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

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Introduction

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

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

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

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

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

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

Methods

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

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

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

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

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

Amphibian and Reptile Statistics

Data quality

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

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

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

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

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

Amphibians

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

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

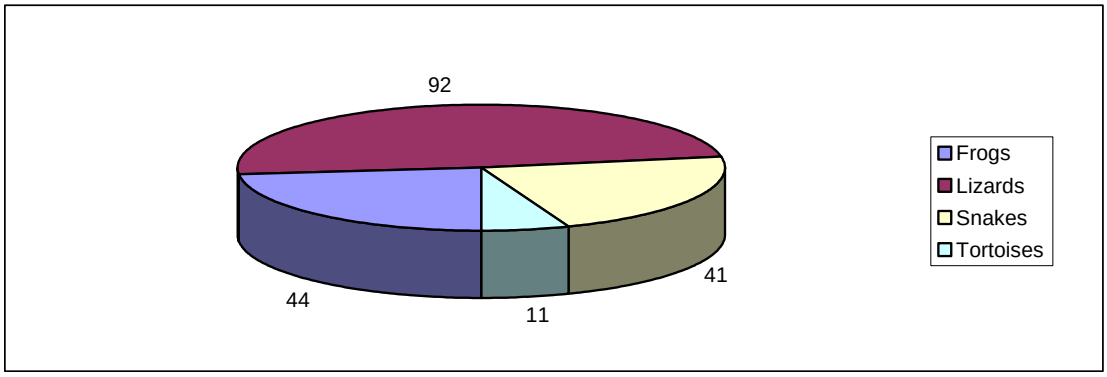

Figure 1. Number of Western Cape Province amphibians and reptiles.

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

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

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

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

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

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

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

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

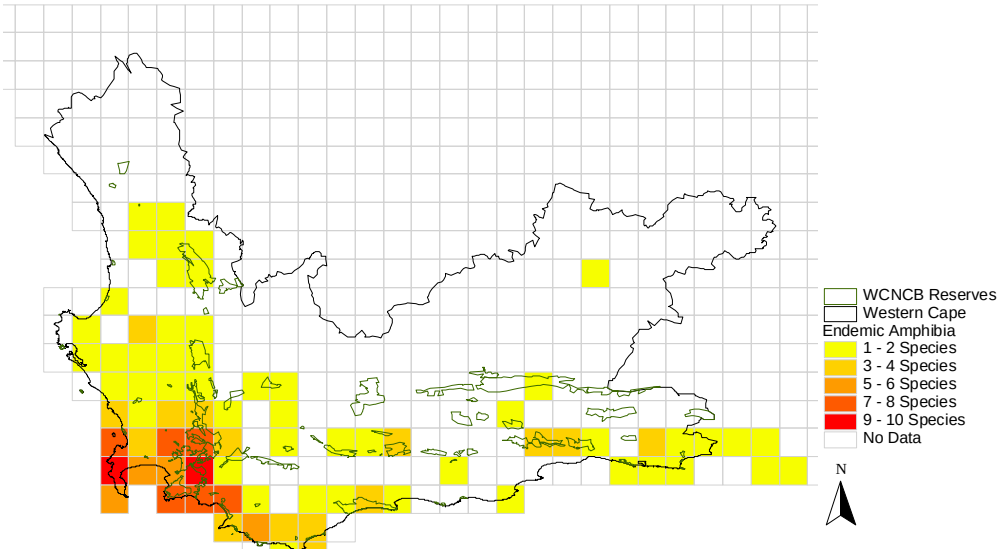

Figure 2. Degree of Western Cape Province frog endemism per quarter degree grid square.

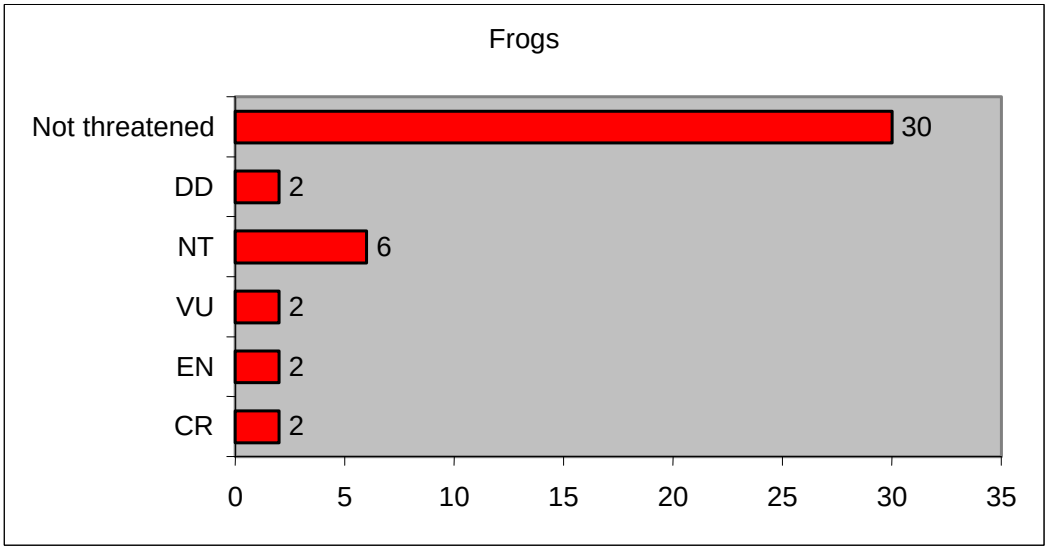

Figure 3. Conservation status of the indigenous frogs of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

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

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

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

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

Lizards

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

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

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

Reptiles

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

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

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

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

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

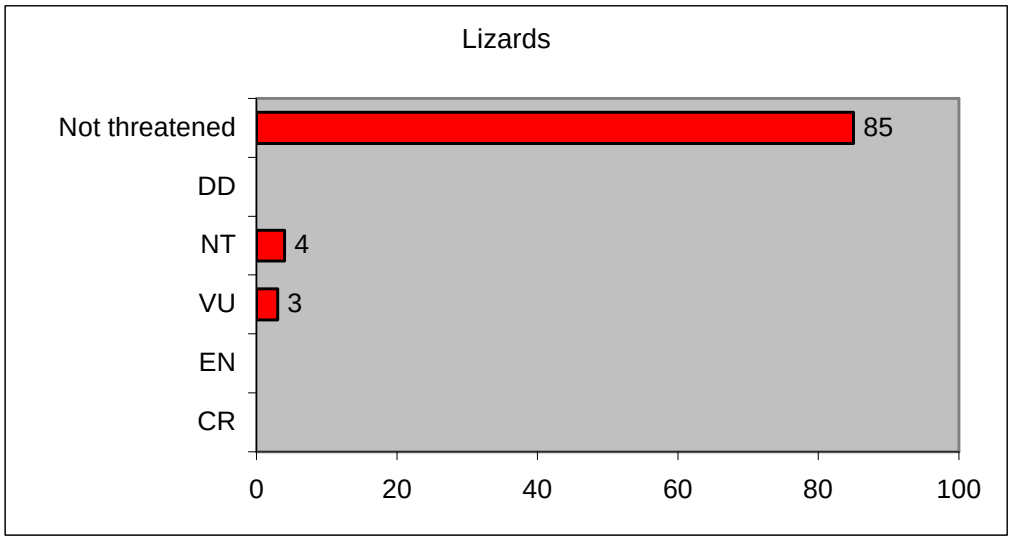

Figure 5. Conservation status of the indigenous lizards of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

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

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

Snakes

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

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

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

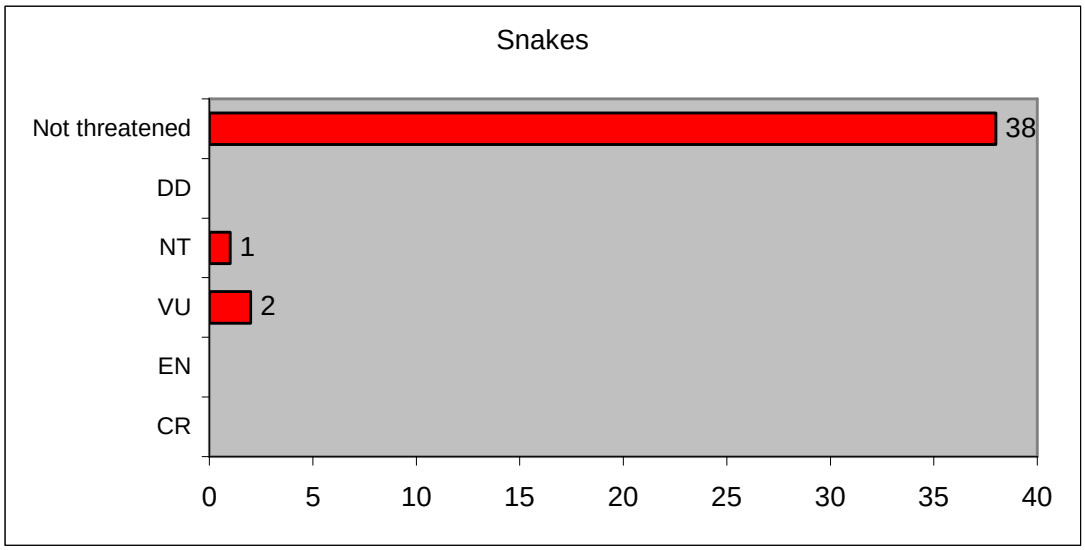

Figure 6. Conservation status of the indigenous snakes of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Defidient.

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

Tortoises and Terrapins

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

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

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

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

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

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

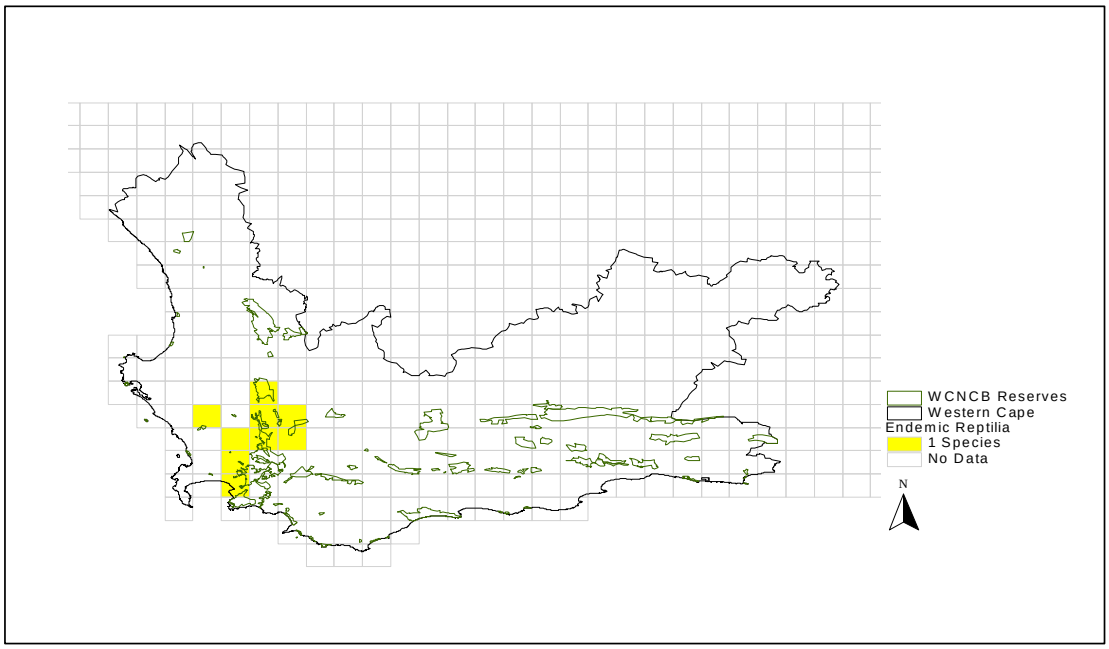

Figure 4. Degree of Western Cape Province reptile endemism per quarter degree grid square.

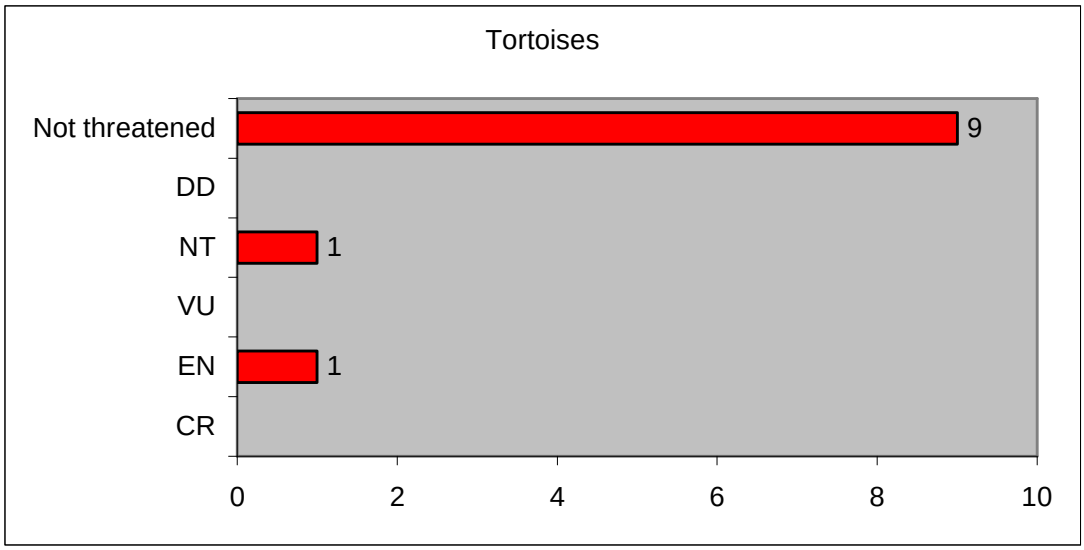

Figure 7. Conservation status of the indigenous tortoises of the Western Cape Province. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

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

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

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

Critical Habitats

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

Perennial mountain stream habitats

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

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

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

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

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

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

Coastal, acidic blackwater lakelets

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

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

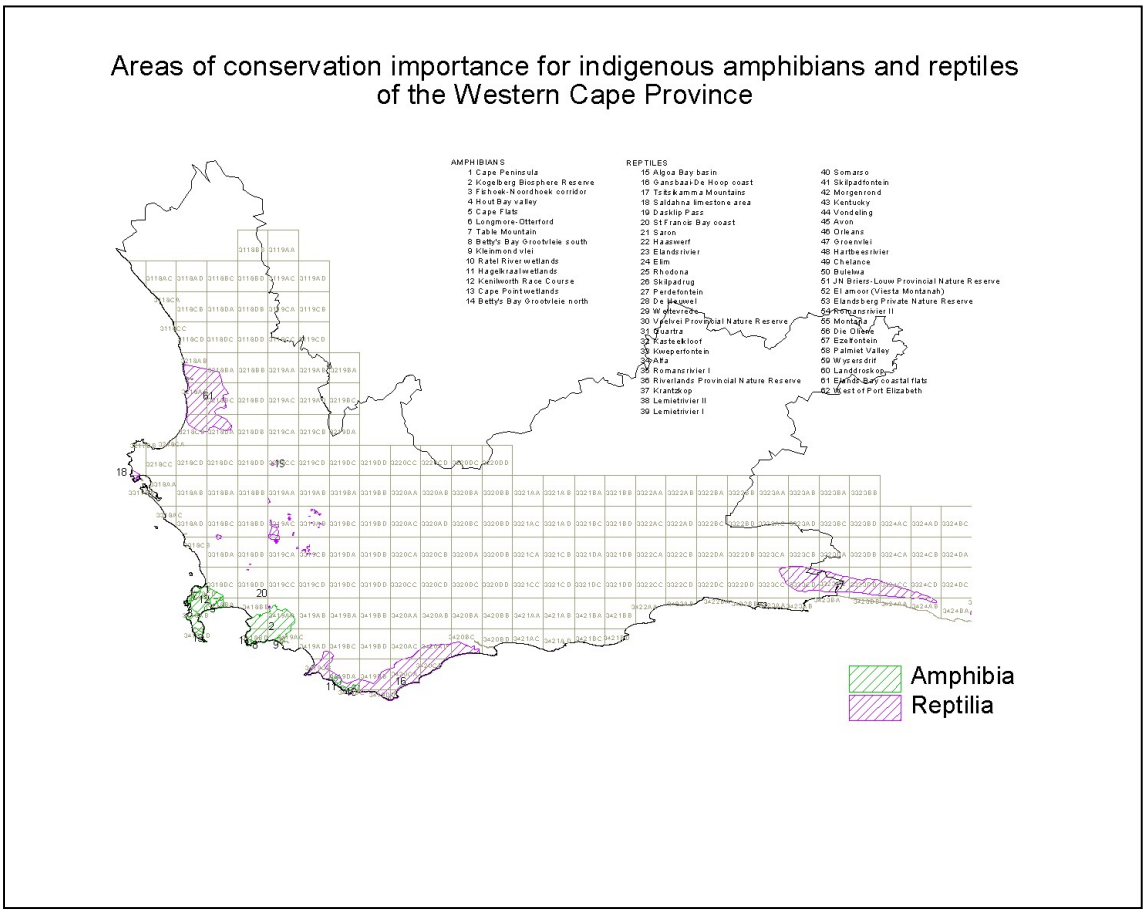

Figure 8. Map indicating areas of conservation importance for amphibians and reptiles in the Western Cape Province.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Threats to Herpetological Biodiversity

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

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

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

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

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

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

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

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

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

Effectiveness of Current Conservation

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

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

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

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

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

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

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

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

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

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

Utilization of Herpetological Diversity

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

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

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

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

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

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

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

Economic Incentives to Conserve Herpetofauna

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

Trends in Herpetological Conservation Ethic

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

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

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

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

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

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

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

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

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

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

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

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

Conservation Research and Actions

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

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

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

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

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

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

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

Status of Herpetological Knowledge

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

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

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

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

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

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

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

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

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

Recommendations towards the Conservation of Herpetofauna

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

Amphibians

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

Reptiles

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

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APPENDIX I Western Cape Province Herpetological Checklist

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

Appendix 1 (*continued)*

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

Appendix 1 (*continued)*

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

Appendix 1 (*continued)*

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

Appendix 1 (*continued)*

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

Appendix 1 (*continued)*

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

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

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