1. INTRODUCTION.

South Africa has a unique biological diversity. The variety of genes, species, ecosystems and ecological processes occurring in the country is the guarantee for ecosystem functioning and services, and the variation of functional ecosystems is the life insurance for sustainable development. This should be a fundamental understanding of any approach to the long-term conservation and use of biodiversity. The remarkable richness of South Africa's biodiversity is largely as a result of the mix of tropical and temperate climates and habitats occurring in the country. South Africa ranks as the third most biologically diverse country in the world, and as such is of major global importance for biodiversity conservation. As can be seen in table 1, South Africa has an extraordinarily varied plant and animal life. In terms of these numbers of mammal, bird, reptile and amphibian species which occur only in this country, South Africa is thus biologically the 24th richest country in the world. (White Paper on Biological Diversity, 1997)

Table1: Species Richness of South African Taxa. (White Paper on Biological Diversity, 1997)

TAXA	Number of described species in total in South Africa	Percentage of the earth's species
Mammals	227	5.8 %
Birds	718	8%
Amphibians	84	2.1 %
Reptiles	286	4.6 %
Freshwater fish	112	1.3 %
Marine fish	2 150	16 %
Invertebrates	77 500	5.5 %
Vascular plants	18 625	7.5 %

Human activities such as hunting, agriculture, deforestation and urban development have caused habitat loss and degradation, overexploitation of certain species, introduction of exotic species, and the pollution or toxification of the soil, water and atmosphere. All this has had major effects on South Africa's terrestrial, freshwater and marine biodiversity. As can be seen in figure 1, 3435 (15%) of South Africa's plant species, 102 (14%) of bird, 72 (24%) of reptile, 17 (18%) of amphibian, 90 (37%) of mammal, and 142 (22%) of butterfly species are listed as threatened in the *IUCN Red List of Threatened Species* (2000), which indicates the conservation status of threatened species and ecosystems.

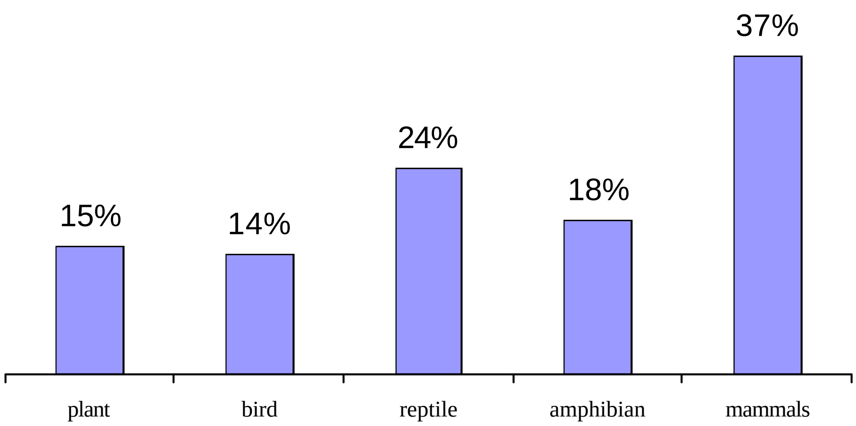

Figure 1: Percentage of threatened species in South Africa (White Paper on Biological Diversity, 1997)

One of the mammal species in the *IUCN Red List of Threatened Species* (2000) that is threatened and faces possible extinction is the Roan Antelope. This thesis will consequently focus specifically on the Roan Antelope. Their numbers have gradually declined from thousands since W. Cornwallis Harris first described them in 1837, but over the last twenty years, their numbers in the Kruger National Park have declined from 350 in 1983 to only 50 free ranging animals in 1993, as can be seen in figure 2. Although there was an increase of Roan Antelope population numbers in the Kruger National Park in 1986 (which was caused by possible over-counting by management) the reasons for the population decrease since 1982 is thought to have been caused by various changes in habitat. One of these changes was the building of more water holes in the Roan Antelope's preferred habitat within the Kruger Park. The increase in water holes attracted more competition such as zebra, and also more predators that were moving after the zebra. Today there are only 30 free ranging Roan Antelope left in the Kruger National Park. Other possible reasons for this decline could be habitat deterioration, encroachment by agricultural and human activity on the park, uncontrolled or illegal hunting, and anthrax. In figure 2 there was a sharp increase in population numbers in 1986. The reason for this was caused by possible over-counting by game rangers in the Kruger National Park.

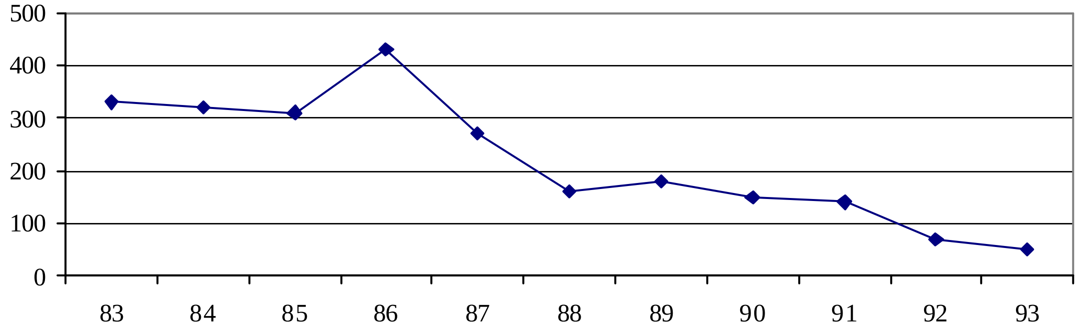

Figure 2: Observed decline of roan antelope numbers in the Kruger National Park (Harrington *et al.*, 1999)

The Roan Antelope is a mammal that is scientifically classified as the species *Hippotragus Equinus*. The Roan Antelope as a species is also further divided into six subspecies based on their geographic distribution (Ansell, 1971). One of these subspecies is believed to be endemic only to South Africa. Great confusion exists as to what the differences between these subspecies actually are and where they are supposed to occur.

The main aim of the study is therefore as follows:

- To establish the geographical range and perceived differences of the alleged Roan Antelope subspecies in order to determine whether any subspecies actually do occur ;
- To determine which subspecies, if any, would be endemic or exotic to South Africa;
- To establish what effect the cross boundary translocation and relocation of the different Roan Antelope subspecies have had on the biodiversity of South Africa's *endemic* Roan Antelope populations; and

- To determine the actual number, if possible, of *endemic* and *exotic* Roan Antelope in South Africa.

This study is important because the Department of Nature Conservation and Tourism in South Africa has placed a moratorium on the movement and sale of alleged *exotic* Roan Antelope subspecies imported by private breeders in order to conform to the Convention on Biological Diversity's guidelines to protect the alleged *endemic* Roan Antelope populations (Wessels, 2001). This has caused great financial loss to the private breeders of Roan Antelope in that they cannot sell their excess stock. There is, however, reason to believe that there is no such thing as a Roan Antelope subspecies. Should the Department of Nature Conservation and Tourism insist that Roan Antelope subspecies do exist, there is evidence to the contrary that suggests that the alleged *endemic* Roan Antelope populations in South Africa have been contaminated and crossbred with *exotic* Roan Antelope subspecies in the early 1970's and 1980's. If this is in fact the case then there is no pure endemic Roan Antelope left in South Africa. That will mean that the guidelines of the Convention on Biological Diversity to keep endemic Roan Antelope populations pure, should no longer be applicable to Roan Antelope in South Africa as there are no pure endemic Roan Antelope populations left in South Africa, and that the moratorium should be lifted to allow free trade.

2. STATEMENT OF THE PROBLEM.

This study relating to the Roan Antelope is important because the Department of Environmental Affairs and Tourism have placed a moratorium on the sale and movement of all Roan Antelope within South Africa, as well as the import of Roan Antelope from other countries into South Africa. This was done to protect the alleged *endemic* Roan Antelope subspecies from hybridising with other alleged *exotic* subspecies. This was a serious blow to the conservation of an animal whose numbers have seriously declined because of mismanagement and neglect by nature conservation authorities. The moratorium meant that private breeders of the Roan Antelope, who contributed the most to protecting and increasing the numbers of the species, could not successfully continue with their breeding programs. Nor could they buy or sell new stock to improve their herds. The statement of the problem thus revolves around two broad facets:

1. To determine whether or not there are Roan Antelope subspecies. This will be done by:

- Explaining how the historical geographical distribution of Roan Antelope were erroneously used to classify subspecies;
- Explaining the concept of species and subspecies with reference to Roan Antelope;
- Explaining and identifying how Roan Antelope were erroneously classified into subspecies according to their colour; and
- Describing the general characteristics and habitat of Roan Antelope in southern Africa.

2. To establish the purity of South Africa's alleged *endemic* Roan Antelope and how the Department of Environmental Affairs and Tourism's moratorium (based on the guidelines set out by the Convention on Biological Diversity) affects the sale and movement of Roan Antelope in South Africa.

This will be investigated by means of:

- Explaining how invasive or exotic species affects the biodiversity of South Africa's *endemic* Roan Antelope, as well as guidelines on how to protect South Africa's the alleged *endemic* Roan Antelope;
- Describing the different instances of roan antelope relocation from exotic to indigenous habitats and the effects this had on the purity of alleged *endemic* South African Roan Antelope;
- Determining the actual number of *endemic* and *exotic* Roan Antelope in South Africa; and
- Proposing recommendations for the effective management of Roan Antelope in South Africa.

3. Study area and general description of the Roan Antelope

3.1. Geographic location.

According to East (1998), the IUCN/SSC Antelope Specialist Group believes that, although their exact numbers are not known, the Roan Antelope still occur in the following countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, The Democratic Republic of the, Côte d'Ivoire, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Swaziland, Tanzania, United Republic of Togo, Uganda, Zambia, Zimbabwe.

3.2. Description of physical characteristics.

The name "roan" is derived from the colour roan, a grizzled mahogany, also seen in horses. Antelope is from *anthalops* (Greek) a horned animal, probably an antelope. Another possibility, and also possibly the stem of *anthalops*, is *anthos* (Greek) a flower and *ops* (Greek) the eye which seems to refer to the large, beautiful eyes of these ungulates (Buckley, 1876).

Figure 3: A juvenile Roan Antelope heifer

- **Colour**

As can be seen in figure 3, the upper body is grizzled grey to roan (reddish brown) in colour with the legs darker. The underparts are white. On the face there is a black/brown and white facial mask, slightly lighter in females, that consists of a white spot on either side of the eye and a white muzzle. On the neck and withers is an erect, dark-tipped mane, while a light 'beard' is present on the throat. A long tuft of dark hair is present on the tips of the ears. The arched, ringed horns are found in both sexes, though slightly smaller in females, and can grow 60-100 cm / 2-3.3 feet in length. (Parker, 1990)

- **Size**

Body length: 220-265 cm.

Shoulder height: 140-160 cm.

Tail length: 60-70 cm.

Weight: 225-300 kg (Stuart, 1996)

- **Reproduction**

The gestation period is 268-280 days and the give birth to one young. There does not appear to be a specific breeding season for the Roan Antelope. Females become sexually receptive within three weeks of giving birth, and are capable of reproducing every 10-10.5 months. A pregnant female will separate from her herd prior to giving birth, and remain with her new calf for about five days afterwards. After the female has rejoined the herd, the young calf remains concealed in tall grass for five more weeks, subsequently joining a 'creche' with other youngsters in the herd. (Kingdon, 1997)

- **Life Cycle**

Weaning: 4-6 months.

Sexual maturity: At 2.5-3 years.

Life span: Up to 17 years. (Stuart, 1996)

- **Habits**

Roan Antelope are usually most active in the morning, late afternoon, and evening. Roan Antelope are relatively unwary, running away from a potential source of danger for a short distance, and then stopping to look back. However, when pressured, they maintain a speed of about 60 km. per hour for considerable distances. If cornered, these antelope are formidable opponents, charging and brandishing their horns with skill. Roan Antelope never move far from water, and overall have localized movements, using 200-400 hectares at any given time, with a home range of no more than 10,000 hectares throughout the year. Neighbouring herds rarely share territory. Female herds are accompanied by a single adult male, who defends a wide swath (300-500 meters) around his herd against potential rivals. Young males are driven from their natal herds when they reach about 2.5 years of age. Fighting for dominance is prevalent among both males and females, with the most dominant initiating herd movements. Fights occur with both animals on their "knees" (carpal joints) and are almost exclusively horn against horn. (Hoskin and Withers, 1996). Roan Antelope appear in family groups of a single dominant male with 6-15 females and other sub-adult bulls, but rarely up to 35 animals. Adult males associate in bachelor herds of 2-5 animals. (Stuart, 1996)

3.3. Status of the Roan Antelope.

The roan antelope is classified as a low risk, conservation dependent species by the World Conservation Union, or IUCN (1996) and are placed on appendix 2 of CITES (Convention on International Trade in Endangered Species). Numbers have declined drastically in recent decades through habitat deterioration, agricultural encroachment, illegal hunting, and deliberate slaughter for tsetse fly control. They are highly vulnerable to Anthrax, which has caused population crashes in the Kruger National Park between 1983 and 1992 (Harrington *et al.*,1999). The exact numbers that were lost to Anthrax is not known, but is expected to be high.

3.4. Typical habitat

Open savanna woodland with extensive open areas of grassland with medium to tall grasses, where water is available. Joubert (1976) noted that they avoid woodland where the trees form a closed canopy or where the underbrush, from the level of 1.5 m to 4.0 m forms thick closed stands. They are tolerant of low bush growth up to 1.5 m in the grassland provided this forms an open scattered association and remains so and they avoid areas of short grass, the open stands of medium to tall grasses being an essential habitat requirement. As a result of these habitat requirements the distribution of the Roan Antelope is patchy and discontinuous. Their occurrence can within a short space of time be inhibited through factors such as bush encroachment or the over utilization of the grass (Joubert, 1976).

3. DATA AND METHODS.

This research is based largely on the investigation of existing literature relating to the Roan Antelope, dating back from 1820 up to the present, to emphasize and clarify the different reasons for subspecies classification. Through this literature study the confusion between the Roan Antelope and the Blue Buck, an antelope species of the same taxonomic family, also became apparent. Various governmental reports and permits, as well as the actual people involved, regarding the translocation and possible hybridization of the different Roan Antelope subspecies were consulted, and the effect this has had on the Roan Antelope biodiversity was investigated. An attempt was made by personal communication and electronic mail correspondence to obtain the Department of Environmental Affairs and Tourism's official statement regarding the purity of South Africa's *endemic* Roan Antelope subspecies, *Hippotragus equinus equinus*, but it was without success. Conservation biologists, Mrs. T. Carrol and Mrs. S. Meintjies from the Department of Environmental Affairs and Tourism, Mr G. Castley from the National Parks Board and Mrs. R. Grant from the Northern Plains Research Group of the Kruger National Park, as well as various private Roan Antelope breeders were contacted during the research period in 2002 to obtain data of the current Roan Antelope numbers and management strategies. Current data and publications of Roan Antelope DNA and Roan Antelope's geographical distribution were also consulted and is referred to in the text.

The Transvaal Museum was also contacted and various Roan Antelope skin and bone samples were found, dating back as early as 1906. These samples could be used to clarify historical subspecies distribution of Roan Antelope in South Africa by doing the same DNA tests that was done by Matthee and Robinson (1999) to determine their geographic origin. Comparing their DNA structures with that of living animals could show if there is a strong or weak geographic relationship. The actual DNA testing of the samples is beyond the scope of this study, but extensive and planned DNA testing needs to be done on museum samples as well as living Roan Antelope in order to obtain a better historical background on the distribution of the different Roan Antelope subspecies.

5. CONTROVERSY REGARDING THE SUBSPECIES OF THE ROAN ANTELOPE.

5.1. Introduction.

Roan Antelope, *Hippotragus equinus*, are still distributed widely throughout Africa (Skinner and Smithers 1990), but are found only in low densities. Today the status of Roan Antelope in South African reserves are listed as endangered by Skinner and Smithers (1990). There are three distinct species recognised under Hippotragus, of which one, *Hippotragus leucophaeus*, also known as the Blue Buck, became extinct in 1799 while the other two, the Sable Antelope and the Roan Antelope, are still well represented in Africa. According to Joubert (1976) the Blue Buck inhabited a restricted range in the south western and southern districts of the Cape Province, in South Africa. During the latter half of the eighteenth century the Blue Buck became uncommon and the last one was recorded towards the end of that century and thereby became the first recorded African mammal to become extinct.

There are various classifications of the Roan Antelope subspecies based on phenotypic and geographic characteristics, which caused confusion and contradictions. The first time the Roan Antelope was officially classified was by Desmarest in 1804 (Harris, 1852), and further classifications were made by Sclater and Thomas (1899), Sclater (1900), Dollman and Burlace (1922 & 1928), Dollman and Lydekker (1926), Shortridge (1934), Allen (1939), Hill and Carter (1941), Roberts (1951), Best *et al.* (1962, 1971), Ansell (1971), Smithers and Lebao-Tello (1976), Wilson and Hirst (1977), Dorst and Dandelot (1980), as well as Skinner and Smithers (1990).

Ansell (1971), who is also referred to by Skinner and Smithers (1990), listed six subspecies of *Hippotragus equinus* and his results are considered by many modern day taxonomists to be the best investigation into the taxonomic status of the alleged subspecies. The geographical distribution of the six subspecies can be seen in figure 4.

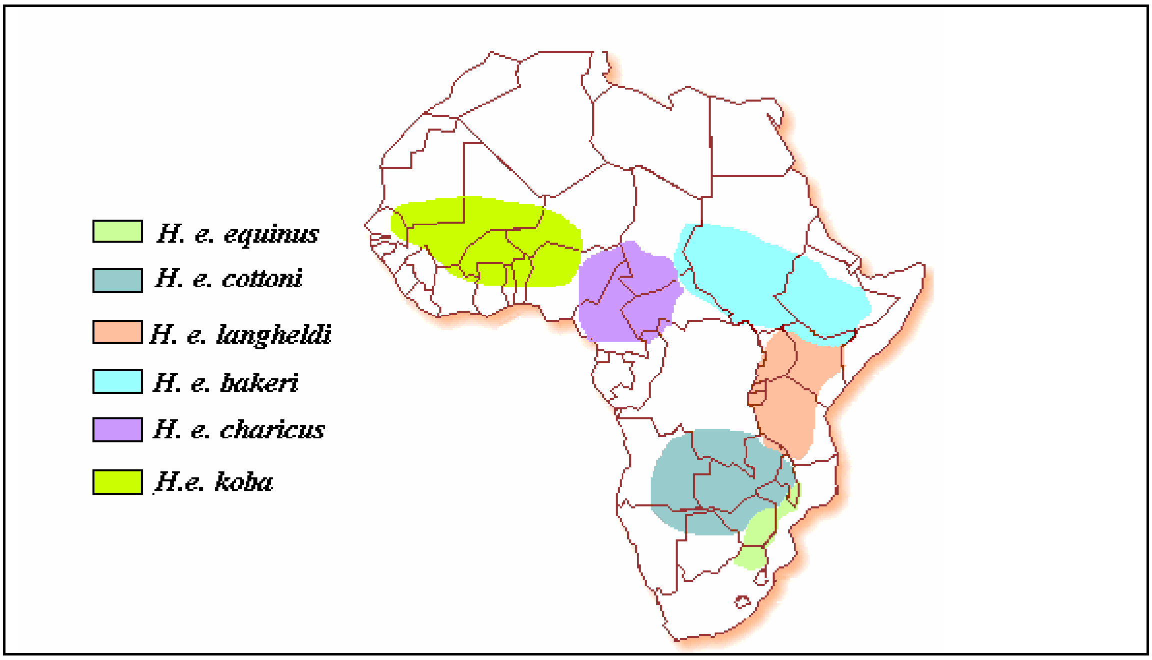

Figure 4: Distribution of Roan Antelope subspecies according to Ansell (1971).

Ansell (1971) lists the following six subspecies:

i) *Hippotragus equinus equinus* (Desmarest, 1804). This subspecies has also been referred to as *typicus* by Sclater and Thomas (1899). In historical times the Roan Antelope's range extended to the Orange River in the south but according to Ansell (1971) and Smithers (1983) it presently occurs from the Northern Province northwards through Zimbabwe and perhaps southern Malawi.

ii) *Hippotragus equinus cottoni* (Dolmann and Burlace, 1928.) According to Ansell (1971) they occur in Northern Botswana, Angola, southern Congo, Zambia and perhaps central and northern Malawi. Smithers (1983) said that they also occur in northeastern Namibia. Both Ansell and Smithers state that there are wide areas of integration between the subspecies *equinus* and *cottoni* and therefore no distinct limits between these two subspecies can be set. Subspecies (i) and (ii) have often been referred to as the 'southern race' of the Roan Antelope (Best *et al*, 1962)

iii) *Hippotragus equinus langheldi*. The typical East African form. Occurs in Tanzania, Rwanda, Burundi and southern Uganda. Also called *rufo-pallidus*.

iv) *Hippotragus equinus bakeri*. Their distribution includes northern Uganda, northeastern Congo, Ethiopia and Sudan.

v) *Hippotragus equinus sharicus*. Cameroun, western Chad and the Central African Republic and eastern Nigeria.

vi) *Hippotragus equinus koba*. The typical western forms of the Roan Antelope and extends from western Nigeria westwards to Senegal.

Grobler and Nel (1996) assessed genetic diversity in an isolated Roan Antelope (*Hippotragus equinus)* population at the Percy Fyfe Nature Reserve in the Limpopo Province, and found it to be very low, meaning that the individuals within the population genetically differ very little from each other. More recent studies regarding genetic diversity and subspecies classification have been undertaken by Matthee and Robinson (1999) where they did DNA tests on three individuals of the so-called *H. e. equinus* animals and six individuals of *H. e. cottoni* animals. These DNA tests relied entirely on the maternal lineages. The findings of this study by Matthee and Robinson (1999) were that in the case of roan antelope the mitochondrial DNA revealed significant structure among populations, meaning each population does to a certain extent have its own genetic identity that could distinguish them from other populations. The study by Matthee and Robinson (1999) thus confirmed that there is a difference between the subspecies *H. e. equines, endemic* to South Africa, and *H. e. cottoni,* which was believed to be *exotic* to South Africa. It was recognised that the sampling group was very small and the results needed strengthening with larger sample sizes, including samples from other roan subspecies as well as museum samples.

Alpers and Robinson (2001) greatly expanded their Roan Antelope sample database during March 2000 – March 2001 to include data from 175 individuals from 12 countries. Their research found that there was evidence pointing to two distinct different genetic groups of Roan Antelope, also called Evolutionarily Significant Units (ESUs) within the Roan Antelope subspecies, one in ‘West Africa’, and another for the ‘Rest of Africa’. In the ‘Rest of Africa’ ESU there is a possibility for different smaller genetic groups, also called Management Units (MUs). The concepts of ESUs and MUs will be discussed on page 23.The geographic distribution of the four different genetic groups can be seen in figure 5. Note that the distribution of these genetic groupings does not correlate with the alleged subspecies distribution as seen in figure 4.

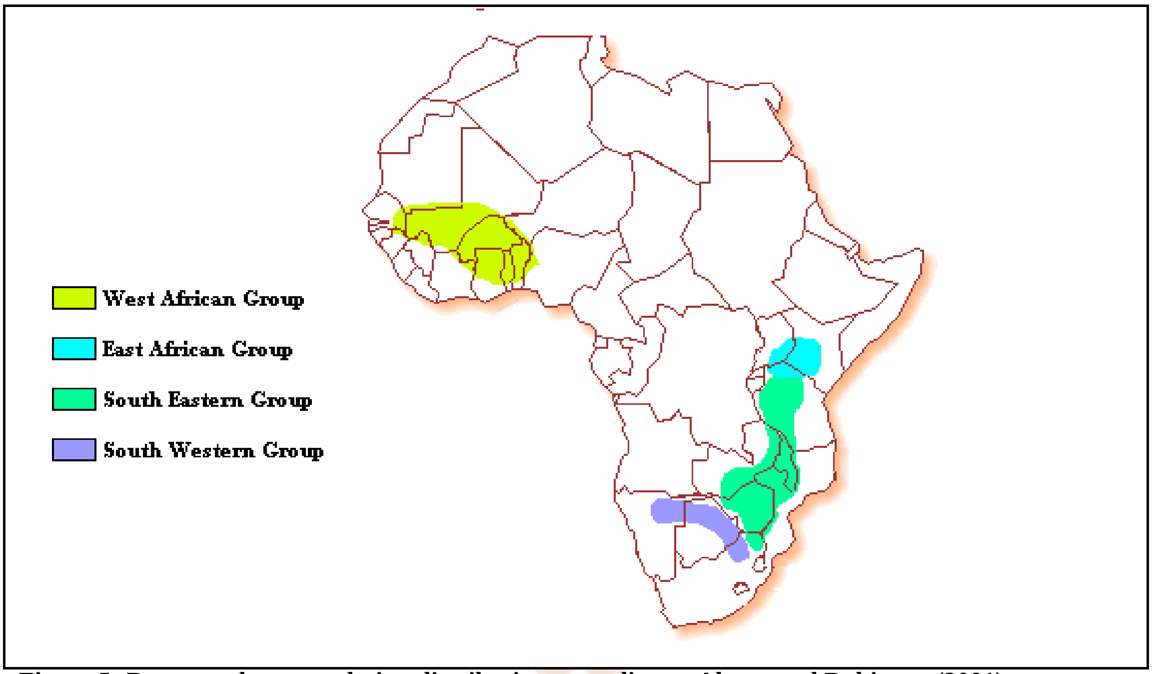

Figure 5: Roan antelope population distribution according to Alpers and Robinson (2001).

Extensive studies regarding the historical distribution of Roan Antelope were undertaken by Du Plessis (1969), Joubert (1976), Skead (1980), Klein (1987), Rookmaaker (1989) and various others, and the modern day status and social structures of the Roan Antelope were addressed by Joubert (1976) Wilson and Hirst (1977), Grobler and Nel (1996) and Harrington *et al.* (1999). Some of these authors often contradict each other with regards to the location of the various subspecies and the general appearance of the subspecies. From the foregoing it is evident that there is great confusion with regards to the different Roan Antelope subspecies – specifically what a subspecies is, where they occur and what it looks like. If there is no clear definition as to what the differences, if any, are between the different subspecies, it cannot be determined what effect translocations have had on the biodiversity of the South African *endemic* Roan Antelope.

5.2. The concept of 'species' and 'subspecies'.

Firstly the concepts of species and subspecies need to be defined in scientific terms. To resolve the issue of Roan Antelope subspecies and to make the Roan Antelope a component of conservation, it is firstly important to agree upon the basis for species and subspecies classification.

- **The biological species concept (BSC)**

Mayr (1940) proposed the Biological Species Concept (BSC) that defined a species as "a group of actually or potentially interbreeding populations that are reproductively isolated from other such groups" *(Mayr 1940, 1963).* Reproductive isolation, the primary component of the BSC, refers to the heritable tendency of distinct species to avoid gene flow or interbreeding even when they are brought into physical contact in nature. In clarifying this notion, Mayr *(1970)* noted that most species occupy distinct ecological niches, and that this ecological distinctiveness is the keystone of evolution. Although various alternative species concepts and criticisms have appeared, the BSC has survived the test of time and weathered the assault with its major components affirmed.

A major strength of the BSC is that it reflects the occurrence in natural situations of the irreversible process of speciation. It emphasizes reproductive isolation as the sole discriminator of species as whole entities, but acknowledges the occasional production of hybrid individuals, or even hybrid zones. There are numerous examples of stable hybrid zones that appear to be geographically balanced by selective disadvantages of hybrids vs. dispersal of individuals from the contact zone. The distinction here is that natural occurrences of hybrid individuals or hybrid zones between good species do not disintegrate the genetic integrity of the species as a whole, while hybridizations between subspecies normally produce gene flow and genetic mixing. Reproductive isolation in nature provides an effective protective device for well-integrated genotypes. Importantly, the BSC acknowledges the existence of appreciable genetic diversity within species that is often partitioned geographically (or temporally) by population subdivision into subspecies, ordinarily under conditions of geographical separation. Groups of such genetically distinguishable but still reproductively compatible races are subspecies that together would comprise a polytypic species (Paterson, 1985).

- **Genetic traits**

Classically, a subspecies has been defined as "a geographically defined aggregate of local populations which differ taxonomically from other subdivisions of the species" (Mayr 1940, 1963, 1970). More recently, Avise and Ball (1990) have argued that subspecies identification should be based on genetic traits. In an attempt to provide formal criteria for subspecies classification, O'Brien and Mayr (1991) suggest that members of a subspecies share:

1. A unique geographic range or habitat;
2. A group of phylogenetically concordant phenotypic characteristics that can be described; and
3. A unique natural history relative to other subdivisions of the species.

Because they are below the species level, different subspecies are reproductively compatible. Smith and Whyte (1954) state that when the word subspecies is used, it implies that the population has attained such a degree of recognizable differentiation as clearly to demonstrate the potentiality for speciation. Seymour (2002) states that a dual-concept approach is required to describe the subspecies. This reflects the practical, taxonomic approach and the more conceptual theoretical approach. The secondary concept must operationalise and apply the defined unit according to the patterns observed in nature.

The primary species concept is an evolutionary or ecological unit. Individuals experience novel environmental and ecological conditions and varying evolutionary pressures in different geographical regions, leading to phenotypic differentiation of conspecific populations. Hence, subspecies represent an isolated population that may be considered as an ecological or evolutionary unit within a species that shows initial signs of evolutionary divergence with the potential for full speciation (Seymour, 2002).

The secondary concept involves practical identification and is pattern based. This operational concept is that of taxonomic rank. The act of naming subspecies indicates discontinuities in the phenotype of the species across its range. This secondary concept is functional and simply reports the patterns in nature. Seymour (2002:45) then goes further, and in accordance with the dual nature of the subspecies concepts, and recognizing the requirement of geographical and phenotypic patterns, he defines the subspecies as:
" A phenotypically distinct, geographically restricted sub-unit of a species whose phenotypic variation derives from the effects of differential ecological and/or evolutionary processes"

- **Evolutionary Significant Units (ESU's)**

Matthee and Robinson (1999), Alpers and Robinson (2001) and Alpers *et al.* (2001) conducted research on the genetic variation among populations of Roan Antelope to see if there is indeed a genetic difference between the alleged Roan Antelope subspecies. The results indicated that Roan Antelope in Africa can be grouped into two groups, and that these two groups were historically isolated and independently evolving populations. The one group is found in West Africa, and the other group is found in the rest of Africa. According to the various inconsistent ways in which subspecies have been described, these two groups were described as two separate Evolutionary Significant Units, or ESU's.

Definitions of ESU's have changed over time. Ryder's (1986) definition is that an ESU is a population that actually represents significant adaptive variation based on concordance between sets of data derived by different techniques. Waples' (1991) definition is that a population that is reproductively separate from other populations and have unique or different adaptations can be classified as an ESU. Seymour (2002) says that the treatment of the ESU that has gained the greatest general acceptance is that of Moritz (1994), and that Moritz says " *the concept of an ESU seeks to identify and preserve diversity into the future, and that the only information we can glean is about the evolutionary past, by inferring the phylogenetic history*". Seymour (2002) further states that Moritz (1994) suggested that historical isolation, rather than current adaptation indicates a distinct potential in the future, and by Moritz's definition, an ESU is a historically isolated population or set of populations. Moritz states that this definition "*should be applied with common sense*."(Moritz, 1994:374)

Alpers *et al.* (2001) also said that within the 'Rest of Africa ESU', there is evidence of Management Units. Moritz (1994) describes the management unit (MU) as "*populations with significant divergence of allele frequencies at nuclear or mitochondrial loci, regardless of the phylogenetic distinctiveness of the alleles*" (p.374). It is suggested that such populations have diverged from their parent population, but only recently, so they have not had a chance to accumulate diagnostic character states. According to Seymour (2002), these populations essentially represent separate breeding units. As such they may possess the potential for independent evolutionary trajectories divergent from the parent population and so may be deserving of conservation protection.

The problem that arises here is that the concept of a subspecies was simply replaced with the concept of an ESU. There are thus now two different Roan Antelope subspecies, or ESU's. These subspecies or ESU's are then further divided into sub-subspecies, or MU's, further confusing the issue. Thus far a subspecies, or ESU, has been defined as a population of a species that has become geographically isolated or partitioned. Evolutionary pressures then led to recognisable phenotypic and genetic differentiation across its restricted geographic range. The problem with the Roan Antelope is that there are no geographic boundaries that could have restricted populations from mixing with each other. There is also no clear evidence that a certain subspecies only occurred in a certain geographic area or that there are clear recognizable phenotypic differentiation between the alleged six different subspecies or the two newly proposed ESUs and their management units. The confusion regarding what the alleged Roan Antelope subspecies looked like and where they occurred will be discussed next.

5.3. The erroneous classification of Roan Antelope subspecies according to their phenotypic qualities.

Naturalists have seen fit to separate the Roan Antelopes in different parts of Africa into different subspecies or varieties, based upon very slight local phenotypic variations (variation in colour, horn size etc.). It should be noted that even among Roan Antelope found in South Africa, great variation of colour can seen. It was believed by most early naturalists, that the colour of the alleged *endemic* Roan Antelope, or *H. e. equinus* is that of a greyish roan, and the colour of the alleged *exotic* Roan Antelope, *H. e. cottoni* is that of a rufous, or more reddish tint. The problem in the early 1900's was that accounts and records of the colour of the animal were that of personal opinion, and there were no other specimens from different geographical locations to compare them with. The specimens that were in museums could have differed from each other because different methods and chemicals were used to treat the skins, and these skins were on the back of wagons and boats for months on end before they reached the museums. Here are a few descriptions of the different Roan Antelope that were observed:

"the colour of the coat, which ranges from dark rufous in the west, through sandy or reddish-fawn in the east, to grizzled roan in the south" (Best *et al.*, 1962)

" there is the colour of the coat, which in the typical race is grizzled roan, although in the eastern race it becomes sandy or reddish fawn, while in the western race it is of decidedly dark red" (Dollman & Lydekker, 1926)

"Roan antelope differ considerably from one another in colour, some being of a light greyish or brownish shade, whilst others are reddish roan or dark grey. When standing in an open plain with the sun shining on them, they often look almost white, which accounts for the name White Sable Antelope by which they are known in many dialects"(F.C. Selous in Dollman & Lydekker, 1926)

Smith (1849) give a detailed description of the *Aigeceros Equina* and describes almost all the subspecies in one animal when he says, *"the body and extremities are rusty cream-yellow, the shoulders, back, buttock, and outer surface of limbs darkened with rusty reddish-orange; neck pale cream yellow, with strong greyish tint; throat yellowish white; the sides of the head, between the base of the horns and the angles of the lower jaw, together with the middle portion of the face and breast, chocolate red."*

"The western race (koba) has a pale brown general coloration. The East African race (langheldi) is pale rufous roan, while the southern race (equinus) is greyer. The Angolan race (cottoni) is characterized by a rich rufous ground colour". (Dorst & Dandelot, 1970)

" Upper side of body grey (H. e. equinus), fallow brown to umber (H. e. bakeri), pale brownish red (H. e. langheldi), yellowish-brown (H. e. koba), or ochreous-red (H. e. charicus) (Haltenhorth & Diller, 1977)

"Colour a grizzled pale or fawn brown, rather like what is sometimes known as roan chestnut (almost a strawberry roan) in horses" (Haagner, 1920)

"Ozanna equina equina: General colour light reddish brown (strawberry colour) on a pale whitish ground. Ozanna equina cottoni: General colour of upper parts near cinnamon rufous. Three specimens from the Pungwe River in Portuguese East Africa (Mozambique) *are slightly paler and duller in colour than the Ngamiland* (Botswana) *specimens, but otherwise much the same. The examples from Ngamiland* (Botswana) *are slightly paler than those from Angola, but resemble the latter more than they do the descriptions of the typical form".* (Roberts, 1951)

"The body colour is greyish-brown, tinged with strawberry, which is more pronounced in some individuals than in others. The West African subspecies is distinctly reddish" (Skinner & Smithers, 1990).

Bryden (1936) stated that too much importance has been attached by naturalists to colour variation in naming subspecies and he claims to have examined all the Roan Antelope specimens in the Natural History Museum of London, as well as all specimens known at that time from *H. e. typicus, H. e. langheldi, H. e. bakeri, H. e. gambianus*, and *H. e. sharicus*, and came to the conclusion that: *"After the examination of all these skins and specimens there is but one roan antelope all over Africa. The species varies greatly in hue even in the same localities, and although scientists may choose to create races or subspecies, the differences upon which these are founded are in reality not always sufficiently marked to justify such separation"*. (Bryden, 1936:47)

Bryden (1936:54) further states that in a letter from Captain Stephenson of the Egyptian Army to W. L. Sclater, a person by the name of Stephenson says *" I quite agree with Bryden that there is but one roan all over Africa, although I can only speak from those I've seen shot in various parts of the Sudan"*.

Sclater and Thomas (1900:36) state the following regarding colour differences. *"It is a well known and generally accepted fact amongst naturalists that animals which have a wide distribution have also a special tendency to vary, and that if specimens of them from different parts of their ranges are compared, such specimens are usually found not to agree exactly, but to be distinguishable by differential characters more or less evident. When these characters are easily observable and definable their possessors are usually referred to different species, which are supposed to "represent" one another in their respective areas, and are hence often called representative species".*

They further say that *"when the distinguishing characters are slight and less easily recognizable it has recently become the practice, especially among American naturalists, to designate their possessors as 'subspecies', and, in order to indicate this, to add a third sub specific name to the ordinary generic and specific terms"*. They then state that the Roan Antelope is one of these cases. Roan Antelope are found all over Africa, and specimens from all the countries present a very general resemblance, and during that time, all the Roan Antelope were considered by most authorities to be identical. They suggest that all Roan Antelope in the different districts of Africa, in order not to complicate things, be considered only of sub specific rank, and to class them all under the specific head as *Hippotragus equinus*. (Sclater & Thomas, 1900)

It can be seen that subspecies were arbitrarily assigned to general geographical areas and according to the taxonomist interpretation of the colour of the animal. Any arbitrary rule is open for criticism simply due to its arbitrary nature. Lidicker, in Berry and Southern (1970:317) concluded that the "*ability to prove that two populations are statistically different is only a measure of the persistence and patience of the systemetist*", and that the use of the subspecies category for description of geographical variation in a few characters, or as a way of cataloguing geographical variants, means that nothing more than "*artificial classifications of convenience*" will be produced.

The statistical properties of population samples of Roan Antelope will vary according to the size of the sample taken, i.e. how many samples were at the disposal of the taxonomist, and population sampling biases (potentially exacerbated with smaller sample sizes). The adoption of any such arbitrary criterion as an absolute indication of the sub specific status of a population is fallacious. Such a criterion can be indicative and, while a failure to meet the required threshold can be used to deny subspecies status to a population, the attainment of that criterion should not automatically result in the description of subspecies. As can be seen in table 2, different taxonomists assigned various Roan Antelope to a subspecies according to their colour. Dorst and Dandelot (1970) and Roberts (1951), claims that *H. e. equinus* and *H. e. cottoni* look different from each other, while the rest of the taxonomists in table 2 claims that these two subspecies look the same, and thus classified them as one subspecies instead of two.

There are many other factors that a taxonomist must take into consideration before describing subspecies. Beyond the extent of overlap, other factors include the biologically interpretability of the character complexes used to separate the populations, the geographic distribution of the individuals causing overlap (are the phenotypically overlapping individuals in hybrid zones or showing gradual, clinical variation, or truly homogeneous within each population?) and the demographic structure of the populations compared (is there an age or gender effect between the different populations causing bias). (Seymour, 2002)

Table 2: Different colours assigned to the different Roan Antelope subspecies.

	Southern Roan Antelope		**Eastern Roan Antelope**			**Western Roan**
Authors:	**H.e. equinus**	**H.e. cottoni**	**H.e.langheldi**	**H.e. bakeri**	**H.e charicus**	**H.e. koba**
Smith, 1849	Are rusty cream-yellow, the shoulders, back, buttock, and outer surface of limbs darkened with rusty reddish-orange					
Haagner, 1920	Grizzled pale or fawn brown, what is sometimes known as roan chestnut (almost a strawberry roan)		Reddish fawn			Dark rufous
Dollman & Lydekker, 1926	Grizzled Roan Antelope					
Roberts, 1951	Light reddish brown (strawberry)	Cinnamon rufous				
Best *et al*.,1962	Grizzled Roan Antelope		Sandy or reddish fawn			Dark red
Dorst & Dandelot, 1970	Grey	Rich rufous	Pale rufous			Pale brown
Haltenhorth & Diller, 1977	Grey		Pale brownish red	Brown to umber	Ochreous-red	Yellowish brown
Skinner & Smithers, 1990	Greyish-brown, tinged with strawberry, which is more pronounced in some individuals than in others					Reddish

Widespread species, like the Roan Antelope contain phenotypic variation, some of which are geographically structured. This variation may be thought of as representing different levels in the process of speciation. The decision to describe subspecies must be taken based on the greatest quantity of available information from all sources.

A good example of erroneous classification is the Angolan Roan Antelope. The Angolan Roan Antelope was classified as the subspecies *H. e. cottoni*, (named after Major Powell Cotton who shot the specimen) on the grounds of its rufous tint (Dollman & Burlace, 1928). Bryden (1899) and Sclater and Thomas (1900) both saw roan shot in Angola, and both say they are identical to the Roan Antelope of South Africa, or *H. e. equinus*. In all the editions of *Rowland Ward's Records of Big Game,* previous to 1928, all classified the Roan Antelope shot in Angola as *H. e. equinus* and nobody mentioned any difference between the Roan Antelope in Angola and the rest of Southern Africa. One would assume that all the animals that were shot and mentioned in the records, would have been examined by people in the know, in order to verify the measurements for the record, yet no differences were noted. The subspecies *H. e. cottoni* was thus classified according to one animal shot in Angola.

By their nature, subspecies are not necessarily directly comparable units. It is the species level that represents the fundamental, objectively definable taxonomic unit. Subspecies are hypothesis that summarise observed patterns of phenotypic variation. The description of subspecies comes from the recognition of geographically structured patterns in representative specimens. These patterns can only be recognised *a posteriori* from the empirical results of analysed data. It is not defensible to prescribe, *a priori*, a level of 'difference'. The only valid, defensible criterion that may be asserted before analysis is that the variation discovered must be geographically consistent within an empirically determined tolerance. The differences found should then translate to biologically interpretable characters. A subspecies is completely and adequately defined by two factors; the description of geographically structured phenotypic variation within the species and the delineation of discrete geographic ranges demarcating the boundaries of the subspecies. In practice, the valid description of a subspecies representing consistent, geographically structured variation within species based on consideration of the available data and careful analysis, is sufficient to propose the recognition of a subspecies (O'Brian & Mayr, 1991). Acceptance of these observations, and their justification, by the proposer's peers leads to common usage of the new taxon.

As stated above, the example of mistaken classification of subspecies according to their phenotypic appearance (their colour) is the Angolan Roan Antelope. This one specimen was used by Dollman and Burlace (1928) to classify the subspecies *H. e. cottoni*. There were no geographic boundaries that could have kept the Angolan Roan Antelope, or *H. e. cottoni*, apart from the Roan Antelope in South Africa and Namibia, which were classified as *H. e. equinus*. The mistaken classification of *H. e. cottoni* as a subspecies on the grounds of its rich rufous colour, can best be summed up as follows:

"In colour they may be a blue or red roan; this coloration varies considerably in different localities, though one or the other mainly predominates. In the same herd I have seen animals marked in both shades, and I think the blue or greyish tint is usually found in the oldest animals. Certainly most of the younger beasts are a strawberry or reddish colour, so that the variation may be due to age" (Lyell, in Shortridge, 1934:78).
"The roan antelope is found also in Angola on the west coast, where Mr. G. W. Penrice has shot specimens which I has the pleasure of examining. These are practically identical with the roan antelope of South Africa" (Breyden, 1899).

On the grounds of various interpretations made by naturalists regarding colour differences, the conclusion can be made that the Roan Antelope shot in Angola, that was used as the type specimen to identify the subspecies *H. e. cottoni*, was erroneous. There are but two accounts where the Roan Antelope in Angola is described as being more reddish brown or as having a rufous tint. If indeed there was a colour difference, it could have been because of the time of year, or the age of the animal that was shot. Lydekker, in *Game Animals of Africa* (1926), writes of the western race of the Roan Antelope that it's redness is, however, more marked in young than in old specimens, the latter being pale tawny. Further genetic studies (Alpers & Robinson, 2001) also proved that there was no difference between the Angolan Roan Antelope race and the South African Roan Antelope race. The erroneous classification of Roan Antelope subspecies according to their geographic distribution will be discussed in the next chapter.

6. THE HISTORICAL DISTRIBUTION OF ROAN ANTELOPE IN SOUTHERN AFRICA AND THEIR ERRONEOUS SUBSPECIES CLASSIFICATION

" The difference between the truth and a lie is so small, it is a matter of confusion" (Anon)

Extensive research has been done on the distribution of the Roan Antelope (*Hippotragus equinus*) and the Blue Buck (*Hippotragus leucophaeus*) in Africa and Southern Africa by Shortridge (1934); Du Plessis (1969); Klein (1974); Joubert (1976), Skead (1986); and Penzhorn (1996), to name a few. There was great confusion with the early explorers and hunters as to where Roan Antelope occurred, especially how far the southern range extended, as well as the difference between the Roan Antelope and the Blue Buck. This was due to the fact that the early hunters had never seen these animals before, and they had to rely on the local people for the names of these antelope, who possibly also saw them for the first time.

All the historical records state that the Roan Antelope's most southern distribution was the Orange River, and Skead (1986) says that Gordon Cumming holds the record of the most southerly Roan Antelope sighting yet at the Vaal River and Riet River confluence in 1844. (Skead, 1986). Sclater (1900) is adamant that "*there is no evidence that this species (Roan Antelope) ever extended south of the Orange River*". Buckley (1876) speculated on the possibility that the Kalahari Desert formed the south-western limits in the Roan Antelope's distribution. North of the Orange River the Roan Antelope's range of distribution covered most of Griqualand West and the adjoining areas of southern Botswana (Sclater, 1900). Further mention of the occurrence of Roan Antelope in Griqualand West is made by Cumming (1850) and Bryden (1899). According to Joubert (1976), in historic times the Roan Antelope was also known to occur extensively over most of the western, northern and eastern areas of the Transvaal. The first record of this species in the Transvaal is by Smith in 1835 (according to Kirby, 1940 in Du Plessis 1969) where he found the antelope at the confluence of the Little and Great Marico rivers in the western Transvaal. Harris (1852:21) also mentioned that Roan Antelope "inhabits the elevated ridges near the source of the Vaal and Limpopo Rivers". Kirby (1846) said that Roan Antelope still occurred along the foothills of the Drakensberg Mountain Range in the vicinity of Mariepskop along the upper reaches of the Timbavati River and along the Olifants River.

The furthest southeastern extension of the distribution of the Roan Antelope seems by Joubert (1976) to have been Swaziland. Bryden (1899), Sclater (1900) and Bryden (1936) also refer to their occurrence in Swaziland although no indication of their distribution within the area was given. The impression gained from the references of the pioneer travellers and hunters is that the Roan Antelope was never abundant in South Africa, but nevertheless was well distributed. Buckley (1876) referred to it as probably the rarest of the genus and that it appears nowhere to be common.

According to Shortridge (1934) the Roan Antelope was first recognised as a newly found antelope by Truter and Somerville who saw a Roan Antelope in the neighbourhood of the Kuruman River in 1801, and named it the Tackhaitse, phonetically the Roan's North Sotho name. The animal was only observed from a distance, and it was here that confusion between the Roan Antelope and the Blue Buck set in. Samuel Daniell was the artist and secretary to the expedition, and he sketched the animal, as can be seen in figure 6, with a long pointed goatee beard, a horse-like main and a pointed tale on a blue-grey body.

Figure 6: Daniell's sketch of the Tackhaitse (Rookmaaker, 1989)

He was obviously influenced by early travellers' descriptions, such as the first European to record the Blue Buck, Peter Kolb, a German who travelled extensively through the southwestern and southern Cape Province between 1705 and 1712. He mistook the Blue Buck for a kind of wild goat, and he even portrayed it with a goat-like beard, which it certainly did not have (Klein, 1974). It would appear that the natives were just as confused as to what the difference between the Roan Antelope and the Blue Buck were.

The Blue Buck *Hippotragus leucophaeus* or Blue Antelope was the first recorded African mammal to become extinct. Its range was already extremely small when the species was first seen by Europeans who settled in the Cape Colony in the 17th and 18th century. Here, in the lush and green southern tip of Africa, this graceful antelope lived in well-watered, grassy country. At the time, it was probably restricted to the area south of Swellendam. The German Peter Kolb in 1719 was the first to write about the existence of a "B*lue Buck*" and as early as 1774 the Swedish naturalist Carl Peter Thunberg noted that these animals were becoming rare. According to the German zoologist Martin Lichtenstein, the last Blue Buck was killed in 1799 (Klein, 1987).

In 1775 a Swedish zoologist by the name of Sparrman, saw a skin of the Blue Buck in the Langkloof, said that the hairs on the belly were long and white, and that the colour of the creature when alive was blue velvet, but when dead it is of a lead colour (Klein, 1974). According to Klein (1974), Pallas made the scientific description of the Blue Buck in 1766 based on museum specimens, and it was believed that its range was limited to the Swellendam area in the southwest Cape. The Blue Buck was 1.0 to 1.2m high with a faint blue inkling to gray colour. The dull whitish under parts did not contrast with the colour of the flanks. The face lacked the tuft of black hair seen in Roan Antelope. It had narrow pointed ears and the horns swept back in an even curve from the top of the head, but it was of a much lighter build than the Roan Antelope (Klein, 1974).

In 1778 Robert Jacob Gordon accompanied Governor van Plettenberg on a journey along the Cape south coast. On this journey the governor named Bahia Formosa "Plettenberg

Bay" after himself, and the name still remains. At that spot Gordon shot a Roan Antelope (figure 7) and wrote that he thought that this animal was a cross between a Blue Buck and the 'Cape gemsbok', and that its likes has not been seen within a circumference of 200 hours. He later confirmed from the Hottentots that this animal was not a hybrid, but a Roan Antelope, usually occurring along the Orange River.

Figure 7: The Roan Antelope shot by Gordon at Plettenberg Bay in 1778, described by Gordon in Rookmaaker (1989) as "*an unknown gazelle, possibly a hybrid …It is strange that this animal was the only one of it's species to stray some 300 hours from it's country. It was found by me in the forests of Plettenberg Bay*"

Gordon also shot a so-called Cape Gemsbok (figure 8) and describes it in Rookmaaker (1989) as *"Cape gemsbok. This animal is called the Pasan by mistake, and also erroneously gemsbok, as it is much larger than those smaller animals"*. From figure 8 it can be seen why Gordon thought the Roan Antelope he shot was a hybrid between the Blue Buck (figure 10) and the Cape gemsbok, for the Cape gemsbok had similar facial markings, tail, main and build as the Roan Antelope he had shot, but it had straight horns. The Blue Buck had curved horns. From Gordon's description it is clear that he had previously seen a normal gemsbok, a Cape gemsbok and the Blue Buck, and he would have known if he had mistaken the Roan Antelope he shot at Plettenberg Bay for any of these animals. His uncertainty about the animal he had shot at Plettenberg Bay was because he had never seen a Roan Antelope before. Although the range of the Roan Antelope was unsure at the time of Gordon's expedition in 1778, his account gives evidence that the Roan Antelope did occur in the Cape Province and it lived in the same geographic range as the Blue Buck.

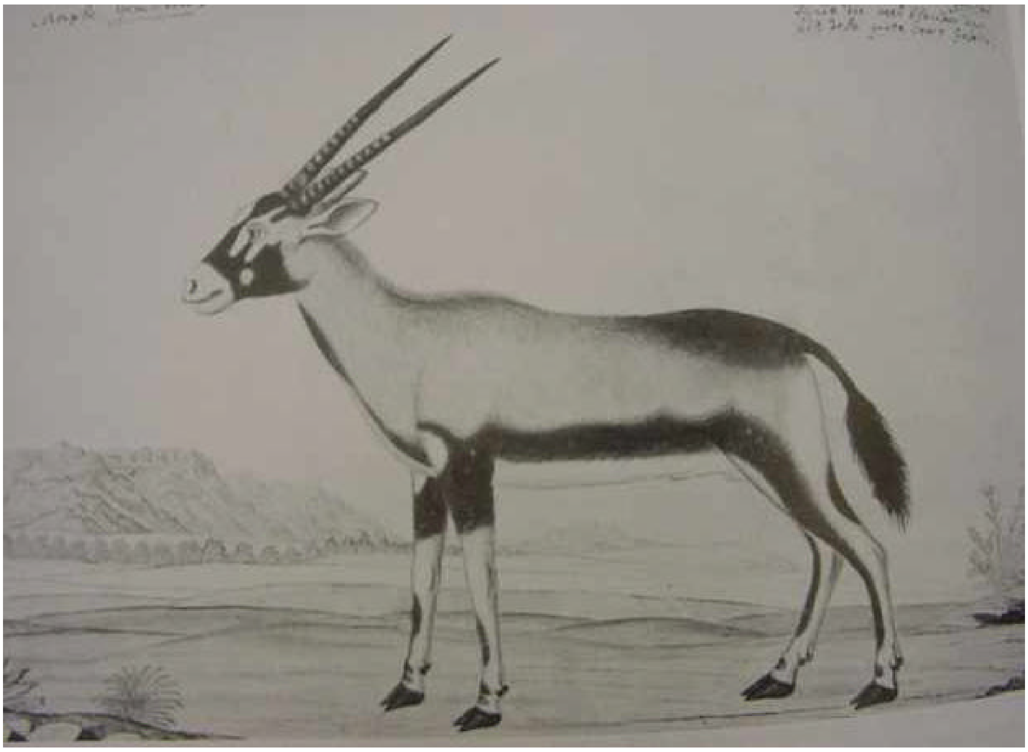

Figure 8: Gordon's Cape Gemsbok (Rookmaaker, 1989)

Early hunters sent some skulls and skins of the Blue Buck back to museums in Vienna, Stockholm, Paris, and Leiden (figure 9). These specimens reveal a creature that resembled both the Roan Antelope and the Sable Antelope in basic horn shape and body form, though it lacked their conspicuous manes. It was also much smaller than the Roan and Sable Antelope. Maybe the Roan Antelope was erroneously called the Blue Buck because of the eighteenth century travelers' contradictory descriptions of the Blue Buck, perhaps because some were embellishing, while others had not actually seen it and were simply repeating hearsay, as can be seen in figures 10 and 11. In figure 10 the Blue Buck is described with a mane on the neck, a characteristic the Blue Buck did not have.

Figure 9: Blue Buck specimen in the Leiden Museum

Figure 10: A Roan Antelope erroneously called a Blue Buck in Rookmaaker (1989), Africana Museum 61/1248. Named the "Blauwe bok". The description is: "*This is the name of this kind of bock in Africa at the Cape of Good Hope. Its skin is blueish, with a mane on the neck, two curved horns… it's height from the ground to the head is almost four feet*".

Figure 11: Blue Buck (*Hippotragus leucophaeus*) by Gordon "*This is the Blue Buck of the Cape*" (Rookmaaker, 1989)

In the 1780's Francois Le Vaillant, a French traveler visited the Cape and shot a Blue Buck (figure 12) in the "*valley of the Soete-Melk*" near Riviersonderend. He said that he first mistook it for a white horse, but when he saw the horns he realised his mistake. Selous, in Dollman and Lydekker (1926) said about the Roan Antelope that: "*when standing in an open plain with the sun shining upon them, they often look almost white, which accounts for the name of white sable antelope by which they are known in many dialects.*"

This specimen (figure 12) was then sent to the Museum of Paris where Smith (1849) studied it further and came to the conclusion that the Roan and Sable antelopes were the only species of this group in South Africa, and the he believed the Blue Buck to be a fictitious species constituted on poor descriptions of the Roan Antelope. He said that he had no difficulty in coming to the conclusion that the Blue Buck specimen in the Paris Museum (figure 13) was a young Roan Antelope male. Others like Millais (1895), as cited by Bryden (1899) said about the Paris Museum specimen (figure13) that it is a genuine Blue Buck, and he is backed up by Fitzsimons (1925).

Figure 12: Blue Buck shot and sketched by La Vaillant (Rookmaaker, 1989)

Figure 13: The Blue Buck in the Paris Museum, believed by Smith (1849) to be a Roan Antelope male.

Bryden, (1899) states that La Vaillant's (1796) accounts are not always to be trusted and that he had been convicted of faking bird skins in a most outrageous manner just to get his name in books, and his accounts of adventure and hunting were stoutly denied and laughed at by his Dutch contemporaries at the Cape. The question can thus be asked: Is the Paris Museum specimen a Roan Antelope mistaken for a Blue Buck? The mounted specimens are precious for documenting basic body form and size, but they do little else

Figure 14: Blue Buck (Hippotragus leucophaeus) according to Sclater and Thomas (1899).

Figure 15: Roan Antelope (*Hippotragus equinus*) according to Sclater and Thomas (1899).

to supplement the often inadequate and inconsistent early travelers' accounts. Other descriptions of the Blue Buck (fig. 14) and the Roan Antelope (figure15) were also made by Sclater and Thomas (1899) and although there is a difference between the two antelope, the characteristics are generally the same.

The conclusion one can derive from this brief mentioning of historical records is that the Roan Antelope range did in fact stretch to the Cape south coast, and if the historical records are interpreted it can be noted that there was a time when the Blue Buck and Roan Antelope ranges overlapped (figure16). This proves that they could have indeed been mistaken for each other. The question still remains as to whether in fact there were two separate species, or was the Blue Buck perhaps a subspecies of the Roan Antelope? Perhaps the Blue Buck did not become extinct, it was merely the Roan Antelope that retreated to a more northerly habitat. If on the other hand the Blue Buck did exist, and became extinct, the reasons for this must have been similar to cause the Roan Antelope to retreat to a more northerly habitat, because they existed in the same geographical area. If one can identify the causes of extinction for the Blue Buck, the same causes could possibly be identified that today could threaten the Roan Antelope's existence.

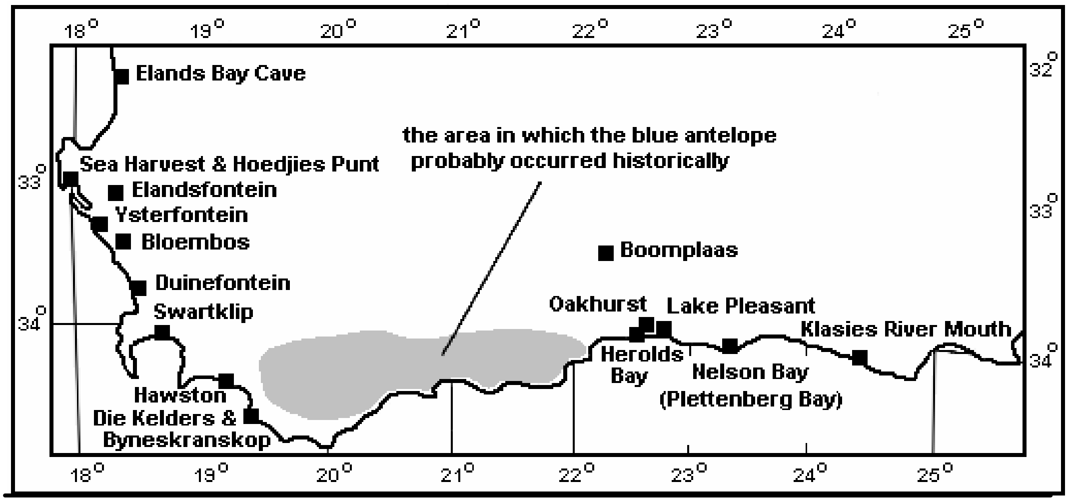

Figure 16:The approximate locations of the fossil sites where Blue Buck has been found. Note that two of the sites (Oakhurst and Nelson Bay Cave) also contain fossils of roan antelope. (Klein, 1987)

Klein (1987) provides persuasive arguments for the disappearance of the Blue Buck and the shrinkage of the Roan Antelope's range that might provide future conservationists with management tools or warnings for future Roan Antelope survival. Klein (1987) says that the animals that accompany the Blue Buck in fossil sites may provide answers and further insight into this question. Wherever the Blue Buck was especially common, the associated species usually included Black Wildebeest, Springbok, Southern Reedbuck, Quagga, White Rhinoceros, and other grazing ungulates like the Roan Antelope that were rare or unknown in the southwestern and southern Cape in previous times. They could have thrived only if the regional vegetation was richer in grass and poorer in bush and fynbos.

What then is the explanation for the extinction of the Blue Buck? Klein (1987) states that archaeological sites on the southern Cape coast may provide a clue. At least, tentatively, they suggest that Blue Buck numbers dropped about 2,000 years ago, at roughly the same time that domestic sheep and perhaps cattle were first introduced to the southern and southwestern Cape. Prior to this time, the indigenous people lived entirely by hunting and gathering. Afterwards, they probably combined hunting and gathering with herding. The Blue Buck may have suffered from veld degradation initiated by stock grazing or from being hunted by the herders because they competed with stock. Perhaps, like the Roan Antelope, they were also unusually susceptible to some of the epizootic diseases that stock carry. The decline of the Roan Antelope in nature reserves could be ascribed to similar events, such as:

(a) A general deterioration in habitat conditions;
(b) Interspecific grazing competition (Wildebeest and Zebra numbers have increased);
(c) Increased predation relating to increased Zebra and Wildebeest numbers in areas where the Roan Antelope populations are concentrated; and
(d) Minor localised anthrax outbreaks (Harrington *et al.*,1998)

In any case, if the 2,000 year date of blue antelope decline is confirmed at more archaeological sites, it would suggest that local Stone Age people, not climate, brought the species to the verge of extinction. Firearms, poaching and the degradation of natural habitat, as can be seen in the case of the Roan Antelope in the Kruger National Park (figure 17), can steer the Roan Antelope in the same direction as the Blue Buck.

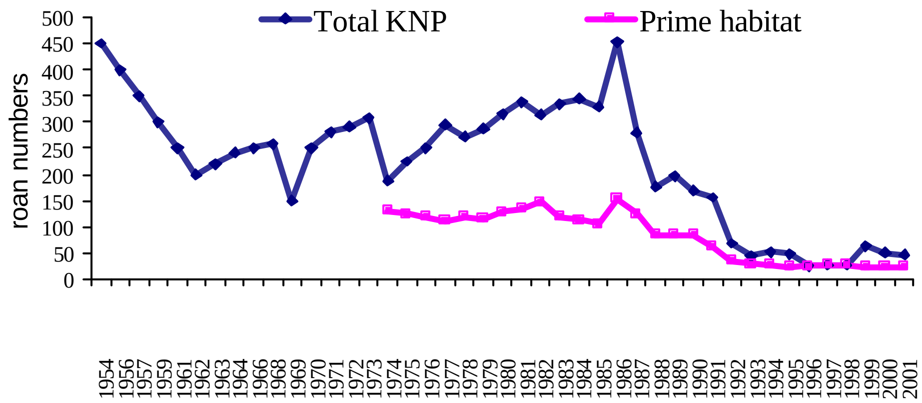

Figure 17: Decline of Kruger National Park Roan Antelope numbers caused by prime habitat change and destruction (Harrington *et al.*,1999).

When European hunters came to South Africa they were eager to explore and establish their mark on the unknown continent. In those days it was very popular to publish books of hunting trips and travels around Africa. With this came the quest to identify as many as previously unknown specimens as possible, and to send them back to museums where they were taxonomically classified. The classification did not always take place according to what the specimens looked like, but as to where the specimens were found, i.e. their geographic area. This caused great and unnecessary divisions between species and subspecies without any scientific evidence. Ansell (1972:76) addresses the question of taxonomic classification as follows: *" There are a number of doubtful records, which may be due either to faulty or speculative field identification, or to ambiguity or outright error in the localities attributed to certain museum specimens. In the early days of zoological collecting in Africa, specimens were often poorly labelled, and in some cases the station at which the collector was based, or even the port of shipment, has subsequently been assumed to be the locality where the specimen was obtained".*

With the following taxonomic classifications of the alleged Roan Antelope subspecies, it can be seen that different Roan Antelope subspecies were assigned to the same geographical area, but on the other hand individuals from the same Roan Antelope subspecies were also assigned to different geographical areas (table 3). All of the alleged Roan Antelope subspecies in Africa identified will be addressed. Examples will also be given regarding the erroneous classification of the two southern most subspecies, *H. e. equines*, believed to be *endemic* to South Africa, and *H. e. cottoni*, believed to be *exotic* to South Africa. The reason why the subspecies *H. e. cottoni* is referred to is because the majority of Roan Antelope that were imported into South Africa are alleged *H. e. cottoni* subspecies, or were captured in the geographic area of the *H.e. cottoni*. The following is a chronological account of the Roan Antelope subspecies classification according to their geographic locations:

Sclater and Thomas (1899) classified the Roan Antelope into four subspecies; *H. e. typicus*, or the Southern species, *H. e. rufo-pallidus* from German and British East Africa, *H. e. Bakeri* from North East Africa, and *H. e. gambianus* or *koba* from West Africa. They also state that specimens taken from the interior of Angola in 1892 at the location of Mossamedes by Prof. J.V. Barboza du Bocage is the same as the typical South African form *H. e. typicus*

Sclater (1900) found *H. e. typicus* from South Africa, *H. e. rufopallidus* from German and British East Africa, *H. e. bakeri* from the upper Nile Valley, and *H. e. gambianus* from West Africa

Dollman and Burlace (1922) noted *H. e. typicus* from the whole of Rhodesia (now Zimbabwe), South Africa, Angola, Nyassaland (now Malawi), Matabeleland and the Okavango Valley, *H. e. langheldi* from East Africa, *H. e. bakeri* from Sudan, and *H. e. gambianus* from West Africa.

Dollman and Lydekker (1926) recorded *H. e. equinus* as the typical roan of South and South Central Africa, described from some part of South Africa north of the Orange River; the range extends up to and across the Zambezi as far as Northern Rhodesia

(Zambia) and Nyasaland (Malawi), and westward to Angola. They further describe *H. e. langheldi*, from East Africa, *H. e. bakeri* from Sudan, *H. e. gambianus (koba)* from Gambia and *H. e. sharicus* from Nigeria

Up until 1928 there was only one Southern subspecies identified, namely the *H. e. typicus* or the *H. e. equinus.* It was only in 1928 when Dollman and Burlace published the ninth edition of *Rowland Ward's Records of Big Game* that the subspecies *H. e. cottoni* emerged from a specimen shot next to the Cuanza River in Angola by Major Powell-Cotton. In all the previous classifications and publications the Roan Antelope in Angola was classified as *H. e. typicus* or *H. e. equinus.* What made this species different was a rich rufous colouring, or reddish brown tint of the coat of the specimen shot. The mistake of using colour differences for subspecies classifications was discussed earlier. Since we are only interested in the South African subspecies *H. e. equinus*, and the imported exotic subspecies *H. e. cottoni*, only the history and classification of *H. e. equinus* and *H. e. cottoni* will be discussed further.

Table 3: Southern Roan Antelope subspecies classifications for different geographical areas.

Authors	South Africa	Angola	Namibia	Northern Botswana	North Eastern Zimbabwe	Zimbabwe	Mozambique	Central Malawi	Southern Malawi	Northern Malawi	Zambia
Sclater & Thomas, 1899	Typicus	Typicus									
Sclater, 1900	Typicus										
Dollman & Burlace, 1922	Typicus	Typicus		Typicus		Typicus		Typicus			
Dollman & Lydekker, 1926	Equinus	Equines				Equinus		Equinus			
Dollman & Burlace, 1928	Equinus	Cottoni		Equinus		Equinus		Equinus			Equinus
Shortridge, 1934	Equinus	Cottoni									
Ellerman & Allen, 1939	Equinus	Cottoni		Cottoni		Cottoni Equinus	Cottoni				
Hill & Carter,1941		Cottoni									
Roberts, 1951	Equinus	Cottoni				Equinus	Equinus Cottoni				
Best, 1962, 1971	Equinus	Cottoni				Equinus	Equinus	Equinus			
Ansell, 1960					Cottoni						
Ansell, 1971	Equinus	Cottoni		Cottoni		Equinus		Cottoni	Equinus	Cottoni	Cottoni
Smithers, 1971				Cottoni							
Smithers & Lebao-Tello, 1976							Equinus Cottoni				
Wilson & Hirst, 1977	Equinus	Cottoni		Cottoni		Equinus			equinus	cottoni	Cottoni
Dorst & Dandelot, 1980											
Skinner & Smithers, 1990	Equinus	Cottoni	Cottoni		Cottoni	Equinus		Cottoni	Equinus	Cottoni	Cottoni

Dollman and Burlace (1928) stated that *H. e. equinus* is referred to as the Southern Race, distributed in the whole of Zimbabwe, Malawi, South Africa, along the Zambezi, in Mashonaland, Matabeleland and the Okavango Valley. The newly identified subspecies *H. e. cottoni* is referred to as the Angolan Race, and all Roan Antelope found in Angola is classified as *H. e. cottoni.*

Shortridge (1934) gives a detailed account of Roan Antelope distribution in the then South West Africa (Namibia), and although he mentions *H. e. equinus* from 'Southern Africa' and *H. e. cottoni* from the Quanza river in Angola, he does not specify which subspecies occurred in South West Africa, and only refers to the Roan Antelope as *Egocerus equines*.

Allen (1939) and Ellerman *et al.* (1953) found that *H. e. equinus* comes from the old Transvaal, Zimbabawe, parts of Mozambique, and *H. e. cottoni* from the Cuanza River, northern Angola. Range includes Botswana to Beira in Mozambique.

Hill and Carter (1941) report on the Vernay Anglo Expedition to Angola where 2300 mammal specimens for the American Museum of Natural History were collected. The Vernay Angola Expedition secured 14 specimens of *H. e. cottoni*, and stated that " *The original description of this subspecies is extremely abbreviated, merely stating that the coloration is more richly rufous. This is true of the specimens examined*"(Hill & Carter, 1941: 160). This statement contradicts the earlier statement of Sclater and Thomas (1900) when they stated that they could not see any difference between the South African Roan Antelope and the Angolan Roan Antelope.

Roberts (1951) found that *Ozanna equina equina* , formerly from Griqualand West, but now from about the Tropic of Capricorn in Transvaal on the west and Swaziland northwards to Southern Zimbabwe and Mozambique on the east.

Dorst and Dandelot (1970) refer to *H. e. equinus* as the Southern race, according to its colour which is greyer, and which occurs from Southern Congo, Uganda and South Africa. They also refer to *H. e. cottoni* as the Angolan race characterised by a rich rufous ground colour.

Ansell (1971) as cited in Meester and Setzer (1972), talks about the Roan Antelope's original and present distribution, and states that the species has become very scarce in many places, and may be in a state of decline. He gives the following classification: *H. e .equinus* (Desmarest, 1804): Rhodesia (Zimbabwe) and perhaps southern Malawi southwards, exact limits and overlap with *H. e. cottoni* not clear. In his book, *Mammals of Northern Rhodesia* (1960), Ansell refers to *H. e. cottoni* as the subspecies occurring in that area, and *H. e. cottoni* (Dollman & Burlace 1928): Northern Botswana, Angola, Southern Congo and Zambia, and perhaps central and Northern Malawi. Geographic limits intergrading with *equinus* to the south and *langheldi* to the north not clear.

Smithers and Lebao-Tello (1976) compiled a checklist of the mammals of Mozambique, and it was said that both *H. e. equinus* and *H. e. cottoni* occur in Mozambique. They refer to Ansell (1971), who places Zambian material with *H. e. cottoni*, and suggests the possibility of this subspecies occurring in central Malawi. They state that if this is eventually shown to be correct, then it will be the subspecies occurring at least in the northern parts of the Tete province in Mozambique. *H. e. equinus* occurs from about Southern Tete and Zambezia Districts in Mozambique southwards.(Smithers & Lebao-Tello, 1976)

Wilson and Hirst (1977) claim that the southern most limits of the subspecies *H. e. equinus* were the northern, eastern, and western Transvaal and the boundaries of the south western arid zone in the Cape province (Ansell, 1971), but that the subspecies then only survived in the Kruger Park, Percy Fyfe Nature Reserve and the Belgium Block in the Waterberg area. Northwards they occurred in Rhodesia (Zimbabwe) and southern Malawi. The intergrading of *H. e. equinus* with *H. e. cottoni* is not clear, but the latter subspecies is the only one occurring across northern Botswana, Zambia, Angola central and Northern Malawi, and into Zaire.

Dorst and Dandelot (1980) refer to *H. e. equinus* as the southern race, according to it's colour which is greyer, which occurs from Southern Congo, Uganda and South Africa, and *H. e. cottoni* as the Angolan race characterized by a rich rufous ground colour.

In the classification of Skinner and Smithers (1990) they refer to Ansell (1971) and list six subspecies from the continent of which the following two occur in the sub-region: *H. e. equinus*: from parts of the Transvaal, parts of Zimbabwe, and perhaps southern Malawi; and *H. e. cottoni*: from northeastern Zimbabwe, Northern Botswana, Northeastern Namibia, Angola, Southeastern Zaire, Zambia and perhaps central and northern Malawi.

Smithers (1971), in his work regarding the mammals of Botswana, stated that *H. e. cottoni* occurred in the northern parts of the territory in the valley of the Okavango River and in other parts of the extreme north-west, west to the South West African border; throughout the fringes of the Okavango delta, along the Chobe river and its environs throughout its length in Botswana and narrowly south along the Rhodesian border to the Nata river.

Skinner and Smithers (1990) and Ansell (1971) state that there are wide areas of integration of the various subspecies and, as can be seen in table 3, it is not possible to set limits to their occurrence except on a very broad basis.

As can be seen from the above, the geographic distribution of the alleged Roan Antelope subspecies overlapped in some areas, and in other areas there was no certainty as to which subspecies should occur where. Because of the uncertainty or carelessness to designating specific areas to specific subspecies, translocations were done from various locations into South Africa. The results of this was that *exotic* subspecies were translocated into South Africa without much thought as to how this would affect the biodiversity of the *endemic* Roan Antelope populations. The consequences of these translocations will be discussed next.

7. THE EFFECT OF INVASIVE OR EXOTIC SPECIES, CAUSED BY TRANSLOCATIONS, ON THE BIODIVERSITY OF SOUTH AFRICA'S ALLEGED PURE ENDEMIC ROAN ANTELOPE.

7.1. Introduction

Biological diversity faces many threats throughout the world. One of the major threats to endemic biological diversity is now acknowledged by scientists and governments to be biological invasions caused by exotic invasive species. In the case of the Roan Antelope the exotic species would be the alleged *H. e. cottoni* subspecies that were imported by private breeders. The impacts of exotic invasive species are immense, insidious, and usually irreversible. They may be as damaging to endemic species and ecosystems on a global scale as the loss and degradation of habitats on a local scale. The umbrella term "translocation" includes several different concepts as defined below:

- Re-introduction: in strict terms, an attempt to establish a species, subspecies or race in an area which was once part of its historical range, but from which it has become extinct. Re-establishment is a synonym, but implies that re-introduction has been successful. This is something that may require considerable time to assess.

- Translocation: movement of individuals or populations from one part of their range to another.

- Reinforcement/Supplementation: addition of individuals to an existing population of the same species, subspecies, or race.

- Conservation/Benign introduction: an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area (IUCN SSC, 1987).

All of the above methods, have in the past, been used to increase the Roan Antelope numbers in South Africa. The effect of this was that, because the *endemic* Roan Antelope numbers in South Africa were so low, the only other places where there was an abundance of Roan Antelope left, were in the geographic areas of alleged *exotic* subspecies. Little or no attention was given to the above fact, and *exotic* Roan Antelope were imported and hybridised with *endemic* Roan Antelope.

The principle aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management (IUCN SSC, 1987). The objectives of a re-introduction may include the following:

- to enhance the long-term survival of a species;
- to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem;
- to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy;
- to promote conservation awareness; or
- a combination of the above.

'Alien invasive species' means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity. 'Alien species' (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part of such species that might survive and subsequently reproduce (O' Brian & Mayr, 1991).

Translocations are powerful tools for the management of the natural and man made environment which, properly used, can bring great benefits to natural biological systems and to man, but like other powerful tools they have the potential of causing enormous damage if misused, causing the loss of biodiversity and adaptability to populations of species forever.

The earliest known translocations of Roan Antelope occurred on September the11th and 12th in 1848 when Whitfield, as recorded by Gray in 1852, brought to England three Roan Antelope for the Derby menagerie on board the S.S. 'African' (Sclater & Thomas, 1899). From where in Africa they came from is not known. Gray, in Sclater and Thomas (1899) also states that he saw specimens of west African Roan Antelope, and that these Roan Antelope were exactly the same as those found in the Cape. In 1868 Sclater gave an account before the Zoological Society of London of a Roan Antelope observed in the king of Italy's menagerie, which was received from the king's agent in Khartoum. On November 24th, 1878, the Zoological Society of London acquired a male Roan Antelope from Mr. C. Hagenbeck, who stated that it was an example of the *H. e. bakeri*. It was kept in the Regent's Park Gardens until 1889 (Sclater & Thomas, 1899). Haagner (1920) claims that a Roan Antelope was kept in the South African National Zoo for fourteen years before it died, and that it was not young when received. He unfortunately does not state when it was received or from where. This statement suggests that Roan Antelope were captured and relocated in South Africa as early as 1914.

7.2. Translocations in Namibia

One of the largest Roan Antelope translocations took place in the then South West Africa (Namibia) in 1970. There has been an alarming decline in the Roan Antelope populations in South West Africa and they have become restricted to the most north-easterly part of the country where surveys (Hofmeyr, 1974) revealed that there were no more than 400 left. This decline in numbers coincides with the decline of Roan Antelope in the Kruger National Park, but the causes were not known. These Roan Antelope were captured in Botswana which was originally classified by Ansell (1971) as a *H. e. cottoni* geographic area. Hofmeyr (1974) refers to these Roan Antelope as *H. e. equinus*. Again confusion sets in regarding the distribution of the subspecies. An ambitious operation was therefore launched by the South West African Division of Nature conservation and Tourism for the capture and transfer of 74 Roan Antelope to the Etosha National Park in 1970 where they stood in quarantine. These Roan Antelope were then systematically released at the Waterberg Plateau in Namibia where they adapted very successfully and their numbers increased dramatically to unknown numbers. The exact reasons for this is unknown, but lack of predators, better vegetation and better management could be attributed to this success. Some of these animals were later relocated to South Africa in 1985. During this whole operation, from the first capture, the time spent in the bomas and the transport that included a C130 Lockheed Hercules air freighter having to land in a dry riverbed, and the heat of S.W.A, only 7 animals died (Hofmeyr, 1974).

7.3. Translocations in the Kruger National Park

Between 1986 and 1993, the numbers of Roan Antelope (*Hippotragus equinus*) counted in the Kruger National Park (KNP), South Africa, declined from about 450 to about 45. This drastic decline, which occurred in one of Africa's largest and most intensively managed national parks, was of serious concern to park staff. Roan antelope, because of their low numbers, represent one of the rare ungulate species in the park, and are locally endangered in South Africa because of the great difficulty conservation managers encounter in increasing their numbers. Owing to the Roan Antelope's vulnerability to anthrax (Wilson and Hirst, 1977), immunisation against outbreaks of this disease in the Kruger population has been a management practice over the past two decades (De Vos, 1990). Despite such interventions during the late 1980's, the Roan Antelope numbers were still declining within the park.

Harrington *et al.*,(1998) identified several potential causes of the Roan Antelope decline in the Kruger National Park.

- With the provision of artificial water points in the Roan Antelope's range there seemed to be an associated increase in Zebra and Wildebeest numbers. Hence the first hypothesis was that increased competition for grazing by these species precipitated the Roan Antelope decline.

- Hypothesis two was that, rather than being mediated through food resources, the Roan Antelope decline was caused by increased predatio n following the build-up in herbivore numbers (so-called "apparent competition").
- Hypothesis three was habitat deterioration following a sequence of low rainfall years.
- Hypothesis four was that anthrax may have affected Roan Antelope numbers despite attempted immunisation.
- Hypothesis five was that stress associated with immunisation, which originally entailed firing darts, and subsequently bio-bullets, into the animals from a helicopter, may have exacerbated the effects of droughts, food restrictions or predation.

When, in the 1960's, the Kruger National Park realised that their Roan Antelope populations were in serious danger of becoming extinct, they started looking at options of supplementing their Roan Antelope with Roan Antelope from Angola, South West Africa and Zimbabwe (Annual Report, 1967-1968). A Roan Antelope breeding camp of 1,6 km² was built at Nwashitsumbe in July 1967 in the Kruger Park to hold ten Roan Antelope that were caught in the Kruger Park. The idea of this camp was to establish a breeding herd to restock the park with the offspring (Joubert, 1970). Another similar camp, called Hlangwine, was build for the same purpose as Nwashitsumbe at Pretoriuskop in 1973 to house 12 Roan Antelope caught in July 1973 in Zimbabwe

According to Joubert (1976), during July 1973, 44 Roan Antelope were captured in the Sehubu area of the Tjolotjo Tribal Trust lands in Zimbabwe for translocation to the Kruger National Park in South Africa. Of these 44 Roan Antelope, 6 went to the Matopos National Park, but 5 died of unknown causes shortly after release. It must be noted that the Tjolotjo Tribal Trust land falls within the geographical area of north east Zimbabwe, the same area for Skinner and Smithers' (1990) *H. e. cottoni*. The implications of this is that the subspecies *H. e. cottoni* were relocated to an area, the Kruger National Park, containing *H. e. equinus*, by the National Parks Board. This could surly have serious implications for keeping the subspecies pure? The account of Joubert (1976) regarding the number of Roan Antelope relocated conflicts with reports from the Kruger National Park. Joubert (1976) says 44 Roan Antelope were caught and relocated to the Kruger National Park, but the annual Kruger National Park Reports states that only 12 Roan Antelope were released into the Hlangwine camp. It is unclear what happened to the rest of the animals, but it seems they were released into the greater Kruger National Park (45th Annual Report)

The Kruger Park's 48th annual report stated that on July 17th, 1973, twelve Roan Antelope arrived at Pretoriuskop and were released into the Hlangwine enclosure on July 29, 1973. Five of these animals died of Cytauxzoonosis, a blood parasite transmitted from ticks due to a severe parasitic infection during detention in the boma. In the 47th Annual Report it is stated that a Roan Antelope bull was captured from the Nwashitsumbe camp (the original roan from the Kruger Park) and released into the Hlangwine camp that was to house the Zimbabwe Roan Antelope . In Hlangwine camp there now were an *endemic* Roan Antelope bull from the Kruger Park, and *exotic* Roan Antelope bulls and cows from Zimbabwe. This again could have serious complications for keeping the subspecies pure and raises a number of controversial questions.

In the 50th Annual report it is stated that the alleged *exotic* Roan Antelope herd bull of the Hlangwine camp (from Zimbabwe) was replaced with an *endemic* Roan Antelope bull from the Kruger Park because the Zimbabwe bull seemed not to be mating with the cows. It is presumed to have been released into the Kruger Park. Again the original *exotic* Zimbabwe Roan Antelope herd was mixed with *endemic* Kruger Park Roan Antelope bulls, thus influencing the biodiversity of the Kruger National Park Roan Antelope. In the 52nd Annual report it is stated that an *endemic* Roan Antelope bull from outside the Hlangwine camp at Pretoriuskop fought with the herd bull inside the camp through the fence. The fight later became so violent that the *endemic* Roan Antelope bull from outside the camp broke down the fence, killed the herd bull, and then killed an *exotic* juvenile Roan Antelope bull (from Zimbabwe) and took over the herd. The next year the same thing happened where a bull from outside the fence broke into the camp, killed the herd bull and took over the herd. That same year (1978-1979) an *endemic* Roan Antelope bull from Percy Fyfe Nature reserve was relocated to Nwashitsumbe camp presumably to import new genes into the breeding herd. The Nwashitsumbe camp thus had *exotic* Roan Antelope from Zimbabwe, as well as *endemic* Roan Antelope from two different populations, the Kruger National Park and Percy Fyfe Nature Reserve.

The 60th Annual report of the Kruger National Park stated that there was only one surviving exotic Roan Antelope cow left from the original group brought from Zimbabwe to the Hlangwine camp, and that this cow produced her ninth male calf. It is common knowledge that it is impossible to keep more than one adult Roan Antelope bull in a breeding herd or camp due to violent and often fatal fighting, and that these nine exotic bull calves must have been released back into the Kruger Park as was the original intention. The problem with all the mixing of the alleged endemic and exotic Roan Antelope is that the animals from Zimbabwe, *H. e. cottoni* crossbred with the animals from the Kruger National Park, *H. e. equinus* in the Hlangwine camp, and these animals were later released back into the Kruger National Park to further breed with the free ranging Roan Antelope (National Parks Board Annual Report No.60). The Kruger Roan Antelope are thus possibly hybrids of *H. e. cottoni* and *H. e. equinus.*

When the Kruger National Park and the Department of Nature Conservation and Tourism was notified of this authors' intentions to investigate the purity of the endemic Roan Antelope populations in national parks, the following response was given by Rina Grant (2002) of the Northern Plains Research Project in the Kruger National Park.

"The animals that have been tested (by Alpers et al., 2002) were all animals that were originally from here(the Kruger National Park). ***All the introduced roan died before they bred.*** *We were also very surprised at the results of the genetic tests, but I believe we have to realise that the KNP animals are more closely related to the eastern race."*

The statement that all introduced Roan Antelope died before breeding is not true, as has been suggested above. When the records of all translocations of Roan Antelope by National Parks were requested, the reports containing information regarding the import of alleged exotic Roan Antelope from Botswana, Namibia and Zimbabwe were missing from National Parks Head Office in Pretoria, as well as the library of the University of Pretoria. When copies of these reports were eventually found and shown to the Department of Nature Conservation and Tourism, the official staff expressed shock and wanted to know where they had been found and who supplied them. They also stated that the possibility that the endemic Roan Antelope in national parks were not pure would cause great problems regarding their implementation of the moratorium on Roan Antelope, and that this information must be withheld. Surely this is a serious problem that needs urgent attention and explanation at the highest level as this has serious financial implications for the breeders of Roan Antelope. An explanation for this contradiction and apparent withholding of information needs an explanation.

During 2001 another initiative, where Roan Antelope were to be imported into South African national reserves, was launched. Roan antelope were captured in Botswana in the Pandamatenga area (Northern Botswana) in an exchange deal for Rhino from the Kruger National Park. Some of the Roan Antelope were destined for the new expansion of Marakele National Park and some animals were destined for Vaalbos National Park. The Roan Antelope were held in the game pens of Fauncap Game Capture owned by Mr. Thys Maritz in Hoedspruit. The animals ended up in the facilities in Hoedspruit as a result of the stringent veterinary protocol requirements that South Africa and Botswana observe, which are designed to protect the two countries against outbreaks of Foot and Mouth disease. From here they were transported to Marekele National Park and also Vaalbos National Park just before Christmas 2001. During the operation, 106 roan were captured, 30 animals died of heat exhaustion during transport and only 81 were relocated to Vaalbos and Marakele national parks (Joubert, 2002).

What is interesting and disturbing is that this type of transaction could have taken place while a moratorium was placed on all exotic Roan Antelope subspecies imported into South Africa. During September 2000 a purchaser bought ten Roan Antelope (*H. e. cottoni*) at an auction (Wessels, 2001). When he applied for permits to relocate these animals on his farm, his permits were refused, and the responsible official from Northern Province Nature Conservation stated as follows:

" The primary reason for the refusal (of the permits) is in fact that the applicant intended, on the one hand, to introduce roan antelopes belonging to an alien subspecies, namely H. e. cottoni into the province and, on the other hand to relocate such alien subspecies to a new locality.

(i) In doing so, the indigenous subspecies would otherwise, taking into consideration the limited natural habitat available, be deprived of such natural habitat, which is necessary to conserve and protect such subspecies and to ensure an increase in their population.

(ii) Furthermore, in view thereof that such roan antelope is intended to be kept at a new location, it would increase the number of farmers farming with an alien subspecies and, therefore, promote, contrary to government's duty to preserve the indigenous subspecies, the farming of alien subspecies, and furthermore, place a further burden on government in administering the policies in this regard" (Wessels, 2001)

It would appear that the same rules that apply to private breeders do not apply to National Parks. Regardless of the moratorium and the above mentioned refusal of a permit, Northern Province Nature Conservation allowed Roan Antelope from Botswana, that belong to the subspecies *H. e. cottoni*, to be relocated to Marekele National Park, a government reserve. These animals were also not genetically tested before translocation. Surely double standards appear to exist.

7.4. The Percy Fyfe Nature Reserve translocations.

Another incident where endemic Roan Antelope were contaminated by alleged exotic Roan Antelope is at Percy Fyfe Nature Reserve. The Percy Fyfe Nature Reserve in the Northern Province hosts one of the largest endemic populations of Roan Antelope *H. e. equinus* in South Africa (Grobler & Nel, 1992). The founding history of the population is summarized in Table 4. Small nucleus breeding herds of unknown numbers have been removed from the herd regularly since 1977, with the most recent removal in August 1994. By that time, the population had multiplied to 100 individuals and 30 animals were translocated to the Skuinsdraai Nature Reserve (Northern Province). It is believed that founder groups for many new populations of endemic Roan Antelope will ultimately originate from Percy Fyfe and special genetic management of this population may therefore be advisable to allow for future management options (Grobler & Nel, 1992).

Table 4: Introductions of Roan Antelope into the Percy Fyfe Nature Reserve from 1968 to 1985. Figures in brackets indicate mortalities (Grobler & Nel, 1992)

Year	Male	Female	Calves	Total	Origin
1968	3 (2)	2 (2)	1 (1)	6 (5)	Waterberg
1969	4 -	8 (3)	- -	12 (3)	Waterberg
1970	- (2)	10 (3)	- (2)	10 (5)	Waterberg
1971	- -	10 (4)	- -	11 (4)	Waterberg
1985	2 (-)	4 (3)	- -	6 (3)	Namibia

The fact that alleged *exotic* Roan Antelope were introduced from Namib ia in 1985 places a question mark on the genetic purity of the Percy Fyfe Roan Antelope population as being purely *endemic*, and one questions the proposal that this population should be used as the founder population for future translocation and breeding programs of *endemic* Roan Antelope. According to Perrin & Taolo (1999) another herd of Roan Antelope were translocated from the Waterberg Plateau Park in Namibia. They were introduced into Itala Nature Reserve in 1979 and in 1988 nine Roan Antelope were introduced to Weenen Nature Reserve. The specific aim was to establish another independent population of this endangered species.

From Table 4 it can also be seen that from a total of 45 Roan Antelope introduced into Percy Fyfe Nature Reserve, 20 died. The reasons for this is unclear. In March 2001 this trend continued with the death of 22 Roan Antelope, worth an estimated value of R3.5-million. This drastic decline raises questions about the care of South Africa's natural heritage. The Roan Antelope had beenmoved into a smaller camp within the Percy Fyfe Nature Reserve outside Potgietersrus in anticipation of being sold. The Northern Province

Department of Agriculture and Environment spokesman, Thembi Makhuvele, attributed the deaths exclusively to tick overburden brought about by good rains in the area. Wildlife veterinarians on the other hand feel the size of the camp where the Roan Antelope were held was too small for normal grazing and feeding stress most definitely contributed to the death of all the antelope. Whatever the case, carelessness appears to be permanent regarding the conservation of these threatened species.

Mr. Makhuvele said the loss of the 22 rare antelope was "*a serious blow to the breeding programme of this endangered species*". Surely a drastic understatement ? It would appear that the provincial body has neither the manpower, the financial resources nor sufficient wildlife management skills to be running breeding programs (Helfrich, 2001). If this trend continues it will have drastic negative effects on the genetic diversity and biodiversity of this rare species; a trend that surely cannot be allowed to continue.

7.5. Nylsvlei Nature Reserve translocations.

The Roan Antelope in the Nylsvlei Nature Reserve at Naboomspruit originated from the original stock that was relocated to the Percy Fyfe Nature Reserve from the Belgium Block in the Waterberg, South Africa. Some of the animals were relocated to Percy Fyfe. It is believed that these Roan Antelope in Nylsvlei are pure endemic South African *H. e. equinus,* but records in the Transvaal Museum in Pretoria indicate that Roan Antelope from the Waterberg in Namibia, which are *H. e. cottoni,* were introduced to Nylsvlei before 1985. The Nylsvlei Roan Antelope population, together with the Roan Antelope populations in the Percy Fyfe Nature reserve and the Kruger National Park all appear to be contaminated with alleged exotic Roan Antelope and possible hybridisation has taken place.

On the basis of the above disturbing evidence all the endemic Roan Antelope populations in national parks are believed to be contaminated by exotic Roan Antelope, and it would appear that South Africa thus does not have any pure endemic Roan Antelope populations left.

7.6. Private Breeders and translocations.

Captive breeding has normally been a primary concern of zoo expertise, but the recent development of breeding ranches has changed all of this and the maintenance of genetically viable populations of rare and endangered species has been of prime importance since the early 1980's. In terms of species conservation, it is important to maintain viable populations of rare species in captivity for the following reasons *(IUCN 1987)*:

- as an insurance population for possible reintroduction should the species become extinct in the wild or over part of its range; and
- as a source of new genetic material to infuse diversity into depleted wild populations.

In 1986 Dr. Johan Kriek imported fourteen Roan Antelope (*H. e. cottoni*) with the necessary permits from Malawi into South Africa, from which he established a successful breeding herd and sold some of the animals with the necessary permits to breeders all over South Africa. In 1991 Dr. Kriek brought another 88 Roan Antelope (*H. e. cottoni*) from Malawi with the necessary permits. These animals were again translocated to various breeders all over South Africa, with the permission of nature conservation authorities (Wessels, 2001).

Various other translocations by private game ranchers took place, some with success, and others ending in tragedy. The numbers of alleged exotic or imported Roan Antelope in the hands of private ranches presently stands at approximately 800 to 900. Pienaar (1974) probably summed the relocation of Roan Antelope successfully when he stated that:

" *It is well to remember that no matter how successful an introduced foreign species appears to adapt itself and thrive, it is bound to compete in a detrimental manner with some or other of the naturally occurring herbivorous species of an area. Habitat dependence is also so highly developed in some species that when these animals are* *taken out of their natural environment, factors which may seem innocent enough at the time, could bring around a derangement of its protective mechanisms and cause an increased susceptibility to disease conditions, predation and other mortality factors".* (Pienaar, 1974: 194)

Caughley and Sinclear (1994) point out that there is general agreement that re-introduced animals should be taxonomically and genetically as close as possible to the former population, yet an objective definition of "suitability" has not yet been developed, and cannot realistically be expected to emerge for some time.

In terms of restocking, or infusing genetic diversity, there are several major tasks which need to be accomplished before such action can be undertaken. Firstly, small, isolated and endangered populations need to be systematically identified through greatly increased field survey efforts. Secondly, their demography and dynamics need to be understood so that appropriate candidate populations - and possibly even candidate individuals - can be selected. Thirdly, it is an open question whether new, captive-reared animals can be introduced to existing wild populations and both survive and breed. Fourthly, assisted reproductive techniques need to be further developed before they can be used effectively in the field.

The same consideration applies to introducing animals of potentially different genetic make-up to resident, albeit severely reduced, populations. The draft guidelines of the IUCN Re-introduction Specialist Group advise against it. However, managers of Roan Antelope may some day face a real dilemma: is it better to let a population go extinct, or become highly inbred, rather than "contaminate" it?

In South Africa tranlocations of species from a certain geographic area to another are governed by the Convention on Biological Diversity, signed in 1993 by the South African government. The aims of this convention are to protect the biodiversity of South Africa's fauna and flora and to propose active environmental conservation through proper management. The biodiversity status of the Roan Antelope and how the Convention on Biological Diversity affects the management of the Roan Antelope will be discussed next.

8. THE BIODIVERSITY STATUS OF SOUTH AFRICAN ROAN ANTELOPE AND THE RELATIONSHIP TO THE CONVENTION ON BIOLOGICAL DIVERSITY.

8.1. Biodiversity status of the Roan Antelope.

Effective conservation of our biodiversity is clearly critical given our dependence on biological resources for economic development, and on related ecological processes for keeping our country fit for survival. However, as in the rest of the world, our biotic wealth is being lost at an increasingly rapid rate, and the survival of a significant part of our remarkable species diversity is seriously threatened. At present, about 25% of the land has been transformed - largely by agriculture, urban developments, afforestation, mining, dams, and alien plant and animal invasions. Rivers, wetlands and estuaries have also been substantially affected, as have some marine ecosystems. Already 2 527 (12%) of South Africa's plant species, 102 (14%) of bird, 72 (24%) of reptile, 17 (18%) of amphibian, 90 (37%) of mammal, and 22% of butterfly species are listed as threatened in South Africa. Trends indicate that this situation is not improving (White Paper on Biological Diversity, 1997). Unless fast and effective action is taken, much of this biodiversity will soon be lost. The Roan Antelope is but one example illustrating biodiversity loss.

One of the major threats to native biological diversity is probably biological invasions caused by alien invasive species. In the case of the Roan Antelope, it is the introduction of the alleged exotic subspecies *H. e. cottoni* to South Africa. For millennia the natural barriers of oceans, mountains, rivers and deserts provided the isolation essential for unique species and ecosystems to evolve. In just a few hundred years these barriers have been rendered ineffective by major global forces that have combined to help alien species travel vast distances to new habitats and become alien invasive species. The globalisation and growth in the volume of trade and tourism, coupled with the emphasis on free trade, provide more opportunities than ever before for species to be spread accidentally or deliberately. Customs and quarantine practices, developed in an earlier time to guard against human and economic diseases and pests, are often inadequate safeguards against species that threaten the local biodiversity.

The assessment of the alleged different subspecies of Roan Antelope that is found in Africa is plagued with difficulties. First and foremost biologists, as previously discussed, lack a precise definition of what exactly defines a species. The concept of a species often refers to a population of physically similar individuals that can successfully mate between each other, but cannot produce fertile offspring with other organisms. However, many species are composed of a number of distinct populations that can interbreed even though they display physiological and anatomical differences, also called subspecies. Scientists developed the notion of biodiversity to overcome some of the difficulties of the species concept. According to Mayer (1970), to accomplish this task, biodiversity describes the diversity of life at the following three biological levels:

- **Genetic Level** or **Genetic Diversity** - refers to the total number of genetic characteristics expressed and recessed in all of the individuals that comprise a particular species. Variation of individual geno types within or among species is known as genetic diversity and is an important attribute for long-term survival of a species. Genetic diversity may enable a population to adapt to new conditions, such as those brought about by environmental change

- **Species Level** or **Species Diversity** - is the number of different species of living organisms present in an area. As mentioned above, a species is a group of animals that are similar and able to breed and produce viable offspring under natural conditions. Species diversity can be described in numerous ways, but simply speaking, it is the number, type, and distribution of different species within a particular environment. Greater species diversity usually results in a more resilient ecosystem.

- **Ecosystem Level** or **Ecosystem Diversity** - is the variation of habitats, community types, and abiotic environments present in a given area. An ecosystem consists of all living and non-living things in a given area that interact with one another.

The IUCN, also known as the The World Conservation Union, through its Species Survival Commission (SSC), has for almost four decades been assessing the conservation status of species, subspecies, varieties and even selected sub-populations on a global scale. This is done in order to highlight taxa threatened with extinction, and therefore promote their conservation. In 1996 the Roan Antelope were assessed by the Antelope Specialist Group, using the following list of conservation categories to assess the status of the species (IUCN SSC, 1987):

Extinct (EX) - A taxon is extinct when there is no reasonable doubt that the last individual has died.

Extict in the wild (EW) - A taxon is extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR) - A taxon is critically endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) as described below.

Endangered (EN) - A taxon is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) as described below.

Vulnerable (VU) - A taxon is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) as described below.

Lower Risk (LR) - A taxon is lower risk when it has been evaluated, does not satisfy the criteria for any of the categories critically endangered, endangered or vulnerable. Taxa included in the lower risk category can be separated into three subcategories:

1. **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. **Near Threatened (nt).** Taxa which do not qualify for conservation dependent, but which are close to qualifying for Vulnerable.

3. **Least Concern (lc).** Taxa which do not qualify for conservation dependent or near threatened.

Data deficient (DD) A taxon is data deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking.

The Roan Antelope was given the IUCN *Red List Conservation Category* of **Lower Risk- Conservation Dependant**, which means that special management and breeding programs must be implemented to prevent them from becoming threatened or endangered. The IUCN *Red Lists* are widely recognized as the most comprehensive, apolitical global approach for evaluating the conservation status of plant and animal species. The threatened species categories developed by the IUCN are used in *Red Data Books* and *Red Lists*. These categories are widely recognized internationally, and they are now used in a whole range of publications and listings produced by the IUCN as well as by numerous governmental and non-governmental organizations. The *Red Data Book* categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them.

8.2. The Convention on Biological Diversity (1992)

The concern and confusion regarding the different Roan Antelope subspecies started when South Africa signed the Convention on Biological Diversity in June, 1993. South Africa ratified the Convention on Biological Diversity in November 1995. In doing so, the country joined 135 other countries already party to the Convention in a global drive towards conservation of biological diversity. The objectives of the Convention in general are to conserve biological diversity, promote the sustainable use of its components, and encourage equitable sharing of the benefits arising out of the utilization of genetic resources by using the following guiding principles. These guidelines are concerned with preventing the loss of biological diversity caused by biological invasions of alien invasive species by:

- Preventing the introduction of alien invasive species. This is the cheapest, most effective and most preferred option and warrants the highest priority.
- Rapid action to prevent the introduction of potential alien invasives is appropriate, even if there is scientific uncertainty about the long-term outcomes of the potential alien invasion.
- Since the impacts on biological diversity of many alien species are unpredictable, any intentional introductions and efforts to identify and prevent unintentional introductions should be based on the precautionary principle.
- In the context of alien species, unless there is a reasonable likelihood that an introduction will be harmless, it should be treated as likely to be harmful.
- Alien invasives act as "biological pollution" agents that can negatively affect development and quality of life. Hence, part of the regulatory response to the introduction of alien invasive species should be the principle that "the polluter pays" where "pollution" represents the damage to native biological diversity.
- The risk of unintentional introductions should be minimised.
- Intentional introductions should only take place with authorisation from the relevant agency or authority. Authorisation should require comprehensive evaluations based on biodiversity considerations (ecosystem, species, genome). Unauthorised introductions should be prevented.

- The intentional introduction of an alien species should not be permitted if experience elsewhere indicates that the probable result will be the extinction or significant loss of biological diversity.
- The intentional introduction of an alien species should only be considered if no native species is considered suitable for the purposes for which the introduction is being made.

The above principles forced nature conservation authorities to investigate the trade, movement and import of Roan Antelope inside and outside of South Africa with the purpose of establishing the status of the Roan Antelope's biodiversity. A project by the Department of Nature Conservation was launched in 2000 to determine the status and distribution of the Roan Antelope in the different provinces in South Africa. As has been mentioned before, various alleged Roan Antelope subspecies were imported in the past from countries like Senegal, Malawi, Namibia, Togo, Benin, Zambia, Zimbabwe etc. to South African game ranches, government nature reserves and national parks. According to the traditional Roan Antelope subspecies classification, South Africa has alleged foreign or exotic subspecies on its soil, and as has been stated before, nature conservation officials believe these alleged exotic Roan Antelope utilize valuable habitat intended for the endemic subspecies, *H. e. equinus*.

With this realisation, Dr Burgers, the Northern Province MEC for Nature Conservation, stated in 1997 that import permits for Roan Antelope would only be issued if the importer could prove by means of **genetic testing** that the animals to be imported belonged to the same subspecies as the South African Roan Antelope. Owners of Roan Antelope in the Northern Province must register their Roan Antelope with the Department of Nature Conservation for future control purposes. Burgers was quoted by Helfrich (1997) as saying *"These principles will also be applicable to the import, export or movement of all other game species considered to be alien, non-indigenous and non-endemic to Northern Province"*.
Burgers also said *"Due to the importance of this problem, a consultative process will soon be under way to formulate a national policy in this regard. Until a national policy is*

formulated, Northern Province is relying strongly on the guidelines of the Convention on Biological Diversity, as well as the latest scientific facts, to aid its decision-making process".

By virtue of the government's policy, inter alia, to control, eradicate and prevent the introduction of harmful species which threaten South Africa's biodiversity, conservation authorities in 1999 embarked on a policy of refusing permits for the translocation or importation of Roan Antelope which they believe to be *exotic* to South Africa until a genetic basis for the classification of subspecies could be found. On the grounds of the Convention of Biological Diversity's 'precautionary principle', which means that action must be taken to stave off significant threats to biodiversity without waiting for scientific proof about their cause or extent, a moratorium was placed on the sale and relocation of Roan Antelope in South Africa (Wessels, 2001).

This decision has upset the private game ranchers who have imported Roan Antelope from other countries or bought Roan Antelope from game sales in South Africa, without any complaints from nature conservation authorities, and have successfully relocated and bred with these so called exotic species. Millions of Rands were invested in these breeding projects, and these animals that fetched R 120 000 per animal, now have no value in that they cannot be sold.

With the forging of closer links between the Department of Nature Conservation's biodiversity unit and researchers from universities, meaningful steps have been taken to implement the Convention on Biological Diversity. For example, Alpers *et al.*, (2001) did genetic tests on Roan Antelope found all over Africa to determine the genetic groupings or affiliation of the different populations in order to establish which alleged subspecies, if any, would be endemic or exotic to South Africa. The methods and results of their research were discussed on pages 19 and 20.

From the results of Alpers *et al.*, (2001), as indicated in Table 5, it is clear that Smithers and Skinner (1990) erroneously used morphological and geographical, rather than genetic, evidence to classify the different Roan Antelope subspecies. The animals that were traditionally classified as different subspecies according to their geographic locations were now genetically grouped together by Alpers *et al.*, (2001).

Table 5. The relationship between previously designated geographic subspecies according to Skinner and Smithers (1990) and current genetic groupings according to Alpers *et al.*, (2001)

Sub-Species / Genetic ESU	H. e. equinus	H. e. cottoni	H. e. langheldi	H. e. koba
Western ESU.				Senegal Ghana
Rest of Africa ESU with three suggested management units . **1.South Eastern MU.**	Kruger National Park South Africa	Zambia Zimbabwe Malawi		
2.Eastern MU.			Tanzania Kenya Uganda	
3.South Western MU.	Nylsvlei – South Africa Percy Fyfe – South Africa	Botswana Namibia		

As was suggested earlier, the fact that the alleged subspecies, *H. e. cottoni* and *H. e. equinus* grouped genetically together, proved the point that no distinction should have been made between the two alleged subspecies.

It was expected that the Kruger National Park Roan Antelope, that was alleged to be pure endemic *H. e. equinus*, would group together with the other alleged endemic Roan

Antelope populations of Percy Fyfe and Nylsvlei (figure: 18). Against all expectations, the Kruger Park Roan Antelope grouped genetically together with animals from Zimbabwe, Malawi and Zambia, that were alleged exotic *H. e. cottoni* subspecies. This might prove that the Zimbabwe Roan Antelope that were imported to the Kruger National Park from Zimbabwe could possibly have bred with the Kruger National Park Roan Antelope, thus upsetting and confusing the traditional genetic groupings. This will need further intensive investigation as the implications of this fact being genuine has far reaching implications.

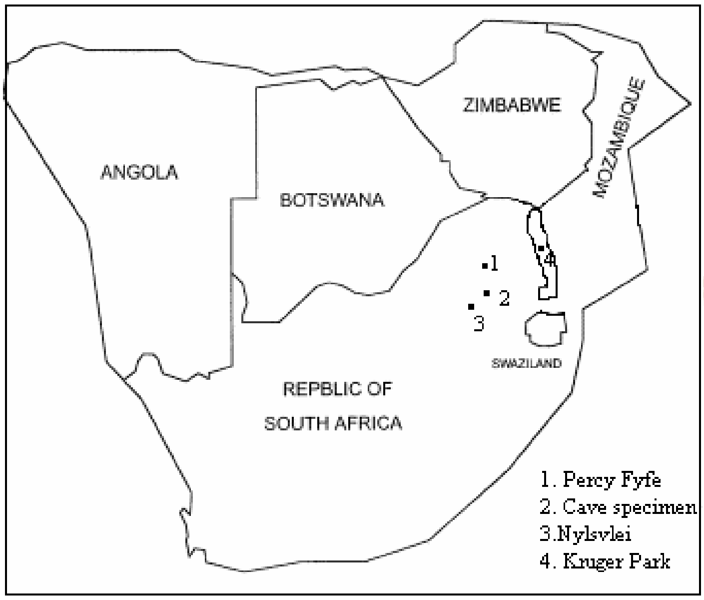

Figure 18: Locations of Percy Fyfe Nature Reserve, Nylsvlei Nature Reserve, the Kruger National Park and the Roan Antelope specimen found in a cave near Potgietersrus, in the Northern Province, South Africa.

There is a hypothesis by the Department of Environmental Affairs and Tourism that the Drakensberg escarpment was a barrier between the eastern and western Roan Antelope populations in South Africa. This hypothesis, and the fact that the Kruger Park animals might not be pure, could be proven to be incorrect by a skull of a Roan Antelope that was found in a cave near Potgietersrus, 60 km from the Percy Fyfe Nature Reserve (figure: 18). It is believed by Wessels (2001) that this animal fell to its death in 1954. This single animal genetically groups together with the Kruger National Park Roan Antelope, as well as the specimens from Zimbabwe, Zambia and Malawi, proving that the Drakensberg escarpment was possibly not a geographic boundary keeping the Percy Fyfe and Nylsvlei Roan Antelope populations separate from the Kruger National Park Roan Antelope.

But how could there be two genetically different populations (Percy Fyfe, Nylsvlei and the Potgietersrus cave specimen) of Roan Antelope 60 km from each other with no natural boundary to keep them from interbreeding. When the statement of Haagner (1920) referring the Roan Antelope in the South African National Zoo that was kept there since 1914 is considered, it is clear that translocation of Roan Antelope from different geographic locations took place long before it was first expected, possibly explaining why the cave specimen was to be found next to a genetically different population.

Alpers and Robinson (2001) from the University of Stellenbosch wrote a letter in the *Trans-Vaal Game Association Newsletter* suggesting that museum samples that predate any possible human interference, and for which there is precise data on the geographic range, should be DNA tested to get a more accurate picture of the Roan Antelope distribution and their genetic affiliation with each other. The author of this research found eleven Roan Antelope samples in the Transvaal Museum, all predating 1910, and all collected east of the Drakensberg escarpment. If these samples were to be tested and they tested genetically the same as the Kruger National Park Roan Antelope, it could prove that:

- The Roan Antelope in the Kruger National Park are indeed a pure population
- That the Drakensberg escarpment was a natural boundary keeping the south eastern and south western Roan Antelope populations apart.

If the museum specimens did *not* test genetically the same as the Kruger National Park, but the same as the Percy Fyfe and Nylsvlei populations, it could prove that:

- The Roan Antelope in the Kruger National Park is not a pure population, and

- The Drakensberg escarpment was not a natural boundary keeping the south eastern and south western Roan Antelope populations apart.

Prof. T.J. Robinson, at this researcher's request, unfortunately declined to do the genetic tests on the museum samples. The reason for this was that he said he had completed his research on the Roan Antelope. This was quite surprising because as stated earlier he had suggested the above museum samples should be tested. To send these samples from the Transvaal Museum to other scientists to do DNA tests, are beyond the scope of this study. **The researcher recommends that these samples should be tested in order to obtain a clearer picture on the historical geographic and genetic distribution of Roan Antelope in South Africa.**

9. MANAGEMENT RECOMMENDATIONS FOR ROAN ANTELOPE IN SOUTH AFRICA.

Upon the classifications of Alpers and Robinson (2001), Kruger and Nel (2002) made the following recommendations and guidelines for the management of Roan Antelope, and gave two options for the management of the identified ESUs and MUs.

Option 1: Maintain the moratorium on the import of the West African ESU and lift the moratorium on the movement of all other Roan Antelope falling within the Rest of Africa ESU.

Implications:

- Free trade with all non West African roan antelope in South Africa.
- Mixing of the south western and south eastern groups will be allowed
- Voluntarily preservation of the different MUs to keep separate breeding units
- Possible loss of MUs when mixing occurs.

Disadvantages:

- Possible loss of genetic entities.
- Negative impact on the regulation of other game species.
- Biodiversity and NEMA requirements such as the precautionary principle may not be addressed.
- Effects of mixing will be irreversible.
- It will limit the population growth potential for the south western group, which is believed to be the traditional *H. e. equinus*, in that their natural habitat will be used by hybrid Roan Antelope

Option 2: Maintain the refusal of importing of West African roan into South Africa and manage Roan Antelope in South Africa as two separate MU's

Implications:

- The geographical separation of the two MUs need to be identified (perhaps the Drakensberg escarpment, but what about the sample from Potgietersrus).
- South eastern and south western groups will need to be managed separately as MUs, without a clear boundary.

Disadvantages:

- There is no clear understanding of the reasons and processes responsible for the differences in the two groups.
- There is no significant, conclusive support for separate management based on present data.

The following statement from Kruger and Nel (2002), conservation biologists from Northern Province Environmental Affairs, is rather puzzling. They state that "*since the south western group* (traditional *H. e. equinus*) *is on government land* (Percy Fyfe and Nylsvlei)*, it is pure and all new locations within the geographical area must be registered."* Merely because these Roan Antelope are on government land, does not necessarily mean they are pure. As has been suggested earlier, the Roan Antelope in Percy Fyfe and Nylsvlei are not pure populations, but were interbred with Roan Antelope from Namibia. Perhaps that is why they have the same genetic make up, and the question arises as to whether the translocations of in these reserves of animals originating in Namibia, did not influence the genetic tests?

The best management advice regarding the Roan Antelope ESUs and MUs comes from Moritz who introduced these phrases. Moritz (1995: 116) states that "*the approach often adopted by wildlife managers - do not cross genetically distinct stocks (populations) – appears conservative, at least from the perspective of maintaining entities. However, this approach, which at the extreme can border on 'genetic typology', may be inappropriate* *when compared with long-term processes that operate in the species concerned. From the perspective of long-term process,* ***translocation of individuals within ESUs is unlikely to be detrimental and may well be an advantage,*** *whereas deliberate translocations of individuals between ESUs should be avoided. The focus should be on maintaining the overall process, i.e. historical levels of gene flow, rather than the specific entities, e.g. MUs within ESUs."* He further says that hybridization may be an important part of the evolutionary process, injecting genetic variance back into populations that would otherwise lose their diversity through genetic drift.

10. CONCLUSION.

It is indeed very sad that Roan Antelope conservation and management only became important when their numbers had become so insignificant. Their low numbers are however the reason for their high economic value. As long as these antelope have a financial value a great deal more attention will be given to their management to ensure their survival. Unfortunately in Africa there are more pressing questions than the protection and management of the Roan Antelope, and it is only in South Africa that private breeders are still prepared to pay R 150 000 per animal. It is thus not just the Roan Antelope that needs to be protected, but also the viability to breed them for financial gain. The moratorium that was placed on the sale and translocation of the Roan Antelope is therefore not doing its survival any good. From the above it can be seen that the reason for the current situation is as follows:

The Roan Antelope as a species were split up into various subspecies according to their phenotypic variation. This concept is widely accepted as a method of classifying subspecies, but then there must be a consistent phenotypic variation of all the animals within a population that is geographically isolated from the rest of the species. In the case of the Roan Antelope, these phenotypic differences were not consistent in all the animals within a certain geographic range, and there is no evidence of natural boundaries that could have kept these animals geographically isolated from each other.

Avise and Ball (1990) suggested that subspecies identification should be based on genetic traits, rather than phenotypic differences. The recent study by Alpers and Robinson (2001) attempted to solve the Roan Antelope subspecies saga by doing genetic tests on the alleged different Roan Antelope subspecies to investigate the subspecies distribution. Their results, as mentioned before, showed that the historical Roan Antelope subspecies distribution were different than were originally thought. The other surprising result was the Cave specimen that was surrounded by genetically different Roan Antelope populations.

This finding would suggest that Roan Antelope translocations, from as early as 1848 up to today, could have had a serious effect on their biodiversity and genetic distribution as has been mentioned before. It is difficult to assess the exact impact that these translocations could have had on the Roan Antelope found in South Africa, because there are possibly, because of widespread translocations, no pure endemic Roan Antelope populations left.

But did pure, isolated Roan Antelope populations ever exist? Kruger and Nel (2002) suggests that *"the frequency and intensity of gene flow is not yet fully understood but the assumption can be made that Roan Antelope populations had contact with each other where their ranges overlapped, as can be expected from neighbouring populations"* .

One can assume that habitat fragmentation, the construction of fences, and the creation of game reserves caused Roan Antelope populations to become isolated from each other, thus creating artificial isolation of the species. Because no natural migration can take place, these "captured" populations experience different environmental and ecological conditions and varying evolutionary pressures, thus creating new subspecies. Hence, these artificially created subspecies represent an isolated population that may be considered as an ecological or evolutionary unit within a species that shows initial signs of evolutionary divergence.

This study suggests that there are no phenotypic, nor genetic data that can prove beyond reasonable doubt that South Africa had only one Roan Antelope subspecies. In fact, genetic data proves that there are two genetic groupings of Roan Antelope in South Africa. There is also evidence that the alleged endemic Roan Antelope populations that are found in South Africa are not pure and isolated, as was originally thought.

Therefore, the moratorium that was placed on the sale and translocation of Roan Antelope in South Africa, should be cancelled as there are no pure Roan Antelope subspecies or populations to left protect from alleged *exotic* Roan Antelope subspecies.

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12. GLOSSARY

adaptation -- Change in a organism resulting from natural selection; a structure which is the result of such selection.

ancestor -- Any organism, population, or species from which some other organism, population, or species is descended by reproduction.

allele -- Any of the alternative expressions (states) of a gene (locus)

basal group -- The earliest diverging group within a clade; for instance, to hypothesize that sponges are basal animals is to suggest that the lineage(s) leading to sponges diverged from the lineage that gave rise to all other animals.

character -- Heritable trait possessed by an organism; characters are usually described in terms of their states, for example: "hair present" vs. "hair absent," where "hair" is the character, and "present" and "absent" are its states.

clade -- A monophyletic taxon; a group of organisms which includes the most recent common ancestor of all of its members and all of the descendants of that most recent common ancestor. From the Greek word "klados", meaning branch or twig.

conspecific – Belonging to the same species

convergence -- Similarities which have arisen independently in two or more organisms that are not closely related. Contrast with homology.

diversity -- Term used to describe numbers of taxa, or variation in morphology.

DNA -- Deoxyribonucleic Acid

evolution -- Darwin's definition: descent with modification. The term has been variously used and abused since Darwin to include everything from the origin of man to the origin of life.

extinction -- When all the members of a clade or taxon die, the group is said to be extinct.

genotye -- The total genetic character of an organism, it's full DNA or genes

lineage -- Any continuous line of descent; any series of organisms connected by reproduction by parent of offspring.

locus -- The location of a given gene on a chromosome

monophyletic -- Term applied to a group of organisms which includes the most recent common ancestor of all of its members and all of the descendants of that most recent common ancestor. A monophyletic group is called a clade. More?

outgroup -- In a cladistic analysis, any taxon used to help resolve the polarity of characters, and which is hypothesized to be less closely related to each of the taxa under consideration than any are to each other.

phenotype -- The totality of characteristics of an individual (its appearance) as a result of interaction between genotype and the environment

phylogenetics -- Field of biology that deals with the relationships between organisms. It includes the discovery of these relationships, and the study of the causes behind this pattern.

phylogeny -- The evolutionary relationships among organisms; the patterns of lineage branching produced by the true evolutionary history of the organisms being considered.

polyphyletic -- Term applied to a group of organisms which does not include the most recent common ancestor of those organisms; the ancestor does not possess the character shared by members of the group.

rank -- In traditional taxonomy, taxa are ranked according to their level of inclusiveness. Thus a **genus** contains one or more **species**, a **family** includes one or more genera, and so on.

relatedness – Two clades are more closely related when they share a more recent common ancestor between them than they do with any other clade.

Re-introduction – an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct. ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).

selection -- Process which favors one feature of organisms in a population over another feature found in the population. This occurs through differential reproduction -- those with the favored feature produce more offspring than those with the other feature, such that they become a greater percentage of the population in the next generation.

sister group -- The two clades resulting from the splitting of a single lineage.

systematics -- Field of biology that deals with the diversity of life. Systematics is usually divided into the two areas of phylogenetics and taxonomy.

taxon -- Any named group of organisms, not necessarily a clade.

taxonomy -- The science of naming and classifying organisms.

Translocation -- deliberate and mediated movement of wild individuals or populations from one part of their range to another.