COLOUR VARIATION OF AFRICAN BOVIDAE: CONSEQUENCES FOR CONSERVATION AND THE WILDLIFE RANCHING INDUSTRY

By

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DECLARATION

I, Phillip Arnold Olivier, declare that the Master's Degree research thesis that I herewith submit for the Master's Degree qualification Magister Scientiae Zoology at the University of the Free State is my independent work, and that I have not previously submitted it for a qualification at another institution of higher education.

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CHAPTER 1

INTRODUCTION

In recent years colour variants of African Bovidae have received considerable media attention (Bezuidenhout 2012a; Stafford 2013, 2014; Flack 2014a, 2014b; York 2014), consequently becoming a topic of great interest within the wildlife industry (Needham & Hoffman 2014). Colour variation of wildlife is however, not a new phenomenon, nor is it limited to the Bovidae (Hofreiter & Schöneberg 2010; Needham & Hoffman 2014). Black and white springbok are known to have occurred naturally in the past, though at low densities; a black springbok was recorded in 1886 near Skietkuil (Kruger *et al.* 1979; Hetem *et al.* 2009). White springbok was well known to the San and /Xam people, who believed white springbok should not be hunted (Needham & Hoffman 2014). Golden Oryx are also known to have occurred under natural conditions in Namibia, whilst Golden Wildebeest are known from the Limpopo river basin (Van Niekerk 2011; Anonymous 2013a). Kruger *et al.* (1979) referred to black and white springbok colour variants as being scarce, however in recent years colour variants have become a common sight on game ranches and many new colour variants have become known. Several new springbok colour variants have since been recorded including bont, coffee, cream, ivory, kings, royal, and three colour candy springbok (Figure 1.1). In addition to this nowadays common phenomenon, the increase in number of colour variants is a result of selective breeding in the game ranching industry (Hetem *et al.* 2009). In 2001 a mere 11 colour variant animals were sold at Vleissentraal auctions, by 2014 this had increased to 1298 colour variants sold and currently there are over 40 different colour variations of African Bovidae (Table 1.1).

The rapid increase in the number of different variations is however questionable, as a statement from a game rancher indicates:

> *"Who decides what a colour variation is? E.g. a red hartebeest with an arbitrary patch on its nose is now apparently a "kings" hartebeest!!!!" – game rancher*

Within the game ranching industry the definition of what constitutes a colour variation seems to be arbitrary, some of the new colour variants only differ slightly from existing animals, e.g. the white springbok (Figure 1.1I), photographed in 2013, also shows the light brown/fawn shading that is present in the cream springbok (Figure 1.1J). Additionally some variants seem to only be temporary colour phases and may change colour, e.g. Bezuidenhout (2015) reported a yellow blesbok changing colour, to represent a normal coloured animal, after being purchased.

The selective breeding of different colour variants of Bovidae is causing concern among nature conservation officials (Hamman *et al.*, 2003; Hamman *et al.*, 2005). Nature conservation in South Africa is, however very closely linked to the private wildlife industry. The private wildlife industry has contributed towards the conservation of several game species and is responsible for saving a number of species from extinction e.g. bontebok (27 individuals protected on private farm Nacht Wacht in 1837), black wildebeest (less than 1800 individuals in 1965) and cape mountain zebra (H.J. Lombard contributed majority of animals to the core breeding population of 13 in 1950) (Hamman *et al.* 2005; Skinner & Chimimba 2005; Bothma *et al.* 2009). Furthermore, private game ranches have become the de facto conservators of habitats and their associated biota which are not properly protected within state run protected areas, ultimately increasing the area of South Africa being conserved (Bothma *et al.* 2009). Game ranches occupy 20 million hectares of previously unconserved land and is a potential sustainable land use for another 12 million hectares of overgrazed communal land (Dry 2013; Stafford 2013). Currently there are approximately 10 000 game ranches in South Africa; with high value wildlife, such as colour variants, present on an estimated 3000 of these ranches (Bothma *et al.* 2009; Anonymous 2014a). The game ranching industry also contributes towards the South African economy through revenue and job creation and as a whole is currently considered to be worth almost R9 billion (Anonymous 2013b).

Table 1.1. List of Bovidae colour variants currently available in South Africa, as well as some of the better known non-Bovidae colour variants.

Species	Colour variant	Species	Colour variant
Springbok: (*Antidorcas marsupialis)*	white black blue/silver/grey copper coffee cream/caramel ivory king bont royal three colour candy	**Blesbok:** (*Damaliscus pygargus phillipsi)*	apache bont copper painted red saddle back silver white yellow
Impala: (*Aepyceros melampus)*	black saddle back white white flanked white painted	**Oryx:** (*Oryx gazella)*	golden cardinal white painted black
Eland: (*Tragelaphus oryx)*	white king cape painted	**Blue wildebeest:** (*Connochaetes taurinus)*	golden kings
Kudu: (*Tragelaphus strepsiceros)*	white black	**Black wildebeest:** (*Connochaetes gnou)*	kings
Nyala: (*Tragelaphus angasii)*	red (male only) white	**Waterbok:** (*Kobus ellipsiprymnus)*	black white
Red hartebeest: (*Alcelaphus buselaphus)*	kings	**Non-Bovidae variants:**	golden zebra red zebra white ostrich white lion king cheetah

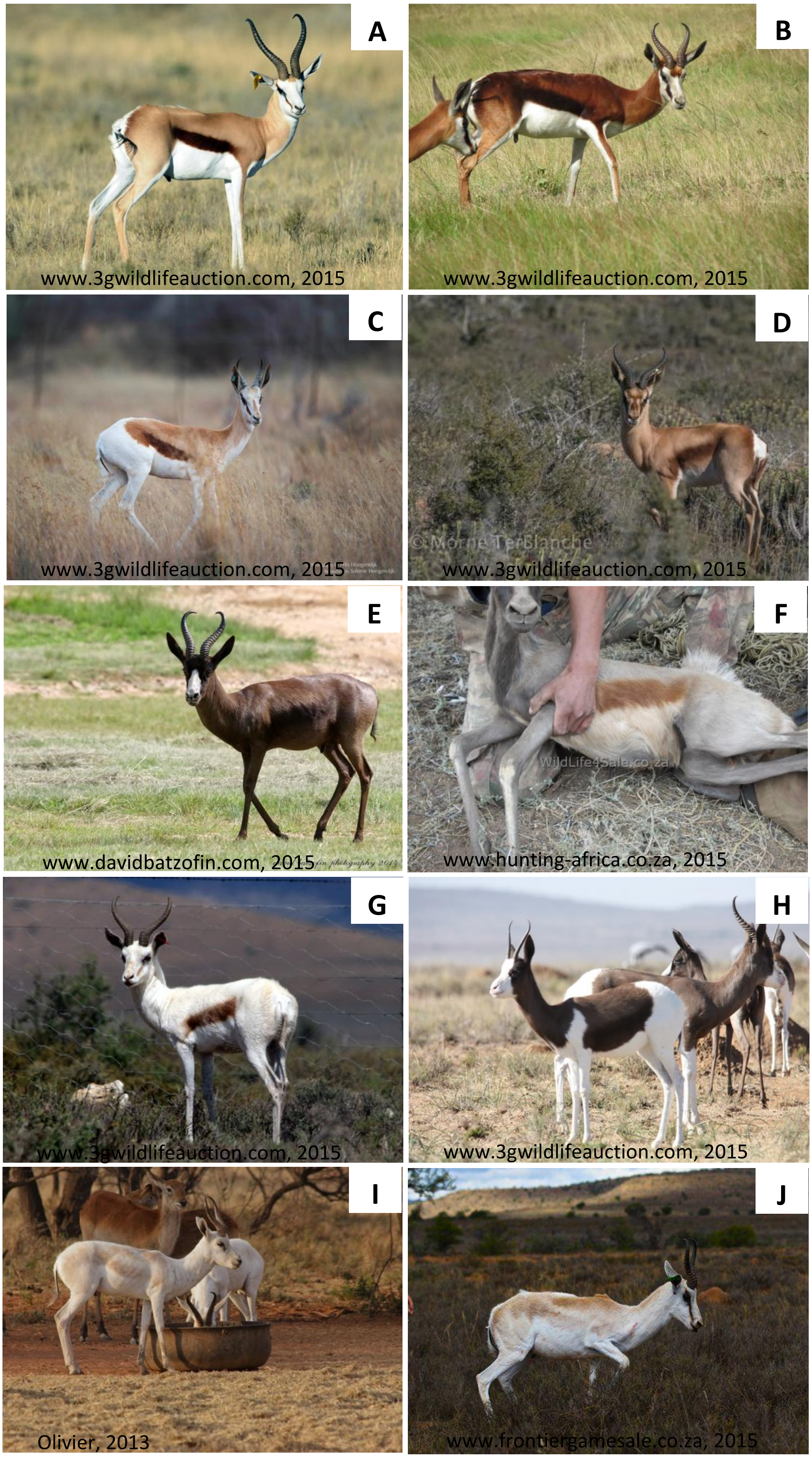


Figure 1.1. Normal springbok (*Antidorcas marsupialis*) and colour variants of springbok currently found in the game ranching industry in Southern Africa. A, normal; B, coffee; C, kings; D, royal; E, black; F, three colour candy; G, ivory; H, bont; I, white; J, cream.

It is well accepted that one of the functions of nature reserves, managed by government institutions, is to maintain viable populations of all animal species in order to assure the existence of that species. However, due to limited funding available to governmental conservation bodies, the conservation role of private wildlife ranches is becoming increasingly important (Cousins *et al.* 2008). Additionally it has now become known that springbok numbers in some nature reserves in the Free State are declining due to unknown reasons (Vrahimis *pers comm.* 2011). Stapelberg (2007) also mentioned that springbok numbers in the Kalahari have been declining over the last 20 years. If it would happen that natural populations of antelope became threatened, private game farmers will again play a vital role in the conservation of such animals. Consequently, the debate whether selectively bred colour variations of springbok contribute to nature conservation or not is ongoing and decisions regarding legislation may therefore have to play a very important role in the long term conservation of these antelopes.

Little data, concerning colour variants, is available and the lack of published scientific data concerning colour variants has resulted in a debate about these animals (between those who are opposed to colour variant breeding, preferring the environment to remain "as natural as possible" with minimal intervention and those who are in support of it seeing it as a natural part of evolution and an opportunity to grow the wildlife industry), seeing as neither faction can present concrete data to support their arguments. Accordingly, Needham & Hoffman (2014) mentions that the implications of coat colour variation are unclear, due to a lack of scientific study, specifically relating to genetics. Two of the major role-players in the debate at the moment are the South African Hunters and Game Conservation Association (SAHGCA), which is strongly opposed to the practice of breeding colour variants, and Wildlife Ranching South Africa (WRSA), which supports breeding of colour variants (Anonymous 2015a; Oberem 2015). The consequence of this debate is that nature conservation authorities are unable to verify whether concerns are valid and therefore cannot implement regulations concerning colour variations. It is the opinion of York (2005) that decisions in the creation of wildlife regulations are based on emotions and not on scientific, ecological or socio-economic principles. In 2010 the SANBI Scientific Authority recommended that legislation against colour variants should not be implemented but did recommend that colour variant breeding be discouraged and monitored through registration of breeders as well as that these breeders report on the numbers of animals traded (Donaldson 2010).

More recently though, there have been renewed calls for greater regulation of the wildlife industry by the South African Hunters and Game Conservation Association (Anonymous 2015a). Additionally the National Council of SPCA's (NSPCA) has called on government too not only regulate but to ban selective and intensive breeding practices, although it is not clear on what animal welfare grounds they wish to have these bans made (Anonymous 2015b).

Financial gain is the main motivator behind the breeding of colour variants as they have become sought after by game farmers (Hamman *et al.* 2005; Radder 2007). Investing in wildlife gives greater return on investment than in stock market shares and has consistently outperformed the JSE ALSI and Dow Jones (Slabbert 2013). Even though colour variants have become very sought after and profitable to farm with and most ranchers truly care about the environment (Bothma *et al.* 2009), Hamman *et al.* (2003) and Hamman *et al.* (2005) warned that colour variants do not contribute to conservation or the long term survival of a species since colour variants normally do not survive in nature. In this regard, Hetem *et al.* (2009) reported that colour variants have different energy requirements and farmers are reporting that black coloured individuals are preferred by predators and are the first to fall prey (Anonymous 2011a).

The adaptive significance of colour variants is uncertain since these animals have been bred for aesthetic purposes (Hetem *et al.* 2009). Colour variation could potentially be a selective pressure. Finch & Western (1977) found that different colours of cattle were selected against during periods of limited food supply. Hetem *et al.* (2009) proposed that colour variation could be a possible pre-adaptation to future environmental conditions. According to Loehr *et al.* (2008) hybridization can lead to traits that influence sexual selection and found that coat colour in Stone's sheep, *Ovis dalli stonei*, is associated with dominance and mating behaviour. Jess De Klerk, member of Wildlife Ranching South Africa as well as Free State Hunters and Game Conservation Association, has reported that white blesbok are larger and more dominant than the normal coloured animals (De Klerk *pers comm.* 2011). He further claimed that white blesbok rams are more dominant during the mating season (De Klerk pers comm. 2011). If such claims proof to be true, this will have a huge effect on the rate at which the gene, coding for that specific colour, sped through the population. In male-to-male competition physical characteristics, such as size, are generally important in determining which individual will win mating rights. It might even force runaway selection, a process that occurs when a female preference for a specific male trait , in this case colour, becomes stronger and more frequent with every generation (Ryan 1997; Dugatkin 2000). Current genetic knowledge of coat colour is based on other mammal species, such as mice (Needham & Hoffman 2014). Colour variation is a Mendelian trait; it is controlled by a single locus, with additional genes influencing coat colour to a lesser degree (Needham & Hoffman 2014). The coat colour of an animal is ultimately dependant on the melanin pigment found in the hair and epidermis.

Darker colours (brown to black) are due to eumelanin, whilst lighter colours (red to yellow) are due to phaeomelanin (Needham & Hoffman 2014). Colour variation is a natural phenomenon, occurring within populations due to spontaneous mutations (Needham & Hoffman 2014). Consequently colour variant Bovidae are not manmade, however they have become more common due to selective breeding practices. Mutations can be beneficial, detrimental or neutral in its effect on an animal (Needham & Hoffman 2014). However, the environmental conditions such as temperature (Hetem *et al.* 2009) and food availability (Finch & Western 1977) combine with the effects of mutations to determine an animal's ultimate fitness (survival). Under natural conditions, mutations would be subject to natural selection and it would be expected that beneficial mutations would become more common within a population, whilst detrimental mutations would be selected against. However, artificial conditions, including supplementary feeding and removal of predators, along with selective breeding on game ranches do not allow natural selection to take place (Needham & Hoffman 2014). Furthermore colour mutations are pleiotropic, affecting multiple genes, and have been shown to affect the sorting of blood platelets (leading to excessive bleeding) as well as disorders such as melanosis (Needham & Hoffman 2014). Consequently, it is possible that many colour variants carry detrimental mutations that are being masked by current methods of wildlife management. This gives rise to concerns that colour variants of African Bovidae do not contribute to conservation, even though they occur naturally, as they do not normally survive, or at least become common in nature (Hamman *et al.*, 2003;

Hamman *et al.*, 2005). It should be kept in mind though that colour variation can be beneficial as well. Colour variant animals can be more resistant to environmental changes (Delhey *et al.* 2013), black springbok are reported to survive cold conditions better (Hetem *et al.* 2009) and black leopards are known to better survive epizootics (Needham & Hoffman 2014). Du Toit *et al.* (2010) states that colour variants should not be selectively bred but rather left to occur naturally.

The aim of this study was to address the lack of scientific information regarding colour variant Bovidae. This was done by investigating several claims (including but not limited to: colour variants do not contribute to conservation, that there will not be a demand from hunters for colour variant animals, that colour variant wildlife is damaging South Africa's conservation image) concerning colour variants through:

1. Observing colour variant behaviour, to determine whether colouration influences an animal's behaviour
2. To determine the role of colour variants within the wildlife industry
3. Determining what the stakeholder opinions are concerning these animals

Colour variants have become a large part of the wildlife industry and consequently research concerning these animals will be extremely important to facilitate management and, if required, regulation of colour variant Bovidae.

CHAPTER 2

STUDY AREA

The study was carried out in the Free State Province of South Africa, which is a landlocked province covering much of central South Africa and is part of South Africa's high interior plateau, known as the Highveld (Holmes *et al.* 2008). Mixed small and large stock farming and commercial dry land cultivation takes place in the province (Wiggs & Holmes 2011). The Free State falls within the catchment of the Vaal and Orange rivers, which also form the province's northern, north western, southern and south western borders, with the Drakensberg Mountains forming the eastern border (Holmes & Barker 2006). The Free State is a mostly semi-arid region with summer rainfall of between 300 and 900mm annually, the driest part of the province is in the west with annual rainfall increasing towards the northeast where the climate becomes subtropical (Moeletsi, Walker & Landman 2011).

The study site for the behavioural research was the game ranch Exotic Safari. Exotic Safari is located in the western Free State and falls under the Letsemeng Municipality. The farm of approximately 2000 ha is situated S29°22'23.8" and E24°32'22.4", on the Free State/Northern Cape border and is approximately 200km west of Bloemfontein and 80km south of Kimberley; the nearest towns are Jacobsdal and Koffiefontein (Figure. 2.1). This area is known for having the largest concentration of pans in South Africa and it is the transition zone between the humid grasslands to the east, semi-arid Karoo to the south and arid Kalahari to the north (Holmes *et al.* 2008, Wiggs & Holmes 2011).

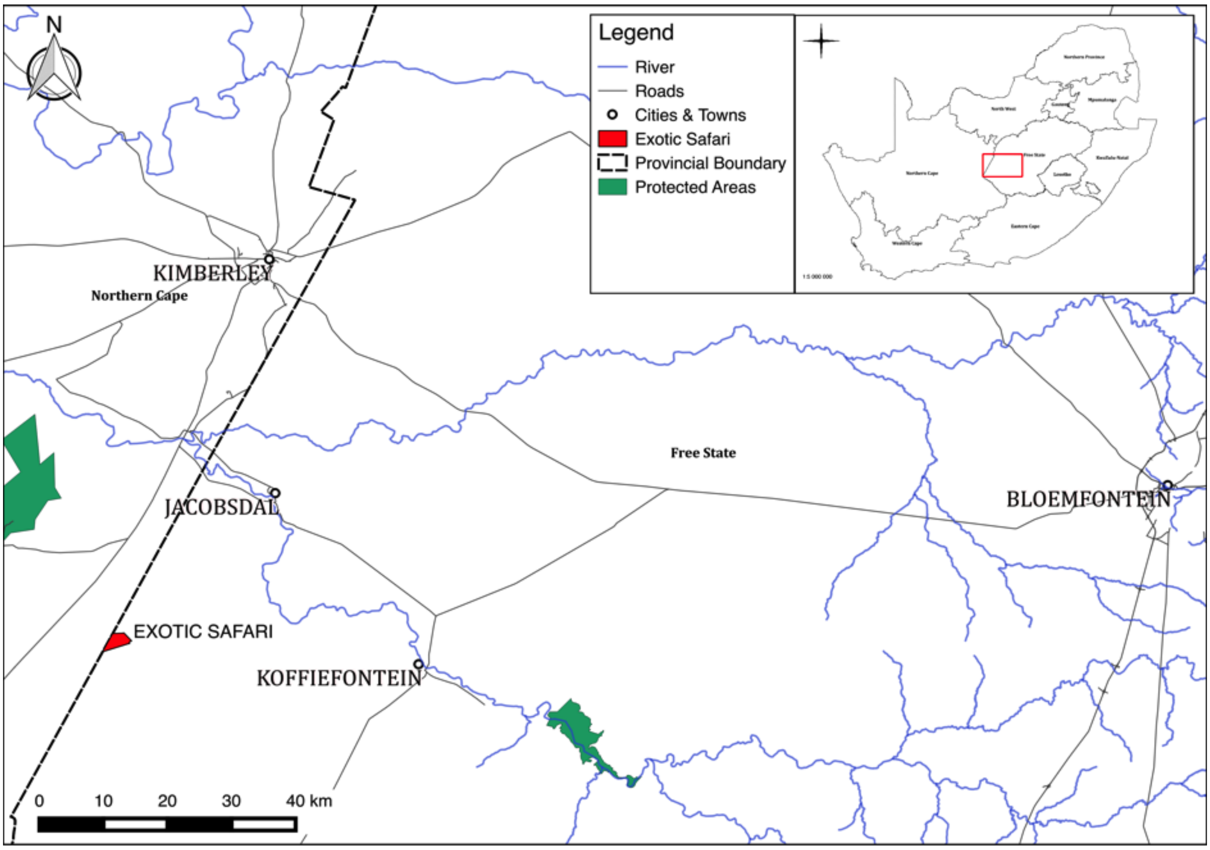


Figure 2.1. The location of Exotic Safari within the western Free State and South Africa (inset)

The western Free State is considered to be of very low to non-arable agricultural potential, where possible crops are grown, otherwise large stock are grazed on unimproved grassland (Wiggs & Holmes 2011). The Jacobsdal area is also home to the Orange-Riet Government Water Scheme which is used for irrigation in the area. The Orange-Riet canal, which transfers water from the Vanderkloof dam to the Riet River irrigation scheme, flows though the Heuningneskloof valley where Exotic Safari is situated (Department of Water Affairs and Forestry n.d.). The landscape of the western Free State can be described as flat to rolling with characteristic scattered dolerite hills of limited height, commonly referred to as koppies (Holmes *et al.* 2008).

2.1 Topography

The study area consists of a landscape with predominantly level and gently sloping plains and ridges, which is the result of weathering and erosion of the Ecca Group rocks (Holmes & Barker 2006). Dolerite sills are responsible for the formation of the ridges and koppies which are common to the area (Rutherford *et al.* 2006). Elevation ranges from 1200m to 1270m above sea level. A single koppie occurs within the wildlife enclosure. An ephemeral stream flows from west to east in the southern part of the enclosure and drains into a farm dam, whilst a second ephemeral stream lies just north of the enclosure. In addition to the farm dam, several water troughs are scattered throughout the enclosure at the various feeding sites (Figure 2.3), to provide water to the animals from boreholes. These water troughs are the main water source for most of the animals.

2.2 Geology

The geology of the Free State consists mostly of rocks from the Karoo Supergroup. Ecca Group sedimentary rocks (mostly shales) are common in the western Free State along with dolerite intrusions, some diamond bearing kimberlites are also present, such as at the nearby town of Koffiefontein (Holmes & Barker 2006; Wiggs & Holmes 2011). Diamictites of the Dwyka Group and shales from the Volksrust and Prince Albert formations occur in the area (Mucina *et al.* 2006). According to AGIS (2007), the generalized soil pattern of the study area was determined to be one of cambisols (CM), which are red soils with a high base status. According to Mucina *et al.*, (2006) soils in the area vary from shallow Glenrosa and Mispah soils to shallow to deep, apedal, red-yellow, freely drained soils: these soils support the Northern Upper Vegetation. Rutherford *et al.* (2006) indicates that the Hutton soil form is associated with Kimberley Thornveld vegetation, whilst Mispah and Glenrosa soil forms are associated with Vaalbos Rocky Shrubland vegetation; both these vegetation types occur within the study site. Pleistocene calcretes, from the Kalahari Group, and unconsolidated sandy alluvial and colluvial deposits are also widely distributed through the western Free State (Holmes and Barker 2006; Mucina *et al.* 2006; Wiggs and Holmes 2011). Unconsolidated, windblown sands also occur surficially in the western Free State and are a familiar trait of ephemeral streams (Hensley *et al.* 2006; Holmes *et al.* 2008). Nodular and hardpan calcretes are also common beneath soil or on the surface in the western Free State (Holmes *et al.* 2008).

2.3 Climate

The climate of Free State is controlled by macro-scale atmospheric circulation (Holmes *et al.* 2012). The climate of the Free State west of Koffiefontein, where the study area is located, is arid to semi-arid (Moeletsi *et al.* 2011). Available literature (Moeletsi *et al.* 2011) states that mean annual rainfall in the area is less than 350 mm, however over the last 13 years the ARC weather station at Rietrivier has recorded a mean annual rainfall of 385.1 mm.

The mean duration of the rainy season is less than 160 days, starting in November and ending in April (Moeletsi *et al.* 2011). Wind is highly variable in the area mostly blowing north to northeast; during winter months cold fronts are associated with north-westerly winds (Holmes *et al.* 2008). Localised dust storms occur in the area in the late winter and spring when the area is at its driest (Holmes *et al.* 2012). The maximum temperature recorded during the study period, by the nearest weather station (29 km away), was 36°C and the minimum 1°C. The area experiences a 4-month, wet period from December through March, followed by a dry period (with less than 50mm rain per month) from April through November (Figure. 2.2). The driest month is July with less than 5mm mean monthly rainfall, July and June are also the coldest months with a mean temperature of 10.5°C (mean maximum temperature of 19.6°C and mean minimum of 0.7°C). January is the wettest (65.3mm mean rainfall) as well as the warmest (mean temperature of 25.4°C, mean maximum temperature of 32,7°C and mean minimum of 16.9°C) month in the study area.

2.4 Vegetation

The study area falls on the ecotone between the Savanna and Nama-Karoo biomes. According to Acocks' veld types South Africa, the farm's vegetation can be described as False Upper Karoo (Acocks 1988). Low & Rebelo (1998) classifies the vegetation as part of the Eastern Mixed Nama Karoo. The more recent vegetation map by Mucina & Rutherford (2006) shows three types of vegetation occurring in the area, two from the Savanna Biome, Kimberley Thornveld and Vaalbos Rocky Shrubland, and one from the Nama-Karoo Biome, Northern Upper Karoo. Several feeding sites are also located within the study area (Figure 2.3), where additional feed is provided to the animals throughout the year in the form of lucerne and supplements.

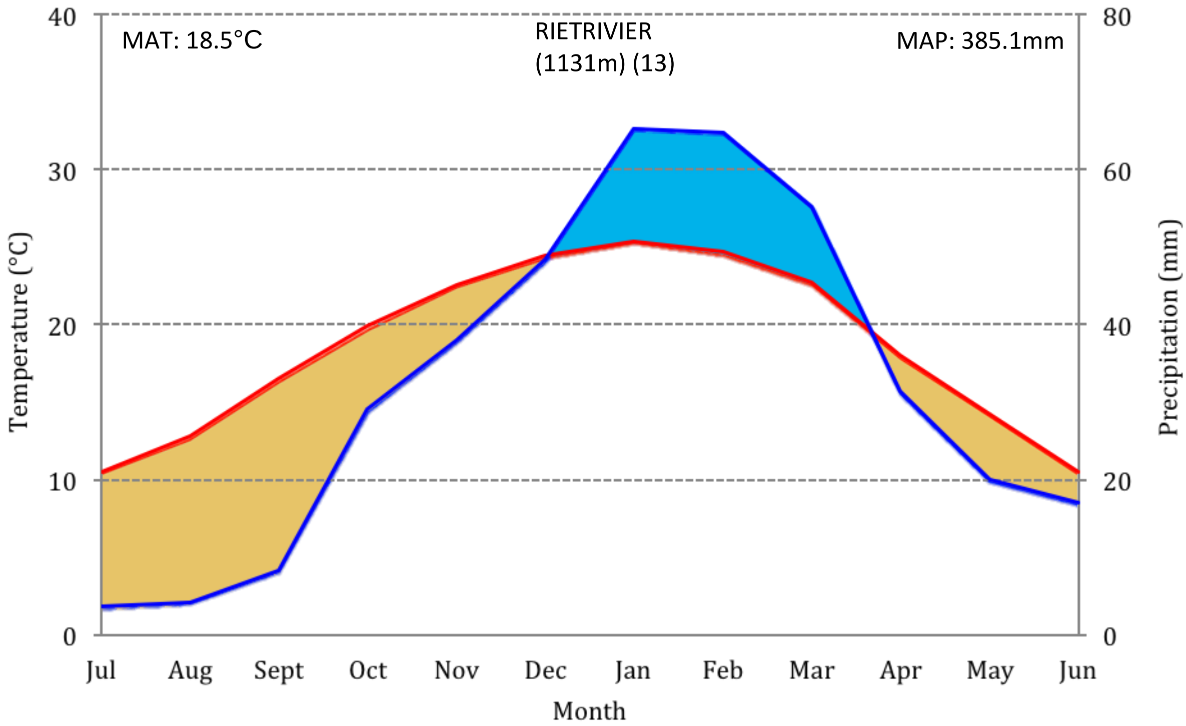


Figure 2.2. Climate diagram for the study area, following the Walter & Leith (1967) method. Where rainfall line exceeds the temperature line (blue shaded area) it indicates the wet season (December to March) and where the rainfall falls below temperature (yellow shaded area) it indicates the dry season (April to November). (red line: temperature, blue line: precipitation, yellow area: dry season, blue area: wet season)

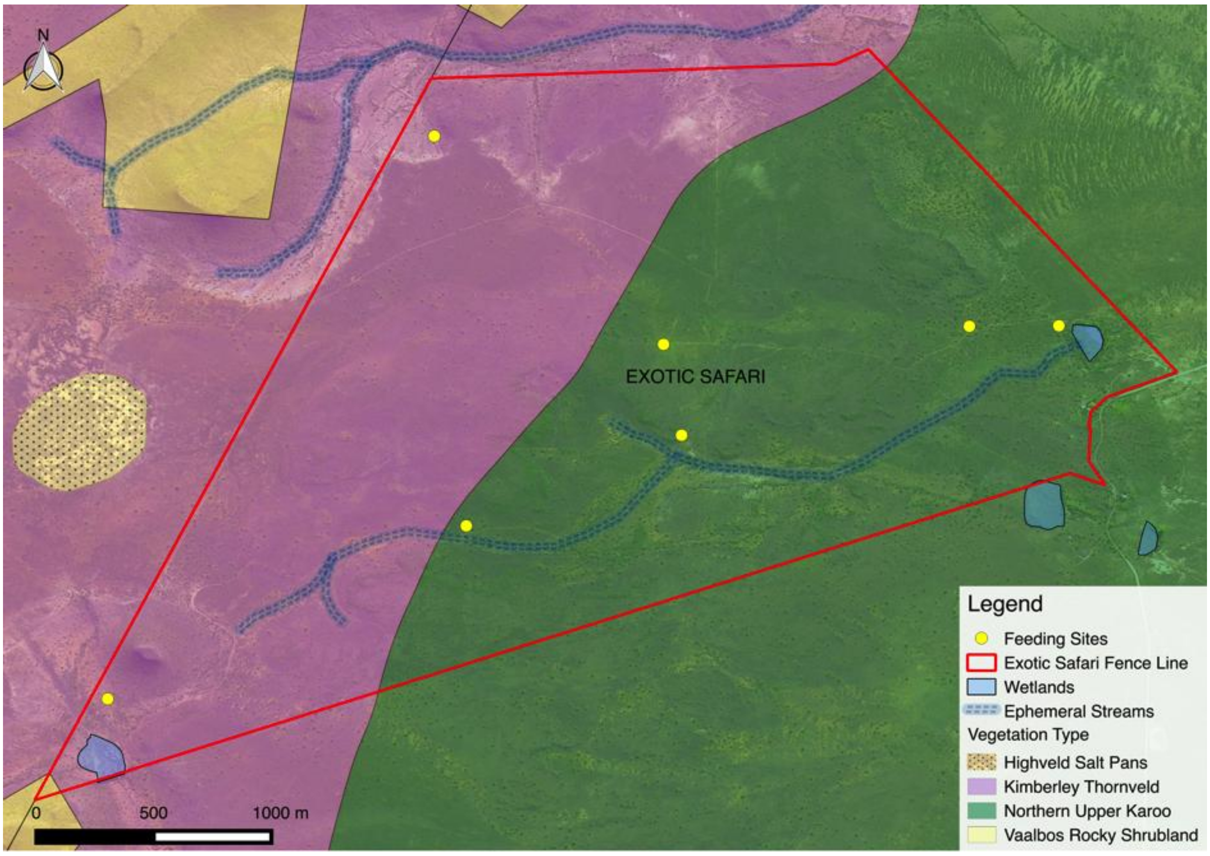


Figure 2.3. Distribution of vegetation, based on map by Mucina & Rutherford (2006), and feeding sites at Exotic Safari. Small patches of Vaalbos Rocky Shrubland, which occur on koppies and ridges, are not indicated on this map due to small size.

2.4.1 Northern Upper Karoo

Covering the eastern half of the wildlife enclosure at Exotic Safari (Figure 2.3), the Northern Upper Karoo vegetation is part of the Nama-Karoo biome and comprise approximately 50% of the study area. This vegetation type occurs on flat or gently sloping landscapes and is found on the transitions between Nama-Karoo, Kalahari savanna and highveld grassland. This type of vegetation is characterised by the occurrence of dwarf karoo shrubs, grasses and low trees, predominantly *Vachellia mellifera*. *Lithops hookeri, Stomatium pluridens, Atriplex spongiosa, Gelenia exigua and Manulea deserticola* are endemic to this vegetation type. Grasses that occur within this vegetation type include: *Aristida adscensionis, A. congesta, A. diffusa, Enneapogon desvauxii, Eragrostis lehmanniana, E. obtusa, E. truncata, E. bicolor, E. porosa, Sporobolus fimbriatus, Stipagrostis obtusa, Fingerhuthia africana, Heteropogon contortus, Stipagrostis ciliata, themeda triandra, Tragus berteronianus, T. koeleriodes, T. racemosus. Prosopis glandulosa* is a common invasive plant within the Northern Upper Karoo vegetation zone. Northern Upper Karoo vegetation has a conservation status of least concern and is mostly threatened by human settlement (Mucina *et al.* 2006).

2.4.2 Kimberley Thornveld

Kimberley Thornveld is associated with plains and is part of the Savanna biome. This vegetation type has well developed tree and shrub layers as well as a grass layer with exposed soil, the tree layer includes various *Vachellia spp*. Kimberley Thornveld may also have thick stands of the shrub *Tarchonanthus camphoratus* and *Vachellia mellifera* trees, other trees include *Vachellia karroo* and *Searsia lancia*. Grasses of this vegetation type include *Eragrostis lehmanniana* as well as other *Eragrostis spp., Aristida spp., Digitaria spp., Enneapogon spp.* and *Themeda triandra*. Succulents include *Aloe hereroensis* and *Aloe grandidentata.* Kimberley Thornveld covers an estimated 45% of the study area and occurs on the western half of the enclosure. This vegetation type has a conservation status of Least Threatened (Rutherford *et al.* 2006).

2.4.3 Vaalbos Rocky Shrubland

The remaining 5% of the study area is covered by Vaalbos Rocky Shrubland, which is also part of the Savanna biome, and occurs in small isolated patches on koppies and ridges within the wildlife enclosure. Vaalbos Rocky Shrubland is characterised by the occurrence of evergreen shrubs including *Olea europaea* and *Tarchonanthus camphorates*. Other characteristic plants include small trees such as *Boscia albitrunca, Cussonia paniculata* and *Searsia lancea* as well as shrubs such as *Euclea crispa* and *Ziziphus mucronata*. Grasses found in this vegetation include *Aristida spp., Eragrostis lehmanniana* and *Themeda triandra* (Rutherford *et al.* 2006).

2.5 Fauna

The Fauna at Exotic Safari includes various ungulates that are kept for hunting and breeding practices, these include: black wildebeest (*Connochaetes gnou*), blesbok (*Damaliscus pygargus phillipsi*) and blesbok colour variants, blue wildebeest (*Connochaetes taurinus*) and blue wildebeest colour variants, buffalo (*Syncerus caffer*), eland (*Taurotragus oryx*) and eland colour variants, giraffe (*Giraffa camelopardalis*), impala (*Aepyceros melampus*) and impala colour variants, kudu (*Tragelaphus strepsiceros*) and kudu colour variants, lechwe (*Kobus leche leche*), nyala (*Tragelaphus angasii*), red hartebeest (*Alcelaphus buselaphus*), roan (*Hippotragus equinus*), sable (*Hippotragus niger*), springbok (*Antidorcas marsupialis*) and springbok colour variants, steenbok (*Raphicerus campestris*), tsessebe (*Damaliscus lunatus*), vaal ribbok (*Pelea capreolus*), waterbuck (*Kobus ellipsiprymnus*) and waterbuck colour variants and zebra (*Equus quagga*). Ostrich (*Struthio camelus*) is also present on the farm along with several other bird species, including crows and vultures that are attracted to carcasses left over after hunting. Black backed jackal (*Canis mesomelas*) and caracal (*Caracal caracal*) are known predators in the area. Several species of small mammal and reptiles are also present on the ranch.

CHAPTER 3

MATERIALS AND METHODS

3.1 Behaviour Sampling Methods

Springbok (*Antidorcas marsupialis*) was selected for behavioural observations of colour variants, as this species of antelope have the largest number of variants and were present at Exotic Safari in sufficient numbers. Furthermore, in addition to the normal coloured animals, three different springbok variants were all kept within the same area at Exotic Safari and were therefore subject to the same conditions and interaction between variants were also possible. The three springbok colour variants that were observed were black/chocolate, copper and white variants. The numbers of antelope present at Exotic Safari, varied throughout the study as a result of hunting, addition of newly acquired animals, relocation to other wildlife enclosures and births and natural deaths. The maximum number of springbok were 45 normal springbok (which may include colour variant gene carriers, known as 'split' animals in the wildlife ranching industry), 7 black, 8 copper and 34 white springbok.

Fieldwork involving behaviour sampling of Springbok was carried out from October 2011 to July 2013. Although the collection of data during the winter months was limited as a result of restricted access to the farm during the hunting season, data was collected during each season. Sampling was carried out in such a way that a full 24h day is represented in the data. Diurnal springbok behaviour was sampled from first light till twilight and nocturnal behaviour from before twilight till after first light.

As far as possible, springbok were observed from the same locations every day, with a large field of view, near the feeding site they most frequented. Springbok were observed from the vehicle at a distance, with the aid of a Celestron 12 x 50 spotting scope, to minimise disturbance by the observer. Where possible the vehicle was parked close to/between vegetation cover to further limit influencing animals' behaviour. When observations were not possible from these locations, springbok were slowly followed, by vehicle, at an increased distance, only moving once visibility was no longer sufficient for observations to be made.

Nocturnal observations were done with the use of a spotlight with a red filter attached. During nocturnal observations it was also possible to observe the animals from a shorter distance, than diurnal observations, without disturbing them.

3.1.1 General Daily Activity

The general daily activity of springbok was measured by making use of instantaneous scan sampling, as described by Martin & Bateson (2007). With this method the behaviour of the entire group being studied was quickly scanned at fixed 15 minute intervals and each individual's behaviour, at that instant, and the colour variant recorded. The following categories of behaviour were recorded with this method: feeding (natural), feeding (supplements), standing, lying down, walking, running, drinking and other behaviour.

3.1.2 Thermoregulatory Behaviour

Thermoregulatory behaviour was also sampled using instantaneous scan sampling with 15 minute intervals, as described by Martin & Bateson (2007). Each colour variant's orientation towards the sun or whether it was in the shade was recorded on each sampling point. Data for orientation towards the sun was recorded from first light to twilight each day.

3.1.3 Rare and Significant Behaviour

Rare and significant behaviour, such as fights and copulation was recorded using behaviour sampling and continuous recording as described by Martin & Bateson (2007).

3.1.4 Grouping Behaviour

The composition of springbok herds concerning colour variation was recorded each time a herd was spotted, only adult animals were counted, since juveniles of differing colours would move with their mother (it was assumed that dependence by juveniles on their mother would override any preference towards herding with animals of the same colour). An individual springbok was considered to be part of a herd if it was less than twenty body lengths from the next nearest individual and moved in the same general direction as other individuals of the same herd.

3.2 Survey: Stakeholder opinions concerning colour variants

In this chapter, the term "stakeholder" refers to game breeders, hunters, nature conservation authorities, veterinarians, scientists and other parties with an interest in the wildlife ranching and nature conservation industry. Information regarding attitudes towards colour variant wildlife was gathered by reading through online wildlife, eco-tourism, hunting and conservation orientated web forums and popular media such as magazines. A survey was therefore created to quantify opinions concerning colour variant wildlife. Information gathered from these online forums was used to aid in the creation of the questions for the survey.

The survey was created in the Likert style, by giving respondents a choice of answers ranging from strongly agree to strongly disagree. The survey created Likert type data and not true Likert data. A section was also added where respondents could make additional comments.

To limit non-response bias the survey was made as easy as possible to answer by making it available to be answered electronically, Google Forms was used to create the electronic survey and was hosted alongside printable versions of the survey on a Google Drive. The survey was furthermore distributed as widely as possible through e-mail. The survey was sent to individual game ranchers, whose contact details were gathered by using advertisements in the Game & Hunt magazine.

The survey was also sent to the South African Wildlife Management Association (SAWMA), Wildlife Ranching South Africa (WRSA) and South African Hunters and Game Conservation Association (SAHGCA) for distribution to their members. The Professional Hunters Association of South Africa (PHASA) was also contacted but PHASA did not respond to any communication concerning colour variants until after data analysis was completed. Furthermore the survey was sent to national and provincial nature conservation authorities, including SANPARKS, Cape Nature and Free State Department of Economic Development, Tourism and Environmental Affairs. Several respondents who received the survey also redistributed it; in this manner a link to this survey was also published in the African Indaba (a newsletter of the International Council for Game and Wildlife Conservation).

3.3 Game Auction Statistics

Auction results were gathered by contacting the Game & Hunt Magazine, which provided the statistics they had published from 2004 to 2013 as well as by contacting Vleissentraal, which provided their game auction results from 2001 to 2014. In 2014 Vleissentraal was responsible for more than 75% (R1.4 billion) of the total auction turnover (R1.8 billion) at 83 official auctions as recorded by Cloete (2015a).

3.4 Climate Data

Weather data for the study period was obtained from the Agricultural Research Council Institute for Soil, Climate and Water (ARC-ICSW) from two weather stations. Data from the nearest weather station, Rietrivier (29 km away), to the study site was primarily used; in the event that data from this site was incomplete it was supplemented with data from the next nearest weather station, in Mokala National Park (31 km away). Weather data included hourly readings of average hourly temperature, incoming solar radiation (insolar), wind speed and direction as well as rainfall. Historical climate data was also obtained from the ARC-ICSW from these two weather stations. Data from to 2004 to 2014 was obtained for the Rietriver Station and from 2007 to 2014 for the Mokala station. Readings included daily minimum and maximum temperature as well as total rainfall.

3.5 Geographic Information System

All maps were created using QGIS (2014) (previously known as Quantum GIS) geographic information system software. Geographic data of the study site was created manually by use of a Garmin GPSmap 62s handheld GPS device as well as digitizing, creating vector data, features observed on a SPOT imaging of the study site. SPOT images of the study area were obtained from the Department of Geography at the University of the Free State. Vector data sets, in the form of shapefiles, were also obtained from the Department of Geography.

Vegetation data sets were obtained from the South African National Biodiversity Institute (SANBI), as web based downloads from the Biodiversity GIS (BGIS) and PlantZAfrica.com

3.6 Data Analysis

A professional statistician was approached to assist with data analysis. The data generated by the behavioural observations had a skew distribution with a large variance, therefore median values and the Kruskal-Wallis test was used to determine whether there were significant differences in behaviour between colour variants. Spearman Correlation Coefficients were used, as a result of the skew distribution of the data, to determine whether there was any correlation between environmental variables, specifically temperature and insolar, and thermoregulation behaviour of the four colour variants. Spearman Correlation Coefficients were also used to determine whether there was any correlation between environmental variables and general behaviour of the springbok colour variants. Significant differences were calculated at a 95% confidence level.

CHAPTER 4

BEHAVIOUR OF SPRINGBOK COLOUR VARIANTS

4.1 Introduction

Black and white springbok are known to have occurred under natural conditions in the past (Skinner & Louw 1996; Hetem *et al.* 2009). Kruger *et al.* (1979) investigated the morphological differences between springbok variants. At the time three variants were known: the normal, white and black springbok. Several new springbok colour variants have since been recorded including blue, bont, coffee, copper, cream, ivory, kings, and royal springbok (Figure. 1.1). Kruger *et al.* (1979) found that the only significant difference between colour variants was the colour of the hair.

The colour of an animal's pelt has a variety of functions including communication, concealment and physiological functions such as thermoregulation (Stoner *et al.* 2003; Hetem *et al.* 2009; Caro 2013). In the case of springbok colour variants, the purpose of the different coat colours is unclear, specifically the adaptive significance, as these animals have been selectively bred for aesthetic purposes (Hetem *et al.* 2009).

Springbok behaviour varies seasonally (Estes 1999), with daily activity being influenced by the environmental conditions such as temperature and the availability of forage (Skinner & Louw 1996). Black springbok experience different environmental pressures, specifically from solar radiation, than the white or normal coloured springbok (Hetem *et al.* 2009). This is as a result of the darker coat leading to greater heat gain from the environment (Finch & Western 1977; Hetem *et al.* 2009). Hetem *et al.* (2009) found that behavioural differences were present between colour variants with black springbok being less active than the other variants.

Springbok is the only gazelle in the southern African region (Estes 1991). They are mixed feeders, filling a wide niche usually occupied by various gazelles in the rest of Africa (Estes 1991). Grass is an important part of a springbok's diet, but springbok will selectively feed on young and tender grasses and short Karoo vegetation (Skinner & Louw 1996).

Springbok are selective feeders and food quality is an important factor in habitat choice. However, black springbok exhibited a preference for bushveld-like habitat, largely avoiding the karroid vegetation, which contrasts with the social organisation of Bovidae as described by Estes (1974), Jarman (1974) and Leuthold (1977) which states that gazelle such as springbok are open area species which mainly run away from danger rather than depending on concealment from predators.

Springbok are preyed upon by a variety of predators including but not limited to black-backed jackal (*Canis mesomelas*), caracal (*Caracal caracal*), cheetah (*Acinonyx jubatus*) leopard (*Panthera pardus*), lion (*Panthera leo*), wild dogs (*Lycaon pictus*), Spotted hyena (*Crocuta crocuta)* and Brown hyena (*Parahyaena brunnea*). Attempted predation by black-backed jackal on springbok was observed during the study, whilst caracal are known to occur at Exotic Safaris, lion and cheetah are also kept on the ranch in separate enclosures next to the springbok enclosure. Consequently, springbok make use of herds for protection through the dilution effect and increased vigilance (Pays *et al.* 2007; Garay 2009; Rodgers *et al.* 2011). Males are either territorial or occur in bachelor herds whilst females tend to form nursery herds with their young. Mixed herds are formed during migrations (Estes 1991; Skinner & Louw 1996). Estes (1974), Jarman (1974) and Leuthold (1977) stated that the social organization of ungulates into herds provides them with protection from predators. Predation is a strong selective factor in the creation of groups and can influence behaviour (Reid 2005; Garay 2009; Rodgers *et al.* 2011). Anecdotal reports supported by Hetem *et al.* (2009) indicated that springbok differentiate into herds by colour variant.

During the study it was hypothesised that:

- Springbok colour variants would show differing behaviour as a result of the altered impact of environmental conditions on colour variants;
- antipredator behaviour, through the odd-prey (oddity) effect is responsible for the formation of phenotypically differentiated herds; and
- based on anecdotal evidence, colour variant animals are often dominant over normal coloured individuals. It was consequently also hypothesised that colour variants would differ in sexual selection. It was, however, not possible to study sexual selection due to selective breeding and hunting practices taking place.

4.2 General Daily Activity

According to Hetem *et al.* (2009) springbok colour variants show similar behaviour patterns with the exception of black springbok being less active. The Kruskal-Wallis test indicates a significant difference ($P < 0.0001$) between the median percentages among the springbok colour variants concerning activity and resting.

4.2.1 Level of Activity

White, normal and copper springbok showed relatively similar periods of activity over the entire study period (Figure 4.1.). Springbok were most active during the day with peaks in activity during dawn (05:00-07:00), midday (11:00-16:00) and evening (17:00-19:00). These three periods are interspersed with limited resting. White, normal and copper springbok also show similar resting (absence of any visible physical activity) periods, peaking shortly after evening (20:00) and again just before dawn (04:00). Between the two nocturnal peaks in resting there is a period of activity, though not as intensive as during the day. During this period the majority of activity is in the form of feeding. Black springbok showed markedly different periods of activity; they still show the same peaks in activity during dawn and evening, but were markedly less active during most of the day (Figure 4.1). Even though the small sample size of black springbok could have an influence on the data, Hetem *et al.* (2009) also found that black springbok were less active than both white and normal springbok.

Springbok showed clear seasonality in activity between the wet and dry seasons (Figure 4.2). During the wet season normal, white, copper and black springbok were extremely active, nearly 100% of animals observed, during dawn and evening. Normal, white and copper springbok continued to stay active during morning and midday, with only a small (proportional) number of springbok resting between 09:00 and 16:00. In contrast, black springbok showed little activity during most of the day, dawn and evening being the only periods when there was considerable activity. Throughout the wet season nocturnal activity was dominated by alternating periods of activity and rest. Just before evening

(18:00) most springbok among all four variants, are active. This period of activity is directly followed by a period of rest throughout the night, with a peak between 20:00 – 22:00 and second peak in resting at 04:00. These two peaks of rest are interspersed by a period of limited activity (22:00-03:00) (Figure 4.2).

During the dry season springbok are less active than during the wet season (Figure 4.2). Normal springbok maintained activity at approximately 80% during the day compared to nearly 90% in the wet season. White springbok showed a greater disparity between dry and wet seasons maintaining activity at about 50% and close to 80%, respectively, throughout the day. Copper springbok exhibited similar levels of activity to the white springbok during the dry season, with activity levels falling to 0% twice during the day. Nocturnal activity during the dry season consisted of a short period of rest at 20:00, followed by limited activity from 21:00 – 23:00, which then gradually declined reaching a nadir before dawn (Figure 4.2). Normal and white springbok exhibited similar nocturnal activity during the dry season. Copper springbok however, reached higher levels of activity (nearly 80%) during the night and exhibited a sharper decline in activity after midnight.

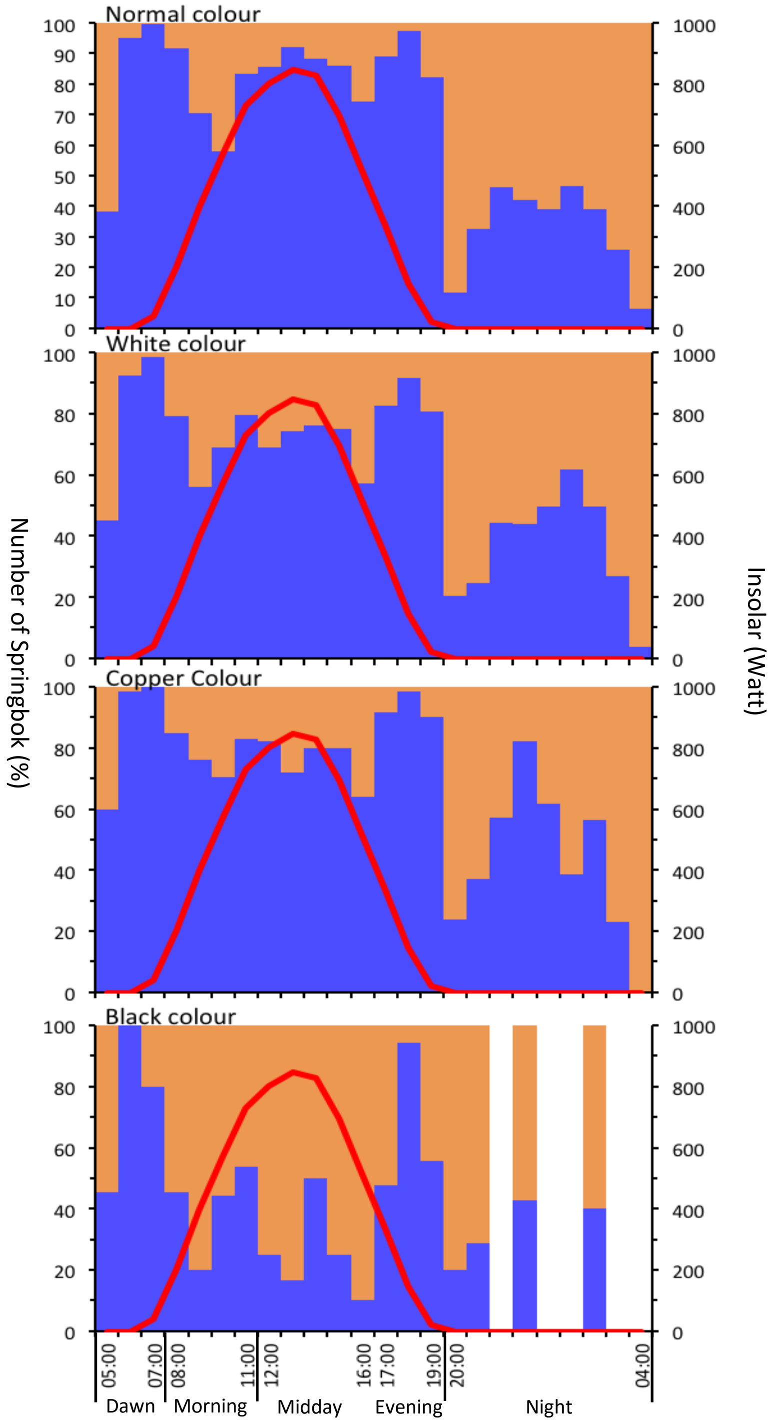


Figure 4.1. Periods of activity (combination of feeding, movement and other observations) and resting (combination of standing and laying observations) of four springbok variants versus insolar for the entire study period. (Red line: insolar, blue: activity, orange: resting).

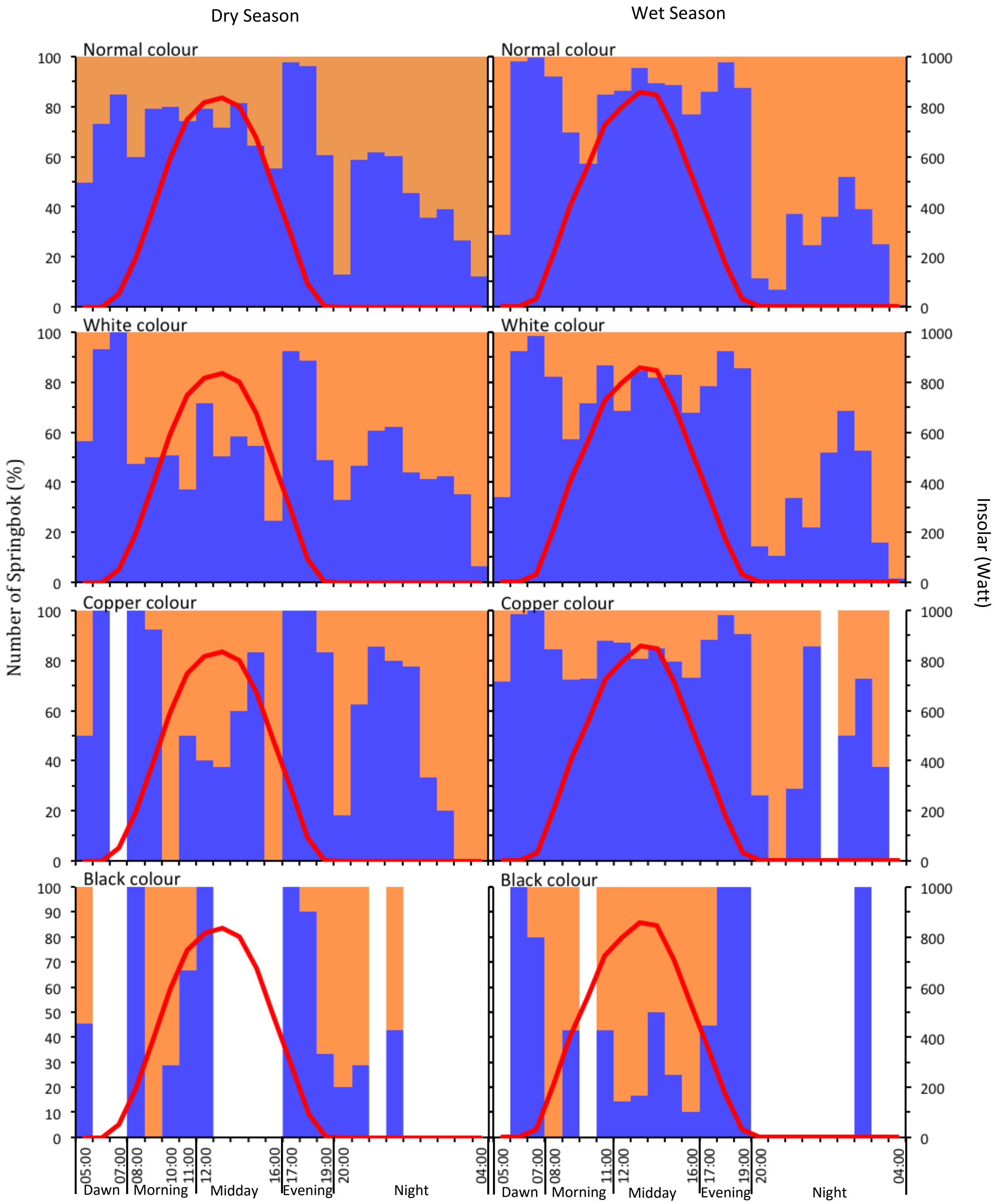


Figure 4.2. Seasonal periods of activity (combination of feeding, movement and other observations) and rest (combination of standing and laying observations of four springbok variants versus insolar (incoming solar radiation). (Red line: insolar, blue: activity, orange: resting).

4.2.2 Feeding Activity

Springbok are known to adapt their diet and feeding behaviour in accordance with environmental conditions (Stapelberg *et al.* 2008). Results showed that all variants of springbok exhibited very different feeding activity and food preferences between the dry and wet seasons (Figure 4.3). According to Skinner & Louw (1996) springbok exhibit very different feeding behaviour depending on the time of year and nutritional quality of available forage. Springbok and other gazelle feed mostly on grasses during the wet season, decreasing in volume towards the dry season (Leuthold 1977; Skinner & Louw 1996). During dry periods springbok make use of more browse, specifically Karoo shrubs (Skinner & Louw 1996). Although grass as well as browse were freely available as food source in the study site, grazing and browsing was combined into one category as the Springbok at Exotic Safari's exhibited very little interest in browsing. Even though browse items are usually more nutritious, they are dispersed and available in small quantities, requiring more energy to find and feed on (Leuthold 1977). The ample availability of supplementary feed, in the form of lucerne (*Medicago sativa*), may also have influenced the amount of time springbok spent browsing. Stapelberg *et al.* (2008) also found that springbok preferred feeding on grass to feeding on shrubs. The Kruskal-Wallis test indicated a significant difference between the median percentages of colour variants that utilised feed ($P < 0.0001$) and grazing ($P < 0.0001$). Skinner & Louw (1996) stated that springbok are known to alternate periods of feeding with periods of rest; similar results were found in this study. Nocturnal feeding was clearly alternated with periods of rest, though diurnal alternation between feeding and resting was less pronounced.

During the wet season all springbok variants fed mostly during the daytime, from just before sunset to just after sunrise, peaking during dawn (06:00-08:00) and evening (17:00-19:00), with two lesser peaks in feeding activity during midday. These results are in agreement with the known periods of feeding activity of springbok (Skinner & Louw 1996). Following the evening peak, normal, white and copper springbok feeding activity nearly ceases at 21:00; this coincides with a period of rest (Figure 4.5). The crepuscular feeding activity is likely related to higher water content of forage (Cain *et al.* 2006; Stapelberg *et al.* 2008). Feeding activity reaches its lowest point at 04:00 just before sunrise when nearly 100% of normal, white and copper springbok rest. During the wet season springbok utilized very little artificial supplementary feed (lucerne & supplements) compared to foraging in the veld.

According to Skinner & Louw (1996), springbok feed mostly on grass during the wetter times of the year, switching to browse in the dry season. Foraging on lucerne required no additional movement as its location was known and fixed; consequently springbok could potentially feed on comparatively large quantities of lucerne in relatively short time periods. Feed was utilized to a greater degree during the night, however it was still considerably less than grazing. The exception to this was the copper springbok, which fed, in large numbers (proportionally), on the feed during the night (Figure 4.3). During daytime a maximum of only 7% of normal springbok utilised the feed, whilst at night this went up to over 20%. Comparatively, white springbok utilised more feed during the day with a maximum of 10%, but utilised less feed at night with a maximum of 13%. Copper springbok utilised feed in greater numbers than both normal and white springbok, with maximum diurnal usage at 13% and nocturnal as high as 36%. Normal springbok fed slightly less than the other variants and showed two distinct nadir points (09:00-10:00 and 13:00) during daytime feeding when less than 50% of normal springbok fed on natural forage and less than 1% fed on the supplemented feed (Figure 4.3). White springbok also showed these nadir points, but the second nadir was extended (12:00-13:00). Between 50-63% of white springbok engaged in either browsing or grazing at this time, whilst up to 4% of white springbok utilised the feed. Copper springbok followed a similar pattern during daytime. The copper springbok did however have an extended nadir period from 09:00 to 11:00 and then again at 13:00. During copper springbok's nadir up to 3% utilised the supplemented feed, whilst between 50-60% either grazed or browsed. Data concerning feeding activity of the black springbok was unfortunately limited (as a result of the small number and more skittish nature of black springbok which led to a smaller sample size). Results however did show that black springbok made use of both natural veld and the provided feed during the night. Black springbok also showed the same peaks in feeding activity during dawn and evening as well as similar nadir periods in feeding activity.

During the dry season springbok fed less throughout the day, with feeding activity staying more constant throughout the 24 hours. Springbok also did not show the sudden drop, to less than 10%, in feeding activity just after evening, however a decrease in feeding activity is still present. During the dry season all springbok variants utilized considerably more of the supplemented feed than natural grazing or browsing, likely because natural vegetation has very low nutritional value during cold-dry seasons in this study region (Stapelberg *et al.* 2008). During the dry season, feeding activity peaked during dawn (05:00-07:00) and evening (17:00-19:00). During dawn (05:00-07:00) and evening (17:00-19:00) peaks in feeding on natural vegetation was also present, preference to feeding at this time is possibly due to increased moisture content of food (Cain *et al.* 2006; Stapelberg *et al.* 2008) (Figure 4.3). Normal springbok maintained feeding activity between 40-60% with a peak at dawn of 70% and again during evening at nearly 90% during the dry season. Comparatively normal springbok maintained diurnal feeding at nearly 80%, which then dropped to below 40% at night during the wet season. White springbok maintained feeding between 40 and 60%, with dawn and evening peaks at nearly 80%. Copper springbok exhibited fluctuating feeding activity during the dry season constantly shifting between less than 10% to more than 60% of animals feeding. Copper springbok do however exhibit the same trend of feeding more on the supplemented feed than during the wet season. Even though data on black springbok was limited it also showed that the additional feed was utilised to a higher degree.

4.2.3 Movement

The Kruskal-Wallis test indicated that there was a significant difference ($P<0.05$) between the median values of the four colour variants concerning movement constituted by walking. Most movement took place diurnally (morning, midday and evening) (Figure 4.4), coinciding with feeding activity (Figure 4.3). Movement peaked during midday for the normal springbok during both the wet and dry season. A peak in feeding activity during the evening followed diurnal movement activity. Peaks in springbok walking is often associated with times of moving to and from feeding areas (Skinner & Louw 1996). Normal springbok walked more during the dry season than during the wet season. A possible reason for this is that normal springbok were observed to move between feeding sites regularly; additionally limited forage during the dry season may have led to more effort being needed to find food. White springbok tended to stay closer to the feeding site located in the Karoo section of the ranch throughout the study, often resting in the area as well, ultimately leading to less movement activity than the normal springbok. Comparatively, the normal springbok utilised more of the game ranch often moving through the Karoo into the Kalahari section. As white springbok spent most of the time close to the feeding station, of which the immediate surrounding area was heavily overgrazed and trampled, during the dry season white springbok showed a small peak in movement during dawn, which was absent in normal springbok. This peak coincides with a peak in feeding activity during which the natural forage was mostly utilised. Copper springbok showed a very similar pattern in movement, although in smaller numbers, to normal springbok; with most movement during the dry and wet season taking place diurnally. Copper springbok show a peak during the night, which coincides with a period of feeding on the additional feed. Dry season data for the black springbok was very limited and proved to be inconclusive. However the wet season showed that black springbok also moved mostly during the daytime (Figure 4.4). The black springbok's morning movement peak was preceded by a period of feeding and the evening movement was followed by a period of feeding. It should be kept in mind that black springbok were in general much less active than the other variants (Figure 4.2.).

4.2.4 Resting

Copper, normal and white springbok show very similar patterns of resting behaviour (Figure 4.5). However, the Kruskal-Wallis tests of standing ($P<0.0001$), lying ($P<0.0001$) and the combined rest ($P<0.0001$) indicate a significant ($P<0.05$) difference in the median numbers (proportionally) of animals that rested.

Skinner & Louw (1996) stated that resting in springbok increases with an increase in ambient temperature. This was not observed during this study with any noteworthy correlations found between ambient temperatures and resting behaviour. The majority of resting behaviour occurred at night (20:00-05:00) during the wet season for the copper, normal and white springbok variants. During this time the majority of resting is in the form of lying down, nonetheless a small number of the animals do stand during the night, possibly to contribute to vigilance in the herd. Resting behaviour reached its peak at 04:00 shortly before dawn, when nearly 100% of the springbok are resting, regardless of colour variant. This was followed by a sharp decline in resting behaviour during dawn, with almost no springbok resting by 07:00. During the day a greater proportion of resting behaviour was in the form of standing in comparison to night (Figure 4.5).

During the dry season the majority of resting behaviour still took place at night. However smaller numbers of springbok, from all the colour variants, rested during the first half of the night, the period after sunset (19:00-23:00), when compared to the wet season. This period of resting is replaced by a period of feeding activity during the dry season. The second half of the night (00:00-05:00) is the time when most of the springbok rested, reaching a peak at 04:00. A higher number of white and copper springbok rested than the normal springbok, specifically during the daytime. Copper animals rested less during the first half of the night than the other variants (Figure 4.5).

Although there is limited data on the black variants due to small sample size, the available data does indicate that the black springbok rested in greater numbers during the day in the wet season. During the dry season, the data suggests that black springbok rest at similar times as the other variants, but in greater numbers (Figure 4.5). Hetem *et al.* (2009) also found that black springbok was less active than either normal or white springbok.

4.2.5 Other behaviour

Springbok can drink in excess of two litres of water every second day. Nevertheless, if their food contains sufficient water, springbok can become independent of surface drinking water (Estes 1991; Skinner & Chimimba 2005). According to Skinner & Louw (1996) springbok drink throughout the day. However, all variants of springbok utilised very little water during the wet season, and when drinking took place it was close to evening or dawn. This could be as a result of higher water content of forage at this time of the year. During the dry season there was a clear increase in drinking activity which took place throughout the day (Figure 4.6).

The social behaviour (which included vocalizing, play behaviour, fights and reproductive behaviour) that was recorded using the scan sampling method showed that social behaviour mostly occurred during sunrise and sunset with the black, normal and copper springbok. White springbok, however, showed more consistent levels of social behaviour throughout the day. A contributing factor to this was that all the territorial males, at the time of the study, were white and engaged in much more social activity, including herding of females as well as aggressive acts between males (Figure 4.6). Results concerning the sexual selection between springbok colour variants proved inconclusive since white springbok rams were the only territorial males present at Exotic Safari for the greatest part of the study period. This was due to the preference of the rancher's choice of males to breed at the time. A territorial white springbok male was on a single occasion challenged by a black springbok male, but the white springbok was able to deter the black competitor without physical combat. The territorial white springbok males, furthermore never showed any preference towards antagonising bachelor males or females of a specific colour.

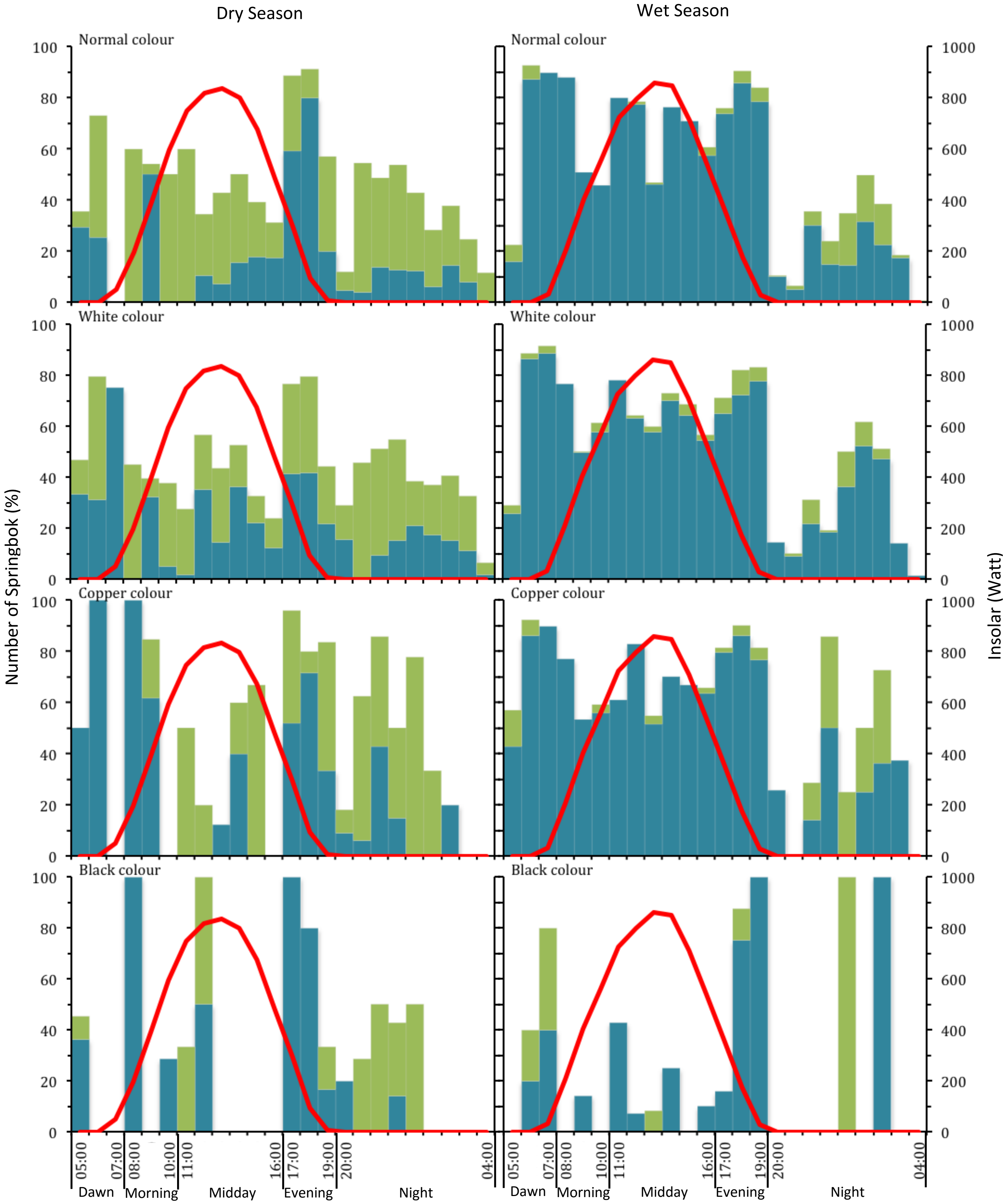


Figure 4.3. Seasonal feeding activity of four springbok colour variants versus insolar (incoming solar radiation). Feed (indicated in green) refers to additional feed provided by the game ranch, which included lucerne, maize and supplements. The grazing and browsing category represents feeding activity taking place on the natural vegetation. (Red line: insolar, blue: grazing or browsing, green: feed).

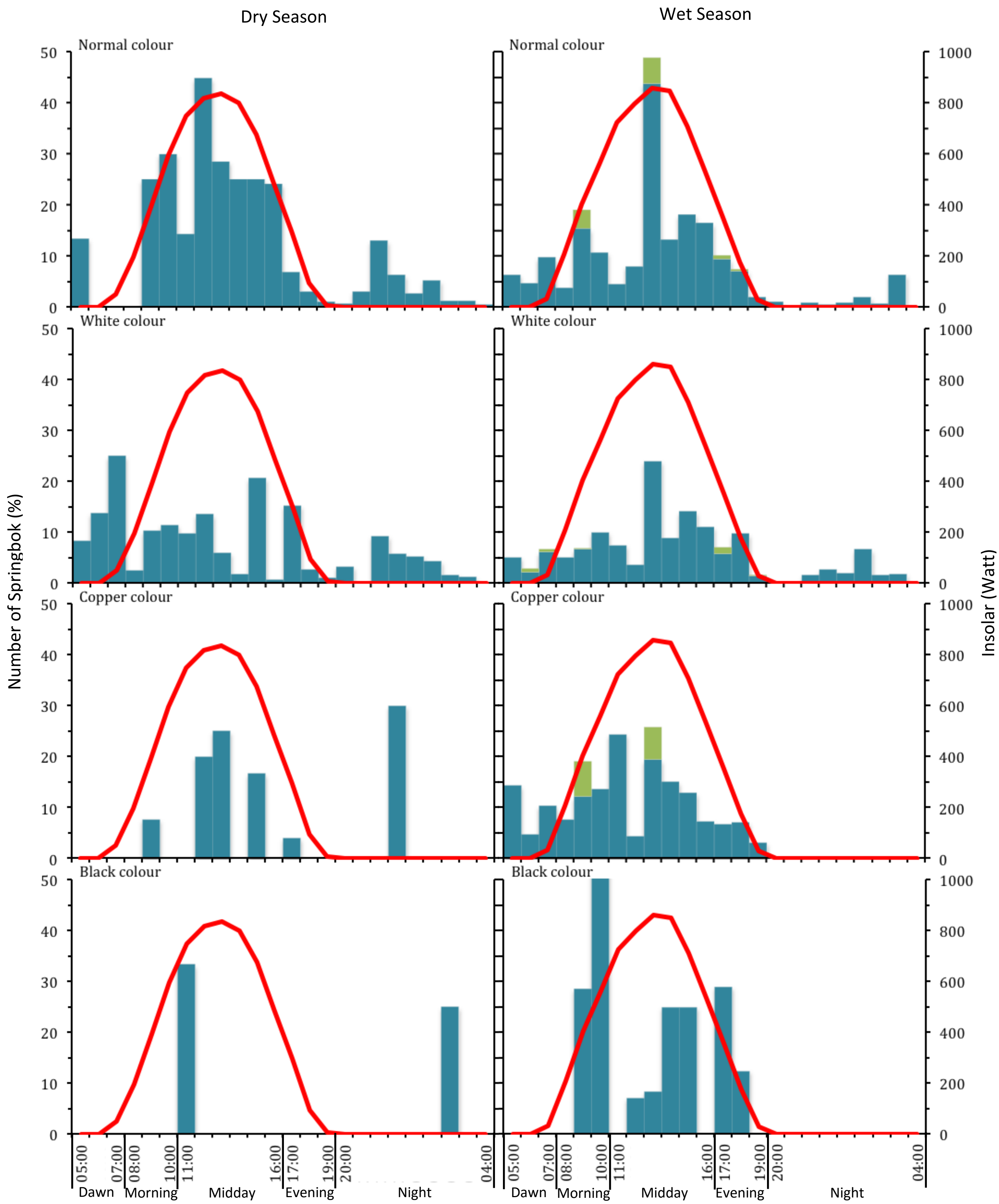


Figure 4.4. Seasonal movement activity of four springbok colour variants versus insolar (incoming solar radiation). (Red line: insolar, blue: walking, green: running).

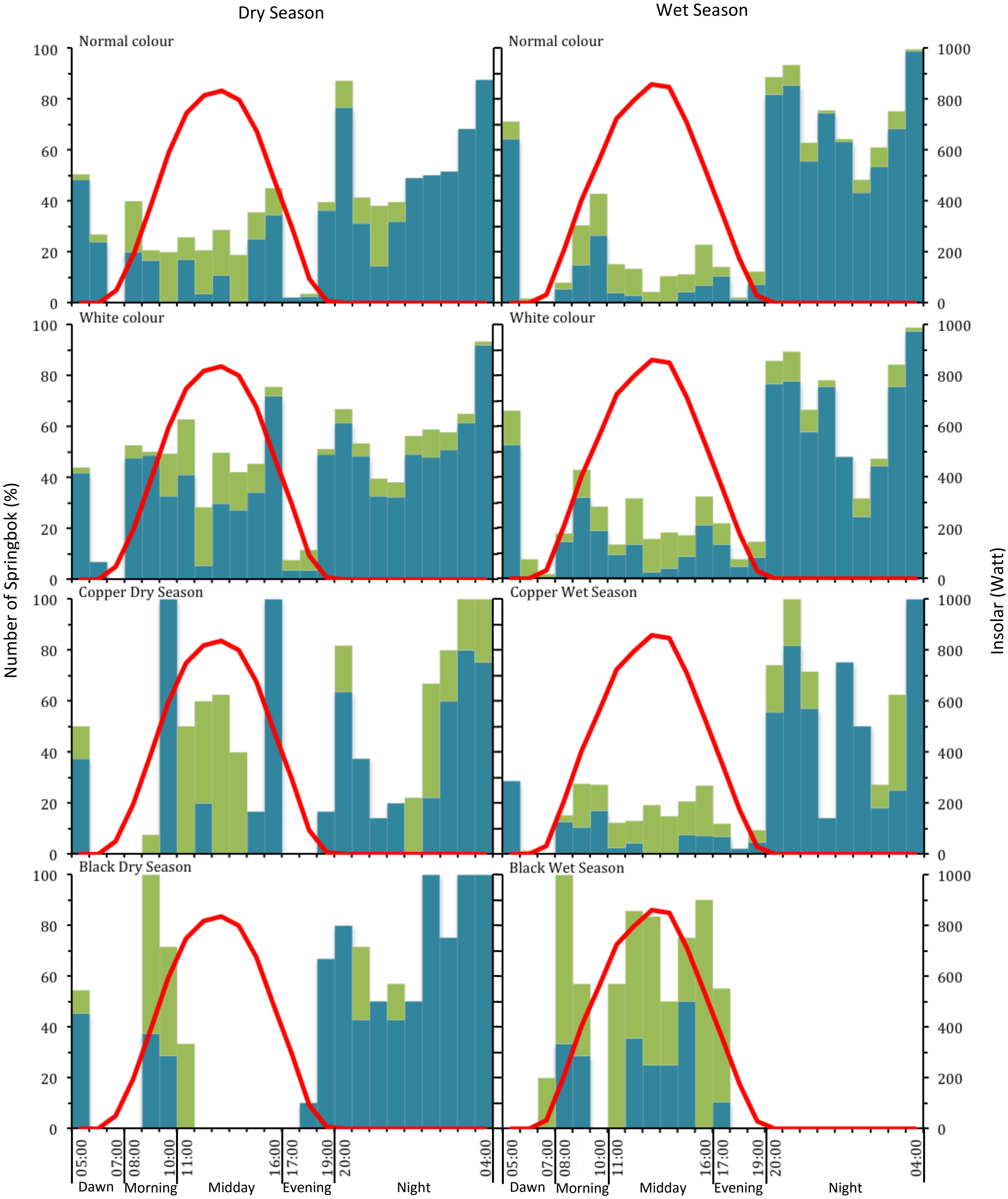


Figure 4.5. Seasonal resting of four springbok colour variants versus insolar (incoming solar radiation). (Red line: insolar, blue: lying, green: standing).

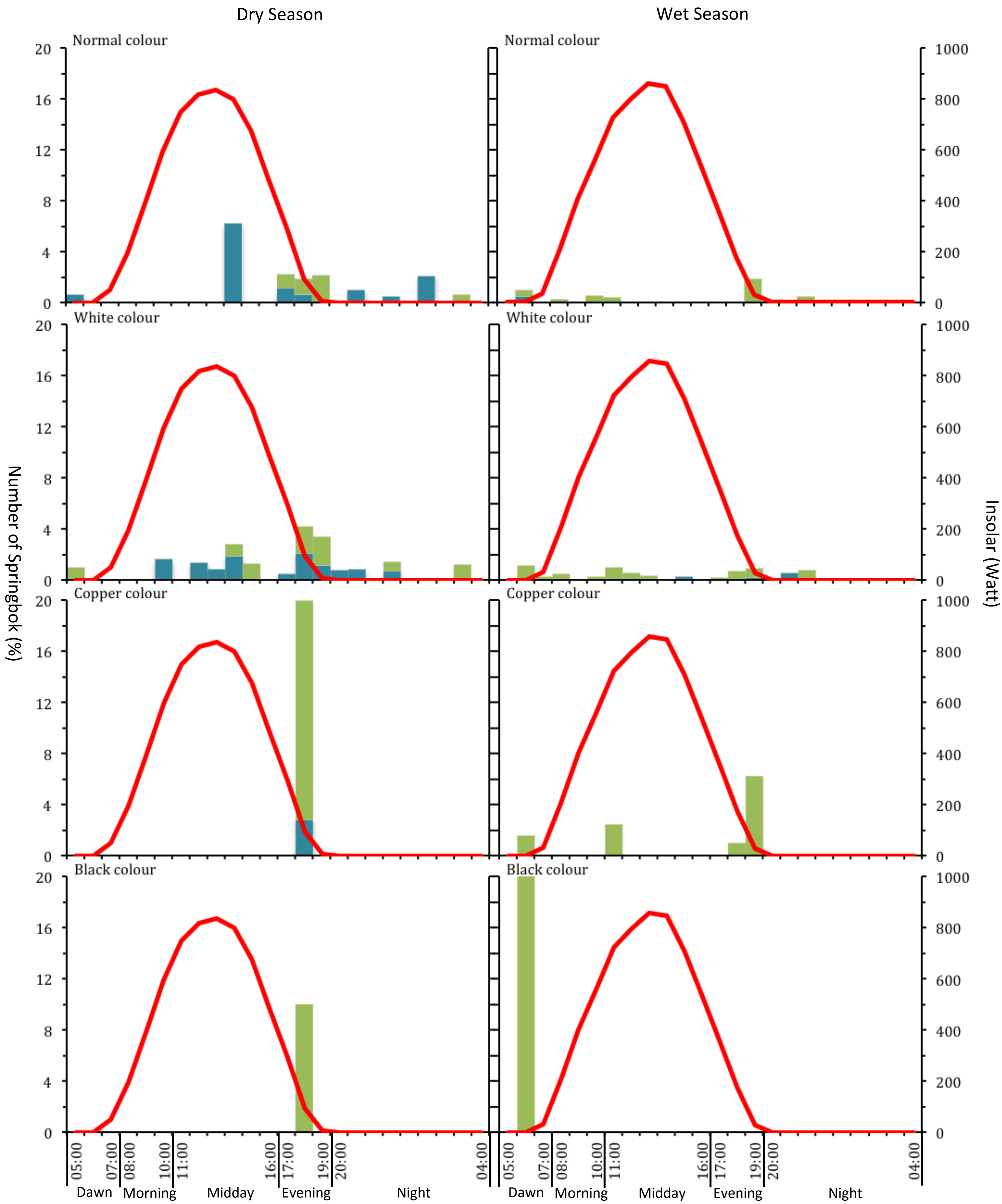


Figure 4.6. Seasonal drinking and social activity of four springbok colour variants versus insolar (incoming solar radiation). (Red line: insolar, blue: drinking, green: social).

4.3 Thermoregulation Behaviour of Springbok Colour Variants

It has been stated in the past that the study of relationship between coat colour and solar heat gain does not have any benefit (Walsberg 1983). However, current breeding practices in the game ranching industry has resulted in several colour variant animals becoming increasingly common, creating additional implications for the management of wildlife. Hetem *et al.* (2009) found that colour variants experience differing selection pressures at various times of the year. Furthermore, it is well documented that darker coloured animals have a greater heat gain than lighter coloured animals (Finch & Western 1977; Finch *et al.* 1980; Hetem *et al.* 2009).

Springbok are adapted to a warm desert environment as they have a thin and more conductive pelage, compared to other African Bovidae (Skinner & Louw 1996). This thin pelage, however, has the disadvantage that springbok are susceptible to cold weather, possibly even leading to mortalities (Skinner & Louw 1996). In this regard it has been reported that black springbok are better able to survive cold conditions as they are able to gain more heat from the environment (Hetem *et al.* 2009). Half of all incoming solar radiation (insolar) is in the visible range and therefore provides sufficient energy that pelt colour could influence an animal's body temperature (Walsberg 1983). Colour is, however, not necessarily a determining factor in solar heat gain, the coat structure and optical properties of the hair plays an important role (Walsberg 1983). The hair of black, white and normal springbok are similar (Kruger *et al.* 1979), differing only in colour, and therefore possess similar qualities (Hetem 2009). Although providing similar insulation, the colour of the pelt does provide significant differences in reflectance, conductance as well as solar and ambient heat gains (Hetem *et al.* 2009). According to Skinner & Louw (1996), the white part of the springbok pelt is less absorbent than the brown (black) and fawn (copper) colours. Hetem *et al.* (2009) found that black springbok pelt had a much higher ability to gain heat from the environment, even though there are no differences between the hair structure of springbok colour variants (Kruger *et al.* 1979). Black springbok pelt had a much lower solar reflectance than white springbok, whilst normal springbok had an intermediate reflectance (Hetem *et al.* 2009). Additionally black springbok pelt has a significantly higher conductance, radiant heat absorption and solar heat gain (Hetem *et al.* 2009).

Consequently black springbok have a higher peak body temperature than normal and white springbok (Hetem *et al.* 2009). It can therefore be hypothesised that colour variants would show differing thermoregulation behaviour. Results from the Kruskal-Wallis Test indicated that there is a significant difference (P<0.05) in the thermoregulation behaviour between colour variants in all four categories (lateral orientation P<0.0001, anterior orientation P<0.0001, posterior orientation P<0.0001 and shade usage P<0.0001).

The time at which animals are most active might have an influence on an animal's heat load (Cain *et al.* 2006). However, according to Hetem *et al.* (2009) the activity level of springbok does not influence body temperature. This was confirmed by the results in this investigation as springbok showed significant levels of activity during midday, which is associated with the highest incoming solar radiation and increasing environmental temperature (Figure 4.2.). The use of microclimates such as shade is also effective at reducing heat absorption and is a behaviour known to be utilised by many Bovids (Cain *et al.* 2006). Animals experience a significant decrease in absorbed radiation whilst in shade (Finch *et al.* 1980). Alternative explanations of body orientation preference, such as magnetism, by Bovidae was refuted by Hetem *et al.* (2011), showing that preference, under South African conditions, was dominated by energy demands. The difference in solar heat load between the presentation of the lateral and anterior/posterior sides can be as much as 101 Wm^{-2} (Skinner & Louw 1996). Additionally Skinner & Louw (1996) stated that a posterior orientation would expose a smaller surface area to the sun when compared to the anterior orientation and should then be favoured to limit heat load from insolar. Correlation analysis of the data furthermore showed that significant, although poor to moderate strength, correlations were present between thermoregulation behaviour and temperature as well as radiation (Table 4.1). Orientation towards the sun and shade usage consequently plays a significant role in thermoregulation behaviour.

There is clear seasonality regarding thermoregulation behaviour. When compared to the cold dry season (Figure 4.7), during the warmer wet season there is a more clearly observable relationship between the temperature and the orientation to the sun of the springbok (Figure 4.8).

During the colder dry season the orientation of all four variants as well as utilisation of shade fluctuates more and trends in thermoregulation behaviour are more difficult to observe than during the wet season (Figure 4.7). Lateral orientation to the sun showed a peak in the early morning after sunrise (07:00), which is when body temperature is at a minimum (Hetem *et al.* 2009), a nadir in the afternoon between 12:00 and 14:00 (highest body temperature is experienced between 14:00 and 16:00 (Skinner & Louw 1996)) and then shows a sharper increase towards the evening than during the wet season. Both the normal and white springbok had significant, though weak, negative correlation between temperature and lateral orientation (Table 4.1). During the dry season, lateral orientation towards the sun reach a second peak for all the colour variants. This happens when nearly 90-100% of animals orientated laterally towards the sun just before sunset (Figure 4.7). This corresponds with Hetem *et al.* (2009) which determined that evening is the time when body temperature starts to decline reaching a minimum just before sunset. Accordingly springbok attempt to increase their body temperature before nightfall through lateral orientation. There seems to be little preference between orientating either the anterior or posterior body surfaces towards the sun, during the dry season; the difference in surface area presented to the sun is likely negligible during the colder dry season. The anterior and posterior orientations also fluctuate throughout the day, with the greatest number of animals orientating this way during the late morning, midday and afternoon. Copper springbok however do show a preference towards orientating posteriorly in the afternoon (Figure 4.7); and showed a significant moderate correlation with temperature and insolar in this regard (Table 4.1). Surprisingly, normal, white and black springbok showed higher levels of shade usage during the dry season (Figure 4.7) than during the wet season (Figure 4.8), with a significant peak in the late morning. This peak in shade usage coincides with a period of rest (mostly lying) and a decline in feeding activity (the majority of food consumed was the additional feed) (Figures 4.2.3 and 4.2.5). Stapelberg *et al.* (2008) also found that usage of shade by springbok often coincided with rest. Solar radiation along with food intake plays an important role in homeothermy, several species have lower nadir body temperature during periods of limited food supply (Hetem *et al.* 2009, 2011). Hetem *et al.* (2009) found that black springbok, which reach the highest body temperature, fed less than normal and white springbok; additionally white springbok did not have a significantly lower body temperature when conditions were more favourable including the provision of additional feed. Consequently it is possible that the anthropogenic food source provided sufficient nutrition during the colder dry season, which assisted with maintaining homeothermy, and ultimately allowed the antelope to rest more often. The provision of additional feed can therefore play an important role in negating the effects of cold weather especially as pertaining to the colour variants.

Copper and normal springbok show similar trends in orientation during the wet season, with the number of springbok presenting their sides to the sun at its highest in the early morning (06:00), gradually decreasing throughout the day reaching a nadir in the early afternoon (14:00). At this time, orientation of the anterior or posterior towards the sun reaches a peak. After reaching a nadir, lateral orientation towards the sun gradually increases throughout the day reaching a second, but lower, peak in the late afternoon just before sunset (18:00-19:00). Utilisation of shade by normal and copper springbok starts in the late morning (09:00) and continues to the late afternoon. Copper variants show a lower nadir (37%) in lateral orientation than normal coloured (34%) animals and also greater utilisation of shade. Considering that the colour of the coat influences heat absorption (Hetem *et al.* 2009), it is probable that the darker coloured coat of copper springbok necessitate increased anterior or posterior orientation and shade usage, during midday, compared to normal or white springbok; yet it was still less than black springbok. White springbok follow a similar pattern of orientation behaviour, however white springbok reach their nadir (37%) in lateral orientation earlier in the day (14:00) and it is not as low as that of the normal (34%) or copper (5%) animals. White springbok also mostly utilised shade later in the day than compared to their darker coloured counterparts. Black springbok absorb more solar radiation than normal springbok and nearly twice as much as white springbok (Hetem *et al.* 2009). Consequently black springbok exhibited much higher usage of shade than the other variants, specifically during the midday. Furthermore, black springbok orientated the posterior sides of their bodies to sun much more than any other variant with peaks in this activity already present early morning (Figure 4.8). Comparatively, copper springbok only reached a peak in posterior orientation by late midday. This could be as a result of the higher rate at which black springbok's body temperature rises, compared with white or normal springbok (Hetem *et al.* 2009).

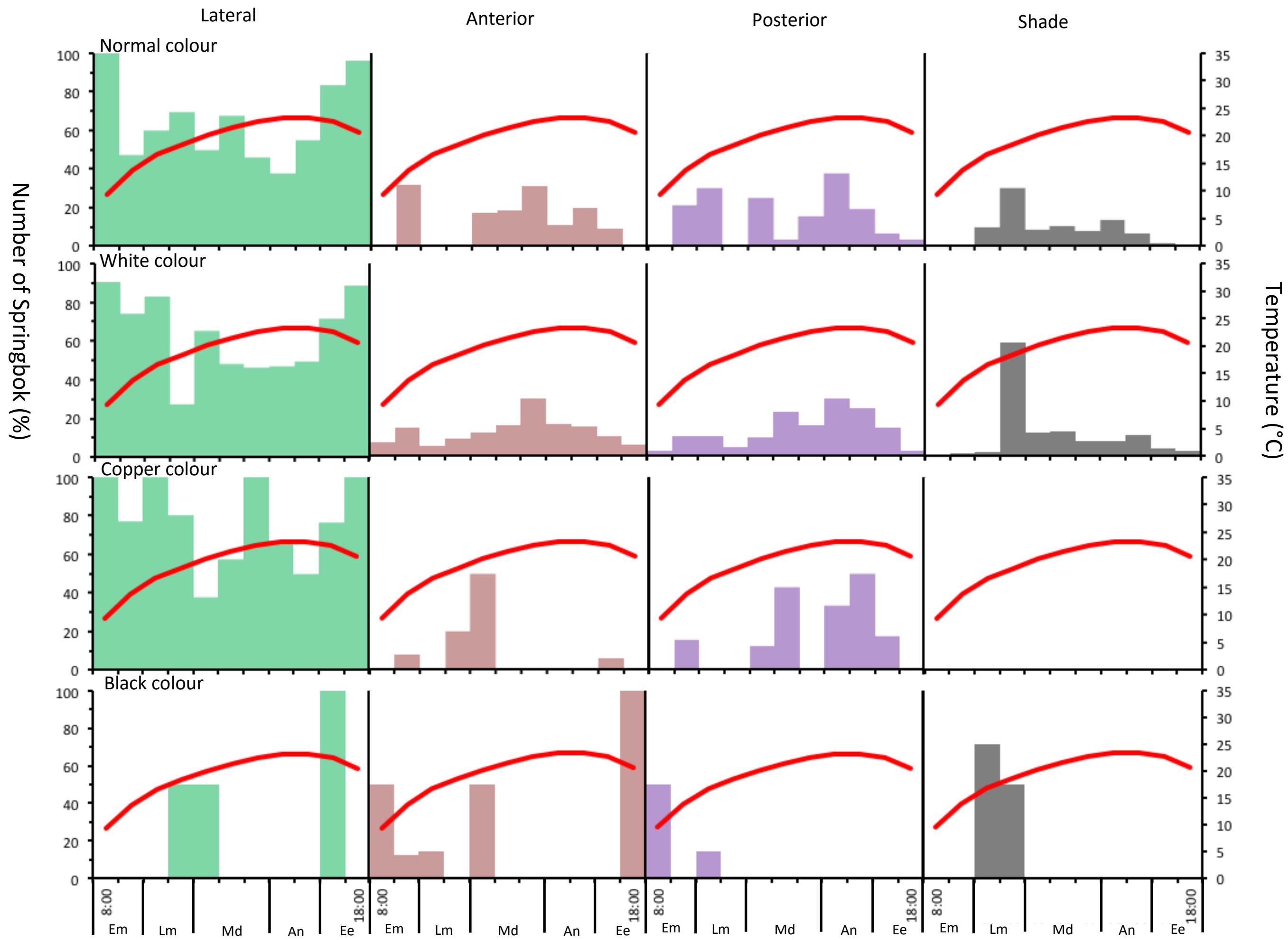


Figure 4.7. Thermoregulatory behaviour, during the colder dry season, by means of body orientation (lateral, anterior or posterior), towards the sun, and shade usage throughout the day (Em: Early morning, Lm: Late morning, Md: Midday, An: Afternoon, Ee: Evening).

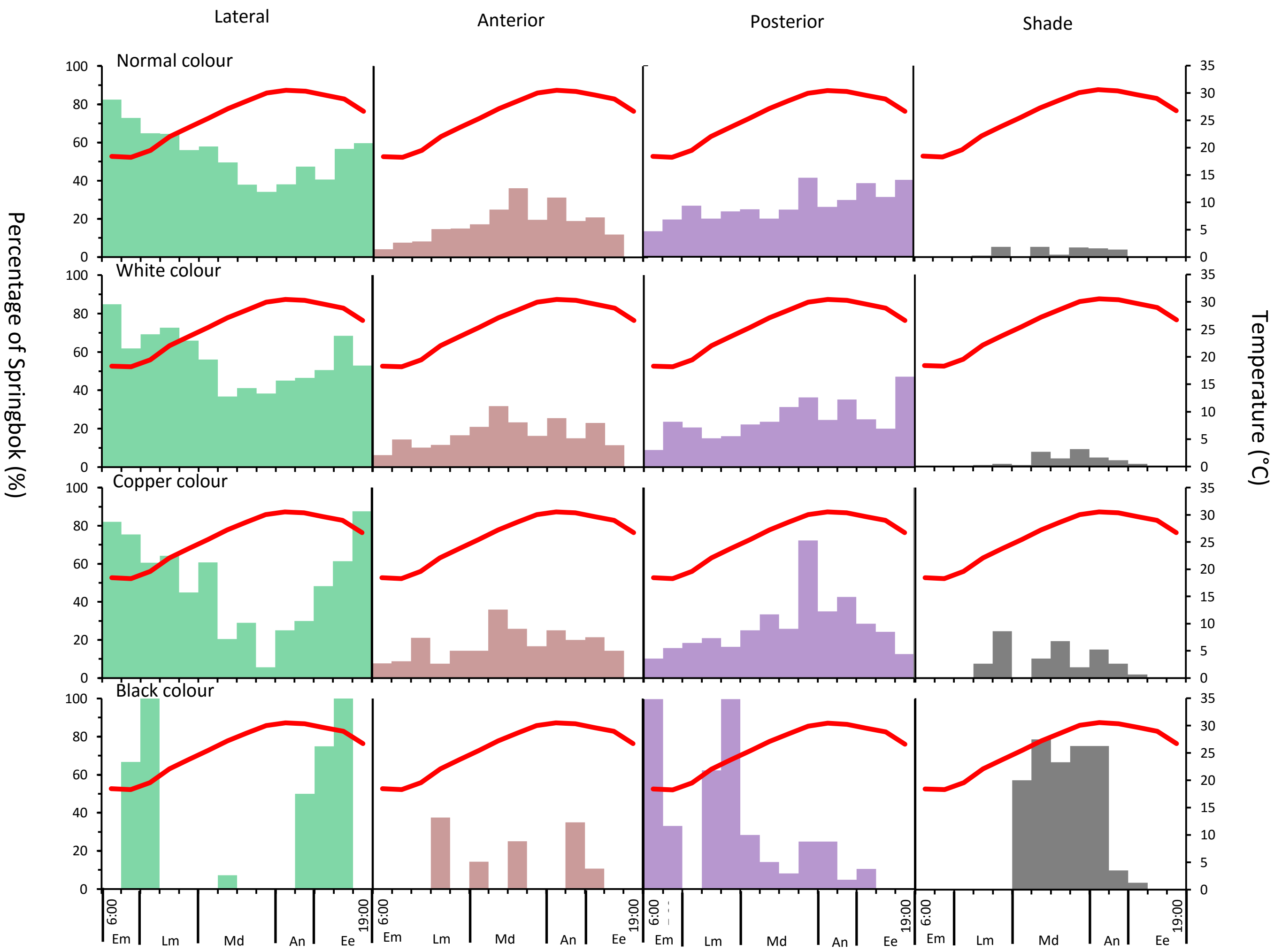


Figure 4.8. Thermoregulatory behaviour, during the warmer wet season, by means of body orientation (lateral, anterior or posterior), towards the sun, and shade usage throughout the day (Em: Early morning, Lm: Late morning, Md: Midday, An: Afternoon, Ee: Evening).

Table 4.1. Correlation analysis of thermoregulation behaviour (by normal, white, copper and black springbok) with temperature and radiation.

Variant & Thermoregulation Behaviour	***Average hourly Temperature (°C)***		***Average hourly Radiation (watts)***	
	P-value	***Spearman Correlation Coefficient (r_s)***	***P-value***	***Spearman Correlation Coefficient (r_s)***
White lateral*	***<0.0001***	-0.309	0.243	-0.056
Normal lateral *	***0.006***	-0.146	***<0.0001***	-0.316
Copper lateral	0.824	-0.016	0.129	0.111
Black lateral	0.664	-0.107	0.725	-0.086
White anterior*	***0.0001***	0.217	***<0.0001***	0.389
Normal anterior *	***<0.0001***	0.313	***<0.0001***	0.304
Copper anterior	0.555	0.067	***0.0001***	0.418
Black anterior	0.843	-0.055	0.9	-0.016
White posterior *	***<0.0001***	0.312	***<0.0001***	0.278
Normal posterior *	***0.0006***	0.213	0.052	0.123
Copper posterior *	***<0.0001***	0.394	***<0.0001***	0.529
Black posterior	0.113	-0.387	0.998	-0.0005
White shade usage*	0.834	-0.026	***0.002***	0.367
Normal shade usage	0.993	-0.001	0.166	0.197
Copper shade usage	0.071	-0.383	0.737	-0.074
Black shade usage	0.329	-0.199	0.697	-0.080

*Indicates significant correlation present at P<0.05. Spearman Correlation Coefficient indicates the strength of the correlation.

4.4 Grouping Behaviour

Springbok have an adaptable, unfixed social structure forming groups as small as five individuals to herds of over 3000 (Estes 1991), and have in the past been known to congregate into concentrations, numbering in the hundreds of thousands, during treks (Skinner & Louw 1996; Skinner & Chimimba 2005). Springbok herds are often mixed consisting of adults and young of both sexes as well as males in bachelor herds (Skinner & Chimimba 2005). Nursery herds, consisting of young and females, bachelor herds and lone territorial males can also be distinguished (Estes 1991, 1999). Anecdotal reports have indicated that different colour variants of springbok do not intermingle:

> *"I've seen large herds of white and common Springbok in the Karoo and in Namibia. Wild and not interbreeding. Black tend to be smaller groups and using different habitat, again, not interbreeding." – Hunter*
>
> *"Common and White don't mix. Maybe that's what maintains the aberration." – Hunter*

In support of these anecdotal reports, Hetem *et al.* (2009) found that black springbok tended not to join herds along with normal and white springbok. Furthermore during this study, three main types of springbok herd, based on the colour variants present, were identified: herds consisting of more than 50% of a single variant; herds where the majority of animals came from a single variant but were less than 50% of the herd and herds consisting of equal numbers of different colour variants. Seven different types of springbok herds, based on their composition by colour variant, were observed at Exotic Safari: Black 50%+, Copper 50%+, Normal 50%+, White 50%+, mostly normal, mostly white and an equal herd (Table 4.2).

Table 4.2. Maximum size, average size and composition of springbok herds, over the entire study period, based on colour variants present.

Variant	n		Average herd composition (%)						
	n-Max (individuals)	n-Median (Individuals)	Normal 50%+	White 50%+	Copper 50%+	Black 50%+	Mostly normal	Mostly white	Equal
Normal	27	10	**65**	18	10	*0*	**42**	43	0
White	27	6	14	**68**	*0*	13	40	**44**	50
Copper	7	2	12	9	**50**	14	10	8	50
Black	7	2	*9*	*5*	40	**73**	*8*	*5*	0
Combined	49	15.5	100						

In the case of Black 50%+, Normal 50%+ and White 50%+, the herds were dominated by a single colour variant representing more than 50% of the herd. The mostly normal and mostly white herds were dominated more than 40% by a single variant (Table 4.2). The Copper 50%+ herd was uncommon representing only 2.5% of the observed herds. The mostly normal and mostly white herds were also uncommon respectively representing only 6.25% and 5% of the observed herds. The majority of herds observed were the Normal 50%+ and White 50%+ herds at 31.25% and 50% respectively.

Hetem *et al.* (2009) observed that the different colour morphs herded together at night. The results supported this and indicated that the mostly white, mostly normal and equal herds were predominantly observed between 17:00 and 09:00 and was never observed during midday. This suggests that the different colour variants herded together at night whilst breaking up again during the day into their respective colours. The combined herds at night could be as result of anti-predator behaviour, through increased vigilance and the dilution effect, which increases individual survival rates (Pays *et al.* 2007; Garay 2009; Rodgers *et al.* 2011).

The results showed that a herd consisting of a single colour springbok was never observed. The springbok, which were divergent within a herd, could be explained by the adult or sub-adult offspring of females that still moved with their mothers.

Female springbok are known to stay close to their mothers even as yearlings (Estes 1999). Additionally territorial males are known to actively herd females and chase other springbok (Estes 1999). This herding and chasing behaviour by territorial males was observed to be the cause of some mixing of different colour variants into a single harem herd.

During an incident when springbok where chased by the game rancher's dog it was observed that springbok immediately fled into herds consisting of the same colour. Consequently, it was hypothesised that antipredator behaviour, through the odd-prey (oddity) effect, is a possible explanation for springbok forming herds consisting of a specific colour variant. The odd prey effect is a phenomenon through which a morphologically distinct animal becomes an easier target for predators (Rodgers *et al.* 2011). Goshawks are known to preferentially select colour variant pigeons as prey (Rutz 2012). Predation is an important selective factor in the formation of groups and can have non-lethal effects on animals by influencing their behaviour (Reid 2005; Garay 2009). Furthermore, according to Rodgers *et al.* (2011) the odd-prey effect is known to cause behaviour that leads to the formation of phenotypically separated groups. In this regard it has previously been found that fish prefer to join a homogenous group (thus avoiding being the odd-prey) in addition to joining a group based on numbers (benefitting from increased survival chances due to the dilution effect) (Mathis & Chivers 2003; Rodgers *et al.* 2011).

Increased vigilance and reduced risk to each individual through the dilution effect (Pays *et al.* 2007; Garay 2009), should benefit all springbok regardless of colour. In the case of plains antelope, the herd takes the place of cover (Estes 1974). By herding together, individual animals are able to become less conspicuous to predators (Estes 1974; Jarman 1974). Jarman (1974) stated that a herd must provide some protection to its nondescript members that is not available to its more conspicuous individuals and presents examples of antelope leaving, or avoiding to join, a herd so as not to be conspicuous within the herd. The odd-prey effect then likely negates the anti-predatory function of the dilution and confusion effects, driving springbok to selectively join phenotypically similar herds. It is also worth noting that copper animals occurred in greater numbers with the black and normal coloured animals, to which they bear a closer resemblance and consequently where they would be less conspicuous, rather than with white springbok.

Colour variants occurred infrequently in the past (Kruger *et al.* 1979), the odd-prey effect likely causing such animals to be preferentially captured by predators. Through natural selection normal springbok became the most common variant, likely as it represents the middle ground between the different variants (Hetem *et al.* 2009). However, natural selection is being trumped by human selection through selective breeding, which has resulted in several colour variants becoming more common (Hetem *et al.* 2009). Selective breeding is not the only factor that may lead to colour variants becoming more common, as wildlife ranching becomes more commercial, predator prosecution on game ranches also becomes more intensive. The absence of selection by predators may lead to more and new colour variants. Guppies (*Poecilia reticulata*) developed greater diversity of colour and larger spots in the absence of their main predator (Futuyma 2009). Since colour variants rarely occur and survive in nature, it is reasonable to state that if natural selection was allowed to take place, colour variants would have a low survival rate due to predation, and only occur very seldom. Additionally, a possible consequence of colour variant Bovidae becoming more common is runaway selection, through which a certain characteristic (usually male) becomes more exaggerated or common within a population (Ryan 1997; Dugatkin 2000). During an experiment on guppies, runaway selection (based on colour) was successfully observed with males becoming brighter, in one group, and another experimental group of males becoming less brightly coloured over successive generations, after fish were initially selectively bred (Dugatkin 2000). Females also often select males which least resemble a heterospecific animal (Ryan 1997). Mate copying (or imitation) is likely at work within groups of phenotypically differentiated animals. Mate copying is a process through which a young female copies the choice of an older female, and was successfully observed to influence female preference; even towards a previously non-preferred male (Ryan 1997). Consequently in the case of colour variants, it is a possibility that females will select males based upon the choices of other females. Herd differentiation and selective breeding practices, which expose females only to males of a certain colour, could then potentially lead to runaway selection.

Springbok, like other antelope tend to avoid cover where ambush predators may occur (Reid 2005), yet black springbok still preferred to make use of the Kimberley thornveld habitat rather than the Karoo habitat. An additional factor in the formation of colour orientated herds could then be as a result of thermoregulation requirements, since black springbok have a much higher heat load from solar radiation (Hetem *et al.* 2009), they make use of cooler conditions (from a greater abundance of shade) in the thornveld habitat. White springbok are better able to manage heat from insolar and consequently do not have to move away from the exposed (treeless) Karoo vegetation, ultimately causing the two colour variants to separate into colour orientated herds making use of different habitats. Furthermore, it is unlikely that black springbok are making use of the thicker vegetation to avoid predation, as crypsis is only effective for antelope that occur sparsely (Jarman 1974).

4.5 Concluding Remarks

Results clearly showed behavioural differences were present between colour variants. Statistical analysis by the Kruskal-Wallis test indicated significant differences in multiple behavioural categories.

Orientation towards the sun as well as shade usage is important methods of maintaining a constant body temperature for springbok. Black springbok have to endure a much higher heat load and the availability of shade would be important when stocking black springbok on a game ranch.

White springbok would likely need additional feeding in cold areas or where natural forage does not have a high nutritional value. Darker coats which allow more heat to be absorbed give the animals an advantage in terms of energy requirements as the energy costs of maintaining homeothermy is less (Hetem *et al.* 2009).

Adaptive significance of colour variation, as different coloured animals experience different pressures during the year, could be a pre-adaptation to future environmental change (Hetem *et al.* 2009). Taking the above into consideration, the normal coloured springbok is then the compromise between the different colours.

Odd-prey effect is likely to be responsible for springbok colour variants mostly associating with other springbok of the same colour. Selective breeding, leading to unnaturally large concentrations of colour variants occurring together, enhances the formation of phenotypically separated groups of springbok. The problem that arises from constant human selection is that it could influence future sexual selection and possibly lead to runaway sexual selection taking place, through female mate choice copying.

CHAPTER 5

STATUS QUO OF THE WILDLIFE RANCHING INDUSTRY

5.1 Introduction

Dry (2013) defined commercial wildlife ranching as the management of wildlife in a sizeable fenced system, with minimal human intervention in the form of water provision, food supplementation during drought, parasite control and strategic healthcare. The wildlife ranching industry is a growing, multibillion rand industry (Anonymous 2014a; Molewa 2014), which is consistently increasing in value (Bothma *et al.* 2009; Cloete 2014b, 2015a). This growth can be attributed to a growing middle class throughout the world according to Mr. Norman Adami, game rancher and WRSA marketing director, in an interview with the Financial Mail (Stafford 2013).

Currently there are approximately 10000 game ranches (and an additional 4000 mixed wildlife/livestock ranches) in South Africa, high value wildlife is present on an estimated 3000 of these ranches (Bothma *et al.* 2009; Anonymous 2014a). Game ranches occupy 20 million hectares of previously unconserved land and is a potential sustainable land use for another 12 million hectares of overgrazed communal land (Dry 2013; Stafford 2013).

The private wildlife industry has played an important role in South African conservation (Bothma *et al.* 2009; Cousins *et al.* 2010) and has been responsible for saving several species, including bontebok, black wildebeest and many rare plants (Hamman *et al.* 2005; Bothma *et al.* 2009). The private wildlife industry has also assisted in raising South Africa's population of large mammals to roughly 24 million animals (Niehaus 2014a) and consequently South Africa currently has more wildlife than at any time during the previous 100 years (Bothma *et al.* 2009). Additionally, private game ranches have become the *de facto* conservators of habitats and their associated biota which are not properly protected within state run protected areas, ultimately increasing the area of South Africa being conserved (Bothma *et al.* 2009).

Even though most ranchers truly care about the environment (Bothma *et al.* 2009), there seems to be a general disregard by many in the wildlife ranching industry of conservation principles. Hamman *et al.* (2003), lists several trends in the wildlife ranching industry that are causes for concern; these include: hybridizations, genetic manipulation, colour variant freak animals, inbreeding of rare game, game outside their distribution range, impact on habitat, veld conversion, unregulated relocation, lack of information and the conduct of professional hunters. In a later report to the Department of Environmental Affairs, Hamman *et al.* (2005) again lists these trends, emphasizing their impact in the industry. Hamman *et al.* (2003) also acknowledges that nature conservation bodies must take some of the responsibility for the current trends in the wildlife industry, as they had allowed other factors to overshadow conservation principles.

5.2 Current value of the Wildlife Ranching Industry

The industry as a whole is currently considered to be worth almost R9 billion (Anonymous 2013b). Wildlife ranching currently has the highest return per hectare of any agricultural activity (Slabbert 2013) at approximately R220/ha compared to R80/ha of normal livestock farming (Anonymous 2013b) and has a higher gross margin than cattle farming (Cloete *et al.* 2007). Annual return on investment of 80% or more is currently not unrealistic (Stafford 2013).

Four main types of income-generating activities can be distinguished on game ranches: hunting for meat and/or trophies, photographic or wildlife viewing eco-tourism, live sales of wildlife and meat (venison) production. These activities are influenced by a number of factors such as the game ranch's distance from cities and major tourist areas, the size of the ranch and the wildlife present (for eco-tourism the presence of the Big Five is especially important) (Bothma *et al.* 2009). In Gauteng, the most populous province in South Africa (Statistics South Africa 2014) and also arrival destination for many international tourists, eco-tourism is responsible for 40% of income generated by game ranches (Bothma *et al.* 2009). Comparatively in the rural bushveld, only 5-10% of income is generated by eco-tourism, whilst the majority of income, 60-65%, is from hunting (Bothma *et al.* 2009).

Game ranches show better profitability when the ranch supports more than one activity (Bothma *et al.* 2009).

5.2.1 Live game auctions

Initially conservation bodies opposed private game sales, as they believed conservation should be managed by government alone (Scriven & Eloff 2003). Nature conservation was concerned over a lack of skills in the fledging private wildlife ranching industry and the possible negative effects of trading with wildlife (Bothma *et al.* 2009).

The first auction that took place in South Africa, in 1975, only raised a total turnover of R20 362 through the sale of 128 animals, this is a trivial amount compared to the R1.029 billion and R1.875 billion turnover made in 2013 and 2014 respectively, with the sale of over 20 000 animals (Bothma *et al.* 2009; Cloete 2014b, 2015a).

From 1991 to 2000 the wildlife industry went through a phase of establishment, during which the surface area occupied by game ranching increased by 5.6% annually, driven by ecological and economic advantages (Cloete 2015b). In 2000 it was estimated that live game sales contributed 21% of the gross income generated by the wildlife industry (Bothma *et al.* 2009). It is likely that this has changed over the last 13 years as turnover from live game auctions have increased to over R1 billion (Cloete 2014b, 2015a). Additionally live game auctions are estimated to only make up about 20% of all sales taking place (Cloete 2015b).

Live game sales are an important indicator of growth in the wildlife industry (Bothma *et al.* 2009). The average price per animal has grown considerably from 2001 to 2014 (Table 5.1) and the setting of new record prices has also become increasingly common in the wildlife industry at auctions (Stafford 2013)(Table 5.1).

According to Cloete (2015b), game ranchers experienced a cost price squeeze during the mid-90s to 2000 and started intensive wildlife production of high value animals in smaller enclosures and moved away from free roaming game ranching. This continued shift is a cause of the increasing demand for these animals (Cloete 2015b).

Table 5.1. Summary of Vleissentraal auction data from 2001 to 2014. The colour variants category includes data from colour variants and split animals. The normal coloured counterparts includes only data for the normal coloured animals from species with colour variants at auction.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total turnover all animals (Rand)	52 857 575	75 002 771	73 015 122	71 894 818	32 506 098	39 290 260	89 544 195	111 478 250	221 829 536	232 657 655	434 046 178	864 024 987	857 391 133	1 406 713 138
Colour Variants:														
Turnover (Rand)	12 727	2 204 390	1 584 339	464 150	56 800	205 314	2 280 500	4 768 450	8 078 944	16 272 850	57 386 115	147 107 541	108 761 186	350 233 013
Proportion of Turnover (%)	0.02	2.9	2.2	0.6	0.2	0.5	2.5	4.3	3.6	7.0	13.2	17.0	12.7	24.9
Average price per animal (Rand)	1 157	18 370	22 315	17 852	1 420	3 064	44 716	31 579	33 110	107 767	39 386	206 902	147 173	269 825
Normal Coloured Counterparts:														
Turnover (Rand)	494 527	4 202 765	3 942 516	4 225 490	611 730	2 959 248	4 532 105	6 145 150	5 765 259	5 650 132	9 727 395	17 072 147	45 580 830	104 906 488
Proportion of Turnover (%)	0.9	5.6	5.4	5.9	1.9	7.5	5.1	5.5	2.6	2.4	2.2	2.0	5.3	7.5
Average price per animal (Rand)	737	734	701	643	794	818	954	1 268	1 287	1 325	1 924	2 525	3 527	7 509
Other high value game:														
Turnover other high value game (Rand)	29 887 513	39 289 300	42 569 935	37 833 500	15 657 509	19 991 805	63 234 750	81 729 000	186 631 463	194 552 983	351 759 295	680 394 078	603 590 529	927 978 046
Proportion of Turnover (%)	56.5	52.4	58.3	52.6	48.2	50.9	70.6	73.3	84.1	83.6	81.0	78.7	70.4	66.0
Average price per animal (Rand)	126 642	123 551	116 630	87 375	69 900	68 700	96 986	124 777	184 601	215 452	274 812	465 068	549 718	576 384
Total Number animals sold	8972	12304	12084	15014	7833	8662	9484	9139	9654	8300	10325	11576	17407	19852
Colour Variants:														
Number of animals sold	11	120	71	26	40	67	51	151	244	151	1457	711	739	1298
Proportion of animals sold (%)	0.1	1.0	0.6	0.2	0.5	0.8	0.5	1.7	2.5	1.8	14.1	6.1	4.2	6.5
Normal Coloured Counterparts:														
Number of animals sold	671	5729	5625	6568	770	3616	4752	4846	4481	4263	5057	6762	12922	13970
Proportion of animals sold (%)	7.5	46.6	46.5	43.7	9.8	41.7	50.1	53.0	46.4	51.4	49.0	58.4	74.2	70.4
Other high value game:														
Number of animals sold	236	318	365	433	224	291	652	655	1011	903	1280	1463	1098	1610
Proportion of animals sold (%)	2.6	2.6	3.0	2.9	2.9	3.4	6.9	7.2	10.5	10.9	12.4	12.6	6.3	8.1
Number of different colour variations at auction	1	4	4	5	6	7	6	8	9	8	13	17	22	31
Number of Record Prices Reached/Equalled						18	6	16	8	13	27	17	38	38

Data Sources = Bosveld Vleissentraal and record prices from Wild en Jag / Game & Hunt Magazine

High value wildlife such as buffalo, sable and colour variant animals are very sought after to farm with (Hamman *et al.* 2003) as they allow ranchers to keep smaller numbers of the animals and still be profitable (Cloete *et al.* 2007; Van Niekerk 2011); consequently high value wildlife make up a large part of the annual turnover at auctions (Table 5.1).

In 2001 *Bosveld Vleissentraal* had a total auction turnover of R52 857 575 of which colour variant animals contributed less than 1% to the total turnover at auction, represented only 0.12% of the animals sold and were all from a single variant: white blesbok (Table 5.1). The wildlife industry showed considerable growth from 2010 onwards and by 2014, 31 different colour variants, represented only 6.5% of the animals sold but 24.9% of the total turnover (Table 5.1). In the period 2009 to 2014 colour variant animals made up an increasingly larger proportion of annual auction turnover, peaking in 2012 at 17.3% and again in 2014 at 24.9%. During this same period other high value wildlife (buffalo, Livingstone eland, rhino, roan and sable) had decreased by more than 10% in terms of the proportion of annual turnover they made up (Table 5.1). However, other high value wildlife still dominate auction sales, consistently contributing more than 70% of the total annual auction turnover since 2007, only falling below 70% in 2014 resulting from colour variants nearly doubling in the proportion of turnover from 2013 to 2014 (Table 5.1). From a financial viewpoint the wildlife industry is a lucrative investment since the price per animal continues to increase; concurrently the number of animals sold at auction has more than doubled since 2001, which has subsequently led to turnover increasing 26 times. In 2014 other high value game sold at an average price per animal of R576 384 compared to an average price per animal of R269 825 for colour variants. These prices are both exceptionally high when compared to the average price per animal of R7 509 of the normal coloured counterparts (Table 5.1).

Colour variant animals have also become more common in the industry, both in terms of the number of different variants sold and the number of individual animals sold (Table 5.1). In 2001 there was a total of 11 colour variant animals sold at *Bosveld Vleissentraal* auctions from a single species; by 2014 there were 31 different types of variants from seven species with a total number of 1298 colour variant animals sold. This is still a small proportion (6.5%) of the total number of animals sold and it is likely that there is still much room for growth with colour variants within the wildlife industry; as evidenced by growth of

222%, 75% and 83% in proportion of turnover, number of animals sold and average price per animal, respectively from 2013 to 2014 (Table 5.1). Cloete (2015b) list several reasons for the growing demand of high value wildlife (including colour variants): improvement of the financial performance of ranching through events such as a ban on hunting in Botswana; enterprises listing high value wildlife on the JSE; continued cost-price squeeze on traditional agriculture which is driving many farmers towards high value wildlife to overcome their financial troubles by getting higher value per hectare from their farms; continued outlook of significant financial performance (of high value wildlife) which continues to attract investment (including international corporate investments); and the land reform model of Wildlife Ranching South Africa which represents highly profitable land use on small properties.

From data presented in Table 5.1 it can also be observed that there has been a great increase in the number of normal coloured counterparts (species which had colour variants at auction) being sold at auction. From 2001 to 2014 normal coloured counterparts grew from 7.5% of the total number of animals to more than 70.4% of the animals sold annually at *Bosveld Vleissentraal* auctions; the average price of these animals has also doubled from 2013 to 2014. This increase is however not just a function of the number of individual animals sold but is also a result of the increase in the number of species which have colour variants. This growth in not only the number of colour variants but also in the number of normal coloured counterparts can be attributed to the fact that colour variants are the ideal starting place for a new rancher (York 2014). Game ranchers who want to start breeding with high value game need large amounts of start-up capital. Cloete *et al.* (2007) states that it is not always profitable to switch to game ranching as a result of the high capital inset costs. If a rancher is considering starting with high value wildlife such as buffalo (R500 140 average price in 2014) or sable (R237 933 average price in 2014), they need to buy an entire herd of these animals at a high cost, which can cost as much as R20 million to get a ranch started (Weavind 2014). In the case of colour variants it is however not necessary to purchase an entire herd but one or a few male colour variants (or even just split animals at a further reduced cost) along with a herd of normal coloured females (normal blue wildebeest had an average price of R3 641 in 2014), which sell at a fraction of the price of a colour variant (golden blue wildebeest had an average price of R513 137 in 2013). This would enable a rancher to start farming high value wildlife at a lower start-up cost.

In this regard colour variants males are now being offered at auction along with split or normal females as package deals. Over time the game rancher can then progressively move on to having herds consisting purely of colour variants (York 2014). This makes colour variants a lucrative investment opportunity as any colour variant offspring from a normal coloured female results in a very large return on investment; the sale of a single colour variant offspring could potentially cover the cost of all the normal coloured females. In an article for Moneyweb, Mr. Johan van der Merwe, well known game rancher, presents data showing that return on investment when breeding a black impala with normal impala ewes can be as much as 130% (Slabbert 2013); it is known that the black colour in impala is caused by a single recessive gene and it is therefore easy to breed splits and turn black impala within a few generations (Anonymous 2015c). This is consequently a large part of the reason for their popularity and the popularity of their normal coloured counterparts.

5.2.2 The industry in context

The prices of wildlife have in general increased, with a few exceptions, over the last ten years (Figure 5.1, Table 5.1, Table 5.2). Most species of wildlife showed positive growth, with many species showing better growth rates than gold from 2004 to 2014 (Table 5.2). The prices of many colour variants grew at rates higher than their normal coloured counterparts, notably yellow blesbok has a total growth rate of 10244%. There are however some exceptions: white kudu prices dropped drastically, shedding R800 000.00 of its price in 2013, only recovering slightly during 2014 to show a total decline of 79% from 2011 to 2014. Simultaneously the black variant also suffered a decline in price. Furthermore, kings wildebeest showed slight decline from 2012 (conversely recovering most of its losses in 2014), however the prices of kings wildebeest splits grew 229%. Along with the kudu variants they are still relatively new and over time they may also show a positive CAGR, as was the case with black impala (Figure 5.1a). From 2004 the prices of normal coloured animals, excluding rare high value wildlife such as buffalo and sable, increased at rates that would be expected as a result of inflation (Figure 5.1 (b) & (d)).

In most cases the average auction prices of normal coloured wildlife increased to levels slightly higher than the inflation adjusted prices, but also showed more fluctuations than colour variants and other high value wildlife. High value wildlife such as buffalo and sable as well as colour variants had higher than inflation growth from 2004, with prices increasing to well above the inflation adjusted prices, with sharp increases after 2008 (Figure 5.1 (a) & (c)). Some colour variants such as springbok (Figure 5.1 (d)), which were among the first colour variants traded (York 2014), sell for much lower prices than variants such as black impala and golden wildebeest (Figure 5.1 (c)), however they still sell at higher prices than their normal coloured counterparts.

These above inflation price increases are most likely a reason these animals attract so much attention as they represent a good investment opportunity. Mr. Johan van der Merwe, in an article for Moneyweb, stated that investing in wildlife gives greater return on investment than investing in shares and that wildlife has consistently outperformed the JSE All Share Index (ALSI) and Dow Jones (Slabbert 2013). According to van der Merwe, the JSE ALSI had a total return on investment in 2012 of 26.68% compared to wildlife which gave a return of 28-42%, whilst colour variants such as black impala can reach returns of up to 130% (Slabbert 2013).

Table 5.2 Growth in monetary value from 2004 to 2014 of selected colour variant and other high value wildlife. Colour variant animals shown by shaded areas.

Species	Initial Price (Rand)	Year	Recent Price (Rand)	Year	CAGR (%)	Total Growth (%)
Blesbok, Copper	177 666	2012	566 176	2014	79	219
Blesbok, Normal	747	2004	2 187	2014	11	193
Blesbok, Painted	7 000	2012	271 700	2014	523	3781
Blesbok, White	1 122	2004	8 446	2014	22	653
Blesbok, White Split	2 400	2012	2 163	2014	-5	-10
Blesbok, Yellow	2 600	2006	268 956	2014	79	10244
Blesbok, Yellow split	9 000	2013	59 177	2014	558	558
Blue wildebeest	1 631	2004	3 641	2014	8	123
Blue wildebeest, Golden	80 000	2005	513 137	2014	23	541
Blue wildebeest, Golden Splits	23 221	2011	44 297	2014	24	91
Blue wildebeest, Kings	3 350 000	2012	3 175 000	2014	-3	-5
Blue wildebeest, Kings Split	81 553	2012	882 917	2014	229	983
Buffalo	148 867	2004	500 140	2014	13	236
Eland	4 390	2004	9 037	2014	7	106
Eland, Livingstone	10 188	2004	73 603	2014	22	622
Eland, King Cape	42 313	2013	6 500	2014	-85	-85
Gold (per troy ounce)	2 635,70	2004	13 722,70	2014	18	421
Impala	638	2004	2 496	2014	15	291
Impala, Black	86 000	2004	284 964	2014	13	231
Impala, Black Split	3 172	2006	83 283	2014	50	2526
Impala, Blackback	818 750	2012	2 070 588	2014	59	153
Impala, Blackback Split	320 000	2012	612 045	2014	38	91
Impala, White	260 000	2012	8 200 000	2014	462	3054
Impala, White Splits	10 750	2012	61 250	2014	139	470
Kudu	2 032	2004	7 597	2014	14	274
Kudu, Black	320 000	2011	80 000	2014	-37	-75
Kudu, White	860 000	2011	180 000	2014	-41	-79
Kudu, White Split	16 090	2012	45 000	2013	180	180
Oryx	3 519	2004	7 010	2014	7	99
Oryx, Golden	355 000	2011	169 566	2013	-31	-52
Oryx, Golden Split	40 000	2013	45 038	2014	13	13
Roan	149 521	2004	500 674	2014	13	235
Sable	62 718	2004	237 933	2014	14	279
Springbok	523	2004	2 891	2014	19	453
Springbok, Black	912	2004	7 062	2014	23	674
Springbok, Copper	8 000	2004	24 238	2014	12	203
Springbok, Heartwater	2 703	2004	19 719	2014	22	630
Springbok, Heartwater Black	45 238	2012	35 844	2014	-11	-21
Springbok, Heartwater Copper	26 615	2013	70 667	2014	166	166
Springbok, Heartwater White	16 125	2013	41 571	2014	158	158
Springbok, Kalahari	865	2004	9 071	2014	26	949
Springbok, White	2 819	2004	6 768	2014	9	140

CAG = compound annual growth rate (average annual growth if it took place at a fixed rate).
Data Sources = Wildlife prices from Wild en Jag / Game & Hunt Magazine; gold price obtained from World Gold Council

5.2.3 Hunting and Meat Industry

Hunting plays a very important role in the value of the wildlife industry. According to Bothma *et al.* (2009), hunting activities sustain up to 6 000 jobs, whilst an additional 60 000 jobs are sustained by secondary industries such as eco-tourism and taxidermy. In her keynote address to WRSA, Minister Edna Molewa put this figure at 100 000 (Molewa 2014). It is estimated that trophy hunters may spend up to four times more than a non-hunting tourist (Bothma *et al.* 2009). Hunting can also easily be combined with non-consumptive eco-tourism to ensure greater profitability (Bothma *et al.* 2009). Foreign and local hunters generated a combined, direct and indirect, revenue of R6.2 billion rand in 2010 (Stafford 2013). Prices for normal coloured antelope to hunt are on the increase (Olivier 2014), likely driven by increased demand in the breeding market. Current high prices are however a concern; Peter Flack and Gerhard Damm both warn, in a Financial Mail interview, that South Africa could lose out on buffalo hunters since trophy sized animals can be hunted much cheaper elsewhere in Africa (Stafford 2013). However, the rest of Africa is also often seen as unsafe by foreigners which could counteract the high prices (Slabbert 2013). At the moment hunting demand is still high which will lead to further price increases (Olivier 2014).

A major challenge facing the hunting industry is the lack of standardised regulations across South Africa's provinces often creating difficulties for professional hunters with clients who wish to hunt in more than one province (F. Myburg, *pers comm.* 2011; Slabbert 2013).

A factor that influences hunting income is the distance of the ranch to a population centre (Bothma *et al.* 2009) and in this regard it has been reported that the majority of hunters in the North West are from neighbouring Gauteng, which is within a comfortable driving distance (Olivier 2014).

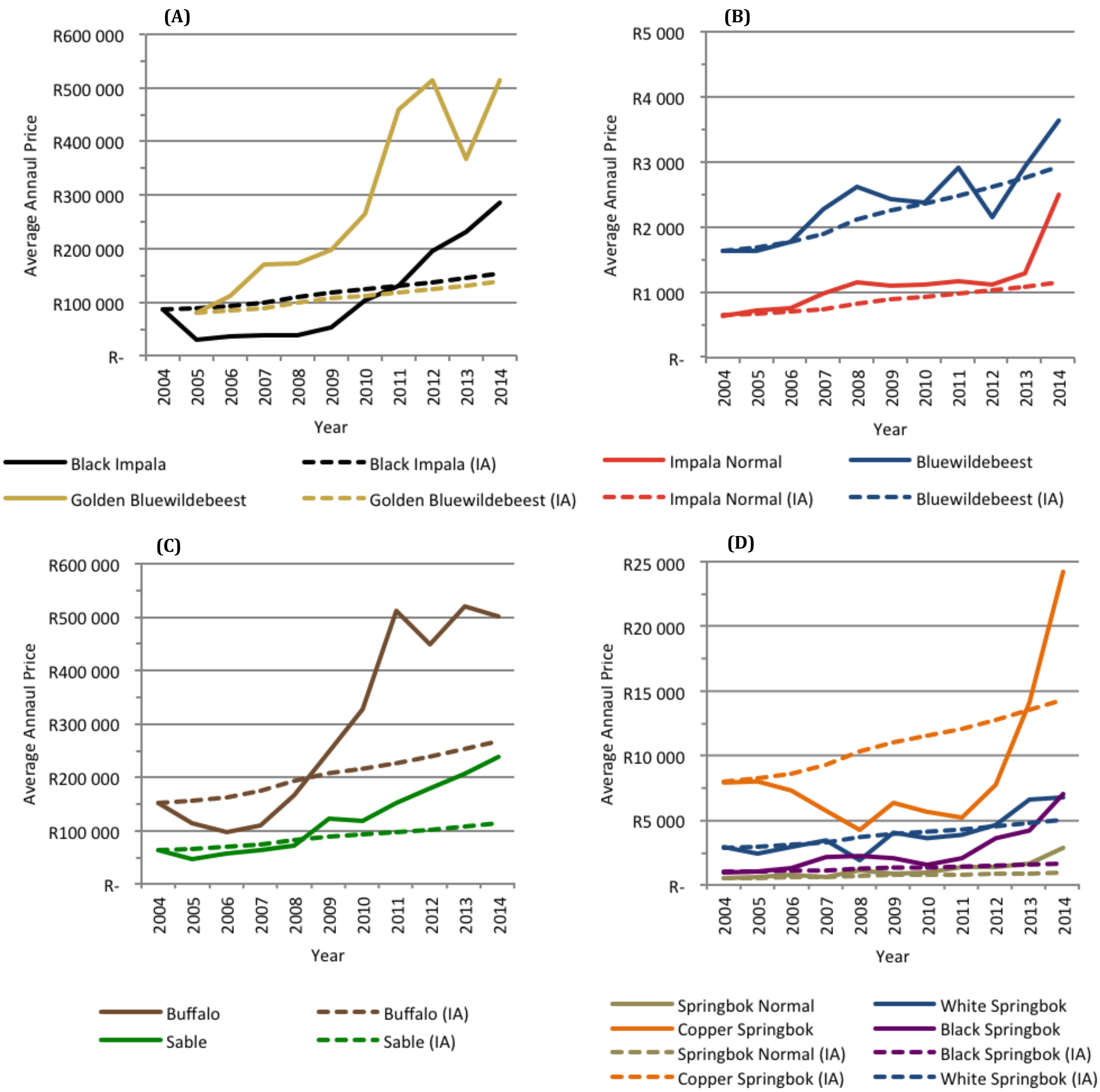


Figure 5.1. Average annual prices of some of the most popular high value wildlife, blue wildebeest (A+B), buffalo (C) and impala (A+B), as well as a springbok (D), which has reached or is close to reaching saturation in the breeding market. Dashed lines indicate inflation adjusted (IA) prices, calculated by applying the average annual inflation rate to the previous year's price starting with the 2004 price. As a result of the disparity between the prices of normal coloured animals and variants chart (A) indicates the prices of blue wildebeest and impala colour variants whilst the normal coloured animals' prices are charted on graph (B).

5.2.3.1 Contribution of Foreign Hunting

The Department of Environmental Affairs estimated that during 2013 foreign trophy hunters spent R1.072 billion in South Africa (Anonymous 2014b). These numbers however do not include additional spending on items such as food, transport, additional sight-seeing, clothing, ammunition, accessories, permits and licensing fees, taxidermy and trophy shipping, which can increase the Department's estimate by as much as 50%. With these values included, 9 000 foreign hunters contributed an estimated R1,24 billion to the South African economy in 2012, R400 million more than the R811 million estimated by the Department of Environmental Affairs (Anonymous 2014c). This is up from the 2003-2004 hunting season during which 5000-6000 foreign hunters shot 53 453 (44 028 in 2013) animals with a total value of R265 million (Bothma *et al.* 2009).

Most foreign hunters are from the USA (88%), Spain and Denmark with smaller numbers coming from the UK, France, Germany and Norway. Foreign hunters also often extend their stay in South Africa, thus further contributing to tourism income (Slabbert 2013; Anonymous 2014c). Bothma *et al.* (2009) estimated that in 2000, foreign hunters were responsible for 18% of the gross income in the wildlife ranching industry, compared to 54% contributed by local hunters.

The majority of foreign hunters are trophy hunters (Van der Merwe & Saayman 2013) and during 2013 these hunters favoured hunting impala (5 697), warthog (3849), kudu (3 519), normal blesbok (3 354), springbok (2 954), blue wildebeest (2 694), gemsbok (2585), Burchell's zebra (2 492), nyala (1 503) and waterbuck (1 380). However, all of these were not responsible for the most income; lion (R122,3 million), buffalo (R90.9 million), kudu (R62,5 million), white rhino (R54,8 million), sable (R47,8 million), gemsbok (R33,6 million), nyala (R32,8 million), Burchell's Zebra (R30,2 million), waterbok (R27,5 million) and blue wildebeest (R26.1 million) (Anonymous 2014b).

5.2.3.2 Contribution of local hunting

Local recreational hunters, also referred to as biltong hunters, vary between 3 and 17 hunters per hunting trip and they pay between R7 500 and R46 000, depending on group size and animals hunted, for these trips (Olivier 2014). The average hunting trip includes four days stay, hunting five species with an average spend of R15 752 (Saayman *et al.* 2011). Local hunters are still willing to pay the increasingly higher costs of animals, many of which have doubled in price from 2013-2014 (Olivier 2014).

South Africa's 200 000 – 300 000 domestic hunters are mostly meat (biltong) hunters and they spent R1 billion more than the 15 000 foreign trophy hunters (Van der Merwe & Saayman 2013; Flack 2014b; York 2014). Since local hunters mainly hunt for meat they tend not to hunt scarce and expensive wildlife (Van der Merwe & Saayman 2013). Saayman *et al.* (2011) estimated that local biltong hunters contribute in excess of R6 billion to South Africa's GDP.

5.2.3.3 Meat production

Game meat and biltong are the main products acquired from hunting (Young 2013). Furthermore, local hunters are also more likely to hunt for the meat than for trophies (Young 2013). There is a lot of room for expansion concerning wildlife meat production as a result of growing demand for natural, healthy and organic protein. Comparatively South Africa's game meat market is underutilised. Currently it is worth between R300 and R400 million rand annually, whilst New Zealand is producing 50 times more game meat (Stafford 2013; Anonymous 2014a).

An important factor for meat export is strict safety and quality control, up to European Union standards (Bothma *et al.* 2009). Meat production from wildlife is seen as the next area where the wildlife industry will grow (Oberem 2014). Colour variant animals are, however unsuited to meat production as a result of their extremely high cost. Consequently the value of meat from these animals would only constitute a very small proportion of the total cost of the animal. Therefore meat production cannot be considered as part of the value of colour variants to the wildlife industry. Situations might arise where breeders shoot excess male splits in order to prevent these animals to become too common and therefore sell at a cheap price. It is however doubtful if this irregular supply of meat would drive the practice of breeding with colour variants.

5.2.4 Eco-Tourism

Eco tourism can be seen as a non-consumptive utilisation of wildlife and was according to Bothma *et al.* (2009) the second smallest contributor to the gross income of the wildlife industry in 2000 at just 5%. The cause of this is that for ranches to be suited to non-hunting eco-tourism activities, they need to offer beautiful scenery and the Big Five animals in order to attract tourists (Radder 2007; Vegter 2012; Maciejewski & Kerley 2014). Such a ranch would cost in excess of R85 million rand (Bothma *et al.* 2009). A large number of game ranches are too small to support viable elephant or predator populations such as lion and leopard and so only a small number of private ranches cater for non-consumptive eco-tourism (Bothma *et al.* 2009).

The possible contribution of colour variant animals to eco-tourism income is also uncertain as opinions concerning these animals differ greatly (discussed further in chapter 6). Furthermore Maciejewski & Kerley (2014) found that eco-tourism can be successful, without the need to stock a ranch with extra-limital species. Colour variant antelope are unlikely to attract many tourists as traditionally tourists want to experience nature in an unspoilt, scenically beautiful location (and colour variants could be considered interference with nature) and as mentioned above, tourists are mostly interested in the Big Five. However, colour variants such as white lions and king cheetah do attract tourists (Oberem 2015), but in general tourists are more interested in predators (Maciejewski & Kerley 2014).

5.3 Are current trends in the industry sustainable?

It has been warned that if conservation principles continue to come second it may also negatively impact the economic viability of the game ranching industry (Hamman *et al.* 2003).

In recent years there have been several articles (Slabbert 2013; Stafford 2013, 2014; Spillane 2015) by well-known financial news agencies, such as Moneyweb and Financial Mail, reporting on the investment potential of wildlife in South Africa, specifically high value wildlife such as buffalo and colour variants. In some cases game ranchers have presented purchases made by well-known businessmen such as Dr. Johan Rupert, who paid R40 million for a buffalo, to portray investment in the wildlife industry as a good investment opportunity (Slabbert 2013). However Dr. Johan Rupert spoke out against this in an interview with the Landbouweekblad, saying that he did not purchase the buffalo as a financial investment but as an investment in nature and warned that the wildlife industry could be a bubble waiting to burst (Botha 2014). Mr. Chris Niehaus shares this sentiment and is concerned that the current trends in the industry could put South Africa's conservation success at risk (Niehaus 2014a). Niehaus also warns that with high returns on investment comes high risk (Niehaus 2014a). To-date the debate on whether colour variants (and the wildlife ranching industry) contribute to conservation is still on-going.

5.3.1 Colour variants in the hunting industry

Cloete (2014b) identifies two markets in the wildlife industry currently: a breeding market and a hunting market, both of which influence prices and investors' choices. Ultimately the value of any trophy animal will be determined by what the hunters are willing to pay (Stafford 2013). Currently hunters are still willing to pay higher prices for non-trophy wildlife, even if prices have doubled (hunting rates for impala increased form R1000 to R2600 from 2013 to 2014) (Olivier 2014). Before determining whether current trends in the wildlife industry are an economic bubble, it is important to first determine whether there will be a market for colour variants in the long term. Among ranchers there seems to be a feeling comparable to the saying: "if we build it they will come". However will the hunters be interested in hunting colour variant animals?

The Confederation of Hunters Associations of South Africa (CHASA) (n.d.) states that it is opposed to the breeding of genetic variations and discourages its members from paying more for colour variant trophies in its policy on wildlife conservation. The South African Hunters and Game Conservation Association (SAHGCA), the largest such organisation in South Africa, openly opposes genetic manipulation of wildlife through selective breeding and specifically refer to coat colour in their policy document (Anonymous 2014d). In this document SAHGCA also discourages their members from partaking in the hunting and trade of manipulated animals (Anonymous 2014d). SAHGCA furthermore actively promotes awareness of their concerns to government and the scientific community and has received international support for their position on the matter (Niehaus 2014b; Anonymous 2015a). In addition to the above the Professional Hunters' Association of South Africa (PHASA) states in its position paper on colour variants that PHASA rejects any claim that these animals are bred to supply a demand from trophy hunters and the inclusion of any further colour variants into record books (Anonymous 2015d). PHASA furthermore refers to a SANBI document, in their position paper, which states that the breeding of colour variants should be discouraged (Anonymous 2015d). In addition to these South African associations the International Council for Game and Wildlife Conservation (CIC) stated that it is opposed to the manipulation of wildlife, specifically referring to coat colour, through controlled breeding programs (Anonymous 2011b). Following this recommendation, Flack (2014) argues that the influence the CIC and its member bodies such as the Boone and Crockett Club have, will prevent interest in colour variants as trophy animals from growing.

Opinions concerning these animals (discussed in chapter 6) are very varied. Nonetheless, there seems to be common trend among hunters (local and foreign) that they are interested in either the meat (and will not pay more for a colour variant) or they value the quality of the stalk more than the trophy and are concerned that colour variants will not pose the same challenge as normal coloured animals (see chapter 6 for comments made by hunters). According to Dorrington (2015), colour variants contribute to a perception that wildlife presented for hunting is canned and farmed. Research by Van der Merwe & Saayman (2013) showed that the experience and excitement of hunting as well as the spiritual motive (relaxation and enjoying nature) are the most important factors motivating local biltong hunters and not trophies. The spiritual motive is also very important to foreign hunters along with adventure (which includes acquiring new trophies) based motives, whilst adventure was the least important motivation to local biltong hunters (Van der Merwe & Saayman 2013). Mr. Rodney Kretzschmar, an experienced taxidermist, makes the statement that European hunters may see colour variants as interference with nature and that few hunters are interested in hunting these animals, since it can be regarded as artificial. According to Mr. Stewart Dorrington, a former president of PHASA, there is very little interest from hunters in colour variants (Dorrington 2015). European hunters prefer to hunt animals they consider natural in their natural environment (Bezuidenhout 2012b). Bearing in mind that the vast majority of hunting in South Africa is by 200 000 – 300 000 domestic hunters, the majority of which are meat (biltong) hunters, compared to just 15 000 foreign trophy hunters in 2011 (Flack 2014b; York 2014), it seems likely that there will be little interest to hunt colour variant wildlife in large numbers (Flack 2014a; Niehaus 2014a). There is very limited data on the numbers of colour variant animals being hunted; results from the survey (discussed in chapter 6) indicated that only 15% of the respondents had hunted a colour variant animal, of these the majority where game ranchers, who likely already owned the animals they hunted. Colour variants which have reached saturation on the breeding market, such as some springbok variants, are used as an example that these animals will be hunted once their prices drop (York 2014). However, data (provided by Dr P. van Niekerk and J. Fereira-Barnard from Department of Agriculture and Game Management, Nelson Mandela Metropolitan University) from a 2012 study on the utilization of game in the Eastern Cape does not support this. This study indicated that an insignificant number of colour variant springbok were hunted in 2012. Extrapolated values showed that from a total of 40 995 springbok hunted in the Eastern Cape during 2012, 40 609 were normal springbok (99.1%) compared to a mere 344 black springbok (0.8%), 25 copper springbok (0.06%) and 17 white springbok (0.04%). It should also be noted that from 2012 springbok prices, especially that of copper springbok, have increased significantly.

In contrast to the above York (2014) argues that there is and will be a market for these animals. In support of this York (2014) states that the Professional Hunters' Association of South Africa (PHASA) encourages the hunting of colour variants by offering members the chance to earn medals for their colour variant trophies. More recently however, PHASA has indicated that it rejects the inclusion of any further colour variants as trophy hunting records (Anonymous 2015d). Furthermore, he presents data which shows that Safari Club International (SCI) already has several hundred colour variant entries into its record book (York 2014) (Table 5.3). A clear relationship is observable between the number of trophies in SCI's record book and the average price of the animals. In general the higher the price, the fewer trophies there are. The majority of colour variant entries into SCI's record book are from animals that have an average price below R10 000 (Table 5.3). SCI, however, has newly introduced requirements before admitting any new colour variant animals, amongst these are that there must be a sustainable use management plan and that there must be an endorsement to accept the species by a local, regional or national wildlife authority (SCI

Table 5.3. Number of trophies in Safari Club International record book alongside 2015 average auction price.

Variant	No of trophies*	Average Price**
Black Impala	6	R 284 964
Copper Springbok	168	R 24 238
White Springbok	699	R 6 768
White Blesbok	802	R 8 446
Black Springbok	921	R 7 062

* Data from York (2014); **Data from Cloete (2015)

Record Book Committee 2015).

Endorsement by governmental nature conservation authorities seems unlikely, considering calls on government for regulation (Anonymous 2015a), and even to ban it (Anonymous 2015b), as well as that SANBI has recommended that colour variant breeding be discouraged (Donaldson 2010), a viewpoint which was also adopted by PHASA (Anonymous 2015d).

It can then be reasonably concluded that there will be some demand for colour variant animals from hunters once the breeding market has been saturated and prices have decreased sufficiently enough to make hunting a colour variant animal affordable to the average hunter. The demand, in terms of numbers of animals, would however be relatively low compared to normal coloured animals, considering the majority of hunters in South Africa are interested in meat and would have no preference for and consequently would not pay a higher price for a colour variant. Additionally, demand for these animals as trophies will be limited to only those hunters to whom the trophy is more important than the experience, whilst several more hunters are likely to be swayed by the influence of hunting and conservation organisations such as the CIC, CHASA, PHASA and SAHGCA. For the moment at least, there are very few end users involved in the purchasing of colour variants.

5.3.2 Are colour variants just another bubble?

An economic bubble forms when the prices of a commodity are determined largely by past performance and not on intrinsic value. Economic bubbles are also characterised by assets which trade at much higher values than their intrinsic value; early entrants make profit while later entrants lose money and the transition from increasing to decreasing prices can be catastrophic (Niehaus 2014a).

According to Stafford (2013), Mr Bernard Groenewald told delegates at the 2013 WRSA congress that prices will fluctuate but that the bubble will never burst as there will always be demand for top genetics. Dr. Johan Rupert warns that investing in high value wildlife carries much risk (Botha 2014) and in this regard Cloete (2014b) states that current price increases seen in the wildlife industry will not be sustained indefinitely and that prices will drop as soon as demand for high value wildlife is met. Cloete (2015b) identifies the high value wildlife market as being in the middle-late bull market period. This period is characterised by continuing price increases, but less significant than during the early bull period. Cloete (2014b) predicts that wildlife prices will stabilise at a high level whilst some species will even continue to show growth, but warns that this does not reduce the risk of investing in wildlife, specifically for those who invest in the short term solely for financial gain. Cloete's (2014b) assessment seems to be supported by the prices of some springbok colour variants (black and white), among the first colour variants traded, which have not shown a major drop in prices but has rather grown at reduced rates (compared with other variants) close to inflation (Figure 5.1). Mr Dries Visser, chairman of the Trophy Breeders Group, believes that demand for high value game such as buffalo and sable will remain for many years still, but he does concede that colour variant animals disquiet him and that prices are not always justified (Visser 2014).

Several people, including Dr. Johan Rupert, believe that it is a small group of ranchers who trade, specifically with high value wildlife, among themselves (Botha 2014; M. Eksteen, *pers comm.* 2013; Flack 2014a; Niehaus 2014a; Stafford 2014; Spillane 2015). Cloete (2014b) states that it is a number of mostly well-established game ranchers who are willing to pay these high prices. Conversely Jacques Malan, chairman of Stud Game Breeders, says it is a myth and there are several newcomers in the industry (Malan 2014). Mr Marius Eksteen, a well-known businessman and game rancher, and Mr Chris Niehaus, former CEO of SAHGCA and HSBC Holdings SA are, however, convinced that it is the trade between this group of ranchers that is artificially inflating prices in the industry (M. Eksteen, *pers comm.* 2013; Spillane 2015). Mr Brandon Leer, a wildlife auctioneer, says that the market is not "rigged", but that many business people are looking to wildlife as an investment (Stafford 2014). Furthermore, there has also been interest in high value wildlife from foreign corporate investors, which is keeping the demand for these animals high (Cloete 2015b).

Game ranchers such as Jacques Malan (former WRSA chairman), Dr. Peter Oberem (WRSA President) and Reuben Saayman (Buffalo owners advisory committee head) continually endorse the current high prices in the wildlife industry. They contend that they are breeding back top genetics through selective breeding, that return on investment is high, that animals which reach record prices (and drive up average prices) are rare and that the bubble will never burst (Stafford 2013, 2014). Jacques Malan further says that people have been asking for years when the wildlife bubble will burst and it is still going strong, he also encourages people to join the wildlife industry (Malan 2014). Several stakeholders (Oberem 2014; van der Linde 2014; York 2014; Malan 2014) in the wildlife industry contend that the future of the industry is bright and there is no reason for concern as there are underutilised areas where the industry can still grow, such as the consumer meat market. The colour of an animal will have no influence on its value in the meat market and as a result the primary users for these animals will be trophy hunters. Consequently the value of colour variant animals will primarily be influenced by demand from trophy hunters.

Taking into account that the end user is still uncertain (Botha 2014) and very few end users are buying colour variants, several people have likened the current practice of breeding colour variants and other high value wildlife, in the wildlife industry to a pyramid scheme (Bezuidenhout 2012; Mr M. Eksteen, *pers comm.* 2013; Flack 2014). Currently the majority of sales of colour variant animals is from breeder to breeder and not from breeder to consumer (Botha 2014; Flack 2014a, 2014b; Survey Colour variations of African Antelope: Opinions of Stakeholders 2014). Furthermore, as mentioned in section 5.3.1, the potential future market for colour variant wildlife seems limited and it is possible that once demand from breeders for these animals has diminished, there will not be enough demand created by hunters to maintain economically viable prices. This is a possible reason that there is a strong push from South African ranchers to open up the Namibian market for these animals (Flack 2014b) where they are still scarce and in demand as evidenced by attempts to smuggle animals across the border into Namibia (!Gaeb 2014). Considering the above information, Chris Niehaus may be correct in stating that the current situation in the wildlife industry is an economic bubble (Niehaus 2014a). Jacques Malan however opposes this conclusion and says that breeding wildlife offers an escape from declining prices. Wildlife, unlike normal financial investments, have the ability to propagate which can negate any decline in prices since all a rancher would need to do is sell more offspring to recover his losses (Cloete 2015b; Spillane 2015).

Several small game ranches are common in South Africa (Bothma *et al.* 2009). High value game such as buffalo require ranches of at least 500ha, however the smaller antelope with colour variants, such as blue wildebeest and Impala can be kept on ranches as small as 50ha (Weavind 2014). Consequently, colour variants has allowed many new entrants to wildlife ranching to keep a small number of animals with a high capital value on small plots of land (Cloete 2015b), which would otherwise not have been able to support an economically viable game ranch. The high value of these animals allow ranchers to provide the animals with additional feed; which may be required in some cases (springbok utilise additional feed in large quantities if available, especially during the cold dry season, see chapter 4), as the enclosures where animals are kept are often small (Niehaus 2014a) and do not have adequate carrying capacity for the animals present.

A significant drop in the prices of colour variant game would drive many of these small-scale ranchers out of the industry as they would no longer be able to afford to supplement the diet of their animals. Large, well-established game ranches would be less influenced by dwindling prices as they can support large enough populations of animals to be economically viable.

5.4 Effects of current trends in the wildlife Ranching Industry

5.4.1 Effects on species

It has been warned that colour variants do not contribute to conservation or the long term survival of a species since colour variants normally do not survive in nature (Hamman *et al.* 2003, 2005). In this regard farmers are reporting that black coloured individuals are preferred by predators and are the first to fall prey (Anonymous 2011a). Furthermore, selective breeding with colour variants could also easily lead to inbreeding, possibly decreasing the genetic integrity of South Africa's wildlife (Hamman *et al.* 2005; Anonymous 2015a; Nel 2015). Stating that selective breeding, for either colour or horn length, breeds back top genetics (Stafford 2014) is debateable as selective breeding has several negative aspects (Niehaus 2014a). Selective breeding risks reducing genetic variation of the animals including losing other important traits and perpetuating negative traits within a breeding herd. Selective breeding isolates animals from their available genetic diversity leading to a potential loss of rare alleles (Nel 2015). Furthermore, captive bred animals may lose their ability to adapt to natural vegetation, drought and predator response. Selective breeding may also allow less hardy animals to survive where they would not have survived under natural conditions (Spillane 2015). There is a risk that the effects of selective breeding may not yet be noticeable as a result of intensive management of such animals (Nel 2015), through e.g. additional feeding.

Colour variants of which not only the hair colour but also the skin colour is affected may also be more sensitive to sun burn and skin cancer, as is the case with skilder gemsbok which have pink noses and blue eyes (Needham & Hoffman 2014). However colour variation may also have positive effects such as greater adaptability to environmental change (Hetem 2009; Delhey *et al.* 2013) and have been known to be more resistant to epizootics (Needham & Hoffman 2014).

According to Stapelberg (2007), springbok numbers in the Kalahari have been declining over the last 20 years; at the time the decline occurred only in the Kalahari.

However, it has now become known that springbok numbers in some nature reserves in the Free State are also declining (unpublished data; Vrahimis *pers comm.* 2011). Intensive captive breeding of wildlife could lead to genetic pollution of wild populations as selective breeding is associated with several negative effects for the receiving wild populations (Cousins *et al.* 2010; Nel 2015). Therefore selectively bred colour variations of springbok may become a threat to the long-term conservation of springbok.

5.4.2 Extended effects

Beyond the effects on the animals of selective breeding with colour variants, there are also other additional effects, both positive and negative, that result from this practice.

One such effect is habitat fragmentation resulting from increasingly impenetrable fencing (Bothma *et al.* 2009), constructed with the purpose of securing the large capital investments made into high value wildlife such as colour variants (Anonymous 2015a). Additionally electrified fencing, used to keep predators out of game camps, is known to cause tortoise deaths as the animals easily get stuck against the live wires.

A further effect is increased persecution of predators that impact the economic viability of a game ranch (Bothma *et al.* 2009; Anonymous 2015a).

Current breeding practices could negatively impact South Africa's reputation as an authentic hunting destination (Bezuidenhout 2012b; Anonymous 2015a; Dorrington 2015; Nel 2015) and hunting trophies from South Africa may become suspect as being manipulated (Niehaus 2014a). This would drive foreign trophy hunters to other destinations, further decreasing the value of the private wildlife industry. Damage to South Africa's image as a hunting destination is evidenced by a recent advertisement in the African Outfitter; luring hunters to Zimbabwe by offering them an experience free of colour variants and mockingly portraying colour variant wildlife as domestic livestock (Anonymous 2015e).

On the other hand, colour variants can act as umbrella species for conservation. In most cases wildlife ranching does not take place on previously conserved land, ultimately increasing the overall surface area of South Africa that is being conserved (Oberem 2015).

According to Bothma *et al.* (2009) private wildlife ranches have had a mostly positive impact on biodiversity although this has to date not yet been quantified scientifically.

Colour variants allow ranchers to keep less animals and still be profitable, consequently utilising less of the veld's carrying capacity; farming with colour variant wildlife thus has the potential of having a lesser impact on the veld (Cloete *et al.* 2007; Van Niekerk 2011)

Expensive genetic testing may become a requirement to accurately identify some animals (Bezuidenhout 2012b). Such as provided by Onderstepoort Veterinary Genetics Laboratory and Wildlife Stud Services (WS^2). This may increase costs of wildlife ranching, but will also create job opportunities for geneticists and contribute to better genetic management of wildlife.

5.5 Concluding Remarks

Hamman *et al.* (2005) suggests a number of possible solutions for the problems facing conservation and wildlife ranching. Among these solutions are national norms and standards, clear guidelines, partnerships, reliable information, recognition of trophies only when they fulfil conservation criteria. Solutions for the issues facing the wildlife ranching industry and conservation are dependent on the co-operation of the stakeholders (Hamman *et al.* 2005). Considering that governmental protected areas cover only 7.5 million hectare and support only 6 million animals compared to some 18 million animals on 20.5 million hectares in private hands, any activity that impacts such a large section of South Africa's wildlife and conservation industry is extremely significant (Niehaus 2014a).

Ranchers and investors will continue to breed colour variants as long as they are more profitable to farm with than other agricultural activities (Cloete 2015b). However at the moment there are very few end-users (hunters and game viewing) involved concerning colour variants. Current data as well as considerable opposition to colour variant wildlife by hunting organisations suggest that it is unlikely that there will be large-scale interest in consumptive use of colour variants even if prices become more affordable.

CHAPTER 6

STAKEHOLDER OPINIONS IN THE CONSERVATION AND THE WILDLIFE RANCHING INDUSTRY

6.1. Introduction

The biggest contribution to conservation of the wildlife ranching industry is in maintaining natural areas, which is becoming increasingly important as a result of limited funding available to governmental conservation bodies (Cousins *et al.* 2008). The breeding of different colour variants of Bovidae has in recent years become one of many practices in the private wildlife industry (hunting and game ranching) which is causing concern among nature conservation officials (Hamman *et al.* 2003, 2005). Some people disagree that colour variants are a cause for concern (York 2005; Oberem 2015) and conclude that colour variation is a natural part of evolution, that these variations increase biodiversity and that farmers have the right to create wealth from breeding with the animals that give the largest economic returns (York 2005). Little data is available concerning colour variants and the lack of published scientific data has resulted in a debate concerning colour variations as neither faction can present concrete data to support their arguments. Consequently, nature conservation authorities are unable to consider implementing regulations concerning colour variations. It is the opinion of York (2005) that decisions in the creation of wildlife regulations are based on emotions and not on scientific, ecological or socio-economic principles.

The opinions of stakeholders can be extremely important in understanding the role of the private wildlife ranching industry's role in conservation (Cousins *et al.* 2008). Two of the major role-players in the debate at the moment are the South African Hunters and Game Conservation Association (SAHGCA), which is strongly opposed to the practice of breeding colour variants, and Wildlife Ranching South Africa (WRSA), which supports breeding of colour variants (Anonymous 2015a; Oberem 2015). The South African Hunters and Game conservation Association's viewpoint seems to stem from a desire to maintain an "as natural as possible" environment with minimal anthropogenic intervention, concern about the impact on biodiversity and South Africa's conservation image as well as abnormally high wildlife prices, which has a negative impact on the consumptive use of wildlife (Anonymous 2015a). Wildlife Ranching South Africa sees opposition to the breeding of colour variants as an attack on the wildlife ranching industry as a whole (Peter Oberem, 3 March 2015, letter to the Minister of DEA) and states that colour variation is a natural phenomenon. The current president of WRSA, Dr Peter Oberem has stated previously that he does not understand the opposition to colour variants since such animals occur naturally in the wild (Stafford 2014; Oberem 2015). Supporters of breeding colour variants also argue that game ranchers have the right to financial gain from wildlife (York 2005). This is important since ranchers will only be truly motivated to do more for conservation if there is a financial advantage (Cousins *et al.* 2010).

According to Cousins *et al.* (2008) conservationists have been interested in making use of more contextual analyses, inspired by social sciences, in conservation efforts. Interviews and questionnaires are a useful, effective and affordable method to generate large amounts of data in a short time (Stapelberg 2007; Cousins *et al.* 2008). Opinions can also be important in shaping land use decisions and as a predictor of responses to policies and planning decisions (Balram & Dragićević 2005). WRSA states that it is only a few people/organisations who oppose colour variants, based on unscientific and emotional reasons (Oberem 2015). The survey utilised in this study was created with the objective of determining what the opinions of various stakeholders in the industry are concerning colour variants. Additionally the survey aimed to determine whether there would be support for or opposition to the implementation of regulations pertaining to colour variant animals, as was recently called for by the South African Hunters and Game Conservation Association (Anonymous 2015a).

Very few nature conservation officials responded to the survey. After contacting several nature conservation authorities in South Africa it became evident that many of these organisations do not currently have an official position regarding colour variant animals partly due to a lack of scientific evidence to base it on, which could have influenced the response rate. Cousins (*et al.* 2008) also experienced reluctance from government departments to participate in opinion-based research as a result of officials feeling they had a lack of knowledge on the topic.

The survey research was created in the Likert style, it did not generate true Likert data but Likert type data (each question's response was analysed separately and results presented as percentages of the total responses to each question; the questionnaire responses were not analysed as a whole (summed to create a scale) such as when using true Likert Data). The aim of the survey was to determine what the stakeholder opinions on the topic of colour variants are, by making provision for the respondents to make comments on the topic in addition to answering the questions. Further comments were gathered through interviews and responses on online web forums. All comments used are quoted, except where translation from Afrikaans to English was required.

6.2. Survey Results and Discussion

6.2.1 General Results

Respondents were able to select from a set of predefined categories or to add a custom category upon answering the demographic questions. The demographic results, questions one to three, of the respondents (n=54) were as follows: Most (94%) of respondents were South African citizens, the other respondents were from Botswana, Canada, Germany and Namibia (Table 6.1). The majority of the respondents identified themselves as being game ranchers (37%), the next largest groups were recreational hunters and veterinarians (equally 15%); this was followed by environmental scientists/students (13%), nature conservation officials (7%), wildlife enthusiasts (5%), ecologists (2%), professional hunters (2%), professional scientists (2%) and wildlife registering authority (2%) (Table 6.1). The majority of respondents identified their employers as a private game ranch (35%), this was followed by respondents whose primary employment is not within the wildlife industry (17%), provincial government (13%), self-employed (13%), private environmental consultants (7%), national government (5.5%), tertiary education institution (5.5%) and non-governmental organizations (4%) (Table 6.1).

The aim of question four (Q4. Colour variations are new species) and five (Q5. Colour variations are a natural phenomenon) was to determine whether respondents had a basic knowledge of colour variants. Respondents seemed to mostly have an adequate basic knowledge of colour variants as all respondents correctly identified that colour variant animals are not new species, however 9% of the respondents incorrectly answered that colour variation is not a natural phenomenon. This error could have arisen from inadequate knowledge on the topic or, as is the case with the following statement, that they differentiated between the practice of selectively breeding these animals with their natural occurrence in nature.

> *"We all know that colour variation does occur in nature from time to time. But nature has a way of getting rid of these animals through predation. What is taking place in the wildlife industry is line breeding to get animals of various colours. To say that this is a natural phenomenon is simply not correct. Many of the new colour variants have never occurred under natural circumstances before." Environmental Scientist*

Table 6.1. Stakeholder opinion survey questions and results categorised by stakeholder, n=54

Question Number	**Question/Statement**	**Answers/Options**	**Total (%)**	**Stakeholder (%)**							
				Ecologist	Scientists	Game Rancher	Nature Conservation official	Hunters	Veterinarian	Wildlife enthusiast	Wildlife Registering Authority
Q1	I am a...	Botswana Citizen	2						2		
		Namibian Citizen	4		2	2					
		South African Citizen	**90**	2	13	35	7	13	13	6	2
		Canadian	2					2			
		German	2					2			
Q2	Which best describes you		100	2	15	37	7	17	15	6	2
Q3	Which best describes who you work for?	I do not work in the wildlife or conservation industry	17			2		13		2	
		National Government	6		2		2		2		
		Non-governmental organization (NGO's) e.g. WWF	4		2			2			
		Private environmental consultancy firm	7	2					2	2	2
		Private game ranch/farm	**35**		4	26		2	2	2	
		Provincial Government	13		4		6		4		
		Self-employed farmer/breeder/professional hunter	13			9			4		
		Tertiary education institution e.g. University	6		4				2		
Q4	Colour variations are new species	**FALSE**	**100**	2	15	37	7	17	15	6	2
Q5	Colour variations are a natural phenomenon	FALSE	9		2	2		4		2	
		TRUE	**91**	2	13	35	7	13	15	4	2
Q6	Colour variations should not be bred because nature should be allowed to run its course without human intervention	Agree	17		4	2	4	2	4	2	
		Disagree	22			11	2	2	6		2
		Strongly Agree	**52**	2	11	17	2	13	6	2	
		Strongly Disagree	9			7				2	

Table 6.1 continued

Question Number	Question/Statement	Answers/Options	Total (%)	Stakeholder (%)							
				Ecologist	Scientists	Game Rancher	Nature Conservation official	Hunters	Veterinarian	Wildlife enthusiast	Wildlife Registering Authority
Q7	I enjoy seeing/hunting colour variations in the veld whilst game viewing/hunting	Agree	26		2	9	2	6	2	4	2
		Disagree	22		6	6	4	4	4		
		Strongly Agree	11			9				2	
		Strongly Disagree	**41**	2	7	13	2	7	9		
Q8	Colour variations contribute to the aesthetic value of game viewing	Agree	22			11		4	2	4	2
		Disagree	28		9	4	7	6	2		
		Strongly Agree	11			7		2		2	
		Strongly Disagree	**39**	2	6	15		6	11		
Q9	Colour variations are sought after/popular exclusively because of their high monetary value	Agree	37		7	11	6	7	2	4	
		Disagree	6		2	2		2			
		Strongly Agree	**56**	2	6	24	2	7	13	2	
		Strongly Disagree	2								2
Q10	Colour variations are sought after/popular because they contribute to biodiversity/conservation	Agree	11			6		2		2	2
		Disagree	20		4	7	4	4		2	
		Strongly Agree	9			6		2		2	
		Strongly Disagree	**60**	2	11	19	4	9	15		
Q11	I have bought and hunted a colour variant antelope as a trophy	**FALSE**	**85**	2	15	26	7	13	15	6	2
		TRUE	15			11		4			
Q12	The breeding and trade of colour variations should be regulated/monitored by Governmental Nature Conservation Authorities	Agree	24	2	6	7	2	4	4		
		Disagree	19			4		6	7	2	
		Strongly Agree	**33**		9	11	6	4	2	2	
		Strongly Disagree	24			15		4	2	2	2

Table 6.1 continued

Question Number	Question/Statement	Answers/Options	**Total (%)**	Stakeholder (%)							
				Ecologist	Scientists	Game Rancher	Nature Conservation official	Hunters	Veterinarian	Wildlife enthusiast	Wildlife Registering Authority
Q13	The breeding and trade of colour variations should be regulated/monitored by guidelines set out by non-governmental organizations/associations	**Agree**	**37**	2	2	11	2	7	7	6	
		Disagree	22		4	7	4	4	4		
		Strongly Agree	22		9	6	2	2	4		
		Strongly Disagree	19			13		4			2
Q14	The breeding and trade of colour variations is comparable to any other livestock farming and should be treated as such	Agree	22		2	4	2	6	7	2	
		Disagree	24	2	6	2	4	4	6	2	
		Strongly Agree	**32**		4	22		2		2	2
		Strongly Disagree	22		4	9	2	6	2		
Q15	Farmers/breeders know how to manage wildlife better than Nature Conservation authorities due to practical experience	Agree	24			7	2	6	2	6	2
		Disagree	**46**	2	13	11	2	7	11		
		Strongly Agree	15			15					
		Strongly Disagree	15		2	4	4	4	2		
Q16	The breeding of colour variations pose a threat to the long term survival of their species	Agree	28	2	9	6	2	6	4		
		Disagree	**39**		2	9	6	6	9	6	2
		Strongly Agree	17		4	9		4			
		Strongly Disagree	17			13		2	2		

6.2.2 Should colour variant antelope be bred?

The answer to question six (Q6. Colour variations should not be bred because nature should be allowed to run its course without human intervention) is the most basic expression of support or opposition to the breeding of colour variants. Results from all respondents showed that the majority (69%) agreed that colour variants should not be bred compared to 31% which disagreed with the statement (Table 6.1). When categorizing the results from this question into the different stakeholder groups it can be seen that the majority of support for the breeding of colour variant animals comes from game ranchers, however among ranchers there is not a majority of support with a 50/50 split between support and opposition towards these animals (Figure 6.1).

A concern that many stakeholders have raised is that colour variants are in conflict with conservation (Hamman *et al.* 2003, 2005; Cousins *et al.* 2010; Alberts 2014; Verdoorn 2014; Anonymous 2015a, 2015c; Chardonnet & Mallon 2015). Question 16 (Q16. The breeding of colour variations pose a threat to the long term survival of their species) aimed to determine whether there is a widespread concern or limited to a few individuals that colour variants pose a threat to the conservation of their species. When taking all responses into account the results are spilt very closely with the slight majority (56%) disagreeing that colour variants pose a long-term threat to their species. These results reflect the SANBI Scientific Authority's conclusion that these animals pose a low risk to species (Donaldson 2010). Notably among veterinarians and scientists the slight majority (55%) however, believe that colour variants do pose a long-term threat to their species (Figure 6.2). A veterinarian has expressed great concern for the welfare of these animals:

> *"What you do not address is the possible effect that colour variation breeding may have on the welfare of the individual animals. To get the most likely chance of a colour variant breeders will inbreed other colour variants because the genes are usually recessive. This leads to the increased expression of other recessive genes which may be detrimental to the animals. This trend has been seen in many domestic animals, for example in dogs, inbred 'pure bred' dogs are prone to all sorts of problems, bulldogs cannot breathe normally or breed*

> *naturally. This form of genetic cruelty is what is in store for inbred wildlife in the future." – Veterinarian*

Even though colour variants have become very sought after and profitable to farm with, Hamman *et al.* (2003) and Hamman *et al.* (2005) warned that colour variants do not contribute to conservation or the long term survival of a species since colour variants normally do not survive in nature. Contrary to this some farmers, who breed with these animals, claim that they do contribute to conservation. York (2005) disagrees with Hamman *et al.* (2003) and Hamman *et al.* (2005) and states that colour variation is a natural part of evolution and that these variations increase biodiversity. A game rancher in support of breeding with colour variants stated that:

> *"We live in an ever adapting climate where scientist continue to inform us about the drastic effects global warming is having on the world's climate. Are colour variants not nature's way of adapting to these changes? We must however realize that not all colour variants are functionally efficient and only those that can meet these criteria should be bred with." - Richard York (Game Rancher)*

In the above statement Richard York alludes to the fact that colour variants are a natural phenomenon but that not all variants are capable of surviving in nature. Black and white springbok are known to have occurred naturally, though at low densities; a black springbok was recorded in 1886 near Skietkuil (Kruger *et al.* 1979; Hetem *et al.* 2009). York advocates that ranchers should be allowed to breed such animals.

However, springbok variants such as three-colour-candy, cream, blue and copper have never before been recorded and it is highly unlikely that these animals contribute to springbok conservation. A comment made by a veterinarian concerning golden wildebeest, indicates that these animals also occurred naturally in the past, but that current breeding practices have allowed these animals to become more abundant:

> *"My answers are limited to Golden wildebeest with which I have a lot of experience (capture, selling, breeding). They originated in the Limpopo Valley and in living memory occurred mainly on the relatively undeveloped Botswana side. Undoubtedly, before game ranching developed they were mainly lost to*

predators. Now they are protected from most predation and perhaps more significantly they are subjected to in-breeding on ranches that have fragmented and confined the natural population. They therefore crop up and survive more often." – Veterinarian

In support of Richard York, a well-known geneticist working on registering wildlife has indicated that any selective breeding, even to maintain the natural/normal colour, may lead to inbreeding with the same negative effects. He stresses that the problem currently is not the occurrence of colour variants but rather the management of these animals.

"Mutations cause colour and other variants and some come from millions of years ago. Incorrect breeding methods - line-breeding/inbreeding cause negative effects and not mutation. These colour variants have been described since 1652 and have increased as we confined populations and due to incorrect genetic management inbreeding increased and caused recessive mutations to surface. Colour variants can be as sustainable as naturally bred animals. Put in another way: If you give me a closed population and I in-breed them and ensure they stay the natural colour they will show the same negative effects (lower reproduction, lower disease resistance, lower longevity, etc) The problem is thus genetic management and not the colour mutation" – Wildlife Registering Authority (Geneticist)

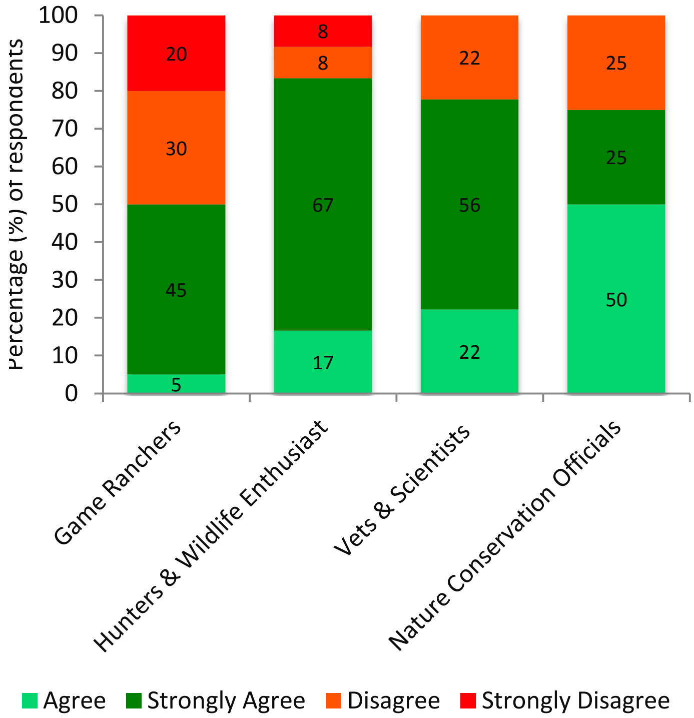


Figure 6.1. Stakeholder specific results to question 6 (colour variations should not be bred because nature should be allowed to run its course without human intervention). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

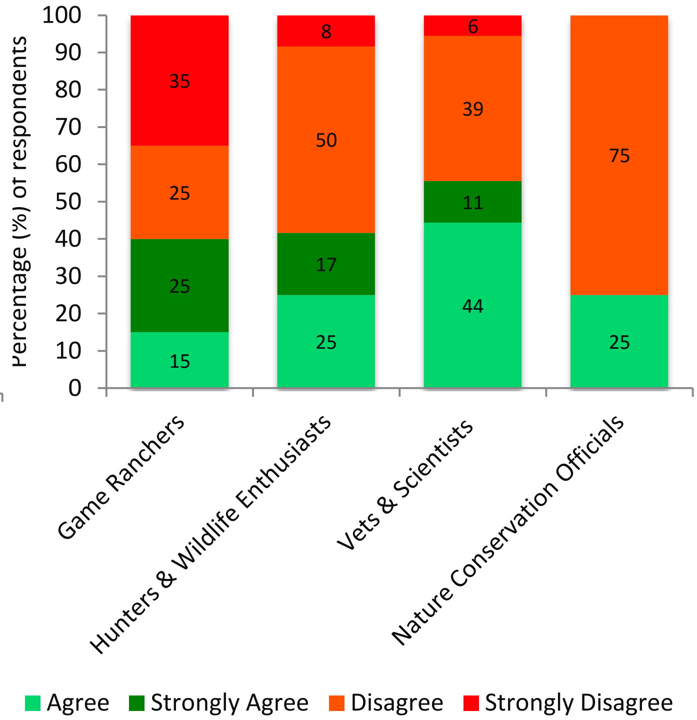


Figure 6.2. Stakeholder specific results to question 16 (the breeding of colour variations pose a threat to the long term survival of their species). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

Even though few nature conservation officials responded, the practice of breeding colour variant animals is a cause of concern for nature conservation officials (Hamman *et al.* 2003, 2005; Cousins *et al.* 2010). A statement made by such an official calls for at least a cautionary approach to breeding with colour variants until the effects on the animals become clearer:

> *"The precautionary approach should be adopted regarding the breeding of colour morphs until the extent of such has been fully researched. More specifically around the impact that genetic mutation may have on disease transfer." – nature conservation official*

Dr Ian Rushworth, from Ezemvelo KZN wildlife, stresses that the private wildlife industry's conservation role is being eroded by current practices (Bezuidenhout 2014). Results from the survey showed that nature conservation officials do not support the breeding of colour variants (75%) (Figure 6.1). This is evident in a statement by a nature conservation official:

> *"Colour variations are genetic abnormalities and human intervention should not be encouraged. Similar as albinos." – nature conservation official*

However, 75% of nature conservation officials also disagreed that colour variants posed a threat to the long term survival of their species (Figure 6.2); possible reasons for this are that SANBI stated they consider colour variants as low risk (Donaldson 2010) and that there is still great uncertainty surrounding the potential effects for conservation of breeding colour variants as stated by a nature conservation official:

> *"...Long term Impact on Biodiversity?? Who knows? It may take several generations to ascertain the true impact of such activities." - Nature conservation official*

This uncertainty is possibly the result of a lack of scientific data concerning colour variants (Bezuidenhout 2012a).

Although there’s a 50/50 split between opposition and support, the majority (45%) of game ranchers responded that they strongly agree that colour variant animals should not be bred, compared to 5% who agreed, 20% who strongly disagreed and 30% who disagreed (Figure 6.1). A game rancher in opposition to breeding of such animals identified several additional issues:

> *“1.) Where does this end? Who decides what a colour variation is? E.g. a red hartebeest with an arbitrary patch on its nose is now apparently a “kings” hartebeest!!!! 2.) Because it is all about money (sheer greed in my opinion!) normal services to the industry are taking a backseat. Game capture operations have changed focus, vets miss appointments because something more lucrative crops up etc. etc.” – Game Rancher*

These results were surprising as Wildlife Ranching South Africa (WRSA) (the sole representative of game ranchers at national level) supports the breeding of colour variant wildlife and sees opposition to it as opposition to the entire ranching industry, as evidenced by media releases (Stafford 2014; Oberem 2015). Wildlife Ranching South Africa has never given any indication what their member’s opinions on the topic are. It should, however, be taken into consideration that only 1500-2000 of the 10 000 game ranches in South Africa are members of WRSA (Anonymous n.d.; Alberts 2014) and as such about 80% of ranches in South Africa are not represented by this organisation, which could account for the discrepancy between the results and the position of WRSA. In each of the other three major stakeholder groups, more than 70% of respondents agree that colour variant wildlife should not be bred (Figure 6.1).

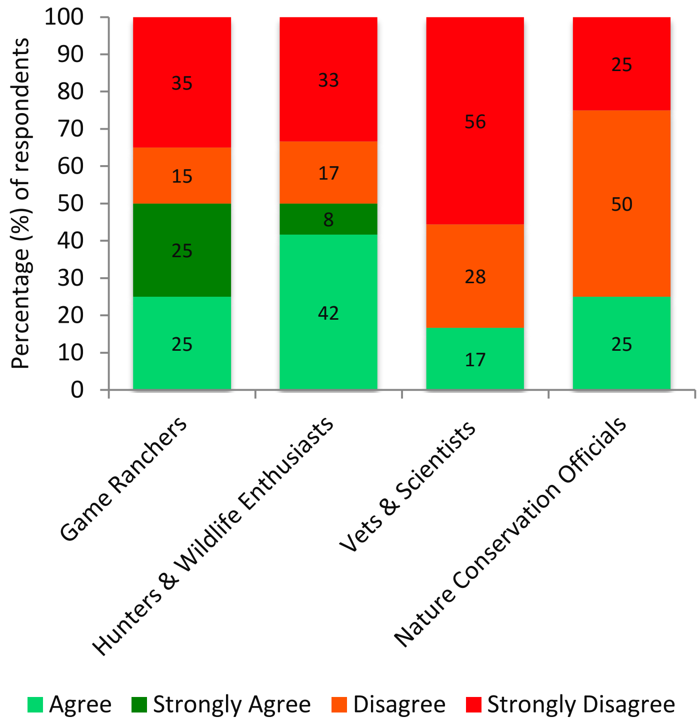


Figure 6.3. Stakeholder specific results to question 7 (I enjoy seeing/hunting colour variations in the veld whilst game viewing/hunting). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

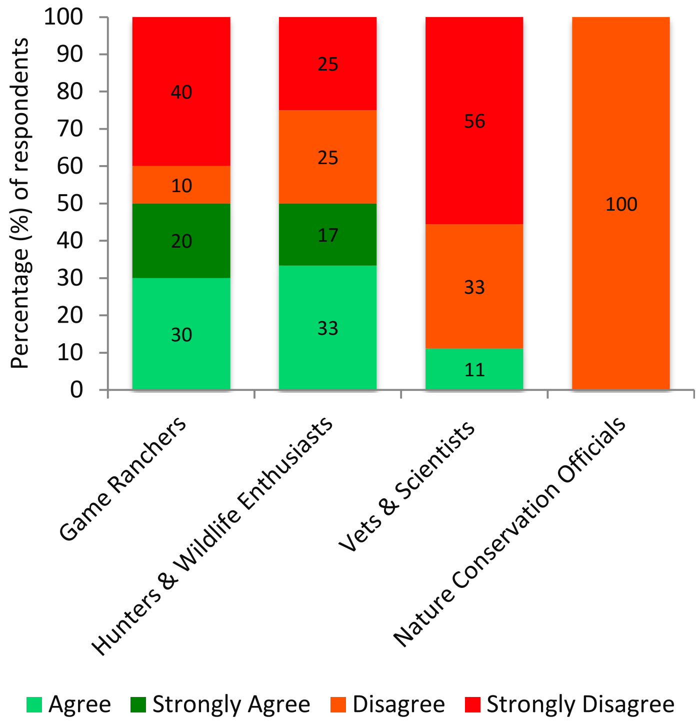


Figure 6.4. Stakeholder specific results to question 8 (colour variations contribute to the aesthetic value of game viewing). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

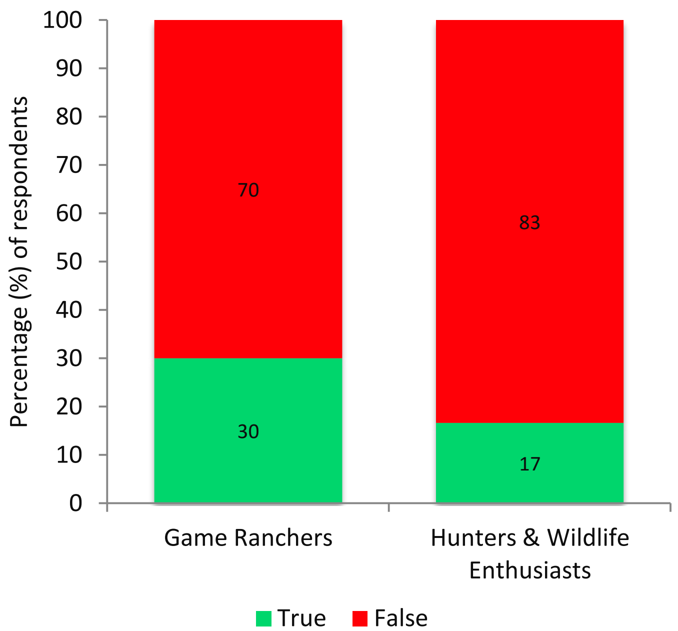


Figure 6.5. Stakeholder specific results to question 11 (I have bought and hunted a colour variation antelope as a trophy). Game ranchers n=20, hunters & wildlife enthusiasts n=12

6.2.3 Eco tourism and hunting of colour variants

Eco-tourism is one of the four areas from which the wildlife industry generates income (Bothma *et al.* 2009). It is yet uncertain whether colour variant wildlife will have a positive impact on eco-tourism as a result of the significant opposition to these animals, (see section 5.3.1), and since it is clear that tourists are mostly interested in viewing the Big Five (Cousins *et al.* 2010; Maciejewski & Kerley 2014). Mr. Stewart Dorrington, a hunting outfitter and former president of PHASA, stated that there is very little interest in colour variants from hunters (Dorrington 2015). Many hunters are more interested in the quality of the hunt than in the trophy. Two different hunters stated that:

> *"I don't care what colour the animal is, it is the quality of the stalk/hunt that matters. I feel the same about trophies. The best animal I have stalked to date was a Red stag last year in Scotland 45 minutes crawling on my belly in P**sing rain, wade a river and then got to drop him only 4 points but what a memory. As for colours they all taste the same when skinned. But if the market dictates a need for different colours then I'm afraid the usual human frailties will come to for (greed)." – hunter*

> *"I wouldn't pay to hunt one. I have a reasonable idea of what is involved in line breeding, be it tropical fish, birds or even reptiles. The chances are that the quality of the animal will be poor due to inbreeding and selection of traits that may not be desirable in nature, genetic garbage perhaps?" – hunter*

Questions seven (Q7. I enjoy seeing/hunting colour variations in the veld whilst game viewing/hunting) and eight (Q8. Colour variations contribute to the aesthetic value of game viewing) were concerned with determining whether there is interest in consumptive and non-consumptive use of colour variant animals. The results of question seven from all respondents showed that only 37% enjoy seeing or hunting colour variants (Table 6.1). However, when differentiating between the major respondent groups, the results showed that among game ranchers, hunters and wildlife enthusiasts a 50/50 relationship was present between agreement and disagreement with the statement. The result of the nature conservation officials, veterinarians and scientists conversely differed greatly as only 17% and 25% respectively agreed that they enjoyed seeing colour variant animals (Figure 6.3).

Results from question eight (Figure 6.4) shows the same 50/50 relationship among game ranchers, hunters and wildlife enthusiasts. The difference compared with the nature conservation officials, veterinarians and scientists was more significant since only 11% of veterinarians & scientists agreed with the statement that colour variants contribute to game viewing, whilst not a single nature conservation official agreed. An additional effect is on South Africa's reputation, as expressed by SAHGCA (Anonymous 2015a). A scientist for nature conservation expressed concern for what the breeding of colour variants could do to the industry's image:

> *The important question to be asked is what changes with the purpose bred activities whilst line breeding is done for a variety of colour and / or other external features. Then we can go on to ask what the impact will be on tourism where tourists come to South Africa for wildlife (with natural features) to come and view but all they see is a bunch of coloured "freaks", and it is just to make more money. Game farming has for certain people become nothing other than trading with wildlife like Brahman cattle. The difference is that they now offer the purpose bred animals for foreign hunting." - Dr MD von Wielligh (Environmental Scientist for Provincial Government)*

The most significant set of results of these two questions are those from the hunters and wildlife enthusiasts as this group represents the consumer of colour variants, whether through trophy hunting or wildlife viewing eco-tourism. When further examining the results from hunters and wildlife enthusiasts, only 8% of the respondents strongly agreed that they enjoy seeing such animals and only 17% agreed that colour variants contribute to the aesthetic value of game viewing (Figure 6.3 & 6.4). A hunter stated that he does like some colour variants, but that he does not believe that the average hunter will be interested in such animals:

> *"As a hunter I'm mixed about this, while I think Golden Wildebeest are nice looking, I think Black Impala are gross. I don't think that breeding for colour has anything to do with conservation but has to do with money. This is really no different than some of the horrible white tail Deer here in North America. Most of these animals will not be hunted by the average hunter, but by rich*

people who are on an ego trip, and that in itself turns me off of ever hunting these." - hunter

Question 11 (Q11. I have bought and hunted a colour variant antelope as a trophy) is associated with question 7 and 8 as it aims to determine whether there is interest in the consumptive use of colour variants. Among all the respondents only 15% answered that they had bought and hunted a colour variant animal (Table 6.1). These all came from either the game rancher or hunters and wildlife enthusiast groups. The majority (75%) of respondents who had hunted colour variants came from the game rancher group representing a mere 30% of the ranchers. The other 25% of respondents who had hunted a colour variant came from the hunter and wildlife enthusiast group and represented only 17% of the respondents from this group (Figure 6.5). An administrator of a large hunting forum for British hunters indicated that he did not consider hunting of selectively bred colour variants as true hunting:

This is not true hunting this is more akin to a computer game where you can choose which colour animal you want to kill providing you have the finance to do it. Anyone that partakes in this is not a hunter, he/she is nothing more than an idiot with a gun and money." – administrator of hunting forum

Results from question 7, 8 and 11 suggest that there is a potential, but limited, market for these animals for both consumptive trophy hunting and non-consumptive wildlife viewing (Figure 6.5). Two comments, one from a hunter and the other from a veterinarian, further support the survey results:

"Certain variations (white or black) can occasionally occur, but a number of the variation today on 'offer' are clearly the product of line breeding. This refers also to the following questions - discovering a white or black specimen in the wild among its normal coloured brethren may indeed be exciting, but being driven through a camp with line-bred colour variations and splits is totally unpleasant. Breeding and trade as a livestock farming practice must be regulated strictly to avoid that wild animals are 'contaminated'"– Recreational Hunter

"It is fashionable to breed them, but it is like a pyramid scheme and is doomed to failure long term from a monetary point of view as there is nil to limited desire to shoot these freaks of nature at the prices one has to pay for them." – Veterinarian

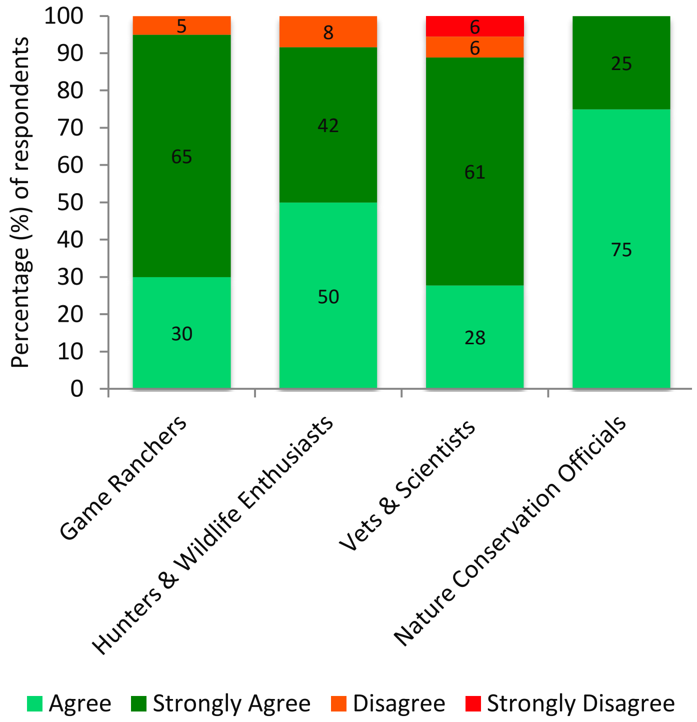


Figure 6.6. Stakeholder specific results to question 9 (colour variations are sought after/popular exclusively because of their high monetary value). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

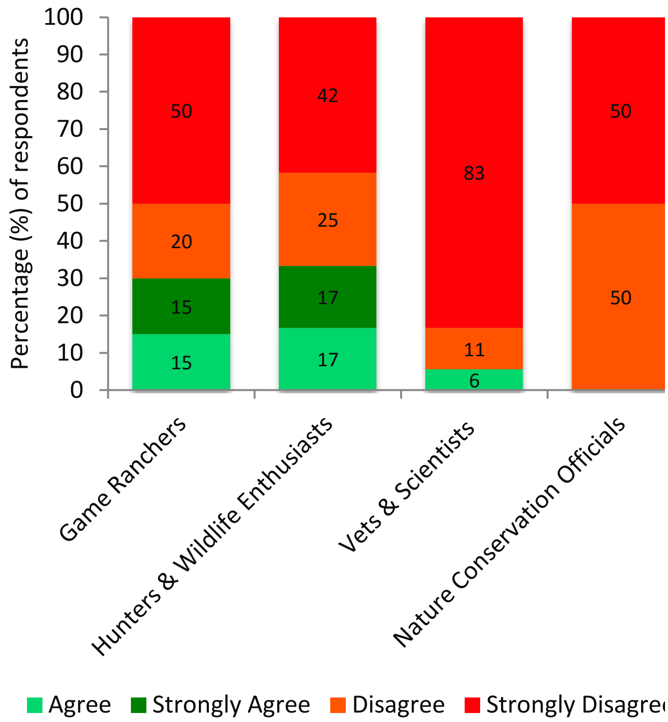


Figure 6.7. Stakeholder specific results to question 10 (colour variations are sought after/popular because they contribute to biodiversity/conservation). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

6.2.4 Why colour variants

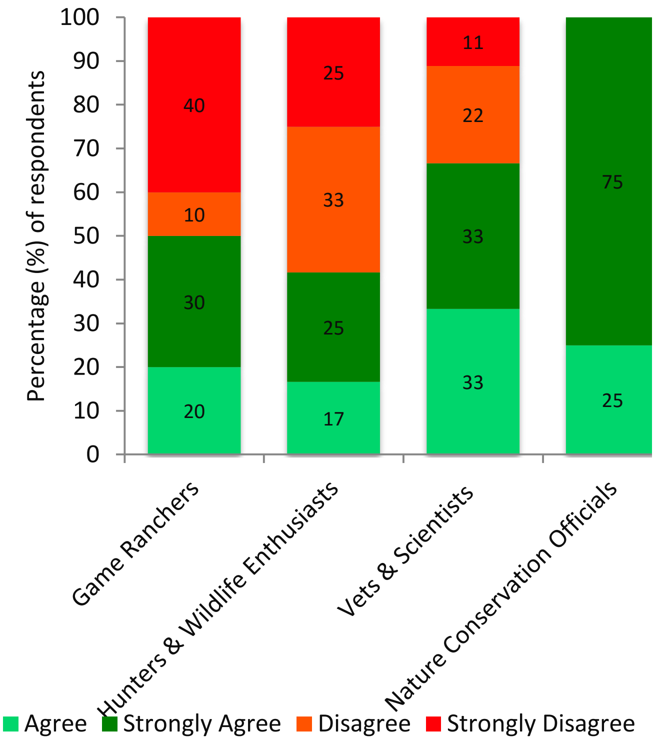
Questions nine and ten deal with what stakeholders view as the primary motivation for the selective breeding of colour variant antelope. The results from question nine (Q9. Colour variations are sought after/popular exclusively because of their high monetary value) showed that the vast majority of respondents believed the only motivation for the breeding of colour variant animals is as a result of their high financial value. Among all respondents 93% agreed that the high financial value of these animals is the only reason for their popularity (Table 6.1).

Only 5% of game ranchers, 8% of hunters and wildlife enthusiasts and 12% of veterinarians and scientists disagreed with the statement (Figure 6.6). Question ten (Q10. Colour variations are sought after/popular because they contribute to biodiversity/conservation) presented an alternative explanation for the reason why colour variants are popular. Supporters of breeding with colour variant animals state that these animals contribute to conservation and biodiversity (York 2005; Oberem 2015). The results from question ten however, contradicts this as among all stakeholders, 80% disagree with the statement that colour variant animals contribute to biodiversity or conservation; this correlates well with the results from question nine (Table 6.1). Correspondingly an environmental scientist and a veterinarian stated that:

> *"Colour variations play little conservation value with the exception of acting as an umbrella species. Alternative species are potentially conserved on land set aside for colour morphs. It seems as if these colour variation among the species don't hold their value. They are temporarily prices unlike species such as buffalo and sable which hold their value. I believe farming with colour variations is caused by a lack of education, greed and lack of conservation ethics". – environmental scientist*

"I think colour variations have their place in the system, yet don't think that they are bred at all with conservation in mind. Some farmers are extremely well informed and even consider conservation efforts in their breeding programs, but at the end of the day they need to make financial ends meet. I however cannot see the long term benefit of breeding colour variations for the buyer and seller are the same type of guy: an investor. The flow is not from breeder/seller to buyer/hunter." – veterinarian

The strongest support for the statement that colour variants contribute to conservation and biodiversity comes from game ranchers (30% agree) as well as hunters and wildlife enthusiasts (34% agree) whilst very few veterinarians and scientists agree (6%) and no nature conservation officials (Figure 6.7). There seems to be a desire from colour variant breeders to be considered as conservation, this is likely a result of the fact that most hunters (and likely eco-tourists) would not make use of a ranch that cannot be considered natural, e.g. PHASA only accepts hunting of animals in areas which can be considered an extensive (natural) wildlife system (Anonymous 2015d).



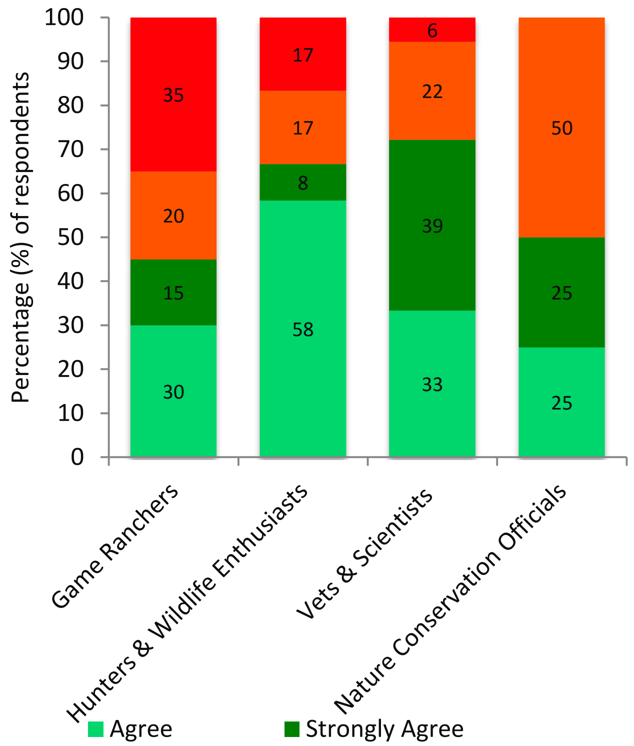


Figure 6.8. Stakeholder specific results to question 12 (the breeding and trade of colour variations should be regulated/monitored by Governmental Nature Conservation Authorities). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

Figure 6.9. Stakeholder specific results to question 13 (the breeding and trade of colour variations should be regulated/monitored by guidelines set out by non-governmental organizations/associations). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

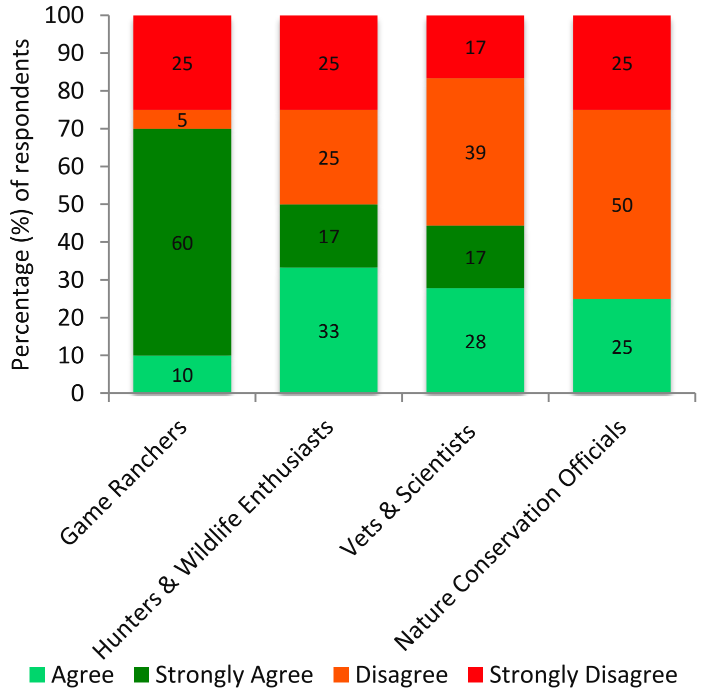


Figure 6.10. Stakeholder specific results to question 14 (the breeding and trade of colour variations is comparable to any other livestock farming and should be treated as such). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

6.2.5 Towards regulating colour variant breeding

If colour variants are a possible threat to conservation in South Africa, should colour variant animals not be regulated within the wildlife industry? In 2010 the SANBI Scientific Authority recommended that legislation against colour variants should not be implemented (Donaldson 2010). More recently there have been calls for greater regulation of the wildlife industry e.g. from a recent press release by the South African Hunters and Game Conservation Association (2015). A game rancher made the following statement indicating a desire for nature conservation to regulate colour variant breeding:

> *"It is important that nature conservation realise they made a mistake by allowing colour variants to become an integral part of the wildlife industry and should start taking action now to limit it." – Game Rancher*

A hunter however disagrees and states that as long as it is not detrimental it should be allowed:

> *I can't see a problem really, it's not hurting anyone and if you don't want to do it (as I don't) then just don't do it. I really don't like football but I don't think it should be banned as it floats so many boats. If shooting a pink striped blesbok floats someone's boat all power to their elbow I say. - hunter*

Questions 12, 13 and 14 aims to determine whether there would be support for regulation from the stakeholders in the industry and whether wildlife ranching should be seen as an agricultural activity rather than conservation.

Results from question 12 (Q12. The breeding and trade of colour variations should be regulated/monitored by Governmental Nature Conservation Authorities) show that a slight majority (57%) of the respondents would support regulation of colour variants by governmental nature conservation authorities (Table 6.1). Results from question 13 (Q13. The breeding and trade of colour variations should be regulated/monitored by guidelines set out by non-governmental organizations/associations) show a similar level of support (59%) for regulation by non-governmental organisations (Table 6.1). Results according to each stakeholder group shows that the most support for regulation by governmental authorities comes from nature conservation officials (100%) as well as veterinarians and scientists (66%) (Figure 6.8). Veterinarians and scientists are mostly in favour of regulating colour variant animals as they also support (72%) regulation by non-governmental organisations (NGOs); this group is also more in favour of and the strongest supporter of regulation by NGOs (Figure 6.9). Game ranchers are split 50/50 between support and opposition to regulation by government, with the situation only slightly different for regulation by NGOs with a 45/55 split between support and opposition (Figure 6.8 and 6.9). Contrary to the request from SAHGCA that government implement regulations, the survey results showed that hunters and wildlife enthusiasts are mostly opposed (58%) to regulation by government. They do, however, show strong support (66%) for regulation by non-governmental organisations (Figures 6.8 and 6.9). In this regard a hunter made the following statement indicating that he thinks the Professional Hunters Association of South Africa (PHASA) should play a role:

> *"It should be banned in my opinion. And for the life of me I cannot understand why P.H.A.S.A has not done something to stop it." – hunter*

Since this statement has been made, PHASA has indicated (following a SANBI recommendation) that they do not believe colour variants are bred to provide for a demand from hunters; reject any procedure that produces artificial colour variants (i.e. intentional cross breeding of different variants to create new ones could be seen as such a process) and reject inclusion of any new variants in record books (Anonymous 2015d).

Another hunter, opposed to regulation, indicated that he supports breeder's rights to financial gain and suggests that regulation should be in the form of demand (or lack of) created by hunters:

> *"...I would like to add that if you are against this, don't participate. Don't buy. Express your opinion with how you spend your money. And be grateful for having the choice to decide for yourself... But please try to understand it... or at least be understanding and tolerant. Don't protest it just to protest it. That is what the anti hunters do. And please don't try to come up with reasons to take away the freedom for entrepreneurs to do business... Or worse yet come up with grandiose plans to collectivize individual game farmers' property." - hunter*

Though the SANBI Scientific Authority did not recommend that legislation should be implemented against colour variants, they did recommend that colour variant breeding be monitored through registration of breeders as well as that these breeders report on the numbers of animals traded (Donaldson 2010). The survey results showed that nature conservation officials were 100% in agreement (75% strongly agreed and 25% agreed) that government should regulate the breeding and trade of colour variant animals (Figure 6.8). Cousins (*et al.* 2010) stated that the implementation of the TOPS (Threatened and Protected Species) regulations is a source of tension between stakeholders and could encourage ranchers away from conservation friendly land use as a result of possible reduction in the value of wildlife. A similar outcome could be expected if regulations concerning colour variants are implemented. A nature conservation official suggests that there should be a separation of activities and warns that regulations should be applied with caution and compromise:

> *"Personally, colour variations are crap [sic], and all statutorily protected areas should allow natural evolutionary processes to continue - and we would be interested in seeing how a colour variation perpetuates in the natural world - to which can be afforded in many such areas - for academic purposes. No statutorily protected areas should indulge in such - as it is not conservation. BUT - private game farmers are de facto conservationists - where maybe habitat on game farm protects a few species, and we shouldn't meddle too much with them...so I put my personal cap down, and put professional cap on and make such a compromise...the main issue is that there is separation of activities and that private guys can do things while state parks mustn't buggar around with this - we are the conservationists. While private guys are wildlife managers and they may/may not contribute to conservation – depending. The alternative for them is that if we are too strict with regulations, they may say fuck it [sic], lets just mine this place, or go into crop farming. One must make compromise to heed this." – Nature conservation official*

Considering that regulations created and enforced by governmental nature conservation could be a cause of tension in the industry, should regulation then come from non-governmental organisations? From the survey results, 50% of the nature conservation officials supported regulation by non-governmental organisations. However, according to Cousins (*et al.* 2010) self-regulation within the wildlife industry has been mostly unsuccessful. A game rancher suggested a compromise for the implementation of regulations:

> *"Breeding and trade of colour variations should be regulated by authorities based on guidelines drawn up with breeders and other organisations. Also 'the breeding and trade of colour variations is comparable to other livestock farming' is correct but such animals must be properly controlled like farm livestock and have no place in the wild." – Game Rancher*

Game ranchers strongly support (70%) the statement made at question 14 (Q14. The breeding and trade of colour variations is comparable to any other livestock farming and should be treated as such) i.e. breeding and trade of colour variant animals should be seen as an agricultural activity. A game rancher who opposes regulation by nature conservation said that:

> *"Stay away from regulations. Nature conservation authorities cannot regulate an agricultural activity. This is an agricultural activity and should be seen as such. It has no role in conservation or is a threat to conservation." – Game Rancher*

Hunters and wildlife enthusiasts are split (50/50) on whether colour variants should be treated as livestock, whilst veterinarians and scientists show 45% support and nature conservation officials only 25% (Figure 6.10).

Cousins (*et al.* 2010) reports that stakeholders have previously expressed the notion that current breeding practices of rare wildlife is having a domestication effect on the animals. A nature conservation official makes the statement that breeding colour variants should be seen as an agricultural activity:

“Colour variations are a natural phenomenon. If, however, artificially selected for it may lead to problems in future. Wildlife (irrespective colour or natural) bred in un-natural conditions such as intensive camp systems should be utilised as agricultural commodities and not marketed as so-called African Game. I have never seen a Merino Sheep ram being advertised for hunting purposes. Why then a golden something bred in captivity marketed as a trophy animal.” – Nature Conservation Official

The wildlife ranching industry argues that the breeding of colour variants is contributing to conservation and biodiversity (York 2005; Oberem 2015). A hunter, however, disagrees with this and made the following statements that selective breeding of colour variants cannot be seen as conservation:

“I don't know, to me it seems off, I believe that the special species breeding industry as some might call it should be seen for what it is and would refrain from hanging a conservation label around its neck.” - hunter

“I very strongly have an extreme dislike in the commercial game breeding industry, all of which claim to do so in the name of conservation.... LIE! Terrible LIE.” - hunter

SAHGCA also stated in their press release that they consider colour variant breeding similar to livestock breeding and not as conservation (Anonymous 2015a). Considering the statements above there is support for colour variant breeding being seen as an agricultural activity, however, the available information also indicates that it cannot be considered conservation and consequently that game ranchers cannot claim to be contributing to conservation by breeding these animals.

Question 15 (Q15. Farmers/breeders know how to manage wildlife better than Nature Conservation authorities due to practical experience) ties in with question 12, 13 and 14 as it aims to determine whether game ranchers and other stakeholders have trust in the abilities of nature conservation authorities to regulate the industry. Results from all respondents show that 61% of respondents do not agree with this statement (Table 6.1). The only stakeholder group that showed a majority agreement with this statement was the game ranchers (60%), this was closely followed by hunters and wildlife enthusiasts at 50%. Veterinarians and scientists showed almost no agreement with this statement at 11% (Figure 6.11). Cousins (*et al.* 2010) states that breeding may not always take place with the long term effects on the species considered. A statement by a veterinarian indicates that there is a difference in the knowledge and skills between game ranchers and nature conservation:

> *"Game ranchers have better knowledge concerning intensive wildlife management but not according to ecological principles. The selective breeding of colour variants makes no contribution to conservation and makes a mockery of our African wildlife (which is popular among foreign hunters for sentimental reasons) and will drive hunters to more 'natural' destinations to hunt" – veterinarian.*

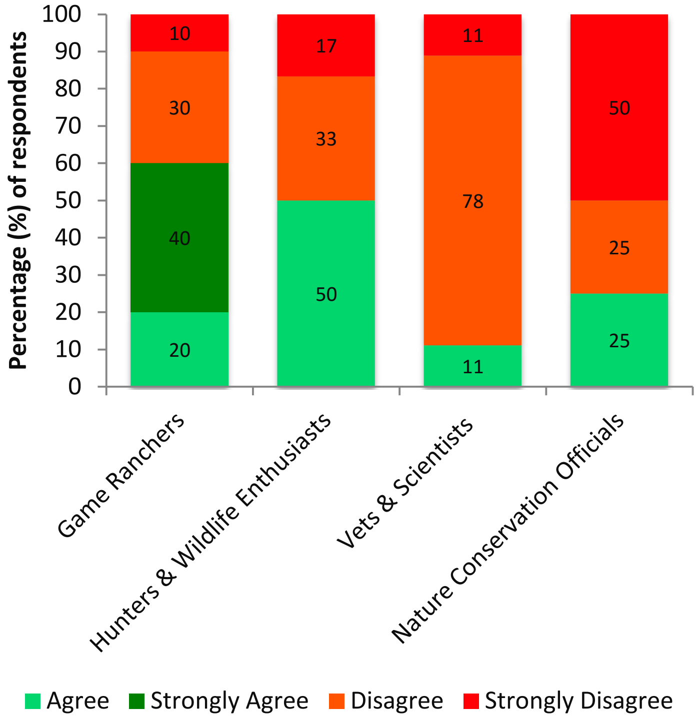


Figure 6.11. Stakeholder specific results to question 15 (farmers/breeders know how to manage wildlife better than Nature Conservation authorities due to practical experience). Game ranchers n=20, hunters & wildlife enthusiasts n=12, veterinarians & scientists n=18, nature conservation officials n=4.

6.2.6 Ethical Behaviour

The National council of SPCA's (NSPCA) expresses concerns over animal welfare and ethical behaviour in the wildlife ranching industry in its formal stance on the selective breeding of colour variants (Anonymous 2015b). In this regard an environmental scientist stated that:

> *I believe farming with colour variations is caused by a lack of education, greed and lack of conservation ethics". – environmental scientist*

A hunting outfitter suggests that there is nothing specifically wrong with hunting or breeding colour variants but that ethical behaviour from the breeders and professional hunting outfitters is what is necessary:

> *"Although we do have common and white blesbok at our Lodge, there is no attempt to "manage" these colour variants and they breed as they will. We do offer colour variants because there is a definite market for them and after all, we are in business. Like other hunters, we are in ethical business, and like them, we abhor the thought of "canned" hunts, drugged animals and captive "bred to hunt" animals. We do not think a person is a bad hunter or wrong because he wishes to hunt colour variants, as long as in doing so, all proper ethics are observed. We also agree with SA Hunt that there is (or there should be) a great element of luck in successfully hunting an exceptional trophy. However, we know they are out there and we know where to look" – hunting outfitter*

A wildlife trader further suggests that there should be a code of conduct to protect the different stakeholders in the industry:

> *"Yes, Wildlife traders need better knowledge understanding and a code of conduct when doing trade with colour variation animals – there are way too many sharks in the industry and those of us that are trying to make this a profession and be professional about it are being undermined by inconsiderate uninformed individuals that are trying to make a quick buck." – Wildlife Trader*

Furthermore situations where animals change colour after being purchased (Bezuidenhout 2015) may cause a lot of distress for a buyer and may raise suspicions of foul play in the industry.

6.3 Concluding Remarks

Some game ranchers want the private wildlife industry to be seen as an agricultural activity (which would have less regulation compared with nature conservation) and also to portray an image of contributing to conservation. However, the majority of stakeholders stated that colour variants do not contribute to conservation (whilst some agreed that it should be seen as an agricultural activity) and that it cannot then be portrayed as a conservation effort.

Concerning regulations, there is equal support for their implementation by either nature conservation or by non-governmental organisations, however, it is not overwhelming from any other stakeholder group than the nature conservation officials. In the past, regulations have been a source of tension between stakeholders and it should therefore be implemented with care and in consultation with the various stakeholders.

When considering the breeding of colour variants, nature conservation and the wildlife ranching industry should be aware of the difference between conservation, on an extensive wildlife system, and preservation of numbers, in an intensive breeding system.

CHAPTER 7

CONCLUSION

Results of this study showed that there were definite behavioural differences between colour variants of springbok, which have potential management and conservation implications.

Coat colour can influence homeothermy and consequently energy requirements of springbok (Hetem *et al.* 2009). This has implications for wildlife management as white springbok have higher energy demands and consequently require greater or more nutritious food sources to maintain homeothermy. Similar requirements could likely be important for all light coloured variants of other species as well. Consequently, the way in which veld carrying capacity is calculated would need to be adjusted to accommodate for the higher energy requirements of light coloured animals, specifically where they occur in colder areas of South Africa.

Black springbok avoided karroid vegetation and demonstrated greater shade usage during the study, most probably as a result of a higher heat load from the environment (Hetem *et al.* 2009). These animals would therefore be better suited to areas with ample available shade; unlike the Karoo which would place greater heat stress on the animal.

Springbok colour variants were found to form phenotypically differentiated herds, preferring to associate with homogenous animals, likely as a result of the odd prey effect.

Ranchers and investors will continue to breed colour variants as long as such animals are more profitable to farm with compared to other agricultural activities (Cloete 2015b). Subsequently, the majority of stakeholders considered colour variants not to contribute to conservation but regard the breeding of these colour morphs purely as financial investment. However, there is little evidence that there will be future end users of colour variant wildlife, as there is much opposition from hunting organisations and only a few survey respondents stated that they enjoy colour variant wildlife.

Apart from nature conservation officials, support for the implementation of regulations concerning colour variants could not be found in surveys of this study. In addition, considering that governmental protected areas cover only 7.5 million hectare and support only 6 million animals compared to some 18 million animals on 20.5 million hectares in private ownership, any activity that impacts such a large section of South Africa's wildlife and conservation industry is extremely significant (Niehaus 2014a). However, nature conservation authorities and the wildlife ranching industry should also distinguish between conservation and preservation of species' numbers. Therefore, if regulations are considered, it should be created and implemented with care as it has been a source of tension between stakeholders in the past (Cousins *et al.* 2010). Should government officials consider regulations which are too stringent, valuable habitats, conserved by private ranchers, may be lost if they leave the game ranching industry. Alternatively, unregulated breeding activities could have negative effects on South Africa's wildlife as well as conservation and nature tourism image.

Even though colour variation is a natural phenomenon, selective breeding has led to increasing numbers of colour variant wildlife. Selective breeding is also associated with several negative aspects (Niehaus 2014a). As colour variants normally do not survive in nature (Hamman *et al.* 2003; Hamman *et al.* 2005) natural selection most likely no longer takes place on most ranches, due to intensive management practices. Intensive management practices including the provision of additional feed and provision of supplementation could mask detrimental effects associated with colour variation. Furthermore, constant human selection could influence future sexual selection and possibly lead to runaway sexual selection which can take place through female mate choice copying in phenotypically differentiated herds. It is then strongly recommended that natural selection be allowed to take place to a greater degree to ensure that the most suitable genetic traits are passed on. Adaptive significance of colour variants could be a pre-adaptation to future environmental conditions, as different coloured animals experience different pressures during the year (Hetem *et al.* 2009; Delhey *et al.* 2013).

Colour variation is a natural phenomenon resulting from mutations; consequently such animals contribute to biodiversity. Colour variation is present in many animals and can be beneficial as well as detrimental to the animal. Current selective breeding practices of African Bovidae colour variants (which used to only occur sparsely) is however not contributing to conservation as it excludes natural selection, allowing animals which would have been selected against to survive. According to Du Toit *et al.* (2010) colour variants should not be selectively bred but rather left to occur naturally. Ultimately the existence of colour variants does not pose a threat to conservation but it is rather the management of these animals which holds a potential threat to conservation of South Africa's wildlife.

CHAPTER 8

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SUMMARY

Colour variant game species have become a common sight on game farms and at auctions, as a result of their oddity and high monetary value. Currently there are more than 40 colour variants of African Bovidae. Even though these colour variants have become very sought after and profitable to farm with, it has been warned that colour variants do not contribute to conservation since colour variants normally do not survive in nature. Consequently the intentional breeding of colour variants is causing concern, as they may be a threat to conservation. The objective of this study was to collect data to facilitate decision making in the game ranching and conservation industry.

Statistical analysis showed that there were significant behavioural differences between four springbok colour variants studied. Black springbok were less active and utilised much more shaded areas compared to other colour variants or normal coloured animals. The darker coloured animals presented less body surface area to the sun during the warmest times of the day than the white springbok. Springbok were also found to form herds based on phenotype, preferring to associate with homogenous individuals. This phenomenon was likely due to the odd-prey effect.

Wildlife auction turnover grew from R62 million to over R1 billion in the last ten years. In conjunction with this growth, record prices for animals are being recorded every year. However in most cases colour variant game are reaching much higher prices than the normal coloured nonspecific's. Colour variants also achieve annual growth which is greater than inflation often providing better return on investment than stock market shares. Even though a normal Kalahari springbok ram set a new record at R1.2 million it was far exceeded by coffee coloured springbok that sold for R4 million. Financial gain then seems to be the main motivator behind the breeding of colour variants as they have become sought after by game ranchers. There is however concern amongst various stakeholders that the breeding of colour variant wildlife is unsustainable. This is as a result of the increasing opposition against the selective breeding of these animals and a general disinterest in these animals from end-users which include hunters and eco-tourists. No significant proof could be found

during this study that there will be large-scale interest in the consumptive or non-consumptive use of colour variants.

Little published scientific data is available concerning colour variants and most of the available information is in the form of popular magazine articles, newsletters and websites. The lack of published scientific data has resulted in a debate concerning colour variants. Opinions on this issue are much divided and can also evoke strong emotional responses from those involved; particularly from ranchers that are concerned their livelihoods may be threatened by any control measures. Most wildlife ranchers feel that they should be allowed to breed with any animal that provides the best return on investment and that, since colour variants are a natural phenomenon, they do not threaten conservation. Survey results showed that although many respondents did not consider colour variants to be a threat to conservation the majority did not support breeding of such colour variant wildlife. The vast majority of respondents indicated that financial gain was the main reason for the popularity of colour variants. Many stakeholders also expressed great concern about potential damage being done to the conservation and eco-tourism image of South Africa as many, specifically foreign hunters, consider colour variants wildlife to be unnatural.

The ultimate conclusion of this study is that the existence of colour variants does not pose a threat to conservation but it is rather the management of these animals which pose a potential threat to conservation of South Africa’s wildlife as well as South Africa’s conservation image.

Keywords: colour variants, springbok, conservation, game ranching, survey, Bovidae, behaviour

OPSOMMING

Kleur variante van wildspesies het ‘n algemene gesig geword op wildplase en by wildveilings as gevolg van hul uniekheid en hoë geldlike waarde. Huidiglik is daar meer as 40 kleur variante van Afrika Bovidae. Ondanks die gesogdheid asook die winsgewendheid om met kleur variante te boer, word daar gewaarsku dat kleur variant diere nie ‘n bydrae maak to bewaring nie, aangesien hierdie diere nie normaalweg in die natuur oorleef nie. Gevolglik veroorsaak die opsetlike teel van hierdie diere bekommernis aangesien hulle ‘n bedreiging vir natuurbewaring kan wees. Die doel van hierdie studie was om data in te samel wat besluitneming vir bewaring en die wildbedryf sal vergemaklik.

Statistiese analise het gewys dat daar beduidende verskille was ten op sigte van die gedrag van die vier springbok kleur variante wat bestudeer is. Swart springbokke was minder aktief en het meer skadu kolle benut vergeleke met ander kleur variante of normale kleur springbokke. Die donker gekleurde springbokke het ook kleiner oppervlaktes aan die son blootgestel gedurende die warmste deel van die dag as die wit springbokke. Springbokke is ook waargeneem om troppe te vorm gebaseer op fenotipe, waartydens hulle voorkeur getoon het om saam met homogene individue te bly. Hierdie verskynsel is toegeskryf aan die uitstaande prooi effek.

Wildveiling omset het die afgelope tien jaar van R62 miljoen na meer as R1 biljoen gegroei. Gepaardgeaande met hierdie groei word rekordpryse ook elke jaar aangeteken. In meeste gevalle behaal wild kleur variante egter baie hoër pryse as die soortgelyke normale kleure. Kleur variante bereik ook groeikoerse wat beter is as inflasie en opbrengste wat beter is as aandele. Selfs al het ‘n normale Kalahari springbok onlangs ‘n rekordprys van R1.2 miljoen behaal word dit steeds ver oortref deur ‘n koffie-kleurige springbok wat teen R4 miljoen verkoop is. Finansiële gewin blyk dan die hoof aansporing te wees vir die handel in kleur variant wild wat gesog geraak het by wildboere. Daar is egter bekommernis onder verskeie belanghebbendes dat die teel van kleur variante wildspesies onvolhoubaar is. Dit is as gevolg van toenemende teenkanting teen die selektiewe teëling van kleur variante asook ‘n gebrek aan belangstelling in kleur variante deur verbruikers wat jagters en eko-toeriste insluit. Geen betekenisvolle bewyse kon tydens hierdie studie gevind word dat daar belangstelling sal wees in die verbruik van kleur variante.

Daar is beperkte wetenskaplike data beskikbaar betreffende kleur variante en die meeste inligting wat beskikbaar is, is in die vorm tydskrifte, nuusbriewe en webtuistes. Die beperkte wetenskaplike data wat beskikbaar is aangaande kleur variante het ook gelei tot 'n debat omtrent hierdie diere. Huidiglik is opinies uiteenlopend en gaan dikwels gepaard met sterk emosionele reaksies van belanghebbendes, veral vanaf wildboere wat voel dat hulle heenkome bedreig mag word deur enige beheermaatreels. Meeste wildboere voel dat hulle toegelaat moet word om met enige dier te boer wat vir hulle die beste opbrengste lewer en aangesien kleur variasie 'n natuurlike verskynsel is, dit nie 'n bedreiging vir bewaring inhou nie. Meningsopname resultate het getoon dat, alhoewel baie belanghebbendes gevoel het kleur variante nie 'n bedreiging vir bewaring is nie, die meerderheid nie die teel van diesulke kleur variante ondersteun nie. Die oorgrote meerderheid belanghebbendes glo dat finansiële gewin die hoof rede is vir die gewildheid van kleur variante. Verskeie belanghebbendes het ook kommer uitgespreek oor die potensieële skade wat kleur variante kan veroorsaak aan Suid-Afrika se bewarings en eko-toerisme beeld aangesien kleur variante veral deur buitelandse jagters as onnatuurlik beskou word.

Die uiteindelike gevolgtrekking van hierdie studie is dat die bestaan van kleur variante nie 'n bedreinging inhou vir bewaring nie, maar dat dit eerder die bestuur van hierdie diere is wat 'n bedreiging vir bewaring asook vir Suid-Afrika se bewarings beeld inhou.

Sleutelwoorde: kleur variante, springbok, bewaring, wildboerdery, meningsopname, Bovidae, gedrag