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THE DEVELOPMENT OF A NATIONAL POLICY AND STRATEGY FOR WETLAND CONSERVATION IN SOUTH AFRICA

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The development of a national policy and strategy for wetland conservation in South Africa

by

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

1.1.1 Importance of this study

Wetlands are South Africa's smallest and rarest landscape type, probably covering a total of less than 1% of South Africa's land area. Because South Africa is an arid country, this landscape type and the ecosystems found within it are threatened by a range of development actions. It is imperative that physical planning in South Africa takes place so as to promote the conservation of wetlands and their wise use. This has been recognised at the international level in the Convention on Wetlands (Ramsar, 1971). This study recognises the importance of South Afirca's wetlands, it reviews the international approach to wetland conservation, and provides a planning tool for wetland conservation in South Africa in terms of its Constitution and which will also assist us in meeting our international obligations.

1.1.2 The problem context

Landscape architecture which has been described as the science, technique and art of ecological, functional and aesthetic planning and design of exterior and open spaces for human use and enjoyment, for environmental conservation and rehabilitation (van Riet, 1986; Cowan, 1987; ILASA, sd). Thus landscape architecture goes well beyond being an artistic or design profession and the landscape architect, if suitably qualified, can be involved in ecological planning, which demands a number of multidisciplinary skills in the earth sciences, biological sciences and social sciences as well as a sound planning approach (van Riet, 1986).

Steiner and Brooks (1981) gave a succinct review of ecological planning. They defined planning as "the use of scientific and technical information to provide alternatives for making decisions" and ecology as "the relationship of all living things .... to their biological and physical environments". Thus they came to the definition of ecological planning as "the use of biophysical and sociocultural information for decision making" (Steiner and Brooks, 1981: 496). This concept has been advocated by numerous writers all over the world. Aldo Leopold advocated the ecological ethic for planning in the United States in 1949. Others who have developed or championed the ecological planning method are Hills (1961) in Canada, Glickson (1971) in Israel, Vroom (1980) in Holland, Wolski (1961) in Poland, while in the United States Juneja (1974), Johnson, Berger and McHarg, (1979), Lewis (1969), McHarg (1969), Olschowy (1975), Radford (1981), Robinson and Collier (1979) and Steiner (1980) show that this method gained an active foothold in that country. Smuts (1926) is credited as the first South African to venture into the field of holism or ecology (van Riet, 1986), followed by people such as Phillips (1972, 1983), Giliomee (1977), MacVicar (1978), van Riet (1986) and Cowan (1987). More recently, this approach has been identified as a crucial component of the Convention on Biological Diversity, where the ecosystem approach is advocated (SBSTTA, 1997) and accepted (CBD-COP4, 1998).

Landscape architectural projects are carried out at a range of levels. Most often these are at site level, quite often at local level (eg open space planning for a town/city), in the context of nature usually at the level of protected area planning. A landscape planning approach at provincial level has been used to identify areas for potential conservation areas (Cowan, 1987). Wetlands, being an integral part of the hydrological system, and subject to a wide range of demands and impacts due to human activities, require planning at least catchment level. In South Africa this is well beyond provincial level (consider the Orange River alone, has a catchment area which includes parts of or all of six provinces and two other states. They are considered both functional and ecological systems, and this study utilizes the ecological planning method at a national scale using approaches which are currently being explored at and encouraged at international fora and adapted to the South African situation.

1.1.3 The main problem

Even though wetlands are a small but extremely important part of the South African landscape, their conservation has been sorely neglected. This is due to:

- South Africa not knowing the extent of its wetlands;
- South Africa does not have a planning tool in place for the conservation of this important landscape type;
- Therefore South Africa cannot meet its international commitment in terms of wetland conservation

1.1.4 Definitions

In this study the following terms are used:

conservation	-	the protection, management and sustained utilization of a resource;
CBD	-	Convention on Biological Diversity;
CMS	-	Convention on Migratory Species;
Contracting Parties	-	governments which have ratified a convention
Convention on Wetlands	-	Convention on Wetlands of International Importance especially as Waterfowl Habitat, signed in Ramsar, 1971
COP	-	conference of (contracting) parties
ecosystem	-	an unit consisting of both the biotic communities and the abiotic environment with interact to produce a dynamically stable system
endorheic	-	wetland systems with a closed drainage system

estuarine	-	wetland systems associated with estuaries
habitat	-	the natural environment of a plant or animal
hydrology	-	the science or study of water
hydrophyte	-	plant adapted to living in water or saturated conditions
hydrophytic soil	-	poorly drained or saturated soils
lacustrine	-	wetland systems associated with lakes
landscape	-	a classification of an area based on its landform, cover and their dynamics
lentic ecology	-	ecology of standing water
lotic ecology	-	ecology of running water
marine	-	wetland systems associated with the ocean
palustrine	-	wetland systems associated with emergent plants
policy	-	the principles which indicate intended activities for government
protected area	-	an area protected by law such as a national park or nature reserve
Ramsar	-	see Convention on Wetlands
region	-	a contiguous area with recognizable features, differentiating it from others
riverine	-	wetland systems associated with rivers
SBSTTA	-	Subsidiary Body for Scientific, Technical and Technological Advice to the CBD
strategy	-	the actions to be taken to ensure the implementation of a policy
taxa	-	any taxonomic (ordered or systematically named) group or entity
topography	-	the configuration of the earth's surface
wetland	-	an ecosytem whose driving force is water

1.2 LANDSCAPES

Geomorphologists describe landscapes as synonymous with landforms (Bloom 1969). Landforms have been described in terms of their evolutionary history covering structure, process and time (Davis in Bloom, 1969). Calvin *et al* (1972) define landscapes purely in terms of aesthetics. Dearden (1980) defined landscapes in terms of land form, land-use and land features, as well as in visual terms. A broader view of landscapes has been taken by landscape architects (Mc Harg, 1969; Olschowy, 1975; Steiner and Brooks, 1981; Giliomee, 1977; van Riet, 1986; Cowan, 1987) and other planners (Rowe and Sheard, 1981; Tubbs and Blackwood, 1971; MacVicar, 1978) where landscapes are defined in terms of ecological inventories or classifications of regions into similar units.

This thesis proposes that wetlands are a particular landscape type, which require specific attention in planning and development especially due to their connection through the hydrological system, which has the ability to transfer pertubations to the system a long way from their source. For this purpose a definition of landscape will take into account the interrelationship between the physical factors (such as hydrology, geomorphology, soils), the biological factors (flora, fauna and ecological interactions between the abiotic and biotic environments) as well social factors (such as man's influence on the systems and the systems value to man).

Definition: A landscape is a homogenous area showing typical combinations of features, comprising of landforms, their associated substrate, typical vegetation, providing a habitat for its associated fauna. The landscape may have a significant influence on the climate, hydrology and man. In turn, man may have a significant influence on a landscape.

1.3 WETLANDS

Wetlands is a relatively new term used to describe the landscape that many people knew before under different names and indeed is used as a generic term for any ecosystem which has an aquatic base or hydrological driving force. Wetlands occur in many different climatic zones, in many different locations from the upper reaches of a catchment, through river mouths and estuaries and include coral reefs, and have a wide range of soil and sediment characteristics. Because of this, wetlands have been an integral part of the landscape since earliest times, and often an integral part of the economy. Consequently they have been given various names used differently in a number of locations which add to the confusion (Williams, 1990). For example in there are some 90 different English terms to describe peat lands, and alternatively, in South Africa the term "vlei" is used to describe lakes (eg Rondevlei), reed marshes (eg Blood River Vlei / Bloedriviervlei) and flood plain grasslands (eg Nylsvlei).

Whatever the local name given to them, the distinguishing feature of all wetlands is the interplay between the land and the water, and the consequent characteristics which reflect both. The water regime may be a result of a number of different factors such as the periodic flooding of flood plains, tidal rise and fall, impeded surface flow due to geological and or geomorphological processes (such as tilting, uplift or landslip, land subsidence, deposition of sediments in estuaries or deltas, the impediment of subsurface flow by aquicludes), or the rising of the water table to above surface level. All these contribute to standing water, or to saturated or waterlogged soils.

While hydrology is the salient factor in the formation of wetlands, it by no means explains their distinctiveness. Wetlands have a distinctive and characteristic vegetation, often at odds with the surrounding vegetation. This vegetation is adapted to wet conditions (hydrophytes), being covered by water for at least part of the growing cycle and thus deficient in oxygen. It also decomposes slowly and thus contributes to the process of wetland formation or maintenance by trapping silt or forming peat. Wetland fauna also has specific adaptions such

as the ability to breathe under water, or have developed behavioural patterns making use of wetlands such as moulting at seasonally high water levels. Wetland soils, also known as hydrophitic soils, are adapted to anoxic biochemical processes. They are physically volatile and are in constant flux with the decomposition of the vegetation and the erosion of sediments with river flow, flood and tidal shift. The interaction between water level, sedimentation and decomposition is finely balanced, and within the soils there are biochemical processes at work as energy flows through the ecosystem leading to the transformation and trapping of nutrients. All of these factors lead to a highly diverse ecosystem type which is one of the most productive in the world, and their products have been a constant lure to mankind (IUCN, 1980; OTA, 1984; Mitsch and Gosselink, 1986; Williams, 1990; Cowan, 1995a; SBSTTA, 1997).

1.3.1 Wetlands Definition

There are a number of definitions of wetlands in use. As South Africa is a Contracting Party to the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar 1971), the definition accepted by the Convention is used here. Article 1.1 of the Convention defines wetlands as:

> "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres".

These areas may also include adjacent riparian and coastal zones (Article 2.1). This is an intentionally broad definition used to help stem encroachment on habitats as diverse as mangrove swamps, peat bogs, water meadows, coastal beaches, coastal waters, tidal flats, mountain lakes and tropical river systems.

1.4 WETLAND BENEFITS

The importance of wetlands, their functions, attributes and values cannot be overestimated. As an integral part of the hydrological cycle they are influenced by and in turn influence runoff patterns, they include ecosystems and habitats containing high diversity and large numbers of endemic and threatened species, which are unique or associated with key ecological processes. They perform valuable ecological functions and their components are of scientific, social and economic importance. They directly support millions of people and provide goods and services to the world outside the wetland.

There are many ways of categorizing these functions and values. Tiner (1984) proposes three categories: fish and wildlife values, environmental quality values and socio-economic values. The OTA (1984) report suggests two: intrinsic values and ecological services and resource values. Williams (1990) proposes four: physical/hydrological, chemical, biological, and socio-economic. Barbier, Acreman and Knowler (1997) classifies the economic value of wetlands into use values (direct use value, indirect use value and option value) and non-use values (existence value). The possibilities of combining these functions and values under different groupings is endless, and it must always be remembered that none of these categories, whichever system is used, is exclusive. Each could have a profound effect on the other. For example, chemical pollution will effect biological processes and thus wildlife habitats and biological diversity. Secondly, no one benefit is exclusive to any one category. For example flood attenuation by a wetland is a natural function and could be seen as a hydrological benefit, but is also obviously a socio-economic benefit (Williams, 1990).

Some of the functions and values recognized by various authors include:

> nutrient retention, nutrient export, groundwater recharge, groundwater discharge, flood attenuation and flow regulation, sediment retention, erosion control, coastal protection,

salinity control, water treatment, pollution trapping, removal of toxic residues, waste processing, climate stabilization, role in the life cycle of some fauna species, ecosystem stability, contribution to stability of other ecosystems. To this list can be added the numerous resources that wetlands provide and are utilized by society including: the provision of agricultural resources, fishery resources, forage resources, forest resources, wildlife resources, natural products, water supply energy resources. Finally a number of non-consumptive benefits are provided to society by wetlands including transport corridors, tourism and recreational opportunities, and attributes including: scenic values, uniqueness, naturalness, rarity, aesthetic values, archaeological, cultural heritage, scientific, research, educational, biological diversity (Williams, 1990; Davies and Claridge, 1993; Cowan, 1995a, 1995b,1995c; Roggeri, 1995; Frazier, 1996; Barbier *et al,* 1997; Costanza, d'Arge, de Groot, Faber, Grosso, Hannon, Limburg, Naeem, O'Niell, Paruelo, Raskin, Sutton and van den Belt, 1997).

1.5 APPROACH

Accepting that wetlands are a special type of landscape, they are spread widely across the countryside and that they provide both tangible and intangible benefits to society, which in turn exploits them, their conservation (defined as protection, management and sustained utilization) is essential. The protected area approach to conservation of these landscapes is inadequate since they are affected by events occurring outside the boundaries of the protected site. Article 3.1 of the Ramsar Convention obliges Contracting Parties to include the conservation of wetlands in their land use planning. This is being promoted through the emphasis on the wise use of all wetlands which includes the adoption of a national wetland policy. This approach is being supported through the Convention on Biological Diversity (Davis, 1993, 1994; SBSTTA, 1997; CBD-COP4, 1998).

1.6 PROBLEM STATEMENT

South Africa, in common with the rest of the developing world is undergoing rapid population growth. With the changes in political power, this has led to the need for rapid development (eg the fast tracking RDP (Reconstruction and Development Programme) and SDIs (spatial development initiatives).This pressure in turn leads to an increasing demand on our natural resources. These conditions often result in the destruction of the very natural resources that our sustained development depends on (van Riet, 1986).

Man has always been dependant on nature, and it is clear that for his continued existence, natural resources will have to be carefully managed for their sustained utilization. Since the industrial revolution, man's capacity to disturb and destroy the ecosystems on which he is dependant for his existence has increased exponentially. The demand for land for agricultural, industrial and urban purposes as well as the demand for natural resources such as minerals and water, is increasing at such a rate that the normal constraints operating in a natural system are often eliminated. The pressure of people is outstripping the potential of the natural system to support such an increase in demand.

While some natural resources are robust, and can bear sustained utilization pressure, others are so unique and sensitive that great circumspection is required when exploiting them in order to avoid destroying their inherent natural value.

Wetlands exhibit both of these characteristics. Wetlands and their resources have always been utilized by society and yet, they require due respect when being exploited if they are to continue being of benefit to it. Wetlands were identified as the third most important life support system on this planet in the World Conservation Strategy (IUCN ,1980), and have been valued at between 1,4 and 1,8 times the global gross national product (Costanza *et al*, 1997).

Wetlands are places where marine, aquatic, and land ecosystems meet and interact. Despite the relatively small area they represent, they support an enormous variety of plants, invertebrates, fish, reptiles, birds and mammals. All of the major taxonomic groups which are likely to contain in excess of 100,000 species occur in fresh water (McAllister, 1997). Many species can survive nowhere else. About one quarter of the wold's vertebrates are restricted to fresh water systems (Kottelat and Whitten, 1996).Other species utilize wetlands on a global scale. In the southwestern Cape alone, over 50 species of migratory birds depend on the local wetlands (Hockey, Underhill, Neatherway and Ryan, 1989; Smit and Hiersma, 1989). Anything happening to these wetlands has implications for wildlife in other countries and continents.

Wetlands moderate water quantity and quality. Acting as natural filters and vast "sponges", wetlands take up run-off, attenuate floods, reduce erosion, recharge groundwater, trap sediments, recycle nutrients, oxygenate the water, and release the purified water gradually back into the system.

Wetlands are important sources of fish, crustaceans, shellfish and other food for people. They provide housing material and certain medicinal plants. They are the source of the water that sustains agriculture, industry, and our towns and cities.

Wetlands are valuable research and educational resources. The scenic beauty of their open landscape as well as wildlife make wetlands popular tourist and recreation destinations, vital to local economies and an integral part of our cultural heritage (Maltby, 1991).

Even with all these values, wetlands worldwide are under threat (McComb and Lake, 1988; Finlayson and Moser, 1991; Scott and Poole, 1989; Hughes and Hughes, 1992). Although society has always made use of wetlands and their resources, in the last 200 years, as a result of the Industrial Revolution, rapid economic development and population growth, transformations of wetlands have been brought about on an unprecedented scale. Overexploitation of the resources has been rampant, resulting in massive extinctions of

species. Worldwide, it is estimated that over 20 per cent of freshwater fishes are either recently extinct, endangered or vulnerable (McAllister, 1997). Man-made changes to the landscape are extensive and accelerating, and they have significant consequences on wetlands. The construction of dams, navigation channels, flood control and irrigation structures, along with wetland drainage are the most obvious signs of human intervention on wetlands. Land-use activities in the catchment areas of wetlands, including agriculture, silviculture, deforestation, mining, overstocking, industrialization and urbanization, all contribute to the degradation of wetland systems through water withdrawals and/or additions of nutrients, pollutants and sediments. Increasing demand for water for many activities is a real cause for concern as this affects the maintenance of healthy ecosystems. Between 1900 and 1995 water withdrawals worldwide increased by a factor of six, more than double the rate of population growth. The introduction of alien invasive species into wetland systems is also causing wide concern (Dugan and Jones, 1993; Abromovitz, 1996; Kottelat and Whitten, 1996; Stiassney, 1996; SBSTTA, 1997).

The situation is no different in this country. South Africa is an arid country. The average annual rainfall of about 497 mm for the country as a whole is well below the world average of 860 mm. A relatively narrow region along the eastern and southern coastlines is moderately well watered, but the greater part of the interior and the western portion of the country are arid or semi-arid. Sixty five percent of its area has a mean annual precipitation of less than 500mm, while 21% of the country receives less than 200mm. Over most of the country the average annual potential evaporation, which ranges from about 1 100 mm to more than 3 000 mm, is well in excess of the annual rainfall.

It follows that South Africa is a country with very few wetlands. To make the situation worse, it has been estimated that over half of the wetlands have been destroyed and lost (Breen and Begg, 1989; Kotze, Breen and Quinn, 1995). Those that remain are some of our most threatened natural areas (Noble and Hemens, 1978; Zaloumis, 1987; Begg, 1990).

Despite the benefits provided by wetlands, South Africa lacks a planning tool for effective wetland conservation. With such heavy losses to a small but extremely important landscape type it is imperative that a strategy to conserve wetlands be developed. The strategy should be based on an understanding of the types and distribution of wetlands in South Africa, the international obligations South Africa is under, and the structure of conservation management in South Africa.

This study aims to do just that. A hypothesis is proposed and then tested against four goals.

1.7 HYPOTHESIS

A policy and its implementation strategy is a means of planning for wetland conservation which will enable South Africa to meet both its national objectives and international obligations.

This hypothesis is further divided into three secondary hypotheses for testing and for setting goals for this study:

1.7.1 South Africa does not know the extent of its wetlands;

1.7.2 South Africa is not meeting its international obligations in terms of wetland conservation;

1.7.3 A wetland conservation policy can provide an effective land-use planning tool.

1.8 GOALS

To test this hypothesis three goals are set:

1.8.1 To determine what is known about South Africa's wetlands, and to improve on that knowledge;

1.8.2 To determine the relevant international obligations for wetland conservation, South Africa's approach to meeting them, and to identify the major obligations not met by South Africa;

1.8.3 To develop a model national wetland conservation policy aimed at improving wetland conservation in South Africa, thereby assisting South Africa meet its international obligations and make wise use of a neglected, but valuable resource.

1.8.4 To propose a strategy for the implementation of the policy in terms of South Africa's infrastructure.

In chapter two wetland regions are defined based on the fundamental elements of any natural landscape. The relevant landscape regions are identified, mapped and described.

Chapter three analyses a large sample of South African wetlands in terms of type, threats and conservation status. An analysis of our wetlands and their status is considered necessary to determine the where the needs for such a policy and strategy are most needed.

Chapter four introduces the Convention on Wetlands of International Importance especially as Waterfowl Habitat, being the main international instrument for the conservation of wetlands. The obligations of Contracting Parties are set out and South Africa's role in the convention to date elaborated on.

Chapter five develops a national wetlands conservation policy and a strategy for its implementation which is based on the preceding chapters. The policy and its strategy is essentially a tool for the protection, management and utilization of this important landscape unit and all its

functions, values and attributes.

The conclusion, Chapter six of this thesis is that the development of a conservation policy and strategy forms part of the ecological planning approach developed by a number of esteemed landscape architects and other planners (see below).

1.9 ASSUMPTION

The Ramsar Convention on Wetlands' approach to wetland conservation is not questioned because:

- It is an international agreement;
- It is supported by a range of expertise from across the globe;
- South Africa has been intimately involved and has contributed substantially to its development.

1.10 LIMITATIONS

This application of this study is limited to the Republic of South Africa only.

As a number of new policies (eg Water Policy, Policy on the Conservation and Sustainable Use of South Africa's Biological Diversity) and acts (eg National Environmental Management Act No of 1999, Water Act No of 1998) have been recently promulgated, and more are under development, and the Ramsar Convention is under continuous review, the literature review for this study is limited to the end of 1998. Indeed it is anticipated that the Ramsar COP7 will support the

previous Conferences of Parties and reemphasize the importance of implementing national planning so as to promote the conservation and wise use of our wetlands[1].

1.11 SUMMARY

In this chapter the importance of wetlands as an element of the South African landscape is identified. A definition of wetlands is proposed and their benefits noted. Problems wetland conservation is facing worldwide, and particularly in this country are highlighted.

It was shown that wetlands are a small but extremely important part of the greater South African landscape. although South Africa recognized this by becoming a Contracting Party to the Convention on Wetlands as far back as 1975, wetland conservation in South Africa has been sorely neglected. Based on these findings a hypothesis is presented and goals set for this thesis.

The assumption that the Convention on Wetlands is not questioned is made and limitations are set in terms of study area and time for this study.

[1]At the Ramsar COP7 held in Costa Rica during May 1999 this proved to be the case.

CHAPTER 2

WETLAND REGIONS OF SOUTH AFRICA

2.1 INTRODUCTION

The hypothesis that wetland conservation has been sorely neglected, and that a national wetland conservation policy will provide a planning tool meets its first test here.

The development of a set of wetland regions is considered the first step in planning for the conservation of a country's wetlands. This chapter will review previous efforts at identifying wetland regions. After having shown that regions based on the distribution of limited sets of biota to be inadequate, and relevant only to them, a set of wetland regions for South Africa, based on the more substantial abiotic characteristics of the country is proposed.

2.2 BACKGROUND

A region is defined as a contiguous area which has a set of recognizable features, which together differentiate the region from another. Ecosystem regionalization is the process of delineating usually large units of land according to the ecological relationships among neighbouring ecosystems. A boundary is placed around groups of ecosystems that are related, and that show similarities in both appearance and structure (Bailey and Hogg, 1986).

Regional variations are important in the development of ecosystems, and most often, different regions have different management-conservation problems. It is therefore important to recognize regional differences in order to facilitate:

a Synoptic planning of large areas where it is necessary to study conservation

problems and potential solutions on a regional basis;

b Organization and retrieval of data generated in inventories; and

c Interpretation of inventory data (Bailey and Hogg, 1986).

A substantial volume of work has been completed in developing terrestrial ecoregion maps throughout the world (Dasman, 1972; Udvardy, 1975; Rowe, 1980; Bailey, 1983; Bailey and Hogg, 1986; Omerink, 1987). Similarly terrestrial biogeographical divisions for southern Africa have been reviewed by Werger (1978), Phillips (1983), Meadows (1985) and Rutherford and Westfall (1986).

A number of abiotic factors have been identified by the above authors, which should be taken into account when developing regions. It is recognized that regions developed from a combination of these factors would be able to determine its biotic characteristics. This method has been used with success in the forestry and horticultural industry to determine growing regions and therefore to determine suitable species for planting in those regions (Poynton, 1971, 1971b, and 1984). In order to delineate wetland regions for South Africa the factors which determine wetland regions are identified. The regions are described in terms of these factors, and a comparison of regions proposed by authors using biotic factors is made.

2.3 STATE OF KNOWLEDGE

In South Africa, a number of other authors have suggested regions or zones based on the distribution of species or suites of species. A review of those papers which consider species which are wetland related, reveals the value of the wetland regions proposed in this thesis.

Winterbottom (1959) proposed four zoogeographical divisions within South Africa based on the avifauna of the region. He had built on previous work by Chapin (1923), who had considered ecological aspects of bird distribution in tropical Africa into two regions; and

Hewitt (1910), who deduced zoological regions of South Africa based on its herpetology. The four divisions proposed by Winterbottom (1959) are the south west arid region, its western border approximating the 500mm isohyet, the east African coastal region, the highveld region and the Rhodesian highlands region. It should be noted that the avifauna considered was much wider than waterbirds.

Milstein (1989) in considering wetlands as a habitat for waterbirds, divides southern Africa into five broad zones based on vegetation, temperature and rainfall. While his tropical zone falls outside South Africa, the East coast zone can be considered an extension of the tropical zone, being a corridor of considerable importance north of Richards Bay. His highveld zone comprises much of the inland plateau of southern Africa, and is characterised by shallow pans and depressions with some ancient flood plains. The winter rainfall zone, with approximately the same boundaries as the Fynbos biome (Rutherford and Westfall, 1986), has few major wetlands. The Arid zone, corresponding to the driest biomes of the western half of the subcontinent, only contains wetlands of importance when depressions are flooded by the erratic and infrequent rains of this region. These are then used by nomadic waterbirds. Finally, to complete the series of wetland habitats Milstein includes the oceans, sea-shores and off-shore islands. They have their own distinctive bird faunas.

Poynton (1964) refines the work of Hewitt (1910) with a comprehensive survey of the amphibia of southern Africa. He found that the amphibian fauna appeared to be polarized into a tropical fauna and a south-western Cape fauna, with a large, but essentially heterogenous assemblage of forms occupying the intermediate or transitional area. He determined that the 18°C July isotherm can be used to delimit the tropical faunal region, and the limits of the main portion of the Cape flora (Veld Types 46, 47 and 48 of Acocks, 1953) can be used to delimit the Cape faunal region. He noted that "these features cannot be cartographically precise or permanently fixed, but this is indeed an advantage, since it allows the terms "tropical" and "Cape" to be used in a consistent sense despite long-termed changes in the climate and consequently of the faunal pattern in relation to geographical points." (Poynton, 1964: 229-230). A point well made, being as valid today with such aspects as the El nino phenomenon and the effects of global warming, as it was then.

In his discussion on the distribution of fresh water fish in southern Africa, Bowmaker (1978) identified the geomorphological processes, starting in the Cretaceous as determining the distribution and characteristics of the aquatic ecosystems in the region. Further, he noted that present day climate has a profound effect on conditions on rivers, particularly temperature and flow on a short term basis. Hence latitude, altitude and rainfall all have profound influence on river systems. Five broad climatological zones were identified for South Africa:

> The tropical zone where temperatures are high enough to support warm water fish species, with mainly permanent rivers with maximum flow during the summer months.
>
> The winter rainfall zone includes most of the western portion of the south coastal drainage system, with its temperate climate and permanent rivers.
>
> The semi-arid zone lies between these two zones and west of longitude 25°E; this is an area of low, erratic rainfall with high day temperatures and low night temperatures, its few perennial rivers being fed from outside the zone.
>
> The Drakensberg Lesotho highlands zone is dominated in the east and south by the highlands of these names, but includes most of the eastern plateau region. This is a zone of cold waters, mainly permanent, with a summer high flow.
>
> The east-coast lowland zone is a transitional zone with summer rainfall, more frequent to the north, its climate temperate to tropical depending on the topography.

It was suggested by Allanson, Hart, O'Keefe and Robarts (1990) that the geomorphological, geochemical and climatological features of southern Africa may be used to define five limnological regions for the subcontinent. These are:

> A subtropical coastal peneplane with a strong marine influence. It has extensive flood plains, a great diversity of shallow wetlands, flood plain pans and freshwater lakes. The zone has elevated salinities in subsoil water. It is an important tropical subtraction

zone.

The summer rainfall region of the elevated plateau and the south eastern coastal plain with both temporary and permanent surface water with total dissolved solids (TDS) less than 500 mg/l, alkaline pH varying between 7,5 and 9. Rivers, endorheic pans and vleis (*Phragmites* dominated, shallow wetlands associated with rivers) characterize the region.

The elevated mountain massif of Lesotho, the so called australo-montane region with surface water TDS concentration of 47-273 mg/l, pH 6,6-8,4 (pH higher than 7,5 in lowland streams). The alpine bogs of Lesotho are found in this region.

. The temperate acid waters of the western Cape arising principally from the Table Mountain Sandstone in the mountainous regions, but at lower levels variously influenced by salts of marine origin, which increase buffering capacity so that pH may increase to neutral. This region is characterized by the peat stained acidic waters with their endemic fauna.

The arid west stretching northwards from inland of Port Elizabeth into Namibia and southern Botswana. Surface waters are temporary, with high TDS and alkaline pH.

Davies, O'Keefe and Snaddon (1993) in their synthesis on South African river ecosystems support the five regions defined by Allanson *et al* (1990). They feel that description of the regions by Allanson *et al* is essential for an understanding of the lotic ecology of the subcontinent. The combination of geomorphology, geochemistry and climate are essentially those used to determine wetland regions in this paper, which should be considered as a refinement of their proposals.

At a workshop held at the University of Cape Town (Eekhout 1993) on the requirements of potential users of a national river classification, the delegates were asked to draw boundaries of geographic regions within which they considered rivers to be of a similar nature. The

resultant 14 regions were defined by a combination of two or more of following variables:

> geology, geomorphology (channel morphology), climate, hydrology (eg persistence/seasonality of flow, runoff response to rainfall (volume and intensity)), hydraulic characteristics, water chemistry (eg total dissolved solids (TDS), dominant major ions (Na+K):(Ca+Mg) ratios,Cl:SO4 ratio) and biota (Macro-invertebrate distribution, vegetation type).

The fourteen regions identified by the delegates were south-western Cape, Olifants system (W Cape), south-western Cape shales, southern Cape, Karoo, Natal coastal, Natal tropical, Natal highlands, Orange River, eastern Transvaal escarpment, eastern Transvaal lowveld, highveld, highveld tropical, and interior.

While the characteristics provided by the delegates were by no means complete, and in many cases not well defined, this exercise proved that there is a need for a regionalization which goes well beyond the broad lumping of the earlier authors. The delegates also made the following suggestions which are equally valid for wetlands in general, and not just rivers:

> The biotic classification of rivers in South Africa may be better approached by defining regions using abiotic data and then testing biotic distributions against these regions; and
>
> Temperature and runoff were important variables which should be included in the deliniation of ecoregions.

It is these last two points which this thesis addresses. It is concluded that the use of a limited set of biota or a taxon is inadequate for determining wetland regions. There is a need to go wider than river systems and species distribution. Wetland regions for a country like South Africa must be robust enough to account for all groups of taxa. This is only possible if the abiotic characteristics of the country are considered as the driving force. Indeed, this is supported by implication by many of the authors cited above.

2.4 PROBLEM STATEMENT

While broad terrestrial ecoregions may be of some use in wetland ecosystem planning and management, it is felt that wetland regions can and should be defined separately, especially in an arid region such as South Africa, where wetland ecosystems are often atypical of, or exotic to the terrestrial ecoregions.

2.5 METHODS

The Canadians define wetland regions as areas within which similar and characteristic wetlands develop in locations that have similar topography, hydrology, and nutrient regimes. Subdivision of the wetland regions are made based on the distribution of these wetlands, the relative abundance of the various kinds of wetlands, or development trends somewhat divergent to those in the rest of the region . Regional studies in Europe and Asia have shown that broad geographic regions have characteristic wetlands. In Canada regional differences in the development of wetlands is readily apparent. Some of these differences relate to the distribution or abundance of wetlands. Although distribution is often influenced by physiography, the development and the establishment of specific kinds of wetlands can be attributed to climatic factors (National Atlas of Canada, 1986; National Wetlands Working Group, 1988).

The methodology used here to identify South Africa wetland regions is as follows:

1. Identify those factors (determinants) which have an influence on the topography, hydrology and nutrient regime of wetlands in South Africa;

2. With the aid of GIS (geographic information system) as a data management tool, map those factors individually, then collate and analyse them as a group

to determine regions. Typical wetlands will be incorporated into each region. It should be noted that regions will not be exclusive to any wetlands except in some cases.

2.5.1 Determinants

Topography is determined by the underlying geology of a region and the processes of geomorphology acting upon that geology. Wellington (1955) proposed geomorphologic regions of South Africa. These were adapted by King (1967). Truswell (1970) provides an overview of the historical geology of South Africa. More recently Kruger (1983) produced a terrain morphological map of southern Africa as an indicator of terrain ruggedness. Partridge and Maud (in Dardis and Moon, 1988), showed the distribution of erosion surfaces and dissected areas of South Africa refined the earlier work.

Hydrology is determined by a combination of climate (Schultze, 1947; Schultze, 1965; Schulze and McGee, 1978; Clemence, 1986) including rainfall regions (Dent, Lynch and Schulze, 1987) and runoff (Koch and Schmidt, sd) and topography (Department of Water Affairs, 1986).

Nutrient regime is probably the most complex of the three factors. In identifying abiotic factors which will determine nutrient regime it was decided that climate (in terms of temperature zones as well as humidity zones (rainfall : potential evapotransiration)) will be used (after Poynton, 1984) as well as the stratigraphy (Kent, 1980) for its affect on the water chemistry, especially the pH (Bond, 1946) on the waters.

2.6 RESULTS: WETLAND REGIONS OF SOUTH AFRICA

2.6.1 The Study area

South Africa is a diverse country with some special aspects which determine the wetland types,

their distribution, and the pressures which are being exerted on them.

2.6.1.1 Climate

South Africa is an arid country. The average annual rainfall of about 497 mm for the country as a whole is well below the world average of 860 mm. A relatively narrow region along the eastern and southern coastlines is moderately well watered, but the greater part of the interior and the western portion of the country are arid or semi-arid. Sixty five percent of its area has a mean annual precipitation of less than 500mm, while 21% of the country receives less than 200mm (fig 2.1). This precipitation has a disparate seasonal and spatial distribution (fig 2.2). Over most of the country the average annual potential evaporation, which ranges from about 1 100 mm to more than 3 000 mm, is well in excess of the annual rainfall (fig 2.3).

2.6.1.2 Geomorphology

Topography is determined by the underlying geology of a region and the processes of geomorphology acting upon that geology.

Most of the country consists of a geologically warped plateau at more than 1 000 m above sea-level with only a narrow coastal strip separated by a steep escarpment (figs 2.4 and 2.5). Therefore there are few lowland wetland regions of any significance. The coastal plain is narrow in the south and broadest in the north-east on the Mozambique border. In places the coastal plain has been deeply dissected by river valleys. The valleys of the Limpopo and Orange rivers penetrate deep into the interior. The Great Escarpment forms a mountain belt surrounding the plateau, reaching its greatest elevation in the Drakensberg, along the Lesotho border, where basalt deposits overly earlier sandstone formations. In the south the distinctive Cape fold mountains are interposed between the coast and the Great Escarpment. They consist of a double east-west orientated arc from Algoa Bay to the S-W Cape and a north-south arc parallel to the west coast. Although karst landscapes are not typical of the country, dolomitic formations are found in a band through the central part of the country and the north eastern escarpment, further minor formations are found along the southern marginal area (Wellington,

1955; King, 1967; Truswell, 1970, 1983; Partridge and Maud, 1988; Skelton 1993).

2.6.1.3 Hydrology

The largest river system in South Africa, that of the Orange River flows westwards, draining the

Fig 2.1 Annual rainfall of South Africa (after DWAF 1992)

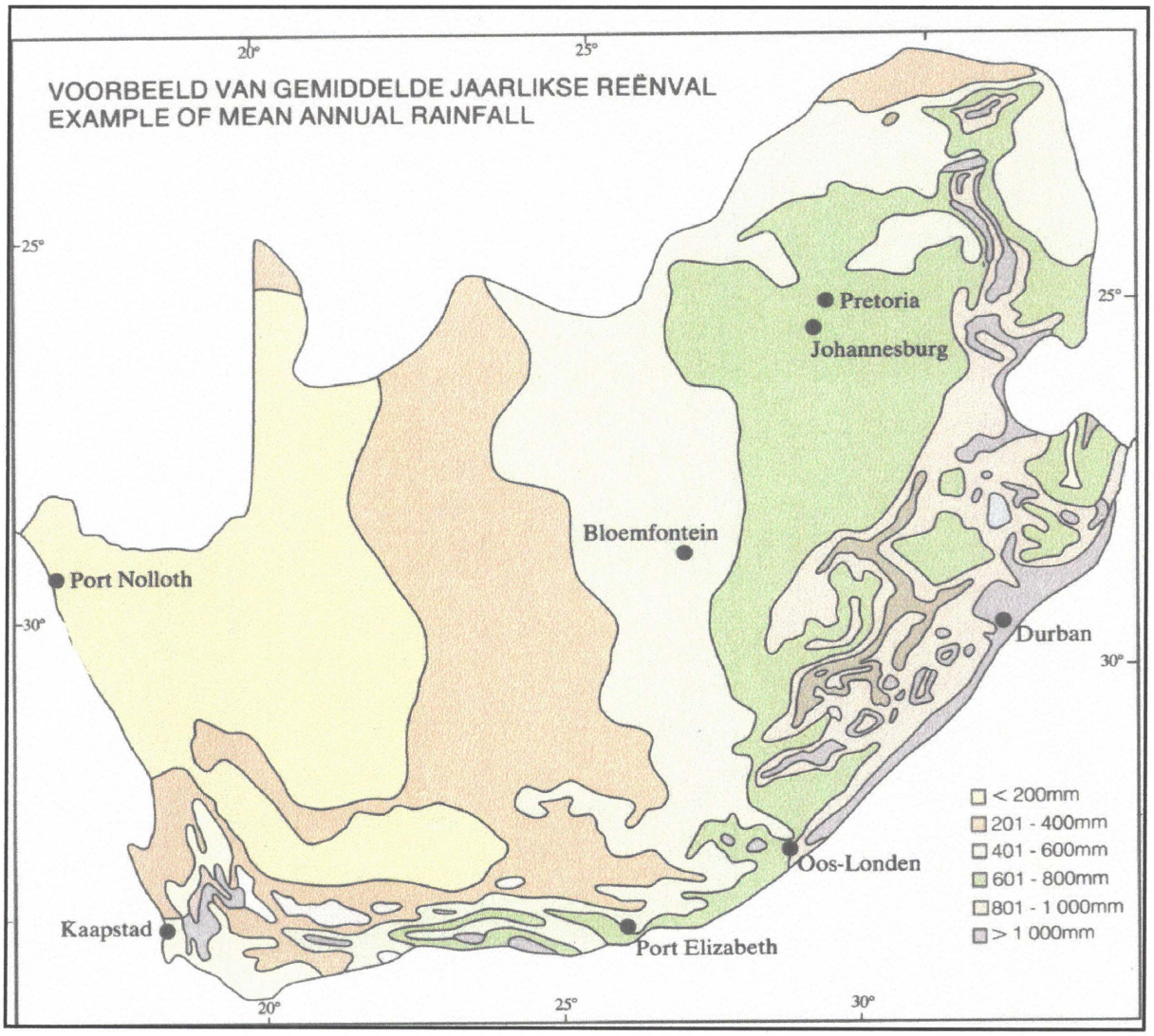

Fig 2.1 Annual rainfall of South Africa (after DWAF 1992)

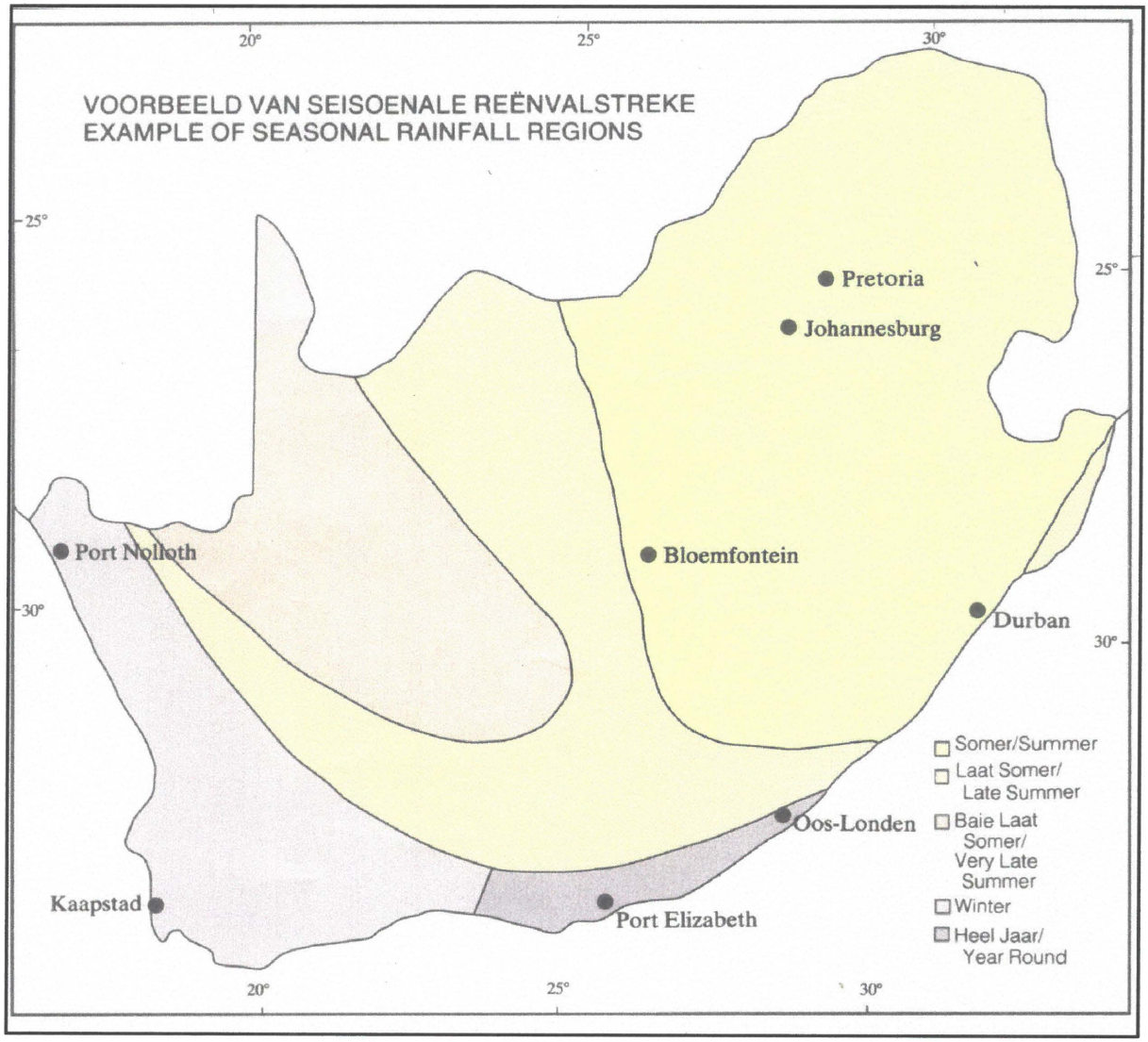

Fig 2.2 Rainfall regions of South Africa (after DWAF 1992)

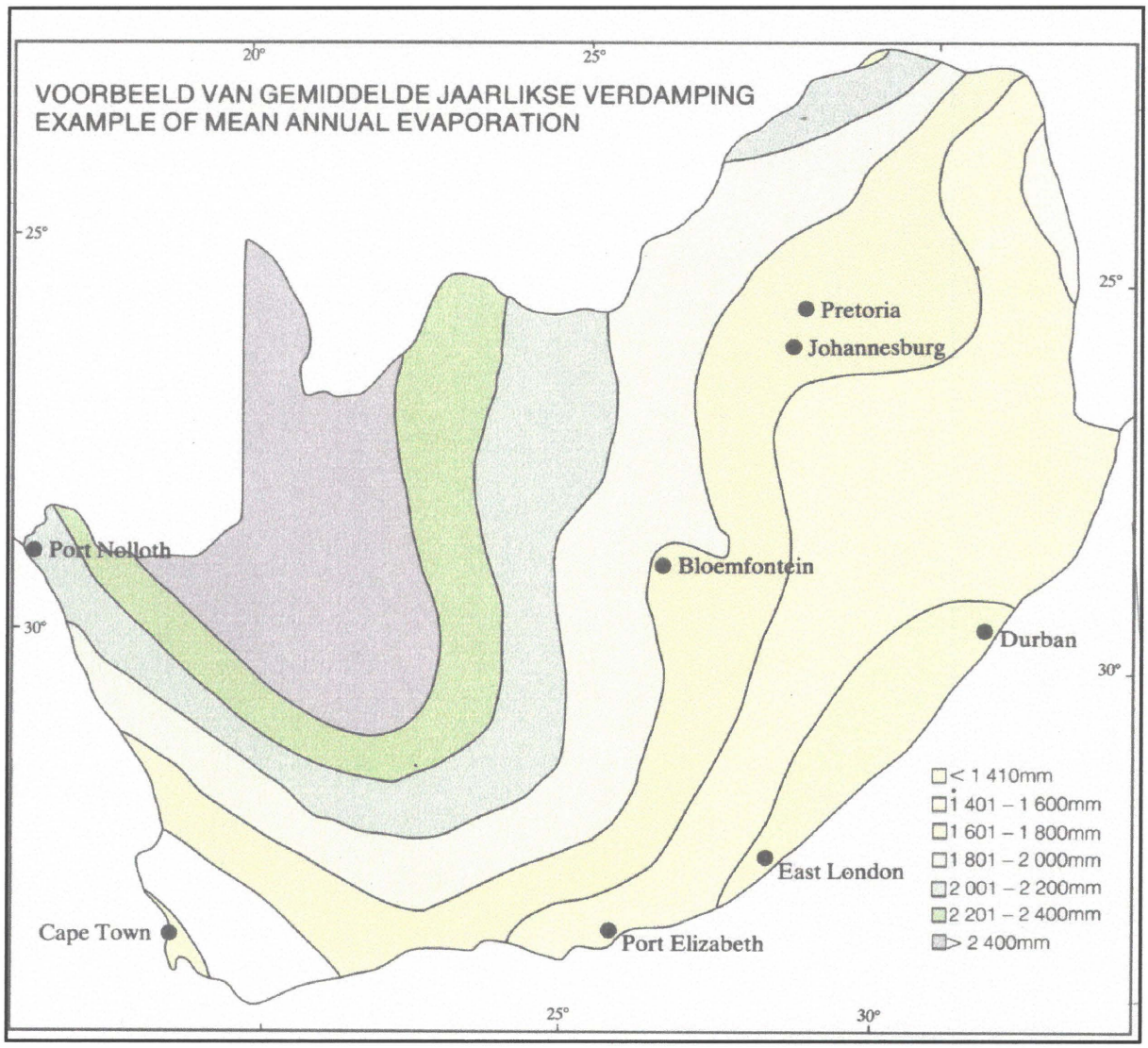

Fig 2.3 Annual evaporation for South Africa (after DWAF 1992)

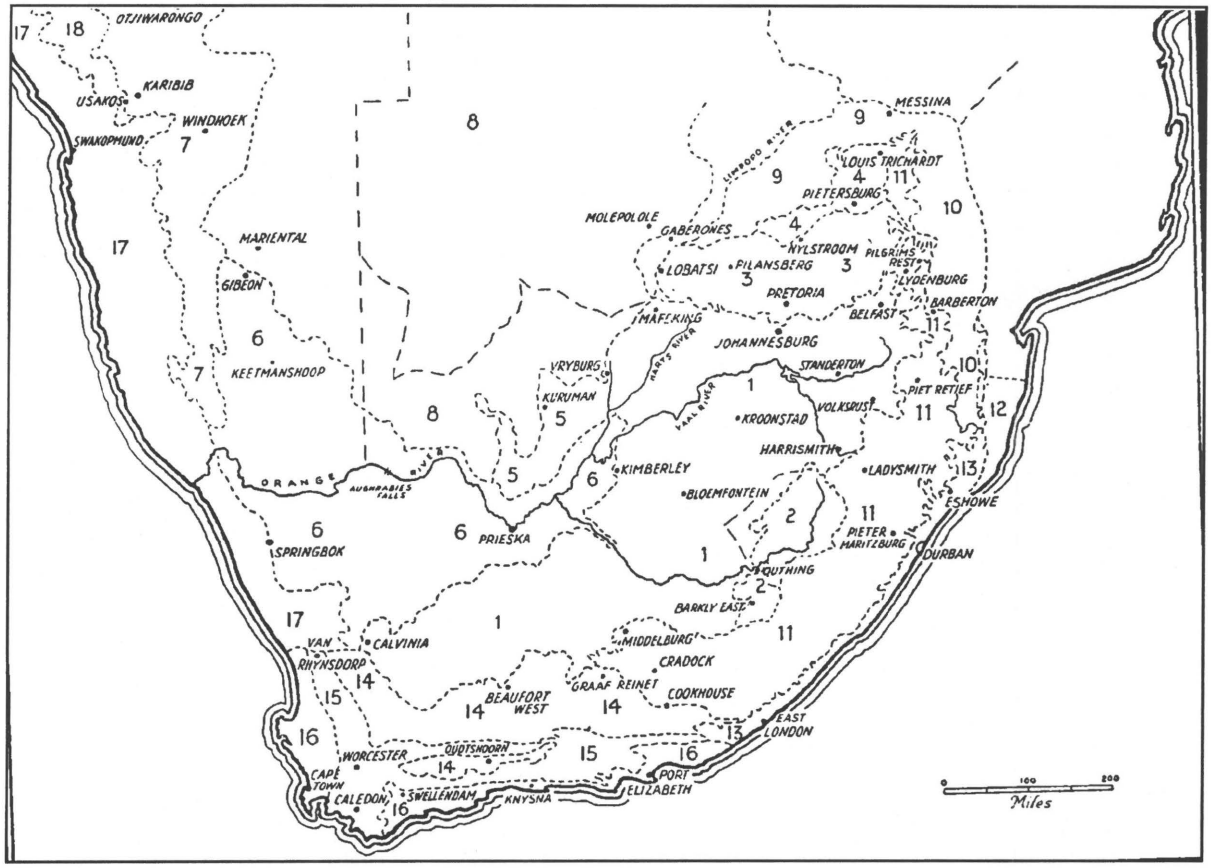

Fig 2.4 Geomorphological provinces of South Africa (after King 1967)

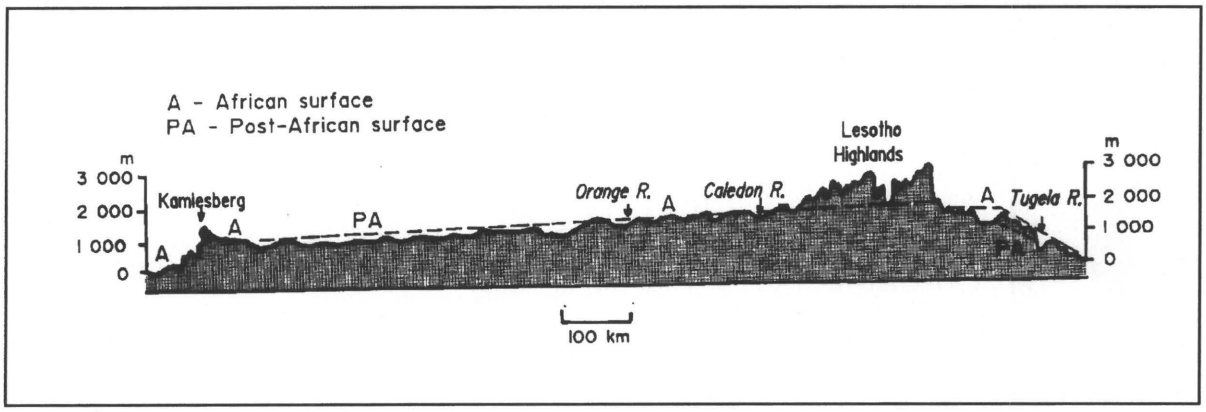

Fig 2.5 X-Section of South Africa (after King 1967)

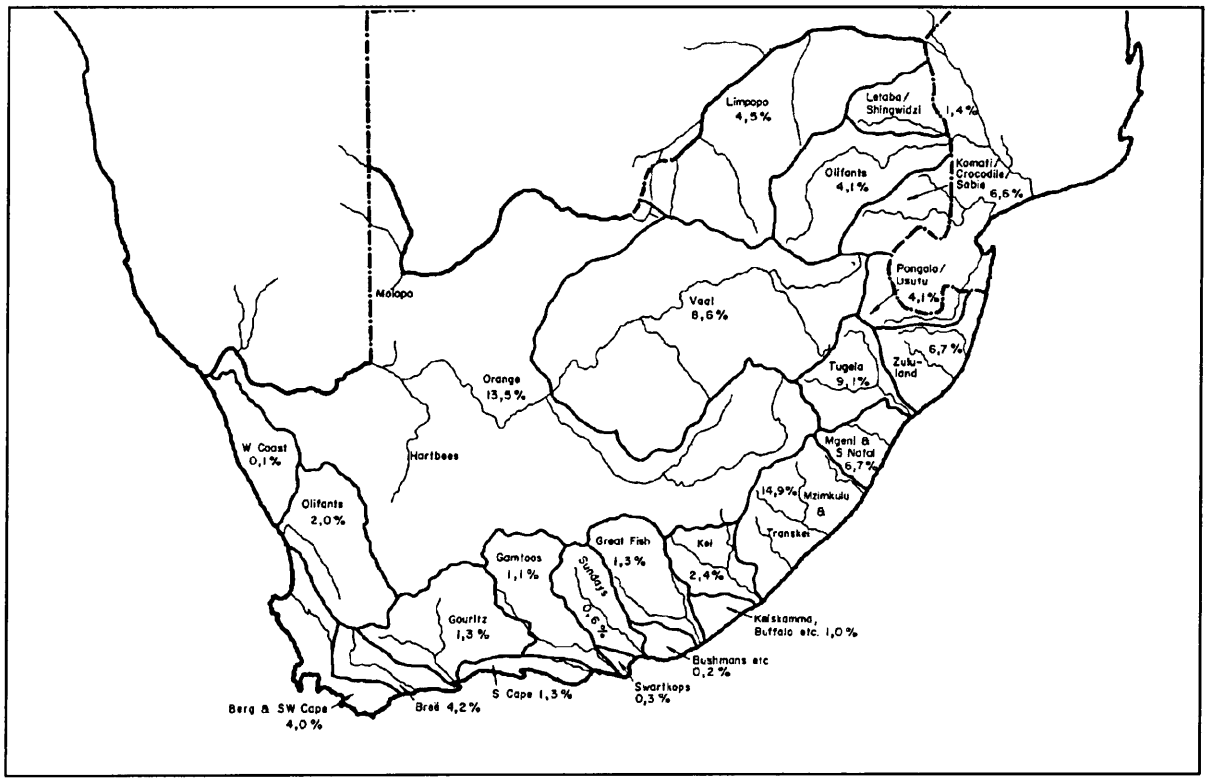

Fig 2.6 Catchment areas of South Africa showing estimated runoff per catchment (after Noble and Hemens 1978)

major part of the plateau into the Atlantic Ocean. The Limpopo River, forming the northern border of South Africa, is the second largest system. It flows eastwards into Mozambique and the Indian Ocean. Both of these rivers flow through relatively flat, arid areas, the source of their waters being in their upper catchments which are rugged. The comparatively well watered rivers that rise in the escarpment and flow eastwards to the Indian Ocean are relatively short with steep gradients (King, 1963; Dept Water Affairs, 1986). For management purposes, South Africa has been divided into 22 catchment areas (Fig 2.6).

2.6.2 Wetland regions

Using the above determinants, wetland regions of South Africa can be divided into four broad groups based on the broad morphology of the country . Plateau, mountains, coastal slopes and rim-land, and coastal plain. Regions are determined by the sub-division of these broad groups into geomorphological provinces and their climate. Differences in geology will determine minor groups within these regions. With this diversity of wetland regions, it should be noted that wetlands typical of a region are not necessarily exclusive to that region. The first part of each region's code indicates its geomorphology (using upper-case letters) and the second part indicates the climate (lower case letters). The sub-code for climate follows that of Schultze (1965). For continuity of region boundaries, the kingdoms of Lesotho and Swaziland are included in the map of the regions (Fig 2.7, Table 2.1).

Table 2.1 Wetland Regions of South Africa

REGION	MOPRPHOLOGY	CLIMATE
P	**Plateau wetland group**	
PW.w	Western plateau	desert region
PW.sn	Western plateau	steppe region
PS.w	Southern plateau	desert region
PS.ss	Southern plateau	steppe region
PE.h	Eastern plateau	highveld region
PNB.nt	Bankenveld	northern Transvaal region
PNW.nt	Waterberg	northern Transvaal region

REGION	MOPRPHOLOGY	CLIMATE
PNBb.nt	Bushveld basin	northern Transvaal region
PNP.nt	Pietersburg plateau	northern Transvaal region
M	**Mountain wetland regions**	
MD.d	Drakensberg/Maluti	drakensberg region
MCF.k	Cape Fold mountains	karoo region
MCF.M	Cape Fold mountains	mediterranean region
S	**Coastal slope and rimland wetland regions**	
SW.w	Western coastal slope	desert region
SW.m	Western coastal slope	mediterranean region
SSE.w	Southern escarpment	desert region
SK.k	Karoo	karoo region region
SSE.ss	Southern escarpment	southern steppe region
SS.a	Southern coast	temperate region
SE.d	Eastern coastal slope	drakensberg region
SE.se	East coast	south-east coast region
SE.e	East coast	sub-tropical region
SNE.l	Northern escarpment	lowveld region
SL.l	Lowveld	lowveld region
SLV.nt	Limpopo valley	northern Transvaal region
SOR.w	Orange River canyon	desert region
C	**Coastal plain**	
C.e	Coastal plain	sub-tropical region

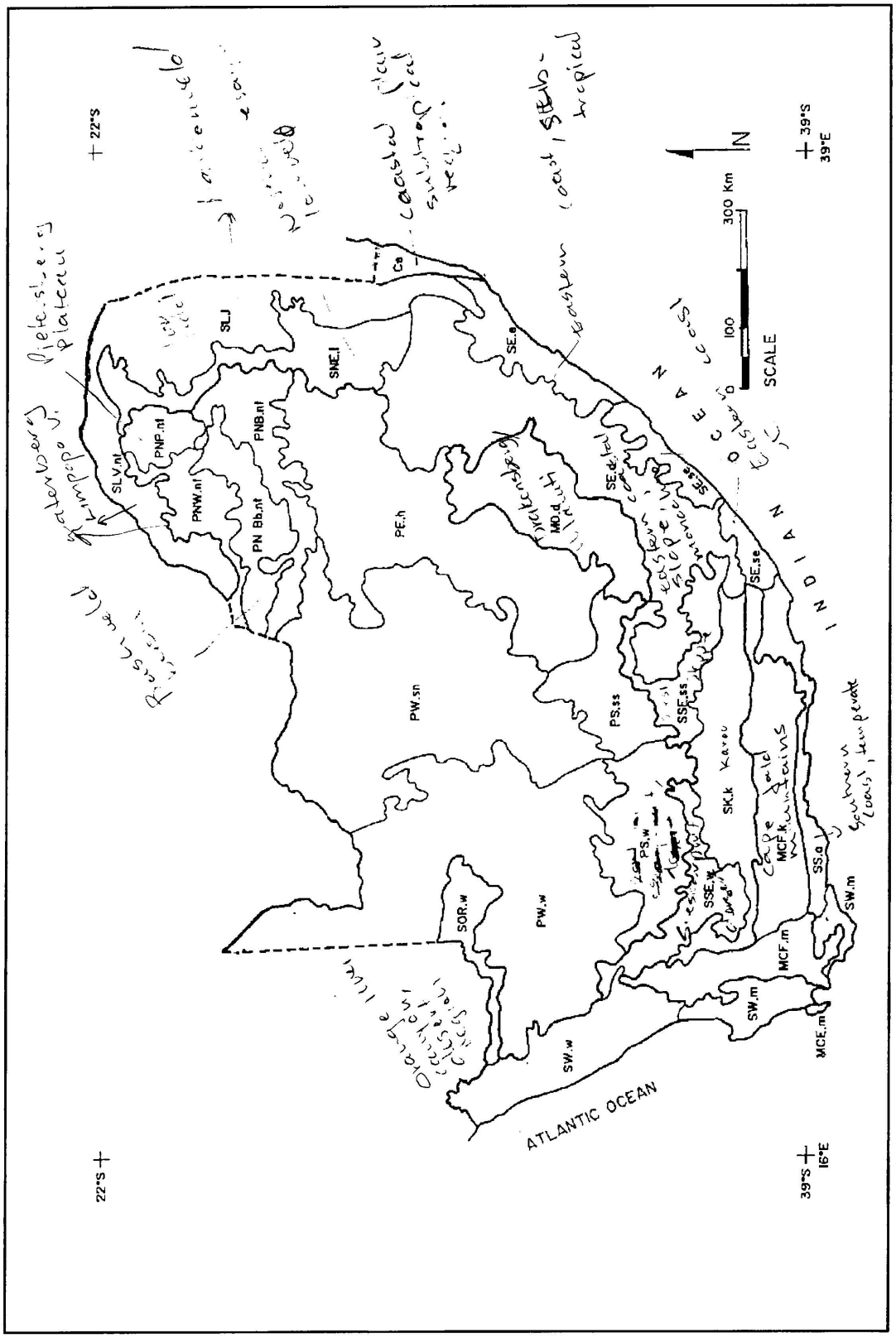

Fig 2. 7 Wetland regions of South Africa (after Cowan 1995)

2.6.2.1 Plateau wetland group (P)

The plateau, bounded by the Great Escarpment is a vast, mature pediplain, elevated 2 000m in the east, sloping to 1 000m in the west (Moon and Dardis, 1988). In the north it has been subjected to intrusions and warping.

PW Western plateau, also called the central interior plain (Kruger, 1983), includes the geomorphological provinces Cape middelveld, Kaap (Gaap) plateau and Kalahari (King 1967). Wetlands typical of this greater region are intermittent/ephemeral shallow lakes (pans), which become increasingly saline as they dry out. On the basis of climate and geology the western plateau wetland can be subdivided into three regions

PW.w Western plateau, desert region.

Main characteristics of this region are desert climate with a low, unreliable rainfall of up to 250mm, mainly in the form of convectional showers in summer and autumn; and a large seasonal and diurnal range of temperature (BW climate after Koppen). In the north the underlying geology comprises mainly of tertiary Kalahari sands while the south is dominated by Karoo sediments. Typical wetlands found in this region are pans and deflation basins. The larger pan complexes are found on the Karoo sediments.

PW.sn Western plateau, steppe region.

Main characteristics of this region are a semi-arid climate, with large seasonal and diurnal temperature ranges, a summer rainfall pattern in the form of showers and thunderstorms, varying from 254mm in the west to 500mm in the east (mainly BS(kh)w climate after Koppen). The geology comprises Karoo, Pre Transvaal and Transvaal sequences. The latter including dolomitic areas in which a number of well known dolomitic eyes are located (eg Molopo oog, Kuruman). It is in this region that the greatest concentration of pans is found (Goudie and Thomas, 1985).

PS/E The southern and eastern plateau also called the southern interior plain (Kruger, 1983), is a greater wetland region which includes the highveld geomorphological province (King, 1967). Except in the north west, where the pre Karoo surface is found, the region is entirely underlain by Karoo sediments. Climate determines the three subdivisions of this area into regions.

PS.w Southern plateau , desert region.
An area of desert climate with a low, unreliable rainfall of up to 250mm, mainly in the form of convectional showers in summer and autumn; and a large seasonal and diurnal range of temperature (BW climate after Koppen).
Better known wetlands are Grootvloer, Verneukpan and van Wyksvlei.

PS.ss Southern plateau, steppe region.
Main characteristics of this region are a semi-arid climate, with large seasonal and diurnal temperature ranges, a summer rainfall pattern in the form of showers and thunderstorms, varying from 254mm in the west to 635mm in the east (mainly BSkw climate after Koppen). Characteristic wetlands of this region are pans.

PE.h Eastern plateau, highveld region.
This region enjoys a warm, temperate climate with a dry winter. Annual rainfall varies from 635mm in the west to 890mm in the east. Rainfall is almost exclusively due to showers or thunderstorms. Snow occurs in the high lying areas occasionally (mainly Cwb climate after Koppen). Riparian grass-marshes and reed marshes are typical of this region. Some of the larger, better known marshes include Wakkerstroomvlei, Seekoeivlei at Memel and Blesbokspruit. Numerous pans are also found in this region.

PN The northern plateau greater wetland region is a geologically complex area, comprising primarily of Transvaal and Waterberg series, with the Bushveld Basin as a main intrusive feature. Other alkaline complexes (including Pilansberg) are found in the

region. To the north the Pietersberg Plateau is largely a granite complex. The region has a sub-tropical, semi-arid climate. Annual rainfall, derived mainly from summer thunderstorms, varies from 380mm in the Limpopo River and Sand River valleys in the north to 710mm in the Waterberg (mainly BShw climate after Koppen). Regions are determined on the basis of geomorphology.

PNB.nt Bankenveld, northern Transvaal region.
An area dominated by a series of dip and scarp slopes leading to a trellis drainage pattern. Characteristic wetlands include riparian reed swamps.

PNW.nt Waterberg, northern Transvaal region.
Comprising of Waterberg sandstone, this region is a rugged area with some deep gorges. The area is known for its seeps and small reed marshes (vleis).

PNBb.nt Bushveld basin, northern Transvaal region.
This a flat area, dominated by norite which has weathered to deep clays or"black turf". The best known wetland in this region is Nylsvlei.

PNP.nt Pietersburg plateau, nothern Transvaal region.
The region is an elevated (900m to 1 360m) granite region which has undergone planation during the African cycle. Riparian wetlands are characteristic of the region.

2.6.2.2 Mountain wetland regions (M)

While much of South Africa is a high lying plateau, surrounded by an escarpment with its associated mountains, there are only two mountain wetland regions in South Africa, namely the Cape fold system and the Drakensberg/Maluti system which was formed by lava deposition. Both these areas have alpine elements, with typical cooler and wetter south facing slopes. Common wetlands are fens, sedge and restio marshes, seeps (sponges)

MD.d Drakensberg/Maluti highlands, drakensberg region.

The Drakensberg comprizes of Stormberg basalts overlying sandstones. The eastern and southern scarp faces are a major erosional feature. This region has a warm, temperate, monsoonal climate, with rain season from November to March, varying from 690mm in the Tugela valley to 1900mm in the mountains. Snow sometimes occurs in winter (mainly Cwb climate after Koppen). Typical wetlands include alpine bogs, fens, restio marshes and grass marshes.

MCF.k Cape Fold mountains, karoo region.

Table mountain sandstone and Witteberg quartzite are the major components of the Cape Fold mountain system. The karoo region has a poor steppe climate, with desert conditions in parts. It falls within the transition zone from winter to summer rainfall and is subject to warm berg winds. Annual rainfall varies from 125mm on the plains to 760mm on the Swartberg (mainly BW and Bsk climate after Koppen). These mountains lie parallel to the coast, resulting in a distinct rain-shadow pattern, with dry interior. The Gamtoos flood plain is found in this region.

MCF.m Cape Fold Mountains, mediterranean region.

This region has a Mediterranean climate with winter rainfall and dry summer. Annual rainfall varies from 250mm on the plains to more than 2500mm in the mountains (Cs climate after Koppen). Restio marshes are typical of this region.

2.6.2.3 Coastal slopes and rimland wetland regions (S)

Comprising of the Great Escarpment, and the slopes between this feature and the coast, it includes the coastal belt, the Karoo, the eastern uplands, the and the lowveld. The Soutpansberg, Wolkberg, Drakensberg, in the east, the Suurberg, Compassberg, Tandjesberg, Winterberg, Amatola Mountains, the Sneeuwberge, Nieuwveld Escarpment, Kompsberg in the south and the Roggeveld Mountains and the Bokkeveld Mountain in the west make up the escarpment (King, 1967). The climate of this region

ranges from the dry west to the subtropical east. Subdivision of the greater region is based on both climate and geomorphological groupings.

As can be expected, a wide range of wetland types are found in these regions.

SW.w Western coastal slope, desert region.

This region has a desert climate. Fog occurs along the coast with a low, unreliable rainfall of up to 250mm, mainly in the form of convectional showers in summer and autumn. Precipitation occurs along the coast during winter and a large seasonal and diurnal range of temperature (BW climate after Koppen). The Orange River Mouth Wetland is found in the north of this region and the Olifants River flood plain is found in the south. In-between a number of small coastal pans and salt marshes are found.

SW.m Western coastal slope, mediterranean region.

Tertiary and Quaternary deposits form the base of this region, with large limestone deposits a feature. The region has a Mediterranean climate with winter rainfall and dry summer. Annual rainfall varies from 250mm on the plains to more than 2500mm in the mountains (Cs climate after Koppen). Wetlands found in this region include coastal lakes, salt marshes, hygryphilous fynbos and restio marshes. Verlorenvlei, the Berg River estuary, Langebaan Lagoon, the Bot River mouth, Heuningnes Estuary and de Hoop are important wetlands in this region.

SSE.w Southern escarpment, desert region.

This region falls in the rain-shadow of the Cape Fold Mountains. Its main characteristics are desert climate, with a low, unreliable rainfall of up to 250mm, mainly in the form of convectional showers in summer and autumn and a large seasonal and diurnal range of temperature (BW climate after Koppen).

SK.k Karoo, karoo region.

This region is the transition zone between winter to summer rainfall. It has a poor steppe climate with desert conditions in parts and is subject to warm berg winds. Annual rainfall varies from 125mm on the plains to 760mm on the Swartberg (mainly BW and Bsk climate after Koppen). Pans are characteristic of this region.

SSE.ss Southern escarpment, southern steppe region.

Main characteristics of this region are a semi-arid climate, with large seasonal and diurnal temperature ranges, a summer rainfall pattern in the form of showers and thunderstorms, varying from 254mm in the west to 635mm in the east. Snow sometimes falls on the mountain ranges (mainly BSkw climate after Koppen). Grass vleis, seeps and sedge marshes are found in this region.

SS.a Southern coast, temperate region.

This region has a temperate, warm and humid climate, sometimes hot with dry berg winds. Rain falls in all seasons varying from 380mm on the western plains to 1140mm on the mountains (mainly Cf climate after Koppen). The region is thought to have been flooded during the Flandrian transgression. It is characterized by coastal lakes, notably the Wilderness Lakes, Swartvlei and Groenvlei.

SE.d Eastern coastal slope(monocline), drakensberg region.

This region forms a large part of the Natal monocline. It has a warm, temperate, monsoonal climate, with rain season from November to March, varying from 690mm in the Tugela valley to 1140mm in the mountains. Snow sometimes occurs in winter (mainly Cwb climate after Koppen). Grass and restio marshes and reed swamps are characteristic of this region. Some of the better known wetlands include Blood River Vlei, Mvoti Vlei, Hlatikulu Vlei, and Franklin Vlei.

SE.se Eastern coastal, south-east coastal region.

The southern part of the eastern coastal belt has a warm, temperate and humid climate with an annual rainfall ranging from 500mm (Fish River valley) to 1260mm at Port St John's. Salt marshes are common in the estuaries and the southern limit of mangrove swamp is found in this region.

SE.e Eastern coastal, sub-tropical region.

The northern part of the eastern coastal belt has a warm and humid climate with an annual rainfall ranging from 760 to 1260mm, mainly falling in summer (October to March) (Mainly Cfw and Cfa climate after Koppen). lagoons, reed marshes, swamp forest and mangrove swamp is typical of the region.

SNE.l Northern escarpment, lowveld region.

Another complex region in which changes in the north-east escarpment are due to geology and erosion patterns. In the south the region is a high-lying, relatively flat grassland. In the north, the escarpment is extremely steep. Sub-tropical, warm and oppressive in lower areas, cooler in the higher lying areas and in winter. Annual rainfall of up to 1900mm occurs in the mountains mostly during the period November to March, frequent orographic mist and drizzle (mainly BShw climate after Koppen). Wetlands of the region are as diverse, and include the Lake Chrissie pans in the south, grassland vleis of the Steenkampsberg and the only living tufa in South Africa at Blyde River Canyon.

SL.l Lowveld, lowveld region.

This includes both the middelveld and lowveld (Cowan 1987). The region is sub-tropical, warm and oppressive in lower areas, cooler in the higher lying areas and in winter. Annual rainfall ranging from 500mm in the north-east up to 1900mm in the mountains most during the period November to March, frequent orographic mist and drizzle (mainly BShw climate after Koppen). The region is characterized by rivers with distinctive riparian communities. In the

north east, the Wambiya pans and the Levuvhu flood plain are noteworthy.

SLV.nt Limpopo valley, northern transvaal region.

The Limpopo valley breaks the great escarpment, allowing a route for migration of eastern and western elements. The region has a sub-tropical, semi-arid climate with an annual rainfall of about 380mm, mainly derived from thunder storms (mainly BShw climate after Koppen). The Limpopo flood plain and its related pans are an important feature. This region merges with the previous one at the confluence of the Limpopo and Levuvhu Rivers.

SOR.w Orange River canyon/brokenveld, desert region

This region splits the western plateau regions. Its main characteristics are desert climate with a low, unreliable rainfall of up to 250mm, mainly in the form of convectional showers in summer and autumn; and a large seasonal and diurnal range of temperature (BW climate after Koppen). Relatively small riparian reed swamps are found in this region.

2.6.2.4 Coastal plain

The southern end of the Mozambique flood plain intrudes into South Africa forming this region, where it is known as the Zululand coastal plain (King 1967).

C.e Coastal Plain, sub-tropical region.

The region has a warm and humid climate with an annual rainfall ranging from 760 to 1260mm, mainly falling in summer (October to March) (Mainly Cfw and Cfa climate after Koppen). Common wetlands are flood plains, swamp forests, swamps (mangrove, papyrus, reed), hygriphilous grass wetlands, coastal lakes and coral reefs. Important wetland systems in this region include the St Lucia System, Lake Sibaya, the Kosi System, Turtle Beaches and Coral Reefs of Tongaland (all designated by South Africa to the List of Wetlands of

International Importance), the Muzi swamps and the Pongola flood plain.

2.7 CONCLUSION

This chapter reviewed a number of attempts at dividing South Africa into regions. These attempts, while all considering wetland biota were all limited by the taxa they considered, and therefore found to be inadequate. A set of wetland regions for South Africa were then proposed. Due to having gone wider than river systems and species distribution, 26 sub-regions have been identified in this paper. While the number of sub-regions may initially seem excessive, especially when compared to many of the above papers, it is felt that these subdivisions will provide the background to a better understanding of the variability within South African wetlands. However, it should be noted that even with this diversity of wetland regions, wetlands typical of a region are not necessarily exclusive to that region.

2.8 SUMMARY

The need for a set of wetland regions as the first step in planning for wetland conservation was identified in this chapter. A review of previous attempts at determining wetland regions was presented. It was found that all of these addressed single groups of species and thus were quite specific.

A methodology for determining wetland regions was presented in which the factors which have an influence on the topography, the hydrology and the nutrient regime of South African was used. This resulted in a set of four major wetland groups based on the broad morphology of the country which are divided into 26 wetland regions based on geomorphology, climate and base rock.

CHAPTER 3

DIRECTORY OF SOUTH AFRICAN WETLANDS

3.1 INTRODUCTION

In testing the hypothesis that wetland conservation has been sorely neglected in South Africa, the corollary or secondary hypothesis is raised:

South Africa does not know the extent of its wetland resources.

In this chapter, this secondary hypothesis is tested. In order to assess the wide range of information collected for a range of reasons on a number of South African wetlands, and to add value to this information, a wetland classification is developed. Minimum data needs are identified and supplementary information sought and applied. The information is then converted into a relevant data set for analysis. The known extent of wetlands by type in South Africa is then discussed.

3.2 BACKGROUND

The benefits of wetlands (their functions, attributes and values) are recognized worldwide. This is particularly so in a dry country such as South Africa, and was recognized 25 years ago, when South Africa took part in the conference held in the town of Ramsar, at which the Convention on Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention) was formally established.

In signing the Convention, Contracting Parties agree to its objectives which include among others (see Chapter 4):

- Stem the loss of wetlands;

- Promote wise use of all wetlands;

The Convention thus promotes the conservation of all wetlands. This is further emphasized in Article 3.1 of the Convention which obliges Contracting Parties to include the conservation of wetlands in their land use planning. Wetland inventories form a base from which wetland conservation strategies can be developed. Contracting Parties to the Convention have been encouraged to implement such inventories at Conferences of Parties (Recommendations 1.5 (Cagliari, Italy, 1980), 2.3 (Groningen, Netherlands, 1984), 3.1, (Regina, Canada, 1987), 4.10 (Montreux, Switzerland, 1990)).

The need for a wetland inventory in South Africa has long been recognized. In 1988 a workshop on the inventory and classification of wetlands in South Africa was held (Walmsley and Boomker, 1988). At the same time initiatives in in Kwazulu-Natal (Begg, 1988) and in the Western Cape (Silberbauer and King, 1991) towards inventories were taking place. Earlier, an assessment of the conservation status of river systems in the country was published (O'Keefe, 1985). The need for such an inventory continues to be expressed (Taylor, Howard and Begg, 1995).

Large scale wetland inventories have been published for Africa (Burgis and Symoens, 1987; Hughes and Hughes, 1992) and for southern Africa (Chabwela, 1991; Taylor *et al* ,1995), while the most complete review of South African wetlands remains Noble and Hemens (1978). More recent summaries of these reviews for South Africa are found in Allanson, Hart, O'Keefe and Robarts (1990) and Breen, Heeg and Seaman (1993). Extended reviews of current knowledge of a number of wetland types in South Africa are found in Schwabe (1995) - alpine mires, Rogers (1995) - riparian wetlands, Steinke (1995) - mangroves, Allan, Seaman and Bozena (1995) - endorheic pans, Hart (1995) -coastal lakes and Schleyer (1995) - coral reef communities. In addition to these reviews, a number of overiews have been published on estuaries in South Africa (Day, 1981; Begg, 1978, 1984; Heydorn and Tinley, 1980; Heydorn and Grindley, 1981-1985). These inventory exercises follow the world wide trend, when most work toward such inventories

took place during the 1980's (Finlayson et al 1998).

The Department of Environmental Affairs and Tourism, being responsible at the national level for the implementation of the Convention, initiated the South African Wetlands Conservation Programme in 1990. The programme is aimed at ensuring South Africa meets its obligations in terms of both the Ramsar Convention and the Convention on Biological Diversity by building on past efforts to protect wetlands in South Africa against degradation and destruction, whilst aiming at the ideal of wise and sustainable use of its resources (Cowan, 1992a, 1992b, 1995b,1995c, 1996).

The objective of the programme is to ensure the conservation of South Africa's wetlands in such a way that the ecological and socio-economic functions of wetlands are sustained now and in the future. In order to meet this objective, an inventory of wetlands in the country is essential and forms a major thrust of the programme. The inventory is aimed at coverage, with an inherent ability to expand, and be computerized preferably with a GIS package.

The development of this directory follows similar initiatives from Australia, Asia (Scott and Poole, 1989), Brazil (Diegues, 1994), New Zealand (Cromarty and Scott, 1995; and Oceania (Scott, 1994). It should be emphasized that this is an initial directory, of the most well known wetlands in South Africa and by no means does it claim to be complete. This directory establishes the extent of our current knowledge of our wetlands and identifies the areas where work is needed.

3.3 METHODS

Recognizing that an inventory of all South African wetlands has yet to be undertaken, but a number of surveys of a range of our wetlands for a wide variety of reasons (eg geological surveys, faunal studies) have been made, the methods used to develop this directory were:

1. Collating all available information on wetlands;

2 Ordering this information by:

2.a Developing a classification system for wetlands;

2.b Determining the conservation status, the threats and the conservation value to each site as classified, thus give the information value;

3 Confirming the data in the field and adding new data and sites where possible.

3.3.1 Data sources

A number of sources were tapped in order to collect the data for this directory. Initially a survey of published literature was made. This was followed by collating data from the conservation agencies (eg Preliminary list of vleis and pans in the Transvaal (now Gauteng, Mpumulanga, Northern Province and North West Province (Transvaal Nature Conservation)), Register of protected areas in South Africa (Department of Environmental Affairs and Tourism) and Priority wetlands in kwaZulu Natal (Natal Parks Board)). Then project reports, funded by the Department of Environmental Affairs and Tourism, were used to supplement the data (Dolomitic eyes of the western Transvaal (JLB Smith Intitute of Ichthyology), Drakensberg wetland survey (Institute of Natural Resources, University of Natal), Peat resources of Kwazulu-Natal (Council for GeoScience) and Coordinated Wetland Counts (Avian Demography Unit, University of Cape Town)). Finally as suggested by Taylor *et al* (1995) use was made of the data available from the Surveys and Mapping Unit. The latter was confined to that available in GIS format (1:500 000), notwithstanding the *caveat* made by Begg (1988) and Taylor *et al* (1995) regarding the imperfections of these data (Table 3.1).

Table 3.1 Sources used to compile this directory, showing the wetland types they cover, where **Mar** marine, **Est** estuarine, **Riv** riverine, **Lac** lacustrine, **Pal** palustrine, **End** endorheic (internal drainage), **Mm** man-made wetlands

Author	Mar	Est	Riv	Lac	Pal	End	Mm
Allan et al, 1995						X	
Allanson et al, 1990			X	X	X	X	
Begg, 1978		X					
Begg, 1984		X					
Begg, 1988					X		
Begg, 1989					X		
Breen et al, 1993				X	X	X	X
Cowan et al, 1994	X	X	X	X	X	X	X
Cowan & Randall, 1995	X	X	X	X	X	X	X
CWAC		X		X		X	X
Day, 1981		X					
Dely et al, 1995					X		
DWAF							X
Grundling in prep					X		
Hart, 1995				X			
Heydorn & Grindley		X					
Heydorn & Tinley, 1980		X					
Hughes & Hughes, 1992		X	X	X	X	X	X
Hugo, 1974						X	
Mepham, 1987		X	X	X	X	X	X
Noble & Hemens, 1978		X	X	X	X	X	X
O'Keefe, 1985			X				
Rogers, 1995			X				
Schleyer, 1995	X						
Schwabe, 1995					X		
Seaman et al, 1991						X	
Silberbauer & King, 1991				X	X		X

Skeepers, 1981	X	X	X	X	X	X	X
Skelton et al, 1994					X		
Steinke, 1995		X					
Tarboton, sd			X	X	X	X	
Taylor et al, 1995		X	X	X	X	X	X
Taylor, 1997					X		
Transvaal Nature Cons[1]					X	X	
Wessels, 1991					X		

3.3.2 Classification system for wetlands

The definition of wetlands (section 1.3.1 above) has been expanded into a category system for wetlands (Recommendation C.4.7 (Rev), 1990). As with definitions, there is a wide range of classifications for wetlands (eg Cowardin, Carter, Golet and la Roe, 1979; Larson Adamus and Clairain, 1989; Scott, 1989; Dugan, 1990; Semeniuk and Semeniuk, 1995). Cowardin *et al* (1979) proposed a classification system based on ecological functions which has proved to be both robust and widely applicable. Dugan (1990) made an attempt to sort the Ramsar wetland types into Cowardin's classification for use with Asian wetlands. Davies and Claridge (1993) recommend that the Ramsar classification of wetlands be adopted together with the Ramsar definition, but have used the adaption by Dugan (1990).

This study found that these classification systems are inappropriate for South Africa as they did not cover the full range of wetland types found here, and . The following classification system, developed for use in this thesis (Table 3.2), uses Dugan's approach but adapted the sorting of the Ramsar wetland types into Cowardin's broad categories in a manner more applicable for the South African situation; it also considers Denny's (1996) system; and separates a wetland type at the class level. The definition and categories of wetland used thus include all of Cowardin *et al*'s (1979) wetland categories. It includes his deep water habitats (except the deep sea) and

[1]The area covered by the previous Transvaal Nature Conservation is now included into the following provinces Gauteng, Mpumulanga, Northern Province and part of the North West Province.

includes all of Noble and Hemens' (1978) wetland categories.

Table 3.2 Classification of wetland habitats

Class	Sub-class	id	Description of wetland types
COASTAL	**WETLANDS**		
Marine	**subtidal**	1	*sea bays, straits*
		2	subtidal aquatic vegetation
		3	*coral reefs*
	intertidal	4	rocky marine shores, including *cliffs, rocky shores*
			shores of *mobile stones* and *shingle*
		5	intertidal *mud, sand* or *salt flats*
		6	intertidal *salt marshes*
		7	intertidal *mangroves*
		8	
Estuarine	**subtidal**	9	estuarine waters
	intertidal	10	intertidal *mud, sand* or *salt flats*
		11	intertidal marshes
		12	intertidal forested wetlands
		13	*brackish to saline lagoons*
INTERIOR	**WETLANDS**		
Endorheic		14	permanent and seasonal, *brackish, saline* or *alkaline lakes, flats, pans* and *marshes*
Riverine	**perennial**	15	*rivers* and *streams* including *waterfalls*
		16	*inland deltas*
	seasonal	17	seasonal *rivers* and *streams*
		18	*riverine floodplains*
Lacustrine	**permanent**	19	permanent freshwater *lakes* (≥ 8ha)
		20	permanent freshwater *ponds*, *pans* (≤ 8ha)
	seasonal	21	seasonal freshwater *lakes* (≥ 8ha)
		22	seasonal freshwater *ponds, pans* (≤ 8 ha)

Palustrine	**emergent**	23	permanent freshwater *marshes* and *swamps*
		24	permanent *peat-forming freshwater swamps*,
		25	seasonal freshwater *marshes*
		26	*peatlands* and *fens*
		27	*Alpine* and *polar* wetlands
		28	*springs* and *oases*
		29	*volcanic fumaroles*
	forested	30	*shrub swamps*
		31	freshwater *swamp forest*
		32	*forested peatlands*
MAN-MADE	**WETLANDS**		
	Aquaculture	33	*aquaculture ponds*
	Agriculture	34	*irrigated land* including rice fields
		35	seasonally flooded agricultural land
	Salt exploitation	36	*salt pans* and *evaporation pans*
	Urban/industrial	37	*excavations*
		38	*wastewater treatment areas*
	Water storage areas	39	*reservoirs*
		40	*hydro-dams*

3.3.3 Wetland data sheet

In order to give the information relevant value it had to be ordered, so that information from the full range of sources could be used. It was rare that information from any one source provided all the data for a wetland. Other sources, which were not necessarily wetland orientated such as those dealing with broader nature conservation (Wahl and Naude, 1996; IUCN, 1994) were also consulted .

This study identified the information required for a directory of wetland as follows:

1. Wetland name (to provide an identity);
2. Location (in terms of latitude, longitude, catchment);

3. Area;
4. Classification (as to habitat type),
5. The level of protection of the wetlands and
6. Threats to the wetlands (in terms of severity and type) as functioning ecological units.

A data sheet was developed, based on these requirements (Appendix 1) to collect the data for processing.

3.3.4 Data verification and analysis

The data thus collected was entered into a computer package for ease of manipulation and display. Printed data was distributed to the South African Ramsar Committee[2] (a sub-committee of the statutory Committee for Environmental Coordination in terms of the Environment Conservation Act (No 73 of 1989), which includes representatives of the Department of Water Affairs, Department of Agriculture, the National Parks Board, and nature conservation agencies of the provinces) for verification. A number of sites were added to those found in the literature and were treated to similar verification. The analysis of the final data set follows under point 4.4.

3.4 RESULTS AND DISCUSSION

3.4.1 Number of wetlands, their area, protection status and threats

Information from the Chief Directorate: Surveys and Land Information at a scale of 1:500 000, shows some 2 813 wetlands in the following groups of wetlands: coastal bays (158), lagoons (13), pans (1 772), lakes (42), marshes (582) and dams (414). This should be viewed as a first estimate, as many more wetlands should be identified with an increase in scale (for example, in the plateau region north of the Vaal River only, Allan et al (1995) identified some 7 600 pans from the 1:50 000 map series, which they estimate fail to show some 16% of the smaller, well vegetated pans).

[2]Now incorporated into the Biodiversity Sub-committee

The data available from other sources and analysed here is well short of this figure (1 334 wetlands), indicating that there is still a substantial amount of work to be done in South Africa. The data for these 1 334 wetlands is analysed below.

Of the 40 wetland types identified by Dugan (1990), some 28 types are represented in the database. The most common wetlands identified are type 14 (endorheic pans (n=289)), followed by type 39 (dams (n=225)), type 13 (lagoons (n=204)) and type 15 riverine habitats (n=164)). The rest of the wetland types are represented by less than 100 sites each. Table 3.3 summarizes the wetlands by class by number. This distribution of information on the various wetland types is an indication of either where the research interest has been, or where an economic value of the wetlands has been identified (eg pans for their mineral resources and dams as part of the infrastructure of the country).

Table 3.3 Wetlands of South Africa showing wetland class, number and area

Class	**Total no**	**%**	**Area (ha)**	**n**(area)	**(n/no)%**
Marine	11	0.80	222 065	9	82
Estuarine	82	5.95	3 590	20	24
Lagoonal	204	14.82	50 712	77	38
Endorheic	289	20.98	56 346	128	44
Riverine	208	15.11	37 743	26	14
Lacustrine	69	5.01	31 807	55	80
Palustrine	263	19.10	151 015	135	51
Man-made	251	18.23	201 262	103	41
Total	1377	100	755 540	553	40

The wetlands with the greatest known area are type 39 (dams) having a total area of 200 192ha (n=96). The total known area for natural inland, freshwater wetland types (riverine, lacustrine and palustrine wetlands) is 220 565ha. However the areas of only 216 of the 540 wetlands recorded in these categories are known at present.

Table 3.4 Number of wetlands and their level of protection

Where **Total#** is the total number of wetlands in that class, **01** is no information; **02** is no legal protection; **03** is those wetlands partly or wholly included within a private nature reserve, non-hunting area or similar reserve with a low level of protection; **04** are wetlands partly protected within a national park, provincial nature reserve, wildlife sanctuary or equivalent reserve; and **05** wetlands wholly protected within a national park, provincial nature reserve, wildlife sanctuary or equivalent reserve.

Protection level			**none**	**low**	**part**	**full**	**% part**	**% full**
Class	**Total #**	**01**	**02**	**03**	**04**	**05**		
Marine	11	0	3	4	0	4	36	36
Estuarine	82	24	38	6	10	3	19	5
Lagoonal	204	20	142	10	17	15	13	7
Endorheic	289	220	31	8	6	24	5	8
Riverine	208	155	18	13	9	13	11	6
Lacustrine	69	22	15	7	4	21	16	30
Palustrine	263	56	56	23	13	54	14	21
Man-made	251	187*	20	15	10	19**	10	8

NB * it can be assumed that most of the man-made wetlands for which there is no information have no legal protection;

** while these wetlands (mainly dams) are located within protected areas, their management is primarily for water resource development

The conservation of wetlands within a system of protected areas is, by their very nature, extremely difficult. Being part of the hydrological system, they form links in normally linear systems which extend beyond the protected area boundaries. Table 3.4 shows the number of wetlands recorded in this directory which are afforded varying levels of on site protection. The classes of wetlands

least well protected are the estuarine and lagoonal wetlands, the endorheic pans and the riverine wetlands. This table must be read with caution, as the wetlands within protected areas are the best known wetlands, and most are recorded here, while the many thousands of wetlands outside protected areas are not.

A disturbing lack of information on the level of threats to our wetlands is illustrated in Table 3.5 With the speed of development taking place, threats will be increasing all the time. An indication of the level of threats can be implied from the number of wetlands with no threats recorded. A comparison between the numbers of wetlands with no known threats with the number of wetlands with moderate or serious threats is an indication that few wetlands in South Africa can be considered safe, and that most are suffering from change in their ecological character. Compare information with Noble and Hemens (1978); Breen and Begg (1989); Kotze and Breen (1995).

All classes of wetlands are threatened by organic and inorganic pollution, which may be reach the wetland either directly or indirectly from a point sources or diffuse sources. With the exception of the marine wetlands, all wetland classes are subject to threats due to changes in their hydrological regimes through water extraction, impoundments, inter-basin transfer and other water resource developments and afforestation. Land-use changes including afforestation, agriculture, industrial and mining developments, recreational and urban developments have both direct and indirect threats on many wetlands. Poor catchment management has resulted in nutrient loading and salinization of the water as well as increased sediment loads. The introduction and spread of invasive alien biota has had a profound effect on both the functioning of wetland ecosystems and on many of their species. While probably the biggest threat to all our wetlands is ignorance of the importance of these systems, their functions, values and attributes.

Table 3.5 Severity of threats to wetlands

Where: **Total #** is the total number of wetlands in that class; **01** is no information; **02** is no threat known; **03** is minor threat (eg some disturbance from hunting, fishing, recreation or overgrazing); **04** is moderate threat, some

serious threats, but irreparable damage not inevitable; and **05** the wetland is under serious threat, from one or several sources; most, if not all of the wetland habitat is likely to be lost or major ecological changes are likely to occur unless some immediate remedial action is taken.

Threat level		**No info**	**None**	**Minor**	**Moderate**	**Serious**	**%mod**	**%high**
Class	**Total #**	**01**	**02**	**03**	**04**	**05**		
Marine	11	3	2	0	4	2	36.4	18.2
Estuarine	82	16	8	22	28	8	34.1	9.8
Lagoonal	204	13	19	64	58	50	28.4	24.5
Endorheic	289	156	33	37	45	18	15.6	6.2
Riverine	208	123	23	18	25	19	12.0	9.1
Lacustrine	69	29	13	8	16	3	23.2	4.3
Palustrine	263	97	26	28	106	6	40.3	2.3
Man-made	251	239	0	4	4	4	1.6	1.6

3.3.2 Marine wetlands

Marine wetlands are normally those inshore areas and open ocean areas not influenced by river flows, as well as their associated high energy shorelines. They may include sea bays and straits, coral reefs, subtidal aquatic beds, rocky marine shores, inshore islands and beaches, and intertidal habitats (Dugan, 1990; Frazier, 1996; Barbier *et al,* 1997). Cowardin *et al* (1979) set the limits of this system as the edge of the continental shelf as opposed to the six metre limit set by the Ramsar Convention.

South Africa boasts a coastline of some 3 100km, portraying a unique variety of landscapes of particular beauty and ecological significance (Robinson and de Graaf, 1994). This coastline has been divided into three biogeographic regions:

- the subtropical region (from the Moçambique border to the Mbashe Estuary) influenced by the south flowing, warm Agulhas Current;

- the warm temperate region (Mbashe Estuary to Cape Point); and

- the cool temperate region (Cape Point to the Namibian border) influenced by the north flowing, cold Benguela Current.

These regions reflect the character of both the marine and estuarine wetlands in South Africa

Seven of the eight marine wetland habitats identified by Dugan (1990) are found in South Africa. Only the intertidal mangroves are absent from our shores (these being confined to estuarine sites). However the 11 sites listed in this directory (Figure 3.1) only represent habitat type 1 (sea bays and straits - two sites), habitat type 4 (cliffs and rocky shores - four sites), habitat type 6 (intertidal mud, sand or salt flats - two sites), habitat type 7 (intertidal salt marshes - two sites) and habitat type 8 (intertidal mangroves - one site). Obviously these sites are but a tiny proportion of the marine wetland habitats to be found along South Africa's coastline (eg the 1:500 000 map series shows 158 coastal bays). However they are all important sites, either being marine reserves (declared in terms of the Sea Fisheries Act (No 10 of 1940) or sites identified for protection under the South African Plan for Nature Conservation (Scheepers, 1981). The sanctuaries provide areas for recruitment of the commercially important rock lobster (*Jasus lalandii*) and line fishing (both commercial and recreational). The Turtle Beaches and Coral Reefs of Tongaland, comprising the two marine Sanctuaries (St Lucia Marine Reserve and the Maputaland Marine Reserve) provide nesting sites for two species of marine turtle, while providing habitat for all five species found in the Indian Ocean (Hughes, 1996). The site includes the southernmost coral reefs in southern Africa (Schleyer, 1995), which are a popular destination for recreational ski-boat fishing and for SCUBA diving (some 120 000 dives were registered from Sodwana during 1997 (Taylor, pers comm) at an average cost of R60 per dive, giving a value of R7 200 000).

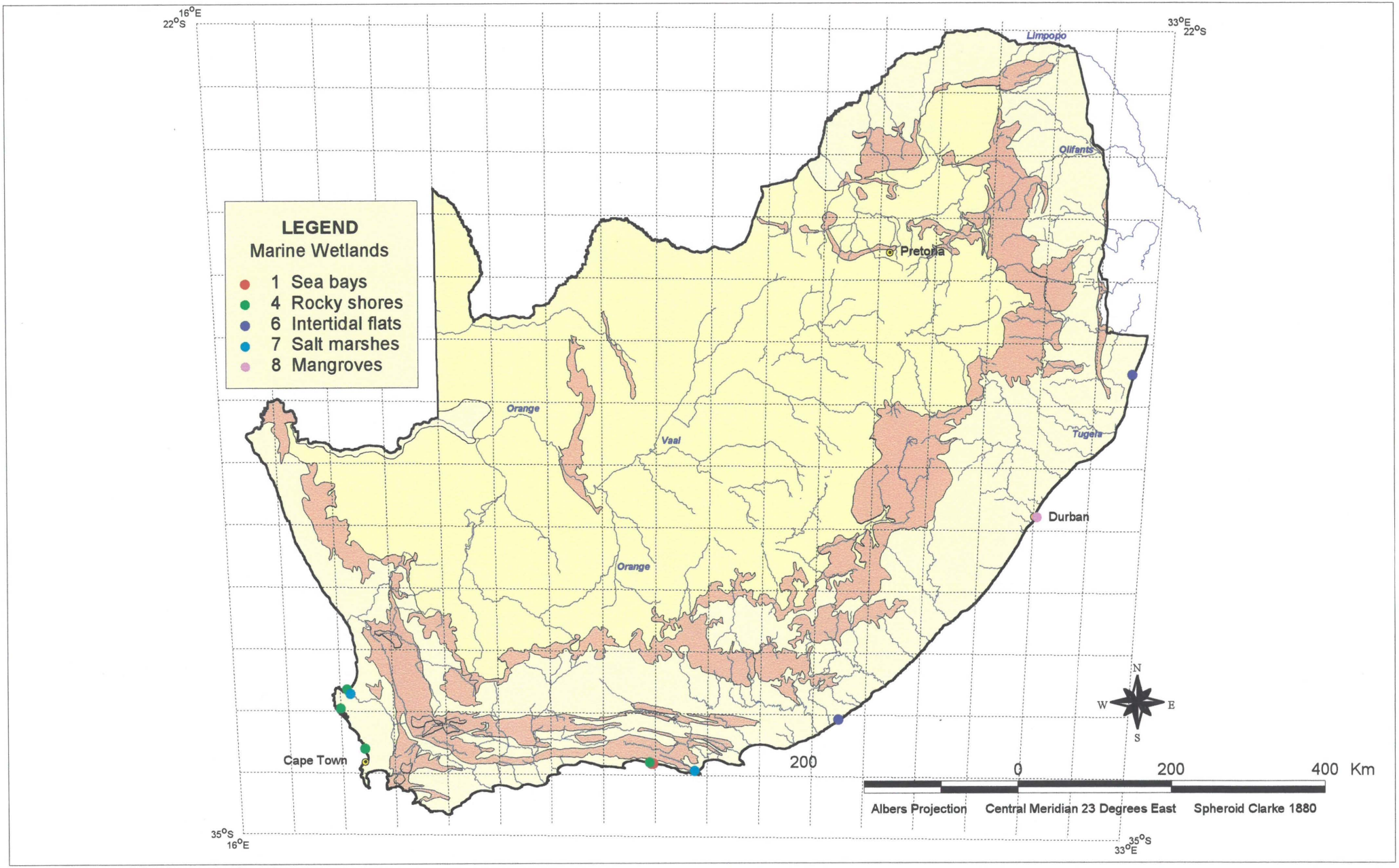

Figure 3.1 Marine wetlands

The Turtle Beaches and Coral Reefs of Tongaland is the only marine Ramsar site at present. The islands which form part of the Langebaan site would fall into this class of site as well. Underhill *et al* (1980) suggests some 14 coastal wetlands of major importance as habitats for waders in the southern and eastern Cape which could be considered as candidates for designation to the List of Wetlands of International Importance in terms of the Ramsar Convention based on the bird life found at these sites (criterion 3). These sites require classification before inclusion into the directory). In terms of criterion 4 (fish criteria) all of the Marine Reserves in this directory could be considered as possible candidates for the List. Robinson and de Graaf (1994) identified some 111 marine protected areas along our coastline plus the Prince Edward Islands. All of these sites have a large terrestrial component and many are included under other sections. The rest will need to be reduced to component parts before the relevant elements are included in the directory.

3.3.3 Estuarine and lagoonal wetlands

Estuaries have been defined as semi-enclosed coastal bodies of water which have a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage (Day, 1981). This definition excludes lagoons, which have been included by Cowardin *et al* (1979) as well as by Dugan (1990) who identifies four estuarine wetland habitats (estuarine waters; intertidal mud, sand or salt flats; intertidal marshes; and intertidal forested wetlands (eg mangroves); and one lagoonal wetland habitat (brackish to saline lagoons).

Five types of estuaries may be recognized in South Africa based on a variety of criteria including salinity, mouth characteristics, tidal prism and mixing processes (Whitfield, 1992):

- estuarine bays;
- permanently open estuaries;
- river mouths;

- temporarily closed estuaries; and

- estuarine lakes (most of these are included under the lacustrine systems).

All five of the habitats defined by Dugan (1990) are found in South Africa. In this directory there are some 63 subtidal estuarine waters, three intertidal mud or sand flats, four intertidal marshes, 12 intertidal forested wetlands (mangrove swamps) and 204 brackish to saline lagoons (Fig 3.2). The high proportion of lagoons is a function of estuary mouths being closed for increasingly long periods.

While most of South Africa's estuarine and lagoonal wetlands are registered in this directory, the habitats are not. The intertidal mud and sand flats as well as the intertidal salt marshes are grossly under represented. South Africa does not boast many significant intertidal forested wetlands, the one found at Richards Bay being our largest at 427,5 ha. Steinke (1995) records 41 estuaries with mangroves along South Africa's east coast, subtropical region. However, most of them are small (more than half being 0,5 to 7,5 ha), the largest stand being found at Richards Bay, St Lucia (160ha), and Kosi (59ha) and the estimated total area is 1 059,5ha. Salt marsh communities, occurring in the warm temperate and cool temperate regions, cover approximately 17 000 ha with more than 75% of this area being confined to the Langebaan and Knysna Lagoons, the Swartkops, Berg and Orange River estuaries (Adams and Bate, 1997).

Seven of South Africa's 15 Ramsar wetlands are included in this category (Kosi System, St Lucia System, Wilderness Lakes, de Mond, Langebaan, Verlorenvlei, and the Orange River Mouth Wetland). Estuaries and lagoons are particularly important for migratory waterfowl in South Africa (Turpie, 1995; Underhill, 1995), and have long been recognized as nursery areas for important marine fish species (Whitfield ,1997). The importance of estuaries is emphasized when considering the fish criterion for identifying sites for inclusion in the List of Wetlands of International Importance (Ramsar, 1996), a number of estuaries can be identified (Randall, 1996).

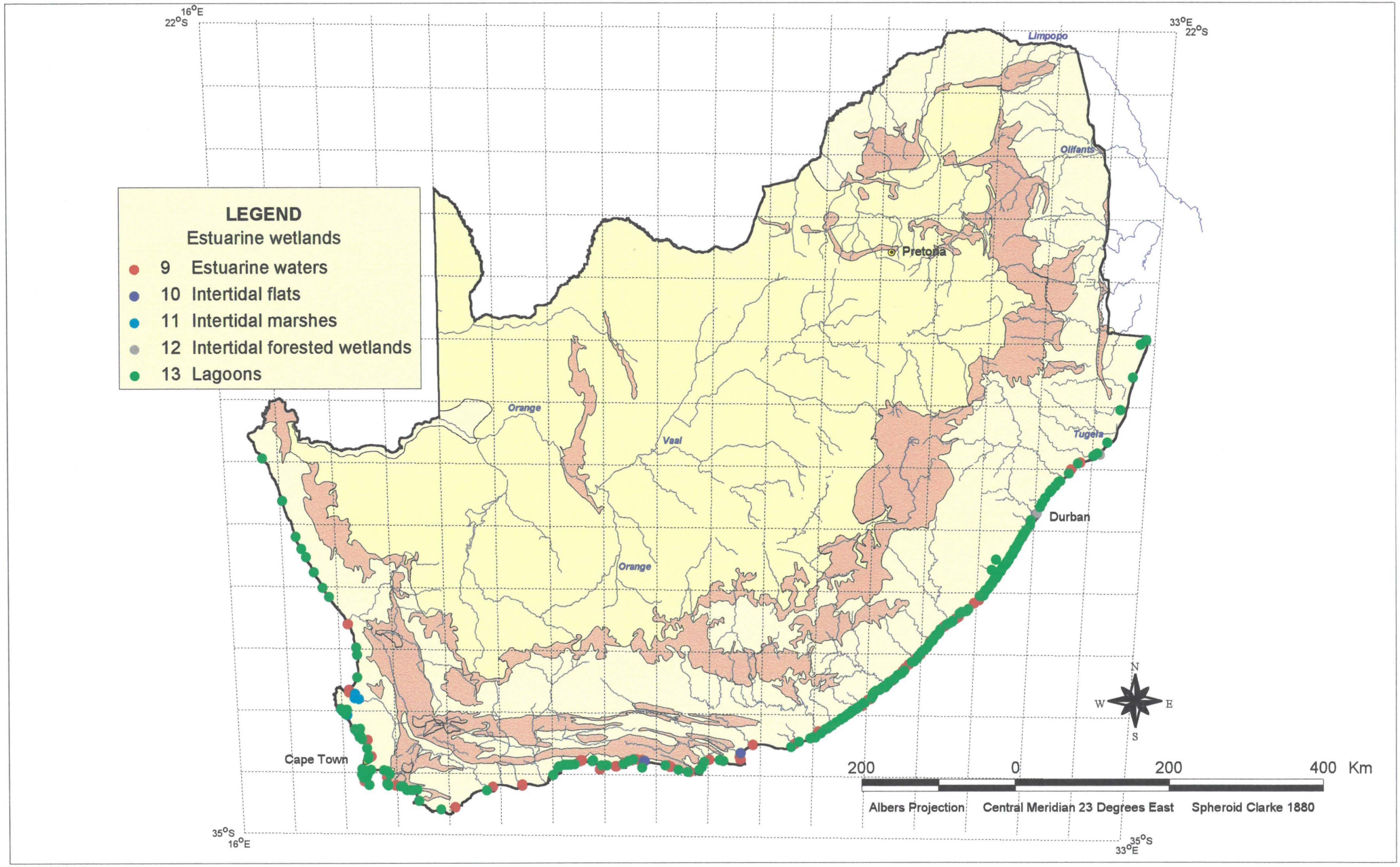

Figure 3.2 Estuarine wetlands

Estuarine and lagoonal wetlands are arguably South Africa's best researched wetlands. Begg (1978, 1984) surveyed the estuaries of Natal (now Kwazulu-Natal), Heydorn and Tinley (1980) provided an overview of the Cape estuaries (including what is now the Northern Cape Province, the Western Cape Province and the Eastern Cape Province (excluding what was then the Ciskei and Transkei)), which has been followed up by a series of synopses of individual systems edited by Heydorn and Grindley (1981-1985). Day (1981) produced a substantial review of the fauna and flora of our estuaries. A range of studies have been reviewed by Noble and Hemens (1978), Allanson *et al* (1990) and more recently Whitfield (1995) published a bibliography of available information on South Africa's estuaries. The CSIR is currently assessing the status of South Africa's estuaries in a project funded by the Department of Environmental Affairs and Tourism (Cooper *et al,* 1994).

Threats to the structure and functioning of South Africa's estuarine wetlands include habitat degradation through land use changes especially industrial and residential development, disruption of essential ecological processes, hydrological manipulations through freshwater abstraction and storage, pollution especially organic and inorganic wastes from industrial, agricultural and domestic sources, the introduction of invasive alien biota and overexploitation of the resources through various activities (Cyrus, 1991; Whitfield, 1992, 1997)

3.3.4 Endorheic pans

Pans (also commonly known as playas in geomorphological literature) are common in many of the world's arid zones, and in southern Africa extend well into Zambia (Allan *et al*, 1995). In South Africa they are best represented in the Western, Southern and Eastern Plateau wetland regions (Cowan, 1995) with their highest concentration being found in the area with a mean annual rainfall of less than 500mm and an average net evaporation loss of 1 000mm per annum (Shaw 1988). Endorheic pans are defined as being typically circular to oval in shape, shallow (less than three metres deep) even when fully inundated, having a flat bottom and having a closed drainage system. Major water loss from pans is by evaporation, which plays some part in their salinity. Inundation is characteristically ephemeral, some pans in the dry western regions standing dry for years between flooding, but in the wetter eastern regions many pans are seasonal to semi-

permanently inundated (Allan *et al*, 1995). Dugan (1990) only considers saline internal drainage areas. Some of the larger pans found on the Mpumulanga highveld which have never been known to dry up can be classified as lakes (Davies 1987), being large, deep, permanent with rooted vegetation, which supports Shaw's (1988) view, which concurs with Cowardin *et al* (1979) that pans are a type of lake.

There are some 289 endorheic pans recorded in this directory (Figure 3.3). This obviously significantly short of the total number to be found in South Africa. At the 1:500 000 scale Surveys and Mapping record some 1 772 pans, while in the plateau region north of the Vaal River only, Allan *et al* (1995) identified some 7 600 pans from the 1:50 000 map series, which they estimate fail to show some 16% of the smaller, well vegetated pans).

Pans have been differentiated into the following groups:

- Salt pans which are dry for most of the time but may contain perennial pools filled by springs;

- Temporary pans are also dry for long periods and are moderately saline. They are flooded during the rainy season;

- Grass or Diplachne pans are seasonal and dry up in the dry season. They are covered by a thick growth of hygrophilous grasses and other low terrestrial vegetation. Their waters are fresh to slightly saline; and

- Reed pans and Sedge pans are temporary or semi-permanent, with dense stands of *Phragmites* and Cyperaceae.

Some of the pans are sufficiently large and permanent to be classified as lakes (Noble and Hemens, 1978; Davies, 1987; Allan *et al*, 1995).

Pans have been identified as important for waterfowl especially migratory birds (Underhill,

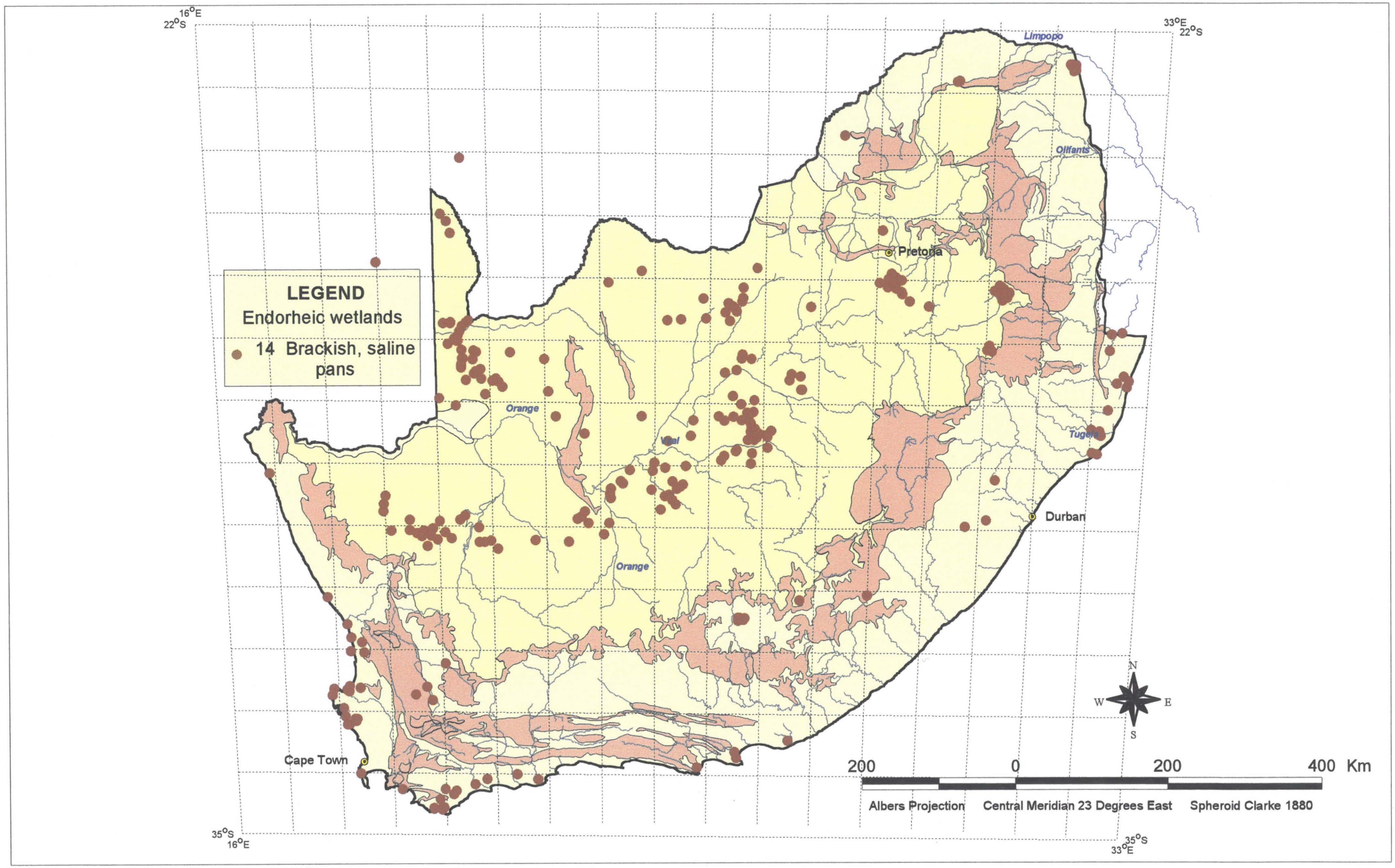

Figure 3.3 Endorheic wetlands

1995). Barberspan was established as one of the only two official bird ringing sites in 1955 (Milstein, 1975), as well as being one the first two wetlands designated by South Africa to the List of Wetlands of International Importance in terms of the Ramsar Convention (Cowan, 1995). They have also been assessed for their mineral content and in particular the salts (Hugo, 1974).

The greatest threats to pans are urbanization (in the Gauteng area), where pans are drained, filled or used as dump sites, or access to them or between them by fauna dependant on them such as the bullfrog, *Pixicephalus adspersus* has been blocked (Batchelor, pers com); afforestation in the Mpumulanga area, affecting both the landscape character as well as the water supply; mining spoil and agricultural pollution in the form of fertilizer and pesticide runoff in some of the other areas.

3.3.5 Riverine wetlands

Cowardin, *et al* (1979) limits these systems to those contained within a channel, which contains moving water either continuously or periodically. This thesis uses the wider definition of riverine wetlands which include the following habitats: perennial rivers and streams (including waterfalls), inland deltas, seasonal rivers and streams, and riverine floodplains (Dugan, 1990; Davis, 1994).

South African rivers are geologically young, they tend to be fast flowing, but are characteristically variable in their flow regime. A number of river classification projects have been initiated in South Africa over the years (O 'Keefe, 1986,1986a; Davies, O'Keefe and Snaddon, 1993). A biotic classification of the rivers is currently under development by the University of Cape Town (a project funded as part of the South African Wetlands Conservation Programme of the Department of Environmental Affairs) while hydrological, water quality classifications are being funded by the Water Resources Commission (Eekhout, 1993).

Of the four wetland habitats used in the classification above for riverine wetlands, three are registered in this directory. Only inland deltas are absent although a part of the Mkuze Swamp is considered to be one (Goodman, 1987). Some 164 sites of conservation importance found on

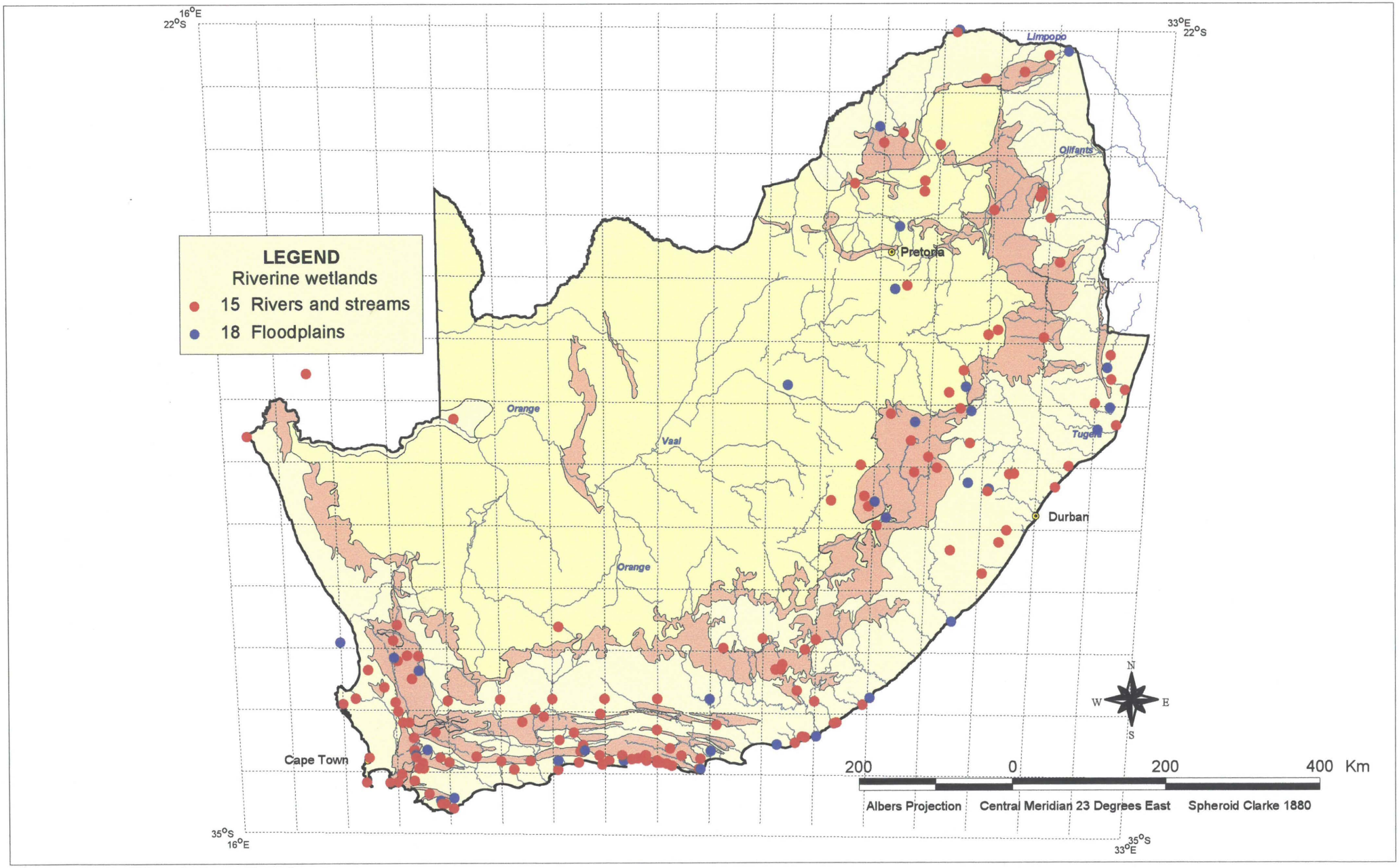

Figure 3.4 Riverine wetlands

perennial rivers or streams have been identified primarily at a workshop held at Midmar (O'Keefe, 1986a), with two on known seasonal rivers or streams. Some 44 riverine floodplain habitats are identified (Fig 3.4) .

Three of South Africa's Ramsar sites are a part of riverine flood plains (Seekoeivlei, Ndumo and Nylsvley), a third (Natal Drakensberg Park) forms the upper catchment area of numerous rivers). The Seekoeivlei plays a vital role in regulating flow and maintaining high water quality standards of the upper Vaal River. Ndumo Game Reserve provides a refuge for fish breeding stock which repopulates the Pongola Flood plain during flooding (it has been estimated that the flood plain yielded up to 500 000 kg of fish per annum to the local people during the early 1980's). The Natal Drakensberg Park consists of an inter-connected system of wetlands which play a key role in the hydrological cycle (Cowan and Marneweck, 1996). Another proposed site (the Limpopo-Levuvhu Floodplain) is also primarily flood plain habitat.

Being a dry country, with a high population growth and increasing demand on its water resources, South African rivers are threatened by rapidly escalating pressures. Water resource management in South Africa has resulted in the fact that nearly all of our rivers are manipulated by storage dams or by water transfer schemes. This is one of the seven main threats to river conservation in the country. This has led to the following statement being made: "there are few rivers in Southern Africa that have not been over-exploited, degraded, polluted, or regulated by impoundments, and we know of many that were once perennial, but which now flow only seasonally or intermittently" (Davies *et al*, 1993: 1). The other major threats are catchment degradation and associated sediment production, organic and mineral pollution, over abstraction of water, salinization, introduction of alien invasive species and the breakdown of natural biogeographic barriers due to the transfer of water between or within catchments (Davies *et al,* 1993).

3.3.6 Lacustrine wetlands

Lacustrine wetlands have been defined as areas of permanent water with little flow (Barbier *et al*, 1997), although Dugan (1990) includes seasonal freshwater lakes (>8ha), ponds and pans

(<8ha). Hart (1995) excludes the pans from lakes which he defines as reasonably extensive and relatively deep open waters. Shaw (1988) considers endorheic pans to be a lake type. In this thesis, endorheic pans have been treated separately (based on salinity), although the continuum is recognized, particularly given the classification used here.

Hart (1995) emphasizes the fact that South Africa is deficient in terms of natural fresh water lakes, and notes that besides Lake Fundudzi which was created by a landslide blockage of the Mutale River, South Africa's only significant natural standing waters are its coastal lakes. Most of these were formed by Flandrian transgression (Allanson *et al*, 1990; Orme, 1990).

Coastal lakes have been classified into three major regional groups (Hart, 1995): sub-tropical lakes on the north eastern seaboard (sub-tropical coastal plain region); warm temperate lakes on the Cape south coast (southern coast temperate region); and a disparate group in the south-western Cape experiencing a Mediterranean climate (western coastal slope -Mediterranean wetland region). Besides the permanent freshwater lakes identified by Hart (1995), a number of largely freshwater permanent and temporary pans, mostly part of flood plain systems, are listed as lacustrine wetlands. Even though some of these systems may tend to become saline as they dry out and could be categorised as pans, they have been included here. This directory includes 41 permanent freshwater lakes, 16 permanent freshwater ponds or pans, nine seasonal freshwater lakes and three seasonal freshwater ponds or pans (Fig 3.5).

Most of the major lake systems have been included in sites designated by South Africa as Wetlands of International Importance in terms of the Ramsar Convention (de Hoop, de Mond, Kosi System, Lake Sibaya, Ndumo, St Lucia System, Verlorenvlei and Wilderness Lakes, all of which have been afforded legal protection (Cowan, 1996)). Lake Fundudzi forms the focus of a rich heritage of ceremonial rituals and myths amongst the local Venda people (van der Waal, 1996).

The major threats to our lacustrine wetlands include agricultural and silvicultural developments in their catchments, leading to reduced flows into the systems, nutrient loading and herbicide/biocide pollution; industrial developments with corresponding increases in pollutants;

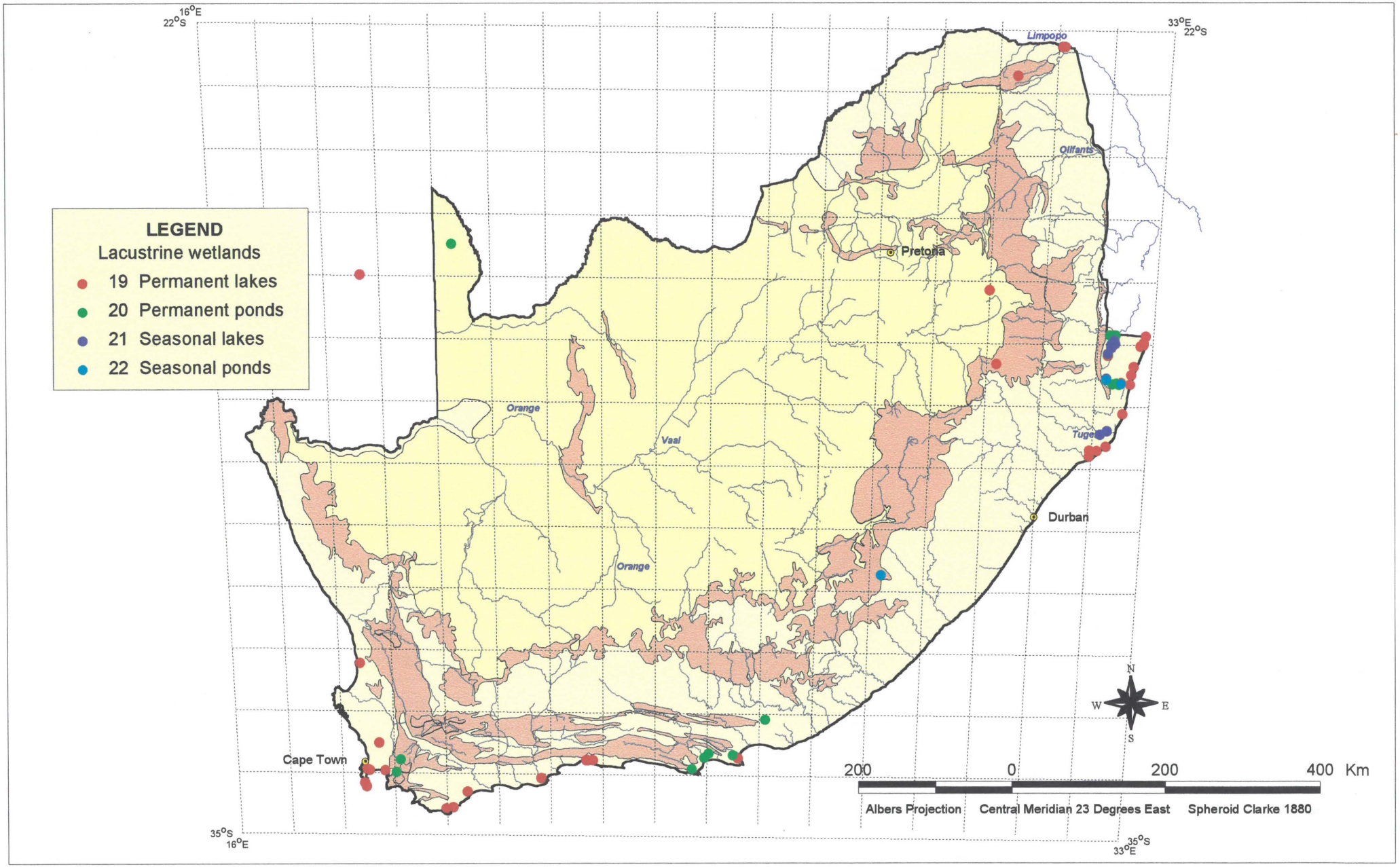

Figure 3.5 Lacustrine wetlands

direct demands due to an expanding population (eg recreational demands and overexploitation of resources), inappropriate riparian developments including reclamation, leading to changes in hydrological regimes and sediment loading (Hart, 1995).

3.3.7 Palustrine wetlands

Cowardin *et al* (1979), while separating "deep water habitats", defined wetlands as the ecosystems which occur between terrestrial and aquatic systems, where an excess of water is the dominant factor. Assuming a freshwater regime, this is possibly the best definition of palustrine wetlands, which comprise a wide range of physical situations, water regimes, chemistries and vegetation types (Orme, 1990). Included in Dugan's (1990) classification of freshwater palustrine habitats are permanent marshes and swamps, permanent peat-forming swamps, seasonal marshes, peatlands and fens, alpine and polar wetlands, springs and oases, volcanic fumaroles, shrub swamps, swamp forest, and forested peatlands. These include both the forested and herbaceous wetlands of Denny (1996).

The main distribution of palustrine wetlands in South Africa almost mirrors the main distribution of endorheic pans. Generally they are found in the areas with a mean annual rainfall greater than 500m. The main exceptions being those found along the main water courses, and those developed around dolomitic eyes (Skelton, Ribbink and Twentyman-Jones, 1994). The rugged geomorphological character of South Africa east and south of the plateau does not allow for palustrine wetland of any great size, the largest being found on the physiographically flat areas of the coastal plain (eg Mfolozi Swamps).

Of the 10 palustrine habitats identified by Dugan (1990), seven are represented in this directory (Fig 3.6). While most alpine wetlands are found in Lesotho, and these are dominated by short sedges and grasses (Schwabe, 1995), some are found in the upper areas of the Drakensberg in South Africa (Bainbridge, 1991), but have not been included here. Similarly, no volcanic fumaroles are listed, but a number of well known hot springs have been developed in South Africa as health and recreation resorts (eg Warmbad, Aliwal North, Badplaas, Loskop, Eiland and Tshipise).

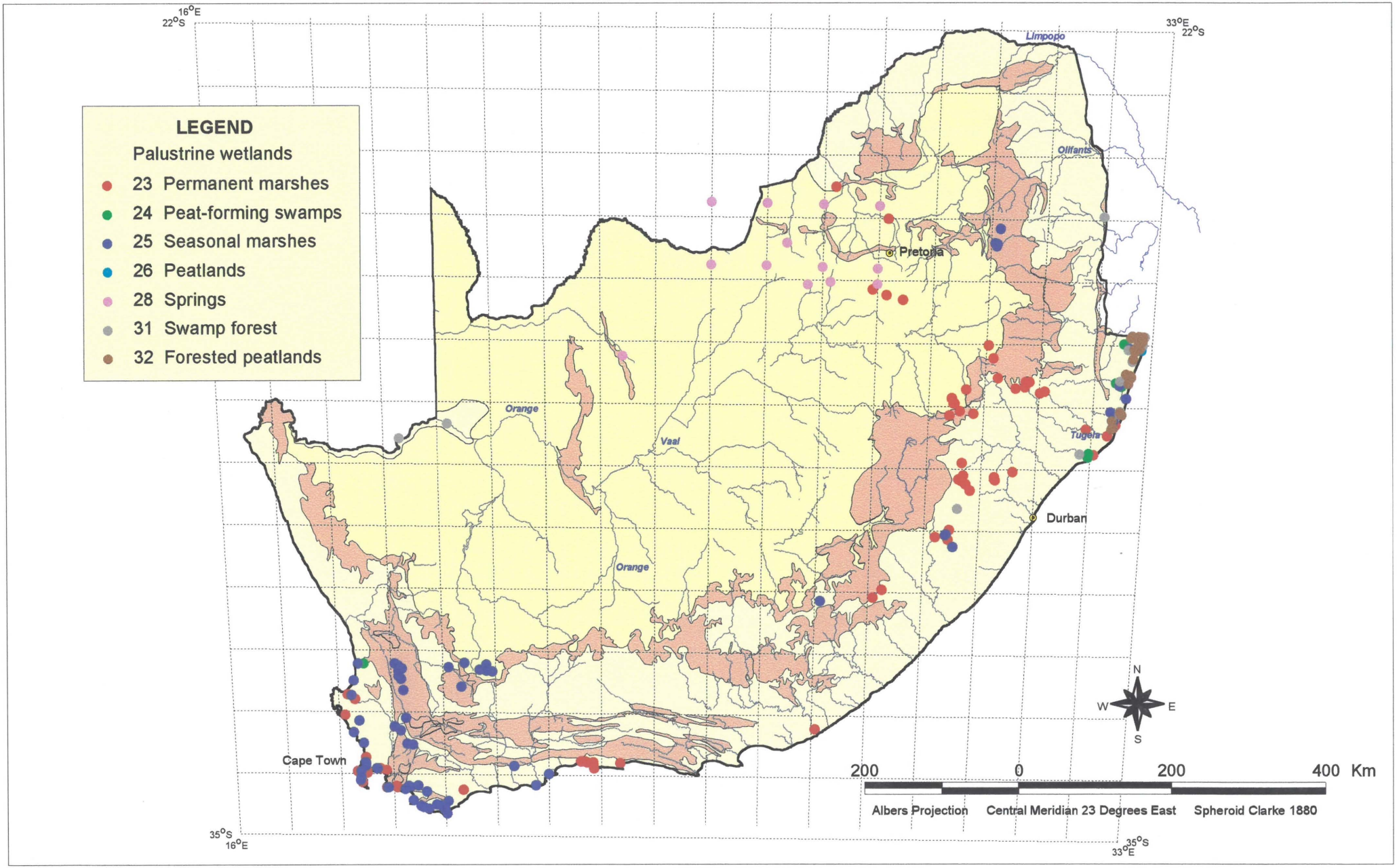

Figure 3.6 Palustrine wetlands

The 54 springs listed here are primarily those related to dolomitic eyes located in the north east of the western plateau wetland region (Skelton *et al*, 1995; Cowan, 1995). These sites are particularly important for a number of endemic fish species found in them, which are facing threats due to the introduction of alien invasive fish species and agricultural pollution. Important as a source of water in a dry area, but threats to the ecosystems due to water abstraction (for urban/ industrial /agricultural use) and dewatering of dolomitic compartments as part of the underground mining processes (Skelton *et al*, 1994).

Some 66 permanent freshwater marshes and swamps and 69 seasonal freshwater marshes are listed in this directory. Four different types of freshwater marshes are recognized:

- Sedge marshes dominated by sedges, hygrophilous grasses and similar plants up to 1m high (including *Scirpus littoralis, S ficiniodes, Festuca caprina, Juncus maritimus , J kraussi, J oxyxapus, Leersia hexandra, Sporobolous virginicus, S consimilis* and *Paspalum vaginatum* (Begg, 1978; Ward, 1982; Bainbridge, 1991; Kotze *et al,* 1994));

- Restio marshes, typical of the south-western Cape which are acid and dominated by Restionaceae (characteristic of the Cape floral kingdom) and sedges. Three communities have been identified: the *Restio compressus* community of seepage steps, the *Eligia cuspidata -Prismatocarpus sessilis* community of recently burnt, seasonally moist sites, and the *E cuspidata - Bobartia india* community of unburnt, marshy flats (Taylor, 1978);

- Reed bed marshes dominated by *Phragmites* species, but where water levels remain close to the soil surface during the dry season stands of *Typha* spp, *Scirpus* spp and *Cyperus* spp are found. Reed bed marshes intergrade with sedge marshes at higher altitudes; and

- Cape seasonal wetlands which include a temporary sand plain community dominated by *Berzelia abrotanoides* and *Chrondropetalum nudum*, a limestone

community characterized by *Elegia verrauxii, Euphorbia muirii, Lachenalia reflexa* and *Phylica harveyana,* a coastal Renosterveld community dominated by *Calopsis paniculata, Psoralea aphylla, Gunnera perpensa, Isolepis trachysperma, Juncus capensis, Typha capensis* and *Zantedeschia aethiopica,* a Strandveld community dominated by *Chondropetalum tectorum, Exomus microphylla* and *Scirpus thunbergii* (Boucher, 1988)

Two types of freshwater swamps are recognized:

- Reed swamps which are found in perennial standing water on flood plains and fringe many coastal and estuarine lakes. They are dominated by *Phragmites australis* or *P mauritianus* while *Typha capensis* frequently form patches in these swamps (Noble and Hemens, 1978; Rogers, 1980; Begg, 1989; Hughes and Hughes, 1992); and

- Papyrus swamps which typically require a stable hydrological regime, are dominated by *Cyperus papyrus*, and are confined to the sub-tropical coastal plain wetland region (Noble and Hemens, 1978; Stormans and Breen, 1986; Cowan, 1995).

Peat in South Africa occurs in wetlands ranging from the sub-tropical interdune mires of the subtropical coastal plain wetland region to the cool highveld reedbeds (Grundling, 1997). The information in this directory (five peat-forming freshwater swamps, one peat land or fen) is from northern Kwazulu-Natal. The main peat formers are *Cyperus papyrus* and *Phragmites australis* in papyrus/reed swamps, *Ficus trichopoda* and *Syzigium cordatum* in swamp forests, and *Fimbristylus longiculmis* and *Leersia hexandra* in sedge dominated peatlands (Bartman, 1997). Peat lands are used for subsistance farming an area of poor sandy soils, they are important as sources of fresh water, fodder and biomass for local communities. Uncontrolled afforestation poses a threat to the ecological processes in peat lands by lowering the water table, while exploitation for commercial horticulture purposes poses a direct threat to the limited peat resource (Grundling, 1997).

The 39 freshwater swamp forest sites and 28 forested peat lands listed in this directory are found exclusively in the coastal plain region of northern Kwazulu-Natal. Small and linear along coastal streams, they have been split into two communities: the *Phoenix reclinata, Microsorium punctatum and Protosparagus falcatus* community, and the *Barringtonia racemosa - Nephrolepis biserrata* community (Wessels, 1991). These habitats are under severe threat by a rapidly increasing population practicing slash and burn agriculture aimed at providing a short term cash crop (mainly bananas) in a densely populated, poor rural area characterized by infertile agricultural soils.

The vast majority of palustrine wetlands are not found in formally protected areas. This true even for the larger wetland systems as shown by Begg (1989) who indicated that 65% of the priority wetlands of Kwazulu-Natal are privately owned. Palustrine wetland habitats are found in most of South Africa's Ramsar sites, and a number are found in national parks and provincial reserves.

- The main causes of palustrine wetland loss are due to agricultural development, erosion, and the building of dams, all of which have a direct effect on the ecological functioning of the systems. Those indirect factors, usually taking place in the catchment areas of these wetlands are disruption of the hydrological regime (by water resource development, afforestation of grassland catchment areas) and excess sedimentation (usually as a result of some form of development or land-use changes, or mismanagement in the catchment (Kotze *et al*, 1995). The introduction of invasive alien plants and animals have also had a profound effect on a number of systems (de Moor and Bruton, 1988; Hamman, 1997).

3.3.8 Man-made wetlands

Man-made wetlands (Fig 3.7) have had a profound effect on our wetland landscapes. South African river systems have been extensively developed for water resource management in order to supply water for industry, irrigation, mining, municipal and domestic use, power generation, stock watering and in some cases for political reasons (Department of Water Affairs, 1986). This is well illustrated in the number of major dams listed here (203), which falls well short of the total number of impoundments on our rivers. Excluded are those dams privately built under

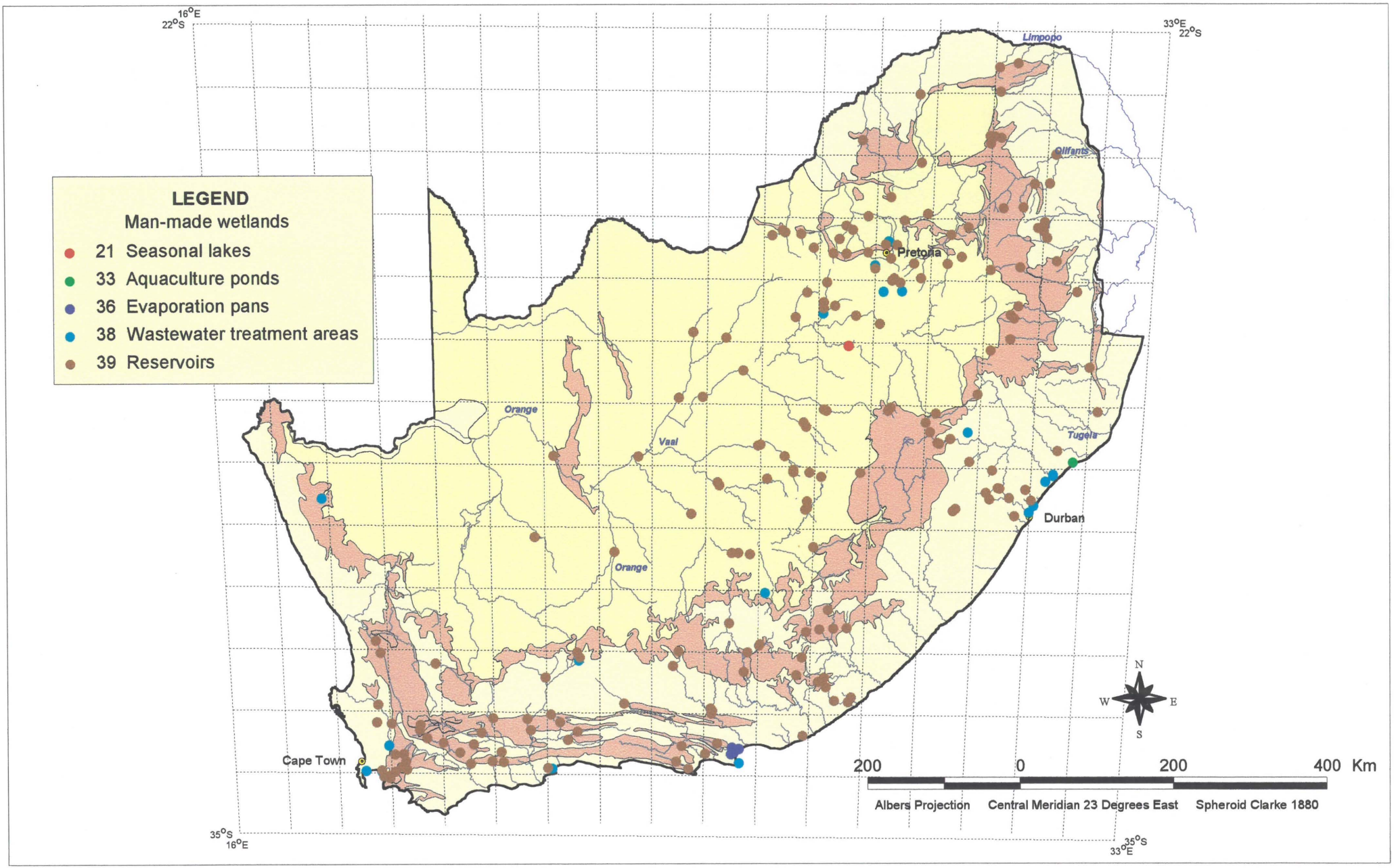

Figure 3.7 Man-made wetlands

permit (with a dam wall greater than five metres high or a capacity of 250 000m³), as well as the large number of small dams found in all our catchments (eg 15 067 farm dams were counted in the Western Cape (Siberbauer and King, 1991)). While these impoundments have had a profound negative effect on our natural wetland systems, by drowning them and changing the hydrological character of our rivers, a few have provided benefits other than water supply. Heyshope Dam, on the north eastern edge of the Eastern Plateau region, has provided a refuge for large numbers of waterfowl during the last few dry seasons and a commercial fishery has been established on the Bloemhof Dam (de Villiers, pers com). Only two aquaculture sites are listed here. To date aquaculture in South Africa has not made substantial changes to the natural landscape, but certainly has had an effect on the fish fauna in our rivers (de Moor *et al*, 1988; Hamman, 1997). Salt exploitation is not done on a large scale in South Africa, the most substantial works being found at the mouths of the Berg River (Western Cape) and the Koega River (Eastern Cape). The 18 wastewater treatment areas listed here are all sites where CWAC counts are made indicating their importance for waterfowl.

3.3.9 Mountain catchment areas

At the scale of a national inventory numerous small but important seep-lines or seepage areas (often referred to as dambos in countries to the north of South Africa) will not be registered. As these are common in mountainous areas with high rainfall, there should be a direct relationship between them and areas identified as mountain catchment areas. An inter-departmental committee on the "Conservation of Mountain Catchments in South Africa" completed their report in 1961 (Anon 1961), where 109 principle mountain catchments were identified, divided into four classes based on unit run-off (run-off per unit area per year):

Group A	URO (unit run-off) of 300 and over
Group B	URO of 150-299
Group C	URO of 50-149
Group D	URO of less than 50

It follows that those mountain catchment areas with the higher URO will have a greater number

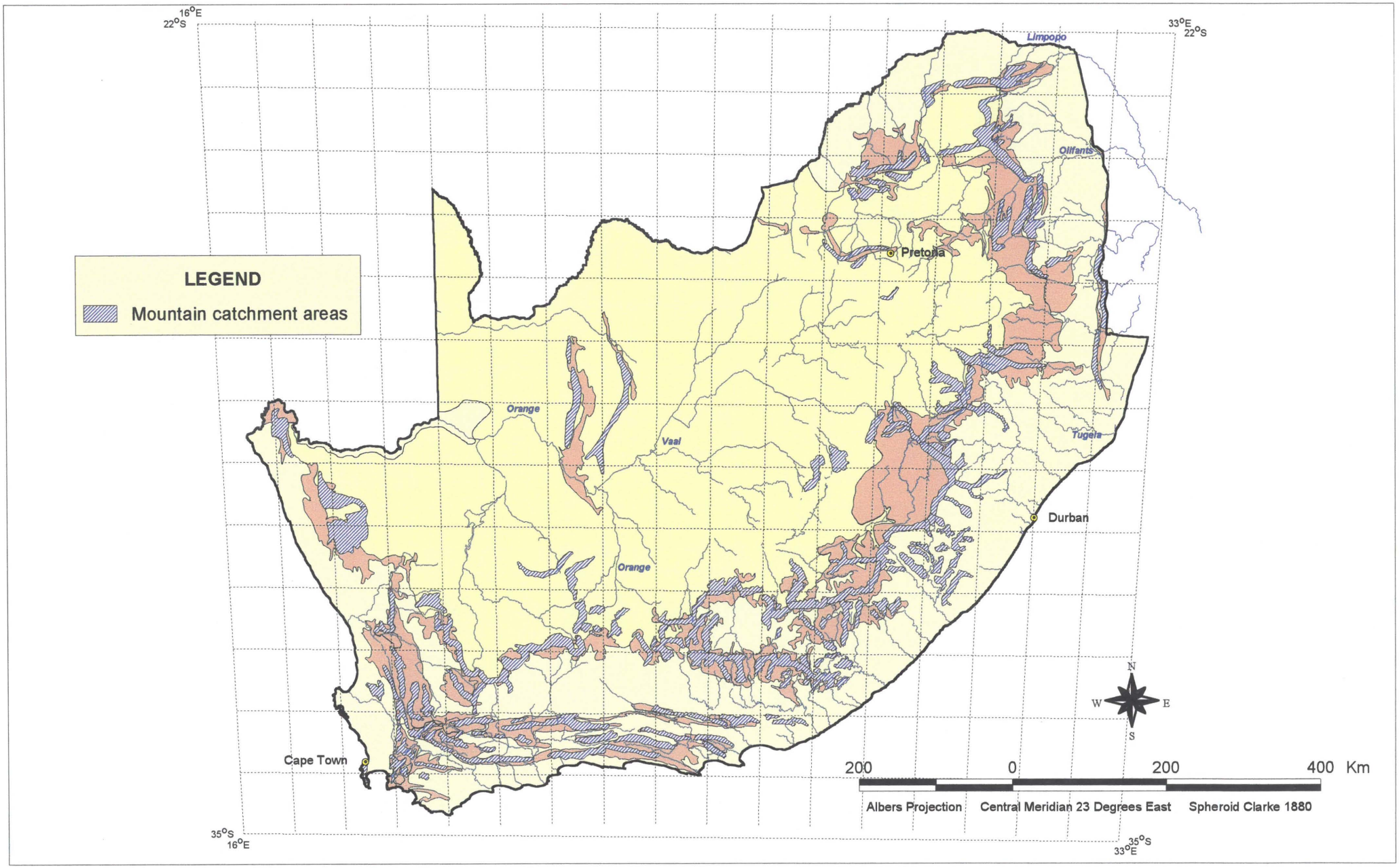

Figure 3.8 Mountain catchment areas

of seep-lines and seepage areas are found on the eastern and southern mountain wetland regions (Cowan and Randall, 1995) (Fig 3.8). Examples of these type of wetlands from the Drakensberg are the *Miscanthus capensis* meadows, *Scleria welwitschii* and *Rhynchospora brownii* seepage slopes, while *Kniphofia caulescens* is often the most dominant and conspicuous species on wetter seepage slopes in the Alpine Zone (Bainbridge, 1991).

The importance of these areas for water yield was recognized as paramount in 1961, this lead to the promulgation of the Mountain Catchment Areas Act (no of 1970). Besides the proclaimed Mountain Catchment Areas mainly in the Western and Eastern Cape, most of the Kwazulu-Natal Drakensberg as well as parts of the northern Drakensberg (in Mpumulanga and Northern Province) are protected as wilderness areas or nature reserves. The Natal Drakensberg Park is the only Ramsar site in which large numbers of these wetlands occur.

A far greater proportion of these areas require protection as they are important in terms of both water supply as well as the habitat for a number of rare and endangered plants and animals. The main threats to these wetlands include afforestation, invasion by alien invasive plant species, flooding by trout dams and poor farming practices.

3.4 CONCLUSION

In this chapter the knowledge of the extent of wetlands in South Africa was assessed. In order to do this, a wetland classification system was developed; a range of sources, many from outside of the conservation field, were used. The information thus found was merged to form a data set for analysis. While adding substantially to the knowledge relating of the wetlands of South Africa by presenting the data in the form of a directory of wetlands, the analysis of this data set showed that South Africa does not know the extent of its wetlands. It was found that a comprehensive wetland inventory is still a priority for wetland conservation because there are still significant gaps in the knowledge of South Africa's wetlands.

3.5 SUMMARY

In this chapter, the secondary hypothesis "South Africa does not know the extent of its wetlands" is tested. To do this a wetland classification system was developed for South Africa. This system relates well to other international systems.

A directory of South African wetlands was then compiled. Data from a range of sources was collected, combined and added to form a data set relevant to this thesis. These data were tested to determine the conservation status of wetlands in South Africa, the threats they are facing and their conservation value. While adding substantially to the knowledge of our wetlands, this exercise proved that South Africa does not know the full extent of its wetlands. The implementation of a national wetland inventory is now an imperative.

CHAPTER 4

SOUTH AFRICA'S INTERNATIONAL COMMITMENTS

4.1 INTRODUCTION

This chapter tests the secondary hypothesis that South Africa is not meeting its international obligations. The relevant international instruments are identified and described and the important aspects are highlighted. A review of South Africa's activities in terms of these conventions is then undertaken and its major shortcomings noted.

4.2 BACKGROUND

A number of international instruments address the conservation and sustainable use of natural resources. The most recent and well publicized are those agreements made at Rio in 1992 - the relevant ones to this thesis being Agenda 21 and the Convention on Biological Diversity. Agenda 21 is not a convention in terms of countries ratifying it. It essentially sets out a process whereby sustainable development is promoted, and encourages all nations toward implementing that process. In the process it recognizes the roles of the other international conservation instruments. The Convention on Biological Diversity (the CBD), on the other hand, is a formal convention. It was ratified by South Africa in 1996. It is a wide ranging convention addressing three essential thrusts:

- The conservation of biological diversity;
- The sustainable use of biological resources; and
- The fair and equitable sharing of benefits arising from the use of genetic resources.

Because its scope is so wide, the CBD has signed memoranda of understanding with other relevant conventions, which in turn take the lead in their fields. Thus at the CBD's 4th Conference of Contracting Parties (CBD-COP4), held in Slovakia during 1998, the CBD recognized the Ramsar Convention on Wetlands as the lead convention as regards wetland conservation. Therefore this chapter will address South Africa's commitments in terms of the latter convention only.

This chapter describes the Ramsar Convention on Wetlands and notes some of the major recommendations made by the convention as accepted at the Conferences of Contracting Parties. South Africa's participation in the Convention is set out and how we are meeting our obligations in terms of the Convention is described.

4.3 THE CONVENTION ON WETLANDS (Ramsar, 1971)

Wetlands are habitats which often transcend international boundaries and co-operation among states is therefore a necessity for effective wetland conservation. The health of wetland habitats is dependant upon the quality and quantity of their water supply. Wetlands are affected, for example by human impacts upon streams and rivers. These impacts can occur at considerable distances from the wetland areas and in many cases beyond national borders. Wetlands are also seriously degraded by transboundary air and water pollution. Much of the wetland fauna is made up of migratory species whose conservation and management require international co-operation.

With this as a background, a series of international conferences and technical meetings, mainly held under the auspices of the International Waterfowl and Wetlands Research Bureau were held. The culmination of these meetings was that the Convention on Wetlands of International Importance especially as Waterfowl Habitat, commonly known as the Convention on Wetlands or the Ramsar Convention, was adopted in February 1971 by the International Conference on the Conservation of Wetlands and Waterfowl at the town of Ramsar in Iran. The short name

for the convention has taken the name of the town where it was adopted.

The Convention on Wetlands of International Importance especially as Waterfowl Habitat is an intergovernmental treaty which provides the framework for international cooperation for the conservation of wetland habitats.

The Convention entered into force in late 1975 following the accession of the seventh party, Greece. As of May 1999 the Convention has 116 Contracting Parties from all regions throughout the world. The Convention is open to any member of the United Nations or one of the Specialized Agencies or of the International Atomic Energy Agency or Party to the Statute of the International Court of Justice. Each Contracting Party shall designate at least one wetland to be included in the List of Wetlands of International Importance (known as "the List") when signing this Convention.

In the preamble to the Convention, the Contracting Parties recognize the interdependance of man and his environment. They consider the fundamental ecological functions of wetlands as regulators of water regimes and as habitats supporting a characteristic flora and fauna (as such the Convention was one of the first to recognize habitat as opposed to animal or plant species). The Contracting Parties note their conviction that wetlands constitute a resource of great economic, cultural, scientific, and recreational value, the loss of which would be irreparable. The Contracting Parties express their desire to stem the progressive encroachment on and loss of wetlands now and in the future. They recognize that waterfowl in their seasonal migrations may cross frontiers and so should be regarded as an international resource. Finally the Contracting Parties express their confidence that the conservation of wetlands and their flora and fauna can be ensured by combining far-sighted national policies with co-ordinated international action.

With the preamble as a base, the broad objectives of the Convention are:

- To stem the loss of wetlands;

- Promote wise use of all wetlands;
- Promote special protection of listed wetlands;
- Promote the training of personnel; and
- Promote the implementation of parties obligations under the Convention

In essence to ensure the conservation of wetlands. These objectives are embodied in the following two articles of the Convention:

Article 3.1 "the Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory."

Article 4.1 "....each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not, and provide adequately for their wardening."

The Contracting Parties meet every three years to discuss national experiences, to review the status of sites on the List, to hear reports from international organizations and to make decisions on the functioning of the Convention. In 1987 the Conference established a financial regime, a Standing Committee and a Bureau. Contracting Parties contribute to the budget in accordance with international practice based upon the United Nations scale. The Standing Committee (made up of nine Contracting Parties, seven of which are elected regional representatives, Africa being represented by Tunisia (from 1987 to 1993), Kenya (1993 to 1996) and Senegal (1996 to 1999), and the other two members being the host of the previous and the next Meetings of the Conference) carries out interim activities between Conferences. The independent Ramsar Bureau, administered by IUCN in co-operation with IWRB, provides a permanent structure for administrative, scientific and technical support. UNESCO acts as Convention Depositary (Ramsar Convention Bureau, 1990).

4.3.1 Definition of wetlands

Article 1.1 of the Convention defines wetlands as:

"areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres".

These areas may also include adjacent riparian and coastal zones (Ramsar Article 2.1). This is an intentionally broad definition to stem encroachment on habitats as diverse as mangrove swamps, peat bogs, water meadows, coastal beaches, coastal waters, tidal flats, mountain lakes and tropical river systems. The definition thus includes all of Noble and Hemens' (1978) and Cowardin *et al*' s (1979) wetland categories.

4.3.2 Criteria for including wetlands in the List of Wetlands of International Importance

Article 2.2 of the Convention requires that wetlands be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology and indicates that in the first instance wetlands of international importance to waterfowl in any season should be included.

A Ramsar Working Group has recently elaborated on the criteria for identifying Wetlands of International Importance under three groupings, at the same time emphasizing that the wetland need meet only one of the criteria to be identified as a wetland of international importance. The criteria (as accepted at the Conference of Contracting Parties held in Montreux, 1990, and added to at Brisbane in 1996) are as follows:

4.3.2.1 Criteria for representative or unique wetlands

A wetland should be considered internationally important if:

a) It is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region; or

b) It is a particularly good representative example of a natural or near-natural wetland type common to more than one biogeographical region; or

c) It is a particularly good representative example of a wetland, which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position; or

d) It is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region.

4.3.2.2 General criteria based on plants or animals

A wetland should be considered internationally important if:

a) It supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal, or an appreciable number of individuals of any one or more of these species; or

b) It is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its fauna and flora; or

c) It is of special value as the habitat of plants or animals at a critical stage of their biological cycles; or

d) It is of special value for its endemic plant or animal species or communities.

4.3.2.3 Specific criteria for using waterfowl

A wetland should be considered internationally important if:

a) It regularly supports 20 000 waterfowl; or

b) It regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity; or

c) Where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl (Ramsar Convention Bureau, 1990).

4.3.2.4 Specific criteria based on fish

A wetland should be considered internationally important if:

a) It supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biodiversity; or

b) It is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

4.3.3 Guidelines for the application of the criteria

To assist Contracting Parties in assessing the suitability of wetlands for inclusion on the List of Wetlands of International Importance, the Conference of the Contracting Parties has

formulated the following guidelines for application of the criteria:

a) A wetland could be considered of international importance under criterion 1 if, because of its outstanding role in natural, biological, ecological or hydrological systems, it is of substantial value in supporting human communities dependant on the wetland. In this context, such support would include:

- provision of food, fibre or fuel; or
- maintenance of cultural values; or
- support of food chains, water quality, flood control or climatic stability.

The support, in all its aspects, should remain within the framework of sustainable use and habitat conservation, and should not change the ecological character of the wetland;

b) A wetland could be considered of international importance under criterion 1,2 or 3 if it conforms to additional guidelines developed at regional (e.g. Scandinavian or West African) or national level. Elaboration of such regional or national guidelines may be especially appropriate where:

- particular groups of animals (other than waterfowl) or plants are considered more suitable as a basis for evaluation; or
- waterfowl and other animals do not occur in large concentrations (particularly in northern latitudes); or
- collection of data is difficult (particularly in large countries);

c) The "particular groups of waterfowl (as decided at Ramsar, 1971), indicative

of wetland values, productivity or diversity" in Criterion 3 b include the following groups of birds:

Gaviiformes	No families in South Africa
Podicipediforms	grebes
Pelicaniformes	tropicbirds, pelicans, gannets and boobies, cormorants, darters, frigatebirds.
Ciconiiformes	herons, egrets and bitterns, Hamerkop, Shoebill, storks, ibises and spoonbills.
Anseriformes	ducks and geese
Gruiformes	cranes, rails, crakes, moorhens, coots, flufftails, gallinules, finfoot.
Charadriiformes	jacanas, painted snipe, oystercatchers, plovers, turnstones, sandpipers, Knot, Ruff, stints, snipes, godwits, curlews, phalaropes, avocets and stilts, Crab Plover, dikkops, coursers and pranticoles
Falconiformes	wetland related raptors were added at the fourth Meeting of the Contracting Parties held at Montreux (1990).

d) The specific criteria based on waterfowl numbers will apply to wetlands of varying size in different Contracting Countries. While it is impossible to give precise guidance on the size of an area in which these numbers may occur, wetlands identified as being of international importance under criterion 3 should form an ecological unit, and may thus be made up of one big area or a group

of smaller wetlands. Consideration may also be given to turnover of waterfowl at migration periods, so that a cumulative total is reached, if such data are available (Ramsar Convention Bureau, 1990).

e) A wetland could be considered of international importance under criterion 4 if :

- It has a high diversity of naturally occurring fishes or shellfishes (where fish diversity includes diversity within species, between species and between ecosystems as well as the diversity of genetically similar intraspecific ecological units). In addition the concept of "niche" should be considered; or

- At least 10% of the ichthyofauna is endemic to the wetland, or to wetlands in a natural grouping; or

- It has significant populations of indicator (presence of which is a useful measure of wetland quality), flagship (species with a high symbolic value) and/or keystone species (species playing vital ecological roles); or

- It has a level of biodisparity (determined by the diversity and predictability of its habitats in time and space); or

- It supports essential ecological processes for fish stocks, even if it does not necessarily harbour large adult fish populations;

f) The fish orders (as decided at Brisbane, 1996) that typically inhabit wetlands and which are indicative of wetland benefits, values, productivity or diversity, include:

Jawless fishes - Agnatha

- Myxiniformes hagfishes
- Petromyzontiformes lampreys

Cartiliagenous fishes - Chondrichthyes

- Squaliformes dogfishes, sharks and allies
- Rajiformes skates
- Myliobatiformes stingrays and allies

Bony fishes - Osteichthyes

- Ceratodontiformes Australian lungfish
- Lepidosireniformes South American and African lungfishes
- Polypteriformes bichirs
- Acipenseriformes sturgeons and allies
- Lepisosteiformes gars
- Amiiformes bowfins
- Osteoglossiformes bony tongues, elephant fishes and allies
- Elopiformes tarpons, bonefishes and allies
- Anguilliformes eels
- Clupeiformes pilchards, sardines and herrings
- Gonorhynchiformes milk fishes
- Cypriniformes carps, minnows and allies
- Characiformes characins, and allies
- Siluriformes catfishes and knife fishes
- Salmoniformes pikes, smelts, salmons and allies
- Mugiliformes mullets
- Antheriniformes silversides
- Beloniformes halfbeaks

- Cyprinodontiformes — killifishes and allies
- Gasterosteiformes — sticklebacks and allies
- Synngnathiformes — pipefishes and allies
- Perciformes — cichlids, perches and allies
- Pleuronectiformes — flatfishes

Shellfishes

- Crustacea — shrimps, lobsters, freshwater crayfishes, prawns and crabs
- Mollusca — mussels, oysters, pencil baits, razor shells, limpets, winkles, whelks, scallops, cockles, clams, abalone, octopus, squid and cuttlefish

Other aquatic invertebrates

- Porifera — sponges
- Cnidaria — hard corals
- Annelida — lugworms and ragworms
- Echinodermata — sea urchins and sea cucumbers
- Ascidiacea — sea squirts

4.3.4 Designation of wetlands to the List and subsequent action

It is important to emphasize that, when a wetland fulfils the "Criteria for Identifying Wetlands of International Importance", it remains the prerogative of the Contracting Party in whose territory it is situated to decide upon its designation for the List. The following considerations may help the Contracting Parties in deciding on designation and action to be taken following designation:

a) The Convention leaves each Contracting Party free to decide on the legal status or protection measures which are appropriate at the time of designation. Contracting Parties have adopted a wide variety of approaches to this matter of which the following may be mentioned:

- The wetland may already enjoy legal protection at national level (or at state or provincial level in a Contracting Party with a federal system);

- The wetland, when legally protected, may include one or more core areas with stricter regulations, and a surrounding buffer zone where regulations are less strict;

- The wetland need not have specific protection (e.g. as a national park or nature reserve) at a national level (or at state or provincial level in a Contracting Party with a federal system). The Convention's aims can, however, be achieved by applying existing general legislation (e.g. by limiting the discretionary powers of the authorities concerned); and

- The wetland may be in public or private ownership.

b) The Convention text provides guidance on measures to be taken at a wetland once it has been listed. Article 3.1 states that Contracting Parties "shall formulate and implement their planning so as to promote the conservation of the wetlands included in the list", while Article 3.2 stipulates that information shall be passed on without delay to the Bureau "if the ecological character of any wetland in its territory and included in the List has been changed, is changing or is likely to change as a result of technological developments, pollution or other human interference". The principle undertaking of Contracting Parties with respect to listed wetlands is to promote their conservation with the aim of preventing changes to their ecological character.

c) Article 4.1 of the Convention states that "Each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands, whether they are included in the List or not". Establishment of nature reserves (whether strict or less strict) is one way of maintaining the ecological character of listed wetlands. Provided its ecological character is maintained, wise use of the wetland is possible, and indeed maintenance of traditional land use practices and values may be the best way to safeguard ecological character. At each listed wetland, consideration should be given to the need for management. If management measures are deemed appropriate, a management plan should be developed and put into action (Ramsar Convention Bureau, 1990).

4.3.5 Definition of wise use

At the third Conference of the Contracting Parties, held at Regina, Canada, in 1987, the following definition of wise use of wetlands was accepted:

> "The wise use of wetlands is their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem."

Sustainable utilization is defined as "human use of a wetland so that it may yield the greatest continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations".

Natural properties of the ecosystem are defined as "those physical, biological or chemical elements, such as soil, water, plants, animals and nutrients, and the interactions between them".

Wise use of wetlands requires action on an extensive scale, giving consideration to all factors affecting the wetlands. In accepting this definition of wise use, the Conference adopted a recommendation encouraging Contracting Parties to pursue wise use through the preparation of national wetland policies. Major items in such policies are to include:

a) A national inventory of wetlands;

b) Identification of the benefit and values of these wetlands;

c) Definition of the priorities for each site in accordance with the socio-economic conditions in each country;

d) Proper assessment of environmental impact before development projects are approved;

e) Ensuring that development projects affecting wetlands permit sustainable utilization; and

f) Regulated utilization of wild fauna and flora, in such a way that these elements of the wetland systems are not over-exploited.

Particular attention to the wise use of wetlands by promoting development of wetland policies containing these elements by Contracting Parties was recommended.

While it was recognized that the elaboration of national wetland policies is a long term process, the following actions were proposed to stimulate wise use of wetlands:

- Interchange of experience and information between countries seeking to elaborate wetland policies;

- Training of appropriate staff in the disciplines which will assist in elaboration of such policies;

- Pursuit of legislation and policies which will stimulate wetland conservation action, and repeal of legislation which favours wetland loss; and

- Review of traditional techniques of sustainable wetland use, and elaboration of pilot projects which demonstrate wise use of representative national and regional wetland types.

4.4 SOUTH AFRICA'S PARTICIPATION IN THE CONVENTION

The World Conservation Strategy (IUCN, 1980) identified wetlands as the third most important life support system on this planet. Yet in South Africa, a country with very few wetlands, it has been estimated that over half of the wetlands have been destroyed and lost (Breen and Begg, 1989). Those that remain are some of our most threatened natural areas (Noble and Hemens, 1978; Zaloumis, 1987; Begg, 1990).

South Africa's arid climate combined with its geomorphology has resulted in a landscape characterized by such wetland features as:

- Small rivers of erratic flow, very few with strong perennial flow;
- Very few well developed flood plains, but most catchments having vleis (palustrine wetlands);
- Endorheic pans being a feature of the plateau;
- Except for one small rock fall lake, no other natural inland lake;
- Coastal and estuarine lakes at places along the coasts of the south-western and southern Cape and in northern Zululand; and
- Estuaries (many with salt marshes, those along the east coast previously with well developed mangrove forest) and estuarine lagoons (Noble and Hemens, 1978)

Wetlands in South Africa tend to be strongly seasonal in most cases, and therefore wetlands of no apparent importance may become significant at certain times. Although South Africa boasts some 20 species of ducks and geese, this high species diversity is more an indication of the variety of wetland types than the overall amount of wetland. Concentrations of anatids in South Africa are not large by Holarctic standards, the largest only consisting of some 5 000 birds, but even these are rather unusual. The more common situation is small concentrations of ducks moving around nomadically (Directory of Wetlands of International Importance, 1990).

A direct result of the highly seasonal rainfall has been the creation of numerous artificial impoundments. There is an increasing demand for water arising from the growth of the human population and the economy. This demand has to be met from a limited resource (Department of Water Affairs, 1986). It follows that water ecosystems in South Africa already exhibit striking evidence of the impact of both development and of increasingly intensive utilization.

Because of the biotic diversity of the wetlands in South Africa, their limited size and the inherent threats to them due to development, wetlands are particularly important ecosystems. As such they enjoy a high priority for protection. Of the eighteen areas identified and rated in the Southern African Plan for Nature Conservation (Cohen and Cowan, 1988), eight include wetlands as a major component of their areas. As in many areas where water is a scarce commodity, pressure on natural wetlands is substantial, leading to reductions in their area and effectiveness. At the same time numerous water storage dams (both small and large) have been constructed, particularly during this latter few years, while the country was experiencing a severe drought (Cowan, 1990a, 1991a, 1992c, 1994).

Being at the southern tip of the continent, South Africa has a special position. A number of endemic species (e.g. Bank Cormorant *Phalacrocorax neglectus,* Cape Shoveller *Anas smithii*) and highly isolated species (e.g.Wattled Crane *Grus carunculata*, Whitewinged Flufftail *Sarothrura ayresi*) associated with wetlands are found within its borders. This country's wetlands host a number of palearctic migrants during the northern winter, some of which come all the way from the Taimyr Peninsula in Siberia (a distance of approximately 15 000km).

South Africa also extends into the tropics, providing the southern limits to a number of tropical species (Pinkbacked Pelican *Pelecanus rufescens,* Rufousbellied Heron *Butorides rufiventris,* Dwarf Bittern *Ixobrychus sturmii,* Openbilled Stork *Anastomus lamelligerus,* Pygmy Goose *Nettapus auritus*). With such a diversity of species and its important geographical position, South Africa has an important role to play in wetland conservation.

Recognizing the importance of wetlands in this country, the Ramsar Convention was signed in 1971 at its inception by South Africa. This recognition was formalized in 1975 when South Africa signed the Convention without reservation as to ratification, thus becoming the fifth Contracting Party to the Convention (Cowan, 1995a).

South Africa's participation in the convention was determined from a review and analysis of the triennial reports submitted to the Convention on Wetlands prior to its meetings of the Conference of the Contracting Parties. The author of this thesis was primarily responsible for the compilation of the last four reports (Cowan, 1992c, 1994; Cowan and Marneweck, 1996; Cowan, Dini, van der Walt and Kyle, 1998).

South Africa took a leading role in the development of the Convention. She became the fifth contracting party to the Convention on 12 March 1975. At that stage, two wetlands were designated for inclusion in the List of Wetlands of International Importance. Subsequently another 14 sites have been added to the List by South Africa. South Africa is one of only 11 African countries which are party to the Convention.

4.4.1 Who is responsible for the convention in South Africa?

The Department of Environmental Affairs and Tourism is responsible at the national level for the implementation of the Convention. Management of any particular wetland is undertaken by the responsible authority concerned, which in this country can be any of a number of Departments, or one of the nine provincial governments, which have the primary responsibility for nature conservation outside national parks. The National Parks Board has full responsibility for all national parks.

4.4.2 Commitments undertaken by becoming a contracting party

In the framework for the implementation of the Ramsar Convention presented at Montreux, commitments undertaken by becoming a Contracting Party were set out under four main headings (Mathews, 1993). In testing the secondary hypothesis, South Africa's activities in these fields are set out below.

4.4.2.1 Conservation of wetlands

To date (December 1998), South Africa has designated 16 wetlands to the List of Wetlands of International Importance (in terms of Article 2.1 and Recommendation 1.3 (Rec 1.3)), (Fig 4.1). The first two wetlands included by South Africa in the List were Barberspan in the Transvaal (now North West Province) and De Hoop in the Cape (now Western Cape). A further four wetlands were added to the List in October 1986 (Blesbokspruit, Heuningnes Estuary in the De Mond State Forest, the St. Lucia System and the Turtle Beaches and Coral Reefs of Tongaland). In 1988 Langebaan (part of the West Coast National Park) was added to the List. Another five wetlands were designated by South Africa to the List in 1991 (Lake Sibaya, Kosi Bay, Orange River Mouth Wetland, Verlorenvlei, and Wilderness Lakes). Three wetlands were added to the List as part of the 25th anniversary celebrations of the Convention during 1996, they are the Natal Drakensberg Park, Ndumo Game Reserve (both in Kwazulu-Natal) and Seekoeivlei (in the Free State). In 1998 Nylsvley (in the Northern Province) was added to the List, while assessments are being completed on a number of other sites.

Of the 16 listed wetlands, two are protected within National Parks, 11 are protected within proclaimed Provincial Nature Reserves or State Forests and two are on state land under the jurisdiction of a provincial nature conservation agency. The remaining wetland is partially in a proclaimed Provincial Nature Reserve and partially on privately owned land. The private land is in the ownership of a large corporation which employs an ecologist and manages the area jointly with the Provincial Government under whose jurisdiction they fall.

Four of these wetlands on the List (De Hoop, the St Lucia System, Blesbokspruit and the Orange River Mouth Wetland) have been threatened with ecological change, and the Bureau has been duly advised on these threats (in terms of Articles 3.2 and Rec 3.6, 3.9 and 4.8). The resultant actions on the part of both the Convention and of South Africa, has been positive in terms of wetland conservation.

At De Hoop, a strong public reaction by landowners and conservationists to the proposed expropriation of this area for a weapons test range, resulted in the commissioning of an independent investigation into the proposal by the Minister of Environment Affairs. At the time De Hoop was one of only two wetlands listed by South Africa as a "Wetland of International Importance". This fact was emphasized in the objections as well as the final

Figure 4.1 Location of sites on the List of Wetlands of International Importance in terms of the Ramsar Convention designated by South Africa.

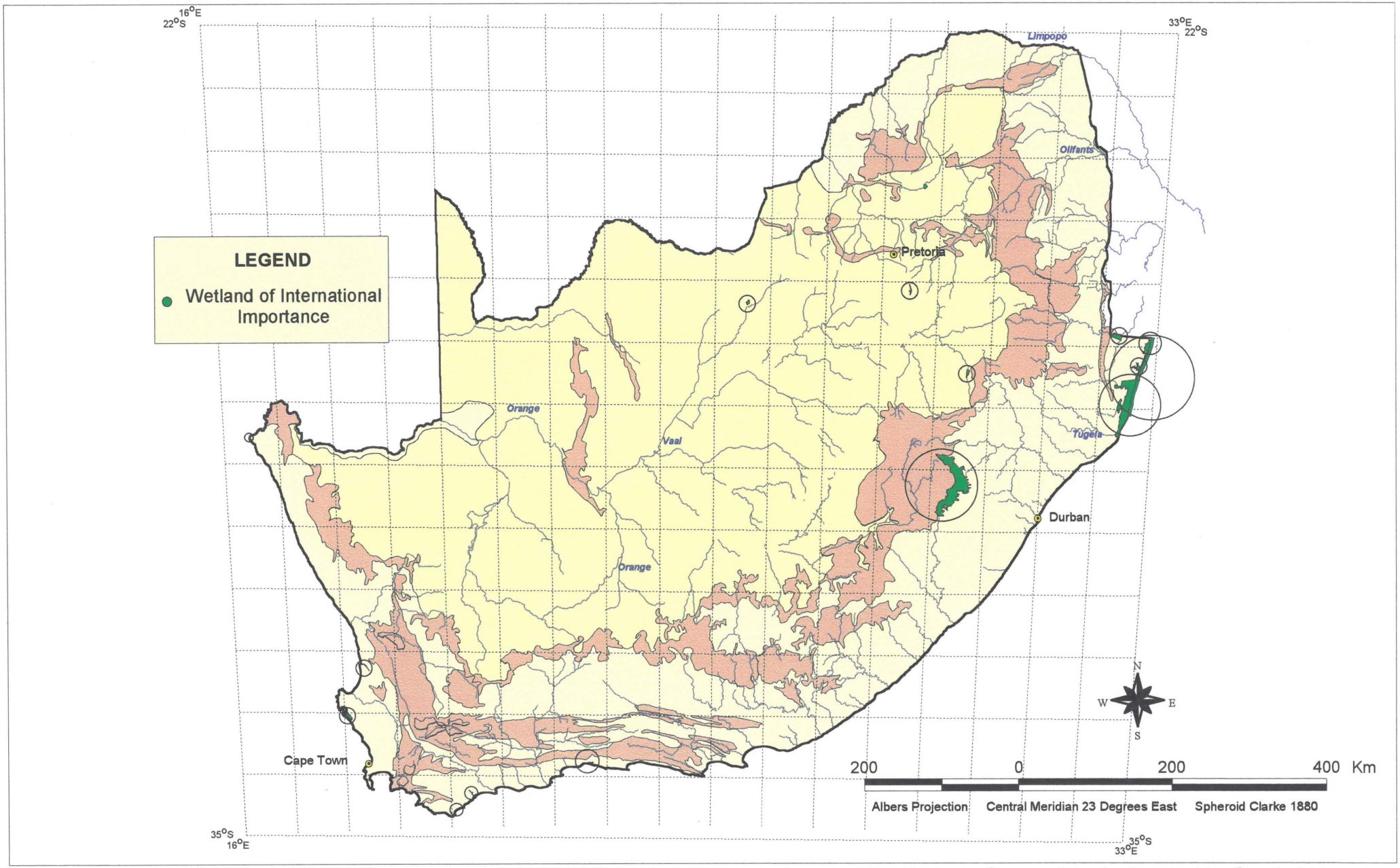

Figure 4.1 Location of sites on the List of Wetlands of International Importance in terms of the Ramsar Convention designated by South Africa

report which was completed in 1983. As a result of the report, the weapons testing was allowed to proceed but was severely restricted, and the De Hoop Nature Reserve was substantially expanded.

The fact that the St Lucia System is listed by South Africa as a "Wetland of International Importance" under the Convention was used extensively by those parties arguing against the proposed mining of the dunes along the Indian Ocean coastline. An environmental impact assessment was called for by the government to inform it on the environmental impact the proposed mining to the east of Lake St Lucia would have. At the Fourth Meeting of the Contracting Parties held in Montreux, Recommendation 4.9 directly addressed the St Lucia System, in which the Conference of the Contracting Parties expressed "its grave concern at the potential impact on the South African Ramsar site of St Lucia of mining for titanium and other heavy metals, and calls upon the South African Government:

a) to prohibit any mining activity which will damage the ecological character of the site; and

b) to ensure the St Lucia System is retained as a protected site because of its national and international conservation importance."

A Monitoring Mission (set up in terms of Rec 4.) visited the site during 1991, their report being finally submitted and accepted during 1992. The EIA was completed during 1993. The recommendations made by the Review Panel to the government that the mining application should not be approved was influenced heavily by the international importance of the site, the recommendations of the Conference of Contracting Parties and those of the Monitoring Mission. The site was officially removed from the Montreux Record in 1996 at the Sixth Conference of Contracting Parties.

A gold mining operation is pumping water from flooding shafts into the Blesbokspruit under permit in terms of the Water Act and the Minerals Act (No 50 of 1991). Permission

has been requested to continue releasing this water which is high in salts into the wetland. Given the lack of information available, and taking into account South Africa's obligations in terms of Article 3.1 of the Convention, the Department of Environmental Affairs and Tourism recommended that an environmental impact assessment (EIA) be undertaken. In response, the Director General of Mineral and Energy Affairs on 28 June 1996 and in terms of section 39 (5) of the Minerals Act (No 50 of 1991), appointed environmental consultants to conduct an EIA on the discharge of mine water into the Blesbokspruit.

At the Orange River Mouth Wetland, the salt marsh on the southern bank of the river collapsed, due to a number of interrelated impacts. The mining company has drawn up an environmental management programme report in terms of the Minerals Act which includes proposals for the rehabilitation of the salt marsh. The implementation of this programme is being monitored by a management committee under the auspices of the Department of Environmental Affairs and Tourism to ensure the requirements in terms of the convention are met.

Blesbokspruit and the Orange River Mouth Wetland were placed on the Montreux Record in terms of Recommendation 4.8 of the Conference of Contracting Parties to the Ramsar Convention and will remain there until the situations are acceptably resolved.

A national inventory of wetlands is being developed (Rec 1.5, 2.3, 3.1, 4.10) by collating known information on the distribution of wetlands in South Africa (see chapter 4 above), and by possible utilization of remote sensing. This inventory will form the basis for determining further potential sites for designation by South Africa to the List (Rec 1.4, 2.3, 3.1, 4.2 and 4.6)

Nature reserves have been established at a number of important wetlands by both the state (eg Nylsvley, Seekoeivlei, Steenkampsberg) and the private sector (eg Rietvlei) (Article 4.1 and Rec 4.4).

Training of competent personel in wetland research is mainly undertaken at Universities

at post-graduate level. Funding of this research is from a number of sources such as directly from the Department of Environment Affairs, or from funding agencies such as the Foundation for Research Development[1] and the Water Research Commission. Training of staff competent in the management and wardening of wetlands requires renewed efforts, as most of the previous training has been aimed at terrestrial ecosystems (Article 4.5, and Rec 4.5).

4.4.2.2 Promotion of international cooperation in wetland conservation

International action in terms of wetland conservation has been restricted to low key efforts with South Africa's neighbours having mutual resources. With South Africa's re-acceptance into the international arena, more prominence will be given to projects which affect wetlands on the Orange, Limpopo, inKomati and Pongola Rivers as well as in the Drakensberg (Article 5). South Africa is already an active participant in the African Wetland Census run by Wetlands International (previously known as the International Waterfowl and Wetland Research Bureau). The author was elected to the Council of Wetlands International for Africa, Europe and the Middle East in 1995, and made chairman in 1998. (Article 5, Rec 3.2, 4.12)

The activities of international development agencies in support of South African wetland conservation have been minimal to date. With the political changes in South Africa, greater effort will be required to promote concern for wetland conservation in these agencies.

4.4.2.3 Fostering communications about wetland conservation

Research on wetland resources is being encouraged. South Africa has recently rejoined the IWRB (during 1992, now Wetlands International). The exchange of data and publications is encouraged internationally, and locally through a "wetland information office" set up

[1]Now the National Research Foundation

at the Department of Environment Affairs (Article 4.3).

National reports on South Africa's wetlands have been regularly presented for consideration at the Conferences of Contracting Parties (Rec 2.1, 4.3). The 1990 and 1993 reports were published in *South African Wetlands*, the newsletter published by the Department of Environment Affairs, while the 1996 national report was published as a separate document (Cowan and Marneweck, 1996). The latest report (Cowan, Dini, van der Walt and Kyle, 1998) has been placed on the World Wide Web, ensuring the widest possible distribution.

The importance of wetlands in the southern African region is recognized and South Africa is promoting the Convention and its principles to its neighbours whenever possible. Aid in terms of expertise has been offered. Presentations on the Convention were made at the SARCCUS Standing Committee for Nature Conservation, Wildlife Utilization and Management (MUNC) in 1990. South Africa continues to encourage its neighbours to become Contracting Parties to the Convention (Rec 1.1, 2.3, 3.6, 3.7 and 3.10). South Africa raised funds and hosted the Southern African sub-regional Ramsar Meeting held in Pretoria in February 1998, where a number of recommendations were accepted towards improving wetland conservation in the sub-region and towards better sub-regional participation in the Convention (van der Walt and Cowan, 1998).

The last two World Wetlands Days (celebrated on the anniversary of the first signing of the Convention, 2 February) have seen an exponential growth in activities around the country, all promoting wetland conservation. Seen in concert with National Water Week and supported throughout the year by programmes such as the National Aquatic Biomonitoring Programme, South Africa's grass roots communications is improving in leaps and bounds.

4.4.2.4 Supporting the work of the Convention

South Africa has had a delegation attend all Conferences of the Parties (Article 6.1, 7.1)

South Africa became a Contracting Party to the "Protocol to amend the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Paris, December 1982) on 26 May 1983 (Rec 1.7, 2.2).

South Africa accepted the amendments to Articles 6 and 7 of the Convention adopted by the Extra-ordinary Conference of the Contracting Parties, Regina, Canada on 26 July 1991 (Rec 1.8, Res 3.4).

4.5 CONCLUSION

After having reviewed the important aspects of the Ramsar Convention on Wetlands, and having analysed South Africa's activities with respect to that convention, it is concluded that South Africa is indeed playing an active role in wetland conservation, thus working toward meeting its obligations in terms of the convention. However, as shown below the are areas where South Africa is falling short of meeting its obligations in particular in terms of planning.

4.5.1 · Conservation of wetlands

While having met the basic obligation of designating at least one wetland to the List of Wetlands of International Importance, and indeed gone well beyond that; and having ensured that special attention has been paid to those wetlands, it was found that:

South Africa has yet to develop a national wetland conservation policy; and
South Africa has yet to complete an inventory of its wetland resources

4.5.2 Promotion of international cooperation in wetland conservation

South Africa has proved and continues to prove itself a leader in the southern African sub-region, and has played an active role in the African region, particularly in the last two Pan

African Regional Meetings;

4.5.3 Fostering communications about wetland conservation

South Africa's role in fostering communications about wetland conservation has been particularly strong at the scientific level. It is playing a leading role in the development of communications relating to wetland conservation using electronic media, but is lagging in the development of a strong communication role at the political level. At the grassroots level a strong groundswell movement is developing in the country, being supported by activities coordinated around national and international promotions.

4.5.4 Supporting the work of the Convention

South Africa's support for the convention has been exemplary. Its payments are up to date, it has made voluntary contributions in the past and has raised funds to promote the convention in the southern African sub-region.

4.6 SUMMARY

In this chapter the secondary hypothesis that South Africa is not meeting its international obligations in terms of wetland conservation was tested. The range of international instruments relating to wetland conservation were identified. It was found that the most relevant is the Convention on Wetlands.

The Convention on Wetlands is explained and the obligations of Contracting Parties to the Convention are set out. South Africa's participation in the convention is detailed and discussed. It was found that, while South Africa is meeting many of its obligations in terms of this convention, there are two major shortcomings in its activities:

1. South Africa has yet to develop a national wetland conservation policy; and

2. South Africa has yet to complete an inventory of its wetland resources.

Thus South Africa does not know the full extent and value of its wetland resources, nor has South Africa made adequate effort to manage the wetland resources it has.

CHAPTER 5

A MODEL WETLAND CONSERVATION POLICY FOR SOUTH AFRICA

5.1 INTRODUCTION

This chapter tests the secondary hypothesis that a wetland conservation policy can provide an effective land-use planning tool.

Policy and strategy is defined. Earlier attempts at wetland conservation policy are reviewed. Then, having established South Africa's short comings in wetland conservation in previous chapters and in meeting its international obligations, a model national wetland conservation policy is presented as a solution.

5.2 BACKGROUND

Policy has been defined as a collection of principles which indicate intended and acceptable activities for a government. It functions as a framework that enables clear conclusions to be drawn about what actions are required. Quite often the term is used synonomously with the term strategy (Lynch-Stewart,1992; Lynch-Stewart, Rubec, Cox and Patterson, 1993; Rubec, 1996). The Standard Dictionary of English Usage (1969) and the Concise Oxford Dictionary (Thomson 1995) have the following definitions:

Policy: the method of management with reference to the attainment of certain ends;
a course or principle of action adopted or proposed by a government;

Strategy: the science and art of conducting a military campaign by the combination and employment of means on a broad scale for gaining

advantage in war;

a plan of action or policy in politics.

In this chapter the model policy states the intention of the government of formulating its planning for more effective wetland conservation. This is set out in terms of an objective, goals and guiding principles. The strategy to implement the policy is the means or plan of action to gain a broad scale advantage for wetlands in the planning field.

5.3 STATE OF KNOWLEDGE

South Africa's position at the southern end of the continent provides a unique opportunity in terms of international wetland conservation. It supports a wide diversity of species, a number of endemic as well as red data species, as well as being host to large numbers of migratory species during our summer. Having taken the lead in Africa by being the first African state to ratify the Ramsar Convention on wetlands and its important geographical position, South Africa has an important position to play in wetland conservation (Cowan, 1995).

Recognizing the importance of wetlands in terms of their functions (such as flood attenuation, streamflow regulation, groundwater recharge, erosion control, nutrient removal and retention of sediments and toxic substances), products (including fish, bird, invertebrate and plant resources, as well as water supply) as well as their attributes (such as biological diversity, cultural importance or geomorphological uniqueness), and as part of our obligations in terms of the Ramsar Convention, a National Policy on Wetland Conservation has been developed.

In South Africa there have been a number of earlier initiatives aimed at or around the development of a wetland conservation policy.

The Department of Water Affairs published a book entitled "Management of the Water Resources of the Republic of South Africa" in 1986. It was aimed at increasing awareness of water management issues so as to promote an effective partnership between water users and

the Department of Water Affairs and Forestry. The Department of Water Affairs and Forestry viewed its function as that of being the custodonian of a limited national resource in a society with a growing, diversified and competitive economy. Its major goal is to ensure the ongoing, equitable provision of adequate quantities and qualtities of water to all competing users at acceptable degrees of risk and cost under changing conditions. While in essence this function is one of wise use and resource conservation, the approach is an engineering one of supply, primarily to an urban industrial economy, in which water requirements of the natural environment are neglected. With the change in government in 1994, a new water policy has been developed (Department of Water Affairs and Forestry1997). The most exciting aspect of this has been the concepts of:

- the ecological reserve; and
- the catchment management approach.

These aspects of policy have been translated into law through the promulgation of the new Water Act in 1998. Methods for the determination of the ecological reserve for a range of aquatic ecosystems are being developed as a first step in the implementation of the act. However it must be emphasized that wetlands, while dependent on the water resource for their existence, are far greater than that resource alone.

In 1988 the Department of Environment Affairs organized a seminar and workshop on the use of existing legislation in the protection of the natural environment (land and freshwater systems) (Boomker, 1988). This workshop showed quite clearly that the existing legislation was totally inadequate for the conservation and protection of wetlands. It was established that wetlands per se have no legal status in South Africa. Generally speaking, legislation which controls the environment has as its main concern either man or the protection of fauna and flora in their natural or cultural context. A law serves a particular purpose and laws that seek to regulate fresh water systems do so with a particular objective in view. Thus a law that views a fresh water system as a resource places emphasis on the exploitation of the resource by man. Considerations of conserving the wider resource, preserving the ecology, etc, take second

place in that law. This was well illustrated by the provincial nature conservation ordinances which were aimed at species protection, or the Agricultural Resources Act (43 of 1983) which cannot be used to effectively protect wetlands because the aim of the act is to protect resources for agricultural purposes. Similarly the Forest Act (122 of 1984) can only be used to limit planting distances of forests from wetlands (Cowan, 1992). We simply do not have the legislation to protect a wetland system as a wetland. Thus a policy on wetland conservation supported by the necessary legislation is considered essential.

Another workshop, held in 1988 and organized under the Foundation for Research Development's Ecosystem Programmes discussed the many problems associated with the development of a national wetland inventory (Walmsley and Boomker, 1988). Among the conclusions and recommendations it was noted that policies and management strategies for wetlands are of national, regional and local concern. Coordination emanating from the highest level of government is essential in order to develop and maintain the necessary expertise for wetland conservation. The workshop supported the opinion that the Department of Environment Affairs should play a key role in such coordination, and that existing policies and priorities will have to be reviewed.

In 1990 the Natal Town and Regional Planning Commission published a report representing the culmination of a six year research project on freshwater wetlands in Natal, initiated by the Commission in conjunction with the Department of Environment Affairs. The aim of the report was "to develop and to ensure the implementation of sound, broadly supported recommendations on how the existing wetland resources of Natal and KwaZulu could best be conserved and managed and, where appropriate, to establish how the functions and values of degraded wetlands could be restored" (Begg, 1990). The formulation of these policy proposals were tailored to suit the circumstances peculiar to the wetlands of Natal and KwaZulu.

The Committee for Terrestrial and Fresh Water Systems of the Council for the Environment (a body set up to advise the Minister in terms of the Environment Conservation Act of 1989), concerned about the condition of our fresh water systems convened a workshop as a matter of urgency in 1990. The objective of the workshop was to reflect on the existing state of

freshwater systems in South Africa and to formulate a national policy and strategy for the future conservation, utilization and management of these systems for submission to the Council for the Environment and eventual advice to the Minister of Environment Affairs. General agreement was that the policy should be to manage the water and water related resources of South Africa in an integrated and holistic manner which recognises and accommodates conflicting needs and values, and which benefits all the people as well as the ecological needs of the region in both the long and short term (Cowan, 1990). To date no further action on these recommendations has taken place.

5.4 DEVELOPMENT OF THIS POLICY (METHODS)

The Contracting Parties to the Ramsar Convention have met on a number of occasions (Ramsar 1971, Cagliari 1980, Paris 1982, Groningen 1984, Regina 1987, Montreux 1990, Kushiro 1993, Brisbane 1996[1]). At these conferences numerous recommendations aimed at the improved conservation of the world's wetlands were accepted. At Montreux, the guidelines for the implementation of the wise use concept of the Convention (Recommendation C.4.10 (Rev)) were accepted. In these guidelines it was stated that "..all Contracting Parties should have comprehensive national wetland policies, formulated in whatever manner is appropriate to their national institutions." In order to ensure the conservation of South Africa's wetlands, the Department of Environment Affairs launched a wetland conservation programme (Pienaar, 1991; Cowan, 1991,1992b). The programme is to build on past efforts to protect wetlands, thus the development of the national policy on wetland conservation has incorporated the above initiatives.

The efforts of other countries in developing wetland conservation policies were also considered, particularly that of Canada, published in 1991. Canada has many similar conservation-political considerations to those in South Africa. The Canadian policy is one of the first of its kind by a national government in the world (Rubec, 1992).

[1]The latest meeting was held in San Jose in May 1999

The draft policy was distributed to numerous organizations for comment and suggested improvements. It was discussed at the first meeting of the S A Ramsar Working Group (a sub-committee of the statutory Committee for Environmental Management as established in terms of the Environment Conservation Act (73 of 1989)). Discussions were also held with representatives of other relevant state departments including the Department of Agriculture and both branches of the Department of Water Affairs and Forestry. After these consultations this policy was finally compiled.

5.5 A MODEL NATIONAL POLICY FOR WETLAND CONSERVATION IN SOUTH AFRICA

5.5.1 National objective of the policy

The objective of the government with respect to wetland conservation is to:

> Ensure the conservation of South Africa's wetlands in such a way that the ecological and socio-economic functions, products and attributes of wetlands are maintained for present and future use. In doing so South Africa will meet the needs and aspirations of its people, as well as meet its obligations in terms of international instruments.

5.5.2 Goals of the policy

In support of the above objective, the government, in cooperation with the South African public, will strive to achieve the following goals:

- Maintenance of wetlands and their functions throughout South Africa.
- Protection of wetlands of national and international significance.
- Enhancement or restoration of wetlands in areas where the continuing loss or

degradation of wetlands or their functions have reached critical levels.

- Recognition of wetland functions in resource planning, management and economic decision-making.

- Utilization of wetlands in a manner that enhances prospects for sustained and productive use by future generations.

5.5.3 Guiding principles to be used in the implementation of the policy

In pursuing the above goals, the government will respect the following principles:

1. Wetlands and their functions contribute significantly to the health and well-being of South Africans and are an essential element of South Africa's natural diversity. As such, the conservation of wetlands is a priority requirement of environmental management and sustainable economic development efforts.

2. Wetland conservation is dependent on the incorporation of environmental objectives into the economic decision-making process, as recommended by the World Commission on Environment and Development.

3. Wetlands and wetland functions are often inextricably linked to surrounding ecosystems and, therefore, wetland conservation must be pursued in the context of an integrated systems approach to environmental conservation and sustainable development and integrated catchment management.

4. The continued development of scientific knowledge and expertise in South Africa is fundamental to the achievement of wetland conservation.

5. Wetland conservation can only be achieved through a coordinated, cooperative approach involving all levels of government and the public, especially landowners

non-government organizations, and the private sector.

6. The government can and must play a leading role in achieving wetland conservation, while respecting the rights of individual landowners coupled to realistic legislation, binding all the groups.

7. Where local communities exercise a traditional use of wetlands, the government will only undertake activities affecting such wetlands in consultation and cooperation with the relevant communities and their leaders.

8. A basic change in the attitude and perceptions of South Africans regarding wetlands, through communication and education programmes, is also a vital prerequisite of wetland conservation.

9. South Africa, as a founder member of the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, 1971), and its location on the southern tip of Africa, has a special responsibility to provide leadership in international wetland conservation efforts, through the management of transboundary resources such as water and wildlife in southern Africa and through encouragement of global wetland conservation.

5.6 IMPLEMENTATION OF THE PROPOSED POLICY

A policy can only be successful if it is implemented. With the change in government in South Africa, this policy needs to be reconstituted. Wider consultation is expected and relevant adjustments to both the proposed policy and a strategy for its implementation will take place. The the policy will be promulgated in terms of Section 2 of the Environment Conservation Act (No 71 of 1989). The implementation of the proposed Wetland Conservation Policy through this Act will have to consider the implications of the Constitution (Act No 108 of 1996), where the following aspects need consideration:

- domain which determines the level of responsibilities at national and provincial level;

- access to the wetlands and their resources; and

- public participation in order to ensure will and support at all levels.

The policy will be developed in terms of the Government of National Unity's overriding policy as spelt out in the Reconstruction and Development Plan (RDP) (African National Congress, 1994) where:

- the benefits of wetland conservation (including water supply) are transferred and seen to be transferred to society; and

- sustainability of wetlands as a resource are ensured through management, compliance and legislation.

The infrastructure needed to apply wetland conservation measures in South Africa requires development through actions which include:

- all aspects of the conservation of biological diversity and physical functions; and

- the development of a capacity to enable wetland conservation in South Africa in terms of a strong conservation agency with full political support.

Other sectors (forestry, water-supply, marine fisheries, agriculture and mining) are already developing their new policies in terms of the RDP (Anon, 1995; Van Der Elst, 1995), and it is imperative that conservation policies keep pace in order to keep the balance between development and protection of the environment. Furthermore, it is proposed that the revised South African wetland conservation policy is developed in consultation with both NGO's and

CBO's (non-government and community based organizations), both taking into account and balancing the other sector interests. The strategy for the implementation of the policy will include legislation which has to be both applicable and enforceable as proposed in the implementation strategy below.

5.7 IMPLEMENTATION STRATEGY

The strategy to implement the wetlands conservation policy for South Africa was developed from the obligations accepted by South Africa in terms of the Convention on Wetlands of International Importance especially as Waterfowl Habitat as well as the Convention on Biological Diversity, supplemented by the recommendations made at the conferences of parties to these conventions, and the White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity, which must form the foundation for this policy. The strategy has eight points, all equally important, therefore must be read as a whole, under which policy statements are made, objectives set and actions which need to be taken are listed.

5.7.1 Conservation of wetland systems

South Africa will promote the effective conservation of its wetland systems, their values, functions and attributes

Objective 1

To identify South Africa's wetland systems and their components and to monitor their status and trends

Actions

Develop and maintain a national wetland inventory of wetlands and their component parts;

- Determine the values to society that these wetlands provide;
- Develop a cost-effective means of monitoring the status of our wetland estate and

a mechanism to report to the nation on this status and the trends which may be taking place;

Objective 2

Promote wetland conservation on all state land, private land and communal land.

Actions

- Develop rules and procedures to ensure that exemplerary conservation actions take place on state land and with state funded or state led schemes;
- Implement effective incentive programmes and necessary control mechanisms for the conservation of wetlands on private land and or communal land;
- Develop an extension service to support wetland conservation.

Objective 3

Provide special measures for the conservation of wetlands of national and of international importance ("priority wetlands").

Actions

- Determine criteria for the identification of priority wetlands based on those accepted by the Convention on Wetlands and the Convention on Biological Diversity;
- Develop a procedure for registration of wetlands of national importance;
- Promote the establishment of a national system of protected wetlands as part of the protected area system;
- Develop a procedure for the designation of Wetlands of International Importance to the List in terms of the Convention on Wetlands;
- Draw up and implement management plans for all priority wetlands, ensuring

sustainable utilization of the wetlands and their products;

- Facilitate catchment management to ensure priority wetlands are not put at risk.

Objective 4

To ensure that wetlands an their component parts are effectively protected

Actions

- Review all current legislation relating to wetlands;
- Consolidate relevant legislation, supplement this with any necessary further legislation and promulgate a wetlands conservation bill;
- Structure the state department for the effective implementation of this legislation.

5.7.2 Developments affecting wetlands

South Africa will ensure the future management of wetlands in an integrated manner, in accordance with the objective of conserving and using biological resources sustainably, and minimizing adverse impacts on aquatic biodiversity. Administrative and legal controls will be implemented on all planning and implementation of all projects which will have an effect on the ecological character and to ensure the integrity and sustainable use of wetlands in South Africa.

Objective 5

To reduce the incidence of both ecological change to wetlands affected by development.

Actions

- Promote an ecological management approach to planning, whereby wetland conservation is pro-actively incorporated into land-use plans;
- Identify both individual and cumulative activities causing change in ecological

character in wetlands;

- Identify areas where such change is most likely to occur;
- Make environmental impact assessments (EIA) as well as strategic impact assessments (SIA) mandatory for these actions in these areas;
- Apply the precautionary principle wherever uncertainty of the potential impacts of a proposed development exists;
- Develop procedures for the mitigation of such impacts where development is allowed;
- Initiate restoration and rehabilitation of wetlands where such impacts have already taken place;
- Regularly review all permits and permit conditions for activities which have an effect on the ecological character of wetlands.

Objective 6

Establish the benefits of wetlands to society in order to assist planning procedures.

Actions

- Determine the economic value of wetlands, their functions and attributes

5.7.3 Sound scientific base

Effective wetland conservation is dependant on a sound scientific base. South Africa will determine its wetland estate, undertake the necessary research to provide the technical basis for wetland conservation, and develop a greater capacity at all levels to effect sound wetland conservation.

Objective 7

To determine the extent, location and viability of the wetland systems in South Africa, their status,

the benefits derived from these systems, and the threats to the systems.

Actions

- Implement a national inventory (see objective 1);
- Determine utilization of wetland systems and their component parts;
- Determine the threats and the extent of such threats to the wetlands;
- Identify areas that support landscapes, ecosystems, habitats, populations and species which could contribute to South Africa's system of representative protected areas;
- Monitor the effects of processes and activities likely to have significant adverse impacts on wetlands;
- Identify key sites for restoration, based on ecological and socio-economic criteria.

Objective 8

To undertake, sponsor and encourage research that is directed toward advancing wetland conservation and sustainable utilization.

Actions

- Develop a research programme which will provide a predictive understanding of the ecological processes taking place in wetlands especially in terms of functions and driving forces;
- Undertake research and develop applicable methods and technologies aimed at removing or reducing adverse impacts of harmful activities on wetlands and improving their management;
- Develop methods to determine the social, economic and environmental values of wetlands;
- Publicize the results of this programme and develop an effective technology transfer system so that maximum benefit is achieved by the widest possible audience;

- Utilize the research programme as a sound scientific base for further policy development and the effective management of wetlands in South Africa;
- Identify and utilize the wide range of funding available both inside of and outside of government as well as from international sources to run this research programme effectively.

Objective 9

To develop the capacity of South Africans at all levels to take actions or make decisions to the benefit of wetland conservation.

Actions

- Identify target groups and develop programmes aimed specifically at each group;
- Develop a range of in-service wetland conservation training programmes;
- Develop a long term wetlands conservation education programme;
- Use every opportunity to develop public awareness of wetland conservation issues, and encourage the public's active participation in such issues;
- Make information about wetlands, their functions, values and attributes available in as wide a range of fora as is possible;
- Develop decision support systems for effective wetland conservation.

5.7.4 Hydrological needs

The driving force behind all wetlands is water. It follows that all wetlands require certain hydrological regimes if they are to continue to exist. Principle nine of the White Paper on a National Water Policy for South Africa ensures that the quality, quantity and reliability of water required to maintain the ecological functions on which humans depend shall be reserved so that human use of water does not individually or cumulatively compromise the long term sustainability of aquatic and associated systems (read wetlands).

Objective 10

Give effect to this principle.

Actions

- Determine the freshwater requirements of all wetlands in terms of quantity, quality, periodicity and reliability;
- Determine the flow requirements for the continuance of fluvial geomorphological processes.

5.7.5 Conservation of wetland biota

In terms of the Convention on Biological Diversity (CBD) the biological diversity of wetlands is a matter of concern since these ecosystems contain a high diversity and large numbers of endemic and threatened species, which are unique or associated with key ecological processes. In addition, wetlands perform valuable ecological functions and their species, genomes and genes are of social, scientific and economic importance. As outlined in Article 1 of the CBD, wetland biodiversity should therefore be maintained through *in-situ* conservation, the sustainable use of their components and the fair and equitable sharing of the benefits arising from the utilization of their genetic resources. As South Africa is a Contracting Party to the CBD, effect will be given to these principles.

Objective 11

To ensure adequate protection of wetland biodiversity (see also Objective 4).

Actions

- Review all current legislation relating to wetland biodiversity;
- Consolidate relevant legislation, supplement this with any necessary further legislation and include these aspects into the wetlands conservation bill;
- Structure the state department for the effective implementation of this legislation.

Objective 12

To ensure the effective management and sustainable utilization of wetland biota.

Actions

- Develop and promote the sustainable utilization of wetland biota to provide a firm social and economic basis for wetland conservation;
- Promote sustainable traditional harvesting of wetland biota;
- Develop and promote sustainable eco-tourism and recreational practices;
- Determine the impact of aquaculture, the species used, and its management practices on biodiversity, and develop appropriate guidelines for aquaculture developments;
- Control, eradicate and prevent the introduction of harmful alien species of plants and animals in our wetlands.

5.7.6 Pollution control

Water quality is determined by chemical and biological constituents, and the physical attributes of the water. With the increased rate of development in South Africa, the country's water resources are becoming increasingly polluted. The main problem areas are salinization, eutrophication, contamination by parasites and pathogens, siltation and sedimentation, pollution by harmful chemical compounds, thermal pollution and acidification. The proposed policy on an integrated pollution control effectively only addresses chemical pollution and waste management. While applying this proposed policy, further actions will have to be taken to address the other problem areas.

Objective 13

To minimize the effects of chemical pollution and solid waste on our wetlands.

Actions

- Implement the policy on integrated pollution control and waste management.

Objective 14

To minimize biological pollution of our wetlands.

Actions

- Control, eradicate and prevent the introduction of harmful alien species of plants and animals in our wetlands (also under objective 12).
- Identify and neutralize sources of parasitic and pathogenic pollution in our wetlands;
- Undertake necessary research to support the control of biological pollution of our wetlands;
- Promulgate legislation, where necessary, to prevent the introduction of further biological pollutants into South Africa's wetlands.

Objective 15

To minimize siltation and sedimentation of South Africa's wetlands.

Actions

- Apply the provisions of the Agricultural Resources Act effectively;
- Implement catchment management as proposed by the new water act.

5.7.7 International obligations and actions

The conservation of wetlands is a global issue, which is recognized by South Africa by its participation in the Convention on Wetlands of International Importance especially as Waterfowl Habitat, the Convention on Biological Diversity as well as in other fora. South Africa will promote the effective implementation of existing international agreements, and ensure that

activities are harmonized within the context of bilateral and multilateral agreements. International cooperation must play a major role in facilitating access to and transfer of technology.

Objective 16

Support international conventions and agreements that contribute to the global conservation of wetlands and their functions.

Actions

- Meet our obligations in terms of the Convention on Wetlands of International Importance especially as Waterfowl Habitat, the Convention on Biological Diversity, the Convention on Migratory Species, the Convention on Trade of Endangered Species of Wild Fauna and Flora;
- Continue our support for Wetlands International, and play an active role in its Africa-Europe-Middle East Regional activities;
- Continue our support for the IUCN and develop an improved profile within their wetlands programme.

Objective 17

To play a leading role in the promotion of wetland conservation in all regional groups in which South Africa takes part.

Actions

- Support the promotion of wetland conservation within the SADC;
- At meetings of the African Region, encourage actions to support wetland conservation;
- Promote wetland conservation as a theme at Valdivia Group meetings;

5.7.8 Management systems

Wetland conservation has always played second fiddle to terrestrial conservation and to water resource development in South Africa. The importance of wetland conservation has at best been a minor priority in the present management systems. A review of the institutions for wetland conservation is required, with a view to allocating the responsibility to one agency as its primary responsibility, with the necessary capacity. Even so, this agency will have to coordinate and cooperate with a number of other institutions.

Objective 18

To establish an effective wetland conservation agency for South Africa.

Actions

- Review and consolidate wetland related legislation, and promulgate the wetland conservation bill (see objectives 4, 5, 11 and 14);
- Establish a wetland conservation agency with the necessary capacity and funding to apply the legislation and to implement this policy.

Objective 19

To establish effective working relationships with other sectors in support of wetland conservation.

Actions

- Involve the private sector in active wetland conservation;
- Apply effective incentive measures to support wetland conservation;
- Promote the integration of traditional knowledge and practices concerning the conservation and sustainable use of wetlands and their biota;
- Support the rights of holders of traditional knowledge
- Develop partnerships with NGOs to effect wetland conservation;

- Promote sound catchment management.

5.8 SUMMARY

This chapter determined that a wetland conservation policy is indeed a land use planning tool. Having identified the range of activities required for effective wetland conservation, a model national policy for wetland conservation was presented. This policy is supported by an implementation strategy in which 19 objectives address the following eight major thrusts:

- Wetland conservation;
- Developments affecting wetlands;
- Sound scientific base;
- Hydrological needs;
- Conservation of wetland biota;
- Pollution control;
- International obligations and actions; and
- Management systems.

For each thrust, objectives have been identified and actions toward achieving these objectives listed.

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1 INTRODUCTION

This thesis sets out to develop a national policy and strategy for wetland conservation in South Africa, based on the hypothesis that wetlands are a small but extremely important part of the greater South African landscape, and although South Africa recognized this by becoming a Contracting Party to the Convention on Wetlands of International Importance especially as Waterfowl Habitat as far back as 1975, their conservation has been sorely neglected. Therefore the development of national policy and strategy for wetland conservation in South Africa will provide a tool for the planning and management of this feature of South Africa's landscape. This hypothesis was broken into three sub-hypotheses:

1. South Africa does not know the extent of its wetlands;

2. South Africa is not meeting its international obligations in terms of wetland conservation;

3. A wetland conservation policy can provide an effective land-use planning tool.

To test this hypothesis four goals were set:

1. To determine what is known about South Africa's wetlands, and to improve on that knowledge;

2. To determine the relevant international obligations for wetland conservation,

South Africa's approach to meeting them, and to identify the major obligations not met by South Africa; and

3. To develop a model national wetland conservation policy aimed at improving wetland conservation in South Africa, thereby assisting South Africa meet its international obligations and make wise use of a neglected, but valuable resource.

4. To propose a strategy for the implementation of the policy in terms of South Africa's infrastructure.

This chapter notes the degree of success this thesis had in achieving the goals, discusses the results presented, and provides some concluding remarks.

6.2 EXTENT OF SOUTH AFRICA'S WETLANDS

In testing the sub-hypothesis that South Africa does not know the extent of its wetlands two aspects relevant to wetland planning were addressed. First, a set of wetland regions for South Africa was proposed, and then a directory of South African wetlands was developed and analysed.

6.2.1 Wetland regions of South Africa

The development of a set of wetland regions was considered the first step in planning for the conservation of a country's wetlands. In Chapter 3 a number of attempts at dividing South Africa into regions was reviewed. These attempts, while all considering wetland biota, were all limited by the taxa they considered, and therefore found to be inadequate. A set of wetland regions for South Africa were then proposed. Due to having gone wider than river systems and species distribution, 26 sub-regions have been identified in this chapter. While the number of

sub-regions may initially seem excessive, it is felt that these subdivisions will provide the background to a better understanding of the variability within South African wetlands. This is contribution to planning for wetland conservation provides the first part of the hierarchy in the framework developed in this thesis. Because the approach is a hierarchical one, it can and should be developed further, providing even finer sub-regions in the future. However, it should be noted that even with this diversity of wetland regions, wetlands typical of a region are not necessarily exclusive to that region.

6.2.2 Directory of South African wetlands

In Chapter 4 the knowledge of the extent of wetlands in South Africa was assessed. In the development of this chapter, two major contributions to the state of knowledge of South African wetlands, their planning and conservation were made, namely a wetland classification system, which relates directly to that of the Ramsar Convention, and a directory of what is known about the conservation status of our wetlands.

It was found that no classification system for wetlands in South Africa existed. Classifications developed for other continents were found to be inadequate or inappropriate. Therefore a wetland classification system was developed which is applicable for South Africa. This contribution, the second part of the framework for planning for wetland conservation in South Africa, provides a logical grouping of the wetland types found in the country.

Using the framework developed here, a directory of South African wetlands was developed (Appendices 2-9). A wide range of sources, many from outside of the conservation field, were used in gathering information on the full range of South Africa's wetlands. The information was improved by combining the different sources to form a data set which was then analysed. This analysis determined the conservation status of the wetlands, the threats they were facing and their conservation values. While adding substantially to the knowledge relating of the wetlands of South Africa by presenting the data in the form of a directory of wetlands, the analysis of this data

set showed that in South Africa we do not know the extent of our wetlands. It was found that a comprehensive wetland inventory is still a priority for wetland conservation because there are still significant gaps in the knowledge of South Africa's wetlands. Thus proving sub-hypothesis 1 to be true.

6.2.3 Conclusion

This section of the thesis, comprising two chapters provided the following additions to the body of knowledge:

- A set of wetland regions, to be used in planning;
- A classification system for wetlands of and relevant to South Africa, which allows direct comparison with international classification systems; and
- A directory of known wetlands of South Africa, analysed according to their conservation system.

6.3 SOUTH AFRICA'S INTERNATIONAL COMMITMENTS

Chapter 5 tested the secondary hypothesis that South Africa is not meeting its international obligations. It was noted that there are a number of international instruments which address the conservation and sustainable use of natural resources. The most recent and well publicized are those agreements made at Rio in 1992 - the relevant ones to this thesis being Agenda 21 and the Convention on Biological Diversity. Agenda 21 is not a convention in terms of countries ratifying it. It essentially sets out a process whereby sustainable development is promoted, and encourages all nations toward implementing that process. In the process it recognizes the roles of the other international conservation instruments. The Convention on Biological Diversity

(the CBD), on the other hand, is a formal convention. It was ratified by South Africa in 1996. Because its scope is so wide, the CBD has signed memoranda of understanding with other relevant conventions, which in turn take the lead in their fields. Thus, at the CBD's 4th Conference of Contracting Parties, held in Slovakia during 1998, the CBD recognized the Ramsar Convention on Wetlands as the lead convention as regards wetland conservation. Therefore Chapter 5 addressed South Africa's commitments in terms of the latter convention only.

6.3.1 Conservation of wetlands

While having met the basic obligation of designating at least one wetland to the List of Wetlands of International Importance, and indeed gone well beyond that; and having ensured that special attention has been paid to those wetlands, it was found that:

South Africa has yet to develop a national wetland conservation policy; and

South Africa has yet to complete an inventory of its wetland resources

6.3.2 Promotion of international cooperation in wetland conservation

South Africa has proved and continues to prove itself a leader in the southern African sub-region, and has played an active role in the African region, particularly in the last two Pan African Regional Meetings;

6.3.3 Fostering communications about wetland conservation

South Africa's role in fostering communications about wetland conservation has been particularly strong at the scientific level. It is playing a leading role in the development of communications relating to wetland conservation using electronic media, but is lagging in the

development of a strong communication role at the political level. At the grassroots level a strong groundswell movement is developing in the country, being supported by activities coordinated around national and international promotions.

6.3.4 Supporting the work of the convention

South Africa's support for the convention has been exemplary. Its payments are up to date, it has made voluntary contributions in the past and has raised funds to promote the convention in the southern African sub-region.

6.3.5 Conclusion

After having reviewed the important aspects of the Ramsar Convention on Wetlands, and having analysed South Africa's activities with respect to that convention, it is concluded that South Africa is indeed playing an active role in wetland conservation, thus working toward meeting its obligations in terms of the convention. However, there are areas where South Africa is falling short of meeting its obligations in particular in terms of planning.

This chapter provided the following additions to the body of knowledge:

- A summary of the relevant obligations South Africa is under in terms of wetland conservation;
- An assessment of South Africa's efforts to meet these obligations for the period 1971-1998.

6.4 A PROPOSED WETLAND CONSERVATION POLICY FOR SOUTH AFRICA

The final goal, goal 4, to propose a strategy for the implementation of the policy in terms of South

Africa's infrastructure, was set out in chapter 6. The policy and its strategy essentially has to be read as a unit. The main function of such a policy and strategy is to provide a tool for the protection, management and utilization of this important landscape unit and all its functions, values and attributes. It is here that the ecological planning process comes into its own in that in terms of wetland conservation such a process aims at:

- The management of the wetland landscape, its attributes, functions and its inherent values for the benefit of society;

- The sustained utilization by society of the natural resources provided by the landscape, its ecosystems and habitats;

- The maintenance of essential ecological functions and essential life support systems of the natural wetland landscape; and

- The protection of the unique, sensitive and rare aspects of the wetland landscape, its ecosystems and habitats against the inherent dangers due to man's activities in the ecosystem. (adapted from van Riet, 1986).

It was shown that the present state structures and legislation are less than adequate for the effective conservation of South Africa's wetlands. The final point in the strategy notes that wetland conservation has always played second fiddle to both terrestrial conservation and to water resource development in South Africa. The importance of wetland conservation has at best been a minor priority in the present management systems. A review of the institutions for wetland conservation is required, with a view to allocating the responsibility to one agency as its primary responsibility, with the necessary capacity.

In terms of the constitution, environment and conservation are dual competencies, to be undertaken at both national and provincial level. However, the management of water resources is

a national competency only. Nature conservation, environmental management and water resource management all play an integral part in wetland conservation. It is therefore proposed that this agency be a national agency. It should be independent of these existing structures, but will have to work closely with them. It should have the following functions and responsibilities:

- Extension — Responsible for catchment areas, extension officers would promote the conservation of wetlands by all land-users, using a range of techniques including the provision of incentives;

- Research — The agency would develop and fund a relevant research programme to ensure continued improvement of our understanding of wetlands and their benefits to society. Research should be undertaken by staff of the agency as well as by other institutions, funded by the agency;

- Inventory — The national inventory should be developed and the data-base maintained by the agency. This should serve as the base for an extensive monitoring programme, also the responsibility of the agency.

- Legal review — The agency should be responsible for legal review at a number of levels.

- Law enforcement — Where cooperation with and coordination of other law enforcement agencies would be as important as enforcing the law itself.

- Fund raising — In order to enable South Africa to build its capacity so that

we can meet all the objectives of this strategy.

This chapter tests the secondary hypothesis that a policy and the strategy to implement that policy is a planning tool. it traces the previous attempts and the development of a wetland conservation policy for South Africa. It draws from a number of disciplines and combines their approaches both in an interdisciplinary and an intradisciplinary manner. A model wetland conservation policy and strategy to implement that policy is then proposed. This model provides a framework for improved wetland conservation in South Africa, and gives guidance on which actions should or may take place in and around wetlands.

Carew Reid (1995) suggests the following ten lessons or features of success in the development of a policy and its implementation strategy:

- Strategies should establish specific objectives in aiming to improve and maintain the well being of people and ecosystems;
- The overall goal of strategies for sustainable development;
- Make choices - too many objectives are counter-productive;
- Strategies should be a process, not an isolated event;
- Strategies should be as participatory as possible;
- Communication is the lifeblood of a strategy;
- Strategies are processes of planning and action - the components must be implemented together to reinforce each other;

- Strategies must be integrated into existing decision making. Politicians and communities need to see its benefits and relevance;
- Build the capacity to implement the strategy at the earliest stage; and
- External agencies should be "on tap" not on top.

In essence the strategy must:

- Address all needs relevant to wetland conservation;
- Be practicable;
- Be seen and able to meet international obligations; but at the same time
- Be relevant to South Africa, including its bio-physical, the socioeconomic and the political conditions.

It is concluded that the policy and its implementation strategy here meets the features of success suggested by Carew-Reid (1995). In doing so:

- provides an effective land use planning tool; and
- it contributes to the body of knowledge.

6.5 CONCLUSION

The conclusion of this thesis is that the ecological planning process can be effectively used at a national scale. For this to be effective it should be used for the development of policy and strategy as illustrated in this thesis by the development of a national wetland policy and strategy to implement the policy. It is trusted that the development and implementation of this procedure will not only contribute to the discipline of landscape architecture, but will also benefit South African society.

Our immediate past President, Nelson R Mandela stated that the Government of National Unity and the people of South Africa share the concern of the global community for the health of the planet Earth. ".... We, the people of the Republic of South Africa, pledge our support for a healthy environment for all people. We will strive to implement national policies which will promote sustainable development, peace and human security. We also pledge our commitment to the custodonianship of a global heritage." (Mandela, 1995: 5)

With support such as this, it is our responsibility to take the initiative, clarify the necessary jurisdiction, promulgate and implement the Wetland Conservation Policy, ideally through a dedicated wetland conservation office responsible for research, law enforcement, and extension services, to develop, enforce and promote wetland conservation in South Africa.

The Development of a national policy and strategy for wetland conservation in South Africa

by

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ABSTRACT

Wetlands are a small but extremely important part of the greater South African landscape. Although South Africa recognized this by becoming a Contracting Party to the Convention on Wetlands of International Importance especially as Waterfowl Habitat as far back as 1975, their conservation has been sorely neglected. It has also been estimated that over half of our wetlands have been destroyed and lost. Those that remain are some of our most threatened natural areas.

With such heavy losses to a small but extremely important landscape type it is imperative that a strategy to conserve wetlands be developed. The strategy should be based on an understanding of the types and distribution of wetlands in South Africa, the international obligations South Africa is under, and the structure of conservation management in South Africa.

This thesis develops a national policy and strategy for wetland conservation in South Africa which will provide a tool for the planning and management of this feature of South Africa's landscape.

Wetlands are established as a functional unit in the broader landscape, in other words a landscape unit or feature. Wetland regions are defined based on the fundamental elements of any natural landscape. The relevant landscape elements are identified, mapped and described.

A large sample of South African wetlands is analysed in terms of type, threats and conservation status. An analysis of our wetlands and their status is considered necessary to determine where the needs for such a policy and strategy are most necessary.

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, is introduced as being the main international instrument for the conservation of wetlands. The obligations of Contracting Parties are set out and South Africa's role in the convention to date elaborated on.

Based on the preceding chapters, a national wetlands conservation policy is proposed. The policy and its strategy is essentially a tool for the protection, management and utilization of this important landscape unit and all its functions, values and attributes.

Landscape architectural projects are carried out at a range of levels. Most often these are at site level, quite often at local level (eg open space planning for a town/city), in the context of nature conservation usually at the level of protected area planning. A landscape planning approach at provincial level has been used to identify areas for potential conservation areas.

Wetlands, being an integral part of the hydrological system, and subject to a wide range of demands and impacts due to human activities, require planning at at least catchment level. In South Africa this is well beyond provincial level (consider the Orange River alone, has a catchment area which includes parts of or all of six provinces and two other states). Wetlands are considered both functional and ecological systems, and this study utilizes the ecological planning method at a national scale using approaches which are currently being explored at and encouraged at international fora and adapted to the South African situation.

The conclusion of this thesis is that the development of a conservation policy and strategy forms part of the ecological planning approach and that the ecological planning process can be effectively used at a national scale.

Die ontwikkeling van 'nationale beleid en strategie vir die bewaring van aquatiese sisteme in Suid Afrika

deur

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EKSERP

Akwatiese sisteme vorm 'n klein maar onontbeerlike deel van die Suid-Afrikaanse landskap. Dit is in 1975 reeds besef, met die toetrede van Suid-Afrika tot die internasionale konvensie wat betrekking het op die bewaring van hierdie ekosisteme ("Convention on Wetlands of International Importance especially as Waterfowl Habitat") Daar is egter steeds 'n agterstand in die bewaring van hierdie ekosisteme, en meer as die helfte daarvan is reeds verlore. Die wat nog steeds bestaan vorm 'n deel van ons mees bedreigde natuurlike gebiede.

Om hierdie rede is dit dringend noodsaaklik dat 'n strategie vir die bewaring van akwatiese

ekosisteme ontwikkel word. So 'n strategie moet op die kennis van die tipe en verspreiding van akwatiese ekosisteme, die internasionale verpligtinge waaraan Suid Afrika onderhewig is en die struktuur van bewaring in Suid-Afrika gebaseer wees.

In hierdie verhandeling word 'n nasionale beleid en strategie vir die bewaring van akwatiese ekosisteme ontwikkel, wat as hulpmiddel vir die beplanning en bestuur rondom hierdie unieke deel van die Suid-Afrikaanse landskap gebruik kan word.

Aanvanklik is akwatiese ekosisteme as funksionele eenhede van die landskap gevestig. Streke van akwatiese ekosisteme is gedefinieer volgens die fundamentele eienskappe van enige natuurlike landskap. Die landskapseenhede is geïdentifiseer, op kaart geteken en beskryf.

'n Monster van akwatiese ekosisteme is geanaliseer op grond van soort, bedreiging en bewaringstatus. So 'n analise is genoodsaak om te bepaal waar die beleid en strategie toegespits moet word.

Die konvensie ("Convention on Wetlands of International Importance especially as Waterfowl Habitat") word omskryf en voorgestel as die belangrikste instrument wat internasionaal gebruik word om die bewaring van akwatiese ekosisteme te verseker. Die verpligtinge, asook die rol wat Suid-Afrika speel in die implementering van die konvensie is uitgespel.

Met die bostaande agtergrond as inleidende hoofstukke, is 'n nasionale beleid vir die bewaring van akwatiese ekosisteme voorgestel. Die beleid en die strategie om dit toe te pas is 'n onontbeerlike maatreel om die belangrike ekosisteme (insluitende al hulle funksies, waardes en eienskappe) te beskerm, te bestuur en te benut.

Landskapsargitektuur vind uitdrukking op verskillende vlakke. Dit word toegepas op die ontwikkelingsperseel, dikwels ook op streekvlak (bv die beplanning van oopruimtesisteme in 'n stad) en in die konteks van natuurbewaring word dit beperk die beplanning van natuurreservate. Die landskapsbeplannings benadering op provinsiale vlak om gebiede te identifiseer vir natuurreservate is reeds voltooi. Akwatiese ekosisteme, wat deel vorm van die

hidrologiese sisteem is onderhewig aan die bedreigings van mensgeïduseerde impakte en aktiwiteite en moet ten minste op opvanggebied beplan word. In Suid-Afrika moet diè beplanning heelwat verder as op provinsiale vlak uitgebrei word (Bv die Oranjerivier se opvanggebied sluit die gebiede van ten minste ses provinsies en twee ander lande in). Akwatiese ekosisteme word as beide funksionele en ekologiese sisteme beskou en hierdie studie maak gebruik van die ekologiese beplanningsmetode op nasionale skaal, aangepas vir Suid-Afrika, met inagneming van benaderings wat tans deur die internasionale gemeenskap ondersoek en aangemoedig word

Die gevolgtrekking van hierdie verhandeling is dat die ontwikkeling van 'n bewarings-beleid en -strategie as deel van die ekologiese beplanningsmetode beskou word wat effektief op nasionale vlak gebruik kan word.

APPENDIX 1 WETLAND DATA SHEET

A LOCATION AND IDENTITY

Country: .....

Wetland name: .....

Geographical coordinates: .....°.....'S .....°.....'E

Area (ha): ..... / Shoreline length (km): .....

Altitude (masl): .....

River catchment (name): .....

Does this wetland form part of a larger system? .....
Name of larger system: .....

B HABITAT TYPES

Please insert the code number of all habitat types found in the wetland as follows:

A:	dominant habitat	....	approx area	.....	ha
B:	important, but not dominant habitat	....	approx area	.....	ha
C:	minor habitat	....	approx area	.....	ha

Description of plant communities

Please provide a short description of the dominant and important wetland plant communities:

.....
.....
.....
.....

C PROTECTION

Please identify the level of protection at the site using the code number: ....
.

D LEVEL OF THREAT

Please identify the overall degree of threat to the site using the code number ....

E TYPE OF THREAT

Where possible identify the types of threat using the relevant code numbers as follows:

To the catchment

Major threat ....
Secondary threats ....

To the wetland

Major threat ....
Secondary threats ....

F CONSERVATION VALUE

Identify the the principal conservation values of the wetland according to the Ramsar criteria. Use the code numbers:

....

Description

Please provide reasons for including the site in this inventory:
.....
.....
.....
.....

APPENDICES

Please append where available:

1. Species lists for the wetlands

2. Counts (eg bird/game counts) for the wetland. Please state when the last count was done.

3. References - relevant published and unpublished reports on the wetland

4. A map of the country, showing location and extent of the wetland.

5. Legal documents: proclamation and description (ie relevant government gazette) where relevant

5. Contact names and addresses of persons who are knowledgable of the wetland

WETLAND DATA SHEET
CODE NUMBERS

A LOCATION AND IDENTITY

No codes numbers used

B HABITAT TYPES

SALTWATER

Marine subtidal

01 permanent unvegetated shallow waters less than 6m depth at low tide including *sea bays, straits*.
02 subtidal aquatic vegetation, including *kelp beds, sea grasses, tropical marine meadows*.
03 *coral reefs*.

Marine intertidal

04 rocky marine shores, including *cliffs, rocky shores*, *off-shore islands*.
05 shores of *mobile stones* and *shingle*.
06 intertidal unvegetated mobile *mud, sand* or *salt flats*.
07 intertidal vegetated sediments on sheltered coasts, including *salt marshes*.
08 intertidal vegetated sediments on sheltered coasts, including *mangroves*.

Estuarine subtidal

09 estuarine waters; *permanent waters* of estuaries and estuarine systems of deltas.

Estuarine intertidal

10 intertidal *mud, sand* or *salt flats*, with limited vegetation.
11 intertidal marshes, including *salt-marshes, salt meadows, saltings, raised salt marshes, tidal brackish* and *freshwater marshes.*
12 intertidal forested wetlands, including *mangrove swamp, nipa swamp, tidal freshwater swamp forest*.

Lagoonal

13 *brackish to saline lagoons* with one or more relatively narrow connections with the sea.

Saline (internal drainage)

14 permanent and seasonal, *brackish, saline* or *alkaline lakes, pans, flats* and *marshes.*

FRESHWATER

Riverine permanent

15 permanent *rivers* and *streams*, including *waterfalls*.
16 *inland deltas*.

Riverine temporary

17 seasonal *rivers* and *streams.*
18 *riverine floodplains,* including *river flats, flooded river basins, seasonally flooded grassland*.

Lacustrine permanent

19 permament freshwater *lakes* (≥ 8ha), including shores subject to seasonal or irregular inundation.
20 permanent freshwater *ponds*, *pans* (≤ 8ha).

Lacustrine seasonal

21 seasonal freshwater *lakes* (≥ 8ha), including *floodplain lakes*.
22 seasonal freshwater *ponds, pans* (≤ 8 ha).

Palustrine emergent

23 permanent freshwater *marshes* and *swamps* on inorganic soils, with emergent vegetation whose bases lie below the water table for at least most of the growing season.
24 permanent *peat-forming freshwater swamps*, including upland valley swamps dominated by *Papyrus* or *Typha*.
25 seasonal freshwater *marshes* on inorganic soil, including *sloughs, potholes, seasonally flooded meadows, sedge marshes* and *dambos.*
26 *peatlands*, including acidophilous, ombrogenous or soligenous mires covered by moss, herbs or dwarf shrub vegetation, and *fens* of all types.
27 *Alpine* and *polar* wetlands including seasonally flooded meadows moistened by temporary waters from snowmelt.

28 *springs* and *oases* with surrounding vegetation.
29 *volcanic fumaroles* continually moistened by emerging and condensing water vapour.

Palustrine forested

30 *shrub swamps*, including shrub-dominated freshwater marsh, shrub carr and thickets on inorganic soils.
31 freshwater *swamp forest*, including seasonally flooded forest, wooded swamps on inorganic soils.
32 *forested peatlands*, including peat swamp forest.

MAN-MADE WETLANDS

Aquaculture/mariculture

33 *aquaculture ponds* including fish ponds and shrimp ponds.

Agriculture

34 *irrigated land* including rice fields.
35 seasonally flooded agricultural land.

Salt exploitation

36 *salt pans* and *evaporation pans.*

Urban/industrial

37 *excavations* including gravel pits, borrow pits and mining ponds.
38 *wastewater treatment areas* including sewage farms, settling ponds and oxidation basins.

Water storage areas

39 *resevoirs* for irrigation and/or human consumption with a pattern of seasonal drawdown of water level.
40 *hydro-dams* with regular fluctuations in water level on a weekly or monthly basis.

CLASSIFICATION OF MAJOR WETLAND VEGETATION

Main vegetation type	**Community**
Forests	Swamp forest
	Mangrove forest
	Riparian forest
Grasslands	Intermittantly flooded grassland
	Seasonally flooded grassland
	Permanently flooded grassland
Herbaceous wetlands	Emergent plant communities
	Euhydruphyte communities
	Surface floating communities
Mudflats	
Uplands	

C PROTECTION

01 No information

02 No legal protection

03 Partly or wholly included within a forest reserve, non-hunting area or similar reserve with a low level of protection

04 Partly protected within a national park, nature reserve, wildlife sanctuary or equivalent reserve

05 Wholly protected within a national park, nature reserve, wildlife sanctuary or equivalent reserve

D LEVEL OF THREAT

01 No information

02 No threat known

03 Minor threat (eg some disturbance from hunting, fishing, recreation or overgrazing)

04 Moderate threat: some serious threats, but irreparable damage not inevitable

05 Under serious threat, from one or several sources; most, if not all of the wetland habitat is likely to be lost or major ecological changes are likely to occur unless some immediate remedial action is taken

E TYPE OF THREAT

To the catchment

01 Afforestation
02 Urban development
03 Mining
04 Water resource/hydroelectric development: dams, barrages, water abstraction
05 Degradation of the catchment, soil erosion, sedimentation
06 Alien plant infestation along water courses

To the wetland

07 Drainage
08 Dredging
09 Groundwater abstraction
10 Abstraction/diversion of water supply for irrigation/urban/industrial use
11 Flood control
12 Flooding

13 Construction of roads, airports, waterways, etc
14 Urban/industrial development
15 Human settlement/encroachment
16 Mining and assoiated development

17 Waste disposal
18 Urban/industrial pollution
19 Agricultural fertilizers
20 Agricultural biocides
21 Eutrophication
22 Introduced alien plants
23 Introduced alien animals
24 Infestation with aquatic weeds

25 Agricultural development
26 Conversion to aquaculture ponds
27 Conversion to salt pans
28 Overgrazing
29 Commercial logging

30 Tourism/recreation and associated development

31 Fishing and associated disturbances
32 Hunting and associated disturbances
33 Use of poisons for fishing/hunting
34 Harvesting of aquatic plants

35 Woodcutting for domestic use
36 Harvesting eggs, nestlings or hatchlings of birds and reptiles
37 Burning of wetland

38 Other (please state).....
.....
.....

F CONSERVATION VALUE

01 The site is a particularly good representative example of a natural or near natural wetland, characteristic of its biogeographical region
02 The site is a particularly good representative example of a natural or near natural wetland, common to more than one biogeographical region
03 The site is a particularly good representative example of a wetland, which plays a substantial hydrological, biological or ecological role in the natural functioning of a major river basin or coastal system, especially where it is located in a trans-border position
04 The site is an example of a specific type of wetland, rare or unusual in its biogeographical region

05 The site supports populations of one or more threatened or endemic species of plant or animal
06 The site is of special value for maintaining the genetic or ecological diversity of the region in which it is situated
07 The site is of special value for certain species of plants and animals at a critical stage of their biological cycle
08 The site is of special value for one or more endemic plant of animal species or communities

09 The site regularly supports at least 20 000 waterbirds
10 The site regularly supports substantial numbers of individuals of waterbird species indicative of wetland values, productivity or diversity
11 The site regularly supports 1% of the global population of a species or subspecies of waterbird

12 The site is of considerable socio-economic or cultural value

13 The site is thought to be important for one or more of the above reasons, but insufficient information is available to assign any particular values.

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