by the Minister or the member of the executive council. Such authority must also report annually on the performance achieved against such set of indicators. The Minister or member of the executive council may appoint external auditors to assess the management authority's compliance with the overarching objectives of the management plan.

Access to protected areas

Section 45 makes provision for the regulation of access to special nature reserves. No person may enter, reside or conduct any activity in a special nature reserve. This does not apply to any person authorized by the Minister to undertake a task relative to the objectives of this Act. The management authority of a special nature reserve may exempt any person from these provisions after consultation with the Minister if such person:

- is performing scientific work;
- is undertaking an activity relating to the protection of biodiversity in such a special nature reserve;
- a person reporting on a news event or education program in such a reserve;
- an official of the management authority; and
- an official from an organ of State.

Section 46 makes provision for regulation of access to nature reserves, national parks and world heritage sites. No person may enter or reside within a nature reserve or world heritage site without the written permission of the management authority of such nature reserve or world heritage site.

Section 47 regulates the use of aircraft in special nature reserves, national parks or world heritage sites. This includes the airspace 1500 m above the highest point of a special nature reserve or world heritage site as part of such area, and provides that no person may use such space for taking off or landing.

Regulation of activities

Section 48 makes provision for directives that restrict prospecting and mining activities in protected areas. These activities are prohibited in special nature reserves and nature reserves, national parks and protected areas, and may only take place by permission of the Minister in protected environments. The Minister and Cabinet Member responsible for mineral and energy affairs should review all activities that were lawfully conducted before this section took effect. They should collectively decide on measures to be undertaken to reduce the negative impact

on the biodiversity and the environment in such area where these mining activities are operational. Conditions should be determined under which such mining activities should operate in the immediate future. The Minister should take the community and the principles of section 2 of the National Environmental Management Act into consideration when determining such conditions.

Section 49 prescribes directives that regulate or restrict anthropocentric activities in special nature reserves or nature reserves. These activities in such areas are regulated by the provision of section 86 of this Act. Section 51 makes provision for the regulation or restriction of development or any other anthropocentric activities in a protected environment. The Minister or member of the executive council may restrict or regulate anthropogenic activities or development in such protected area. Such regulation or restriction may be imposed when the development is inappropriate for the objectives for which the area was declared as protected.

Section 50 makes provision for the regulation of commercial or community related activities to be undertaken in nature reserves, national parks or world heritage sites. The management authority may permit commercial activities or activities that are aimed to improve the revenue of such area. Such activities should comply with the principles of the management plan of such area. The management authority of a reserve may enter into a written agreement with a local community, inside or adjacent to the reserve to allow members of the community to use biological resources within the nature reserve or site, in a sustainable manner. The management authority of a nature reserve or world heritage site may establish norms and standard pertaining to the conducting of any activity in a nature reserve or world heritage site. The commissioning of any activity under this section may not impact negatively on the survival of any biodiversity or compromise the integrity of natural systems in such area. The management authority must establish a system to monitor the impact of such activities on the biodiversity of the area. Such a monitoring system should ensure compliance with the principles of the agreements entered into by the management authority and the local community. It should also ensure compliance with the norms and standards determined by the management authority of the nature reserve or the world heritage site. The termination date may not be amended without the written consent of the Minister. No construction, farming or development may be undertaken in a nature reserve or world heritage site without the permission of the management authority of such reserve or site.

Section 52 makes provision for the establishment of internal rules. The management authority of a nature reserve, national park or world heritage site may make rules that pertain to the proper administration of the area. Sections 45 and 55 make provision for the continued existence of national parks to assist in the conservation and protection of biodiversity.

Rights

Section 80 makes provision for the acquisition of private land by the State. The Minister in concurrence with the Cabinet Member responsible for land affairs may acquire private land or a right upon such land that has been declared as a national protected area. Such rights may be acquired through purchasing, exchanging or expropriation of such land. Expropriation must comply with the provisions of the Expropriation Act 63 of 1975 and section 25 of the Constitution of the Republic of South Africa. Section 81 makes provision for the acquisition of private land by the South African National Parks

Section 82 makes provision for the cancellation of a servitude or private right on State land. The Minister in concurrence with the Cabinet Member responsible for public works may cancel any servitude or private right on state land if such area is to be declared or included as a national protected area. Section 85 provides that the Minister may use money provided by Parliament to acquire land or to cancel a right or servitude on such land.

Regulations

Section 86 allows the Minister the necessary power to promulgate regulations that pertain to any objective of this Act, (see Notice 417) or to confer management authorities additional power or tasks.

Section 87 makes provision for the promulgation of regulations by the member of the executive council.

Section 88 provides general guidelines for the promulgation of regulations under this section. The regulations may have the following characteristics:

- they may restrict or prohibit any act conditionally or absolutely;
- may apply to the Republic, or a province or a local area;
- may apply to all persons or to a category of persons; and
- may apply to all species, some species or only to a certain category of species.

Offences

Regulations made under sections 86 and 87 may provide that any person who fails to comply with such provision will be guilty of an offence, and may be liable for conviction and imprisonment of up to 5 years, a fine, or to both such fine and imprisonment.

Section 89 makes provision for offences and penalties. A person is guilty of an offence if he/she fails to comply with the following provisions:

- Section 45(1) relevant to prohibition of access to special nature reserves;
- Section 46(1) relevant to prohibition of access to nature reserves or world heritage sites;

- Section 47(2) and 47(3) relevant to the use of aircrafts in special nature reserves or world heritage sites;
- Section 48(1) relevant to prospecting and mining in protected areas;
- Section 50(5) pertaining to the regulation of farming, development and construction in a nature reserve or world heritage site;
- a notice under section 51 of this Act.

A person will also be guilty of an offence if he/she interferes or hinders the management authority in the performance of their official duties, or falsely professes to such authority.

Notice under section 86

Notice 417 of 11 March 2005, under section 86 of this Act makes provision for guidelines to assist in the administration of protected areas. These are discussed in the 90 regulations (sections) of this Notice and *should not* be confused with the separate sections of the Protected Areas Act.

Regulation 2 ensures that the measures discussed in this Notice apply to all special nature reserves, national parks and world heritage sites.

Regulation 3 allows a relevant authority to promulgate regulations relating to protected areas.

Regulations 4 and 50 ensure that various activities are regulated/prohibited, and that no person may: introduce any species; engage in any restricted activities; disturb any species; feed any species; use any methods to attract animals; remove any material from protected areas; damage any species; or cause pollution to such area.

Regulation 7 regulates mining activities through management plans and initiatives that include mitigation and rehabilitation measures.

Regulation 8 makes provision for the regulation of the use of biological resources by the community.

Regulations 9, 11, 14, 15, 17 and 18 regulate the access to these protected areas.

Regulation 10 ensures that the management authority of such protected area annually reports to the Minister on the use of biological resources and the status of these resources.

Regulations 19-21 regulate the access of vessels into marine protected areas. It also ensures that illegal vessels may be removed from such a protected area.

Regulation 27 makes provision for measures to ensure that strategic environmental assessments or environmental impact assessments are undertaken for the implementation of any commercial activities, as discussed under section 50 of the Protected Areas Act.

Regulations 28, 36-39 and 45 ensure that recreational and scientific activities are regulated in a sustainable environmental manner in these protected areas. Regulations 30, 31, 58 and 59 manage: noise; erection of any structure; commercial photography and public meetings in these protected areas. Regulation 32-34 and 46 manages recreational activities within these protected areas, and the identification of certain areas for the undertaking of such activities.

Regulations 35 and 56 regulate the discharge of any firearms in a protected area. Regulation 40 manages the air space above protected areas.

Regulations 41-43 ensure that harvesting of biological resources in such a protected area is managed in a sustainable manner. Regulation 44 ensures that public participation takes place when an area is to be declared a protected area. Regulations 52-54 prohibit various forms of littering and pollution in protected areas. Regulation 55 ensures that no person may undertake any activity that may negatively impact on the integrity of a protected area without permission by the relevant management authority. Regulation 83 makes provision for measures to regulate bioprospecting in a protected area.

Aspects not covered by this Act

- *Determination of the minimum size, number of nature reserves and their interconnection to adequately sustain biodiversity. A minimum size of a protected area is necessary to ensure the adequate survival of various types of biodiversity. Various ecotypes need to be protected in an adequate number of reserves, and reserves should preferably be interconnected to prevent genetic isolation of species. Genetic isolation should be overcome through responsible exchange of larger species, especially mammals that are genetically isolated by artificial fencing systems (also see 2.4, 3.5.1.5 and Table 8).*

4.5 Conclusion

Environmental law is a branch of law that should regulate anthropocentric activities on the environment. Environmental law is sectoral and covers various aspects such as: agricultural resources, land development planning, environmental impact assessment, biodiversity, genetic modification, marine systems, protected areas, biological resource use, water management, mining and energy, natural heritage, and pollution control.

The Constitution is important in environmental law since it sets the framework for the administration of environmental laws by national, provincial and local spheres of government. It ensures that all spheres of Government exercise the powers and functions in such a manner as not to encroach on the geographical, functional and institutional integrity of Government in other spheres. The nine provinces that replaced the four previous provinces have provincial environmental nature conservation departments. The Constitution provides that the national parliament may pass legislation on any matter referred to in Schedule 4 but not Schedule 5, unless it is a matter in which parliament can specifically intervene. Section 104 of the Constitution makes provision for the competence of provincial spheres. It allows provinces to pass legislation in regard to Schedule 4 and 5 and also to any other matter assigned to it by national legislation. Chapter 7 of the Constitution states that every municipality has the right to govern the local affairs of its community that are subjected to national and provincial legislation as provided for in the Constitution.

International law governs the relationships between countries. International environmental commitments manage cross-boundary problems and provide a framework for political and scientific co-operation. Government can be bound to international commitments in the three different ways. When a commitment is signed the State is under an obligation of good faith to refrain from acts that do not comply with the objects of such a commitment. The legal effect is however, influenced by whether a commitment is subjected to ratification, acceptance or approval. The Constitution of the Republic of South Africa (1996) makes provision for cooperation of international commitments. Commitments can be made part of national legislation once the Republic supports it. Section 25 of the National Environmental Management Act 107 of 1998 makes provision for the incorporation of international environmental instruments.

One may speculate whether such soft law is adequate to ensure the protection of biodiversity. The fact that such an international commitment is signed does not unequivocally ensure that the objectives of such a commitment will be enforced.

The National Environmental Management Act 107 of 1998 makes provision for aspects that relate to environmental management. It includes national environment management principles, the establishment of a National Environmental Advisory Forum and Committee for Environmental Coordination, conflict management, fair decision-making, integrated environmental management, compliance, enforcement, management of environmental hazards, and the implementation of Environmental Management Cooperation Agreements. This Act did not make adequate provision for:

- The control of human population growth in South Africa; and
- measures to regulate the disposal of corpses in the face of the high HIV/AIDS mortality rate.

The Environment Conservation Act 73 of 1989 covers aspects that relate to the protection of the natural environment, management of environmental pollution, and identification of activities that may have a detrimental impact on the environment. It also regulates waste management, littering, noise, vibration shock, and limited development areas. This Act did not make adequate provision for:

- Inspection in domestic communal land communities and farms to ensure unsound environmental impacts are monitored and managed;
- Improved use of environmentally degradable products;
- Improved regulation on the excessive use of unnecessary plastic or paper packaging; and
- improved regulation of littering in private areas and regulation of littering in private areas.

The Convention on Biological Diversity (1992) makes provision for measures to ensure the protection of biodiversity. This Convention makes provision for the following aspects: promotion of international cooperation on issues that relate to biodiversity; strategies for sustainable use of biodiversity; monitoring of biodiversity; *in situ* conservation measures; *ex situ* conservation measures; conservation measures; public education regarding biodiversity; environmental impact assessment; use of genetic resources; information exchange; use of technology; and enforcement of provisions of this Convention.

The National Environmental Management: Biodiversity Act 10 of 2004 is concerned with the management of biodiversity in South Africa. The following aspects are covered: establishment of a National Biodiversity Institute, a national biodiversity framework, bioregional plans, biodiversity management plans, protection and trade of threatened/protected species, control of alien and invasive species, regulation of bioprospecting, and directives regarding the issuing of permits. This Act did not make provision for:

- Establishment of zoos and the management thereof on State land;
- Regulation on trade and use of certain indigenous wood and improved regulation of *muthi* markets; and
- Regulation of *in situ* bioprospecting activities.

The National Environmental Management: Protected Areas Act 57 of 2004 makes provision for measures to ensure the protection and conservation of ecologically viable areas in the Republic. Such areas should represent South Africa's biodiversity and natural landscapes. It further makes provision for the establishment of a national register that includes all national, provincial and local protected areas, and the management of those areas in accordance with national norms and standards. It covers matters relative to intergovernmental cooperation and public consultation pertaining to protected areas, and any other matter concerning protected areas. This Act did not make provision for:

- Determination of the minimum size, number of nature reserves and their interconnection to adequately sustain biodiversity.

The fact that various Government departments are responsible for the administration of legislation on national level reflects on the fragmentation of the administration system. The Department of Environmental Affairs and Tourism is for example ideally responsible for the regulation of environmental matters. It should regulate activities like environmental impact assessment, but not in the case of mining where the Department of Minerals and Energy Affairs is responsible for such approval. Another example is the regulation of water use managed by the Department of Water Affairs and Forestry. On provincial level each province has created its own provincial department to deal with these issues at provincial level. One may therefore conclude that the environment is a provincial competition. One may further speculate whether or not this is responsible for the ineffective administration of legislation pertaining to the environment, and ultimately to biodiversity.

CHAPTER 5

SECTORAL LEGISLATION: THE MARINE ENVIRONMENT

5.1 Introduction

Sectoral legislation pertaining to the marine environment should make provision for aspects that relate to: marine harvesting, marine protection, marine regulation, prevention of marine pollution and protection of Antarctica.

The following relevant acts are discussed in this chapter:

- Marine Living Resources Act 18 of 1998;
- Sea-Shore Act 21 of 1935;
- Sea Birds and Seals Protection Act 46 of 1973;
- Sea Fishery Act 12 of 1988;
- Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986;
- Marine Pollution (Intervention) Act 64 of 1987;
- Dumping at Sea Control Act 73 of 1980;
- Marine Pollution (Control and Civil Liability) Act 6 of 1981; and
- Antarctic Treaties Act 60 of 1996.

The following international commitments form part of international law and include:

- International Convention for the Regulation of Whaling, 1946 (IWC), and
- International Convention for the Conservation of Atlantic Tunas, 1966.

5.2 The Marine Environment

The marine environment includes the territorial waters of South Africa, the adjoining seashore and coastal zone, and all features associated therewith. These features include estuaries, sea lakes, lagoons, islands, and river mouths.

5.2.1 Marine harvesting, protection, and regulation

5.2.1.1 The International Convention for the Regulation of Whaling, 1946 (IWC)

Objective

The International Whaling Commission supports whale research and conservation. It was signed by South Africa in December 1946 (IWC, 2003).

Regulation of whaling

Article 1 ensures that this Convention applies to factory ships, land stations, and whale catchers under the jurisdiction of contracting parties. Article 3 makes provision for the establishment of the International Whaling Commission to be represented by one member of each contracting party. The Commission may independently or collectively undertake research, collect statistical information, and investigate actions relevant to whaling. Article 5 provides that the Commission may amend the schedule under this Convention at any time regarding issues pertaining to:

- protected and unprotected species;
- open and closed seasons;
- open and closed areas;
- size limits for each species;
- time, methods and intensity of whaling;
- appliances that may be used for whaling; and
- statistical records.

Article 8 provides that any contracting party may grant authorisation to any of its officials to kill whales for the purpose of scientific purposes. Each contracting party must ensure that it implements measures to ensure the provisions of this Convention are enforced under its jurisdiction. It must also provide adequate punishment for the breach of any of these provisions.

5.2.1.2 The International Convention for the Conservation of Atlantic Tunas, 1966

Objective

This Convention is responsible for the conservation and sustainable use of tuna species, including the longfin tuna. South Africa acceded to this Convention in October 1967, and it was ratified in 1970 (Agenbach, 1999:21).

Conservation of tunas

Article 1 provides that the objectives of this Convention apply to the Atlantic ocean and the adjacent seas. Article 3 provides for the establishment of the International Commission for the Conservation of Atlantic Tunas to administer the provisions of this Convention. Article 4 provides that the Commission should undertake the following tasks:

- collection and analysis of data pertaining to the tuna fishery resources;
- undertaking of research relevant to the conservation of tuna; and
- consultation with contracting parties on issues pertaining to the Convention.

Article 6 makes provision for the establishment of panels in geographic areas to undertake the following activities:

- review of species or groups of species; and
- to make recommendations to the Commission based on scientific investigations.

Article 8 provides that the Commission may make recommendations to the Convention regarding the sustainable use of tuna, based on scientific research. Article 9 mandates all contracting parties to take the necessary measures to enforce the provisions of the Convention under its jurisdiction. Contracting parties must on request of the Commission provide scientific information regarding any aspects relating to the objectives of the Convention.

5.2.1.3 Marine Living Resources Act 18 of 1998

General

The ecologically varied 3200 km South African coastal zone is the focal point of numerous human activities and urbanisation. This concern is becoming more evident with the change in the political situation in South Africa over the past 10 years. The Seashore Act (21 of 1935) proved inadequate in ensuring integrated coastal management (Schrijvers, 2000:97; Glazewski, 1997:1, 19).

The Marine Living Resources Act makes provision for the establishment of a forum to manage various administrative issues, the issue of permits, the management of marine living resources, allowable catches, management areas, emergency measures, priority areas, granting of rights, subsistence fishing, recreational fishing, commercial fishing, local fishing vessel licences, reduction of rights, fees, recovery of interest, fishing harbours, suspension of fishing rights, establishment of Fisheries Transformation Council, international agreements, foreign fishing vessel licences, prohibition of high seas fishing, conservation strategies and marine protected areas.

Objectives

The objectives of this Act in terms of section 1 make provision for optimum and sustainable utilisation of marine living resources. It provides for the protection of ecosystems and species and aims to minimise the effect of pollution on these living resources. This Act also supports those international agreements signed by the Republic.

Forum

Section 5 provides for the establishment of a Forum to provide consultation on any matter relevant to this Act. Section 9 makes provision for the appointment of

Fishery control officers and honorary marine conservation officers to assist in the enforcement of the provisions of this Act.

Section 10 provides for the establishment of a marine living resources fund to finance the objectives of this Act.

Section 12 mandates the Director General to keep a register of all rights of access, other rights, permits and licences that have been granted under the provisions of this Act. Government Notice Regulation 1111 of 2 September (under section 12) makes provision for the information that should be contained in such a register. It should contain information regarding: the species of fish; mass of fish; validity of permit; species to be caught; and species to be allowed in the case of mariculture.

Harvesting

Section 13 requires that any person should be granted the relevant permit to conduct activities as described in the provisions of this Act.

Section 14 provides for the determination of allowable catches. Such catches may be relevant to any recreational, subsistence or commercial fishing. It may apply to certain areas, species or methods of harvesting.

Section 15 allows the Minister to assign areas to be fisheries management areas meaning that such areas may be subjected to certain management principles to protect the integrity of marine living resources in such area.

Section 16 provides for measures that allow the Minister to suspend or restrict any fishing activities in the case of an imminent emergency when any species are seriously depleted and endangered. Priority fishing areas may also be established by the Minister when deemed necessary in terms of section 17 of this Act.

Section 18 provides for the authorisation to conduct any commercial fishing, subsistence fishing, engage in mariculture and operate a fish processing facility. The authority may order the applicant to undertake an environmental impact assessment if deemed necessary by such authority. Applicants that were previously disadvantaged may receive priority over any other applicant. Rights granted may be valid for a period of up to 15 years. The Minister should determine sustainable utilisation measures where necessary.

Section 19 provides for the declaration of subsistence fishing areas, as well as for the right of certain individuals or communities to be declared subsistence-fishing communities. Any other type of harvesting may be prohibited in such an area.

Section 20 prohibits any person from selling or trading any fish caught through recreational fishing.

Section 21 provides for the conditions relevant to commercial fishing practices. These conditions allow the authority to determine: the formula for the determination of such rights; the allowable portions; rights regarding by-catches; and the monitoring and control of such rights. Any rights regarding the harvesting of marine living resources may be leased by the State at any period of time in terms of section 22 of this Act.

Section 25 provides that any right, licence or permit may be cancelled when any person granted such right fails to comply with the conditions of such right or is found guilty of an offence under the provisions of this Act.

Section 40 requires that any person who wants to conduct any high seas fishing must have the relevant authorisation to do so.

Prohibited fishing methods

Government Notice Regulation 1111 of 2 September 1998 makes provision for certain aspects regarding marine harvesting. It provides that no person may without authorisation engage in marine harvesting during periods or times specified for each species in Annexure 2 of this regulation. No person may fish in a tidal river or lagoon or within 3 nautical sea miles from the high water mark seawards without authorisation from a relevant authority. This may also include an area declared for such purposes under the provisions of this Act. Authorisation is also required for possession of the followings items on board a fishing vessel: any gear, stake net, setnet, gillnet, driftnet, bottom trawl net, midwater trawl net, purse-seine net, purse-net, longline or any type of rock lobster trap. It further provides for specification directives regarding nets and mesh sizes. Trawl net fishing is prohibited in a few areas specified in this regulation. It is also prohibited in tidal rivers and tidal lagoons without authorisation from an authority. Precise specifications for mesh net size have to be complied with, unless a person is authorised not to comply with such specifications. It also provides that no person may attach any canvas, netting or other material to the cod-end of a trawl net. The use of a purse-seine net is prohibited in a tidal river or lagoon without proper authorisation. Such gear is also prohibited in areas as determined by the relevant authority.

Authorisation is needed to use nets of mesh sizes differing from the standard specification. Owners of a fish processing establishment are mandated to have standard equipment to determine the weight of marine species harvested. Authorisation is required for the use of any beach-seine net, staked net, set-net, hoop net, shove net, drag net, driftnet or gillnet. Driftnet may only be used within a distance of two nautical miles seaward of the high-water mark. The use of driftnet is also prohibited in certain areas as been determined in these regulations.

It further provides that no person may use drift net, staked net or any track netting within 2 nautical miles of the seashore. This regulation also applies to

areas been designated by the authority. Fishing with more than 10 fishing hooks may only be undertaken on consent of the authority. This regulation also makes provision for measures that regulate bag limits. No person may harvest any protected species without authorisation. The same principle applies to the harvesting of more than 2 specimens per day on the critical list, 5 specimens per day on the restricted list, and 10 specimens per day relevant to recreational and subsistence harvesting. The following activities may not be undertaken without authorisation:

- harvesting of any marine species;
- collection of marine species for aquarium purposes;
- collection of species smaller than the limits determined by the authority;
- The dumping of any marine species for which a limit has been set;
- Trading species designated for recreational purposes;
- Trading swordfish;
- Trading aquatic plants;
- Catching sharks or possession of any specimens; and
- Import or export of any species or products thereof.

Any species harvested in contravention with the provisions of this regulation should be returned to the sea, when such species are alive. This regulation does not apply to the trade of swordfish caught as a by-catch by means of trawl nets or longlines, or swordfish imported under permit. Such harvested species should also not exceed 10% mass of the total catch. This regulation makes provision for measures to regulate the amount of by-catch that may be kept each day by permit holders. All birds caught by longline must be released when alive and dead birds must be handed over to the fishery control officer at the end of the voyage. A record of all fishing related activities must be recorded on a register as stipulated on the permit. It also regulates the activities pertaining to the use of gear for longline fishing. This regulation further makes provision for measures to regulate the number of specimens that may be harvested by subsistence, commercial or recreational fishing. It provides that commercial fishing may not be undertaken in areas as designated by the authority. It provides specific restriction for commercial gear that may be used for harvesting purposes.

The permit for conducting mariculture activities should indicate information on: measures to be taken to prevent the introduction of exotic parasites, commensals, and pathogens; details on cultivation; and environmental impact and mitigation measures. Cessation of mariculture activities must be reported to the Minister. A permit may be suspended if the holder fails to comply with the provisions thereof, or if the Minister deems it necessary to suspend such actions due to environmental impact. The Minister may determine the conditions for such permit at any stage. No person may release any exotic fish into South African waters without authorisation from the Minister. Genetically altered organisms may only be used for mariculture on authorisation of the Minister. No person may deposit any fish in the waters of South Africa, if it is suspected that such specimen contains a disease that may pose a threat to the integrity of the marine

environment. The use of any chemical substance for mariculture purposes must be reported to the Minister.

Section 44 further describes prohibited fishing methods. These include: use of poison; explosives, or any other obnoxious substance to improve the chance of catching fish.

Section 45 prohibits the use of any gear prohibited under the provisions of this Act.

Section 47 provides that drift net fishing may only take place by authorisation of the relevant authority.

Section 48 ensures that any fish aggregating device may only be used with the relevant authorisation to do so.

Section 49 provides that any unauthorised fishing gear on foreign vessels is to be stowed when such vessel is in the waters of the Republic. The Director General may appoint observers to monitor certain actions on vessels in terms of section 50 of this Act.

International issues

Section 38 provides that the Republic may not enter into any international agreement on foreign fishing rights when such agreement exceeds the limits of the total resources present in the waters of the Republic. Any vessels operating foreign marine harvesting must comply with the conditions determined by the Republic to harvest any marine living resources in the waters of the Republic. Section 39 provides that all foreign fishing vessels in the waters of the Republic must have the necessary authorisation for harvesting.

Section 42 provides for the implementation of international conservation and management measures. The Minister may use international information to which the Republic is entitled, to support the objectives of this Act. The Director General may take the necessary steps against any foreign vessels that have contravened any international environmental commitment in the waters of the Republic.

Protection

Section 43 provides for the declaration of marine protected areas to protect the integrity of marine living resources in any area. No person may carry out any restricted activity in such an area without the necessary permission. Such activity may include: fishing; killing of any marine living resources; polluting, physically disturbing the environment; or to carry out any activity that compromises the integrity of such area. Government Notice Regulation 1810 of 27 July 1990

makes provision for setting aside areas as marine reserves to protect areas that contain specific marine biodiversity.

Enforcement

Section 51 ensures that a fishery control officer may enter and search any vessel, vehicle, aircraft or premises or seize any property to fulfil the provisions of this Act. Section 52 allows such officer the authority to act on any foreign vessels within the provisions of his or her duty, and to act internationally when deemed necessary.

Section 58 provides that any person who contravenes a provision of this Act, (except foreign fishing vessels) may on conviction be liable for a fine of up to R3 000 000 or imprisonment for up to 5 years. Any person who contravenes the provisions of section 39 (foreign fishing vessels), section 45 (the use of prohibited gear), section 47 (drift net fishing), section 48 (fishing aggregating device) and section 49 (unauthorised fishing gear on foreign vessels to be stowed) may on conviction be liable for a fine of up to R5 000 000.

Section 63 makes provision for the disposal of perishables seized by any officials who executed their duties under the provisions of this Act. Such perishables may be returned to the person from whom they were seized, or may be sold, or an officer may destroy such specimen or return it to the original habitat.

Section 77 relates to formulating regulations. The Minister may make regulations regarding: fines to be greater than those discussed in this Act; regulations in accordance with international law, fisheries measures; conservation measures; the prohibition of certain fishing gear; the prevention of marine pollution; the regulation of marine protected areas; and utilisation of various species.

Section 81 allows the Minister to exempt any person from any conditions determined by this Act.

Aspects not covered by this Act

- *Improved regulation of boats and other anthropocentric activities in estuaries, lagoons, and sea lakes. These areas provide protection and nurseries for various species that are harvested along the coast. Such areas should not be disturbed by any anthropogenic activities (also see 2.4.2, 3.3.1 and Table 6).*
- *Biodiversity equality harvesting, which means that subsistence harvesting and recreational harvesting should be equally managed. Both activities are environmentally equally detrimental to marine resources (also see 2.4.2, 3.3.1 and Table 6).*
- *Release of living confiscated marine biodiversity back into the environment. Government Notice Regulation 1111 of 2 September 1998*

- provides that a certain amount of by-catch may be kept by commercial harvesters per day. All living specimens of by catch should be released (also see 2.4.2, 3.3.1 and Table 6).*
- *Determination of minimum size and number of marine protected areas to sustain biodiversity. A certain sized area is needed to ensure the protection of marine biodiversity and associated systems. Legislation should determine the size of such areas in various types of marine systems, and implement measures to achieve such objectives (also see 3.3.1 and Table 6).*
 - *Stricter measures for trawling. Trawling is extremely detrimental to all marine taxa and is responsible for the killing of numerous untargeted species. It is in the interest of marine biodiversity to preferably totally ban all trawling activities, as seen in some international coastal areas (also see 3.3.1 and Table 6).*

5.2.1.4 Sea-Shore Act 21 of 1935

General

This Act stipulates that the President is the owner of the seashore and the sea, and that the Government may regulate the use of these areas. This includes letting of seashores and the sea, measures to determine the high-water mark, application of mining laws in respect of the seashore and in territorial waters of the Republic of South Africa.

Relevant sections

Section 2 declares that the President is the owner of the seashore, while section 3 provides that the President may let the seashore for various commercial purposes such as the construction of facilities for recreation. Section 10 allows the Minister to make regulations regarding: use of the seashore; pollution thereof; or the use of material from the seashore. Any person contravening any provision of this Act will on prosecution be liable for a fine of R500 or to imprisonment for a period of up to 2 years, or to both such fine and imprisonment.

Government Notice Regulation 168 of 2 February 1962 as amended by regulation 70 of 20 January 1989 makes provision for general seashore regulations under section 10 of this Act. It regulates animals on the seashore, use of firearms, vehicles on the seashore, use of boats, and the making of fire on the seashore. Any person who contravenes this regulation may on conviction be liable for a fine of up to R50.

Government Notice Regulation 2466 of 18 October 1991 makes provision for regulations regarding the use of vehicles and dumping of refuse on certain portions of the sea-shore.

5.2.1.5 Sea Birds and Seals Protection Act 46 of 1973

Objective

This Act controls the protection, capturing and killing of birds and seals (and their products) on certain islands and in certain areas. It also covers the powers of the Minister, prohibitions, issue and transfer of permits, general exemptions and limitation of liability.

Biodiversity on islands

Section 2 provides for the power the Minister holds over islands, sea birds, seals and products of sea birds and seals. The Minister has the power to make decisions regarding the utilisation of any products of seabirds or seals under the provisions of this Act. The Minister may at his discretion mandate the killing of any seabird or seal when deemed necessary by him/her. Section 3 prohibits any person from setting foot and remaining on any island or in any area between the high water and low water mark. No person may capture or kill any seabird or seal in such area, and the removal of any products is also prohibited in terms of this section.

Section 4 determines the conditions under which authorisation for the harvesting of any seals or seabirds and/or their products may take place. Exemptions permitting such activities (such as for scientific research) may be approved by the relevant authority. Section 8 makes provision for the appointment of officers to enforce the provisions of this Act. Any person contravening a provision of this Act may on prosecution be sentenced to 3 months in prison or a fine of up to R200 or to both such fine and imprisonment. Government Notice Regulation 1933 of 22 October 1976 provides directives relevant to seals. It provides that any permit holder should ensure that any person employed by him to conduct any activity described in this Act, has the relevant knowledge to effectively undertake such activity mandated to him/her. This regulation finally provides for information regarding the procedure for the hunting of seals.

5.2.1.6 Sea Fishery Act 12 of 1988

This Act was repealed by section 84 of the Marine Living Resources Act 18 of 1998, except for certain sections thereof.

Levies

Section 29 makes provision for the establishment of a levy on fish and fish products and certain other marine resources. Government Notice 153 of 31 January 2003 also makes provision for measures that impose a levy on fish and fish products.

Harvesting and illegal activities

Section 38 prohibits any person from collecting any seashells or aquatic plants from the seashore. Section 47 provides that any person will be guilty of an offence when he/she is guilty of the following activities:

- using chemical substances to fish;
- detonation of explosive substance to catch fish;
- harvesting under seize fish;
- illegally trading in fish;
- harvesting marine taxa without a permit;
- failure to comply with the conditions of a permit;
- polluting the marine environment; and
- preventing officers from performing their duty.

A person guilty of an offence under this Act may be imprisoned for up to 6 years or be liable for a fine of up to R50 000 or to both such fine or imprisonment.

5.2.2 Marine pollution

5.2.2.1 Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986

Objective

This Act makes provision for the prevention of pollution by oil and other substances discharged from ships. Under Schedule 1 the objectives are concurrent to those of the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978. The international commitments therefore form part of South African environmental law, since it is integrated in legislation.

Relevant sections

Section 2 ensures that the provisions of this Act apply to any South African ship irrespective of where it may be, and any other ship in the waters of the Republic of South Africa. Section 3 allows the Minister to make regulations pertaining to:

- carrying out of the provisions of the Convention;
- exemptions to certain ships from the provisions of the Convention; and
- any other modification to the Convention.

Any person will be guilty of an offence if he/she does not comply with the provisions of this Act or to those provided for in the Convention. On conviction such person may be liable for a fine of up to R500 000 or to imprisonment for period of 5 years, or to both such fine and imprisonment.

Section 4 mandates ships to be certified by official surveyors to ensure that the structure, equipment, systems, fittings, arrangements and material are standard and in working order. The relevant authority may exempt any ship from these provisions in terms of section 7 of this Act.

Regulation

Pollution

Government Notice Regulation 1146 of 24 April 1992 makes provision for prevention of pollution by garbage from ships. It also includes the application of such regulations and penalties regarding offences that are committed under such regulations.

Government Notice Regulation 1491 of 29 May 1992 makes provision for receipt facilities for garbage from ships. It describes its application, requirement, directions for use, and offences for penalties committed under this regulation.

Government Notice Regulation 133 of 23 January 1998 and Government Notice Regulation 134 of 23 January 1998 make provision for Merchant shipping regulations pertaining to pollution. It includes the regulation of survey requirements, issue of an international certificate of fitness of the ship, maintenance of such fitness, directives for the carrying of chemicals, and penalties for non-compliance with such directives. Any person guilty of an offence under the provisions of this Act may be liable for imprisonment for a period of up to 12 months.

Section 10 provides that a ship may be detained if it does not comply with the standards required by these regulations. The International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978 is contained in schedule 1 of this regulation and makes provision for aspects pertaining to the prevention of pollution.

5.2.2.2 International Convention for the Prevention of Pollution from Ships, 1973

Article 1 ensures that the parties to the Convention take all measures necessary to ensure compliance with the principles of the Convention.

Relevant articles

Article 4 makes provision for measures that instigate sanctions against any party violating a provision of this Convention. Section 6 mandates all parties to the Convention to take the necessary steps to report any violations, by any party, of the Convention. Section 8 provides that all accidents involving hazardous substances must be reported to all relevant authorities as soon as possible. Article 11 promotes information exchange between parties on any issue

pertaining to the objectives of the Convention. Article 12 mandates every party to undertake investigations into incidents occurring on its ships and to provide such information to all other parties. Article 17 promotes technical cooperation between parties to the Convention on any issue relating to the objectives of the Convention.

5.2.2.3 Protocol of 1978 to the International Convention for the Prevention of Pollution from Ships, 1973

Pollution from ships

Article 1 of the first Protocol ensures that all incidents on ships are reported as soon as possible. Article 4 ensures that such reporting should provide as much information about the physical characteristics of such incident and pollution.

Annexure 1 of the second Protocol provides regulations for the prevention of pollution by oil. Regulation 2 ensures that the provisions of these regulations apply to all ships. Regulation 4 provides that certain ships must be subjected to a survey within a time period specified by the authority. Regulation 5 ensures that a certificate will be issued after successful completion of such survey. Regulation 8 provides that the validity period of such certificate may not exceed 5 years.

Regulation 9 provides that no oil may be discharged from any ship except under the following circumstances:

- the tanker is not in a special area;
- the tanker is more than 50 nautical miles from land; and
- discharge is less than 60 litre per nautical mile.

Regulation 10 provides methods to prevent oil pollution when any ship is in a special area. Regulation 15 provides technical aspects that may help to retain mixers of oil and water on board. Regulation 16 provides that certain ships be fitted with equipment to monitor release of oil from aboard. Regulation 17 mandates certain ships to have special tanks for the storing of any oil and water mixtures or sludge that may result on long voyages. Regulation 20 provides that all details regarding oil loading and offloading must be recorded in a logbook. Regulation 21 includes technical detail that oil rigs should apply to minimize oil pollution when drilling.

Annexure 2 includes regulations to prevent pollution by noxious bulk liquid. Regulation 5 regulates the discharge of noxious bulk substances, and it allows categories A, B and C substances outside special areas and category D substances in all areas. Regulations 10, 11 and 12 make provision for surveys to be undertaken on ships. A certificate should be issued after such survey and may be valid for up to 5 years. Regulation 13 provides technical advice on methods to minimise or prevent accidental pollution from ships.

Appendix 1 includes classification of categories A, B, C, and D substances, these being:

- Category A: Substances which are bio accumulated and may create a hazard to aquatic life or human health, or which are highly toxic to aquatic life;
- Category B: Substances that are bio accumulated with a short retention time;
- Category C: Substances that are slightly toxic to aquatic life; and
- Category D: Substances that is practically non-toxic to aquatic life.

Annexure 3 makes provision for measures to prevent the pollution of the marine environment by packaged substances.

Regulation 2 provides that such substances must be packaged in a safe and standard manner to prevent their breakage causing pollution casualties. Regulation 4 provides that all activities and packages are adequately documented and managed. Regulation 6 makes provision for quantity limitations on certain harmful substances.

Annexure 4 makes provision for measures for the prevention of pollution by sewage. Regulation 3 ensures the certain ships should have sewage storage facilities to process such substances. Regulation 8 provides that sewage may only be dumped into the marine environment under certain conditions.

Annexure 5 makes provision for measures to prevent the pollution of the marine environment by garbage. Regulation 3 allows the dumping of garbage in certain areas. Regulation 5 ensures that only certain types of garbage may be dumped in special areas.

Marine pollution

Section 2 ensures that the above Convention and Protocol are part of South African law. Section 3 ensures that the Minister may promulgate regulations to ensure that the provisions of the Protocol, Convention, and provisions under this Act are met.

5.2.2.4 The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969

This Convention regulates oil pollution on the high seas and provides measures for the mitigation thereof.

Oil pollution

Article 1 provides that all contracting parties to the Convention must take the necessary measures to prevent, mitigate and eliminate sources of oil pollution in on the high seas. No measures may be taken against war ships and ships owned by a government.

Article 3 provides that all coastal states ensure the necessary consultation measures before taking any actions under Article 1 of this Convention.

Article 4 provides that experts in the field of oil pollution must consult on matters connected with the provisions of this Act. Article 5 provides that effective measures should be taken by coastal states to manage oil pollution casualties. Such measures should only ensure that the actions are proportionate to the damage. Article 6 mandates any party responsible for damage to other parties to pay the expenses resulting from such damage.

5.2.2.5 Protocol relating to intervention on the high seas in cases of marine pollution by substances other than oil 1973

Substances

Article 1 mandates all contracting parties to implement the necessary measures to prevent, mitigate and eliminate cases of pollution by substances other than oil in their marine environment.

Article 2 makes provision for the designation of a specialist to consult on issues of prevention of marine pollution by substances other than oil.

Appendix 1 includes a general reference list of the various types of oil that may be carried in bulk by ships. Appendix 2 includes a list of noxious liquid substances that are carried in bulk. Appendix 3 includes a list of substances carried in packaged form. Appendix 4 includes radioactive materials, and appendix 5 includes a list of liquefied gases.

5.2.2.6 Marine Pollution (Intervention) Act 64 of 1987

This Act enacts the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties as determined by Schedule 1. Schedule 2 is relevant to the Protocol Relating to Intervention on the High Seas in Cases of Marine Pollution by Substances Other than Oil 1973.

5.2.2.7 Dumping at Sea Control Act 73 of 1980

Under this Act provision is made for: the regulation of substance dumping at sea, issuing of permits, reports to the Minister, inspections, and penalties. Schedules 1 & 2 include a list of prohibited and restricted substances, while Schedule 3 describes the factors determining the issue of permits.

This Act is modeled on the totality of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol.

Dumping

Section 2 of the Dumping at Sea Control Act 73 of 1980 makes provision for the regulation of dumping and loading of restricted and prohibited substances. No person may dump or load any substance that is listed in schedule 1 or 2 of this Act, without relevant authorisation from an authority. (See the provisions of the 1996 Protocol that repeal those listed under section 2)

Section 3 makes provision for the granting of authorisation necessary for undertaking activities contemplated in section of this Act. The Director General may determine the conditions of issuing a permit for the undertaking of dumping or loading activities. Section 4 ensures that the Director General reports to the Minister on aspects relating to the dumping or loading of substances contemplated in the provisions of this Act. Reporting should declare the quantities and the nature of substances loaded or dumped. Section 5 allows officers to inspect any person or area when deemed necessary under the provisions of this Act.

Penalties and offences

Section 6 makes provision for penalties for offences committed under the provisions of this Act, and these include the following:

- contravention of section 2(1)(a) relating to dumping of schedule 1 substance may on conviction be liable for a fine of R5 000 – R250 000 or imprisonment for a period of 6 months to 5 years, or both such fine or imprisonment.
- contravention of section 2(1)(a) relating to dumping of schedule 2 substance may on conviction be liable for a fine of R2 000 - R100 000 or to imprisonment for a period of 2 months to 2 years, or to both such fine or imprisonment.
- contravention of section 2(1)(a) or 5(4) relating to dumping of any other substance other than those listed in schedule 1 or 2 may on conviction be liable for a fine of R500 – R5 000 or to imprisonment of between 18 days to 6 months, or to both such fine or imprisonment.

The sum of the fine and the period of imprisonment is concurrent with the number of days over which the offence was committed.

5.2.2.8 The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol

Objective

This Convention regulates the prevention and management of all forms of marine pollution, and includes waste dumping. It regulates control on the disposal of vessels, aircraft, platforms, and other man-made structures into the ocean. This Convention was signed in 1972, and ratified in September 1978 (Anon., 2002b).

The London Convention implied stricter regulation on the types of substances that are allowed to be dumped under the original Convention. South Africa also signed and ratified the 1996 Protocol that has replaced the London Convention. The Protocol represents a major change in the character of dumping of substances under the original Convention.

Prevention of marine pollution

Article 1 mandates all contracting parties to take the necessary measures to prevent pollution in the marine environment through the dumping of wastes and other matter. Article 2 provides that every party should take steps to prevent marine pollution according to its own scientific and technical capabilities. Article 3 defines the terms used in the text of this Convention. Article 4 prohibits contracting parties from dumping any waste in the marine environment, except where otherwise specified. It prohibits the dumping of substances listed under Annexure 1, while the dumping of substances under Annexure 2 requires a special permit. The dumping of all other substances only requires a general permit. Authorisation may only be granted once the conditions for such action as listed under Annexure 3 have been thoroughly assessed.

Article 5 authorises dumping in emergency situations, but such action may only take place when human life is under threat, and where such action may secure the safety of human life. A special permit may be authorised for dumping of substances if such dumping may avert a potential threat to human health. Article 6 provides that every contracting party must designate an authority to administrate the following actions:

- authorisation of dumping activities;
- monitoring of all dumping activities; and
- Keeping of records of the quantities and nature of substances dumped.

Article 7 mandates all parties to implement the necessary measures to ensure that vessels, ships and any platforms comply with the provisions of the Convention. It also encourages all contracting parties to cooperate internationally on issues relative to the directives of the Convention. Article 8 encourages the

implementation of regional agreements between parties to further the provisions of the Convention. Article 9 provides that any party may provide assistance to another party in the implementation of the principles of this Convention. Article 12 provides that all contract parties must implement measures to prevent the pollution of the marine environment with the following types of wastes:

- hydrocarbons, including oils and similar wastes;
- any noxious or hazardous matter;
- wastes generated by any vessels, aircrafts or anthropogenic structures on sea; and
- wastes resulting from any mineral activities in the marine environment.

The 1996 Protocol

The original Convention prohibited the dumping of substances listed under Annexure 1, and these included: organohalogen substances; mercury compounds; cadmium; persistent plastics; crude oil; fuel; high level radioactive wastes; biological weapons and chemical weapons.

Substances listed under Annexure 2 were allowed to be dumped after authorisation has been obtained and these included: arsenic; lead; copper; zinc; organosilicon compounds; cyanides, fluorides; beryllium; chromium; nickel; vanadium; scrap metals and radioactive wastes not included under Annexure 1.

The Protocol introduces a new precautionary principle (article 3) to ensure that preventative measures are taken when there is reason to believe that wastes or other matter introduced into the marine environment are likely to cause harm, even when there is no conclusive evidence to prove that there is no relation between input and their effects. The London Convention permitted the dumping of various substances under a so called black and grey list.

Under the 1996 Protocol dumping of all substances is prohibited, except for the following substances: dredged material, sewage sludge, fish waste, vessels, platforms, manmade structures, inert inorganic material, geological material, natural organic material, bulky steel and solid concrete.

Annexure 3 includes provisions that should be considered in the issue of permits, and these are:

- total amount to be dumped per year;
- physical state of waste;
- physical properties of waste;
- toxicity;
- persistence; and
- biotransformation and accumulation.

It also includes characteristics of the dumping site and methods of dumping:

- location;
- rate of disposal;
- methods of packaging;
- initial dilution achieved;
- dispersing properties;
- water characteristics;
- bottom characteristics; and
- previous dumping in area.

Finally, it makes provision for general considerations to be taken into account and the possible impact on amenities and marine living resources.

5.2.2.9 Marine Pollution (Control and Civil Liability) Act 6 of 1981

Aspects covered by this Act include prohibition of discharging oil into the ocean, reporting thereof, powers of authority to intervene when pollution occurs, removal of pollutants, right to inspect pollution sources and liability for pollution.

Marine pollution

Section 2 prohibits the discharge of oil from a ship, unless such oil is released to secure the safety of the ship or when such ship is damaged. Section 3 makes provision for the reporting to the Republic of South Africa of discharge or likelihood of discharge of any dangerous substance from a ship. Section 4 empowers the relevant authority to take steps to prevent pollution of the sea when a harmful substance has been discharged. The authority may mandate the party responsible:

- to unload such substance;
- to transfer such substance to a safer part of the ship;
- to dispose of such substance in a manner prescribed by the authority;
- to move such ship to a safer location or not to move;
- not to unload any such substance;
- to carry out operations for the sinking or destruction of the ship as may be required by the authority; or
- to take any steps as may be required by the authority.

Section 5 provides that the authority may take any steps necessary to prevent pollution of the sea by any harmful substances. Section 7 allows any person who has been authorised by the relevant authority to undertake inspection of a ship or tanker and to take samples of harmful substances on board such ship or tanker. Section 8 allows any person authorised thereto to enter upon land to enforce the provisions of this Act. Section 9 provides that the owner of the ship or offshore

installation at the time of the incident will be liable for all damage incurred as a result of such incident. Such person will be liable to remedy the detrimental impact resulting from such incident. Such person will not be held liable if he/she can prove that the incident was caused by:

- an act of war, hostilities, civil war, insurrection or an exceptional, inevitable and irresistible natural phenomenon;
- a person not employed by the owner; or
- any other person or party.

Section 11 exempts warships and tankers used by the State from the provisions of this Act.

Aspects not covered by this Act

- *Warships and tankers used by the State should not be exempt from the provisions of this Act. Any ship or vessel should be managed in such a manner as to prevent pollution to the marine environment. Any responsible ship or vessel polluting the marine environment should be responsible for rehabilitation and mitigation measures (also see 2.4.2, 3.3.2 and Table 6).*
- *Provision should be made for measures to regulate thermal marine pollution (also see 3.3.2 and Table 6).*

5.2.3 Protection of Antarctica

5.2.3.1 The Antarctic treaty 1959

The overall objective of this Treaty is to ensure the protection of the Antarctic environment and ecosystems that are associated therewith or dependent on the integrity of the Antarctic environment. A management plan should therefore be utilized to ensure that the integrity of the Antarctic environment is sustained. This international commitment has been integrated as part of legislation and therefore forms part of South African environmental law (SEDAC, 2002). (Also see section 3 of the Antarctic Treaties Act 60 of 1996).

General Principles

Article 2 of the Antarctic Treaty makes provision for ensuring the Parties to this Treaty commit themselves to the protection of the Antarctic environment and to ensure that Antarctica is used as a natural reserve devoted to peace and science.

Article 3 makes provision for environmental principles. The principles emulate to ensure that activities are planned to limit their negative impact on the environment including the impact on biodiversity. This information should be

used to ensure effective assessment and monitoring of such activities and to provide mitigation options for activities that may impact negatively on the environment.

Articles 4 and 5 provide for integration with other components of the Antarctic Treaty to ensure compliance with the provisions thereof.

Article 6 provides for cooperation between contracting parties to ensure that the objectives of the Treaty are met.

Article 7 prohibits mineral resource and mining activities in the Antarctic environment.

Article 8 mandates parties to undertake the necessary environmental impact assessment for on any activities determined under the provisions of the Antarctic Treaty. This assessment process must be conducted according to a pre-determined procedure.

Article 10 makes provision for Antarctic Treaty consultative meetings to obtain detailed information regarding the provisions of this Treaty.

Article 11 makes provision for the establishment of a Committee for Environmental Protection to promote the administration of provisions of this Treaty in terms of Article 12. Article 13 mandates every party to this Treaty to take the necessary actions to ensure compliance with the objectives of the Treaty.

Article 14 makes provision for the appointment of international inspectors to ensure compliance with the objectives of this Treaty.

Article 15 mandates every contracting party to the Treaty to compile contingency plans to ensure effective management of imminent environmental emergencies. Article 16 ensures that contracting parties are liable for environmental damage caused by any such party to the Antarctic environment. Article 17 makes provision for annual reporting by contracting parties on contingency plans or any other matter deemed necessary.

5.2.3.2 The Protocol on Environmental Protection to the Antarctic Treaty 1991

Relevant articles

This international commitment has been integrated as part of legislation and therefore forms part of South African environmental law. (Also see section 3 of the Antarctic Treaties Act 60 of 1996).

Article 1 provides that Antarctica may only be used for peaceful and scientific purposes, and that the establishment of military bases is prohibited. Article 2 makes provision for freedom of scientific research. Article 3 makes provision for scientific cooperation between contracting parties. Article 5 prohibits nuclear dumping and the use of nuclear weapons in the Antarctic environment. Article 6 ensures that the provisions of the Protocol apply to the area south of the 60 degrees south latitude. Article 7 makes provision for the establishment of international observers to ensure international compliance with the objectives of this Protocol.

5.2.3.3 The Convention on the Conservation of Antarctic Seals 1959

Objective

This international commitment has been integrated as part of legislation and therefore forms part of South African environmental law. (Also see section 3 of the Antarctic Treaties Act 60 of 1996).

The overarching objective of this Convention is to protect vulnerable Antarctic seals as a result of commercial exploitation. The parties to the Convention should therefore realise the importance of these seals as an integral part of the Antarctic marine environment.

Scope and principles

Article 1 defines the scope of the Convention and includes the area south of the 60 degrees south latitude under the provisions of this Convention. The following species are included under the provisions of the Convention: Southern elephant seal *Mirounga leonina*, Leopard seal *Hydrurga leptonyx*, Weddell seal *Leptonychotes weddelli*, Crab eater seal *Lobodon carcinophagus*, Ross seal *Ommatophoca rossi*, and the Southern fur seals *Arctocephalus* sp.

Article 2 mandates contracting parties to this Convention to take measures to ensure compliance with the provisions of this Convention. Article 3 includes an Annexure that provides that Contracting Parties may in the future adopt other measures regarding the conservation of seal resources that *inter alia* prescribes the following aspects: permissible catch; protected species; unprotected species; open and closed seasons; open and closed areas; designation of special areas; restrictions regarding harvesting; and assessment of scientific information.

Article 4 makes provision for the issuing of permits for harvesting seals under special circumstances. It provides that any contracting party may issue a permit for killing seals for the purpose of human consumption, dog food or scientific research. Article 5 mandates contracting parties to exchange information and scientific advice on the provisions of this Convention. Article 6 makes provision for consultation between contracting parties on any issue relevant to the provisions of this Act. Annexure 1 includes information pertaining to the following:

- seal species and the number of seals that may be harvested by contracting parties per year;
- protected species that may not be killed;
- closed and open seasons for killing of seals;
- zones where seal killing may be undertaken;
- seal reserves;
- recording and exchange of information; and
- authorised sealing methods.

5.2.3.4 The Convention on the Conservation of Antarctic Marine Living Resources 1980

Objective

This international commitment has been integrated as part of legislation and therefore forms part of South African environmental law. (Also see section 3 of the Antarctic Treaties Act 60 Of 1996).

The most important objective of this Convention is to ensure the protection of marine living resources in the Antarctic environment, and to ensure that measures are taken to preserve this biodiversity.

Scope

Article 1 ensures that the provisions of this Convention apply to the area 60 degrees south of the south latitude. It further ensures the protection of all forms of biodiversity in the Antarctic environment, including avian biodiversity.

General principles

Article 2 makes provision for the following aspects: sustaining the levels of harvested species; maintenance of ecological integrity between various harvested and non-harvested species; and prevention of changes in the ecological stability of the Antarctic environment.

Article 3 provides that all contracting parties must take the necessary action to ensure compliance with the principles of the Convention.

Article 4 provides that no person or party may claim sovereignty over Antarctica under any circumstances.

Article 7 makes provision for the establishment of the Commission for the Conservation of Antarctic Marine Living Resources.

Article 8 provides that the Commission must take all action necessary to ensure that the objectives of the Convention are achieved. Article 9 defines the objectives of the Commission. These are:

- Facilitate research into Antarctic marine living resources;
- Demographic statistics regarding species and population dynamics;
- Identify conservation needs and assess conservation effectiveness;
- Formulate adequate conservation strategies;
- Species harvesting strategies;
- Designation of protected species;
- Harvesting of species in designated areas;
- Size and age of species that may be harvested;
- Open and closed seasons for harvesting of species; and
- Administration of any aspect needed to achieve the objectives of this Convention.

Article 10 provides that the Commission may alert any person or party who contravenes the provisions of the Convention, irrespective of whether such person is a contracting party or not.

Article 11 provides that the Commission must ensure cooperation with contracting parties bordering 60 degrees south latitude. Article 14 ensures that the contracting parties establish a Scientific Committee for the Conservation of Antarctic Marine Living Resources. The objective of this Committee is to consult the contracting parties on scientific issues relative to the objectives of the Convention.

Article 21 mandates all contracting parties to take all necessary measures to ensure compliance with the provisions of this Convention.

Article 22 mandates contracting parties to make effort to convince non-parties not to undertake any activities that contravene with the provisions of this Act.

Article 24 ensures that the international inspection procedure is implemented to ensure that contracting parties comply with the objectives of the Convention.

5.2.3.5 The Antarctic Treaties Act 60 of 1996

Objective

This Act provides directives for the administration of treaties relative to Antarctica. It stipulates the power of the Minister, inspectors, observers and other officials when the Antarctic environment is endangered.

Scope

Section 2 ensures that the provisions of this Act apply to South African citizens in Antarctica and also to contracting parties to the Antarctic Treaty. Section 3 provides that the treaties mentioned in Schedule I of this Act will be integrated as pertinent law of the Republic of South Africa. The following are included: the Antarctic Treaty; the Protocol on Environmental Protection to the Antarctic Treaty; the Convention on the Conservation of Antarctic Seals; and the Convention on the Conservation of Antarctic Marine Living Resources. The text of the treaties has been published under Government Notice Regulation 1999 of 3 January 1997.

Environment

Section 4 provides that when the Antarctic environment is detrimentally affected by any person to whom this Act is relevant, the Minister may mandate such person to take steps to eliminate, reduce and remedy such damage to the environment.

Enforcement

Section 5 provides that the Minister may appoint inspectors, observers and other officials to enforce the provisions of this Act. The Minister may promulgate regulations regarding the qualifications and functions of these persons and the issuing of permits, as contemplated in the treaty in terms of section 6 and 7 of this Act.

Government Notice Regulation 980 of 18 July 1997 makes provision for general regulations under this Act. It provides that no person may catch Antarctic marine living resources that are protected by Convention on the Conservation of Antarctic Marine Living Resources. A permit for such activity must be obtained from the Minister and the conditions thereof must be in accordance with the principles of the convention. Any person contravening the provisions of this regulation will on conviction be liable for a fine as stipulated by the provisions of the Convention on the Conservation of Antarctic Marine Living Resources.

Section 9 provides that any person contravening the provisions of this Act may on conviction be liable for a fine of or to imprisonment. Under the Antarctic Treaty the period of imprisonment may be 5 years for any person or party using Antarctica for purposes that are not peaceful. In the case of nuclear explosions or dumping the period of imprisonment may be extended to 20 years. Under the Protocol on Environmental Protection to the Antarctic Treaty a person may be imprisoned for 2 years in the case of damage to the Antarctic environment, or 5 years for conducting mineral activities.

Under Annexure II of the Protocol on Environmental Protection to the Antarctic Treaty the introduction of alien species into the Antarctic environment and harmful interference with any species is an offence. Any person may on prosecution be liable for imprisonment of 1 or 2 years.

Under Annexure III to the Protocol on Environmental Protection to the Antarctic Treaty the disposal or storage of waste is punishable by imprisonment for 1 year. Under Annexure III to the Protocol on Environmental Protection to the Antarctic Treaty the period of imprisonment may be 2 to 5 years depending on the offence.

The following substances may not be disposed of in the sea: oily mixtures; noxious substances; garbage and sewage.

Under Annexure V to the Protocol on Environmental Protection to the Antarctic Treaty a person may be imprisoned for 1 to 2 years for engaging in the following activities: entry into specially protected areas and damaging monuments or historic sites.

Under the Convention for the Conservation of Antarctic Seals the capture of seals may be punishable by imprisonment for 2 years. Under the Convention on the Conservation of Antarctic Marine Living Resources the harvesting of marine living resources may be punishable by imprisonment for 5 years.

The following international commitments are part of South African law, and are therefore discussed under the provisions of the Antarctic treaties Act. They are: the Antarctic Treaty; the Protocol on Environmental Protection to the Antarctic Treaty; the Convention on the Conservation of Antarctic Seals; and the Convention on the Conservation of Antarctic Marine Living Resources.

5.3 Conclusion

The Convention on the Conservation of Antarctic Marine Living Resources, 1980 (CCAMLR) regulates the exploitation of Antarctic marine living resources. The International Convention for the Regulation of Whaling, 1946 (IWC) supports whale research and conservation. The International Convention for the Conservation of Atlantic Tunas, 1966 is responsible for the conservation and sustainable use of tuna species, including the longfin tuna.

Marine Living Resources Act 18 of 1998 makes provision for the issue of permits, the management of marine living sources, allowable catches, management areas, emergency measures, priority areas, granting of rights, subsistence fishing, recreational fishing, commercial fishing, local fishing vessel licences, reduction of rights, fees, recovery of interest, fishing harbours, suspension of fishing rights, establishment of Fisheries Transformation Council, international agreements, foreign fishing vessel licences, prohibition of high seas fishing,

conservation strategies, and marine protected areas. The following issues are not adequately addressed:

- regulation of boats and other anthropocentric activities in estuaries, lagoons, and sea lakes;
- biodiversity equality harvesting in regard to subsistence and recreational harvesting;
- release of living confiscated marine biodiversity back into the environment; and
- determination of minimum size and number of marine protected areas to sustain biodiversity and stricter measures for trawling.

The Sea-Shore Act 21 of 1935 states that the Government may regulate the use of these areas. This includes letting of seashores and the sea, measures to determine the high-water mark, application of mining laws in respect of the seashore.

The Sea Birds and Seals Protection Act 46 of 1973 controls the protection, capture, and killing of birds and seals (and their products) on certain islands and areas. It also covers the powers of the Minister, prohibitions, issue & transfer of permits, and general exemptions.

The Sea Fishery Act 12 of 1988 makes provision for the regulation of harvesting marine resources. The Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986 makes provision for the prevention of pollution by oil and other substances discharged from ships. Under Schedule 1 the objectives are concurrent to those of the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978. The Convention and Protocol regulates the following aspects: measures to ensure compliance with the objectives of the Convention; reporting of violations, reporting of incidents; information exchange; cooperation between parties; prevention of pollution by oil; inspection of ships, certification of ships; regulation of oil release in certain areas; and prevention of pollution by other substances.

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol regulate the prevention and management of all forms of marine pollution, and includes waste dumping. It regulates the disposal of vessels, aircraft, platforms, and other man-made structures into the ocean.

The Marine Pollution (Intervention) Act 64 of 1987 supports the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties as determined by Schedule 1. Schedule 2 is relevant to the Protocol Relating to Intervention on the High Seas in Cases of Marine Pollution by Substances Other than Oil 1973. It ensures that contracting parties prevent, mitigate and rehabilitate any case of pollution by oil and other substances in the marine environment.

The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 seeks to prevent, mitigate, eliminate pollution on the high seas, and to reduce or eliminate the possible threat of pollution to the coast.

Under the Dumping at Sea Control Act 73 of 1980 provision is made for: dumping of substances at sea, issuing of permits, reports to the Minister, inspection, and penalties. Schedules 1 and 2 include a list of prohibited and restricted substances, while Schedule 3 describes the factors that determine the issue of permits.

Marine Pollution (Control and Civil Liability) Act 6 of 1981 prohibits the discharge of oil into the ocean, reporting thereof, powers of authority to intervene as pollution occurs, removal of pollutants, right to inspect pollution sources, and liability for pollution.

- It does however exclude warships and tankers from the provisions of this Act. Provision should also be made under this Act for measures to regulate thermal pollution.

The Antarctic Treaties Act 60 of 1996 regulates aspects relative to the integrity of the Antarctic environment. It includes the provisions of the Antarctic Treaty, the Protocol on Environmental Protection to the Antarctic Treaty, the Convention on the Conservation of Antarctic Seals; Convention on the Conservation of Antarctic Marine Living Resources. The overall objectives of these international commitments are: protection of the integrity of the Antarctic environment; that Antarctica is used for peaceful purposes; the protection of Antarctic seals; and measures for the conservation of marine resources.

CHAPTER 6

SECTORAL LEGISLATION: THE TERRESTRIAL, ATMOSPHERIC AND FRESH WATER ENVIRONMENT

6.1 Introduction

Sectoral legislation pertaining to the terrestrial, atmospheric and fresh water environment should make provision for aspects relative to: air pollution prevention, population growth regulation, regulation of development, natural heritage protection, aquatic pollution control, hydrological cycle integrity and fire regulation.

The following relevant acts are discussed in this chapter:

- National Environmental Management Air Quality Act 39 of 2004;
- National Water Act 36 of 1998;
- Mountain Catchment Areas Act 63 of 1970;
- Lake Areas Development Act 39 of 1975;
- Development Facilitation Act 67 of 1995;
- Physical Planning Act 125 of 1991;
- Nuclear Energy Act 46 of 1999;
- National Nuclear Regulator Act 47 of 1999;
- National Heritage Council Act 11 of 1999;
- National Heritage Resources Act 25 of 1999;
- World Heritage Convention Act 49 of 1999;
- Mineral and Petroleum Resources Development Act 28 of 2002;
- Petroleum Pipelines Act 60 of 2003;
- Hazardous Substances Act 15 of 1973;
- Explosives Act 15 of 2003; and
- National Veld and Forest Fire Act 101 of 1998.

The following international commitments are supported by South Africa. These are also discussed in this chapter and include:

- Stockholm Convention on Persistent Organic Pollutants, 2002 (POPs);
- Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention);
- Convention on Prior Informed Consent-Rotterdam, 1998 (the Rotterdam Convention);
- United Nations Framework Convention on Climate Change, 1992 (UNFCCC);
- United Nations Convention to Combat Desertification, 1994 (UNCCD);
- Montreal Protocol on substances that deplete the ozone layer, 1987 (Montreal Protocol);
- Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997, (Kyoto Protocol); and
- Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1971 (Ramsar Convention).

6.2 The terrestrial, atmospheric and fresh water environment

The terrestrial, atmospheric and fresh water environment includes the atmosphere, water, and soil. Provision should be made to protect these entities necessary to sustain the living world. This includes the regulation of development, the management of terrestrial, air and aquatic pollution, fresh water management, and control of fire.

6.2.1 Air pollution control

6.2.1.1 The United Nations Framework Convention on Climate Change, 1992 (UNFCCC)

Objective

This Convention addresses global climate change, and urges governments to reduce greenhouse gases. The ultimate objective of this Convention is to stabilize greenhouse gases globally, and therefore prevent global climate changes (UNFCCC, 2003). This convention was signed on 15 June 1993 and 27 August 1997, and ratified on 29 August 1997 (South Africa, 2003a).

Greenhouse gas control

Article 2 states that the objectives of the Convention are to stabilise greenhouse gas concentrations in order to prevent unwanted climate changes. Article 3 makes provision for principles to form the basis of this Convention and these are as follows:

- protection of climate system for future generations;
- special consideration for developing country parties;

- implementation of precautionary principles to prevent negative climate changes;
- promotion of sustainable development; and
- international cooperation on aspects relative to climate change.

Article 4 makes provision for commitments to which parties to the Convention should adhere, these being:

- publication of statistics on greenhouse gas emissions;
- formulation and implementation of programs that relate to the objectives of the Convention;
- preparation for possible impacts to be expected due to global climate changes;
- promotion of scientific climate research;
- promotion of public awareness and education;
- mitigation of negative activities that may induce climate change; and
- consideration for countries that may be severely affected by climate change.

Article 5 makes provision for research and systematic observation. It mandates parties to take the following actions:

- support scientific initiatives that pertain to the prevention of global climate changes; and
- support international research activities.

Article 6 mandates parties to take measures to promote education, training and public awareness. Article 9 makes provision for the establishment of a subsidiary body for scientific and technical advice relevant to the objectives of the Convention.

6.2.1.2 The United Nations Convention to Combat Desertification, 1994 (UNCCD)

Objective

This Convention aims to promote cooperation among countries experiencing serious drought and desertification. South Africa signed on 9 January 1995, ratified it on 30 September 1997, and acceded to it in June 1994 (UNCCD, 2003; South Africa, 2003a).

Desertification control

Article 2 defines the objective of this Convention, and makes provision to combat desertification and mitigate the effects of drought in countries that may be seriously impacted by drought. It makes provision for integrated strategies to

rehabilitate and conserve land and to ensure the sustainable management of such land. Article 3 provides principles that guide the objectives of the Convention and these are:

- implementation of programs to prevent and mitigate the effects of desertification;
- promote international cooperation regarding aspects relative to the provisions of the Convention; and
- take into consideration the needs of developing countries.

Article 4 makes provision for general obligations under the Convention, and these include addressing the factors that may cause desertification but also to implement financial mechanisms to enforce the provisions of this Convention.

Article 5 defines the objectives of affected country parties, and these make provision for the following principles:

- measures to combat and mitigate desertification;
- establishment of policies and strategies within the framework of sustainable development to combat desertification;
- pay attention to underlying causes of desertification;
- promote awareness and public participation regarding the aspects that pertain to desertification;
- promote the promulgation of legislation to address problematic issues.

Article 6 mandates developing country parties to use initiatives to assist affected country parties to combat desertification. Article 7 prioritises African countries as areas that should receive the necessary help from developing countries in combating desertification. Articles 9 and 10 make provision for the establishment and implementation of national action programmes that include the following aspects:

- long term strategies to combat desertification;
- modifications to such programmes for various countries;
- implementation of preventative measures to areas where land is only slightly degraded;
- provide policies to strengthen international cooperation;
- promotion of participation between all levels of society; and
- establishment of early warning systems.

Article 11 makes provision for the implementation of regional and sub regional action plans. Article 12 promotes international cooperation on aspects that relate to the provisions of the Convention. Article 16 mandates parties to establish measures to ensure effective information collection, analysis and exchange. Article 17 provides for the undertaking of research and development by contracting parties. Article 24 makes provision for the establishment of a Committee on Science and Technology. The function of this Committee is to

provide scientific and technical advice on issues that relate to the provisions of the Convention.

Annexure 1 includes a regional implementation plan that has been compiled for Africa. This strategy makes specific provision for the following aspects:

- assistance to developed-country parties;
- promotion on the implementation of the provisions of this Convention with regard to Africa;
- consideration for specific circumstances that are present in African countries;
- commitment between African parties to comply with the directives of the Convention;
- strategic planning framework for sustainable development;
- measures to conserve natural resources and biodiversity;
- implementation of regional and sub regional action plans; and
- use of environmental technology to achieve the objectives of the Convention.

6.2.1.3 The Montreal Protocol on substances that deplete the ozone layer, 1987 (Montreal Protocol)

Objective

This Protocol provides for measures to protect the ozone layer. The London Amendment of 12 May 1992 was designed to restrict the use of ozone destructing chlorofluorocarbons and halons. South Africa signed and acceded on 15 January 1990 (Anon., 2003; South Africa, 2003a).

Protection of the ozone layer

Article 2 provides control measures over the emissions of chemical substances listed under the provisions of this international agreement. Any party may transfer any of its calculated level of production of chemical substances to another party within a specified period of time. Such transfer may only include the following substances: chlorofluorocarbons; halons; other halogenated chlorofluorocarbons; carbon tetrachloride; 1,1,1-trichloroethane; and methyl bromide. It also makes provision for the specific transfer of other substances, and such transfer must comply with the specific provisions of the Protocol. Article 2A-2I makes provision for measures to regulate the emission of chemicals listed under the provisions of the Protocol. All contracting parties must ensure that the determined levels of emission for such chemicals are not exceeded in the specified period of time. The following chemicals are regulated: chlorofluorocarbons; halons; fully halogenated chlorofluorocarbons; carbon tetrachloride; 1,1,1-trichloroethane; hydrochlorofluorocarbons; hydrobromofluorocarbons; methyl bromide; and bromochloromethane.

Article 3 provides measures that are used to calculate control levels of the various chemicals listed under the provisions of the Protocol. Article 4 mandates contracting parties to ban trade with non-parties regarding the import of chemicals listed under the provisions of the Protocol. Article 4A mandates all contracting parties to ban trade of substances after the phase out date, except where the use of such chemical is essential for domestic purposes. Other contracting parties should agree to such use of a particular chemical. Article 4B mandates the licensing of the import and export of new, used, recycled and reclaimed controlled substances as determined under Annexures A, B, C and E. Article 5 makes provision for special measures to apply to the situation of developing countries. It exempts such countries from specific provisions as determined by the directives of the protocol. Article 6 makes provision for the assessment of control measures listed under article 2 of the Protocol. The parties to the protocol should assess the effectiveness of such control measures every 5 years. A scientific specialist in the field of research should undertake such assessment.

Article 7 mandates all contracting parties to the Protocol to provide statistical information to the secretariat regarding the release of emissions as determined under article 2 of the Protocol. Article 8 provides that the contracting parties should take the necessary measures to act against parties that do not comply with the provisions of the Protocol. Article 9 mandates contracting parties to undertake the necessary research, development, public awareness and exchange of information pertaining to the provisions of the Protocol. These should provide adequate technologies regarding the containment, recovery, recycling, or destruction of controlled substances and the reduction of these emissions. It should also make provision for alternative options relevant to the sound environmental management of such controlled substances. The parties should cooperate internationally to establish mechanisms to promote public awareness regarding controlled substances. Annexures A, B, C and E include the chemical structures of substances that are controlled under the provisions of Article 2. They also identify the ozone depleting potential of each listed substance. Annexure D includes a list of products that contain controlled substances as specified in Annexure A of the Protocol.

6.2.1.4 The Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997, (The Kyoto Protocol)

Objective

This protocol regulates the emission of greenhouse gases, and provides for the implementation of measures to reduce greenhouse gas emissions. South Africa acceded to this convention on 31 July 2002 (UNFCCC, 2003a).

Climate control measures

Article 2 includes a list of principles that form the basis of the Protocol, and these are:

- enhancement of energy efficiency in various sectors of the economy;
- protection of reservoirs of greenhouse gases;
- promotion of sustainable agriculture in the face of possible climate changes;
- use of carbon dioxide reduction technologies;
- application of market instruments to reduce carbon dioxide emissions; and
- reduction in methane emissions.

Article 3 provides that countries listed under Annexure 1 must ensure that their anthropogenic greenhouse gases do not exceed the limits set under the provisions of this Protocol. Article 4 provides that parties may reach a commitment together pertaining to the reduction of the allowable quota of greenhouse gases. The individual allowable quota must not however be exceeded. Article 5 mandates parties to implement a national system to assess the quantities of greenhouse gases produced by activities not regulated by this Protocol.

Article 6 provides that any party may transfer to, or acquire from, any other party emission reduction units aimed at reducing anthropogenic emissions in any sector of the economy. Article 7 mandates all parties to take measures to provide information regarding the production of greenhouse gases not regulated by the provisions of the Protocol. Article 8 provides that the information under Article 8 of the Protocol must be submitted to a panel of specialists at the conference of parties. This information should then be used by all parties for making informed decisions on aspects relative to such production. Article 10 includes general obligations which the parties should observe and include the following:

- formulation of national and regional plans to reduce greenhouse gas emissions;
- implementation of measures to mitigate climate change;
- promotion of use of environmental technologies to ensure compliance with the objectives of this Act;
- promotion of scientific research on issues that pertain to greenhouse gasses; and
- promotion of international cooperation and public awareness.

Article 12 makes provision for the establishment of a clean development mechanism. This mechanism helps non-parties to achieve sustainability and assist parties to achieve their objectives under the provisions of this protocol.

6.2.1.5 National Environmental Management Air Quality Act 39 of 2004

This Act makes provision for the establishment of the National Air Quality Management Committee to administrate the objectives listed under this Act. This Act repeals the Atmospheric Pollution Act 45 of 1965. Chapters 2-6 include national and provincial norms and standards for the management of air quality, compilation of air quality plans, institutional and planning matters, priority areas, classification of polluting activities, general control measures, licensing of listed activities, and international air quality management.

Objective

Section 2 defines the objectives of this Act. It makes provision for aspects of enhancement and to protect the air quality of the Republic of South Africa. It also endeavours to reduce the risk on the environment and promote the overarching goal of sustainable development.

Section 5 provides that the provisions of this Act should be read with the principles of the National Environmental Management Act.

Framework and scope

Section 7 makes provision for the establishment of a national framework that includes the following aspects:

- Mechanisms to comply with air quality standards;
- Compliance with international air quality commitments;
- Control of emissions from point and non-point sources; and
- Mechanisms for monitoring and information management.

Section 8 makes provision for provincial and local monitoring of air quality objectives. Section 9 defines national standards, and these include measures to identify air pollution substances, as well as determination of concentrations that may be released from point and non-point sources. Section 10 ensures that the provisions of section 9 apply to provinces. These standards may not be altered, although the member of the executive council may establish stricter standards for certain areas.

Section 10 ensures that the provisions of section 9 apply to local municipalities. These standards may not be changed, except where the member of the executive council wants to establish stricter measures.

Administration

Section 13 makes provision for the establishment of a National Air Quality Advisory Committee to advise the Minister on aspects relative to this Act. Section

14 makes provision for the appointment of air quality officers to assist with enforcement of the objectives of this Act.

Management plans

Section 15 and 16 provide for air quality management plans, the objectives of these plans are to:

- Improve air quality;
- Address the effect of emissions of fossil fuels from use in residential areas;
- Manage industrial air emissions; and
- Manage point and non-point sources.

Section 17 mandates the implementation of air quality management plans and measures to ensure compliance with the objectives of these plans.

Section 18 makes provision for the designation of priority areas. This provides special measures to be implemented when a particular area experiences air quality problems.

Section 19 provides that a management plan may be compiled and implemented in the area following consultation with all relevant interested and affected parties.

Listed activities

Section 21 makes provision for the listing of activities that may contribute to air pollution. The Minister and member of the executive council may implement measures to regulated these activities, and provide standards that should be complied with.

Section 22 provides that no person may undertake a listed activity without an atmospheric emission licence. Section 23 allows the Minister the authority to declare any appliance or activity as a controlled emitter if such appliance or activity results in air pollution.

Section 24 provides quality and quantity standards for emitters and these standards should be complied with. Section 25 provides that no person may manufacture, sell or use an emitter without compliance to the standards determined under section 24 of this Act. Section 26 makes provision for the regulation of controlled fuels and its ingredients that may have a negative impact on the environment. Sections 27 and 28 ensure that any controlled fuels that may have a negative impact on the environment may be phased out, or any regulations regarding its use may be promulgated. It also regulates the manufacturing, selling and using of these controlled fuels.

Section 29 allows the Minister to declare any substance as a priority air polluting substance, and mandate persons and parties responsible for such activities to implement prevention plans to manage these activities. Section 30 may mandate a person to prepare an atmospheric impact report, to assess such person or party's impact on the atmosphere, when deemed necessary by the relevant authority.

Section 32 provides measures for the management of dust. Section 33 makes provision for measures to regulate the production of dust in mining areas. Sections 34 and 35 make provision for the control of odours and noise.

Authorisation

Sections 36 and 37 make provision for the application of licenses for undertaking of restricted air pollution activities. Section 38 makes provision for procedures that relate to the application procedure for conducting listed activities. The authority may conduct its own investigation on the impacts of the activity on the atmosphere and environment. Section 39 makes provision for factors that need to be taken into account by licensing authorities and these are:

- The impact the activity will have on the environment;
- Measures that should be taken to prevent, reduce and mitigate pollution to be caused by the activity; and
- The principles of the National Environmental Management Act and the Environment Conservation Act.

Section 40 ensures that air quality standards are in harmony with the principles of the National Environmental Management Act and the Environment Conservation Act. Section 41 ensures that permits are in harmony with provincial air quality standards. Section 42 makes provision for the issuing of atmospheric emission licenses.

Section 43 defines the contents of atmospheric emission licenses, being:

- The maximum concentration of pollutants that may be discharged;
- Emission measurements and reporting;
- Penalties for non-compliance; and
- Greenhouse gas emissions measurement and reporting.

A licensing authority may vary the conditions of a license where necessary to enforce improved air quality standards. Section 44 makes provision for the transfer of emission licences. Sections 45-47 make provision for review, variations on licences and the renewal of licences. Section 48 makes provision for emission control officers to assist in the enforcement of the objectives of this Act.

International standards

Section 50 provides measures to support international air quality management. Such measures may provide for more effective control over air pollution in the Republic of South Africa that may contribute to international air pollution problems.

Enforcement

Sections 51 and 52 provide that any person, who contravenes the provisions of this Act, may on conviction be liable for a fine or to imprisonment for up to 10 years. Section 53 allows the Minister to promulgate regulations relevant to the following:

- International air quality management;
- Environmental management cooperation agreements relating to air quality;
- Open fires and incinerators;
- Ozone depleting substances;
- Incentives to increase public awareness; and
- Requirements in respect of monitoring.

Sections 56 and 57 make provision for consultation and public participation to assist in the enforcement of the principles of this Act.

Aspects not covered by this Act

- *Increased regulation of air polluting vehicles in all areas, but especially densely populated areas. Legislation should make provision for measures to reduce vehicle air pollution such as those promulgated in Los Angeles (also see 3.4.1 and Table 7).*
- *Increased regulation of using wood or coal in urban areas. Fire in urban areas creates large amounts of smoke that over time may increase carbon dioxide concentrations. Such higher levels are responsible for the increased occurrence of acid rain that is damaging to any biodiversity in urban areas (also see 3.4.1 and Table 7).*

6.2.2 Hydrological integrity

6.2.2.1 The Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1971 (Ramsar Convention)

Objective

The Ramsar Convention provides for measures to promote wise use of all wetlands, and the conservation of water sources. This convention was signed and ratified on 12 March 1975 (Ramsar, 2003).

Protection of wetlands

Article 1 defines the types of wetlands covered by the provisions of this Convention. These are all types of areas that contain permanent or temporary water whether such areas are artificial or natural and contain fresh, brackish or salt water. Marine areas with a depth of less than 6 meters at low tide are included under these provisions. Article 2 mandates contracting parties to designate wetlands within territories of international importance. These should be selected in terms of their unique ecology, botany, zoology, limnology or hydrology. Every contracting party should designate at least one wetland of international importance, but may add any additional wetlands. Every party should ensure the conservation, management and wise use of migratory stocks of waterfowl under its jurisdiction.

Article 3 provides that every contracting party should take measures to protect the designated wetlands of international importance. Any negative impact on these wetlands must be reported to all contracting parties of the Convention. Article 4 mandates contracting parties to establish nature reserves within designated wetlands to protect such areas as habitat for waterfowl. When the boundaries of a wetland are reduced in the jurisdiction of a contracting party, such party should take measures to compensate for such loss by providing additional designated wetland areas. Contracting parties should encourage research relevant to the biodiversity of wetlands. They should also take measures to increase the numbers of waterfowl in these designated wetlands.

Article 5 provides for effective international cooperation on wetlands that overlap the territories of contracting parties. Article 6 makes provision for conference between parties on subjects of the provisions of this Convention. Article 7 provides that such persons representing contracting parties on such an international conference should have the necessary scientific skills and knowledge in the field.

6.2.2.2 National Water Act 36 of 1998

Introduction

This Act covers all related water management strategies, such as national strategies and catchment management strategies. It covers the following related aspects: protection of water resources, water resources classification systems, water resource quality objectives, the water reserve, pollution prevention, emergency incidents, water use principles, authorization of licences, existing lawful water use, stream flow reduction activities, general authorisations, individual applications for water licences, compulsory licences, conditions regarding issue of licences, financial provisions, powers of the Minister and Director-General, water user associations, advisory committees, international water management, Government waterworks, safety of dams, access to and rights over land, monitoring, appeals, dispute resolution and general provisions.

Objectives

Section 2 defines the objectives of this Act, and makes provision for the protection of aquatic biodiversity and associated ecosystems as well as the reduction of water pollution.

Section 3 provides that water must be used in a sustainable manner. Section 4 provides that a person may continue to use water lawfully for domestic purposes, but that any other types of commercial uses must be subjected to necessary authorisation. This includes the impact such person may have on the flow and the quality of water.

Section 5 makes provision for the implementation of a national water resources strategy. The contents of such strategy in terms of section 6 should be to set out directives for the sustainable use of water in South Africa. Section 8 provides for the establishment of catchment management strategies to ensure the conservation of water resources in various catchment areas.

This is an important aspect since the integrity of water resources is a concurrent function of the integrity of aquatic biodiversity.

Classification systems

Section 12 makes provision for the establishment of water classification systems to ensure that the various aquatic systems are managed effectively. Article 13 defines the objectives of these classification systems, and may include principles such as: water quality, water quantity, and the characteristics and distribution of aquatic biodiversity. Article 14 provides that the Minister may establish water quality objectives for the management of water resources. Section 16 makes provision for the determination of and effect on the water reserve. Section 19 regulates the impact and presence of pollution on water resources. It specifically provides for measures to:

- Cease, modify and control any such processes causing the pollution;
- Comply with prescribed waste management standards;
- Contain the impact of pollution; and
- Eliminate and remedy the sources of pollution.

Catchment management agencies

A catchment management agency may direct any person liable for such pollution to take the necessary measures to manage its impact. This includes that the person or party responsible for such pollution must pay the necessary costs of managing the negative impact of such incident.

Section 20 mandates any person or party liable for an emergency incident that has impacted negatively on the environment, to take all measures to report, mitigate and prevent any further such incidents in future.

Authorisation

Section 22 makes provision for the authorisation of water uses, and ensures that any person may use water for domestic purposes without authorisation. Commercial water use must be subjected to authorisation by a relevant authority. This includes the bulk use of water, or changing the quality of such water resource.

Section 39 makes provision for general authorisation to use water, which means that no license is necessary in such instance unless it is repealed later. Section 43 makes provision for compulsory water licenses to regulate the use of water in areas that are under water stress.

Section 26 provides for directives to regulate the use of water, and these include regulations that may pertain to:

- Purpose of such water use;
- Monitoring of use;
- The impact of such activities on the water resource;
- Regulation on the nature of use and design of waterwork;
- Standards and qualifications of persons that manage such waterwork;
- Prohibition of any activity to protect riparian integrity;
- Waste standards that should be complied with in the case of waste water productions;
- Standards for regulation and monitoring of such waste water; and
- Prescription of conditions that should be complied with before such authorisation will be granted.

Sections 27 and 28 make provision for conditions that should be considered when contemplating authorisation for the commercial use of water. Section 29 requires that the following aspects be taken into account regarding the issue of licences:

- Measures for the protection of the water source;
- Monitoring techniques regarding the quality of the water;
- Monitoring of water that is to be returned to the water course;
- Management of prevention of water pollution; and
- Quantity of water that may be taken from the water course.

Activities

Section 36 makes provision for the declaration of stream flow reduction activities. It includes forestation as a stream flow activity, and also provides that the Minister may identify any other activity as a stream flow reduction activity. The declaration of activities as stream flow reduction activities must be thoroughly assessed before the declaration of such activities.

Article 37 makes provision for the declaration of controlled activities, and includes the following:

- Irrigation of land with waste water;
- Activity aimed at increasing atmospheric precipitation;
- Power generating activities that alter the flow regime of the river;
- Recharging of an aquifer with waste water; or
- Any activity declared under section 38 of this Act.

Sections 54 and 55 provide for authority to suspend an authorisation or license if the holder of such authorisation fails to comply with the conditions of such authorisation. Section 56 makes provision for a water pricing strategy that is a concurrent function of the integrity of the water sources and environmental conditions.

Section 77 makes provision for the establishment of catchment management agencies to administrate the objectives of this act in various designated catchment areas. Section 91 makes provision for the establishment of water user associations to administrate the objectives of this Act at a localised level.

Section 99 makes provision for the establishment of advisory committees to provide consultation on issues that relate to the provisions of this Act.

Section 110 mandates the undertaking of an environmental impact assessment for undertaking of all Government waterworks. Section 137 makes provision for the establishment of a national monitoring system to check the following aspects:

- Quantity of water in various water resources;
- Quality of water in these resources;
- Use of water in these water resources;
- Rehabilitation of water resources;
- Compliance with quality resource objectives; and
- Health of aquatic systems;

Section 139 makes provision for the establishment and implementation of national information systems that contain information relevant to the provisions of this Act. Schedule 1 defines permissible uses of water that mainly pertain to non-commercial activities.

Aspects not covered by this Act

- *Increased regulation and preferable prohibition to alter the mouth of a river, lagoon or similar natural system. Such action should not be allowed, since it may compromise the natural character of the ecosystem and hence impact negatively on any endemic species occurring in the system. Lagoons and river mouths are very sensitive marine areas that sustain unique biodiversity (also see 2.4.2, 3.4.5 and Table 7). When the sea temporarily naturally closes the mouth of a lagoon, such area should not be tempered with. Various altering activities are allowed by the Lake Areas Development Act 39 of 1975 in section 2, that may have a negative impact on biodiversity (also see 6.2.2.4).*
- *Increased regulation and preferable prohibition on development in or draining of a wetland. Due to their scarcity in South Africa, wetlands should not be drained under any circumstances. These areas should be protected by legislation on national and provincial level (also see 3.4.5 and Table 7).*
- *Prohibition on the recharge of an aquifer with polluted water as allowed for in section 37 of this Act. Any polluted water may emerge as a spring or river in another area, and may result in diminished aquatic biodiversity in such area (also see 3.4.4 and Table 7).*

6.2.2.3 Mountain Catchment Areas Act 63 of 1970

Objective

The overall objective of this Act includes the conservation, use, management, and control of mountain catchment areas. Other aspects covered include circumstances for the declaration of catchment areas, directions regarding catchment areas, compensations relevant to complying with directions, exemption of certain land from the above directives, management of advisory committees and fire protection plans.

Declaration

Section 2 makes provision for the declaration of mountain catchment areas. Section 3 provides that the Minister may declare a directive to be applicable to any declared area or land situated within 5 kilometres from a declared mountain catchment area. The following aspects may be addressed by the directives:

- conservation, use, management of such land;
- the prevention of soil erosion, protection and treatment of natural vegetation and the destruction of intruding vegetation; and

- any other matter deemed necessary to enforce the provisions of this Act.

Committee

Section 6 makes provision for the establishment of an advisory committee to advise the Minister on issues that relate to mountain catchment areas. Section 7 provides for the establishment of fire protection committees in respect of mountain catchment areas. Section 8 makes provision for the establishment of fire protection plans. These plans should apply to certain areas and should make provision for the regulation of veld burning and the prevention, control and extinguishing of veld and forest fires. Section 9 provides that these plans may be amended by the Director General when deemed necessary.

Section 11 makes provision for authorised persons to have access to any land to enforce the provisions of this Act on any land declared a mountain catchment area.

Aspects not covered by this Act

- *Regulation of the percentage of mountain catchment area that may be planted with trees. These areas usually contain great biodiversity that is unique and sensitive to any changes. Commercial forestry creates “green deserts” that completely destroys the natural biodiversity in the area. It may also fragment large pieces of the habitat. This may lead to genetic isolation of species. The percentage of area planted with such alien trees should be determined, and legislation should enforce such objectives. Natural corridors should be created to prevent habitat and genetic isolation. All development activities should be minimised in these areas (also see 2.4.1, 3.4.5 and Table 7).*

6.2.2.4 Lake Areas Development Act 39 of 1975

The objectives of this Act make provision for the establishment of lake areas under the control of a Lake Areas Development Board, the opening and closing of the mouth of a tidal lagoon or a tidal river, the construction of a water work within a lake area, the acquisition of private land in a lake area and the provision of State land to the Board.

Objectives

Section 2 makes provision for the establishment of lake areas, and includes areas such as: tidal lagoons; tidal rivers; natural lake, natural river or any combination thereof. Any land may also be declared to be part of such area in terms of this section.

Section 11 makes provision for the establishment of a board to administrate various functions that relate to lake areas. Section 23 makes provision for the promulgation of regulations regarding lake areas. The Minister may promulgate regulations that pertain to:

- the use of such areas on State ground for various purposes;
- the construction of infrastructures and buildings in these areas;
- regulation of the use of the sea shore within such area;
- the use of rivers and lakes in such areas; and
- penalties for offences committed under this Act.

Aspects not covered by this Act

- *Section 2 allows the altering of river mouths and lagoons and this may have a negative impact on biodiversity and should be regulated. Also see previous discussion under the National Water Act 36 of 1998 (see 6.2.2.2) (also see 2.4.2, 3.3.1 and Table 6 for detail information)*

6.2.3 Regulation of development

6.2.3.1 Development Facilitation Act 67 of 1995

Objective

This covers measures to speed up plans for reconstruction and development, and provides for the establishment of a Development and Planning Commission to advise Government on policies and plans relevant to land development. Other aspects include the establishment of development tribunals, land development objectives, permitted and prohibited land development procedures, land development procedures relative to small scale farming, land tenure matters and general provisions.

Sustainable conservation

Section 3 defines general principles that form the basis of land development objectives, and includes sustainable land development as such objective. It also makes provision for sustainable conservation of land within the framework of land development.

6.2.3.2 Physical Planning Act 125 of 1991

Objective

This Act promotes the physical development division that includes national and regional development plans, and regional and urban structure plans. It further describes the types, objectives, contents, and administration of policy plans.

Provision is also made for urban structure plans and legal consequences of plans.

Planning

Section 2 provides that the sensitivity of the natural environment must be considered in the planning of activities under this Act. Section 4 makes provision for the establishment of policy plans to guide planning according to specific directives. The objects of such a policy plan are to ensure the orderly physical development in a specific area. Article 7 makes provision for the establishment of planning committees to assist in the planning of development in an area. Section 30 makes provision for the enforcement penalties for offences committed under the provisions of this Act. Any person contravening a provision of this Act may on conviction be liable for a fine of up to R4000 or to imprisonment for up to 1 year, or to both such fine and imprisonment.

6.2.3.3 Mineral and Petroleum Resources Development Act 28 of 2002

Objective

This Act repeals the Minerals Act 50 of 1990. It provides for measures to ensure legal undertaking of prospecting, mining, and exploration activities relevant to mineral utilisation. It ensures that negative environmental impacts are managed whilst allowing justifiable economical development. This Act ensures that all exploration, prospecting, mining, and rehabilitation programmes are implemented within the framework of sound environmental management principles.

Authorisation to mine

Section 2 defines the objectives of this Act, and it ensures that the mineral and petroleum resources are developed in an environmentally sustainable manner. Section 5 provides that the holder of a prospecting right, mining right, exploration right or production right has the real right to commence the activity in terms of its authorization. It further provides that these mineral activities may not be undertaken without an approved environmental management program.

Section 13 makes provision for reconnaissance permission in terms of mineral and petroleum resources. Section 16 makes provision for the application of a prospecting permit, and includes that an environmental management plan must be submitted before such application will be considered. Section 17 provides conditions for the issuing of a prospecting permit. It mandates the holder of such prospecting permit to take measures to prevent environmental damage and degradation as a result of such action.

Sections 22 and 23 make provision for a mining right, and also provides that such mining may not cause ecological degradation or damage to the environment. An environmental management program must be submitted to the

Department of Mineral Affairs and Energy before authorization will be considered. Section 25 describes the rights and obligations of a holder of a mining right. These include that the holder must comply with the conditions of the environmental management program, and take measures to prevent environmental degradation and pollution.

Environmental management and authorization

Section 37 makes provision for environmental principles to ensure that the principles of section 2 of the National Environmental Management Act 107 of 1998 apply to all mineral activities. Section 38 makes provision for integrated environmental management and the following principles apply:

- compliance with the principles of integrated environmental management as provided in the National Environmental Management Act 107 of 1998;
- assessment and communication re the impact that particular mining activity may have on the environment;
- management of all environmental impacts through compliance with the provisions of the particular environmental management plan;
- rehabilitation of post environment as far as reasonably practical; and
- liability for all environmental damage occurring as a result of mining activities.

Section 39 discusses the nature of an environmental management program. The following aspects are covered:

- baseline conditions regarding the pre-mining state of the environment;
- environmental management objectives and management plans;
- assessing the impact of the particular mining event on the environment; and
- measures to stop or remedy environmental degradation.

Section 41 provides that an applicant for a prospecting or mining permit must afford adequate financial provision for the rehabilitation of negative environmental impacts before the Minister may approve the environmental management plan in terms of section 39 of this Act.

Section 42 mandates holders of permits to manage stockpiles according to the prescribed provisions of the environmental management plan. Section 43 provides that the holder of a prospecting or mining right remains responsible for any environmental liability, such as pollution or ecological degradation, and the management thereof. Such liability will only expire after the Minister has issued a closure certificate to the holder of such right. Section 45 allows the Minister the power to mandate any holder of a mining right to take measures to prevent, cease or mitigate any damage such holder may have caused to the environment.

Section 46 provides that the Minister has the power to remedy the environment when such action is deemed necessary. Section 47 provides that the Minister may cancel mining rights at any time if the holder of such mining right fails to comply with the provisions of a mining right, environmental management program, or the provisions of this Act. Section 48 prohibits mining activities in areas designated by the Minister, as well as the provisions of section 20 of the National Parks Act 57 of 1976.

Section 55 allows the Minister to expropriate any land for the purpose of prospecting and mining. Section 74 provides conditions to be complied with when applying for a reconnaissance permit relevant to petroleum development. It further provides that the applicant must submit the necessary environmental management report pertinent to such action.

Section 75 provides that the holder of the reconnaissance permit must ensure that no environmental degradation results from such action. Section 79 makes provision for the application of an exploration right, and requires that an environmental management program be submitted before such application will be considered.

Section 83 provides for the application of a production right and requires that an environmental management program be submitted before such application will be considered. Section 92 provides that authorized persons may enter and inspect any areas when deemed necessary to enforce the provisions of this Act. Section 107 provides that the Minister may promulgate any regulations in regard to the following aspects:

- conservation of the area at the mining works or in the vicinity;
- management of the impacts of any mining activities;
- rehabilitation of mining activities;
- control and management of pollution in the mining area; and
- measures to ensure that the holder of a mining right complies with the provisions of the environmental management plan.

General measures

Regulation 527 of 23 April 2004 makes provision for general measures that relate to the objectives of this Act. The following 83 regulations (sections) are part of this Regulation and *should not be* confused with the sections of the Act. The following regulations are relevant to the protection of biodiversity.

Regulation 2 makes provision for information relating to boundaries, topography, location and scale of the land that are mentioned in the application form for the undertaking of mining activities. Regulation 3 makes provision for public participation. Regulation 5 makes provision for the management of prospecting activities and environmental mitigation and rehabilitation. Regulation 7 ensures

that the applicant have the financial capability to undertake environmental mitigation and rehabilitation. Regulation 8 ensures that the applicant provides a progress report to the authority during prospecting. Regulation 10 makes provision for mining rights and includes: description of period of mining, mitigation, rehabilitation and financial capability of applicant. Regulations 28-30 make provision for exploring rights and include measures for environmental impact management and rehabilitation. Regulation 31 makes provision for exploration reporting and ensures that environmental impacts are reported, mitigated and rehabilitated. Regulation 30 ensures that an Environmental Committee is formed as mentioned under the Mineral and Petroleum Resources Development Act (28 of 2002).

Regulation 44 makes provision for the compilation of a scoping report which should describe: the pre-mining environment, expected environmental impacts, possible alternatives and public participation. Regulation 50 makes provision for the environmental impact assessment report which should describe: duration, magnitude and impact of proposed mining activities. It should also make provision for measures that relate to prevention, mitigation and rehabilitation of mining impacts on the environment. Regulation 51 makes provision for an environmental management programme which should ensure management of environmental impact and mining closure. Regulation 52 makes provision for an environmental management plan which should include: a description of the affected environment; potential impacts; mitigation measures; monitoring of the environmental management plan and public participation. Regulations 53-54 ensure that financial provision is made to ensure that the provisions of the environmental plan are achieved. Regulation 55 makes provision for monitoring and performance assessments of environmental management plans and programmes.

Regulation 56 defines the principles for mining closure and include that:

- closure is a process that starts after mining commences and continues throughout the life of the mine;
- environmental impacts are managed throughout the life cycle of the mine;
- residual and latent environmental impacts are identified and quantified; and
- that the land is rehabilitated as close as possible to its original state to ensure compliance with the principle of sustainable development.

Regulation 57 makes provision for a closures certificate that should include the following aspects: a closure plan; an environmental risk report; and a final performance assessment. Regulation 60 makes provision for the compilation of an environmental risk assessment and measures to quantify, qualify and manage these risks. Regulation 62 makes provision for contents of the closure plan and include rehabilitation and post monitoring of the area. Regulation 63 makes

provision for the regulation and sustainable management of pollutants that may arise during the mining process.

Regulations 64 and 68 ensure that mining complies with sustainable air and water quality objectives. Regulation 69 ensures that mining wastes are managed in a sustainable manner, and that such disposal is in harmony with other relevant pollution prevention legislation. Regulation 70 provides measures to regulate the pollution of soil and also includes erosion prevention directives. It further provides that substances that may pose a risk to the environment are disposed off in a sustainable manner in relevant waste disposal sites. Regulation 73 makes provision for the sustainable management of stockpiles and ensures that the environmental impact of these sources is assessed in terms of quantity and quality. Measures are also provided to provide for sustainable environmental management options that include mitigation and rehabilitation procedures regarding these stockpiles. Regulations 74-83 make provision for administrative measures that relate to the objectives of this Act.

Aspects not covered by this Act

- *Improved regulation of marginal mines to complete the rehabilitation process. These marginal mines may pose a significant threat to the environment and biodiversity when rehabilitation is not completed (also see 2.4.1, 3.4.3 and Table 7).*

6.2.3.4 Petroleum Pipelines Act 60 of 2003

Objective

This Act provides for measures of issuing licences for activities relevant to the construction of petroleum pipelines. It also provides for the establishment of an authority to regulate aspects pertaining to safety, security, health, inspection, and environmental integrity.

Sections pertaining to biodiversity

Section 2 defines the objectives of this Act, and ensures environmentally responsible transport of petroleum through pipelines. Section 16 ensures that the applicant complies with the necessary environmental legislation before a license for conducting such activity will be granted. Section 20 provides that the conditions for authorization should take environmental standards into account when considering an application. Section 25 provides that any person who contravenes a provision of a license may on conviction be liable for a fine of R2 000 000 for each day that such person does not comply with the specific conditions.

6.2.4 Natural heritage

6.2.4.1 National Heritage Council Act 11 of 1999

Objective

This Act deals with the establishment of the National Heritage Council, objectives of such a Council and administrative and management measures that it should implement.

Section 4 makes provision for the objectives of the Council, these being:

- protection of natural heritage for present and future generations;
- coordination of heritage management; and
- protection of living heritage on national and provincial level.

Section 10 ensures that the Council implements all that is necessary to ensure compliance with the objectives of this Act. It also provides consultation to the Minister and to the public on any aspects pertaining to the protection of natural heritage.

6.2.4.2 National Heritage Resources Act 25 of 1999

Objective

This Act deals with the management and conservation of national heritage resources, and the introduction of a system for the identification and establishment of national heritage resources. It further deals with the establishment of the South African Heritage Resources Agency. This Agency and its Council should coordinate and promote the management of heritage resources at national level.

Natural resources

Section 3 provides that natural heritage resources may form part of the national estate of the Republic of South Africa. The following are included:

- landscapes and natural features that have cultural significance; and
- objects of scientific interest.

Section 4 ensures that the provisions of this Act apply to the entire area of the Republic of South Africa. Section 6 provides general principles that should be applied to ensure the protection of natural heritage in South Africa. Section 7 makes provision for 3 levels of classification to be used in the implementation of a strategy to preserve natural heritage. Grade 1 includes resources of exceptional national importance, Grade 2 resources have special significance in

a provincial context, and Grade 3 resources include any natural heritage worthy of conserving. Section 9 mandates every provincial Government department to take all necessary measures to conserve natural heritage under its jurisdiction.

Management

Section 13 describes the duties of the South African Heritage Resources Agency. The following duties can be identified:

- effective management of the natural heritage resources of the Republic of South Africa;
- coordination between the various parties responsible for the protection of natural heritage;
- keeping records of all natural heritage resources;
- provide professional advice to any person or party in need of such advice;
- encourage public education and awareness; and
- administrate any other aspect needed for the protection of national heritage.

Article 27 makes provision for the declaration of national heritage resources in any area of the Republic. The South African Heritage Resources Agency may determine conditions for the conservation of such heritage site, once declared. Section 28 provides that the Agency may designate protected areas around a natural heritage site, if designation of such protected area is essential for the conservation of such a site.

Section 30 provides for the establishment of heritage register to record all natural heritage sites in the Republic, and to ensure effective administration of these areas. Section 31 determines that a planning authority may plan the nomination of heritage areas to be designated when compiling spatial plans. Section 46 makes provision for the orderly expropriation of property when such expropriation is deemed necessary for the conservation of an area.

Enforcement

Section 47 ensures that the South African Heritage Resources Agency takes the necessary steps to ensure the compilation of a general policy for the protection of natural heritage resources. Section 48 makes provision for the application for permits to conduct any activity in a natural heritage site that may be damaging to the integrity of such site or area. It provides conditions of compliance before authorisation may be granted for the specific activity.

Section 50 makes provision for the appointment of heritage inspectors to inspect all heritage areas, and ensure compliance with the provisions of this Act. Section 51 provides that any person who contravenes any provision of this Act may on conviction be liable for a fine or to imprisonment for between 3 months and 5

years, or to both such fine and imprisonment. Section 54 makes provision for the promulgation of by-laws by local authorities to ensure the protection of natural heritage sites, heritage areas, and protected areas.

6.2.4.3 The World Heritage Convention, 1972

Objective

The objective of this Convention is aimed at promoting cooperation on an international level relevant to the protection of world heritage sites of international importance. It was ratified 10 July 1997 (WHC, 2002; South Africa, 2003a).

Protection of natural heritage

Article 2 defines the following features as natural heritage: natural features consisting of physical and biological formations; areas that form the habitat of threatened biodiversity; and sites that have universal conservation and scientific value. Article 4 mandates all parties to take measures to designate and conserve areas that have inherent value as natural heritage sites. Article 5 mandates parties to take the following measures regarding natural heritage sites:

- adopt policies to protect natural heritage;
- establish services for the protection of natural heritage sites; and
- promote scientific research on issues that relate to natural heritage sites.

Article 6 mandates contracting parties to cooperate internationally with other parties to ensure that international natural heritage sites are adequately conserved. Article 8 makes provision for the establishment of the World Heritage Committee to enforce the provisions of the Convention. Article 15 makes provision for the establishment of a world heritage fund to cover financial aspects of the Convention. Article 16 encourages contracting parties to contribute financially to this fund. Article 27 encourages contracting parties to make provision for educational programmes and public awareness of natural heritage sites.

6.2.4.4 World Heritage Convention Act 49 of 1999

Objective

The overall objective of this Act is the incorporation of the World Heritage Convention into South African law. It also deals with aspects relative to the establishment of World Heritage Sites, enforcement of objectives by authorities and the compilation of integrated management plans for World Heritage Sites.

Protection of heritage

Section 2 provides that the world heritage convention is enacted as legislation under the provisions of this Act. Section 3 defines the objectives of this Act, these being:

- protection of world heritage sites;
- giving effect to the principles of this Convention;
- managing tourism of these sites and ensuring that ecological integrity of these areas is sustained; and
- ensuring effective conservation of world heritage sites.

Section 6 makes provision for the nomination of world heritage sites, as nominated by the Minister. Section 21 makes provision for the compilation and implementation of management plans. Section 23 provides that the objective of these plans should be to ensure the sustainable conservation of World Heritage Sites. These plans must not be in conflict with the World Heritage Convention in terms of section 22 of this Act. Section 25 provides that the authority should approve these plans before they are implemented. Section 29 provides that the Minister may purchase any land for the purposes of designating same as a World Heritage Site. Section 30 provides that land may be expropriated in an orderly manner for commandeering as a World Heritage Site.

6.2.5 Land and aquatic pollution control

6.2.5.1 Nuclear Energy Act 46 of 1999

Objective

This Act covers aspects that relate to the establishment of the South African Nuclear Energy Corporation Limited, implementation of the Safeguards Agreement and any additional protocols, and issues that are relevant to nuclear non-proliferation. It also describes the Minister's responsibilities regarding source material, special nuclear material, restricted material, radioactive waste and irradiated fuel.

Nuclear activities

Section 2 makes provision for materials, substances and equipment that may be used for purposes under this Act. These provisions may relate to:

- purity of material to be used for nuclear purposes;
- declaration of materials and mass numbers that may be used;
- regulating the use of any compositions of materials;
- declaring any facilities as nuclear facilities;
- exempting any radioactive materials from the provisions of this Act; and

- determining levels of radioactivity under which the provisions of this Act do not apply.

Section 33 makes provision for the responsibilities of the Minister regarding the use of nuclear material. These are:

- consultation with the International Atomic Energy Agency regarding issues specified in this Act;
- handling of nuclear material and the keeping of records;
- protection of nuclear material; and
- inspections relating to the use of nuclear material.

Section 34 makes provision for restrictions regarding the acquisition of nuclear material. These regulate the following aspects:

- the possession of special nuclear material, restricted material, or uranium hexafluoride (UF₆);
- possession of nuclear fuel or nuclear related material;
- disposal of nuclear material;
- import of nuclear material;
- acquisition or processing of any material;
- production of nuclear energy; and
- transport of any nuclear material.

Authorisation and enforcement

Section 35 prohibits the export of nuclear material without the necessary authorisation. Section 36 mandates any person to provide the Minister on request with information regarding any nuclear activities. Section 37 allows inspectors to enter any nuclear areas to inspect any activities when deemed necessary.

Section 38 allows inspectors to inspect any nuclear area or material when deemed necessary. An inspector may seize, detain, move and restrict any activity or object when such action is needed for the execution of his/her powers. Article 44 provides that the Republic may acquire any nuclear material from any country, when such acquisition is in the national interest. Section 45 provides that the Minister, in consultation with the Minister of Environmental Affairs and Tourism and the Minister of Water Affairs and Forestry, may promulgate regulations regarding the management, storage and disposal of radioactive waste and irradiated nuclear fuel. Section 46 provides that no person may discard any nuclear wastes or material without the relevant authorisation. Section 56 provides that any person who contravenes a provision of this Act may on conviction be liable for a fine or imprisonment for 3-10 years.

Government Notice Regulation 388 of 28 April 2006 makes provision for radioactive waste management measures. These are:

- establishment of waste management programmes;
- identification, quantification, characterization and classification of radioactive wastes;
- treatment and safe storage of wastes;
- environmental monitoring and surveillance of nuclear waste sites;
- and remedial measures for nuclear accidents.

Aspects not covered by this Act

- *Improved regulation of nuclear activities in biodiversity hotspots. Biodiversity hotspots are unique and are of international importance. Any nuclear accident in a biodiversity hotspot could be responsible for a major evolutionary crisis in terms of its genetic resources. Legislation should preferably prohibit all nuclear activities in biodiversity hotspots (also see 3.4.4 and Table 7).*

6.2.5.2 National Nuclear Regulator Act 47 of 1999

Objective

In this Act provision is made for the establishment of a National Nuclear Regulator to regulate nuclear activities, and to administrate objectives of this Act. Other provisions include safety standards, regulatory practices and protection of the environment against nuclear damage.

Nuclear installations

Section 2 provides that this Act applies to nuclear installations, nuclear powered vessels and any action capable of causing nuclear damage. The objectives of this Act in terms of Section 5 are to:

- provide protection for the environment through the regulation of nuclear activities;
- provide control over nuclear vessels capable of causing nuclear damage; and
- provide monitoring of all nuclear activities.

Cooperation

Section 6 encourages international cooperation with other countries on issues provided for in this Act. Section 20 provides that no person may establish, operate, decontaminate and decommission a nuclear installation without the

appropriate authorisation. It also provides that no nuclear powered vessels are allowed into territorial waters of the Republic of South Africa, without a licence.

Authorisation

Section 21 makes provision for measures to apply for a licence to conduct nuclear activities in terms of this Act. Section 23 provides that the chief executive officer may establish conditions for the application of licences under the provisions of this Act. Section 24 provides that special conditions may apply to nuclear vessel licences. These may include: liability for nuclear damage; and security for nuclear damage.

Section 28 allows the Minister to determine fees to be paid for authorisation to conduct nuclear related activities. Section 29 provides that owners of nuclear installations must have the necessary financial security to ensure compensation for damage in the case of a nuclear accident. Section 30 provides that the holder of a nuclear installation licence is liable for all damages resulting from a nuclear accident. Section 31 provides that the holder of a nuclear vessel licence will be liable for all damage occurring as a result of a nuclear accident. Section 36 provides that the Minister may make regulations regarding safety standards for nuclear installations. Section 37 mandates all nuclear license holders to report nuclear accidents to the relevant nuclear authority. Section 38 makes provision for emergency plans when there is a possibility that a nuclear accident may threaten the safety of the Republic.

Notice 287 of 5 March 2004 under section 38 of this Act makes provision for specific requirements regarding development surrounding a nuclear installation. These ensure the control and monitoring of development within the formal emergency planning zone surrounding a specific nuclear installation. Such consultation should include the relevant provincial and municipal authorities.

Management

Sections 39 and 40 provide that the nuclear regulator must keep records of all nuclear installations and accidents. Section 41 allows inspectors to enter into any area where nuclear activities are taking place to inspect such area, or to undertake any action relative to the enforcement of the provisions of this Act. An inspector may request any person to cease any nuclear activities and to take measures to rehabilitate any site as provided by the provisions of this Act. Section 47 allows the Minister to make any regulations regarding nuclear activities under this Act.

Enforcement

Section 52 provides that any person, who contravenes any provision of this Act, may on conviction be liable for a fine or to imprisonment for between 3 to 10 years or to both such fine and imprisonment.

6.2.5.3 The Stockholm Convention on Persistent Organic Pollutants, 2002 (POPs)

Objective

This Convention takes international action to minimise the risks associated with persistent organic pollutants. The overall goal of this Convention is to phase out the use of persistent non-degradable organic pollutants that pose an international threat to human health and biodiversity. South Africa signed this convention on 23 May 2001 and ratified it on 4 September 2002 (Agenbach, 1999:23; South Africa, 2003a; POPs: 2003).

Regulation of persistent organic pollutants

Article 3 provides that every contracting party should take the necessary action to eliminate the import, export; production and use of chemicals listed under Annexure A of the Convention. These chemicals include the following substances: Aldrin; Chlordane; Dieldrin; Endrin; Heptachlor; Hexachlorobenzene; Mirex; Toxaphene; Polychlorinated; and Biphenyls.

The parties should endeavour to restrict the use of chemicals listed under Annexure B of the Convention. This only includes DDT. Article 4 makes provision for the establishment of a register of exemptions regarding the use of chemicals listed under Annexure A and Annexure B by certain parties. Article 5 makes provision for measures to reduce or eliminate releases from unintentional production of persistent organic pollutants listed under Annexure C. This includes: Polychlorinated dibenzo-p-dioxins; dibenzofurans; Hexachlorobenzene; and Polychlorinated biphenyls.

Every party should compile an action plan regarding the reduction or elimination of substances listed under Annexure C of the Convention, and implements such plan. The contents of such plan should pertain to:

- assessment of the current releases of such chemicals;
- evaluation of the policies and legislation of every party to manage such releases;
- steps to promote awareness and education regarding such substances; and
- a schedule for implementing such management plan.

Article 6 provides for measures to mandate contracting parties to take measures to reduce or eliminate releases from stockpiles and wastes that may contain chemicals listed under Annexure A, Annexure B and Annexure C. This includes any waste or article that releases such chemicals on decomposition. These provisions may pertain to sound environmental storage and transport of such products, or may provide that such products be processed in a manner as to destroy the persistent organic pollutants. All parties should internationally cooperate to establish methods for the sound disposal of persistent organic pollutants. Article 7 makes provision for contracting parties to compile and execute implementation plans that pertain to compliance with the provisions of this Convention. Article 8 provides any contracting party the opportunity to submit a chemical to be included under Annexures A, B or C. Such party should provide necessary motivation for such decision and the information should be submitted to the Persistent Organic Pollutants Review Committee for a final decision. The Committee will use the information contained in Annexure D to determine whether such substance should be included under Annexures A, B or C. Annexure D makes provision for the following criteria:

- chemical identity of the substance including various isomers;
- persistence and degradability of substance in environment;
- bio-magnification potential in various types of biodiversity;
- potential environmental transport from source and ability to move in the environment; and
- adverse effects and environmental toxicity.

Article 9 promotes the exchange of information between contracting parties that are relevant to the reduction or elimination of persistent organic pollutants. Article 10 makes provision for public information, awareness and education, and it mandates contracting parties to implement the necessary measures to achieve such action. Article 11 provides for research development and monitoring of persistent organic pollutants, and should contain the following information:

- sources and releases into the environment;
- environmental transformation and fate;
- release reduction and elimination; and
- effects on the environment.

Article 15 mandates contracting parties to provide statistical data on production, import and export of the chemicals listed in Annexure A and Annexure B, or a reasonable estimate of such quantities.

6.2.5.4 The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention)

Objective

This convention provides measures to stop the production of hazardous wastes and their international disposal. When disposal of hazardous wastes is allowed, this Convention ensures sound environmental disposal of such wastes. South Africa ratified this convention in May 1994, and acceded to it on 5 April 1994 (UNEP, 2003a; South Africa, 2003a).

Control of hazardous wastes

Article 1 defines the scope of hazardous wastes, and these are included in a classification system under Annexures 1, 2 and 3 of the Convention. Annexure 1 includes wastes associated with or produced by the following activities: clinical waste; pharmaceuticals; biocides; wood preserving chemicals; organic solvents, mineral oils; hydrocarbon emulsions; polychlorinated biphenyls; polychlorinated terphenyls; polybrominated biphenyls; tarry residues; pigmented substances; adhesives; explosives; photographic chemicals; and industrial substances. Annexure 2 includes most metals, inorganic and organic metal compounds, cyanide; acids, basis; asbestos; phenols, ethers; organic solvents; aromatic substances; and organic halogenated solvents. Annexure 3 includes domestic wastes, and substances arising from the incineration thereof.

Article 3 mandates contracting parties to inform the Secretariat on any substances classified as hazardous under its legislation but not included in the scope of this Convention. Article 4 provides for general obligations under the Convention and these include the following:

- minimisation of hazardous wastes;
- adequate facilities for sound disposal of hazardous wastes;
- reduction or prevention of transboundary movement of wastes;
- prevention of importation of hazardous wastes;
- international cooperation to ensure compliance with the provisions of this Convention;
- prevention of movement of hazardous wastes to and from non-parties; and
- enforcement of strict regulations when moving hazardous wastes according to the directives of the Convention.

Article 5 makes provision for the establishment of a competent authority and a focal point to assist in the implementation of this Convention. Article 6 makes provision for transboundary movement of hazardous substances between parties. Such action may only be undertaken following adequate consultation between the countries concerned. Movement of such substances may only take place with the consent of both countries. Article 10 provides for measures to

promote cooperation between countries regarding the effective environmental management of hazardous wastes. Article 11 makes provision for contracting parties to enter into bilateral, multilateral and regional agreements with parties and non-parties. Such arrangements should not deviate from the environmentally sound management of hazardous wastes as provided by the convention. Article 13 mandates any party in the case of an accident to scrutinise information on such accident to all contracting parties.

6.2.5.5 The Convention on Prior Informed Consent-Rotterdam, 1998 (the Rotterdam Convention)

Objective

This Convention provides for the obligatory international exchange of information relevant to the use of pesticides and hazardous chemicals. This Convention was signed in September 1998 (PIC, 2002; South Africa, 2003a).

Control over hazardous substances

Article 1 promotes international cooperation and shared responsibility regarding international trade of certain hazardous chemicals to ensure the protection of the environment from potential harm arising from their use. Article 3 defines the scope of the Convention and provides that the directives of the Convention apply to banned or severely restricted chemicals and severely hazardous pesticide formulations. The directives of the Convention do not apply to: narcotic substances; radioactive materials; general wastes (industrial and domestic); chemical weapons; pharmaceutical substances; food additives, food, and chemicals in quantities that will not affect human health and the environment. Article 4 provides that every party should appoint a national authority to act on behalf of such party and ensure compliance with the provisions of the Convention. Article 5 provides procedures for banned or severely restricted chemicals. It mandates all parties to internationally notify all other parties regarding the use of substances listed under Annexure 1 of the Convention.

Article 6 allows developing countries that use a severely hazardous substance to take the necessary measures to list such substance under Annexure 3 of the Convention. Article 7 provides the general measures necessary to list a chemical under Annexure 3 of the Convention. Article 9 makes provision for measures to remove a chemical listed under Annexure 3 of the Convention. The chemicals that are currently listed under Annexure 3 include the following: 2,4,5-T; Aldrin; Captafol; Chlordane; Chlordimeform; Chlorobenzilate; DDT, Dieldrin; Dinoseb; 1,2-dibromoethane; Fluoroacetamide; HCH, Heptachlor; Hexachlorabenzene; Lindane; mercury compounds; Pentachlorophenol; Monocrotophos; Methamidophos; Phosphamidon; Methyl-parathion; Parathion; Crocidolite; Polybrominated biphenyls; Polychlorinated biphenyls; Polychlorinated terphenyls; and Tris (2,3-dibromopropyl) phosphate.

Articles 10 and 11 mandate all contracting parties to implement the necessary legislation and other measures to effectively control the import and export of chemicals listed in Annexure 3 of the Convention. Article 12 makes provision for an export notification. It provides that where a chemical is banned or severely restricted by a party such party must provide an export notification to the importing party. Article 13 provides that certain information should accompany exported chemicals. Article 14 mandates information exchange between parties regarding the toxicological and ecotoxicological character of chemicals listed under the provisions of the Convention. The risks concerning all chemicals may not be regarded as confidential under the provisions of the Convention. Article 17 mandates parties to implement procedures to punish parties that do not comply with the provisions of the Convention.

6.2.5.6 Hazardous Substances Act 15 of 1973

Objective

The goal of this Act is to make provision for the control of substances that are toxic, corrosive or of irritant character. It also regulates the management, monitoring, prohibition, importation, manufacture, sale, use, modification and disposal of such substances.

Regulation of hazardous substances

Section 2 provides that the Minister may declare any substance or mixture of substances as hazardous. Groups 1 and 2 hazardous substances may include those that have the following properties: toxic; corrosive; irritant; strongly sensitizing; or flammable. Group 3 hazardous substances include any electronic product.

Section 3 requires that a licence is essential to sell group 1 substances, as well as group 3 substances. No person may acquire, dispose, use, import or export any group 4 substances without the necessary authorisation from the Director General. A group 4 substance includes radioactive material that has an activity concentration of more than 100 becquerels per gram and a total activity of more than 4 000 becquerels.

Authorisation

Section 4 provides for the application of authorisation to undertake restricted activities that pertain to group 1, 3, and 4 substances.

Section 7 provides that a licence may be cancelled if the holder of such licence fails to comply with the conditions of that license or any provision of this Act. Section 9 makes provision for the appointment of inspectors. These inspectors may enter into any area to inspect any substance or activity to ensure compliance with the provisions of this Act.

Section 10 makes provision for the appointment of analysts to analyse any substances listed under the provisions of this Act. Section 12 provides that any imported substances may be examined and analysed if deemed necessary. Such substances may at the discretion of the Director General be confiscated and destroyed, or returned to the sender of such substances. Section 18 provides that any person who contravened any provision of this Act will be guilty of an offence. Such person may on conviction be liable for a fine or imprisonment for between 12 months and 10 years in terms of section 19 of this Act. Section 29 provides that the Minister may make regulations pertaining to the following:

- manufacture, modification, importation, storage, transportation, or disposal of any hazardous substances;
- keeping of records of such substances; and
- determining the safety standards relevant to these substances.

Aspects not covered by this Act

- *Comprehensiveness of substances to be included as hazardous nuclear material, and wastes emitting radioactivity below a certain threshold are excluded from certain regulatory provisions (also see 3.4.4.6 and Table 7).*
- *Regulation of domestic disposal of hazardous substances. Various substances such as batteries that contain heavy metals are still disposed of in domestic municipal wastes. These substances may bio-accumulate in the environment and have a negative impact on biodiversity (also see 3.4.4 and Table 7).*
- *Regulation of acquisition of domestic or commercial herbicides/pesticides. The acquisition of any hazardous substances such as herbicides, pesticides, or any other similar substance should only be provided after adequate motivation for its use has been established. This type of regulation should be similar to a prescription for the acquisition of certain scheduled medicine (also see 3.5.2.5 and Table 8).*
- *Prohibition to store excess herbicides/pesticides. All excess herbicides, pesticides or similar substances should be returned to the provider of such substances. No person should be allowed to store these substances under any circumstances (also see 3.5.2.5 and Table 8).*
- *Prohibition to use recalcitrant pesticides/herbicides (Certain hazardous pesticides/herbicides may still be used on exemption under the Stockholm Convention on Persistent Organic Pollutants). Legislation should mandate the use of biodegradable pesticides and herbicides. Recalcitrant hazardous substances (those that usually have an aromatic character) may have a hormonal and/or mutagenic effect on various types of biodiversity. Other substances interfere with reproductive cycles of many plants and animals and may eventually have a negative impact on biodiversity (also see 3.4.4 and Table 7).*

- *Prohibition for collection/reuse of empty herbicide containers. All containers should be returned to the manufacturer or hazardous waste disposal facility (also see 3.5.2.7 and Table 8).*
- *Government Notice Regulation 453 of 25 March 1977, Regulation 2776 of 21 December 1984, and Regulation 1490 of 14 November 1997 make provision for regulations regarding Group I hazardous substances. It provides that empty containers of group 1 substances must be perforated and buried in the ground after use. This should not be allowed since such decaying containers may eventually pollute the natural environment over time (also see 3.5.2.7 and Table 8).*

6.2.5.7 Explosives Act 15 of 2003

Objective

Section 2 makes provision for the regulation of activities that relate to explosives and includes manufacturing, trading, importing, exporting, packaging, transport and use of explosives.

Sections 4-9 make provision for:

- the appointment of inspectors to undertake inspections and enforce the provisions of this Act; and
- seizure and destruction of illegal explosive substances

Sections 10-19 makes provision for the keeping, storage, possession, transportation, manufacturing, importation, exportation and use of explosives through authorisation. Section 29 makes provision for penalties regarding the contravention of any objectives stipulated by this Act and may include a fine, imprisonment or both.

Section 33 makes provision for the promulgation of regulations that relate to the management of explosives.

Aspects not covered by this Act

- *Improved regulation of manufacture and use of environmentally detrimental explosives. These include explosives containing heavy metals/recalcitrant organic compounds. The use of lead bullets for any type of gun/firearm is currently not prohibited and in some areas lead may bio-accumulate in the environment. Such accumulation may have a negative impact on the integrity and reproduction cycles of various types of biodiversity (also see 3.4.4.7 and Table 7).*

6.2.6 Fire regulation

6.2.6.1 National Veld and Forest Fire Act 101 of 1998

Objective

This Act makes provision for the establishment of fire protection associations, the use of firebreaks and directives regarding fire fighting.

Fire management

Section 1 defines the objectives of this Act that include the prevention and combat of veld, forest and mountain fires throughout the Republic. Section 3 makes provision for the formation of fire protection associations to regulate the occurrence of fires in certain geographical areas. The duties of such a fire protection association should include the following objectives:

- the development and implementation of a fire management strategy for the area;
- to provide strategies for cooperation with adjoining associations;
- identify ecological conditions that affect fire danger ratings;
- organise and train members regarding issues pertaining to fire management;
- report to the minister on statistics regarding fires that have occurred in the area for the past year; and
- to ensure controlled burning to conserve ecosystems and reduce the fire risk in the area.

Enforcement

Section 6 makes provision for the appointment of fire protection officers. The function of these officers is to enforce the provisions of this Act and of the directives determined by the fire protection associations. He/she should also ensure that the members of such association comply with the necessary provisions.

Section 9 makes provision for a fire danger rating system that takes the following aspects into consideration: topography, vegetation, climate, and current and predicted weather conditions. These systems should be used to predict the likelihood of a fire outbreak, and to warn all members accordingly.

Firebreaks

Section 12 makes provision for the establishment and maintenance of firebreaks by owners of land. It ensures that owners of land must maintain firebreaks on boundaries to prevent the outbreak of fires in the area. The establishment of

firebreaks should be completed within a specific period of time during specified times of the year

Section 13 provides that with due regard to the weather, climate, terrain and vegetation of the area such firebreak is wide enough to prevent the outbreak of a fire and does not cause soil erosion in the area. Section 14 ensures that these provisions also apply to international borders. The Minister may exempt any person from making firebreaks when deemed appropriate by him/her.

Section 16 provides that no plants should unnecessarily be damaged in the preparation of firebreaks. Where possible such plants should be transplanted or alternatively a firebreak should be avoided in such immediate area.

Offences

Section 24 provides that any person who contravenes any provision of this Act may be fined or imprisoned for between 6 months to 2 years, or may be liable for both such fine and imprisonment. A court may also sentence such guilty person to community service, preferably to the benefit of the environment.

Section 25 makes provision that the amount of such fine will be determined by whether such offence constituted a first or secondary category offence. Any person who lights a fire in the open air in contravention of section 10 (2) (when the Minister has published a warning that no person may light a fire in the open air in the region where the fire danger is high) will in such instance be guilty of a first category offence. A second category offence occurs when a person leaves a fire unattended or lights a fire by any means in any area where it spreads and causes damage. A person will also be guilty of a secondary offence when he/she does not prepare a firebreak after being requested to do so by the fire fighting association, or fails to cooperate with a fire protection officer. Any person who hinders a fire protection officer or any other official in his/her duties will be guilty of a third category offence.

Aspects not covered by this Act

- *Regulation of the size of a firebreak. In some areas large parts are burnt annually and this continuous burning may have a detrimental impact on the ecology of the area (also see 2.4.1, 3.4.6 and Table 7).*
- *Regulation of consecutive burning of the same area. Legislation should provide measures to ensure that a piece of land is not burnt repeatedly. Repeated burning may completely change biodiversity composition and integrity in these areas (also see 2.4.1, 3.4.6 and Table 7).*

6.3 Conclusion

The United Nations Framework Convention on Climate Change, 1992 (UNFCCC) addresses global climate change, and urges governments to reduce greenhouse gases. The ultimate objective of this Convention is to stabilize greenhouse gases globally, and therefore prevent global climate changes.

The Montreal Protocol on substances that deplete the ozone layer, 1987 (Montreal Protocol) provides for measures to protect the ozone layer. The London Amendment of 12 May 1992 was designed to restrict the use of ozone destructing chlorofluorocarbons and halons.

The Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997, (The Kyoto Protocol) regulates the emission of greenhouse gases, and provides for the implementation of measures to reduce greenhouse gas emissions. The United Nations Convention to Combat Desertification, 1994 (UNCCD) aims to promote cooperation among countries that are experiencing serious drought and desertification.

The National Environmental Management Air Quality Act 39 of 2004 controls air quality, compilation of air quality plans, institutional & planning matters, priority areas, classification of polluting activities, general control measures, licensing of listed activities, and international air quality management. This Act does not provide adequate measures for:

- regulation of air polluting vehicles in all areas; and
- regulation on using of wood and coal (for fire-making) in urban areas.

National Heritage Council Act 11 of 1999 provides for the establishment of the National Heritage Council, objectives of such a Council, and the administrative and management measures that it should implement. National Heritage Resources Act 25 of 1999 deals with the management and conservation of national heritage resources, and the introduction of a system for the identification and establishment of national heritage resources. It further deals with the establishment of the South African Heritage Resources Agency. This Agency and its Council should coordinate and promote the management of heritage resources at national level.

The World Heritage Convention Act 49 of 1999 ensures the implementation of the World Heritage Convention into South African law. It also deals with aspects that relate to the establishment of World Heritage Sites, enforcement of objectives by authorities, and the compilation of integrated management plans that relate to World Heritage Sites. The world Heritage Convention forms part of the World Heritage Convention Act 49 of 1999. It provides for cooperation on an international level that is relevant to the protection of world heritage sites with international importance.

Wetlands are of international importance, especially as Waterfowl Habitat, 1971 (Ramsar Convention) provides for measures to promote wise use of all wetlands and the conservation of water sources.

The National Water Act 36 of 1998 makes provision for water management strategies, for example national strategies and catchment management strategies. It covers the following related aspects: protection of water resources, water resources classification systems, water resource quality objectives, the water reserve, pollution prevention, emergency incidents, water use principles, authorization of licenses, existing lawful water use, stream flow reduction activities, general authorizations, individual applications for water licenses, compulsory licenses, conditions regarding issue of licenses, financial provisions, powers of the Minister and Director-General, water user associations, advisory committees, international water management and Government waterworks. It does not adequately regulate the following activities:

- regulation on altering the mouth of a river, lagoon, or similar natural system; and
- regulation on development in, or draining of a wetland; prohibition on the recharge of an aquifer with polluted water.

The Mountain Catchment Areas Act 63 of 1970 makes provision for conservation, use, management and control of mountain catchment areas. Other aspects covered include circumstances for the declaration of catchment areas, directions regarding catchment areas, compensations relevant to complying with directions, exemption of certain land from the above directives, management of advisory committees, and fire protection plans.

- This Act does not regulate the percentage of mountain catchment area that may be planted with trees.

The Lake Areas Development Act 39 of 1975 makes provision for the establishment of lake areas under the control of a Lake Areas Development Board, the opening and closing of the mouth of a tidal lagoon or a tidal river, the construction of a water work within a lake area, and the acquisition of private land in a lake area.

- It should not allow the altering of tidal lagoons and river mouths. Also discussed under The National Water Act 36 of 1998.

The Development Facilitation Act 67 of 1995 regulates land development plans and procedures. The Physical Planning Act 88 of 1967 makes provision for coordinated environmental planning, utilization of resources, zoning & subdivision of land for industrial purposes, land reservation for specific purposes, controlled areas and restrictions associated with these actions, compilation & approval of guide plans, and the issuing of permits.

The Physical Planning Act 125 of 1991 makes provision for physical development division that includes national and regional development plans, and regional and urban structure plans. It further describes the types, objectives, contents, and administration of policy plans.

The Mineral and Petroleum Resources Development Act 28 of 2002 makes provision for measures to ensure legal undertaking of prospecting, mining, and exploration activities relevant to mineral utilization. It ensures that negative environmental impacts are managed while allowing justifiable economical development. This Act ensures that all exploration, prospecting, mining, and rehabilitation programs are implemented within the framework of sound environmental management principles.

- This Act does not adequately regulate the completion of the rehabilitation process on marginal mines.

The Petroleum Pipelines Act 60 of 2003 makes provision for the issuing of licenses for activities relevant to the construction of petroleum pipelines. It also provides for the establishment of an authority to regulate aspects pertaining to safety, security, health, inspection, and environmental integrity.

The Stockholm Convention on Persistent Organic Pollutants, 2002 (POPs) takes international action to minimise the risks associated with persistent organic pollutants. The overall goal of this Convention is to phase out the use of persistent non-degradable organic pollutants that pose an international threat to human health and biodiversity.

The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention) provides measures to stop the production of hazardous wastes and their international disposal. When disposal of hazardous wastes is allowed, this Convention ensures sound environmental disposal of such wastes.

The Convention on Prior Informed Consent-Rotterdam, 1998 (the Rotterdam Convention) provides for the obligatory international exchange of information that is relevant to the use of pesticides and hazardous chemicals.

The Nuclear Energy Act 46 of 1999 covers aspects that relate to the establishment of the South African Nuclear Energy Corporation Limited, implementation of the Safeguards Agreement & any additional protocols, and issues that are relevant to

nuclear non-proliferation. It also describes the Minister's responsibilities regarding source material, special nuclear material, restricted material, radioactive waste, and irradiated fuel. This Act does not adequately regulate nuclear activities in biodiversity hotspots. National Nuclear Regulator Act 47 of 1999 regulates nuclear activities. Other provisions include safety standards, regulatory practices, and protection of the environment against nuclear damage.

The Hazardous Substances Act 15 of 1973 makes provision for the control of substances that may cause injury, ill health or death to human beings due to their toxic, corrosive, irritant, or flammable nature. It also regulates the management, monitoring, prohibition, importation, manufacture, sale, use, modification and disposal of such substances. The following aspects are not adequately regulated:

- comprehensiveness of substances to be included as hazardous nuclear material;
- regulation of domestic disposal of hazardous substances;
- regulation of acquisition of domestic or commercial herbicides/pesticides;
- prohibition of storage of excess herbicides/pesticides;
- prohibition of use of recalcitrant pesticides/herbicides;
- prohibition of collection/reuse of empty herbicide containers; and
- prohibition of burial of empty hazardous substance containers.

The Explosives Act 15 of 2003 makes provision for the regulation of activities that relate to explosives and includes manufacturing, trading, importing, exporting, packaging, transport and use of explosives.

- This Act does not prohibit the manufacture and use of environmentally detrimental explosives.

The National Veld and Forest Fire Act 101 of 1998 make provision for the establishment of fire protection associations, the use of firebreaks, and directives regarding fire fighting.

- It does not regulate sizes of firebreaks and repeated burning of the same area.

CHAPTER 7

SECTORAL LEGISLATION: THE BIOLOGICAL ENVIRONMENT

7.1 Introduction

Sectoral legislation pertaining to the biological environment should make provision for aspects that relate to: terrestrial conservation; and management of agricultural activities.

The following relevant acts are discussed in this chapter:

- Forest Act 122 of 184;
- Management of State Forest Act 128 of 1992;
- National Forest Act 84 of 1998;
- Fencing Act 31 of 1963;
- Agricultural Pest Act 36 of 1983;
- Animal Health Act 7 of 2002;
- Conservation of Agricultural Resources Act 43 of 1983;
- Genetically Modified Organisms Act 15 of 1997; and
- Genetically Modified Organisms Amendment Bill 34 of 2005.

International law in the form of conventions includes:

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES); and
- Convention on the Conservation of Migratory Species of Wild Animals, 1979 (Bonn Convention).

7.2 The biological environment

The biological environment includes terrestrial conservation of biodiversity. It also includes the regulation of agricultural activities that can have a detrimental impact on the environment.

7.2.1 Terrestrial conservation

7.2.1.1 The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES)

Objective

The main objective of this Convention is to protect and monitor endangered plant and animal species. Benefits include: regulation in trade; keeping in touch with conservation; international conferences; and sustainable utilisation (UNEP,

2003). This convention was signed on 3 March 1973, and ratified on 15 July 1975 (South Africa, 2003a).

The objectives of this Convention as stipulated under the preamble of the Convention strive to ensure the protection of various forms of wild fauna and flora in the world. This biodiversity needs to be preserved due to its aesthetic, scientific, cultural, recreational and economic values. Every country should be responsible for the protection of its own biodiversity, and international cooperation should be encouraged to regulate the exploitation and trade of such biodiversity.

Biodiversity protection

Article 2 provides the fundamental principles that form the basis of the Convention. It classifies species under Appendices 1, 2 and 3, and this relates to the conservation status of these species. Appendix 1 includes species that are threatened by extinction and that may be affected by trade. Trade in these species is subject to strict regulations so as not to endanger their survival. Appendix 2 species include those that are not necessarily currently threatened by extinction but which may become threatened as a result of trade in such species. Appendix 3 species includes those that may be identified by any contracting party to the Convention for the purpose of regulating the exploitation and trade in such species. Trade of species included under Appendices 1, 2 and 3 may only be allowed under the provisions of the Convention.

Article 3 provides conditions for the trade of species listed under Appendix 1 of the Convention. Trade in these species may only take place on issue of an export permit. The permit must ensure that such action does not threaten the survival of the species. An import permit must also be obtained from the country receiving such specimen. An import permit may only be granted once it has been established that such import will not compromise the survival of the species in the country of origin. The country of import must be able to provide suitable conditions for the survival of the imported species. Also, such imported species may not be used primarily for commercial purposes. Article 4 regulates the trade in species included under Appendix 2 of the Convention. The same conditions apply to the export of species under Appendix 2, except that the import of such species is less strict than those under Appendix 1 species. Article 5 regulates the trade in species included under Appendix 3 of the Convention. The export of any species listed under Appendix 3 requires an export permit. An export permit may be granted once it has been determined that the specimen of the particular species was not obtained in contravention of any law. Article 6 provides for permit requirements to be conformed with, to conduct trade in any species protected by this Convention. These requirements are also included in appendix 4 of the Convention.

Article 7 makes provision for exemptions and special provisions regarding trade in species. The provisions of Articles 3, 4 and 5 (pertaining to the regulation in trade of species under Appendices 1, 2 and 3) do not apply to “specimens that are personal or household effects”. It however excludes Appendix 1 species acquired by the owner outside his/her country, and which are imported into that country. This exemption also does not apply in the case of Appendix 2 species that were:

- acquired outside his/her country and where such specimens were removed from the wild;
- specimens that were imported into the owner’s country of residence; and
- where export permits are required by the country from which the wild specimens were removed before they may be exported.

Article 7 further provides that Appendix 1 species bred or cultivated for commercial purposes will be classified as appendix 2 species under the provisions of this Convention. The provisions of articles 3-5 do not apply to any species traded between institutions for scientific purposes. Article 8 mandates contracting parties to the Convention to take all measures necessary to ensure compliance with the principles of the Convention. It also provides that all confiscated specimens must be returned to a scientific authority of the country of origin or to a rescue centre. Article 14 provides that parties to the Convention may promulgate domestic legislation to complement the provisions of the Convention.

7.2.1.2 The Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)

Objective

This Convention provides for international measures relating to the conservation of internationally migratory animals. These include terrestrial mammals, reptiles, marine species, and birds. South Africa is a major partner in this convention, because the Republic is a terminus for many Palaearctic and Antarctic species. South Africa acceded to this convention in December 1991 (CMS, 2003; UNEP, 2002b; South Africa, 2003a).

Protection for migrating species

Article 2 makes provision for fundamental principles that form the basis of the Convention. The following principles are included:

- cooperation between contracting parties to ensure the conservation of migratory species of wild animals; and
- specific management measures for the protection of species included under Appendices 1 and 2 of the Convention.

Article 3 makes provision for Appendix 1 that includes a list of endangered migratory species. Contracting parties should endeavour to ensure that all possible measures are taken to conserve the habitat of such species. The parties should also endeavour to reduce or prevent any factors that could compromise the survival of such species. Contracting parties should not utilise any species listed under Appendix 1, unless such utilisation pertains to scientific purposes, propagation measures, subsistence utilisation or any other purpose that will not compromise the survival of the species.

Article 4 includes a list of species that are included under Appendix 2 of the Convention. Species listed under Appendix 2 have an unfavourable conservation status and may benefit from any international cooperation that provides additional conservation measures. Contracting parties to the Convention should endeavour to implement measures to provide for the protection of Appendix 2 species. Article 5 provides guidelines for agreements regarding the conservation and management of migratory species. Agreements should be compiled in such a manner as to cover the entire migratory range of the species, and allow non-parties to accede to the Convention at any time. These agreements should include the following important aspects:

- identification of migratory species covered;
- description of migration routes of species;
- appropriate instruments to implement the objectives of the agreement;
- regular assessment of conservation status of species;
- coordinated conservation plans;
- undertaking of research and exchange of information;
- protection and restoration of habitats;
- creation of new habitats and maintenance of present habitats;
- reduction or elimination of activities that interfere with the migration pattern of migratory species;
- management of the utilisation of migratory species; and
- prevention of illegal harvesting of migratory species.

Article 7 makes provision for conference between parties. Information discussed on such conference should pertain to: conservation status of migratory species; progress made regarding conservation of species; recommendations regarding the conservation of species; and any other matter relating to the provisions of the Convention. Article 8 makes provision for the establishment of a Scientific Council to provide information regarding scientific matters relative to the Convention.

7.2.1.3 National Parks Act 57 of 1976

The Protected Areas Act repealed the objectives of this Act. (See 4.4.5).

7.2.1.4 Forest Act 122 of 1984

This Act makes provision for the establishment of the National Botanical Institute. The National Forests Act 84 of 1998, repeals all other sections of this Act. The remainder of this Act is repealed by the Biodiversity Act. (See 4.4.4).

7.2.1.5 Management of State Forest Act 128 of 1992

This Act makes provision for the management and control over State forests by an established company as determined in section 2 of this Act. The objective of such company in terms of section 3 is the development of long term sustainable forestry according to accepted commercial and environmental practice.

7.2.1.6 National Forest Act 84 of 1998

Objective

This Act deals with sustainable forest research, monitoring, reporting, and management of national forests. The objective of this Act as defined in section 1 is to: promote sustainable use of forests; promote the protection of certain species of trees; ensure community forestry. Other aspects covered include measures to protect forests, prohibition of destruction of natural systems, establishment of protected areas, measures to control and remedy deforestation, directives regarding the use of forests, regulation of recreation and related purposes, granting of rights to use State forests, community forestry and the establishment of the National Forest Recreation and Access Trust.

Management of natural forests

The principles under section 3 ensure that: natural forests are not destroyed except under special circumstances; a minimum of each woodland type should be preserved; and that forests and their living resources as well as non living resources are protected. The Minister may determine conditions and criteria that should be used in the management of forests. Such criteria may relate to: forest resources; forest health; biological diversity in forests. These may apply to specific areas, persons or types of forests.

Section 6 provides for monitoring of forests and reporting of relevant information both publicly and to Parliament. Section 7 prohibits any person from destroying or utilizing any indigenous tree in any forest without the necessary authorisation from the relevant authority. The Minister may declare any area a natural forest when such declaration is necessary for the protection of such trees. The Minister may also declare any area a forest nature reserve, a forest wilderness area, or

any other type of protected area recognised in terms of international law or practise. Section 10 prohibits any person from destroying or utilizing any produce from a protected area except: in terms of the rules made for the management of the area; in the course of management of the area by an organ of State; in terms of a servitude; in terms of a licence; in case of any exemption; or when a protected area that is not part of State land and with the consent of the owner. Section 11 ensures that the Minister manages a protected area in terms of the purposes for which it was declared protected. Section 12 allows the Minister to declare any species of trees to be a protected species, and such declaration may apply to the entire country in terms of section 14 of this Act. Section 15 concludes that no person may utilize or destroy any such protected species of trees.

Section 17 allows the Minister to declare controlled forest areas to ensure improved management of natural forest resources in such areas. Section 19 provides for access to State forests for recreation, education, culture or spiritual fulfilment. Section 20 regulates access to State forests by members of the public and the conditions to be complied with in such areas. Section 21 regulates access to natural forest that is not State forest, and such access should be after consultation between the Minister and the relevant landowner.

Authorisation

Section 23 includes a list of activities that may be authorised in state forests, including the:

- establishment of plantations;
- utilisation of forest produce;
- use of land for any other purposes;
- construction of infrastructure; and
- undertaking of agricultural practices.

Section 24 provides conditions for the granting of licences by an authority. Such licence should be valid for the time period allowed by the activity in terms of the servitude, lease, agreement to sell forest produce or community forestry agreement. The validity may not exceed ten years in the case of any other activity. The Minister may determine any further conditions regarding the issue of licences, and may exclude certain persons from any conditions regarding the application of such licences. Section 26 makes provision for the granting of servitudes by the relevant authority where such servitude is relevant to the following terms:

- a State forest that is not a trust forest;
- in the case of trust forests held by the Ingonyama referred to in the Kwa-Zulu Ingonyama Trust Act 3 of 1994 where permission from the authority administering this Act is required;

- any other trust forests; and
- does not affect the ecology of state forests.

Section 27 allows the Minister to lease any state forest for any other purposes when such lease is deemed necessary under the circumstances. Section 28 makes provision for measures to allow the selling of forest produce from state forests.

Community forestry

Section 28 makes provision for measures to allow the initiation of community forestry agreements. Such community forestry may include certain activities in State forests. The authority should assess conditions regarding such activity and consult the public on these issues. The relevant authority must determine the suitability of a forest in terms of such activities. Such agreement should provide for remedial measures that may include the cancellation of such agreement in the case of a breach of the conditions. An agreement may determine that a community need not pay any fees for the use of such rights related to community forestry.

Enforcement

Section 58 makes provision for penalties regarding offences committed under this Act. A person found guilty of an offence under this Act may be imprisoned for a period of 6 months or 2 years depending on the type of offence committed. A fine may also be imposed on such a person of up to R50 000 depending on the type of offence committed. In certain circumstances a person may be liable to a fine and imprisonment. Section 59 makes provision for the return of any forest produce by the person responsible for illegally removing such produce. Such person may also be mandated to pay damages to remedy the implication of the offence committed.

7.2.1.7 Fencing Act 31 of 1963

Objective

The objective of this Act is to consolidate legislation relative to fencing, and the fencing of farms. It provides for obligatory fencing and for areas where jackal-proof fencing is required, the repair of fences, owners rights, financial provisions, clearing of bush for fencing, fencing-off of railway lines, access to land and intentional or unintentional damaging of fences.

Section 17 makes provision for the clearing of vegetation 1.5 metres on each side of a fence when constructing a fence in any area.

Aspects not covered by this Act

- *Measures for the regulation of non-lethal electrical fencing that may result in the death of some animals such as hedgehogs (also see 3.5.1.5 and Table 8).*

7.2.2 Management of agricultural activities

7.2.2.1 Agricultural Pest Act 36 of 1983

Objective

The objective of this Act is to provide measures to combat and prevent agricultural pests. It deals with importation of goods, compulsory notification of presence of certain pests on land, investigation and control measures.

Imported products

Section 3 regulates the importation of controlled goods, and prohibits the import of any plant, pathogen, insect, exotic animal, growth medium, infectious thing, honey, beeswax or equipment associated therewith. Controlled goods may only be imported on authorisation. An inspector must inspect all imported controlled goods to ensure compliance with the objectives of this Act. Section 4 provides that any imported product that does not comply with the provisions of this Act may be managed in any way deemed appropriate by the inspector. The following may be instituted:

- refusal for such goods to be offloaded;
- refusal for goods to be transported any further;
- the officer to designate a specific place where goods may be offloaded;
- destruction of such goods; and
- return of goods to the sender.

Pests

Section 5 provides for the compulsory notification of the presence of certain pests on land. Section 6 provides that the Minister may determine the methods of destruction of such pests. This may include:

- destruction of plants;
- clearing of plants;
- combating of pathogens; and
- cultivation or non cultivation of crops.

Section 7 provides that owners of land must carry out any control measures as determined by a pest control officer. Section 8 allows the Minister the authority to take measures to manage the presence of pest on land.

Enforcement

Section 9 allows any person authorised by the Minister to enter any land to enforce the provisions of this Act. Section 13 provides that any person who contravenes a provision of this Act will be guilty of an offence. A person guilty of an offence may on conviction be liable for a fine of between R2000 and R50 000 or to imprisonment for between 6 months to 10 years, or to both such fine and imprisonment.

7.2.2.2 Animal Health Act 7 of 2002

Objective

In this Act provision is made for the promotion of animal health, control of animal diseases, importation/exportation of animals, quarantine, fencing, disposal of straying animals, control over land, animal health schemes, duties of owners, services rendered by national executive officers, control measures and compensation.

Restricted activities

Section 7 makes provision for the limitation of certain experiments and actions on various products. This may relate to research on any experiment with any vaccine, serum, toxin, anti-toxin, antigen or other biological products. Section 8 prohibits the exportation of any animal from the Republic of South Africa without a health certificate. Section 9 prohibits the import or transit of any animal without authorisation. Such authorisation must ensure that the necessary veterinary procedures are enforced to prevent the introduction of unwanted pathogens. Section 10 provides that no person may remove any animal from a quarantined area during the importation or transport process without authorisation. The authority may mandate the destruction of any animal if such animal is infected with any disease, when such importation or transit may result in the spread of such disease. Section 11 makes provision for the designation of quarantine camps and stations to enforce the provisions of this Act. Section 12 makes provision for the construction of fences, and includes the construction of fences at the following places:

- a permanent fence on the borders of the Republic of South Africa;
- a permanent fence on the borders of any national park, provincial park or private game reserve; and
- a temporary fence on any piece of land.

Any vegetation may be removed for the construction of fences. Section 15 provides that the national executive officer may take control over any land to enforce the provisions of this Act, when the owner of such land is incapable of complying with the provisions of this Act. Section 16 makes provision for the establishment of animal health improvement schemes to ensure improved animal health in the Republic of South Africa. Section 17 defines the duties of owners and users of animals in respect of animal health. This includes:

- preventing infection of his/her animals with any disease;
- preventing the spread of diseases and parasites;
- applying prescribed treatment to infected animals; and
- reporting all cases of morbidity and mortality to the relevant authority.

Section 19 allows any authorised person to enter, search and to carry out inspections and controlled veterinary procedures on any land when deemed necessary. Section 20 provides that the relevant authority may mandate any person to destroy any quarantined animal in a prescribed manner, when such action is necessary to prevent the spread of a disease. Strict measures may be implemented when such animal is infected with a disease or parasite that is not indigenous to the Republic of South Africa. Section 28 provides that the Minister may promulgate any regulations that pertain to the following:

- qualifications of specified persons;
- importation and exportation of animals;
- disease control measures;
- hunting of game; and
- killing of animals.

Section 29 provides that any person who contravenes a provision of this Act is guilty of an offence and may on conviction be liable for a fine or to imprisonment for 2-4 years, or to both such fine and imprisonment.

7.2.2.3 Conservation of Agricultural Resources Act 43 of 1983

Objective

This Act regulates utilization of agricultural resources, conservation of soil and water, measures to sustain vegetation and weed control.

Section 6 makes provision for the designation of control measures to ensure that the objectives of this Act are met. These control measures may relate to:

- cultivation of virgin soil;
- utilisation and protection of land that is cultivated;
- irrigation of land;
- prevention of water-logging and salination of land;

- protection of wetlands;
- regulation of the flow pattern of water;
- protection of vegetation;
- regulation of grazing capacity;
- control of field fires;
- control of weeds;
- rehabilitation of degraded land;
- protection of water resources against pollution; and
- conservation of soil.

Government Notice Regulation 1047 of 25 May 1984 makes provision for a soil conservation scheme establishment. This scheme makes provision for the measures regarding the conservation of soil.

Regulation of weeds

Section 5 makes provision for measures to prohibit the spread of weeds, and the following aspects are covered:

- any actions that may be responsible for the dispersal of weeds are fully prohibited;
- imported agricultural products that contain weed seeds must be returned to the sender or destroyed; and
- the regulation of weed seeds on animals that are driven on a public road.

Government Notice Regulation 1044 of 25 May 1984, makes provision for measures regarding a weed control scheme establishment. This includes the regulatory conditions under which weed killers may be supplied by the relevant Government department. Weed killer may only be supplied once proof of an infestation has been provided. All empty containers must be returned on completion of this scheme. Also see 6.2.5.6 and 9.7.3 for more information.

Government Notice Regulation 1045 of 25 May 1984 makes provision for a bush control scheme establishment. This relates to the regulation of invader plants through the payment of subsidies.

Protection of environment

Government Notice Regulation 1048 of 25 May 1984 makes provision for general regulations relative to the objectives of this Act. It regulates the cultivation of virgin soil. The cultivation on land with a slope greater than 20% is prohibited under the provision of this regulation. Every land user should take the necessary steps to prevent soil erosion on cultivated land. This includes cultivation measures to ensure minimum erosion of cultivated soil, and also the protection of

cultivated land against wind erosion that may have an impact in certain geographic areas. Preventative measures should be implemented against water logging of soils and salination. No person may utilise any land within 10 horizontal metres of a wetland without permission from the relevant authority. No person may change the flow pattern of a watercourse without authorisation. Every person using land should take the necessary action to ensure that the land is protected from any degrading activities such as overgrazing of animals. The grazing capacity can be determined through the use of a map obtainable from the executive officer of the relevant authority. The number of animals that may be kept on such surface must be in accordance with these specifications. This regulation further prohibits the burning of any piece of field by the land user in any area. Every land user must also take the necessary measures to restore and rehabilitate any land that has been degraded. Various measures are included to regulate the presence of weeds on land. Weeds are therefore classed in 4 distinct categories. Category 1 plants may not occur on any land or inland water surface except in biological control reserves. Category 2 plants may not occur on any land or inland water surface other than a demarcated area or a biological control reserve. Category 3 plants may not occur on any land or inland water surface other than within a biological control reserve. The executive officer may designate any area as a biological control reserve. All necessary measures must be taken to manage and control bush encroachment irrespective of whether such encroachment is caused by indigenous or exotic species.

Enforcement

Section 10 provides that the relevant Government authority must appropriately counsel any person seeking advice on the objectives of this Act. Section 11 provides that the Minister may take any measure to ensure that the provisions of this Act are enforced. Section 12 mandates all land users to comply with and sustain soil conservation works needed for the conservation of a particular area. Section 14 provides that any piece of land may be expropriated for purposes of restoration and reclamation. Sections 15 and 16 make provision for the establishment of national and regional conservation committees to ensure that agricultural resources are conserved in various areas. Section 18 provides that any authorised person may at any time enter upon any land to ensure that the objectives of this Act are enforced. Section 23 provides that any person who contravenes the provisions of this Act may on conviction be liable for a fine of up to R10 000 or to imprisonment for between 3 months to 4 years or to both such fine and imprisonment.

Aspects not covered by this Act

- *Categorization of alien faunal species in classes relevant to the inherent threat it poses. South African legislation fails to classify and regulate*

invasive faunal species according to the directives that pertain to exotic plants (also see 2.4.1, 3.5.1.7 and Table 8).

- *Improved regulation of domestic animals that have a detrimental impact on the environment such as cats, goats, and hunting dogs (even if only in certain areas). (Also see 2.4.1, 3.5.1.7 and Table 8).*
- *Prohibition of alien species in rivers and riparian systems. Various categories of alien plants are regulated, but legislation should ensure that no alien vegetation poses a threat to indigenous biodiversity. No alien species should be allowed under any circumstances in the Republic's already threatened riparian systems (also see 2.4.1, 3.5.1.7 and Table 8).*
- *Setting a time limit to ensure compliance with rehabilitation procedures. When a problem such as erosion or alien encroachment has been identified, the owner of such land must within a specified time limit comply with the measures determined by the authority to remedy or eradicate such problem (also 3.5.2 and Table 8).*

7.2.2.4 Genetically Modified Organisms Act 15 of 1997

Objective

Under this Act provision is made for the development, application, and release of genetically modified organisms. It also includes directives for the establishment of a council for genetically modified organisms.

Section 2 provides that the objectives of this Act apply to the genetic modification of organisms, and the application and release of such organisms.

Administration

Section 3 makes provision for the establishment of the Executive Council of Genetically Modified Organisms to facilitate the administration of this Act in terms of section 4. The Council consists of members of the following institutions: The Department of Agriculture; the Department of Arts, Culture, Science and Technology; Department of Environmental Affairs and Tourism; the Department of Health; the Department of Labour; and the Department of Trade and Industry; Section 5 defines the duties of the Council, these being:

- To provide consultation to persons involved in the modification of organisms and require that such persons undertake the necessary environmental impact assessment;
- To mandate the inspection of all activities that relate to the modification of genetically modified organisms; and
- To control the release and management of genetically modified organisms.

Sections 8 and 9 make provision for the designation of a registrar to administrate authorisation on the use and release of genetically modified organisms. Section 10 makes provision for the establishment of an Advisory Committee consisting of members with the relevant knowledge in the field to provide advice on relevant aspects. Section 14 provides that the Minister may on consultation with the Council publish a list of activities relating to genetically modified organisms that are restricted.

Enforcement

Section 15 makes provision for the appointment of administrators to assist in the enforcement of the provisions of this Act. Such inspectors may at any time enter into any premises and undertake any action to ensure compliance with the provisions of this Act. Section 17 provides that any environmental liability regarding the use or release of genetically modified organisms must be borne by the user of such organisms. Section 20 allows the Minister to promulgate regulations that pertain to the following:

- applications and issue of permits;
- environmental impact assessment relevant to activities relating to genetically modified organisms;
- the classification of various types of genetically modified organisms;
- conditions for the use of genetically modified organisms; and
- import and export of genetically modified organisms.

Section 21 provides that any person who contravenes a provision of this Act will be guilty of an offence. Such person may on conviction be liable for a fine or to imprisonment for between 2 and 4 years.

7.2.2.5 The Genetically Modified Organisms Amendment Bill 34 of 2005

This Bill makes provision for some changes to the Genetically Modified Organisms Act 15 of 1997, when accepted and promulgated as legislation. It will give affect to Cartagena Protocol on Biosafety to the Convention on Biological Diversity. This Protocol makes provision for aspects that relate to Genetically Modified Organisms. The following articles of the Cartagena Protocol on Biosafety are relevant to biodiversity.

Article 1 ensures that genetically modified organisms are handled, used and transported in such a manner that does not interfere with the sustainable use of biological diversity. Article 2 provides that the Parties to this Protocol must take the necessary action to implement and adhere to objectives thereof. Articles 3 and 4 regulate the import, export, transboundary movement and creation of genetically modified organisms. Article 8 mandates all Parties to this Protocol to inform other Parties when exporting any genetically modified organisms to such Party.

Article 15 mandates all Parties to undertake risk assessments regarding the impact that genetically modified organisms may have on the use of sustainable biodiversity. Article 23 makes provision for public participation and education regarding aspects that relate to genetically modified organisms. Articles 33 and 34 make provision for monitoring, compliance and reporting by Parties to the Protocol on objectives that are determined by the Protocol.

7.3 Conclusion

The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 (CITES) makes provision for protection and monitoring of endangered species of plants and animals. Benefits include: regulation in trade; keeping in touch with conservation; international conferences; and sustainable utilization.

The Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention) provides for international measures relative to the conservation of migratory animals internationally. These include terrestrial mammals, reptiles, marine species, and birds.

The National Forest Act 84 of 1998 makes provision for sustainable forest research, monitoring, reporting, and management of national forests. Other aspects covered include measures to protect forests, prohibition on destruction of natural systems, establishment of protected areas, measures to control and remedy deforestation, directives on the use of forests, regulation of recreation and related purposes, granting of rights to use State forests, and community forestry.

The Fencing Act 31 of 1963 provides for obligatory fencing in areas where jackal-proof fencing is required, the repair of fences, owners rights, financial provisions, bush clearing for fencing, fencing-off of railway lines, access to land, and intentional or unintentional damaging of fences. This Act did not make provision for:

- Measures for the regulation of non-lethal electrical fencing that may result in the death of some animals such as hedgehogs.

The Agricultural Pest Act 36 of 1983 deals with importation of goods, compulsory notification of the presence of certain pests on land, investigation, and control measures.

The Animal Health Act 7 of 2002 makes provision for measures to promote animal health, control of animal diseases, the import/export of animals, quarantine, fencing, disposal of straying animals, control over land, animal health schemes, duties of owners, services rendered by national executive officers, and control measures.

The Conservation of Agricultural Resources Act 43 of 1983 makes provision for utilization of agricultural resources, conservation of soil and water, measures to sustain vegetation, and weed control. The following aspects are not adequately regulated:

- categorization of alien faunal species in classes relevant to the inherent threat posed;
- regulation (or prohibition) of domestic animals that have a detrimental impact on the environment;
- prohibition of alien species in rivers and riparian systems; and
- setting of a time limit to ensure compliance with rehabilitation procedures.

The Genetically Modified Organisms Act 15 of 1997 and the Genetically Modified Organisms Amendment Bill 34 of 2005 make provision for the development, application, and release of genetically modified organisms. It also includes directives for the establishment of a council for genetically modified organisms. The Bill, if accepted and promulgated as legislation, will give affect to Cartagena Protocol on Biosafety to the Convention on Biological Diversity. This Protocol makes provision for aspects that relate to Genetically Modified Organisms.

CHAPTER 8

PROVINCIAL LEGISLATION

8.1 Introduction

Provincial legislation governs environmental aspects on provincial and local level. The ordinances and local bylaws of these acts have been promulgated to make provision for the regulation of the more detailed aspects relevant to provinces. Provincial legislation governs various environmental issues in the nine provinces. Many of the ordinances of the former 4 provinces and homelands are still applicable in the 9 provinces. Provincial acts (ordinances) may be relevant to only one province, or may apply to more than one province. This provincial legislation also complies with the environmental provisions of the Constitution (see chapter 4, 4.3) as discussed earlier. Homeland legislation previously only relevant to homeland areas was integrated as part of provincial legislation in relevant provinces after 1994. Homeland legislation is included as part of the relevant provincial legislation under which such a homeland falls. For example, former Qwaqwa and Bophuthatswana are included under the present Free State Province. The same principle applies to the other 9 provinces.

The following provincial acts and ordinances are currently relevant to the nine provinces. Some ordinances make provision for various measures to protect biodiversity, while other ordinances do not provide these measures. The aim of this chapter is to compare the various province's legislation in a qualitative manner. It should therefore be seen in the context of the holistic discussion regarding provincial legal obligations. Comments are given at the end of this chapter.

8.2 Eastern Cape (Former Transkei, Ciskei, Cape Province)

8.2.1 Nature Conservation Act (Ciskei) 10 of 1987

Objective

The objectives of this Act are to ensure the conservation, management and protection of fauna, flora and fish and their associated habitats. It also makes provision for the establishment and management of nature reserves, hiking trails, water catchment areas and a coastal conservation area to ensure the protection of various types of biodiversity.

Protection of biodiversity

Section 3 defines the general objectives of the Department of Agriculture, Forestry and Rural Development, these being:

- investigation into the integrity of biodiversity in the area;
- promoting public awareness and understanding of biodiversity;
- providing any information relative to the objectives of this Act;
- conducting restocking programmes, and
- regulation of alien and invasive plants and animals on land.

The Minister may mandate that special conservation measures be taken to ensure the survival of biodiversity. This may include the collection of propagating material to ensure that such objectives are met. Section 4 makes provision for the appointment of nature conservation officers to ensure the objectives of this Act are met. These officers may undertake any action to ensure that the directives of this Act are enforced. Section 7 makes provision for the classification of animals under schedules 1, 2 and 3 that define specially protected animals, protected animals, and huntable animals. Sections 8 and 9 provide that no person may kill or utilise any part of a specially protected or protected animal without the necessary authorisation from the relevant authority. Section 10 mandates a license for the hunting of any huntable animals identified under Schedule 3 of this Act. Section 11 provides that no person may capture a wild animal without a permit. When such permit has been granted, the permit holder must ensure appropriate living conditions for such animal. Section 12 provides that the Minister may establish open and closed season for hunting various types of wild animals. Section 13 makes provision to regulate various types of hunting methods pertaining to wild animals. Section 14 regulates the sale or donation of a huntable wild animal or carcase thereof. Section 15 makes provision for directives to regulate the possession of the carcase of a huntable animal.

Section 17 regulates the enclosure of various types of wild animals in fenced areas, and ensures that living conditions are suitable to sustain such species. Section 18 allows a relevant authority to authorise the hunting of any problem animal, irrespective of the conservation status of such species. Section 19 makes provision for the classification of various types of flora under 4 distinct Schedules. Schedule 5 covers specially protected flora, Schedule 6 covers protected flora, Schedule 7 covers unprotected flora, and Schedule 8 covers aquatic growths. Sections 20 and 21 mandate that no person may damage, destroy, sell or possess any specially protected or protected flora without a permit. Section 22 provides the conditions to be complied with by any person wanting to sell any protected flora. It requires the necessary authorisation and such person may not acquire such flora in an unauthorised manner.

Conservation areas

Section 27 makes provision for the establishment of local nature reserves to protect various types of biodiversity in the area. Section 28 allows the Minister to promulgate regulations to ensure the survival of biodiversity in these local nature reserves. Section 29 allows any person to establish a private nature reserve to

protect biodiversity. Section 31 makes provision for the designation and protection of water catchment areas. Section 35 makes provision for the establishment of nature areas to aid in the protection of any particular fauna and flora in need of such protection. Sections 37-40 make provision for the establishment of nature trials on private land and State land. It also includes measures to ensure that people using such facilities do not harm the biodiversity in these areas. Section 42 makes provision for the establishment of a coastal conservation area that includes a 1 kilometre strip inland from the coast. No person may undertake any development within these areas without prior authorisation.

Biodiversity harvesting

Section 43 allows the Minister of Internal Affairs and Land Tenure to let the seashore under certain conditions (including coastal reserves) for certain development activities. Sections 52-58 make provision for the regulation of harvesting aquatic species of fauna, and ensure that such harvesting may only be undertaken with the necessary authorisation. Section 66 prohibits the use of vehicles in the coastal conservation areas without the relevant authorisation.

Enforcement

Section 71 provides that the Minister may promulgate any regulations pertaining to the following:

- conditions regarding authorisation to conduct certain activities;
- regulation of the number of wild animals that may be kept in captivity;
- conditions for keeping wild animals in captivity; and
- quarantine of any wild animals.

Section 72 provides that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of between R500 and R1000 or to imprisonment of between 6 months to 1 year, or to both such fine and imprisonment.

8.2.2 Nature and Environmental Conservation Ordinance 19 of 1974

Objective

This Ordinance makes provision for the conservation of biodiversity and to sustain the integrity of the environment.

Biodiversity protection

Section 5 makes provision for the establishment of a nature conservation advisory committee to provide advice to the relevant authority on issues that relate to this ordinance. Section 6 makes provision for the establishment of provincial nature reserves to ensure the protection of biodiversity on provincial level. Section 7 makes provision for the establishment of local nature reserves to protect biodiversity on a local scale. Section 8 makes provision for the establishment of advisory committees to consult the relevant authority on issues relative to local nature reserves. Section 8 allows local authorities to promulgate municipal by-laws to consolidate the provisions of this Act. Section 12 makes provision for the establishment of private nature reserves on private land, when the owner of such land deems it necessary.

Harvesting of biodiversity

Section 14 prohibits the killing of animals and destruction or gathering of flora in any provincial or local nature reserve. Such action may only be undertaken with the necessary authorisation. Section 16 allows the relevant authority to take any action to ensure the protection of any biodiversity in any areas. This may include surveys, research and other management objectives. Section 17 provides for the relevant authority to take any measures to ensure the survival of rare and endangered species of plants and animals. This may include any action to capture, preserve or propagate such species. Section 18 allows the relevant authority to kill any problem animals in the interests of nature conservation. Section 19 also provides that the relevant authority may destroy any aquatic species of plants or animals when such species have a negative impact on indigenous species. Sections 20, 21 and 23 provide for the appointment of nature conservation officers to assist with enforcing the objectives of this ordinance. Sections 26 and 27 prohibit the hunting or possession of protected wild animals. Such action may only take place on authorisation by the relevant authority.

Section 28 ensures that bag limits are determined to regulate the killing of protected wild animals. Sections 29, 32 and 33 prohibit the following methods of hunting: poison; artificial light; trap; bow and arrow; set gun; narcotic agent; vehicles and by dogs. Such methods may only be used on authorisation. Section 31 regulates the possession of wild animals in captivity, and provides a permit system to regulate such practices. Section 39 allows the landowner to permit any person to hunt any wild animals on his/her land. Sections 41 and 42 regulate the sale and donation of any carcasses of any wild animals. Section 47 provides that the relevant authority may permit any landowner to hunt problem animals when enough evidence has been provided. Section 47A provides directives to ensure the protection of rhinoceros, and regulates interference in any manner with such species.

Restricted activities

Section 48 prohibits the pollution of any inland water resources by any means. No person may place any object in any water resource that may negatively impact on any species of fish. Sections 50-52 regulate the introduction of fish into any water resources and the catching and killing of any such species. Sections 53, 55-57 regulate angling licenses, netting licenses, bag limits, prohibited fishing methods, and the sale of certain species of fish. Section 58 regulates the import and export of fish from the province. Section 60 makes provision for measures to ensure the eradication of aquatic weeds in water resources. Section 61A provides that the relevant authority may exempt any person from the provisions of this Ordinance in the interests of scientific research. Sections 62 and 63 provide that no person may sell, buy, donate, damage, destroy, import, or export any endangered plants without the necessary authorisation. Section 64 regulates the sale and purchase of protected flora through a permit system. Section 65 makes provision for special measures to register nurseries that cultivate and propagate any protected plants. Section 69 provides that a landowner may sell unprotected flora cultivated on their land. Section 70 regulates the import and export of flora.

Section 78 makes provision for open and closed hunting and fishing seasons, and ensures that such activities only take place in open season.

8.3 Free State (Former Qwaqwa, Bophuthatswana, and Orange Free State)

8.3.1 Bophuthatswana Nature Conservation Act 3 of 1973

Objective

The objective of this Act is to make provision for the protection of game, fish, fauna and flora in former Bophuthatswana.

Protection of biodiversity

Section 2 makes provision for the classification of wild animals as protected game, specially protected game, and ordinary game. Such animals may only be killed on authorisation from the relevant authority in terms of section three of this Act. Section 4 makes provision for prohibited methods of killing various types of game, and times of day that such species may not be hunted. Section 6 includes measures to regulate the transport, possession and sale of game and ensures that such actions may only be undertaken on authorisation. Section 6A provides that the Minister may prohibit hunting or determine hunting seasons for various types of game as well as offences and penalties for non-compliance with such directives.

Section 9 regulates the introduction and possession of vermin in Bophuthatswana. Section 10 regulates the granting of permits to hunt various

types of game under this Act. It further provides that specially protected game and protected game may only be hunted once it has been determined that such action will not threaten the integrity and the survival of the species. Section 11 provides that no person may harvest any fish without the necessary authorisation. This Act includes any form of aquatic fauna. Section 12 prohibits the release of any aquatic fauna without the relevant authorisation in any water resources. Sections 14 and 15 classify protected and specially protected plants under this Act, and dictate that these plants may not be harvested or destroyed in any manner without the necessary authorisation from a relevant authority.

Section 18 makes provision for the establishment of game reserves and parks to protect the various forms of biodiversity that occur in the area. Section 19 ensures that measures are implemented to guarantee the protection and survival of various forms of biodiversity in these areas. The management of such areas should ensure that such species are not threatened by any anthropogenic activities. Section 24 makes provision for the appointment of conservation officers and field rangers to assist in the enforcement of the provisions of this Act. These authorised persons may instigate any action to enforce the provisions of this Act.

Enforcement

Sections 27 and 28 make provision for penalties for the contravention of any provision of this Act. A person prosecuted may be liable for a fine of between R600 to R200 000 or to imprisonment for between 6 months to 10 years, or to both such fine and imprisonment. Section 29 provides that the Minister may promulgate any regulations to ensure adequate protection of biodiversity in Bophuthatswana.

8.3.2 Qwaqwa Nature Conservation Act 5 of 1976

Objective

This Act makes provision for the protection and conservation of biodiversity in the former Qwaqwa.

Biodiversity protection and restricted activities

Section 2 classifies wild animals as protected game, and as ordinary game. Section 3 provides that no person may harm, destroy, trade or possess any wild animals without authorisation from the relevant authority. Section 4 prohibits the killing of wild animals by any of the following methods: net; trap; pitfall; cage; airgun; bow; setgun; snare; poison; artificial light; automatic gun; and poison gun. Section 6 regulates the trade and transport of dead game, and ensures that such action may only take place with the necessary authorisation. Sections 7 and 8 regulate the killing of any wild animals by the relevant authority when necessary,

where it will not compromise the survival of any species. It also regulates the hunting and killing of any vermin. Section 9 regulates the introduction and possession of vermin in the former Qwaqwa.

Section 11 provides that no person may harvest any species of fish without authorisation. It also makes provision for measures to regulate the methods by which fish may be caught. Section 12 provides for measures to regulate the introduction of fish and aquatic plants into Qwaqwa by means of a permit. Section 14 classifies plants as protected plants and specially protected plants. Section 15 prohibits the destruction, removal, damage, trade, donation or any other harmful interference with any such species without the necessary authorisation. These provisions do not apply in the case of agricultural or commercial development.

Section 18 makes provision for the establishment of nature reserves and game reserves to ensure the survival of various types of biodiversity. The relevant management authority must ensure that the necessary steps are implemented to guarantee the survival of biodiversity in these protected areas. Section 19 ensures that no person may damage, destroy or interfere in any harmful way with any biodiversity in protected areas. Sections 24 and 25 make provision for the appointment of nature conservation officers and field rangers to assist in the enforcement of the provisions of this Act. These authorised persons may take the necessary steps to ensure the protection of biodiversity.

Enforcement

Section 27 provides that any person that contravenes a provision of this Act will be guilty of an offence. Such person may on conviction be liable for a fine of between R100 to R5000 or to imprisonment of between 3 months to 2 years. Section 29 allows the Minister to promulgate any regulations to ensure the protection of biodiversity or to ensure that any provision of this Act is enforced.

8.3.3 Protected Areas Act (Bophuthatswana) 24 of 1987

Objective

This Act makes provision for the continued existence of areas that previously constituted to national parks and that are currently now known as protected areas.

Biodiversity protection and conservation areas

Sections 2 and 3 make provision for the establishment of protected areas. It ensures that certain areas of land may be made available for the protection of biodiversity after consultation with the relevant owners of such land. The objective of such protected areas should be to ensure the protection of various

forms of biodiversity or any other aspects of scientific interest. Section 4 defines the objectives of protected areas and provides that such areas should be established to ensure the protection and survival of specific forms of biodiversity. These areas should also provide opportunity for recreation and scientific research. Section 5 provides for the establishment of the Protected Areas Board, and ensures that the Board assists in the management of protected areas. Section 20 makes provision for the duties and objectives of the Board and these are:

- Control and management of protected areas;
- Acquisition of land for the establishment of protected areas;
- Control management of biodiversity in protected areas;
- Provide advice and consultation to Government on issues relative to protected areas; and
- Formulate policies for the management of protected areas.

Section 31 prohibits prospecting and mining activities in protected areas except on consultation with the Minister entrusted with Land Matters and Minister of Minerals and Energy. Such activities may only take place in areas designated for mining and where the necessary mineral rights exist. Section 32 regulates entry into protected areas and ensures that no person resides in a protected area without permission from the management authority of the protected area. No person may damage, destroy or interfere with biodiversity in any manner in such protected area. Section 33 provides that authorisation may be granted to any person who wants to reside in a protected area. Such permission will only be granted for recreational and scientific purposes.

Enforcement

Section 36 provides that any person who contravenes a provision of this Act (including the damaging or destroying of any biodiversity) will be guilty of an offence. On conviction such person may be liable for fine of between R200 to R200 000 or to imprisonment for between 6 months to 20 years, depending on the offence committed. Section 40 provides that the Minister may promulgate regulations to ensure compliance with the provisions of this Act or to ensure the survival of biodiversity.

8.3.4 Nature Conservation Ordinance 8 of 1969

Objective

This Act makes provision for measures to ensure the protection and conservation of biodiversity.

Protection of biodiversity

Hunting

Sections 2 and 3 make provision for measures to ensure the declaration of ordinary and protected game, and the protection and hunting thereof. Section 5 provides conditions that should be complied with for the hunting of ordinary game, and also ensures that authorisation is needed before the undertaking of such hunting. Section 4 makes provision for the establishment of hunting seasons for the hunting of game. Sections 6-10 provide measures to regulate hunting at night, prohibition to use poison during hunting, and the use of various types of hunting devices. The following devices are restricted: snare, trap, gin net, bird-lime, pitfall, holing pen, trap cage, stick, set gun or dog. Such methods may only be used by the owner of such land, whereas the use of dogs is limited to bird hunting and wounded animals.

Sections 11-13 regulate: trade in wild animals, donation of wild animals, and the conveyance of a wild animal. Sections 15 and 16 make provision for measures to regulate the import and export of animals to and from the Free State Province. Section 17 allows the competent Government authority that administers this Act, to hunt any wild or exotic animal under certain circumstances. These reasons may include the endangerment of human life, or when such an animal has been wounded, or when deemed necessary for the sake of nature conservation reasons.

Sections 18 and 19 regulate: release, captivation, donation, trade, and hunting of exotic animals. Section 20 regulates the undertaking or organization of hunting for reward. Section 21 provides measures to restrict hunting on private land and public roads.

Aquatic biodiversity

Sections 22-29 regulate undertaking of lawful fishing by the owner or relative of the owner of such land. It further ensures that other persons must be in possession of the relevant authorisation to undertake such angling. Permission must be obtained from the owner to undertake any fishing activities. Section 25 ensures that fish may not be disturbed in any manner during the closed fishing season. Sections 26 and 27 regulate the various methods that may be used to catch fish, and include the use of a fish net or fish trap. Section 28 restricts the importation, sale and release of fish in the Free State Province. Section 29 regulates the cultivation of certain aquatic plants in the waters of the Province.

Indigenous plants

Sections 30–34 regulate various activities that pertain to indigenous plants. This includes the declaration of specially protected plants, and measures to prevent

their destruction/removal by any person entering upon such land. Such activities may only be undertaken by the owner of such land, or through written permission by such owner. The picking/destruction of any indigenous plant within 100 metres of a national road is prohibited by section 32 of this Act, unless permission can be obtained by the relevant Government authority. Sections 33 and 34 restrict: trade, donation, import, export and possession of any protected plant without the relevant authorisation.

Conservation areas

Sections 35 and 36 make provision for the establishment of private and provincial nature reserves. Measures are also provided to ensure that biodiversity are protected in such areas. Authorisation is needed (owner and government) to undertake any activities that may have a negative affect on biodiversity in these areas.

Problem animals

Sections 36A-36C make provision for measures to regulate problem animals that cause livestock losses. This includes the appointment of so called “problem animal hunters” and their entrance upon land to eradicate such animals. Section 36E provides that any person that hinders a “problem animal hunter” to enter upon land, will be guilty of an offence and upon conviction may be liable to a fine of R400, imprisonment of 6 months, or to both such fine and imprisonment.

Nature conservation fund

Sections 36F-36H make provision for the establishment of a nature conservation fund (from donations and other funds) to be used for nature conservation purposes in the Free State Province.

General

Sections 37 and 38 make provision for: permits, licences, fees and exemptions with regard to the provisions of this Act. The administrator of this Act (local Government authority) may also promulgate regulations that relate to the objectives of this Act. Section 39 makes provision for the appointment of officers to assist in the implementation of the objectives of this Act. These officers may undertake any action to assist them in the achievement of the objectives of this Act. Section 40 provides that any person who breach the provisions of this Act, will be guilty of an offence, and upon conviction be liable to a fine of up to R100 000 or imprisonment of 10 years, or to both such fine and imprisonment. Section 41 makes provision for forfeitures should any person be convicted of an offence under the provisions of this Act. Sections 41A and 47 make provision for the administration of this Act.

8.4 Gauteng (Former Transvaal)

8.4.1 Nature Conservation Ordinance 12 of 1983

Objective

This Act makes provision for measures to ensure the conservation and protection of biodiversity.

Protection of biodiversity

Section 14 makes provision for the declaration of nature reserves to ensure the protection of various forms of biodiversity. Section 15 defines the wild animals under as protected game, specially protected game, ordinary game, and as protected wild animals. Section 16 provides that no person may hunt protected game without permission from the authority and from the landowner. Any person who contravenes a provision of this Section may on conviction be liable to a fine of R2000 or to imprisonment for 2 years. Section 16A prohibits the hunting of specially protected game without authorisation, and ensures that any person who contravenes this provision may on conviction be liable for a fine of R100 000 or to imprisonment for up to 10 years.

Court case:

In *S v Ferreira* 1987 ((1) SA 568 (T)) Sections 16 and 20 of the Nature Conservation Ordinance (12 of 1983) were contravened by the accused. An order was declared to forfeit a vehicle belonging to the daughter of the accused as determined by section 112(1). The court determined that such forfeiture may not be used for the purpose of the offence, and the forfeiture was set aside.

Restricted activities

Section 17 regulates the killing of ordinary game through the use of a permit system and ensures that such hunting may only take place in open seasons. Any person who contravenes this Section may on conviction be liable for a fine of R1000 or to imprisonment for 1 year. Section 18 regulates the hunting of protected wild animals and ensures that such action may only take place on authorisation. Any person who contravenes this section may on conviction be liable for a fine of R2 000 or to imprisonment or 2 years. Section 19 prohibits hunting in game reserves without the necessary authorisation. Contravention of this Section is punishable by a fine of between R2000 and R100 000 or to imprisonment or 2 years to 10 years, or to both such fine and imprisonment.

Section 20 regulates hunting at night, while section 21 regulates various weapons that may be used for the hunting of game. Section 22 mandates that no person may use the following devices for hunting: snare; trap, cage; or a holding

gun. These devices may only be used by the landowner and his/her relatives. Section 23 provides that no person may hunt a protected wild animal in a small enclosed area, or with luring substances. Any person who contravenes a provision of this Act may on conviction be liable for a fine of R2000 or to imprisonment for 2 years, or to both such fine and imprisonment. Section 25 prohibits the catching of game without authorisation. Contravention of this Section is punishable by a fine of R2000 to R100 000 or to imprisonment or 2 to 10 years, or to both such fine and imprisonment. Section 27 provides that the following hunting methods may only be used with the necessary authorisation: snare; trap; cage; dog; bow; and arrow. These provisions do not apply to the landowner, problem animals or to the hunting of birds by dogs. Contravention of the section is punishable by a fine of R1000 to R100 000 or to imprisonment or 1 to 10 years, or to both such fine and imprisonment.

Sections 28 and 29 ensure that hunting of animals not classified as game (including exotic animals) may only take place with the necessary permission from the landowner. Section 30 provides that the relevant authority may mandate the killing of any problem animal at any given time if such killing does not compromise the survival of the species. Section 31 prohibits the poisoning of game, and ensures that any person who contravenes this provision may on conviction be liable for a fine of R1000 to R100 000 or to imprisonment for 1 to 10 years, or to both such fine and imprisonment. Section 32 regulates the sale of game, and provides that such action may only take place on authorisation. Contravention of this section is liable on conviction for a fine of R1000 to R100 000 or to imprisonment for 1 to 10 years, or to both such fine and imprisonment.

Sections 35-39 regulate the donation, removal, handling, transport, and possession of dead game. Section 40 ensures that exotic or wild animals are kept under suitable conditions when such animals have to be kept in captivity. Section 42 regulates the exportation of wild animals from the province. Any person who contravenes a provision of this section will on conviction be liable for a fine of R1000 to R100 000 or to imprisonment for 1-10 years, or to both such fine and imprisonment. Section 43 prohibits the possession, donation or trade of any wild animal (Schedule 5) without a permit. Sections 44 and 45 provide that no person may import, possess or trade in any exotic animal or invertebrate (Schedule 6 and 7) without authorisation.

Section 46 allows the relevant authority to take the necessary steps to ensure the survival of any species of plants and animals when deemed necessary. Sections 56 and 57 make provision for measures to eradicate problem animals via professional hunting associations. Such animals may not be hunted in nature reserves in terms of section 55 of this Act. Section 64 provides that the relevant authority may use dogs to kill problem animals. No person may breed, donate, possess or trade any problem animal unless he/she is authorised to do so. Sections 68 and 69 provide open and closed seasons for the catching of fish, and prohibit the catching of fish during closed season. Sections 71-73 provide

that no person may catch fish by any means other than angling without the necessary authorisation. Any person who contravenes a provision of this section will be guilty of an offence, and may on conviction be liable for a fine of R250 to R750 or to imprisonment for 3 to 9 months, or to both such fine and imprisonment. Sections 77 and 78 provide that no person may place any obstructions in any water resources that may impact negatively on any species of fish. Sections 79 to 81 regulate the releasing, sale and importation of any live fish.

Aquatic biodiversity

The provisions of this Ordinance relating to fishing do not apply to the landowner where such fish species and resources are found in terms of section 67 of this Act. Section 84 provides measures to prevent the pollution of any water resources and ensures that any person in contravention of this Section may be liable for a fine of R2000 or 2 years in prison, or to both such fine and imprisonment. Section 85 ensures that no person introduces any aquatic flora into any water resources, unless authorised to do so by a relevant authority.

Indigenous plants

Section 86 classifies the indigenous plants under Schedule 11 as protected plants and under Schedule 12 as specially protected plants. Section 87 prohibits any person from damaging or destroying or interfering in any manner with any protected plant. Sections 88 and 89 prohibit the damaging or destroying of any indigenous plants in nature reserves and along public roads. Sections 91 to 93 regulate the donation, trade, importation, and exportation of any indigenous plants. Nurseries may be exempt by the relevant authority from the provisions of this ordinance relating to protected flora.

Section 95 provides that no person may unlawfully receive any protected plant. Section 96 provides that no person may trade, donate; possess, damage, destroy, import or export any specially protected plant without authorisation. Section 97 ensures that the rare species of fauna and flora under Appendices 1 and 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973) are recognised as rare species of biodiversity. Section 98 provides that no person may import or export any rare species without the necessary authorisation. Contravention of this Section is punishable by a fine of R2000 or to imprisonment for up to 10 years.

Enforcement

Section 102 provides that the authority may promulgate any regulations to ensure the protection of biodiversity or compliance with the provisions of this Act. Section 106 provides that nature conservation officers may take any action necessary to ensure compliance with the provisions of this ordinance. Section

111 makes provision for general penalties for contravening with the provisions of this Act. Any person in contravention of a provision of this Act for which a fine has not been established, may be liable for a fine of R750 or to imprisonment for 9 months to 10 years.

8.5 KwaZulu-Natal (Former Natal and KwaZulu)

8.5.1 KwaZulu Nature Conservation Act 29 of 1992

Objective

The overarching objective of this Act is to make provision for matters that relate to the conservation of biodiversity in KwaZulu.

(The name KwaZulu, as technically mentioned under this Act applies to the entire province of KwaZulu-Natal)

Biodiversity protection and conservation areas

Section 2 makes provision for the establishment of game reserves and nature reserves by the KwaZulu Department of Nature Conservation. It also provides that strict measures must be implemented to ensure the protection of biodiversity in these designated areas. No person should be allowed to destroy any form of biodiversity or interfere with such species, and conservation areas should ensure the survival and continued integrity of these species. Section 6 mandates the department to take the necessary measures to ensure the survival and safety of biodiversity in designated conservation areas. Section 7 regulations entry into game reserves and nature reserves and ensures that no person resides within such area. It also ensure that visitors to conservation areas do not damage the indigenous biodiversity in these areas.

Section 8 provides conditions under which conservation areas may be entered and relates mainly to recreational and scientific purposes. Section 9 allows the Director to promulgate regulations, after consultation with the Minister, on any measure that may be necessary to protect or manage biodiversity in conservation areas. Section 12 provides that any person who contravenes a provision of this Act will be guilty of an offence. Such person may on conviction be liable for a fine of R1000 to R100 000 or to imprisonment for 6 months to 10 years.

Restricted activities

Section 14 classifies all wild animals as protected game. Sections 15 and 16 provide that no person may hunt, possess, injure or interfere with any protected animal without authorisation from the relevant authority. Section 17 mandates any person who legally keeps any wild animal in captivity to provide such animal with suitable living conditions. Section 18 makes provision for the determination

of open and closed seasons for the hunting of any wild animals. Section 19 regulates various methods that may be used for hunting and killing wild animals.

Section 22 regulates the sale, possession, and transport of any carcasses of wild animals. Section 23 provides authorisation for the killing of any wild animal if such action does not compromise the survival of the species. Section 24 allows the destruction of any problem animals when such action is urgently needed. Section 25 regulates safaris in game reserves and nature reserves and ensures that such actions do not pose any threat to the biodiversity in the area. Section 28 regulates the import and export of any wild animals into KwaZulu. Sections 29 and 30 make provision for the establishment, management and registration of zoos to assist in the *ex situ* conservation of wild animals. Section 31 mandates that any person wanting to establish a zoo must apply for the necessary authorisation to do so. Sections 32 and 33 provide that any police officer or nature conservation officer may mandate any person who keeps wild animals in captivity to provide proof of authorisation to do so. Wild animals may be confiscated if such person fails to provide the required proof of authorisation. Section 35 provides that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R200 to R2000 or to imprisonment for 2 months to 2 years, or to both such fine and imprisonment.

Birds

Section 39 prohibits the killing or capturing of any wild birds without the necessary authorisation from relevant authority. This includes destroying any eggs or such wild birds or the disturbance of any nests. Section 40 prohibits the trade of wild birds or any products thereof without authorisation from the relevant authority. Sections 41 and 42 make provision for conditions under which wild birds may be captured or killed, and ensure that any person wanting to undertake such activity applies for a permit to do so. Before authorisation may be granted the authority must fully determine the reasons why such person needs to capture or kill such wild birds. Sections 43 and 45 determine that wild birds may only be kept in registered aviaries of determined standards and quality. Sections 48 and 49 prohibit the import and release of any foreign birds in KwaZulu without authorisation from the relevant authority. Section 50 prohibits the export of any wild birds from KwaZulu without authorisation. Section 52 regulates the various methods permissible to capture wild birds, and ensures that certain methods may not be used without authorisation from the authority. Section 55 ensures that any person who contravenes a provision of the above sections that relate to wild birds will be guilty of an offence. On conviction such person may be liable for a fine of R250 to R2000, or to imprisonment for 3 months to 3 years. Section 57 provides that the Minister may promulgate any regulations to ensure the protection and survival of any species of wild birds.

Invertebrates

Section 58 allows the Minister the authority to promulgate notices that may apply to any species of indigenous amphibian, invertebrate or reptile in KwaZulu. This may include that certain regulations apply to various species. Section 59 prohibits the capturing or killing of any protected indigenous amphibian, invertebrate or reptile without authorisation. Section 60 mandates authorisation for any person to keep any protected indigenous amphibian, invertebrate or reptile in captivity. Section 62 prohibits the import or export of any indigenous amphibian, invertebrate or reptile into or from KwaZulu. Section 67 provides that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R1000 to R5000 or to imprisonment of 6 months to 2 years. Sections 68 and 69 provide for the cancellation of the permit of any person convicted of an offence under this Act. Any amphibian, invertebrate or reptile may be confiscated by a person authorised to do so. Section 71 allows the Minister to promulgate any regulations necessary to ensure the protection and survival of any indigenous amphibian, invertebrate or reptile, or to ensure compliance with any provisions of this Act.

Indigenous plants

Sections 72 and 73 provide that the Minister may at any time suspend the issue of permits for the gathering of specially protected indigenous plants. The Minister may at any time by notice ensure that any provisions of this Act do not apply to any species of indigenous plants. Section 74 ensures that the provisions of this chapter do not apply to unprotected indigenous plants. Section 75 provides that no person may destroy, remove or interfere in any way with any protected indigenous plant. This also provides that no person may interfere with any indigenous plant within 100 metres of any public road. No person may buy any protected indigenous plant or product thereof from any person not been authorised to sell such items.

Sections 76 and 77 mandate authorisation for the sale of any protected indigenous plant. Section 78 provides that any protected indigenous plants may be freely exchanged or donated provided that all details regarding such donation or exchange are recorded. Section 79 and 80 ensure that any person wanting to import or export any indigenous plant must be authorised to do so. Section 81 provides that any person may gather specially protected plants on authorisation. Such gathering may be for scientific purposes or any other public purpose. Section 82 provides that any person who is in possession of a specially protected plant without the necessary authorisation will be guilty of an offence. Section 83 makes provision for procedures to apply for a licence of permit to undertake certain authorised activities under the provisions of this Act. Section 86 ensures that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R2000 to R10 000 or to imprisonment for 3 to 5 years, or to both such fine and imprisonment.

Section 89 provides that the Minister may promulgate any regulations to ensure the protection of indigenous plants and enforcement of the provisions of this Act.

Aquatic biodiversity

Section 90 provides that the Minister may exclude and species of fish from the provisions of this Act. Section 91 makes provision for the creation of river conservancy districts to ensure the survival of various types of aquatic biodiversity in certain areas. Section 92 provides official recognition of angling clubs or associations to regulate the impact of fishing on aquatic biodiversity. Sections 93 and 94 provide that no person may establish fish hatcheries or introduce any aquatic species of fish into any riparian systems without authorisation from a relevant authority. Section 95 provides that the authority may construct dams or weirs to ensure the preservation and survival of various forms of aquatic biodiversity. Section 98 makes provision for the establishment of open and closed seasons for the harvesting of any aquatic fish species. Section 107 provides that any person who contravenes a provision of this Act will be guilty of an offence. Section 108 regulates the protection of particular species of fish and bait and ensures that such biodiversity may not be utilised without prior authorisation. Section 109 provides measures to prevent any person from taking any action that may pollute any water resources and thereby pose a threat to the survival of aquatic biodiversity. Section 110 ensures that any person who contravenes any provision of this Act may on conviction be liable to a fine of R300 to R10 000 depending on the offence committed. A person may also be liable to imprisonment for 3 months to 3 years, or to both such fine and imprisonment. Section 112 provides that the Minister may promulgate any regulation to ensure the survival of aquatic biodiversity, or to enforce any provision of this Act.

Section 113 provides that the provisions of this Act apply to the coast, estuaries, lagoons or coastal lakes within KwaZulu. The Minister may by notice determine that the provisions of this Act do not apply to certain marine and aquatic species. Section 114 provides for measures to determine open and closed seasons for the harvesting of marine biodiversity in KwaZulu. Closed seasons may be relevant to certain species in various time periods. Section 115 provides that no person may capture or destroy the eggs of any marine mammal, reptile or amphibian. No person may kill any marine species with the use of explosives substances or poison under any circumstances whatsoever in terms of section 116 of this Act. Sections 117, 118, 120 and 121 make provision for the procedure to apply for a licence to conduct fishing activities, and the period of validity thereof. Section 122 ensures that the Minister may when deemed necessary restrict the granting of licenses. Section 129 provides that any person who does not comply with the specifications of a net size as determined by a license will be guilty of an offence. Section 136 provides that any person who contravenes a provision of this Act will be guilty of an offence. Section 137 makes provision for directives to prevent the pollution of marine water by any substances. Section

138 provides that any person convicted of an offence under this Act may on conviction be liable for a fine of R200 to R10 000, or to imprisonment or 3 months to 10 years or to both such fine and imprisonment. Section 141 provides that the Minister may promulgate any regulations to ensure compliance with the provisions of this Act, or to ensure the protection and conservation of marine biodiversity.

Environmental policy

Section 142 makes provision for the establishment of an environmental policy to ensure that the integrity of the environment is sustained. The authority must implement all measures necessary to ensure compliance with the objectives of such policy in terms of Section 143 of this Act. Section 145 makes provision for the establishment of protected areas to ensure the protection of particular forms of biodiversity and ecological processes. Sections 146 and 147 regulate littering and waste management and provide that adequate facilities are available for the effective management and disposal of waste. Section 148 makes provision for the identification of activities that may have a detrimental impact on the environment. These activities may relate to the following:

- land use and transformation;
- water use and disposal;
- resource removal, including natural living resources;
- resource renewal;
- agricultural processes;
- industrial processes;
- transportation;
- energy generation and distribution;
- waste and sewage disposal;
- chemical treatment; and
- recreation.

Section 149 mandates that any person wanting to undertake any of the listed activities in terms of Section 148 may only do so on the authorisation of a relevant authority. The authority may mandate such person to undertake an environmental impact assessment to determine the impact that such activity may have on the environment. Section 150 makes provision for the designation of limited development areas and includes that certain activities may not be undertaken in limited development areas. Any person wanting to conduct a restricted activity in a development area should apply for authorisation from a relevant authority. The authority may request any person to prepare a report to assess the impact of such proposed activity on the environment in the limited development area. Sections 151 and 152 provide that the Minister may promulgate any regulations relevant to effective management waste, noise, vibrations and shock. Section 153 allows the Minister to promulgate any regulations relevant to the nature, scope and contents of environmental impact

reports. Section 154 provides that the Minister may promulgate regulations on any conditions that should be taken into account in limited development areas. Section 156 ensures that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R100 to R10 000 depending on the offence committed. A person may also be liable to imprisonment for 3 months to 2 years. Section 164 authorises any officer or duly authorised person to take any action to enforce the provisions of this Act. Section 168 determines that the Minister may exempt any person from any provisions of this Act.

8.5.2 KwaZulu-Natal Nature Conservation Management Act 9 of 1997

Objective

The objective of this Act is to make provision for the conservation of biodiversity and the management thereof in KwaZulu-Natal.

Biodiversity protection

Section 3 makes provision for the declaration of protected areas to ensure the protection and survival of various forms of biodiversity. Sections 4 and 5 make provision for the establishment of the KwaZulu-Natal Nature Conservation Board to assist in the administration and enforcement of the provisions of this Act. Section 41 allows the Minister to promulgate any regulations to ensure the protection of biodiversity and effective management of protected areas.

8.5.3 KwaZulu-Natal Nature Conservation Management Amendment Act 5 of 1999

Objective

This Act amends the KwaZulu-Natal Nature Conservation Management Act 9 of 1997 on aspects that are inadequate in the protection of biodiversity and the management of conservation areas.

Biodiversity protection

Sections 27, 28 and 29 make provision for the appointment of officers to assist in the enforcement of the provisions of this Act. Such persons may take any action necessary to enforce the objectives of this Act. Section 47 provides that the Minister may designate protected areas or amend the boundaries of such areas. Section 48 makes provision for the declaration of candidate protected areas while the decision to declare these as protected areas is pending. The Board must assess the desirability of declaring such area as a protected area. Section 49 provides measures to regulate various activities in protected areas, or parts of protected areas.

Conservation areas

Section 50 prohibits any person from taking any action in a protected area that may damage the environment or biodiversity in such area. No person may instigate any action that may compromise the survival of any species in such area. Section 51 classifies specially protected animals under Schedule 4, and protected animals under Schedule 5 of this Act. No person may kill or interfere with any specially protected or protected animal under any circumstances without the relevant authorisation in terms of section 52 and 53 of this Act. Section 54 regulates the import, export, transport, and introduction of any protected or specially protected species. Section 55 determines that the Minister may implement any additional measures or policies to ensure the survival of any specially protected or protected indigenous animal. Section 56 provides that any animal not under control of its owner that attacks or poses a threat to any indigenous animal, may be destroyed. Section 57 provides that any person who contravenes any provision of the above sections concerning specially protected animals or protected animals will be guilty of an offence. On prosecution such person may be liable for a fine or to imprisonment of 10 to 15 years.

Indigenous plants

Section 58 classifies the conservation status of indigenous plants under Schedule 6, which includes specially protected plants, and Schedule 7, which includes protected plants. Sections 58, 59, 60 and 61 provide that no person may gather, export, import, introduce, purchase, sell, relocate or translocate a specially protected indigenous plant without the relevant authorisation. Section 62 provides that any person wanting to gather or transport an indigenous plant growing in the wild must be authorised to do so by the owner of land on which such plant is growing. Section 63 provides for the formulation of special measures to ensure the survival of certain species in urgent need of additional conservation measures. Section 64 allows traditional healers to collect any plant or animal after such healer has been authorised to do so. Section 65 provides that any person who contravenes a provision of this Act has committed an offence. On conviction such person may be liable for a fine or to imprisonment for up to 15 years.

Hunting

Sections 66, 67 and 68 make provision for the regulation of hunting of specially protected or protected indigenous animals without the relevant authorisation. Section 72 makes provision for the regulation and undertaking of traditional hunting, and provides that a traditional hunting permit must be granted before such hunting may be undertaken. Section 73 provides that any person who contravenes a provision of the above sections will be guilty of an offence, and on conviction be liable for a fine or to imprisonment of up to 10 years. Sections 74 and 75 make provision for measures to regulate the import, export, release or

introduction of any exotic species of plants or animals. It ensures that any person wanting to undertake such action must be authorised to do so by the relevant authority.

Section 76 provides that any person who contravenes any of the above sections relating to exotic plants will be guilty of an offence. On conviction such person may be liable for a fine or to imprisonment or up to 10 years, or to both such fine and imprisonment. Sections 77-81 regulate the issue of permits and conditions that apply to the granting of any rights to undertake any restricted activities in terms of this Act. Section 85 provides that any person who contravenes a provision or regulation of this Act for which a penalty has not been determined, may on conviction be liable for a fine or to imprisonment of 5 years or to both such fine and imprisonment.

8.5.4 Nature Conservation Ordinance 15 of 1974

Objective

This ordinance makes provision for the protection of biodiversity through various legislative measures.

Biodiversity protection

Section 2 makes provision for the establishment of nature reserves, national parks, game reserves and wilderness areas. Section 11A provides that buildings may be constructed in conservation areas, and rented out to certain institutions. Section 15 regulates access to conservation areas and prohibits the following: habitation inside the park or reserve without permission; import of weapons into a park; disturbance of any biodiversity; and destruction of any biodiversity. Section 16 ensures that conservation areas may only be used for recreation and study. Section 17 provides that the Minister may promulgate any regulations to ensure the protection of biodiversity or compliance with the principles of this Act. Section 19 allows the relevant authority to take any measures to ensure the eradication of animal diseases when deemed necessary. Any dog found inside a conservation area may be destroyed at the discretion of the relevant authority.

Any person who contravenes the objectives of Section 15 of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R10 000 to R100 000 or to imprisonment for 2 to 10 years. Section 27 provides that the relevant authority may appoint any nature conservation officers to assist in enforcement of the objectives of this Ordinance outside conservation areas. Section 31 provides open and closed seasons for the hunting and killing of certain game. Sections 33-36 ensure that no person may hunt protected and ordinary game without the necessary authorisation.

Sections 37 and 38 ensure that the hunting, capturing, and captivity of wild specially protected game, protected game and ordinary game may only be done on authorisation. Section 40 provides measures for the management of specially protected game that inflict damage to crops. The relevant authority must investigate such incidences and provide practical solutions to resolve the problem. Section 41 ensures that various species of game may be destroyed for disease prevention and scientific research. Section 43 allows the landowner to destroy any dogs found on his land that inflicts damage on any species of game.

Section 46 prohibits unauthorised carrying of weapons on land where game are likely to be found. Section 47 prohibits snares and provides that such devices may only be used with the necessary authorisation. Section 48 provides that no person may use the following methods to hunt game: traps; snares; artificial lights; vehicles; a bow; and at night. Such methods may only be undertaken on authorisation. Such methods may only be used to ensure the protection of livestock by the landowner. Section 49 regulates the sale and purchase of game. Section 51 regulates the export of game out of the province. Section 55 provides that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R2000 to R100 000 or to imprisonment of 2 to 10 years, or to both such fine and imprisonment.

Section 58 provides that the Minister may promulgate any regulations to ensure compliance with the provisions of this Act or to protect biodiversity. Sections 59 and 60 make provision for the establishment of private nature reserves and regulate the utilisation of biodiversity in such reserves. The hunting and killing of protected, specially protected and ordinary game inside such private areas without a permit is prohibited in terms of section 61 and 62 of this Act. Sections 63 and 64 provide that no area may be demarcated as a private nature reserve if such area is not properly enclosed. Section 75 allows any nature conservation officers to enter into private nature reserves at any time to ensure that the fences are in good condition, and that the wild animals are enclosed under suitable living conditions. Section 76 provides that any person who contravenes a provision relating to private nature reserves will be guilty of an offence. On conviction such person will be liable for a fine of R5 000 or to imprisonment for 1 year, or to both such fine and imprisonment.

Section 79 provides that no person may sell, dispose or keep any endangered animal in captivity. Section 80 provides that indigenous and exotic animals may only be kept in captivity with the relevant authorisation to do so. Section 81 regulates the trade of exotic animals and ensures that such action only takes place with the necessary authorisation. Sections 82-86 make provision for the establishment of zoos, and ensure that such areas comply with the required conditions to ensure the adequate survival of species in such artificial environment. Sections 87-88 provide that any animals may be seized if kept under conditions that are not conducive to their survival. Section 90 provides that any person who contravenes a provision relating to animals in captivity will

be guilty of an offence. On conviction such person may be liable for a fine of up to R500 or to imprisonment for 6 months, or to both such fine and imprisonment. Sections 101 and 102 provide that no person may capture, hold in captivity or kill any protected indigenous amphibian, invertebrate or reptile without authorisation.

Section 104 regulates the import and export of any such indigenous species, and ensures that this may only take place on authorisation. Section 109 provides that any person who contravenes any provision of this ordinance will be guilty of an offence. On conviction such person will be liable for a fine of R500 or to 6 months imprisonment, or to both such fine and imprisonment. Section 114 prohibits the killing of wild birds without the necessary authorisation. This also prohibits damage to any eggs and nest of such wild birds. Section 115 regulates the sale and purchase of wild birds through a permit system. Section 118 makes provision of the establishment and registration of aviaries. Section 123 regulates the importation of foreign birds and provides that such importation may only take place after consultation with the Division of Veterinary Services. Section 127 provides that wild birds may not be killed by artificial luring agents or during the night.

Section 129 provides that wild birds may not be killed on public roads. Contravention of these sections relating to wild birds is punishable by a fine of R1000 or to imprisonment for 1 year, or to both such fine and imprisonment. Section 136 makes provision for the establishment of water conservatory areas to ensure the protection of various species of fish. Sections 138-140 allow the relevant authority to establish fish hatcheries to aid in the conservation and propagation of various species of fish. This includes the construction of dams and the release of any species of fish in water resources. Section 143 makes provision for the establishment of open and closed seasons for the harvesting of various fish species. Section 145 ensures that fishing may only take place on authorisation from the relevant authority. The provisions regarding to the utilisation of fish do not apply to the owner of any such land containing such species. Section 152 prohibits any person from polluting any water resources by any means that may have a negative impact on any species of fish.

Section 154 provides that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R1000 or to imprisonment or 1 year or to both such fine and imprisonment. Section 159 provides open and closed seasons for coastal fishing, and ensures that species as determined only be caught in open season. This includes methods allowed to catch any such species. Section 160 and 161 prohibits the catching of turtle and the use of poisons and explosives to catch any fish. Section 165 provides that no person may use a spear gun to catch any species in areas where such actions are prohibited. Section 175 provides that no person may alter any fishing gear or methods to catch fish, when not officially authorised to do so. Section 185 provides that any person who contravenes a provision relating to coastal fishing will be guilty of an offence. On conviction such person will be

liable for a fine of R500 to R1000 or to imprisonment of 6 months to 1 year, or to both such fine and imprisonment.

Section 191 allows the relevant authority to suspend any permits for the gathering of specially protected indigenous plants at any time. Section 194 provides that specially protected indigenous plants may only be purchased from a person lawfully permitted to sell such plants. Such species may only be sold on authorisation of a relevant authority in terms of section 195 of this Ordinance. Section 197 mandates any person wanting to donate or exchange any indigenous plant to record all details of such action. Section 198 regulates the exportation of indigenous plants, and in the case of cycads no plants with a diameter larger than 15 centimetres may be exported unless such specimen has been fitted with a microchip transponder. Section 199 regulates the importation of specially protected plants into the province. Section 200 provides that the gathering of indigenous plants may only take place on authorisation by the relevant authority. A special permit is required to gather specially protected indigenous plants in terms of Section 201 of this Ordinance.

Section 201A requires a permit for the relocation of specially protected plants. Section 202 prohibits the gathering of indigenous plants along public roads by any person not authorised to do so. Section 203 requires a special permit for the possession of a specially protected plant. Section 208 provides that any person who contravenes a provision relating to indigenous plants or specially protected indigenous plants will be guilty of an offence. On conviction such person will be liable for a fine or to imprisonment for up to 10 years.

8.6 Limpopo (Former Transvaal, Gazankulu, Bophuthatswana, Venda and Lebowa)

8.6.1 Gazankulu Nature Conservation Act 5 of 1975

Objective

The objective of this Act is to make provision for the conservation of game, fish, fauna and flora in Gazankulu.

Biodiversity protection

Section 2 makes provision for the classification of game that includes protected game and ordinary game. Section 3 prohibits the killing or utilisation of any part of a wild animal without the necessary authorisation from a relevant authority. Section 4 regulates the various types of hunting methods and ensures that any person undertaking such action has the necessary authorisation. Section 6 regulates the sale, donation, or possession of game or any carcass and ensures that such action is legally authorised. Section 7 provides that the Minister has the authority to hunt and kill any wild animals when deemed necessary at any time. Section 8 classifies the wild animals under Schedule 5 of this Act as vermin.

Section 9 mandates that no person may keep or release vermin into Gazankulu without the required authorisation.

The Minister may further grant any person the authorisation to hunt any protected game, when such action will not compromise the integrity of the species, and is for education or scientific purposes. Section 11 prohibits the killing of any aquatic fauna without the necessary authorisation. Section 12 regulates the release of any aquatic fauna or plants into any water resources in Gazankulu. Section 14 classifies indigenous plants as protected plants, and as specially protected plants. No person may trade, donate, damage or destroy any protected plant without the necessary authorisation.

Section 18 makes provision for the establishment of game reserves and nature reserves to protect various types of biodiversity. Such areas should be managed in such a manner as to ensure the continued existence of the biodiversity it protects in terms of Section 19 of this Act.

Enforcement

Sections 24 and 25 provide for the appointment of nature conservation officers and field rangers to assist in the enforcement of the directives in the provisions of this Act. Sections 27 and 28 provide that any person who contravenes a provision of this Act has committed an offence. On conviction such person may be liable for a fine of R600 to R100 000 or to imprisonment for 6 months to 10 years. Section 29 provides that the Minister may promulgate any regulations to ensure the protection of biodiversity or any other matter relating to the objectives of this Act.

8.6.2 Weeds Act (Venda) 12 of 1983

Objective

This Act makes provision for the implementation of directives to ensure the eradication of weeds in Venda.

Regulation of weeds

Sections 2 and 3 make provision for the declaration of weeds, and provide that the owner of any land on which such weeds are found may be mandated to eradicate these weeds. Any person who fails to comply with such directive will be guilty of an offence. The relevant authority may implement the eradication of weeds by officers at the expense of the owner of such land or at the expense of the public in terms of section 5 and 6 of this Act. Section 4 allows the Minister to take any steps to gather information on any weeds, and use such information to assist in the eradication of weeds. Section 7 provides that the Minister may issue any landowner to ensure that such land is kept free from any weeds in

compliance with sections 5 and 6 of this Act. Section 9 provides that insects may be used to combat certain declared weeds on land. The use of such insects must only take place with the necessary consultation and instructions from the authority. Section 12 allows the Minister to promulgate any regulations to eradicate weeds on land or to ensure compliance with any provision of this Act.

Enforcement

Any person who contravenes a provision of this Act will be guilty of an offence and will on conviction be liable for a fine of R100 to R500 in terms of section 13 of this Act.

8.6.3 Nature Conservation and National Parks Act (Venda) 20 of 1986

Objective

This Act provides directives to ensure the protection of biodiversity and the establishment of National Parks in Venda.

Biodiversity protection

Section 2 classifies game under Schedule 1 as endangered game (specially protected game) and as protected game. Section 3 prohibits the hunting, killing or disturbing of any endangered game without authorisation. It also ensures that no person removes any carcass of any protected game from Venda. Section 4 provides that no person may hunt, kill, disturb, export or collect any part of protected game without the necessary authorisation from the relevant authority. Section 5 prohibits the following hunting methods: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever. Section 6 prohibits the possession of certain firearms on public roads.

Section 7 regulates the buying, selling, donating and possession of game by means of a permit granted by the relevant authority. This includes the trade of products of game such as biltong and sausage in terms of section 8 of this Act. Section 8 authorises the killing of any animal by the relevant department if such action is deemed necessary to eliminate a problem animal or in the interest of nature conservation. Section 10 provides that permits may be granted to any person to kill game under this Act. An application for such permit must ensure that such action will not compromise the future survival of the species to be killed. Section 11 regulates the catch of freshwater fish, and also ensures that such action may only be undertaken with the relevant authorisation. It also provides that no person may catch any fish by any means other than angling.

Section 12 prohibits the release of any aquatic fauna and flora in any water resources in Venda without authorisation. Section 14 regulates the trading of

freshwater fish and ensures that any person undertaking such action has obtained the relevant authorisation. Section 13 prohibits the pollution of any water resources by any means under any circumstances. Section 16 classifies indigenous plants under Schedule 3 as protected plants and under Schedule 4 as specially protected plants. Section 17 provides that no person may damage, destroy, import, export, sell, donate or interfere in any manner with any indigenous plant in Venda without authorisation. These provisions also apply to trees and indigenous wood. It therefore ensures that these resources are not utilised without the necessary authorisation. Section 18 makes provision for the administration of permits under this Act and ensures that no permit is granted for a modjadji cycad *Encephalartos transvenosus* or a tree fern *Alsophila dregei* with a stem diameter larger than 10 centimetres.

Sections 28 and 29 make provision for the establishment of nature conservation areas. The management authority over such conservation areas should ensure that the necessary measures are implemented to for the protection and conservation of the specific biodiversity in such area. Section 31 provides that the Minister may determine any additional conditions to the issue of permits when deemed necessary.

Enforcement

Sections 32 and 33 make provision for the appointment of nature conservation officers to assist in the enforcement of the provisions of this Act. Section 36 ensures that any person who contravenes a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine of R2000 to R100 000 or to imprisonment for 18 months to 10 years, or to both such fine and imprisonment. Section 40 provides that the Minister may promulgate any regulation to ensure the protection of biodiversity or compliance with the provisions of this Act.

8.6.4 Northern Province Tourism and Parks Board Act 8 of 2001

Objective

This Act makes provision for the establishment of the Northern Province Tourism and Parks Board to administrate various issues relating to tourism and conservation. The objectives of the Board in terms of Sections 3 and 4 of this Act are:

- Establishment of network of provincial reserves;
- Sustainable development within the framework of nature's conservation;
- Provide strategic support on issues pertaining to conservation;
- Determine guidelines for the protection of biodiversity in provincial nature reserves;

- Determine general conditions, provisions and guidelines that may affect provincial nature reserves; and
- Acquire land for the establishment of provincial nature reserves.

8.6.5 Nature Conservation Ordinance 12 of 1983

(Previously discussed under chapter 8, see 8.4.1)

8.7 Mpumalanga (Former Transvaal, KaNgwane and KwaNdebele)

8.7.1 Mpumalanga Nature Conservation Act 10 of 1998

Objective

This Act makes provision for the protection of biodiversity within the province of Mpumalanga.

Biodiversity Protection

Section 3 makes provision for the appointment of nature conservation officers to assist in enforcing the provisions of this Act. Section 4 provides directives to ensure the protection of various wild animals that include specially protected game, protected game, ordinary game, and protected wild animals. Section 5 regulates the hunting and killing of specially protected game through the use of a permit system. It provides that no person may interfere with any specially protected game without authorisation to do so. Section 6 regulates the hunting and killing of all protected game, and ensures that the authority grants a permit to any person wanting to undertake same. Section 7 provides directives for the hunting and killing of ordinary game. Section 8 regulates the hunting and killing of protected wild animals on a permit system. Section 9 prohibits the hunting of any game in any nature reserves without authorisation. Section 10 provides that no person may hunt during the night without authorisation. Section 12 regulates the various devices that may be used during hunting, but provides that certain other devices may be used by landowners. Section 13 prohibits the hunting of protected wild animals through the use of immobilising agents, bait, sounds or any other luring substances.

Sections 14 and 15 regulate hunting on public roads, and the entering onto land with any weapons where such land harbours game. Section 16 ensures that no person may capture any game without being authorised to do so by the relevant authority. Section 18 provides that any person may use the following devices to hunt animals when authorised to do so: snare; trap, dog, cage, aircraft or any similar device. Section 19 regulates the killing of any exotic animal or any animal not classified as game under the provisions of this Act. Prior permission must be obtained from the landowner before this may be undertaken. Section 20 ensures

that any animal causing damage to any cultivated crops may be killed on consultation with the relevant authority. Section 21 prohibits the killing of game through the use of any poison or device that shoots poison without authorisation. Sections 22, 23 and 24 prohibit any person from possessing any elephant tusks and rhinoceros horns without due authorisation, and also regulate the purchase and sale of game. Sections 25, 26, 27 and 28 provide directives to regulate the donation, picking up, transport, and handling of dead game. Sections 29 and 30 provide that any person wanting to keep game, wild animals or any other animal in captivity must have the necessary authorisation to do so. This also includes that such person must provide suitable living conditions to sustain such animals in a healthy state. No person may import or export any live animal into/from Mpumalanga without authorisation in terms of Section 31 and 32 of this Act. Sections 33 and 34 provide that no person may possess, sell, donate or receive as a donation or convey any live wild or exotic animal without authorisation. Section 35 provides that no person may collect, catch, kill, keep, purchase, sell, donate, convey, or import an invertebrate into the Mpumalanga.

Section 37 provides any land that is fenced off by any means which isolates the land and prevents game from moving into or out of such area will be managed differently. According to this Section the owner of such land may be exempt from the provisions of this Act that relate to hunting. Section 39 provides that any person who contravenes a provision under this Act will be guilty of an offence and on conviction such person may be liable for a fine or to imprisonment for up to 3 years, or to both such fine and imprisonment. Section 40 provides that any person wanting to establish a game park or a zoological institution must obtain authorisation from the relevant authority. Sections 44, 45, 46 and 47 of this Act relate to the management of problem animals. They provide that the animals listed under this Act may be killed when deemed necessary. Research should also be undertaken on these animals to assist in the scientific management thereof.

Sections 49 and 50 provide that problem animals may be killed by the use of poison, provided that such poison is applied in the manner specified in this Act. No person may under any circumstances possess any problem animal, or undertake any control action with such animal except as specified in this Act. Section 51 mandates that the provisions of this Act relative to fishing will not apply to the landowner, co-owner, or employees of such owner. Section 52 ensures the designation of open and closed seasons for the harvesting of aquatic fauna. No person may catch any fish or interfere with any fish during closed season. The catching of fish by any method other than angling is regulated by sections 53, 54, 55, 58 and 59 of this Act. Section 56 mandates that any person wanting to conduct any angling must be in possession of a relevant permit of authorisation. Section 57 regulates the catching and selling of fish when it is deemed necessary to protect the integrity of fishing resources.

Section 60 prohibits any person from obstructing the flow of any water resource thereby causing a negative impact on the integrity of fishing resources. Sections 62, 63 and 64 regulate the release of any fish into any water resources, the sale of live fish and the import of any live fish. Any person wanting to undertake such action must obtain prior authorisation from a relevant authority. No person may pollute any water resources in terms of Sections 67 and 68 of this Act. It also prohibits the introduction of any aquatic plants (Schedule 10) and cultivation thereof. Such action may only be undertaken on authorisation from the relevant authority.

Section 69 ensures the protection of indigenous plants as protected plants and specially protected plants. Section 70 provides that no person may damage or destroy any protected plant unless he/she is authorised to do so by the relevant authority. This includes that no person may gather or destroy any indigenous plants in any nature reserves without authorisation. Section 72 prohibits gathering or destroying any indigenous plants within 100 metres of a public road without the necessary authorisation. Section 73 provides that the owner of any land may gather or destroy any indigenous plant on his land without authorisation.

Sections 74, 75 and 76 regulate the sale, export, import or removal of protected plants from Mpumalanga. They also provide that protected plants may only be sold by authorised persons. The provisions of this Act regarding protected plants do not apply to nurseries that commercially cultivate such protected plants in terms of section 77 of this Act. Section 78 provides that no person may possess any protected plant without due authorisation. Section 79 provides that no person may gather, possess or destroy any specially protected plant when such person is not authorised to do so. Any specially protected plant received as a donation must be accompanied by a letter containing the relevant details of such donation. Section 80 provides that the plants under Schedule 13 are listed as invader plants and weeds. No person may cultivate such plants unless he/she has been authorised to do so. The owner of a piece of land harbouring invader plants must take the necessary action to eradicate such invader plants and weeds.

Section 81 ensures the protection of rare and endangered species of fauna and flora. For the purpose of this Act the species listed under Appendices 1, 2 and 3 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora are regarded as rare and endangered species. Section 82 prohibits the import, export or removal of any endangered or rare species from Mpumalanga without authorisation. Section 84 provides that the communities under Schedule 14 will be classified as unique communities. No person may in any way interfere with or damage any unique communities without a permit from a relevant authority. Section 86 allows the Minister to promulgate any regulations necessary to enforce the objectives of this Act, or any other necessary objectives to ensure the survival of biodiversity. Section 88 administers the issue of permits, licenses or any other type of authorisation required to undertake any restricted

activity under this Act. The relevant authority may determine any special conditions regarding authorisations and may exempt any person from any provision of this Act. Sections 90, 92, 93, and 94 provide that any nature conservation officers and honorary officers may instigate any action necessary to enforce the provisions of this Act.

Enforcement

All the sections in this Act make provision for the determination of offences and penalties under each section. It ensures that any person in contravention of a provision of this Act will be guilty of an offence. On conviction such person may be liable for a fine or to imprisonment for 2 to 10 years depending on the offence committed.

8.7.2 Mpumalanga Parks Board Act 6 of 1995

Objective

This Act makes provision for the establishment of the Mpumalanga Parks Board to assist in the administration and enforcement this Act, and any other Act relating to the environment.

Biodiversity protection

Section 15 identifies and describes the functions of the Mpumalanga Parks Board, these being:

- Monitoring of natural resources and biodiversity;
- Administration of legislation pertaining to the environment;
- Promote sustainable development within the framework of nature conservation;
- Ensure the protection of rare and endangered species;
- Control alien and invasive species;
- Establish nature conservation areas;
- Develop and implement policies pertaining to conservation of biodiversity;
- Promote public awareness and education on issues that relate to the environment;
- Promote scientific research;
- Advise provincial Government on issues relative to the provisions of this Act; and
- Promote international cooperation and commitments.

8.8 Northern Cape (Former Bophuthatswana and Cape Province)

8.8.1 Nature and Environmental Conservation Ordinance 19 of 1974

(Previously discussed under chapter 8, see 8.2.2)

8.9 North West (Former Transvaal, Bophuthatswana and Cape Province)

8.9.1 Nature and Environmental Conservation Ordinance 19 of 1974

(Previously discussed under chapter 8, see 8.2.2)

8.9.2 Nature Conservation Ordinance 12 of 1983

(Previously discussed under chapter 8, see 8.4.1)

8.10 Western Cape

8.10.1 Nature and Environmental Conservation Ordinance 19 of 1974

(Previously discussed under chapter 8, see 8.2.2)

8.11 Conclusion

Provincial legislation governs various aspects on provincial level that need additional attention. These acts and ordinances must comply with the objectives of national frameworks and sectoral legislation. Each of the nine provinces has various individual acts and ordinances to govern aspects relevant to that particular province. Homeland legislation previously only applicable to homeland areas has been integrated under various provinces since 1986. This legislation generally makes provision for: the conservation, management and protection of fauna, flora and fish and their associated habitats.

The following aspects were adequately considered in all nine provinces by the all of their provincial legislation. These include:

- Provision for conservation areas (provincial);
- Establishment of authorities to administrate provincial legislation;
- Promulgation of bylaws for extra biodiversity protection;
- Provision for private nature reserves;
- Prohibition to kill indigenous animals;
- Prohibition to destruct indigenous plants;
- Regulation of anthropocentric activities in provincial areas;
- Undertaking of research aimed to protected biodiversity;
- Special conservation measures for rare species;

- Regulation of problem animals;
- Appointment of competent nature conservation officers;
- Harvesting limits;
- Pollution prevention measures; and
- Hunting of protected species.

Many of the aspects were not considered by all of the provincial ordinances for the various provinces, but only by some ordinances. One should therefore expect that if one ordinance makes provision for a specific legislative aspect, other ordinances should also contain such provisions. The following aspects were inconsistently covered by various provincial ordinances:

- Regulation of alien species;
- Establishment and application of hunting seasons;
- *In situ* restocking programmes for threatened species;
- Regulation on captivity of wild animals; and
- Harvesting of biodiversity.

In general, provincial legislation does not make provision for the protection of species that are not geographically bound to political borders. Biodiversity is not subject to provincial borders. This creates a problem, since these acts regulate various conservation aspects on a provincial basis. Certain species may therefore receive adequate protection in a specific province, but may not be protected at all across the border. These species also occur across the borders of such provinces. Illegal poaching may therefore take place in a certain province and such specimens only need to be transported across the border. Criminals involved in poaching may therefore not be liable for conviction.

CHAPTER 9

CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

Environmental legislation has grown tremendously in the past few years, and the promulgation of new acts and regulations will help to combat environmental problems. Environmental legislation in South Africa provides for measures to ensure management of most strategic issues under various sectoral acts. Unfortunately these acts do not address all the strategic and detailed issues necessary to ensure the conservation and sustainable utilization of biodiversity. The following areas should receive attention:

Increased population growth that is ultimately the indirect cause of uncontrolled development poses a threat to natural resources and ultimately to biodiversity and incentives to regulate this may prove beneficial (also see 3.4.2.1 and Table 7). Measures are also needed to regulate the disposal of corpses in the face of the high HIV/AIDS mortality rate. Informal and formal graveyards cover large areas of land, and compromise soil structures, destroying the pristine character of the area. Alternative burial options may decrease the pressure on the environment (also see 3.4.2.2 and Table 7).

Domestic communal land communities and farms need to be inspected to ensure unsound environmental impacts are monitored and managed. There is also a need for the improved use of environmentally degradable products, packaging materials or any other object. The general use and recycling of these materials is currently encouraged but not mandated by legislation. There should be improved regulation on the excessive use of unnecessary plastic or paper packaging materials (excluding regulatory bag regulations). All products should be assessed to determine whether the producer does not manufacture unnecessary packaging material that may have a negative impact on the environment. Improved regulation of littering in private areas is not presently mandated and this aspect needs to be managed and monitored (also see 3.4.4 and Table 7).

There is a need to mention the establishment of zoos and the management thereof on State land. Legislation only provides for the establishment of botanical gardens and not zoos. The use of certain indigenous wood is not regulated and the trade and use of certain indigenous wood should be encouraged to ensure the protection and conservation of forests. There is currently no effective regulation of *muthi* markets and this has a negative impact on biodiversity. Government should provide incentives such as a permit system, limited markets and/or limited to certain areas and/or species to regulate this problem. Involving poor local communities in this aspect may prove beneficial. Bioprospecting activities should preferably not harvest commercially from the habitat and *ex situ*

cultivation techniques should be used for the propagation of commercially important species. Bioprospecting should preferably be subject to environmental impact assessment if such activities cannot be prevented (also see 3.5.1.4 and Table 8).

There is currently no system for the determination of the minimum size, number of nature reserves and their interconnection to adequately sustain biodiversity. A minimum size of a protected area is necessary to ensure the adequate survival of various types of biodiversity. Habitat fragmentation by non-lethal electrical fencing may result in the death of some animals such as hedgehogs and measures are needed to regulate this problem (also see 3.5.1.5 and Table 8).

There is a need for improved regulation of boats and other anthropogenic activities in estuaries, lagoons, and sea lakes. These areas provide protection and nurseries for various species that are harvested along the coast. Such areas should not be disturbed by any anthropogenic activities (also see 3.3.1 and Table 6). There should be increased regulation and preferable prohibition to alter the mouth of a river, lagoon or similar natural system. Such action should not be allowed, since it may compromise the natural character of the ecosystem and hence impact negatively on any endemic species occurring in the system. Lagoons and river mouths are very sensitive marine areas that sustain unique biodiversity (also see 3.4.5 and Table 7).

Marine biodiversity should be equally harvested, which means that subsistence harvesting and recreational harvesting should be equally managed. Both activities are environmentally equally detrimental to marine resources. There is a need for the release of living confiscated marine biodiversity back into the environment. There is currently no determination of minimum size and number of marine protected areas to sustain biodiversity. A certain sized area is needed to ensure the protection of marine biodiversity and associated systems. Legislation should determine the size of such areas in various types of marine systems, and implement measures to achieve such objectives. Stricter measures for trawling need to be implemented. Trawling is extremely detrimental to all marine taxa and is responsible for the killing of numerous untargeted species. It is in the interest of marine biodiversity to preferably totally ban all trawling activities, as seen in some international coastal areas (also see 3.3.1 and Table 6).

Warships and tankers used by the State should not be exempt from the provisions of legislation. Any ship or vessel should be managed in such a manner as to prevent pollution to the marine environment. Any responsible ship or vessel polluting the marine environment should be responsible for rehabilitation and mitigation measures. Provision should be made for measures to regulate thermal marine pollution (also see 3.3.2 and Table 6).

There is not adequate regulation of air polluting vehicles in all areas, but especially densely populated areas. Legislation should make provision for measures to reduce vehicle air pollution such as those promulgated in Los Angeles. Fire in urban areas creates large amounts of smoke that over time may increase carbon dioxide concentrations. Such higher levels are responsible for the increased occurrence of acid rain that is damaging to any biodiversity in urban areas. There should be increased regulation of using wood or coal in urban areas (also see 3.4.1 and Table 7).

Increased regulation and preferable prohibition on development in or draining of a wetland. Due to their scarcity in South Africa, wetlands should not be drained under any circumstances. These areas should be protected by legislation on national and provincial level. There should be prohibition on the recharge of an aquifer with polluted water as allowed for in legislation. Any polluted water may emerge as a spring or river in another area, and may result in diminished aquatic biodiversity in such area (also see 3.4.4 and Table 7).

The percentage of mountain catchment area that may be planted with trees should be regulated. These areas usually contain great biodiversity that is unique and sensitive to any changes. Commercial forestry creates "green deserts" that completely destroys the natural biodiversity in the area. It may also fragment large pieces of the habitat. This may lead to genetic isolation of species. The percentage of area planted with such alien trees should be determined, and legislation should enforce such objectives. Natural corridors should be created to prevent habitat and genetic isolation. All development activities should be minimised in these areas (also see 3.4.5 and Table 7).

There is a need for improved regulation of marginal mines to complete the rehabilitation process. These marginal mines may pose a significant threat to the environment and biodiversity when rehabilitation is not completed (also see 3.4.3 and Table 7).

There should be improved regulation of nuclear activities in biodiversity hotspots. Biodiversity hotspots are unique and are of international importance. Any nuclear accident in a biodiversity hotspot could be responsible for a major evolutionary crisis in terms of its genetic resources. Legislation should preferably prohibit all nuclear activities in biodiversity hotspots. The comprehensiveness of substances to be included as hazardous nuclear material should also be regulated, and wastes emitting radioactivity below a certain threshold should not be excluded from certain regulatory provisions (also see 3.4.4.6 and Table 7).

There is a need for the regulation of domestic disposal of hazardous substances. Various substances such as batteries that contain heavy metals are still disposed of in domestic municipal wastes. These substances may bio-accumulate in the environment and have a negative impact on biodiversity. Regulation of acquisition of domestic or commercial herbicides/pesticides should receive more

attention. The acquisition of any hazardous substances such as herbicides, pesticides, or any other similar substance should only be provided after adequate motivation for its use has been established. This type of regulation should be similar to a prescription for the acquisition of certain scheduled medicine. There is a need for the prohibition to store excess herbicides/pesticides. All excess herbicides, pesticides or similar substances should be returned to the provider of such substances. No person should be allowed to store these substances under any circumstances. The use of recalcitrant pesticides/herbicides needs more attention. (Certain hazardous pesticides/herbicides may still be used on exemption under the Stockholm Convention on Persistent Organic Pollutants). Legislation should mandate the use of biodegradable pesticides and herbicides. Recalcitrant hazardous substances (those that usually have an aromatic character) may have a hormonal and/or mutagenic effect on various types of biodiversity. Other substances interfere with reproductive cycles of many plants and animals and may eventually have a negative impact on biodiversity (also see 3.4.4 and Table 7).

There is also a need to regulate the collection/reuse of empty herbicide containers. All containers should be returned to the manufacturer or hazardous waste disposal facility. Legislation provides that empty containers of group 1 substances must be perforated and buried in the ground after use. This should not be allowed since such decaying containers may eventually pollute the natural environment over time (also see 3.5.2.7 and Table 8).

There is a need for the improved regulation of manufacture and use of environmentally detrimental explosives. These include explosives containing heavy metals/recalcitrant organic compounds. The use of lead bullets for any type of gun/firearm is currently not prohibited and in some areas lead may bio-accumulate in the environment. Such accumulation may have a negative impact on the integrity and reproduction cycles of various types of biodiversity (also see 3.4.4.7 and Table 7).

Legislation does not make provision for the regulation of the size of a firebreak. In some areas large parts are burnt annually and this continuous burning may have a detrimental impact on the ecology of the area. There should also be regulation of consecutive burning of the same area. Legislation should provide measures to ensure that a piece of land is not burnt repeatedly. Repeated burning may completely change biodiversity composition and integrity in these areas (also see 3.4.6 and Table 7).

There is a need for the categorization of alien faunal species in classes relevant to the inherent threat it poses. South African legislation fails to classify and regulate invasive faunal species according to the directives that pertain to exotic plants. There should also be improved regulation of domestic animals that have a detrimental impact on the environment such as cats, goats, and hunting dogs

(even if only in certain areas). Various categories of alien plants are regulated, but legislation should ensure that no alien vegetation poses a threat to indigenous biodiversity. No alien species should be allowed under any circumstances in the Republic's already threatened riparian systems (also see 3.5.1.7 and Table 8).

There is no time limit to ensure compliance with rehabilitation procedures. When a problem such as erosion or alien encroachment has been identified, the owner of such land must within a specified time limit comply with the measures determined by the authority to remedy or eradicate such problem (also see 3.5.2 and Table 8).

Provincial legislation governs numerous detailed aspects that relates to the integrity of biodiversity on provincial level. Provincial legislation (as summarised in Table 10) adequately considered various aspects such as: provision for conservation areas (provincial); establishment of authorities to administrate provincial legislation; promulgation of bylaws for extra biodiversity protection; provision for private nature reserves; prohibition to kill indigenous animals; prohibition to destruct indigenous plants; regulation of anthropocentric activities in provincial areas; undertaking of research aimed to protected biodiversity; special conservation measures for rare species; regulation of problem animals; appointment of competent nature conservation officers; harvesting limits; pollution prevention measures; and hunting of protected species.

Many of the aspects were not considered by all of the provincial ordinances for the various provinces, but only by some ordinances. The following aspects were inconsistently covered and should receive attention: regulation of alien species; establishment and application of hunting seasons; in situ restocking programmes for threatened species; regulation on captivity of wild animals; and harvesting of biodiversity.

All the aspects mentioned in the provincial legislation for all the nine provinces were summarised and used to compile Table 10. It indicates differences and similarities between various provinces. The letter "Y" indicates when provincial legislation makes provision for an aspect, while "N" indicates when such an aspect is not provided for by provincial legislation.

Table 10: Differences and similarities between provincial legislation.

The letter “Y” (Yes) indicates when provision is made for an aspect, while the letter “N” (No) indicates when such an aspect is not provided for by legislation

Legislative aspect	Eastern Cape	Free State	Gauteng	KwaZulu-Natal	Limpopo	Mpumalanga	Northern Cape	North West	Western Cape
Provision for conservation areas (provincial)	Y	Y	Y	Y	Y	Y	Y	Y	Y
Establishment of authorities to administrate provincial legislation	Y	Y	Y	Y	Y	Y	Y	Y	Y
Promulgation of bylaws for extra biodiversity protection	Y	Y	Y	Y	Y	Y	Y	Y	Y
Provision for private nature reserves	Y	Y	Y	Y	Y	Y	Y	Y	Y
Prohibition to kill indigenous animals	Y	Y	Y	Y	Y	Y	Y	Y	Y
Prohibition to destruct indigenous plants	Y	Y	Y	Y	Y	Y	Y	Y	Y
Regulation of anthropocentric activities in provincial areas	Y	Y	Y	Y	Y	Y	Y	Y	Y
Undertaking of research aimed to protected biodiversity	Y	Y	Y	Y	Y	Y	Y	Y	Y
Special conservation measures for rare species	Y	Y	Y	Y	Y	Y	Y	Y	Y
Regulation of problem animals	Y	Y	Y	Y	Y	Y	Y	Y	Y
Appointment of competent nature conservation officers	Y	Y	Y	Y	Y	Y	Y	Y	Y
Harvesting limits	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pollution prevention measures	Y	Y	Y	Y	Y	Y	Y	Y	Y
Hunting of protected species	Y	Y	Y	Y	Y	Y	Y	Y	Y
Regulation of alien species	N	Y	N	N	N	Y	N	N	N
Hunting seasons	Y	Y	N	Y	N	N	N	Y	N
Restocking programmes	Y	N	N	N	N	N	Y	N	Y
Regulation on captivity of wild animals	N	N	N	Y	N	N	Y	Y	Y
Harvesting of biodiversity	Y	Y	Y	N	Y	Y	Y	Y	Y

Source: Created by the author using information from chapter 8.

Many provincial acts are more detailed, while acts of other provinces are incomplete and inadequate. Biodiversity is not geographically bound to provincial

borders, and therefore some species may be adequately protected in one province but inadequately protected in another. This may create an ideal opportunity for poachers to use the situation to escape prosecution.

Finally, various Government departments act in a fragmented manner, because they regulate different focus areas such as water and mining. This results in the absence of an integrated management approach towards the environment that may affect negatively on biodiversity.

The implementation of measures to deal with the above comments in environmental legislation will prove beneficial in sustaining biodiversity in South Africa.

9.2 Recommendations

Recommendations are aimed to provide for improved management measures to ensure that anthropocentric activities that may pose a threat to biodiversity are reduced, eliminated, or mitigated. The recommendations discussed in this chapter are aimed at improving general aspects and legislative measures.

9.3 Strategic recommendations

These recommendations are relevant to strategic administrative issues regarding general environmental management issues relevant to sustainable biodiversity. The following four recommendations stem from strategic problems that were identified during the evaluation of various environmental statutes.

9.3.1 National Interdepartmental Biodiversity Body

The formation of a National Interdepartmental Biodiversity Body should be initiated (Figure 11). This Interdepartmental Biodiversity Body should consist of members that are represented from the Department of Environmental Affairs and Tourism, the Department of Mineral and Energy Affairs, the Department of Water Affairs and Forestry, the Department of Land Affairs and the Department of Agriculture. This recommendation is based on the fact that the various national Government spheres act in a fragmented manner on issues that pertain to the environment and specifically to biodiversity.

The new Body should govern various detailed aspects between various Government departments on issues that relate to biodiversity. All aspects (such as EIA), legislation, activities, policies or any other actions that pertain to biodiversity should be regulated and governed by this Body.

The Body should have workshops, inspectors, courses, and specialists in the various fields of environmental science to ensure the adequate management of aspects relating to biodiversity.

The advantage of the formation of such a National Interdepartmental Biodiversity Body is the integration of all information and actions relating to biodiversity. There would be better communication between mining related activities, land issues, water issues and environmental issues. There should not be one authority that promotes one certain activity and therefore has prejudice over the approval of certain activities. Unfortunately activities such as mining under the Department of Mineral and Energy Affairs cannot currently be seen as independent. This Department promotes mining and at the same time takes decisions on environmental integrity for mining authorisation. The other problem of fragmentation between national organs of State will be eliminated thus ensuring better integration between activities relating to the environment. Various opinions of different specialists may therefore be considered when it comes to the management of activities relating to the environment.

The main objective of the formation of such a new Body should be to eventually strive towards a system to ensure better management of all activities that may have a negative impact on biodiversity.

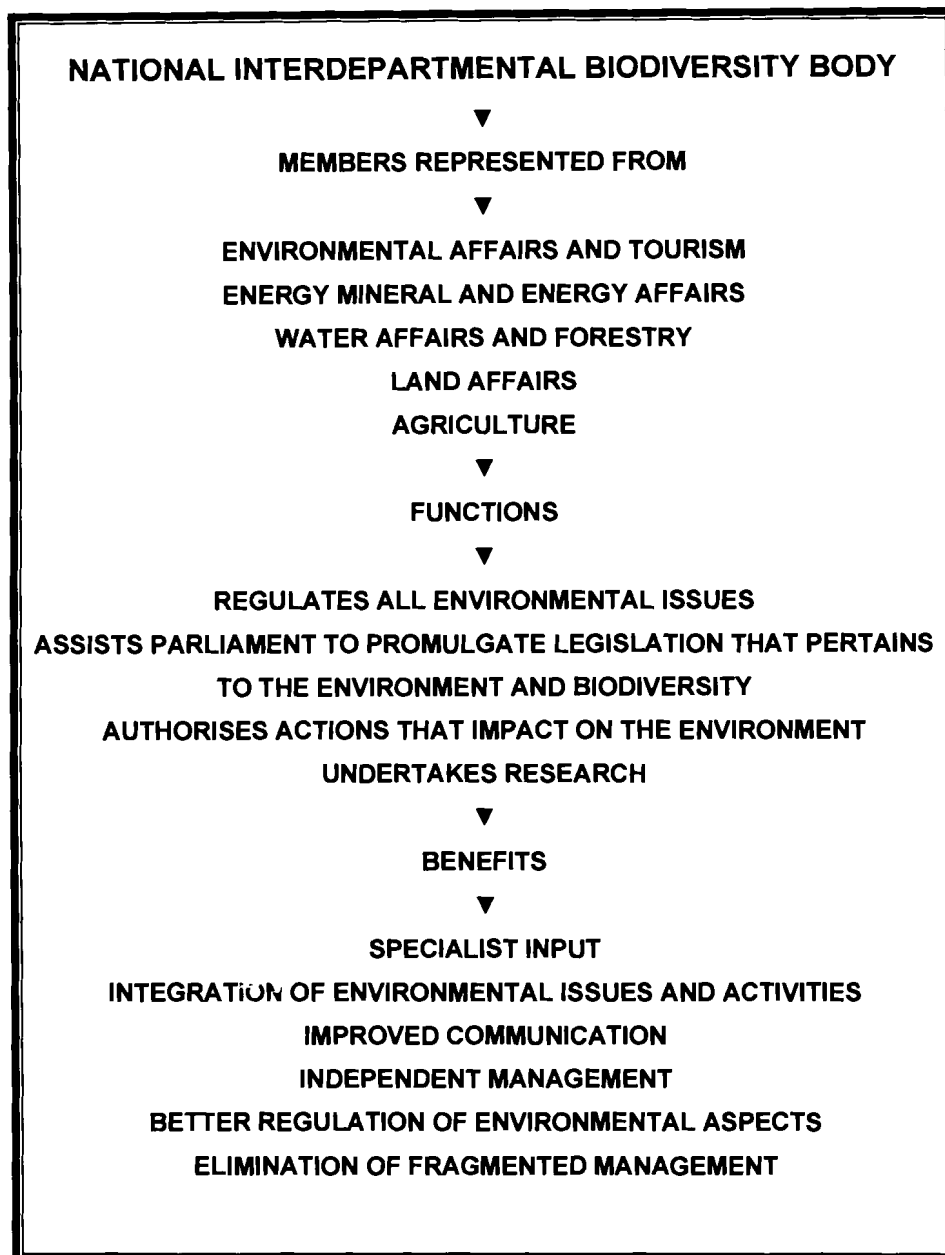


Figure 11: Representation of the structure, functions, and benefits of the formation of the proposed National Interdepartmental Biodiversity Body

9.3.2 Integration and fusion of provincial legislation

Provincial acts/regulations/ordinances should under ideal conditions make provision to manage trans-boundary environmental objectives that are not necessarily contained in provincial boundaries. The highly fragmentary character of unique biodiversity patterns in various provinces may be compromised by legislation that is nationally indolent. It is therefore proposed that the contents of

all provincial acts and ordinances be fused to create a single provincial ordinance (such as the Nature and Environmental Conservation Ordinance 19 of 1974) that protects biodiversity in all 9 provinces (Figure 12).

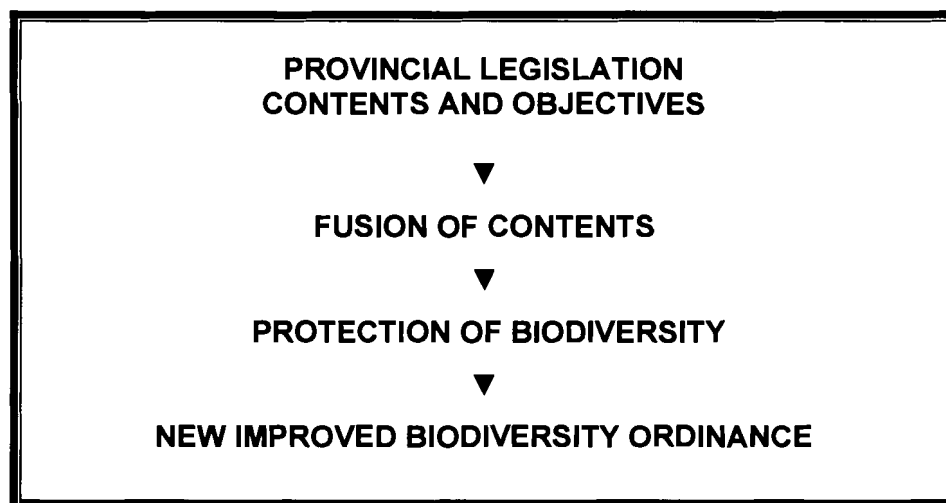


Figure 12: Representation of the fusion of provincial legislation

9.3.3 National integration of international commitments

All international environmental commitments that are supported (signed, ratified, acceded) by South Africa should as soon as possible be made part of legislation (Figure 13). This has been successfully implemented with various international commitments that pertain to the marine environment. The question was raised of why it has been done with some international commitments and not with other international commitments that are supported by the Republic. This would ensure that the objectives of commitments that are supported by the Republic are enforced by an act. It will also ensure better protection of biodiversity, instead of signed international commitments relevant that are not necessarily always binding.

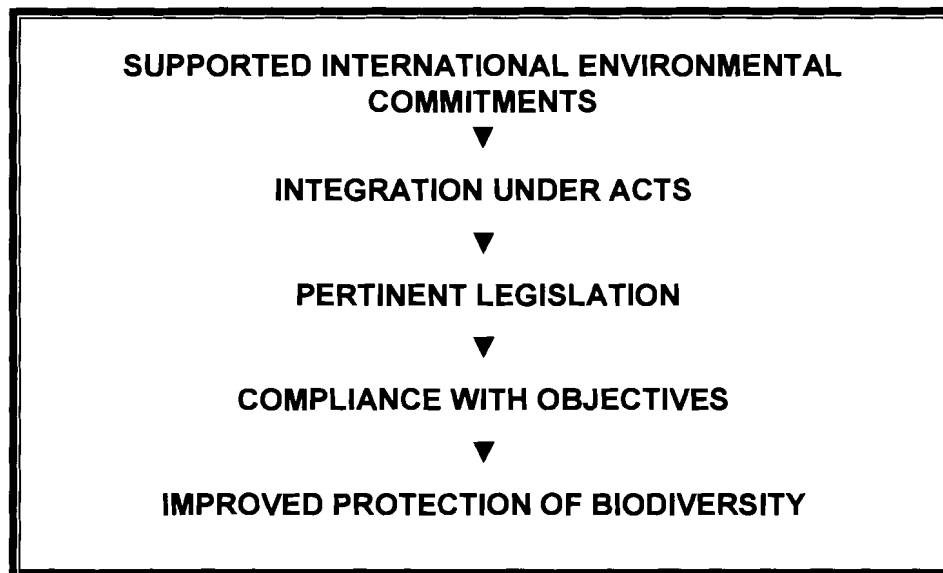


Figure 13: Integration of supported international commitments

9.3.4 The environmental impact assessment agency

Due to the great variation in qualification competencies of environmental impact assessors, it is recommended that an agency is formed to regulate this aspect (Figure 14). The qualifications of a general environmental impact assessor are currently not effectively determined by legislation. Only specialist assessments are currently subjected to registration before such person may undertake such assessment. This may impact greatly on the quality of environmental impact assessment reports. It is recommended that all persons who undertake these general environmental impact assessments also be registered or certified at a national governmental or private agency. Such an agency should provide regular training courses, examinations of its members, and implement quality control measures. It is further recommended that these members be audited on a regular basis to ensure quality control of reports. Such measures may prevent incompetent persons from undertaking environmental impact assessments and will ensure better control over the quality of the process. The formation and functions of this agency should be enforced by national legislation.

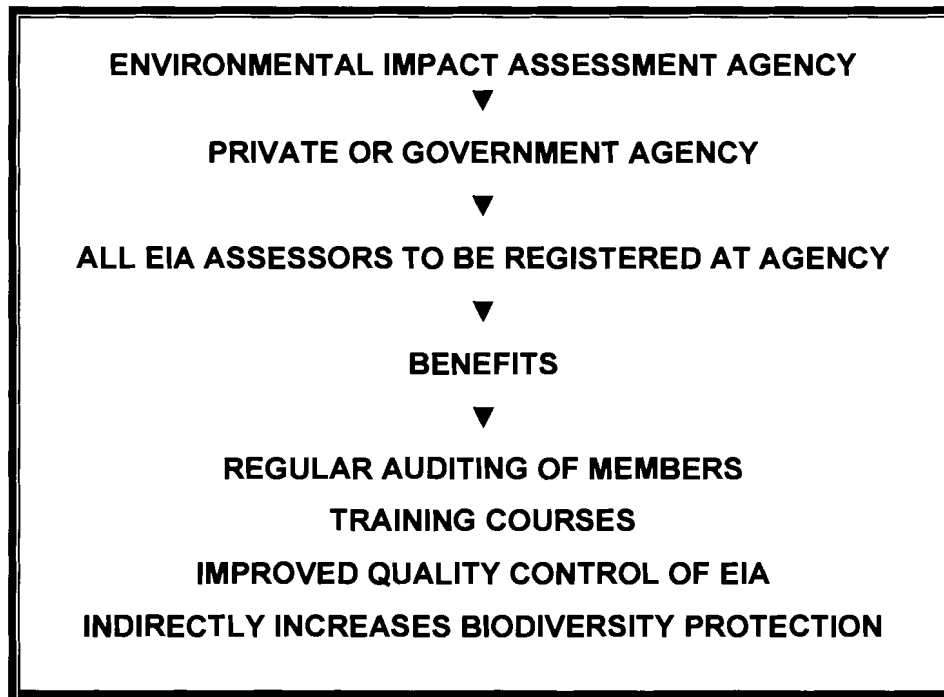


Figure 14: Formation of the Environmental Impact Assessment Agency

9.4 Framework legislation recommendations

The following recommendations are aimed to improve the character of framework acts. It may prove beneficial if the following amendments are made to the mentioned acts.

National Environmental Management Act 107 of 1998

This Act does not provide incentives to regulate population growth in South Africa. It may be beneficial if certain financial incentives were implemented by Government to address this issue. An example of such an incentive may be to provide financial benefits and tax relief for smaller families. Excessive population growth is ultimately the indirect cause of uncontrolled development and poses a threat to natural resources and ultimately to biodiversity. Measures for the regulation of disposal of corpses in the face of the high HIV/AIDS mortality rate needs attention. Due to the impact of this disease on the human population, an exponential increase in deaths can be expected in the next 10 to 15 years. Informal and formal graveyards cover large areas of land, which compromises soil structures, and destroy the pristine character of the area. All plants are usually destroyed in these areas as a result of the excavation process. Associated fauna will also ultimately disappear from the area. (It would prove beneficial if regulations are promulgated under this Act to deal with this problem). The use of environmental impact assessment and strategic environmental assessment to aid the compilation of development plans is needed. Development

plans should not be allowed to take place without first assessing the impact thereof on the environment. The impact on biodiversity should be determined in all instances.

The use of overview, especially biodiversity overview when an environmental authority is scrutinising a submitted environmental impact assessment report should be prioritised. Specialist input is needed to ensure that the environmental impact assessor has effectively assessed the possible impact on biodiversity by the proposed development. A team should be appointed to independently assess the effectiveness of the environmental impact assessment in terms of biodiversity. Regulation of the academic background/competency of the impact assessor/person conducting the assessment is needed. This Act does not specify the academic qualifications of the impact assessor. It only requires that such assessor should have the expertise in the area concerned. This does not mean that such person is required to have the necessary background when it comes to biodiversity assessment.

The current trend in the development of golf estates should be strategically regulated and limited. The large number of golf estates in areas that are usually associated with biodiversity hotspots are alarming. This process, even though regulated by EIA will seriously compromise various forms of biodiversity if not managed in a sustainable manner as soon as possible. Government should not allow these developments to compromise biodiversity permanently for short term economical gain.

Environment Conservation Act 73 of 1989

Limited development should take priority (including mining) in biodiversity hotspot areas. The criteria for limited development areas do take environmental attributes into consideration, but not necessarily areas that are high in biodiversity. Directives should ensure that development is limited in these biodiversity rich areas. Under section 23, and Government Notice 449 of the Environment Conservation Act 73 of 1989, classification and management of limited development areas, and terrestrial protected areas should pertinently take the seven South African biodiversity hotspots into consideration.

Inspection in domestic communal land communities and farms should take place to ensure that unsound environmental impacts are monitored and managed. Measures should be implemented to ensure that these inaccessible areas are managed and monitored by strict legislation.

Increased use, preferably compulsory use, of environmentally degradable products, packaging materials or any other object should be prioritised. The general policy under this Act encourages recycling and sustainable use, but does not mandate that biodegradable products should be used. Where possible biodegradable product use should be mandated by legislation. Toxic products should be banned under all circumstances. This should include prohibition of

excessive use of unnecessary plastic or paper packaging materials (excluding plastic bag regulations). All products should be assessed to determine whether the producer has not manufactured unnecessary packaging material that may have a negative impact on the environment. Prohibition of littering in private areas needs attention.

Section 19 only regulates littering in public places. This can create problems on private land, farms, and communal land and needs to be managed and monitored. Together with this management and monitoring of domestic waste in isolated county areas and rural communities should be prioritised. Inclusion of ash as waste under Notice 1986 of 24 August 1990 and section 20 of this Act must be amended. Ash should be managed in a proper manner, since its irresponsible management may have negative impacts on sensitive biotic systems. All ash generated by electrical generation activities should be managed as waste. Coal ash should be managed in a more responsible manner since it may contain heavy metals and other toxic inorganic compounds.

Under section 23, and Government Notice 449 of the Environment Conservation Act 73 of 1989, classification and management of limited development areas, and terrestrial protected areas should pertinently take the seven South African biodiversity hotspots in consideration.

National Environmental Management: Biodiversity Act 10 of 2004

This Act only provides for the establishment of botanical gardens and not zoos. Measures should be implemented to manage this discrepancy.

It could be beneficial if owners of land are mandated to conserve at least 10% of their land as it was in its natural state. This may not be possible in already degraded areas, but should apply to all new developments, such as land that are acquired for agricultural and forestry purposes. This would also mean that Government organs such as municipalities should also protect at least 10% of land in its natural state in urban centres. Individual conservation of 10% of all private and public land could decrease the habitat fragmentation problem.

Numerous species are becoming extinct as a result of poaching for traditional *muthi* and ornament plant trade. Species that are critically endangered should be removed from the ornamental plant trade, until measures are implemented to ensure their survival. There should be a focus on *in situ* protection and conservation measures, since *ex situ* conservation is not a sustainable conservation option. Government should acquire land for the *in situ* protection of rare plant and animal species that are critically endangered. Government should also subsidise poor rural communities to cultivate local species through nursery initiatives that will ensure survival of such species and poverty alleviation. These plants could be provided to registered *muthi* markets that would reduce their negative impact on species in habitat. Stricter legislation should be promulgated

to provide measures for regulation of these markets. The use of a permit system, limited markets and/or limited areas and/or species may be beneficial.

Prohibition on selling certain indigenous wood should be implemented. Only wood of exotic species should be sold. Trade in indigenous wood of some species should only be allowed on authorisation to an applicant. The Biodiversity Act makes adequate provision for the (medical and scientific) utilisation of various indigenous species. It allows fair advantages to traditional communities in regard to such bioprospecting. Bioprospecting activities should not harvest commercially from the habitat. Artificial techniques should be used for the propagation of commercially important species. Involving poor communities in these projects should be prioritised.

National Environmental Management: Protected Areas Act 57 of 2002

Measures for the interconnection of conservation areas to adequately sustain biodiversity are needed. Various ecotypes need to be protected in an adequate number of reserves, and reserves should preferably be interconnected with one another to prevent genetic isolation of species. Genetic isolation should be prevented through responsible exchange of larger species, especially mammals that are genetically isolated by artificial fencing systems.

9.5 Sectoral legislation recommendations

The following sectoral acts should be amended in a manner so to make provision for the lacunae that were identified in the research project.

9.6 Marine environment

The marine environment includes the territorial waters of South Africa, the adjoining seashore and coastal zone, and also features associated therewith. These features include estuaries, sea lakes, lagoons, islands, and river mouths.

9.6.1 Marine protection

Marine Living Resources Act 18 of 1998

In the case of contravention of this Act, section 63(2) should ensure that all healthy living confiscated marine taxa are released back into the marine environment. Regulations should be promulgated to prohibit any marine harvesting in lagoons, estuaries, sea lakes and associated natural systems. Foreign fishing as allowed under section 39 should rather be prohibited, since these resources should not be compromise in the long term for short term financial gain.

Regulations should be promulgated for the determination of a minimum size and number of marine protected areas to sustain biodiversity.

9.6.2 Management of marine pollution

Marine Pollution (Control and Civil Liability) Act 6 of 1981

Liability for loss or damage due to oil pollution under sections 2-11 of the Marine Pollution (Control and Civil Liability) Act 6 of 1981 are not inclusive, and should also cover other chemical, biological substance or mechanical damage caused by any ship/man made structure. War ships and tankers should not be exempt from any liability for any damage caused by it in the marine environment. Provisions should be made for measures to regulate thermal pollution of the marine environment.

9.7 The terrestrial, atmospheric and fresh water environment

The terrestrial, atmospheric and fresh water environment includes the atmosphere, water, and soil. Provision should be made to protect these entities that are vital to sustain the living world. This includes the regulation of development, the management of terrestrial & aquatic pollution, water management, and control of fire.

9.7.1 Atmospheric pollution control

Under the Air Quality Act, domestic coal and wood fires should be better regulated in urban areas and fire making for recreation should be assigned to restricted areas. Air polluting vehicles (that emit dark smoke) should be prohibited in all areas and catalytic converters may prove beneficial for vehicles in heavy populated urban areas.

9.7.2 Regulation of development

Mineral and Petroleum Resources Development Act 28 of 2002

Under the Mineral and Petroleum Resources Development Act 28 of 2002 authorisation to prospect and mine within an environmental management programme should be governed by an independent authority instead of the Department of Minerals and Energy Affairs (see also strategic recommendations). Authorisation is not objective when given by an authority that promotes such activity. Rehabilitation of the land surface should only be considered complete when it is acceptable to an independent specialist team. Rehabilitation under section 38 should preferably be carried out when mining is marginal as determined by section 51, and should not be postponed until environmental damage is irreversible.

9.7.3 Land and aquatic pollution control

National Nuclear Regulator Act 47 of 1999

It is strongly advised that nuclear activities (including new nuclear energy stations) are prevented in biodiversity hotspots, due to the potential mutagenic effect.

Hazardous Substances Act 15 of 1973

Under the Hazardous Substances Act 15 of 1973, commercial acquisition of any pesticide or herbicide should be subject to motivation for its use. Personal storage of pesticides or herbicides should not be allowed, and any excesses should be returned to the supplier for a refund. Domestic acquisition of any form of pesticide or herbicide should only be permitted after formal motivation (physical proof of a pest or weed) for its use has been presented. (Proof of weed infestations is requested by Government subsidised schemes, but not pest infestations. Proof of animal or plant infestations is not required for private acquisitions of pesticides or herbicides, and this should be regulated). (Also see Conservation of Agricultural Resources Act 43 of 1983 chapter 7, 7.2.2.3).

Domestic herbicides and pesticides should be supplied in smaller quantities to ensure improved monitoring thereof. The address and personal details of all domestic and commercial consumers of pesticides and herbicides must be supplied on purchase. All empty herbicide and pesticide containers irrespective of their size must be returned to the supplier for proper environmental disposal. (Only return of herbicide containers is currently required, and then only for Government subsidised herbicides. This should also apply to pesticides and private acquisition of herbicides and pesticides). (Also see chapter 7, 7.2.2.3). The use of recalcitrant biocides should be prohibited under all circumstances. Regulations should be promulgated prohibiting the production, sale, and use of any persistent organic pollutants currently not effectively managed by the Stockholm Convention on Persistent Organic Pollutants, 2002 (POPs).

Government should promote the use of biological pest control substances through various initiatives.

Explosives Act 26 of 1956

Under the Explosives Act 26 of 1956 provision should be made to ensure that all organic explosives are biodegradable and do not contain heavy metals. Lead bullets should be replaced with less environmentally toxic metals or other suitable degradable organic substances.

9.7.4 Hydrological cycle integrity

Mountain Catchment Areas Act 63 of 1970

Directives under sections 3(i)(a) of the Mountain Catchment Areas Act 63 of 1970, should prohibit or severely restrict forestry in mountain catchment/high biodiversity areas.

Conservation of Agricultural Resources Act 43 of 1983

Under the Conservation of Agricultural Resources Act 43 of 1983, no exceptions should be made for any development in a wetland/riparian system.

9.7.5 Fire regulation

National Veld and Forest Fire Act 101 of 1998 and Conservation of Agricultural Resources Act 43 of 1983

Under the National Veld and Forest Fire Act 101 of 1998 and the Conservation of Agricultural Resources Act 43 of 1983, regulations should be promulgated to control intentional burning of vegetation (excluding firebreaks) in any natural area. These regulations must control the number of times a certain area may be burnt in a 5-year cycle, prohibition to burn certain habitat types, and monitoring thereof. It could also be beneficial if Government and local Government authorities provide firebreaks annually along national roads to prevent the possible beginning of field fires by cigarettes.

9.8 Biological environment

The biological environment embraces aspects relating to terrestrial conservation of biodiversity as well as the regulation of agricultural activities that can have a detriment impact on the environment.

9.8.1 Management of agricultural activities

Conservation of Agricultural Resources Act 43 of 1983

Environmental problems regulated by the objectives of this Act should be subjected to a time limit, to ensure that remedying measures are implemented as soon after a problem is identified as possible. Categorisation of alien/invasive species should be updated regularly to insure the integrity of the information. Irrespective of the categorisation of alien/invasive species, no such species should be allowed in any wetland/riparian system. Invasive and destructive animal species should also be categorised and managed under this Act.

It is nationally evident that the legislation pertaining to overgrazing and erosions is not effective. Government should use initiatives to ensure that overgrazing and

erosion problems in communal land areas and farms are properly managed. Monitoring initiatives and a time limit should be implemented. The involvement of the local community to gain financial returns in these projects could prove beneficial. The local community should be encouraged to protect and conserve biodiversity.

Cremation and burial sites must be managed to ensure minimum environmental pollution, and/or other environmental problems.

Fencing Act 31 of 1963

Measures are needed to ensure that certain non-lethal electrical fencing is not responsible for the death of certain animals such as hedgehogs.

9.9 Provincial legislation recommendations

9.9.1 Eastern Cape

Nature Conservation Act (Ciskei) 10 of 1987

Section 18 allows a relevant authority to authorise the hunting of any problem animal, irrespective of the conservation status of such species. The impact of such action should be assessed prior to its implementation.

It could be beneficial to prohibit the following hunting methods: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity.

Regulation of alien and invasive plants and animals on land should be given more attention.

Nature and Environmental Conservation Ordinance 19 of 1974

Establishment of open and closed seasons for the hunting of wild animals must be implemented. The Ordinance only regulates this on aquatic biodiversity (section 51).

Total prohibition of the following hunting methods: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. Measures should be implemented to regulate alien and invasive plants and animals on land.

9.9.2 Free State

Bophuthatswana Nature Conservation Act 3 of 1973

Measures must be introduced to restock wild populations of endangered and rare species of plants and animals. Regulation of the captivity of wild animals needs more attention. The establishment of open and closed seasons for the hunting of wild animals must be implemented.

Total prohibition of the following hunting methods: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien and invasive plants and animals should be regulated on land.

Qwaqwa Nature Conservation Act 5 of 1976

There is a need for measures to restock wild populations of endangered and rare species of plants animals. The captivity of wild animals must be regulated. Legislation should regulate open and closed seasons for the hunting of wild animals.

Protected Areas Act (Bophuthatswana) 24 of 1987

Measures should be implemented to restock wild populations of endangered and rare species of plants and animals. The captivity of wild animals and their captive living conditions need to be monitored and managed. Open and closed seasons need to be established for the hunting of animals. It is recommended that a total prohibition of the following hunting methods are implemented: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien and invasive species of plants and animals need to be regulated on land.

Nature Conservation Ordinance 8 of 1969

There is a need for measures to restock wild populations of endangered and rare species of plants animals. It is recommended that prohibition of the following hunting methods are implemented: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. Section 18 and 19 should also regulate conditions under which indigenous animals are kept in captivity.

9.9.3 Gauteng

Nature Conservation Ordinance 12 of 1983

Measures must be implemented to restock wild populations of endangered and rare species of plants and animals. It will be beneficial to totally ban the following hunting methods: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien and invasive plant and animal species need to be regulated on land.

9.9.4 KwaZulu-Natal

KwaZulu Nature Conservation Act 29 of 1992

Recommend prohibition of the following hunting methods: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien plants and animals should be regulated on land.

KwaZulu-Natal Nature Conservation Management Amendment Act 5 of 1999

Section 64 authorises the collection of plants by traditional healers - this is detrimental to the integrity and survival of various species and should be better regulated as discussed earlier. The following hunting methods should be preferably prohibited: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien plants and animals should be regulated on land.

Nature Conservation Ordinance 15 of 1974

There is a need for measures to restock wild populations of endangered and rare species of plants and animals. The following hunting methods should preferably be banned: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. Provisions relating to the harvesting of aquatic biodiversity should also apply to the landowner of any such land that contains these species (section 145). All alien plants and animals should be regulated on land.

9.9.5 Limpopo

Gazankulu Nature Conservation Act 5 of 1975

There is a need for measures to restock wild populations of endangered and rare species of plants and animals. Measures are required for the regulation of the captivity of wild animals. Open and closed seasons for the hunting of animals need to be determined. The following hunting methods should preferably be fully prohibited: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien plants and animals should be regulated on land.

Nature Conservation and National Parks Act (Venda) 20 of 1986

There is a need for the establishment of open and closed seasons for harvesting of species. Restocking programs for endangered and rare species of plants and animals should be implemented. All alien plants and animals should be regulated on land.

Nature Conservation Ordinance 12 of 1983

(See 9.9.3)

9.9.6 Mpumalanga

Mpumalanga Nature Conservation Act 10 of 1998

Legislation should make provision for measures to restock wild populations of endangered and rare species of plants and animals. The captivity of wild animals must be regulated. The following hunting methods should preferably be prohibited: trap; airgun, set-gun; cage; snare; poison, with dog; artificial light; automatic gun; shotgun, vessel; aircraft; and at night under any circumstances whatsoever, since these activities are difficult to regulate and may have a detrimental impact on biodiversity. All alien plants and animals should be regulated on land.

9.9.7 Northern Cape

Nature and Environmental Conservation Ordinance 19 of 1974

(See 9.9.1)

9.9.8 North West

Nature and Environmental Conservation Ordinance 19 of 1974

(See 9.9.1)

Nature Conservation Ordinance 12 of 1983

(See 9.9.3)

9.9.9 Western Cape

Nature and Environmental Conservation Ordinance 19 of 1974

(See 9.9.1)

10 Conceptual Framework Act on Biodiversity

Under ideal conditions, without the presence of any sectoral legislation, a conceptual biodiversity act should make provision for all aspects that are needed to protect biodiversity. Such an act should regulate all management, legislative and administrative issues that pertain to biodiversity. If such an act could be promulgated its contents should be of such character to ensure sustainable biodiversity.

Figure 15 is a concise example of the generic proposed chapters of such a conceptual framework act. Such an act should make provision for a National Interdepartmental Biodiversity Body that regulates all aspects that pertain to the environment and biodiversity. The role of integrated provincial biodiversity management should also receive adequate attention. All international environmental commitments that may play an important role in the protection of biodiversity should be formally supported and enacted as legislation. Development that may have a negative impact on the environment (including all anthropogenic activities) should be regulated through EIA, EMP and other management initiatives. The biodiversity criteria discussed in this project should be included and enforced by such an act. This act should also make provision for directives to enforce the principles thereof. Biodiversity research and education should be promoted through the use of reasonable initiatives.

- 
- 1. ROLE OF NATIONAL INTERDEPARTMENTAL BIODIVERSITY BODY AND OTHER NATIONAL ENVIRONMENTAL GOVERNMENT ORGANS**
 - 2. INTEGRATED PROVINCIAL BIODIVERSITY MANAGEMENT**
 - 3. MANDATORY SUPPORT OF INTERNATIONAL ENVIRONMENTAL COMMITMENTS**
 - 4. REGULATION OF DEVELOPMENT (EIA, EMP & AND THROUGH OTHER INITIATIVES)**
 - 5. COMPLIANCE WITH BIODIVERSITY CRITERIA (MARINE, TERRESTRIAL, ATMOSPHERIC, FRESH WATER AND BIOLOGICAL ENVIRONMENT)**
 - 6. INVESTIGATIONS AND ENVIRONMENTAL OFFICERS**
 - 7. OFFENCES AND PENALTIES**
 - 8. BIODIVERSITY RESEARCH AND EDUCATION**

Figure 15: Contents of a proposed generic conceptual biodiversity act

With the completion of this research project the initial objectives as discussed in chapter 1 (see 1.7) were achieved:

Main objective achieved:

- Evaluation of South African environmental legislation to determine whether it provides adequate measures to protect and conserve biodiversity in South Africa, and to make recommendations to improve such legislation in the face of protection and conservation of such biological resources; and
- Formulation of a new concept framework idea that could ensure the protection and conservation of such resources if implemented.

Specific secondary objectives achieved:

- Determination of the state of biodiversity in South Africa;
- Identification and description of criteria needed to protect biodiversity in South Africa;

- Identification, discussion and evaluation of international law and framework environmental legislation relevant to the protection of biodiversity;
- Identification, discussion and evaluation of sectoral environmental legislation pertaining to the marine, terrestrial, atmospheric, fresh water and biological environment; and
- Identification, discussion and evaluation of provincial environmental legislation pertaining to biodiversity.

REFERENCE

- AGENBACH, J.C. 1999. South Africa's International Environmental Commitments. 40 p. (Unpublished)
- AGENCE FRANCE-PRESSE. 1997. Sick Fish are Sign of Severe Antarctic Pollution. [Web:] <http://www.hartford-hwp.com/archives/23/001.html> [Date of access: 26 May 2003].
- AGENCIA DE INFORMACAO DE MOCAMBIQUE. 2003. Environmentalists Call for Prawn Boycott. [Web:] <http://allafrica.com/stories/200302200783.html> [Date of access: 26 May 2003].
- ANON. 1999. Metropolitan Durban. [Web:] <http://www.ceroi.net/reports/durban/index.html> [Date of access: 5 March 2003].
- ANON. 2002a. Unreal dive. [Web:] <http://www.unrealdive.com.html> [Date of access: 5 March 2003].
- ANON. 2002b. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. [Web:] http://www.eelink.net/~asilwildlife/london_dump.html [Date of access: 25 March 2003].
- ANON. 2003. Montreal Protocol for the Protection of the Ozone Layer. [Web:] <http://www.ciesin.org/TG/PI/POLICY/montpro.html> [Date of access: 25 March 2003].
- ANON. 2004. Vegetation Management Workshop. [Web:] http://www.traenviro.com/sanbruno/hcp/vegmemo_7.29.02.pdf [Date of access: 7 February 2004].
- ATLAS, R.M. 1997. Principles of Microbiology. USA : McGraw-Hill.
- ATTWOOD, C.L., MOLONEY, C.L., STENTON-DOZEY, J., JACKSON, L.F., HEYDORN, A.E.F. & PROBYN, T.A. 2000. Conservation of marine biodiversity in South Africa. [Web:] <http://www.nrf.ac.za/publications/marinerep/conserv.html> [Date of access: 5 March 2003].
- BARTHLOTT, W. & WINIGER, M. 1998. Biodiversity: A Challenge for Development, Research and Policy. New York : Springer.
- BAS (British Antarctic Survey). 2002a. Prevention of Marine Pollution. [Web:] http://www.antarctica.ac.uk/About_BAS/Cambridge/Divisions/EID/Environment/Prevention_of_marine_pollution.html [Date of access: 26 May 2003].

- BEAZLEY, P. 1993. Wetlands in Danger (*In* Dugan, P. ed. London : Reed Publishers).
- BEGG, G. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).
- BIRDLIFE SA. 2002. Teacher's Guide to Biodiversity. [Web:] <http://www.birdlife.org.za/resources/wssd2002/bio.html> [Date of access: 5 March 2003].
- BRANCH, G.M. & SHACKLETON, L.Y. 1988. Research Needs in the Transkei and Ciskei Coastal Zone. Pretoria : Council for Scientific and Industrial Research.
- BRAY, E. 1999. Co-operative Governance in the Context of the National Environmental Management Act 107 of 1998. The South African Journal of Environmental Law and Policy. (1999)(1) 1-12, May.
- BREACH. 2002. Policy on Aboriginal Subsistence Whaling. [Web:] <http://www.breach.org/page18.html> [Date of access: 26 May 2003].
- BROOKE, C. 1998. Biodiversity and Impact Assessment. [Web:] <http://biodiversityeconomics.org/pdf/topics-03-01.pdf> [Date of access: 20 February 2004].
- BROOKS, R.O., JONES, R., & VIRGINIA, R. A. 2002. Law and Ecology: The Rise of the Ecosystem Regime. USA : Ashgate Publishing Company.
- BROUWER, S. 2002. Marine Protected Areas-Do we need them? [Web:] <http://www.parks-sa.co.za.html> [Date of access: 19 March 2003].
- CALDWELL, W.J. 1999. Issues and Responses: Land Use Planning in Easter and Southern Africa. Harare : Weaver Press.
- CANADA. 2003. Convention on Environmental Impact Assessment in a Transboundary Context. [Web:] <http://laws.justice.gc.ca/en/C-15.2/SOR-94-637/text.html> [Date of access: 25 March 2003].
- CBD (Convention on Biological Diversity). 2003. Convention on Biological Diversity. [Web:] <http://www.biodiv.org.html> [Date of access: 25 March 2003].
- CEROI. 2000. Indigenous Medicine. [Web:] <http://www.ceroi.net/reports/durban/issues/Terrestri/muthi.htm> [Date of access: 28 August 2005].

CLOKE, P.J. & PARK, C.C. 1985. Rural Resource Management. London : Croom Helm.

CMS (Convention on Migratory Species). 2003. Convention on Migratory Species. [Web:] <http://www.wcmc.org.uk/cms/html> [Date of access: 25 March 2003].

COLLINS, J. 2001. Biodiversity in South Africa. [Web:] <http://www.botany.uwc.ac.za/Envfacts/facts/biosa.html> [Date of access: 5 March 2003].

CONSERVATION INTERNATIONAL. 2002a. Conservation Regions-Africa. [Web:] <http://www.conservation.org/xp/CIWEB/regions/africa/Africa.html> [Date of access: 5 March 2003].

CONSERVATION INTERNATIONAL. 2002b. Biodiversity Hotspots. [Web:] <http://www.biodiversityhotspots.org/xp/hotspots/resources.html> [Date of access: 5 March 2003].

COWLING, R.M. & HILTON-TAYLOR, C. 1993. Species Diversity. (*In* Huntley, B., ed. Botanical Diversity in Southern Africa. Cape Town : National Botanical Institute).

COX, W.G. 1997. Conservation Biology: concepts and applications. USA : Wm. C. Brown Publishers.

CROTHERS, C. 1998. Levels of Winter Smoke Pollution in South Africa: Establishing a Need for Policy to be Developed. The South African Journal of Environmental Law and Policy. (1998)(1) 141-148, May.

CUNNINGHAM, W.P. & SAIGO, B.W. 1997. Environmental Science: A Global Concern. New York : WCB McGraw-Hill.

DASMAN, R.F. 1972. Environmental Conservation. London : John Wiley & Sons.

DBP (Department of Building and Planning). 2000. Draft Critical Areas Ordinance. [Web:] <http://www.cowlitzcounty.org/buildplan/planning/criticalord.html> [Date of access: 20 February 2004].

DELTAENVIRO. 2002. Enviro facts-Biodiversity in South Africa. [Web:] <http://www.deltaenviro.org.za/resources/envirofacts/biodiversitysa.html> [Date of access: 5 March 2003].

DES JARDINS, J.R. 1993. Environmental ethics: An introduction to environmental philosophy. Belmont : Wadsworth Publishing Co.

DIAB, R. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

DOBSON, A. 1998. Conservation and Biodiversity. New York : Scientific America Library.

DORRINGTON, R., BOURNE, D., BRADSHAW, D., LAUBSCHER, & R. TIMAEUS. 2003. The impact of HIV/AIDS on adult mortality in South Africa. [Web:] http://www.lshtm.ac.uk/cps/dfid/2002_16.htm [Date of access: 5 March 2003].

DORLING, K. 1998. Wêreld Atlas. London : Dorling Kindersley Limited.

DU PLESSIS, W. 2000. Omgewingsreg, LLB 411. 51 p. (Unpublished)

DU PLESSIS, W. 2003. Verbal Communication with the Author. North-West University.

GIBBONS, M.J. 2000. Marine Biodiversity Status Report for South Africa. (*In* DURHAM, B.D. & PAUW, J.C., ed. Pretoria : National Research Foundation.

DWA (Department of Water Affairs). 1986. Management of Water Resources of the Republic of South Africa. Pretoria : Department of Water Affairs.

EHS (Environmental Health and Safety). 2002. Carcinogens. [Web:] <http://www.runet.edu/~fac-man/Safety/ChemHyg/chp7.htm> [Date of access: 20 February 2004].

ELDREDGE, N. 1998. Life in the Balance: Humanity and the biodiversity crisis. Princeton : Princeton University Press.

ELKINGTON, J. 1999. Cannibals with forks-Triple bottom line of the 21st century business. New York : NSP Publishing.

ENVIRON. 2003. Habitat Loss. [Web:] http://www.environ.org.uk/issues/nature/habitat_loss/.html. [Date of access: 14 February 2004].

ENVIRONMENT NEWS SERVICE. 2005. Bottom Trawling Banned in Huge Alaska Marine Protected Area. [Web:] <http://www.ens-newswire.com/ens/aug2005/2005-08-09-09.asp> [Date of access 28 August 2005].

ETU (Education Training Unit). 2002. Laws Relating to the Environment. [Web:] <http://paralegaladvice.org.za/docs/chap04/05.html> [Date of access: 22 February 2003].

FABIAN, A. 1982. Transvaal Wild Flowers. Johannesburg : Macmillan South Africa.

FERIS, M-A. 2002. Most SA species on brink of extinction. [Web:] <http://www.iol.co.za/general/news.html> [Date of access: 5 March 2003].

FIELD, M. 2002. World War II Shipwrecks Turning into Pacific Environmental Threat. [Web:] http://www.thingsasian.com/goto_article/article.1901.html [Date of access: 22 February 2003].

FMS (Fisheries Management Sector). 2002. Gear and Bycatch Concerns, Interactions in the Turbot, Crab and Shrimp Fisheries in 2J3KL. [Web:] http://www.gov.nf.ca/fishaq/fdp/ProjectReports/fdp_334.pdf [Date of access: 26 May 2003].

FORBES, A. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

FUGGLE, R.F. & RABIE, M.A. 1992. Environmental Management in South Africa. Cape Town : Juta.

GARLAND, G. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

GEACH, B. & PEART, R. 1998. Land, Resource Use, Biodiversity and Desertification in South Africa: an overview and analysis of post-1994 policies, programmes and institutional mechanisms. [Web:] <http://www.economics.iucn.org.html> [Date of access: 5 March 2003].

GLAVOVIC, P.D. 1997. The Technique of Mitigation in Coastal Management: Case Studies from Florida USA. The South African Journal of Environmental Law and Policy. (1997)(2) 243-252, October.

GLAZEWSKI, J. 1997. Towards a Coastal Zone Management Act for South Africa. The South African Journal of Environmental Law and Policy. (1997)(1) 1-22, March.

GLAZEWSKI, J. 2000. Environmental Law in South Africa. Durban : Butterworths.

- GOODE, D. 1993. *Cycads of Africa*. Cape Town : Struik Winchester.
- GOODE, D. 2001. *Cycads of Africa: Volume 1*. Gallomanor : D & E Cycads of Africa Publishers.
- GOODMAN, D. 2002. Research en Guidelines: Planning for the conservation and development of biodiversity in Kwazulu-Natal. *Indonsa*. (2002)(1): 15-16, March.
- GRAIN (Genetic Resources Action International). 2004. [Web:] <http://www.grain.org/themes/dsp> [Date of access: 7 February 2004].
- GROBBELAAR, N. 2002. *Cycads-with special reference to the southern African species*. Pretoria : Published by the author (Four Images Bureau & Printers).
- HALL, A.V., DE WINTER, M., DE WINTER, B. & VAN OOSTERHOUT, S.A.M. 1980. *Threatened Plants of Southern Africa*. South Africa : Graphic Arts Division of CSIR.
- HALL-SPENCER, J., ALLAIN, V. & FOSSA, J.H. 2001. *Trawling Damage to the Northeast Atlantic Ancient coral reefs*. [Web:] <http://www.wwf.at/downloads/korallen.pdf> [Date of access: 26 May 2003].
- HANNAN, J.C. 2002. *Mine Rehabilitation: A Handbook for the Coal Mining Industry*. Sydney : New South Wales Coal Association.
- HAUCK, M. 1999. Seawatch: Civil Society's Role in Combating Environmental Crime. *The South African Journal of Environmental Law and Policy*. (1999)(1) 101-120, May.
- HAWKSWORTH, D.L. 1991. *The Biodiversity of Microorganisms and Invertebrates: Its Role in Sustainable Agriculture*. Wallingford : CAB International.
- HEWAWASAM, I. 2002. *Managing the Marine and Coastal Environment of Sub-Saharan Africa*. Washington : The World Bank.
- HEYDORN, A.E.F. 1995. *Oceans of Life off Southern Africa* (*In* Payne, A.I.L., & Crawford, R.J.M., eds. South Africa : Vlaeberg Publishers).
- HICKMAN, C.P., ROBERTS, L.S. & LARSON, A. 1997. *Integrated Principles of Zoology*. USA : (WCB)Wm. C. Brown Publishers.

HODGE, K., & GILSON, N. 2003. Environmental Sensitivity Analysis: A Regional Examination in Alberta, Canada. [Web:] <http://gis.esri.com/library/userconf/proc02/pap1198/p1198.htm> [Date of access: 20 February 2004].

HOHMANN, H. 1992a. Basic Documents of International Environmental Law, Volume 1. London : Graham & Trotman.

HOHMANN, H. 1992b. Basic Documents of International Environmental Law, Volume 2. London : Graham & Trotman.

HOHMANN, H. 1992c. Basic Documents of International Environmental Law, Volume 3. London : Graham & Trotman.

HOLMBERG, J., BASS, S. & TIMBERLAKE, L. 1991. Defending the Future: A Guide to Sustainable Development. London : Earthscan

HOWE, G. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

HUGO, L.M. 2004. Environmental Management: An Ecological Guide to Sustainable Living in Southern Africa. Pretoria : EcoPlan.

IMO (International Maritime Organisation). 2003. International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties. [Web:] http://www.imo.org/Conventions/mainframe.asp?topic_id=258&doc_id=680 [Date of access: 5 June 2003].

INDEPENDENT ONLINE. 2004. Greens Give Environmentalists the Blues. [Web:] <http://www.argus.co.za/index.php?fSectionId=342&fArticleId=2120979> [Date of access: 19 September 2006].

IUCN (International Union for the Conservation of Nature). 2000a. Draft International Covenant on the Environment and Development. UK : IUCN

IUCN (International Union for the Conservation of Nature). 2001. Action against severe threat to biodiversity from global warming. [Web:] http://www.iucn.org/info_and_news/press/climatechangessc.html [Date of access: 5 March 2003].

IUCN (International Union for the Conservation of Nature). 2003. World Conservation Union. [Web:] <http://www.iucn.org.html> [Date of access: 25 March 2003].

IUCN (International Union for the Conservation of Nature). 2004. Alien Invasive Species – A Global Threat to Biodiversity. [Web:] <http://www.iucn.org/biodiversityday/overview.html> [Date of access: 7 February 2004].

IUCN (International Union for the Conservation of Nature). 2004a. Protected Area Categories [Web:] <http://www.iucn.org/html> [Date of access: 13 February 2004].

IWC (International Whaling Commission). 2003. International Whaling Commission. [Web:] <http://www.iwcoffice.org/iwc.html> [Date of access: 25 March 2003].

JONES, D.L. 1993. Cycads of the World: Ancient Plants in Today's Landscape. Sydney : Reed Books.

KAIN, R. 1981. Planning for Conservation. London : Mansell Publishing.

KIDD, M. 1997. Environmental law - A South African guide. Cape Town : Juta.

KILLICK, D.J.B. 1990. The Flora of the Natal Drakensberg: A field guide. Johannesburg : Jonathan Ball and Ad. Donker Publishers.

KINDERSLEY, D. 1998. Wêreld Atlas. London : Dorling Kindersley

KLEIN, R.G. 2001. The extinct blue antelope. [Web:] <http://www.museums.org.za/sam/resource/palaeo/bluebuck.html> [Date of access: 5 March 2003].

KLEYN, D.G. & VILJOEN, F. 1996. Beginners Guide for Law Students. Cape Town : Juta.

KZN WILDLIFE. 2000. The Medicinal Plant Trade in KwaZulu-Natal: Conservation Concerns and Actions. [Web:] http://www.kznwildlife.com/muthi_trade.htm [Date of access: 28 August 2005].

LAING, M. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

LEAN, G. & HINRICHSSEN, D. 1992. Atlas of the Environment. London : Helicon Publishing.

LEWIS, J.R. 1964. The Ecology of Rocky Shores. London : English University Press.

LOMBARD, R. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

MACPHERSON, R. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

MAITLAND, P.S. & MORGAN, N.C. 1997. Conservation Management of Freshwater Habitats: Lakes, Rivers and Wetlands. London : Kluwer Academic Publishers.

MAMALOUKAS-FRANGOULIS, V., VOLAKIS, S. & SKARVELIS, S. 2002. Shipwrecks as a Source of Marine Pollution. [Web:] <http://www.efmsts.org/Mamaloukas.pdf> [Date of access: 26 May 2003].

MARINI-BETÒLLO, G.B. 1989. A Modern Approach to the Protection of the Environment. Oxford : Pergamon Press.

MARITIME SAFETY. 2003. Marine Protection Rules. [Web:] <http://www.msa.govt.nz/Protection/protectionrules.htm> [Date of access: 26 May 2003].

MASSICOT, P. 2002. Animal Info- South Africa. [Web:] http://www.animalinfo.org/country/south_af.html [Date of access: 5 March 2003].

MAT (Marine Advisory Team). 1997. Non-native Marine Species in British Waters: a Review and Directory. [Web:] http://www.jncc.gov.uk/marine/non_native/summary.htm [Date of access: 20 February 2004].

MAVASA, W. 2003. Strategy to Preserve Cape Town's Natural Wealth. [Web:] <http://www.allafrica.com/stories/200301230713.html> [Date of access: 5 March 2003].

MCDONALD, A. & KAY, D. 1988. Water Resources Issues and Strategies. New York : Longman Scientific & Technical.

MCLACHLAN, A. & ERASMUS, T. 1983. Sandy Beaches and Ecosystems. Boston : Dr W. Junk Publishers.

MCKEAN, S. 2002. Indigenous Plants: Opportunities for Sustainable Use. [Web:] http://www.kznwildlife.com/symposium_02.htm [Date of access: 5 January 2004].

- MEFFE, G.K. & CARROLL, R.C. 1994. Principles of Conservation Biology. USA : Sinauer Associates Inc. Publishers.
- MILLER, G.T. 1992. Living in the Environment. Belmont : Wadworth.
- MILLER, G.T. 1996. Living in the Environment. Belmont : Wadworth.
- MILLIGAN, K. 2002. Contamination of the Benthic Food Chain. [Web:] <http://www.cleanoceanaction.org/March4Shore/March.htm> [Date of access: 26 May 2003].
- MOLDAN, A.G.S. 1995. Oceans of Life off Southern Africa (*In* Payne, A.I.L., & Crawford, R.J.M., eds. South Africa : Vlaeberg Publishers).
- MOORE, H.B. 1958. Marine Ecology. New York : Wiley and Sons.
- MORGAN, S. 1995. The Encyclopaedia of the Environment. Abington : Andromeda Oxford.
- NARAYAN, R. & PETTIGREW, C.A. 1999. ASTM Standards Help Define and Grow a New Biodegradable Plastics Industry. [Web:] http://www.astm.org/COMMIT/D20biodgrd_plas.pdf [Date of access: 20 February 2004].
- NBI (National Botanical Institute). 2000. Vegetation of Southern Africa. [Web:] <http://www.plantzafrica.com/vegetation/vegmain.html> [Date of access: 5 March 2003].
- NIMRD (National Institute for Marine Research and Development). 2003. The Black Sea Commission Perspective. [Web:] <http://www.blacksea-environment.org/text/Fisheries/Nicolaev1PP.pdf> [Date of access: 12 February 2004].
- NOSS, R. 1990. Indicators for Monitoring Biodiversity: A Hierarchical Approach. *Conservation Biology* (1990) 4(4) 355
- NPWRC (Northern Prairie Wildlife Research Centre). 2002. Introduction to the Malformed Amphibian Issue. [Web:] <http://www.npwr.usgs.gov/narcam/backgrnd/backgrnd.htm> [Date of access: 20 February 2004].
- NYBAKKEN, J.W. 1988. Marine Biology: An Ecological Approach. New York : Harper & Row Publishers.
- OLIVIER, W. & OLIVIER, S. 2001. Toergids vir Suid-Afrika. Cape Town : Struik.

OSBORNE, R. 1993. The Cycad Collection: Durban Botanic Gardens. Durban: Durban Botanic Gardens Publication.

OXENHAM, P. & EBERHARD, A. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

PALMER, C. 1997. Environmental Ethics: Contemporary ethical issues. California : ABC-Clío.

PARKER, R.H. 1975. The Study of Benthic Communities: A Model and a Review. Amsterdam : Elsevier.

PAUW, J.C. & DURHAM, B.D. 2001. State of Marine biodiversity in South Africa. [Web:] <http://www.scienceinafrica.co.za/3marine.html> [Date of access: 5 March 2003].

PAYNE, A.I.L., & CRAWFORD, R.J.M. 1995. Oceans of Life off Southern Africa (*In* Payne, A.I.L., & Crawford, R.J.M., eds. South Africa : Vlaeberg Publishers).

PEARSE, R.O. 1978. Mountain Splendour: The Wild Flowers of the Drakensberg. Cape Town : Howard Timmins.

PETER'S HOMEPAGE. 2002. Extinct Animals. [Web:] <http://www.home.conceptsfa.nl/~pmaas/bluebuck.html> [Date of access: 5 March 2003].

PIC (Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade). 2002. PIC Rotterdam Convention. [Web:] <http://www.pic.int.html> [Date of access: 25 March 2003].

PILLAR, S.C. & HUTCHINGS, L. 1995. Oceans of Life off Southern Africa (*In* Payne, A.I.L., & Crawford, R.J.M., eds. South Africa : Vlaeberg Publishers).

POPS (Stockholm Convention on Persistent Organic Pollutants). 2002. Stockholm Convention on Persistent Organic Pollutants. [Web:] <http://www.pops.int/documents/signature/signstatus.htm> [Date of access: 2 June 2003].

PRESTON-WHYTE, R. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

PRIMACK, R.B. 1993. Essentials of Conservation Biology. USA : Sinauer Associates Inc. Publishers.

RABIE, A. 1997. An Australian Perspective on Coastal Zone Management. The South African Journal of Environmental Law and Policy. (1997)(2) 233-242, October.

RAMSAR. 2003. The Ramsar Convention on Wetlands. [Web:] <http://www.ramsar.org.html> [Date of access: 25 March 2003].

RAMSAR. 2004. The Ramsar Convention on Wetlands. Ndumo Game Reserve [Web:] http://www.wetlands.org/RDB/Ramsar_Dir/SouthAfrica/ZA014D02.doc [Date of access: 25 March 2003].

RAWLINS, B. 1990. The Age of the Aquifer. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

RED DATA. 2002. SARARES. [Web:] <http://www.girlpower.co.za/sites/sabonet/reddata.html> [Date of access: 5 March 2003].

RHP (River Health Programme). 2003. Alien vegetation and the Working for Water Programme. [Web:] http://www.csir.co.za/rhp/state_of_rivers/state_of_crocsabieolif_01/info_wfw.html [Date of access: 20 February 2004].

RICHARDSON, B. 1998. Incentives for Sustainable Use of Wetlands: Australian Experience and Ideas for South Africa. The South African Journal of Environmental Law and Policy. (1998)(2) 205-236, November.

RIDL, J. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

ROBINSON, N.A. 1993. Agenda 21: Earth's Action Plan. New York : Oceana Publications.

ROSS, W. 2003. Biologists Consider Ban on Trawling. [Web:] http://www.propertyrightsresearch.org/articles3/biologists_consider_ban_on_trawling.htm [Date of access: 12 February 2004].

ROYAL SOCIETY. 2002. Coral Reef Damage. [Web:] <http://www.royalsoc.ac.uk/roty/coralReefDamage.htm> [Date of access: 26 May 2003].

SAFARI. 2000. Unprecedented Fire Season In Southern Africa Aids Air Quality, Climate Change Research. [Web:] <http://www.sciencedaily.com/releases/2000/11/001129075753.htm> [Date of access: 18 September 2006].

SATO, H & AOKI, Y. 2003. Mutagens. [Web:] <http://www.bentham.org/sample-issues/cdm3-3/sato/sato-ms.htm> [Date of access: 20 February 2004].

SAVITZ, J. 2003. Stop Sewage Dumping At Sea. [Web:] <http://www.miami.com/mld/miamiherald/news/opinion/5432733.htm> [Date of access: 26 May 2003]

SCHERR, S.J. 1999. Poverty-Environment Interactions in Agriculture: Key Factors and Policy Implications. [Web:] <http://www.undp.org/seed/pei/publication/agriculture.htm> [Date of access: 20 February 2004].

SCHNEIER, S.M. 1997. A Coastal Zone Management Policy for South Africa: Some Perspectives. *The South African Journal of Environmental Law and Policy*. (1997)(2) 167-184, October.

SCHRIJVERS, J. 2000. Towards Integrated Coastal Management for Saldanha Bay and the Langebaan Lagoon, South Africa. *The South African Journal of Environmental Law and Policy*. (2000)(1) 97-136, May.

SCOTT-SHAW, C.R. 1999. Rare and Threatened Plants of KwaZulu-Natal and Neighbouring Regions. Pietermaritzburg : KwaZulu-Natal Nature Conservation Service.

SEAFOOD. 2002. South Africa Notifies Japan on Decision to Ban Tuna Fishing. [Web:] <http://www.seafood.com/news/current/72899.html> [Date of access: 20 February 2004].

SEDAC (Socioeconomic Data and Applications Center). 2002. Antarctic Treaty. [Web:] <http://www.sedac.ciesin.org/texts/acrc/at.txt.html> [Date of access: 25 March 2003].

SIEGFRIED, W.R. 1989. Preservation of Species in Southern African Nature reserves. (*In* Huntley, B.J. ed. *Biotic Diversity in Southern Africa, Concepts and Conservation*. Oxford University Press : Cape Town.

SIMPSON, D. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (*In* Howe, G. & Preston-Whyte, R., eds. *Durban : Centre for Social and Development Studies*).

SMITH, G-G. 1958. Conservation of Natural Resources. New York : John Wiley & Sons.

SMITHERS, R.H.N. 1986. South African Red Data Book-Terrestrial Mammals. Pretoria : Council for Scientific and Industrial Research.

SOUHAMI, R. & TOBIAS, J. 1998. Cancer and its Management. UK : Blackwell Science.

SOUTH AFRICA. 1992. Department of Environmental Affairs and Tourism. Integrated Environmental Management Guideline Series. The Integrated Environmental Management Procedure, Volume 5. Pretoria : Government Printer.

SOUTH AFRICA. 1996. Department of Environmental Affairs and Tourism. Greenpaper on Biodiversity. [Web:]
http://www.polity.org.za/govdocs/green_papers/biodiv2.html [Date of access: 5 March 2003].

SOUTH AFRICA. 1999a. Department of Environmental Affairs and Tourism. State of the Environment South Africa. [Web:]
<http://www.ngo.grida.no/soesa/nsoer/issues/coast/impact.html> [Date of access: 5 March 2003].

SOUTH AFRICA. 1999b. Department of Environmental Affairs and Tourism. South African catches. [Web:]
<http://www.ngo.grida.no/soesa/nsoer/indicatr/indicato.html> [Date of access: 5 March 2003].

SOUTH AFRICA. 2000. Department of Environmental Affairs and Tourism, Strategic Environmental Assessment in South Africa. Pretoria: Government Printer.

ST ANDREW'S UNIVERSITY. 2000. Population, Poverty and the Environment. [Web:] [http://www.st-andrews.ac.uk/~wwwecon/postgrad/ISE/_EC5505_l6.pdf#search='poverty damage environment'](http://www.st-andrews.ac.uk/~wwwecon/postgrad/ISE/_EC5505_l6.pdf#search='poverty%20damage%20environment') [Date of access: 29 August 2005].

STEIN, R. 1997. Regulation of Waste Management in South Africa – A Case for Integration. The South African Journal of Environmental Law and Policy. (1997)(2) 253-268, October.

SWANSON, T. & JOHNSTON, S. 1999. Global Environmental Problems and International Environmental Agreements. UK : Edward Elgar Publishing.

TAIT, J., LANE, A. & CARR, S. 1988. Practical Conservation: Site Assessment and Management Planning. Walton Hall : The Open University.

TINLEY, K.L. 1985. Coastal Dunes of South Africa. South Africa : Council for Scientific and Industrial Research.

TROEH, F.R., HOBBS, J.A. & DONAHUE, R.L. 1980. Soil and Water Conservation: For Productivity and Environmental Protection. New Jersey : Prentice-Hall.

UGF (Urban Green File). 2002. Biodiversity publication. [Web:] <http://www.urbangreen.co.za/archives/regulars/7-3bionews.html> [Date of access: 5 March 2003].

UNCCD (United Nations Convention to Combat Climate Change). 2003. Convention on Desertification. [Web:] <http://www.unccd.int/main.php.ccd> [Date of access: 25 March 2003].

UNECE (United Nations Economic Commission for Europe). 2001. Consolidated Environmental Impact Assessment List. [Web:] <http://www.unece.org/env/eia/documents/eachecklist/consolidatedchecklist.pdf> [Date of access: 28 May 2003].

UNEP (United Nations Environment Programme). 2000. State of the Environment-Africa. [Web:] <http://www.grida.no/geo2000/english/0055.html> [Date of access: 5 March 2003].

UNEP (United Nations Environment Programme). 2002a. Global Environment Outlook 3. London : Earthscan Publications Ltd.

UNEP (United Nations Environment Programme). 2002b. Bonn Convention. [Web:] <http://www.unep.ch/seas/main/legal/lbonn.html> [Date of access: 25 March 2003].

UNEP (United Nations Environment Programme). 2003. Convention on International Trade in Endangered Species of Wild Fauna and Flora. [Web:] <http://www.cites.org.html> [Date of access: 25 March 2003].

UNEP (United Nations Environment Programme). 2003a. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. [Web:] <http://www.basel.int.html> [Date of access: 25 March 2003].

UNEP (United Nations Environment Programme). 2004. Marine pollution. [Web:] <http://www.unep.ch.html> [Date of access: 22 March 2003].

UNFCCC (United Nations Framework Convention on Climate Change). 2003. United Nations Framework Convention on Climate Change. [Web:] <http://www.unfccc.int.html> [Date of access: 25 March 2003].

UNFCCC (United Nations Framework Convention on Climate Change) 2003a. The Convention and Protocol. [Web:] <http://www.unfccc.int/resouce/convkp.html> [Date of access: 25 March 2003].

UNIVERSITY OF WATERLOO. 2004. Fragmentation. [Web:] http://www.science.uwaterloo.ca/course_notes/biology/biol499/forest.html. [Date of access: 7 February 2004].

VAN DER WALT, I.J. 2006. Verbal Communication with the Author. North-West University.

VAN WYK, A.E. & SMITH, G.F. 2001. Regions of Floristic Endemism in Southern Africa: A Review With Emphasis on Succulents. Pretoria (Hatfield) : Umdaus Press.

VAN WYK, B-E. & GERICKE, N. 2000. People's Plants: A Guide to Useful Plants of Southern Africa. Pretoria : Brizza Publications.

VAN WYK, B-E. & SMITH, G. 1996. Guide to the Aloes of South Africa. Pretoria : Brizza Publications.

VAN WYK, B-E., VAN OUDTSHOORN, B. & GERICKE, N. 1997. Medicinal Plants of South Africa. Pretoria : Brizza Publications.

VORSTER, P. 1995. Proceedings of the Third International Conference on Cycad Biology. Stellenbosch : Cycad Society of South Africa.

WARREN, A. & GOLDSMITH, F.B. 1974. Conservation in Practice. London : John Wiley & Sons.

WATLING, L. & ELLIOT, A. 1998. Disturbance of the Seabed by Mobile Fishing Gear: A Comparison to Forest Clear-Cutting. [Web:] <http://www.americanocceans.org/fish/trawlpack8.htm> [Date of access: 26 May 2003].

WATHERN, P. 1988. Environmental Impact Assessment: Theory and Practice. London : Unwin Hyman.

WCNCB (Western Cape Nature Conservation Board). 2000. State of Biodiversity: Western Cape Province, South Africa. [Web:] http://www.capenature.org.za/know_how/html.SOBProgramme.pdf [Date of access: 5 March 2003].

WEAVER, A. 1990. Rotating the Cube: Environmental Strategies for the 1990s. (In Howe, G. & Preston-Whyte, R., eds. Durban : Centre for Social and Development Studies).

WHC (World Heritage Convention). 2002. World Heritage Convention. [Web:] <http://www.cifor.cgiar.org/publications/html/AR-98/w-heritage.html> [Date of access: 25 March 2003].

WILBER, C.G. 1969. The Biological Aspects of Water Pollution. Springfield : Charles C Thomas Publisher.

WILLIAMS, M. 1990. Wetlands: A Threatened Landscape. Cambridge : Blackwell.

WILSON, E.O. 1992. The Diversity of Life. Cambridge: Belknap Press of Harvard University Press.

WOODWELL, G.M. 1990. The Earth in Transition. Cambridge : Cambridge University Press.

WRI (World Resources Institution). 2001. History of Extinction. [Web:] <http://www.wri.org/wri/biodiv/b03-koa.html> [Date of access: 5 January 2004].

WYNBERG, R. 2002. A decade of biodiversity conservation and use in South Africa: Tracking progress from the Rio Earth Summit to Johannesburg World Summit on Sustainable Development. *South African Journal of Science*, (2002)(98):233-243, May/June.

National legislation

SOUTH AFRICA. 1935. Sea-Shore Act, 21 of 1935. Pretoria: Government Printer.

SOUTH AFRICA. 1947. Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 36 of 1947. Pretoria: Government Printer.

SOUTH AFRICA. 1956. Explosives Act, 26 of 1956. Pretoria: Government Printer.

SOUTH AFRICA. 1963. Fencing Act, 31 of 1963. Pretoria: Government Printer.

SOUTH AFRICA. 1965. Atmospheric Pollution Prevention Act, 45 of 1965. Pretoria: Government Printer.

SOUTH AFRICA. 1967. Physical Planning Act, 88 of 1967. Pretoria: Government Printer.

SOUTH AFRICA. 1970. Mountain Catchment Areas Act, 63 of 1970. Pretoria: Government Printer.

SOUTH AFRICA. 1971. Water Research Act, 34 of 1971. Pretoria: Government Printer.

SOUTH AFRICA. 1973. Hazardous Substances Act, 15 of 1973. Pretoria: Government Printer.

SOUTH AFRICA. 1973. Sea Birds and Seals Protection Act, 46 of 1973. Pretoria: Government Printer.

SOUTH AFRICA. 1975. Lake Areas Development Act, 39 of 1975. Pretoria: Government Printer.

SOUTH AFRICA. 1976. National Parks Act, 57 of 1976. Pretoria: Government Printer.

SOUTH AFRICA. 1976. Plant Breeders Right Act, 15 of 1976. Pretoria: Government Printer.

SOUTH AFRICA. 1976. Plant Improvement Act, 53 of 1976. Pretoria: Government Printer.

SOUTH AFRICA. 1977. Livestock Improvement Act, 25 of 1977. Pretoria: Government Printer.

SOUTH AFRICA. 1980. Dumping at Sea Control Act, 73 of 1980. Pretoria: Government Printer.

SOUTH AFRICA. 1981. Marine Pollution (Control and Civil Liability) Act, 6 of 1981. Pretoria: Government Printer.

SOUTH AFRICA. 1983. Agricultural Pest Act, 36 of 1983. Pretoria: Government Printer.

SOUTH AFRICA. 1983. Conservation of Agricultural Resources Act, 43 of 1983. Pretoria: Government Printer.

SOUTH AFRICA. 1984. Forest Act, 122 of 1984. Pretoria: Government Printer.

SOUTH AFRICA. 1986. Marine Pollution (Prevention of Pollution from Ships) Act, 2 of 1986. Pretoria: Government Printer.

SOUTH AFRICA. 1987. Marine Pollution (Intervention) Act, 64 of 1987. Pretoria: Government Printer.

SOUTH AFRICA. 1988. Scientific Research Council Act, 46 of 1988. Pretoria: Government Printer.

SOUTH AFRICA. 1988. Sea Fishery Act, 12 of 1988. Pretoria: Government Printer.

SOUTH AFRICA. 1989. Environment Conservation Act, 73 of 1989. Pretoria: Government Printer.

SOUTH AFRICA. 1990. Agricultural Research Act, 86 of 1990. Pretoria: Government Printer.

SOUTH AFRICA. 1991. Minerals Act, 50 of 1991 National Heritage Resources Act, 25 of 1999. Pretoria: Government Printer.

SOUTH AFRICA. 1991. Physical Planning Act, 125 of 1991. Pretoria: Government Printer.

SOUTH AFRICA. 1992. Management of State Forest Act, 128 of 1992. Pretoria: Government Printer.

SOUTH AFRICA. 1993. Nuclear Energy Act, 131 of 1993. Pretoria: Government Printer.

SOUTH AFRICA. 1995. Development Facilitation Act, 67 of 1995. Pretoria: Government Printer.

SOUTH AFRICA. 1996. Antarctic Treaties Act, 60 of 1996. Pretoria: Government Printer.

SOUTH AFRICA. 1996. Constitution of the Republic of South Africa as adopted by the Constitutional Assembly on 8 May 1996 and as amended on 11 October 1996. (B34B-96.) (ISBN: 0-260-20716-7.)

SOUTH AFRICA. 1997. Genetically Modified Organisms Act, 15 of 1997. Pretoria: Government Printer.

SOUTH AFRICA. 1998. Animal Improvement Act, 62 of 1998. Pretoria: Government Printer.

SOUTH AFRICA. 1998. Marine Living Resources Act, 18 of 1998. Pretoria: Government Printer.

SOUTH AFRICA. 1998. National Environmental Management Act, 107 of 1998. Pretoria: Government Printer.

SOUTH AFRICA. 1998. National Forest Act, 84 of 1998. Pretoria: Government Printer.

SOUTH AFRICA. 1998. National Veld and Forest Fire Act, 101 of 1998. Pretoria: Government Printer.

SOUTH AFRICA. 1998. National Water Act, 36 of 1998. Pretoria: Government Printer.

SOUTH AFRICA. 1999. National Heritage Council Act, 11 of 1999. Pretoria: Government Printer.

SOUTH AFRICA. 1999. National Nuclear Regulator Act, 47 of 1999. Pretoria: Government Printer.

SOUTH AFRICA. 1999. Nuclear Energy Act, 46 of 1999. Pretoria: Government Printer.

SOUTH AFRICA. 1999. World Heritage Convention Act, 49 of 1999. Pretoria: Government Printer.

SOUTH AFRICA. 2000. Firearms Control Act, 60 of 2000. Pretoria: Government Printer.

SOUTH AFRICA. 2002. Animal Health Act, 7 of 2002. Pretoria: Government Printer.

SOUTH AFRICA. 2002. Mineral and Petroleum Resources Development Act, 28 of 2002. Pretoria: Government Printer.

SOUTH AFRICA. 2002a. Identification under Section 21 of activities, which may have a substantial detrimental effect on the environment: (Government Notice No. R. 670, 2002) *Government Gazette*, 23401:443, May 10.

SOUTH AFRICA. 2002b. National Environmental Management: Protected Areas Bill. (Notice No. 3391, 2002). *Government Gazette*: 24151 December 6.

SOUTH AFRICA. 2003. Draft National Environmental Management: Biodiversity Bill. (Notice No. 49, 2003). *Government Gazette*: 24311, January 24.

SOUTH AFRICA. 2003a. International Conventions and Agreements on Environmental Issues. [Web:] <http://www.environment.gov.za/Enviro-Info/env/intro.html> [Date of access: 25 March 2003].

SOUTH AFRICA. 2003b. National Environmental Management Air Quality Draft Bill. (Notice No. 555, 2003). *Government Gazette*: 24777, April 22.

SOUTH AFRICA. 2003c. Petroleum Pipelines Bill. (Notice No. 22, 2003). *Government Gazette*: 24584, March 14.]

SOUTH AFRICA. 2003. National Environmental Management: Protected Areas Act 57 of 2003. Pretoria: Government Printer.

SOUTH AFRICA. 2003. Petroleum Pipelines Act 60 of 2003. Pretoria: Government Printer.

SOUTH AFRICA. 2004. National Environmental Management: Protected Areas Amendment Act 31 of 2004. Pretoria: Government Printer.

SOUTH AFRICA. 2004. National Environmental Management Air Quality Act 39 of 2004. Pretoria: Government Printer.

SOUTH AFRICA. 2004. National Environmental Management: Biodiversity Act 10 of 2004. Pretoria: Government Printer.

SOUTH AFRICA. 2005. Genetically Modified Organisms Amendment Bill 34 of 2005. Pretoria: Government Printer.

Provincial legislation

SOUTH AFRICA. 1969. Nature Conservation Ordinance 8 of 1969. Pretoria: Government Printer.

SOUTH AFRICA. 1973. Bophuthatswana Nature Conservation Act 3 of 1973. Pretoria: Government Printer.

SOUTH AFRICA. 1974. Nature and Environmental Conservation Ordinance 19 of 1974. Pretoria: Government Printer.

SOUTH AFRICA. 1974. Nature Conservation Ordinance 15 of 1974. Pretoria: Government Printer.

SOUTH AFRICA. 1975. Gazankulu Nature Conservation Act 5 of 1975. Pretoria: Government Printer.

SOUTH AFRICA. 1976. Qwaqwa Nature Conservation Act 5 of 1976. Pretoria: Government Printer.

SOUTH AFRICA. 1983. Nature Conservation Ordinance 12 of 1983. Pretoria: Government Printer.

SOUTH AFRICA. 1983. Weeds Act (Venda) 12 of 1983. Pretoria: Government Printer.

SOUTH AFRICA. 1986. Nature Conservation and National Parks Act (Venda) 20 of 1986. Pretoria: Government Printer.

SOUTH AFRICA. 1987. Nature Conservation Act (Ciskei) 10 of 1987. Pretoria: Government Printer.

SOUTH AFRICA. 1987. Protected Areas Act (Bophuthatswana) 24 of 1987. Pretoria: Government Printer.

SOUTH AFRICA. 1992. KwaZulu Nature Conservation Act 29 of 1992. Pretoria: Government Printer.

SOUTH AFRICA. 1995. Mpumalanga Parks Board Act 6 of 1995. Pretoria: Government Printer.

SOUTH AFRICA. 1997. KwaZulu-Natal Nature Conservation Management Act 9 of 1997. Pretoria: Government Printer.

SOUTH AFRICA. 1999. KwaZulu-Natal Nature Conservation Management Amendment Act 5 of 1999. Pretoria: Government Printer.

SOUTH AFRICA. 2001. Northern Province Tourism and Parks Board Act 8 of 2001. Pretoria: Government Printer.

Court cases

Evans and Others v Llandudno/Hout Bay Transitional Metropolitan Substructure and Another 2001 (2) SA 342 (C)

Myburgh Park Langebaan (Pty) Ltd v Langebaan Municipality and Others 2001 (4) SA 1144 (C)

S. v Ferreira 1987 (1) SA 568 (T)

S. v Mawelele 1990 (2) SA 8 (T)