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Detection of hyperthermia during capture of wild antelope

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Dissertation title: “Detection of hyperthermia during capture of wild antelope”

MSc candidate: Ms Marna Broekman

Appraisal of dissertation:

Done

Changed where applicable

Blood samples taken post mortem, were obtained at the wrong time as admitted in the dissertation and it is recommended that in this type of circumstances, blood samples must be obtained direct at death. The results and conclusions from the blood variable results presented in the fifth chapter are therefore restricted with regard to the wrongful timing of sampling, and should be read bearing that in mind.

General comments: In the introduction the explanation of physiological responses to stress is an important part for the theme of the dissertation, yet the explanation is unclear. Section 1.2.2. (particularly page 8 and 9) needs to be rewritten to improve the flow and clarify how the different systems respond to stress. It is currently very fragmented and confusing. I’d suggest that you split the response into autonomic and neuroendocrine and then explain how each system responds to stress.

1.2.2 Response to stressors

Capture and translocation of animals causes a stress response, which may differ between species, genders, and also as a result of an individual’s previous experience of capture (Harthoorn 1975; Hattingh 1988a; Morton *et al.* 1995). This stress response includes physiological and psychological stress, which may result in illness, such as capture myopathy, also known as overstraining disease. Physical stressors include exhaustion, injury and heat exposure whereas psychological stressors include handling and restraint associated with human presence and i.e. inability to escape (Grandin 1996). Intensive management of wildlife entails relatively frequent exposure of animals to humans, handling, capture and translocation and consequently a possible increase in the incidence of capture myopathy (Read *et al.* 2000). More animals died from capture myopathy than from any other wildlife diseases in southern Africa over the past 30 years (Ebedes *et al.* 2006). The degree of the response to a specific type of stressor and the associated

physiological response are therefore of extreme importance in the management of wildlife.

In order to determine the response of an animal to a specific type of stressor, it is important to understand what the term “stress response” entails. The stress response consists of three parts namely behaviour, the neuroendocrine system and the autonomic nervous system (Read *et al.* 2000). When an animal perceives physical and/or emotional stressors two phases are involved namely the autonomic nervous system phase and the neuroendocrine system phase (Mader 1998, Möstl and Palme 2002). The neuroendocrine system phase is also known as the hypothalamic-pituitary-adrenal axis. This involves the stimulus of the hypothalamus during a stressful situation. The hypothalamus stimulates the anterior pituitary which results in the release of adrenocorticotropin hormone (ACTH). ACTH in turn stimulates the adrenal cortex to produce glucocorticoid hormones, in particular cortisol. Simultaneously, the central nervous system perceives a situation as stressful which result in the stimulation of the hypothalamus and consecutively the autonomic nervous system (Mader 1998, Möstl and Palme 2002). The autonomic nervous system includes both the sympathetic and parasympathetic nervous systems. The stress response results in the activation of the sympathetic nervous system and the inactivation of the parasympathetic nervous system. The sympathetic nervous system results in the stimulation of the adrenal medulla which in turn results in the increased release of catecholamines. This phase is also known as the sympatho-adreno-medullary phase. Catecholamines include epinephrine, norepinephrine, dopamine, dehydroxy-phenylacetic acid. Together the increased release of both glucocorticoids and catecholamines typify

the flight and flight response (Hattingh 1988b). Increased glucocorticoid and catecholamine release results in various changes throughout the body. In order to determine the reaction of the individual to the stressor, components of the stress reaction can be measured. The adrenal glands, situated on the kidneys, have an important function with regard to the stress response since they form part of both the above mentioned phases.

During a stress response, the neuroendocrine system phase respond via, the adrenal cortex that discharges corticosteroids functioning to augment fitness through energy metabolism (Mader 1998, Möstl and Palme 2002). The discharge of cortisol during a stress response causes glucose release into the bloodstream to augment energy metabolism (Bonacic *et al.* 2003). The enhanced energy metabolism only improves fitness during mild acute stress in contrast to its detrimental effect on fitness during long-term exposure to stress. With chronic stress exposure and cortisol concentrations that remain high, immunosuppression, tissue degeneration and negative effects on growth and reproduction results (Axelrod and Reisine 1984, Dalin *et al.* 1993, Möstl and Palme 2002).

The autonomic nervous system phase involves the adrenal medulla that responds to stress via the production catecholamines which are involved in the body's immediate response to stress and thus during the alarm phase (Dimsdale and Moss 1980). Catecholamines facilitate the active reaction to a stressor with the associated sympathetic nervous system and adrenal medulla activation (Nwe *et al.* 1996). Catecholamines include adrenaline (epinephrine), noradrenaline (norepinephrine), dopamine and dihydroxy-phenylacetic

acid. However, adrenaline and noradrenaline are predominantly used as measures for indicating the alarm reaction. These two hormones act upon the heart, bronchioles and blood vessels to cause adrenergic stimulation (Mader 1998). They bring about bodily changes that occur when an individual reacts to an emergency that include the rise in blood glucose levels, a dilation of bronchioles, increased heart rate and an increased breathing rate. Blood vessels supplying the digestive tract and skin constrict and the vessels supplying skeletal muscles dilate in addition to the more forceful contraction of the cardiac muscle resulting in an increased heart rate, therefore aiding in the “flight and fight” response (Axelrod and Reisine 1984, Mader 1998). The physiological response during a “flight and fight” situation is of importance in studies aiming to determine possible causes of stress-induced mortalities associated with capture.

Although the “flight and fight” response functions to adapt the species to stress during which catecholamines and glucocorticoids are released, prolonged elevated concentrations of both these variables exerts a suppressing effect on immunity (Nwe *et al.* 1996). Furthermore, stimulation of the sympathetic nervous system for prolonged time periods also has negative consequences in terms of cardiac contractility, muscle changes and negative effects on the liver and kidneys. The hyperthermic response to capture can also in part be ascribed to catecholamine release and sympathetic nervous system activity during the stress reaction as a result of its metabolic and vascular effect in the body (Oka *et al.* 2001). A previous study conducted by Gericke and Hofmeyr (1976) on springbok (*Antidorcas marsupialis*) showed elevated rectal temperatures that increased to values exceeding 42°C and an increase in both cardiac and respiration rate after capture.

Although the increased rectal temperature, heart rate and respiratory rate was originally thought to be a normal response to forced exercise, the immense increase in blood glucose levels, creatine kinase, potassium and lactate with a subsequent reduction in blood pH. Gericke and Hofmeyr (1976) came to the conclusion that capture myopathy in these animals was a result of trauma (mechanical damage), an acute stress response and hyperthermia due to intense forced exercise together with a severe alarm reaction and the simultaneous secretion of catecholamines.

During the secretion of catecholamines, haemoconcentration occurs as well as a plasma glucose concentration increase. The release of catecholamines during an alarm reaction cause splenic contraction which in turn results in the release of an increased number of red blood cells into circulation and thus haemoconcentration. Due to the forced exercise, there is a greater workload on the animal's muscles causing an overload of the mitochondria's oxidative ability which in turn leads to anaerobic metabolism for energy production. With regard to the above changes, hypoxia, an increase in anaerobic metabolism, metabolic acidosis, a climb in blood lactate concentration and a significant increase in cell membrane permeability result (Gericke and Hofmeyr 1976). The vast quantity of lactic acid produced dissociates to form lactate and hydrogen ions that in turn cause a rise in hydrogen ion concentration resulting in a state of acidosis (Read *et al.* 2000).

The significant increase in cell membrane permeability consequently results in a flow-through of electrolytes, particularly potassium. The sudden and continuous rise in plasma potassium as well as the reduction of calcium ions resulting from an increase in

circulating lactate can disrupt normal myocardial function. Additionally, typical cell function disturbance and consequential deterioration of the muscles results from the continuous loss of potassium from the extra-cellular fluid as well as the muscle cells (Gericke and Hofmeyr 1976). The leakage of various intracellular enzymes, such as creatine kinase, into the bloodstream is a result of muscle cell damage and to a lesser degree from increased cellular permeability (Volfinger *et al.* 1994, Montané *et al.* 2002). Furthermore, with the release of catecholamines into the bloodstream, haematocrit increases as a result of splenic contraction that is caused by either circulating catecholamines or sympathetic nerve activity (Mitchell *et al.* 1988). Mitchell *et al.* (1988) came to the conclusion that two phases exist for the response to stress. These include the hypothalamic-pituitary-adrenal axis phase, in which cortisol levels increase, in relation to perceived environmental stresses (e.g. noise), and the sympatho-adreno-medullary phase that is linked to neurogenic stress (e.g. transport).

Similarly, restructure discussion of the thermal response to start by introducing why stress may increase body temperature. Then discuss other factors which may contribute to hyperthermia in separate paragraphs ie. exercise, ambient temperature and drugs. Finally discussing whether body temperature may predict the chance developing capture myopathy and mortality. Be sure to include multiple references in each paragraph

Restructured and changed

1.2.2.1 Thermal response

An animal's body temperature may be a good indication of stress levels during capture because a rise in body temperature can influence the incidence of capture myopathy development (Gericke *et al.* 1978, Harthoorn 1980, Cheney and Hattingh 1988, Bakken *et al.* 1999). Hyperthermia associated with capture is believed to be predominantly

caused by stress-induced hyperthermia which is an anticipatory response of an animal to a stressor (Bakken *et al.* 1999, Olivier *et al.* 2003, Meyer *et al.* 2008a, Mentaberre *et al.* 2010). It has been shown in both silver foxes (*Vulpes vulpes*) and rodents exposed to a stressor that body temperature rises rapidly within minutes after exposure to a stressor (Groenink *et al.* 1994, Bakken *et al.* 1999). The hyperthermic stress response was also confirmed by both plasma concentrations of ACTH and corticosterone, which were found to increase in relation to the rise in rectal temperature within 10 minutes after the first temperature recording (Groenink *et al.* 1994). Stress-induced hyperthermia is coupled to the triggering of the hypothalamic-pituitary-adrenal axis as well as the sympathetic-adrenal-medullary system (Bakken *et al.* 1999, Oka *et al.* 2001, Olivier *et al.* 2003). Other factors that may cause hyperthermia during capture are exercise, ambient temperature and drug effects, and previously have been thought to be the main factors causing hyperthermia.

In a study conducted by Gerike *et al.* (1978), springbok caught in nets showed a marked increase in rectal temperatures ($>42^{\circ}\text{C}$). The authors believed that this increase in body temperature was due to forced exercise because animals were chased into nets. However, more recent literature proposed that stress-induced hyperthermia does not appear to be linked to physical exertion or environmental heat loads. Meyer *et al.* (2008a) showed that impala (*Aepyceros melampus melampus*) that were chased at high exercise intensity, but were not captured, had lower core body temperatures in comparison to impala that were captured without being chased.

Cheney and Hattingh (1988) have proposed that stress-induced hyperthermia is closely linked to ambient temperatures. They found significant correlations between ambient temperature and maximum rectal temperatures of impala as well as between ambient temperature and mean rectal temperatures. The significance of environmental temperatures during studies, such as the study by Kock *et al* (1987a), that aim to determine or measure the stress response of animals is unknown. The importance of environmental temperature during capture and resultant capture-related hyperthermia and death has been mentioned repeatedly in various capture-related studies (Murray *et al.* 1981, Kock *et al.* 1987a, Cheney and Hattingh 1988, Ebedes *et al.* 2006). Due to this belief the capture of wildlife species has been restricted to early mornings and late afternoons, to avoid high ambient temperatures during the midday. However, a study conducted by Meyer *et al.* (2008a) showed that the endogenous rhythm of body temperature reached its peak value late in the afternoon therefore rendering late afternoon capture possibly more likely to be associated with hyperthermia. There has been no systematic investigation to determine whether high environmental heat loads increase body temperature during capture.

Opioids, used mainly as the immobilizing drugs for ungulates, interfere with respiration since they have a depressive effect on the respiratory centre of the brain. Opioids also result in excitement and increased muscle tone, which in conjunction can result in hyperthermia (Murray *et al.* 1981, Kock *et al.* 2006, Meyer *et al.* 2008a). However, Meyer *et al.* (2008a) showed that animals that were chemically immobilized using immobilizing drug etorphine and the tranquilizer azaperone, were net captured without

drugs or just disturbed by the presence of humans, all experienced a hyperthermic response.

Both increased exercise associated with capture and effects of capture drugs may contribute to the rise in body temperature associated with stress-induced hyperthermia, but do not appear to be the cause of stress-induced hyperthermia (Regel and Pütz 1997, Bakken *et al.* 1999, Olivier *et al.* 2003, Meyer *et al.* 2008a, Mentaberre *et al.* 2010).

Several studies have shown that with hyperthermia associated with captures, there is an increased chance of mortality or capture myopathy (Gericke *et al.* 1978, Antognini *et al.* 1996). In a study conducted by Kock *et al.* (1987a) hyperthermia associated with capture was linked to the incidence of capture myopathy in wild bighorn sheep (*Ovis canadensis*). Rectal temperatures of free-ranging wild bighorn sheep were elevated after exposure to different types of capture namely drop-net, drive-net, chemical immobilization and net-gun, in comparison to domesticated sheep (Kock *et al.* 1987a). The sheep were classified into a normal outcome group characterized by healthy animals, capture stress group characterized by high body temperature and excessive struggling and evidence of shock. The third group was classified as diseased where individuals showed clinical infections and the fourth group were classified as the capture myopathy group where mortalities occurred from peracute, acute or chronic myopathy (Kock *et al.* 1987a). Classification of the sheep into various categories post-capture resulted in significant differences between the different groups on the basis of several biological, haematological and biochemical measurements, indicating that individual animals with high rectal temperatures (range

42.5°C – 42.7 °C) died within 6 months after capture (Kock *et al.* 1987a). Animals that had these high temperatures were more likely to die within 6 months after capture than those animals with lower temperatures. Similarly, a study conducted on different capture techniques of impala populations revealed high average rectal temperatures of 41 °C during individual restraint (Murray *et al.* 1981). Eight percent of the impala died after capture with rectal temperatures not returning to resting values. Rectal temperatures in conjunction with other biochemical parameters (glucose, plasma pH) therefore may play an important role in the identification of animals that are likely to succumb to capture-related stress and myopahty (Kock *et al.* 1987a).

The magnitude of the rise in body temperature may thus possibly be a good indication of the level of stress that an animal is experiencing during capture, independent of the amount of physical activity, ambient temperature and whether or not capture drugs have been used, and may predict the chance of an animal developing a capture-related disease.

. For the section 1.2.2.1.1 site of temperature measurement, ideas and references need to be integrated. Firstly sort the references based on the different sites of body temperature measurement ie. tympanic, subcut, gut and muscle. Then integrate the findings of the different studies to argue whether or not it is an accurate measure of core body temperature. Did the site over or underestimate core body temperature? Under what conditions was the technique tested? It currently comes across as this study found..., that study showed... without any indication that you have internalized the findings of the different studies.

Integrated studies and restructured with minor changes after discussion with supervisors

1.2.2.1.1 Site of temperature measurement

Because body temperature has been shown to increase during stressful events such as capture (Kock *et al.* 1987a, Groenink *et al.* 1994, Regel and Pütz 1997, Meyer *et al.*

2008a), it is particularly important to measure body temperature as accurately as possible during these events. The site at which body temperature is measured during a capture event needs to accurately reflect core body temperature so as to determine the degree of stress-induced hyperthermia and the possible occurrence of capture myopathy (Gericke *et al.* 1978, Harthoorn 1980, Cheney and Hattingh 1988, Bakken *et al.* 1999). Additionally, the site needs to be practical, easily accessible under capture conditions, as non-invasive as possible, and needs to provide a rapid instantaneous measure of core body temperature. Even though several studies have been conducted and a variety of sites are available for body temperature measurements, these sites are not always practical during capture of wild animals. In order to investigate a site that fits these characteristics, continuous measurement of core body temperature is necessary to obtain values to which alternative measurement sites can be compared. The continuous measurement of core body temperature is possible by the surgical implantation of temperature-sensitive data loggers (Mitchell *et al.* 2002).

Several studies have been performed on different body sites of temperature measurement and their accuracy with regard to core body temperature (Saltin and Hermansen 1966, Greenleaf and Castle 1972, Blainey 1974, Hansen *et al.* 1996). A study conducted by Ingram *et al.* (2002) on the effect of transport on both core and peripheral body temperature in sheep (*Ovis aries*) showed that core body temperature (measured as rectal temperature) increase significantly during handling and transport. However, measures obtained by automated logging of peripheral (external auditory canal and pinna) temperatures were significantly lower during transport, due to the influencing effects of

ambient temperature and wind chill factors. Peripheral temperatures, nonetheless, increased significantly during uploading and off-loading of animals for transport. Ingram *et al.* (2002) demonstrated that peripheral temperature recordings are easily achievable and may be used as a potential technique to measure thermal response to capture in the future, but only after further investigation on the possible confounding effects of ambient temperature and wind chill factor.

Drew (1996) investigated the accuracy of both tympanic and rectal temperature measurements as a means of core body temperature determination. As a result of the regular occurrence of capture-related hyperthermia in bighorn sheep, Drew (1996) conducted a study to establish whether tympanic temperature or rectal temperature measurements are better to assess hyperthermia in captured bighorn sheep (*Ovis canadensis nelsoni*). Both rectal and tympanic temperature increased during capture, with rectal temperature 2°C higher than tympanic temperatures. Drew (1996) stated that heat produced as a result of exertion and subsequent storage in the abdomen and larger muscle mass in the hind legs, together with the failure of this species to rapidly dissipate produced heat, caused rectal temperature to rise more than tympanic measurements, and concluded that tympanic temperatures are a better method to assist in the determination of pathologic hyperthermia resultant from capture and exertion. In this study, however, rectal and tympanic temperature measurements were not compared to any other basic method for core temperature measurement. The comparison between rectal and tympanic measurement is clear but the validity of the statement that rectal temperature is inferior in measuring hyperthermia, is questionable. Nadel and Horvath (1970) also investigated

tympanic membrane and rectal temperature measurements as accurate measures for core body temperature in humans. They found that tympanic membrane temperature measurements differed significantly from rectal temperature measurements in resting subjects that were exposed to an array of ambient temperatures. Tympanic temperature was always greater than rectal temperature when the mean skin temperature exceeded 30°C but was lower than rectal temperature when the mean skin temperature was less than 30°C. The use of this temperature measurement site as an accurate predictor of core body temperature is therefore confounded by the influence of ambient temperature.

Brengelmann (1987) investigated the problem of how to measure core body temperature, specifying thermal balance as an entity, or regulated temperature, which has to do with input to internal body temperature, when aiming for a non-invasive but accurate body temperature measurement site. Brengelmann (1987) concluded that tympanic temperature cannot be used as an accurate measure of core body temperature because it is influenced by changes in ambient temperature. Instead, he suggested oesophageal temperature as an accurate and non-invasive measurement site however, for wild antelope this measurement site is impractical. Moran and Mendal (2002) also discarded tympanic temperature as an effective measure of core temperature and in union with Brengelmann (1987) suggested oesophageal temperature for core body temperature measurement.

Sawka and Wenger (1988) also suggested rectal temperature as an accurate measurement site for core body temperature since it is not influenced by ambient temperature and is a relatively convenient site. They however highlighted that rectal temperatures are about 0.2°C higher than other core body temperature sites and do not react instantly to changes

in core body temperatures. In a human study, a time lag of up to one hour is possible before rectal temperature accurately reflects true core temperature, due to the blood flow dynamics to the rectum (Benzinger 1969). Moran *et al.* (1998) stated that during exercise, a significant production of heat occurs and that heat loss mechanisms may not be effective enough to compensate for the increased heat production, with rectal temperature increasing as a result of heat retention within the abdominal cavity produced as a side-effect of the contraction of the skeletal muscles.

Similar to tympanic temperature measurement, skin temperature is also inadequate as a measure of body temperature because of the major influence of ambient temperature on this temperature site (Saltin *et al.* 1968). During submaximal exercise in man skin temperature recordings were 5°C lower than rectal and muscle temperature measurements recorded during the study (Saltin *et al.* 1968). A comparison of the rectal and subcutaneous body temperature measurement in the common marmoset (*Callithrix jacchus*) revealed closely parallel values for the determination of body temperature via the two different measurement methods, with drug-induced hyperthermia (Cilia *et al.* 1998). Previous studies on different animals showed differences between rectal and subcutaneous temperature measurements of 0.4°C for common marmosets, 2°C for rhesus monkeys and 5°C for squirrel monkeys (*Saimiri sciureus*), with subcutaneous temperature measurements always lower than temperatures measured rectally (Stitt and Hardy 1971, Lane *et al.* 1996). Moran *et al.* (1998) stated that while skin temperature is higher in warm environments compared to cooler environments, rectal temperatures are fairly unaffected by the ambient temperature over a broad range. The study conducted on

marmosets by Cilia *et al.* (1998) showed close agreement of rectal and subcutaneous body temperatures with an average difference in absolute body temperature of 0.3 °C. Cilia *et al.* (1998) suggested that the differences between rectal and subcutaneous body temperature measurements obtained in other studies might be due to the associated stress and temperature rise that occur during handling and measurement of body temperature with a rectal thermometer. They concluded that subcutaneous measurement of body temperature measured by subcutaneous microchips is an accurate and reliable method to determine body temperature. Even though a tissue probe can be inserted subcutaneously as with a rectal temperature probe during capture, it is as argued with the measurement of rectal temperatures via a probe during capture impractical during actual capture. However, the fact that subcutaneous temperature is so strongly affected by ambient temperature, rules out this site for accurate body temperature measurement in the field.

Regel and Pütz (1997) investigated body temperature increases of penguins (*Aptenodytes forsteri*) during exposure to a stressor. Specifically, their study on the effect of human disturbance on body temperature in penguins showed a significant increase in stomach temperature of penguins exposed to human-induced stressors. This highly significant rise in body temperature was due to human-induced stress and possibly confinement since the experimental animals were kept in relatively small enclosures which inhibited extensive movement and exercise. In this study, the authors used stomach temperature as a measure for core body temperature because heat is produced both in the muscles and body core as a consequence of stress, it was interpreted that stomach and core body temperature rise to

a similar degree. Stomach temperature however, similar to the implantation of abdominal temperature-sensitive data loggers, is also not feasible for field measurement purposes.

Saltin *et al.* (1968) suggested both muscle and rectal temperature as accurate alternatives for the measurement of core body temperature during exercise in man. In another study, on the effect of increased muscle temperature on oxygen uptake kinetics during exercise in humans (Koga *et al.* 1997), rectal and muscle temperatures were not significantly different. In addition, Saltin *et al.* (1968) also found a close correlation between rectal and muscle temperatures during submaximal exercise in man. Muscle temperatures measured in the gluteus, semitendinosus and masseter muscles in exercising horses were closely related to core body temperature measurements in the abdomen and right ventricle whereas rectal temperatures were lower than muscle temperature and reacted with a time lag of approximately 10 minutes rendering them relatively inaccurate, according to Weishaupt *et al.* (1996). Muscle temperature measurement is described as quick and reliable by Imrie and Hall (1990). Muscle temperature measurements of anaesthetized animals measured at the start of malignant hyperthermia in animals responded quicker in comparison to any other core temperature measurement (Imrie and Hall 1990).

Since core temperature measurement is generally invasive in terms of implantation of temperature-sensitive devices or insertion of catheters, there is a necessity for an alternative site. An alternative body temperature measurement site must be practical, adequately reveal alterations in core blood temperature, reflect alterations rapidly and must not be influenced by factors such as ambient temperatures (Sawka and Wenger

1988). Oesophageal temperature and rectal temperature measurement are both effective sites to predict core body temperature (Sawka and Wenger 1988), however oesophageal temperature measurement is impractical in a field situation whereas rectal temperatures are more practical when animals can be restrained or are immobilized. At this point in time, until a more practical and accurate measurement site can be allocated, rectal temperature is still the most effective and practical method to determine the core body temperature during the capture of wild animals (Moran and Mendal 2002).

You also need to better integrate findings and studies within the blood chemistry section 1.2.2.2. I'd suggest you either combine the different capture techniques and which blood variables have been found to be elevated with net capture, for example, or combine studies looking at similar variables eg. Cortisol concentrations were elevated in...

Minor changes have been made to improve flow of paragraph after discussion with supervisors.

1.2.2.2 Blood chemistry change in response to stress

Several studies have investigated various biochemical and haematological variables in response to different capture and handling methods (Ganhao *et al.* 1988, Hattingh 1988 a, 1990, Kock *et al.* 1987a, Knox *et al.* 1992a, b, 1993, Mitchell *et al.* 1988). During exposure to a stressor, the adaptive reaction results in the stimulation of the adrenal glands and the discharge of catecholamines and corticosteroids. Catecholamines and corticosteroids in turn mediate changes of other physiological variables such as glucose concentration, lactate concentration and pH to aid in the adaptation to the stress response (Möstl and Palme 2002). Hattingh (1988b) suggested the measurement of eight variables in order to adequately be able to measure the stress response of a species in terms of both the endocrine effects on metabolism. These eight variables include lactate, haematocrit,

total protein, osmolality, glucose, total lipids, total catecholamines and cortisol. The importance of other stress-related blood variables has also been suggested in other studies namely creatine phosphokinase, potassium, sodium, calcium and pH (Harthoorn 1975, Kock *et al.* 1987a, Ganhao *et al.* 1988, Apple *et al.* 1995, Bateson and Bradshaw 1997).

Ganhao *et al.* (1988) measured a range of variables including haematocrit, osmolality and plasma concentrations of glucose, lactate, cortisol, total protein, total lipid and total catecholamines in the blood of three species, in response to different capture techniques. Net capture (in which animals are chased into a net and physically restrained) of eland (*Tragelaphus oryx*), red hartebeest (*Alcelaphus buselaphus*) and blesbok (*Damalisus pygargus phillipsi*) resulted in significantly elevated mean values of the plasma levels of lactate, glucose, osmolality and total catecholamines as well as an increase in haematocrit.

In a similar biochemical study (Hattingh *et al.* 1988) where blood samples were taken from wild or field impala caught at night, from boma-kept impala after net restraint and from control impala after a single shot in the brain, the authors found significant differences between the haematocrit, lactate, glucose and osmolality values of field, boma-kept and control (brain shot) impala. The above mentioned blood variables were higher for both field and boma-kept impala in comparison to control impala. Blood lactate, glucose and cortisol concentrations were found to be elevated during capture of impala in nets (Knox *et al.* 1992a). A study conducted by Cheney and Hattingh (1988) showed a significant positive linear relationship between time to recumbency after dart, and cortisol and lactate concentrations, total catecholamines, heart rate and haematocrit.

Also, impala darted with barbed needles had higher cortisol and lactate levels in comparison to impala darted with drop-out darts (Cheney and Hattingh 1988).

Additionally, Harthoorn (1975) showed that blood variables such as potassium (K^+), sodium (Na^+) and creatine phosphokinase (CPK) also were indicative of the degree of stress response and muscle damage associated with capture myopathy.

During the stress response, the autonomic nervous system is activated with a consequent secretion of catecholamines from the adrenal medulla (see section 1.2.2). The release of these hormones results in splenic contraction which in turn causes a rise in red blood cell number, in the circulation in order to help with an improved delivery of oxygen to the body tissue (heart and locomotor muscles) for the duration of a stressful event (Read *et al.* 2000). Accordingly, Wesson *et al.* (1979) stated that throughout physical restraint of white tailed deer (*Odocoileus virginianus*), the increased red cell mass or haemoconcentration is much greater in mechanical capture in comparison to capture via chemical immobilization. Another study performed on the evaluation of capture techniques for research on impala populations showed that the handling and capture method can greatly influence blood variable abnormalities and thus mortality during capture (Murry *et al.* 1981).

Additionally, with regard to blood variables (cortisol, lactate, haematocrit, catecholamines), Cheney and Hattingh (1988) established a linear relationship between the physiological response (blood variable concentrations) and both the time and distance to recumbency, with greater physiological responses as times and distance to recumbency

increased, in impala. In a study conducted on capture-related stress by recording blood variable and thermal data in free-ranging bighorn sheep, Kock *et al.* (1987a) found that creatine phosphokinase, glucose, plasma pH and potassium levels were significantly elevated in the blood of stressed sheep compared to non-stressed (on the basis of clinical investigation) sheep. Variables such as cortisol, sodium, chloride and total proteins showed no significant differences between the experimental groups of the sheep. The data of animals that died 1 to 6 months post-capture as a result of capture-related stress were investigated and revealed significant abnormalities in blood chemistry variables. Significantly elevated potassium, glucose and creatine phosphokinase values as well as a slight decrease in plasma pH of 7.3 (normal) to 7.2 were found.

The relevance of the recording of blood and thermal variables to serve as measurements that can rapidly identify individual animals that is at risk and that should be treated for stress (vitamins, selenium) before translocation, is pointed out by Kock *et al.* (1987a). To use only a single variable to measure the stress response of an individual in the field is meaningless since the variable may change in response to an array of uncontrolled stressors, leading to misinterpretation of the results (Hattingh and Petty 1992). In addition to this concern, the variable response during exposure to different stressors as well as the extremely intricate stress hormone interactions, makes single measurements insufficient and invalid (Hattingh 1988a). It is extremely difficult, if not impossible to create controlled capture conditions of wildlife in the field and subsequently to obtain an accurate measure of the stress response of an animal; several variables in combination therefore must be measured.

I think the “types of capture” should be discussed before “capture related stress” since you refer to different types of capture which haven’t yet been introduced. I also think the stress section will flow better into quantification of stress and your aims.

Leave as is after discussion with supervisors

Keep terminology constant (eg capture-induced vs. stress-induced hyperthermia, translocation vs. relocation, boma vs enclosure, chemical immobilization vs darting, abdominal temperature vs. body temperature vs. abdominal body temperature, blood chemistry vs. blood variables, short chase + dart vs. Short Dart vs. SD, carotid arterial blood temperature vs. carotid arterial temperature vs. arterial blood temperature vs. arterial temperature, haematological changes vs. blood variable changes). Different terminology for the same factor/variable makes it difficult to follow your arguments.

Done. Changed terminology to stress-induced hyperthermia, translocation, boma, darting, abdominal body temperature, blood variables, short chase + dart, arterial blood temperature, blood variable changes, throughout the entire dissertation document.

Your methods section is missing essential details such as manufacturer details, resolution, accuracy, memory capacity, range or sensitivity for all data loggers implanted. Although some of these details are included in the brief methods section in some of the chapters, I think your main methods section needs to be complete. Also, you need to be sure your description of data loggers is accurate (eg. an iButton won’t last 5 months on a 5 minute interval). In the methods section per chapter you need to explain which loggers failed, when they failed and why. Also include which impala died and when so that the reader can better understand which data was analyzed from which individuals. Perhaps a table summarizing from which trials you analyzed/acquired data for each individual would be helpful.

Added table in Appendix 2.(referred to on page 49,50)

In chapter 3, and throughout your dissertation, you cannot discuss differences between blesbok and impala if you don’t compare species in your analysis. Also be careful of interpreting results correctly. If variables are not significantly different in your results, you cannot discuss differences in your discussion. If you’re combining or ignoring results for certain trials because you say they are not different you need to show results to justify that exclusion/combination. Include results of your statistical analyses throughout your dissertation as it is unclear when you used parametric versus non-parametric analyses if you simply report p values. Finally, double check your calculations as rate of change of $-1.33819^{\circ}\text{C}/\text{min}$ for blesbok 30 minutes after darting implies that blesbok abdominal temperature decreased by more 39°C within half an hour of darting.

Deleted all the sentences throughout the dissertation where blesbok versus impala were implied.
See table in Appendix 2 for data loggers that failed and data used for analyses).
Checked and changed values (Table 3.2.2)

In chapter 4, I think you need to focus your analysis during the time of capture. I think the question of interest is whether muscle temperature can be used as an estimate of core body temperature during the capture event not during the 24 hour day during which capture occurred. I would suggest that correlations and Bland-Altman analysis be restricted to time of capture (30 min) and that all analysis be conducted per individual rather than averaging individuals which may have been captured at different times.

Decided to keep as is after discussion with supervisors and after admission of wrongful data sampling time

If I understand your analysis in chapter five correctly, I think all blood variable analysis needs to be redone based on blood samples at time of recumbency for all individuals, rather than including blood samples two hours post death when these variables seemingly changed within that two hour period. Results and conclusions then need to be adjusted accordingly.

Decided to keep as is after discussion with supervisors and after admission of wrongful data sampling time and thus the subsequent restriction of the possible conclusion made from these analyses.

Specific comments:

Abstract:

Adjusted abstract according to changes made

Page iv line 5 Page iv line 5 –done

Page iv line 7 Page iv line 7 - done

Page iv line 11 Page iv line 10 – done

Page iv line 22 Page iv line 21-done

Page v line 7 Page v line 4 – done

Page v line 8-10 – done

Page v line 17 Page v line 14 - done

Page vi line 2 Page vi line 1 – done

Page vi line 5 – added table in methods section

Page vi line 10 Page vi line 8-9 – done

Page vi line 17 Page vi line 13 – done

Page vi line 22 Page vi line 18-20 – done

Acknowledgements:

Leith performed all the implant surgery of my study

Page viii line 4 – deleted

done

Introduction:

Page 3 line 3 Page 2 line 3 - done

- done

Page 3 line 3 Page 2 line 4 - done

Page 3 line 14 Page 2 line 14 - done

Page 2 line 15 - done.

Page 2 line 17 – done

Page 4 line 7 Page 2 line 18 – done

Page 3 line 21 Page 3 line 1 – added data and reference

Page 4 line 3 Page 3 line 6 – done

Page 3 line 15 Page 3 line 12 – done

Page 4 line 13 Page 3 line 13 – done

Page 4 line 14,15 Page 3 line 15 – done

Page 4 line 19 Page 3 line 19 - done

done

Page 5 line 9 Page 4 line 9 – done

Page 5 line 10, page 5 line 1,page 4 lines 1,7,13 Page 4 line 10 – done

Page 6 line 6 Page 4 line 23 - done

Page 6 line 20 Page 5 line 14 – done

Page 7 line 2-3 Page 5 line 17 - done

Page 6 line 22, page 7 line1 Page 5 line 20 - done

Page 7 line 6 Page 5 line 21 - done

Page 6 line 1-5 – done

Page 7 line 17 Page 6 line 7 – done

Page 7 line 22 Page 6 line 14 – done

Page 8 line 3 Page 6 line 17 – done

Page 8 line 5 Page 6 line 19 – done

Page 8 line 13 Page 7 line 5 – done

Page 8 line 18 Page 7 line 9 – done

Page 8 line 20 Page 7 line12 – done

Page 8 line 10 Page 8 line 1 – done

Page 8 line 10 Page 8 line 2 – done

Deleted Page 8 line 5 – done

Deleted Page 8 line 8 – done

Page 9 line 9-page 10line9-page11line14 Page 8 line 10 – done

Page 9 line 9-page 10line9-page11line14 Page 8 line 13 – done

Page 9 line 9-page 10line9-page11line14 Page 8 line 14 – done

Page 9 line 9-page 10line9-page11line14 Page 8 line 17 – done

Page 9 line 9-page 10line9-page11line14 Page 8 line 18 – done

Page 9 line 9-page 10line9-page11line14 Page 9 line 4 – done,Page 9 line 5 – done

- done

Page 11 line 14 Page 9 line 13 – done

Page 11 line 18 Page 9 line 17 – done, positive feedback system

Page 11 line 18 Page 9 line 18 – No, Nwe

Page 9 line 19 – noted, keep as is after discussion with supervisors

Page 9 line 21 – noted, keep as is after discussion with supervisors

Page 12 line 4 Page 10 line 3 - done

Page 12 line 11,13 Page 10 line 14 – done

Page 13 line 4 Page 11 line 3 – done

Page 13 line 7 Page 11 line 5 – done

Page 13 line 15 Page 11 line 13 – done

Page 12 line 5 – done

Page 11 line 23 Page 12 line 6 – done

Page 13 line 14 Page 12 line 9 – done

Page 12 line 12 – done

Page 12 line 3, page14line5,page14line13 Page 12 line 12 - done

Page 14 line 20 Page 12 line 15 – done

done

Page 14line21Page 12 line 18 – done

Page 15 line 20 Page 12 line 20 – done

Page 15 line 21 Page 12 line 21 - done

Page 15 line 22 Page 12 line 23 – done

Page 16 line 3 Page 13 line 2 – done

Page 15 line 19 Page 13 line 3 – done

Page 16 line 4 Page 13 line 6 – done

Page 16 line 8 Page 13 line 9 – done, details discussed later
Page 15 line 6,8,11 Page 14 first paragraph – done, added reference
Page 16 line 15 Page 14 line 3 –done
Page 16 line 16 Page 14 line 4 – done, not different species but tame animals
Page 16 line 16-22 Page 14 line 6 – done
Page 17 line 4 Page 14 line 9 – done
 Page 14 line 17 – done
 Page 14 line 20 – done
 - done
Page 14 line 7 Page 14 line 23 – done
Page 17 line 14 Page 15 line 1 – done
Page 15 line 4 Page 15 line 3 – done
 Page 15 line 9 – done
 Page 15 line 13 – done
 Page 15 line 19 – done
Page 18 line 10 Page 16 line 1 – done
 Page 16 line 4 – deleted Ingram section in this paragraph due to confounding effects of ambient conditions
Page 18 line22 Page 16 line 11 – done
 Page 16 line 12 – done
Page 19 line 3Page 16 line 15 – done
Page 19 line 21 Page 16 line 19 – done
Page 19 line 22 Page 16 line 20 – done
Page 19 Page 16 line 22 – done
Page 19 Page 17 line 1 – rephrased and changed paragraph section
Page 19 Page 17 line 5 – rephrased and changed paragraph section
Page 19 Page 17 line 8 – rephrased and changed paragraph section,
Page 19 line 18 Page 17 line 13 – rephrased and changed paragraph section,
Page 19 line 18 Page 17 line 17 – rephrased and added limitations, Page 17 line 19 –rephrased and added limitations
Page 19 Page 18 line 1 – done
Page 19 Page 18 line 7 – done
 Page 18 line 9 – deleted reference and comment, not adding to discussion
 Page 18 line 12 –rephrased, deleted
 Page 18 line 13 – noted and see argument. Rather deleted not adding to the study and confounding since controlling temperatures is not practical in the field.
 - done
Page 20 line 9 Page 18 line 14 – rephrased
Page 20 line 10 Page 18 line 16 – rephrased
Page 20 line 11 Page 18 line 17 – not mention, rephrased
Page 20 line 11 Page 18 line 18 – deleted
Page 20 line 11 Page 18 line 19 – just added for interest, not enough for an entire paragraph
Page 20 Page 18 line 23 – rephrased
 - rephrased
 decided to keep as is with above changes made as discussed with supervisors
Page 20 Page 19 line 1 – reconstructed paragraph
Page 20 line 22 Page 19 line 4 - done
Page 20 line 21 Page 19 line 9 – done
Page 20 Page 19 line 10 – restructured paragraph with previous comment
Page 21 line 22 Page 19 line 12 – done
Page 21 line 19 Page 19 line 14 – done

Page 21 line 22 Page 19 line 16 – yes
Page 22 line 7 Page 19 line 18 - rephrased
Page 22 line 9 Page 19 line 21 – added
Page 22 line 12 Page 20 line 2 – rephrased
Page 22 line 19 Page 20 line 6 – noted, keep as is after discussion with supervisors
Page 23 line 10 Page 20 line 18 – rephrased
Page 23 line 9 Page 20 line 20 – added
Page 23 line 11 Page 21 line 1 – done
Page 23 line 15 Page 21 line 7 – done
Page 23 line 19 Page 21 line 10 – done
Page 22 line 2 – done in rectal temperature section
Page 24 line 16 Page 22 line 6 – done
Page 24 line 18,19 Page 22 line 8 – rephrase.
done
Page 24 line 22 Page 22 line 11 – done
Page 24 line 24 Page 22 line 14 – done
Page 25 line 8 Page 22 line 19 – done
Page 22 line 22 – noted, discussed in previous section
Page 25 line 11 Page 23 line 1 - done
Page 25 line 12 Page 23 line 3 – rephrase
Page 25 line 21 Page 23 line 1-3 – done, other variable did not change and they did not mention it again
Page 25 line 22 Page 23 line 6 – done
Page 25 line 17 Page 23 line 7 – done
Page 25 line 22 Page 23 line 9 – done, decided to keep separate after discussion with supervisors
Page 23 line 11 – rephrased and deleted,(not mentioned or used for my study)
Page 26 line 12 Page 23 line 17 – see section 1.2.2, done
Page 26 line 15 Page 23 line 20 – done
Page 26 line 16 Page 23 line 22 – done, rephrased but did not add extra detail after discussion with supervisors
Page 26 line 22 Page 24 line 1-3 – deleted
Page 27 line 2 Page 24 line 6 – done
Page 27 line 5,6 Page 24 line 8 – done
Page 27 line 6,7,9 Page 24 line 12 – done
Page 24 line 14 – done
Page 24 line 16 – deleted
Page 27 line 17 Page 24 line 21 – rephrased
Page 27 line 19 Page 24 line 22 – done
Page 27 line 21,page 28line4 Page 25 line 6 – done
Page 28 line 6 Page 25 line 9 – done
Page 28 line 4 Page 25 line 12 – done
Page 28 line 12 Page 25 line 14 – done
Page 28 line 13 Page 25 line 16 – done
Page 28 line 17 Page 25 line 19 – done
Page 28 line 21 Page 26 line 1 - done
Page 29 line 3 Page 26 line 5 – rephrased
Page 29 line 5,6 Page 26 line 6 – done, added
Page 29 line 10 Page 26 line 9 – rephrased
Page 29 line 12 Page 26 line 12 –rephrased
Page 29 line 17 Page 26 line 16 – done
Page 29 line 18 Page 26 line 17 – done

Page 29 line 19 Page 26 line 18 - done
Page 30 line 4 Page 27 line 4 – done
Page 30 line 7 Page 27 line 8 –rephrased
Page 30 line 10-21 Page 27 line 9-22 – done
Page 31 line 1 Page 28 line 1 - done
Page 31 line 4 Page 28 line 4 – done
Page 31 line 8 Page 28 line 8 – done
Page 31 line 9 Page 28 line 9 – done
Page 32 line 5,19 Page 29 line 4 – done
Page 32 line 19 Page 29 line 15-18 – done
Page 32 line 14 Page 29 line 20 - done
Page 32 line 21, page 33line1 Page 30 line 3 – done
Page 33 line 8 Page 30 line 10 – done
Page 33 line 9 Page 30 line 11-13 – done
Page 33 line 17 Page 30 line 19 – done
Page 33 line 18 Page 30 line 20 – done
Page 33 line 19 Page 30 line 21 – done
Page 33 line 18,20 Page 31 line 1 – done
Page 34 line 4 Page 31 line 4 – done
Page 31 line 5 – deleted
Page 34 line 13 Page 31 line 10 – done
Page 34 line 13 Page 31 line 11 – done
Page 34 line 16 Page 31 line 14 – done
Page 34 line 5 Page 31 - added
Page 34 line 19 Page 31 line 17 – done
Page 35 line 2 Page 31 – added another reference
Page 35 line 7 Page 32 line 4 – rephrased
Page 34 line 18,20, page 35line10 Page 32 line 8 – done, already mentioned previously
Page 35 line 18 Page 32 line 12 – done, extra detail not applicable to dissertation
Page 35 line 18 Page 32 line 13 – done
Page 32 line 14 – done
Page 32 line 15 – done
Page 36 line 8 Page 33 line 1 – done
Page 36 line 6 Page 33 line 2 – done
Page 36 line 12 Page 33 line 6 – done
Page 36 line 14 Page 33 line 9 – done
Page 36 line 18 Page 33 line 11 – not less handling. Still need to be restrained and tranquillized and are never blindfolded.
Page 36 line 19 Page 33 – done
Page 37 line 7 Page 33 line 15 – if handling tame, zoo or animals in a crate
Page 37 line 9 Page 33 line 18-19 – changed
Page 37 line 12 Page 33 line 20 – done
Page 37 line 14 Page 34 line 1 – done
Page 37 line 16 Page 34 line 3 – done
Page 37 line 20 Page 34 line 7 – done
Page 38 line 1 Page 34 line 9 – done, not necessarily
Page 34 line 10 – deleted
Page 38 line 5 Page 34 line 14 – done
Page 38 line 8 Page 34 line 18 – done
Page 38 line 10 Page 34 - done
Page 38 line 15 Page 34 line 21 – done

Page 38 Page 35 line 1-6 – done
Page 38 Page 35 line 4 – done
Page 38 line 20 Page 35 line 6 – done
Page 38 line 15 Page 35 line 8 – done
Page 38 line 22,23 Page 35 line 11 – done
Page 38 line 23 Page 35 line 19 – worked on paragraph
Page 39 line 12 Page 35 line 21 – done
Page 39 line 21 Page 36 line 8 – done
Page 39 Page 36 line 10 – done
Page 40 line 5 Page 36 line 16 – done
Page 40 line 17 Page 37 line 7 – rephrased
 Page 37 line 16 – deleted
Page 41 line 6 Page 37 line 17 – done
Page 41 line 9 Page 37 line 19 – done
Page 41 line 10 Page 37 line 20 - done
Page 41,42,43 Page 38 – done
Page 42 line 5 Page 38 line 13 – done
Page 42 line 15 Page 38 line 20 – done
Page 42 line 21 Page 39 line 5 – done
Page 43 line 7 Page 39 line 14 – done
Page 43 line 8 Page 39 line 15 - done

Methods:

Page 45 line 6 Page 41 line 2 – did not add extra detail after discussion with supervisors
Page 45 line 7 Page 41 line 4 - done
 Page 41 line 5-15 – did not add extra detail after discussion with supervisors
Page 45 line 16 Page 41 – did not add extra detail after discussion with supervisors
Page 45 line 3, 11 Page 42 – done
Page 46 line 4 Page 42 line 2 – changed
Page 46 line 13 Page 42 line 5 – done
Page 46 line 14 Page 42 line 6 – done
Page 46 line 16 Page 42 line 8 – done
Page 46 line 18 Page 42 line 10 – done
Page 46 line 20 Page 42 line 11 – done
Page 46 line 20 Page 42 line 12 – done
Page 46 line 21 Page 42 line 13 – done
Page 47 line 2 Page 42 line 15 – done
Page 47 line 6 Page 42 line 19 – done
Page 47 line 8 Page 42 line 21 – done
Page 48Page 43 – done
Page 47 line 10 Page 44 line 1 – done
Page 47 line 18 Page 44 line 9 – done
Page 47 line 20 Page 44 line 18 – did not add extra detail after discussion with supervisors, details in chapter 4
Page 49 line 10 Page 44 line 21 – done, details detail in chapter 4
Page 50Page 45 – done
Page 50 line 11Page 46 line 1 – detail in chapter 4
Page 51 line 8 Page 46 line 6 – detail in chapter 4
Page 51 line 8 Page 46 line 7 – done
 Page 46 line 10 – combine, delete
Page 51 line 13 Page 46 line 12 – detail in chapter 4

Page 51 line 20 Page 47 line 1 – done
Page 52 line 4 Page 47 line 6 – combine, delete
 Page 47 – inserted in main methods
Page 52 line 13 Page 47 line 12 – done
Page 52 line 16 Page 47 line 14 - done
Page 54 line 1 Page 47 line 20 – done
Page 53 Page 48 – done
Page 55 Page 49 – done
Page 54 line 13 Page 50 – done
Page 54 line 17 Page 50 line 15 – done
 Page 51 line 8 – details in main methods
Page 56 line 11,12 Page 51 line 10 – done
Page 56 line 13,14 Page 51 line 13 – yes, completed bloods and other procedures
Page 56 line 15 Page 51 – done
Page 56 line 21 Page 51 line 19 – done
Page 57,58 Page 52 – done and changed according to discussion with supervisors
Page 57,58 Page 53 line 3 – done
Page 57,58 Page 53 line 18 – done
Page 57,58 Page 53 – done
 Page 54 line 2 – done
Page 59 line 4 Page 54 line 4 – done
 Page 54 – noted, can either cause increased stress due to human presence and thus increased stress or reduce stress momentarily while at rest
Page 61,62 Page 55 – done
Page 63 line 5,7 Page 56 line 5-7 – done
Page 63 line 12 Page 56 line 11 – done
Page 63 line 16 Page 56 line 15 – done
Page 64 line 4 Page 57 line 2 – done
 Page 57 line 18 – details in each chapter
Page 163 line 7-8 Page 57 line 21 – done
Page 11 line 5 Page 58 line 1 – done
 Page 58 – deleted
 Page 58 line 6 – done
 Page 58 line 11 – done
Page 65 line 6 Page 58 line 15 – done
Page 65 line 7 Page 58 line 16 – done
Page 65 line 7 Page 58 line 15-17 – deleted

Results chapter 3:

Page 67 line 1 Page 60 line 1 – done
Page 67 line 7,9 Page 60 line 6 – done
Page 67 line 15 Page 60 line 14 – done
Page 67 line 19 Page 60 line 15 – done
Page 67 line 22 Page 60 line 18 – done
Page 68 line 10 Page 61 line 6 – done
Page 68 line 11 Page 61 line 7 – done
Page 68 line 11 Page 61 line 8 - done
Page 68 line 13 Page 61 line 9 – done
 Page 61 line 11-13 – done
 Page 61 line 15 - done
 Page 61 line 21 – done

Page 69 line 8 Page 62 line 6 – done
Page 62 – started with original group size, include table in main methods
Page 70 Page 63 – yes, kept as is after discussion with supervisors
Page 71 line 3 Page 64 line 1 – done
Page 71 line 3 Page 64 – did not add extra detail after discussion with supervisors
Page 71 line 21 Page 64 line 17 – done
Page 72 Page 65 – done
Page 72 line 7 Page 66 line 7 – done
Page 73 line 18 Page 66 line 10 – both
Page 73 line 19-21, page 74 line 1 Page 66 line 11 – compared short chase + dart versus short chase + net but had more individuals during the dart trial than during the net trial due to mortalities.
Maximum abdominal temperature reached for each individual and then meaned the maximum temperatures of the animals in the same trial (short chase + dart versus short chase + net), similarly for mean temperature change and mean rate of rise
Page 66 line 13 – did not add extra detail after discussion with supervisors
Page 74 line 4 Page 66 line 16 – done
Page 74 line 11 Page 66 – allowed a greater sample size than the long chase dart. I did compare the variations in the capture techniques ie. long vs short chase but too little sample size for long chase
Page 74 line 14 Page 66 line 18 – Mentioned above. Used Repeated Measures of Annova to compare abdominal body temperatures reached at time 0 and time 10 between short chase + dart, long chase + dart, short chase + net and long chase + net. Noted but after discussion with supervisors decided on using only short chase data due to the results of the Repeated Measures of Annova as well as the lack of data for long chase + net trials.
Page 67 line 1 – noted, did not add extra detail after discussion with supervisors
Page 74 line 17-22, page 75 line 1-4 Page 67 line 2-5 – done
Page 74 line 121 Page 67 line 4-5 – done
Page 75 line 11 Page 67 line 11 – done
Table 3.2.4 Page 67 line 18 – added table with results in results section
Page 75 line 17 Page 67 line 20 – rephrased
Page 68 line 2 – added table with results in results section
Page 68 line 3 – Noted but after discussion with supervisors decided on multiple t-tests
Page 68 line 3 – log transformed, then paired t-test according to supervisor instruction
Page 75 line 20 Page 68 line 14 – blood variables for short chase + dart were correlated with the TRIs of the short chase + dart
Page 77 line 12 Page 69 line 11 – done
Page 77 line 21 Page 69 line 19 – done
Page 77 line 22 Page 69 line 20 – done
Page 78 Page 70 – added, averaged over 5 days, changed to abdominal body temperature
Page 79 Page 71 – explained in chapter 3 that abdominal body temperature will be used as the base temperature, deleted
Page 80 line 1 Page 72 – table in methods, done
Chapter 2 Page 73 line 5&6 – changed in methods
Page 73 line 11 – noted, did not add extra detail after discussion with supervisors
Page 80 line 16 Page 73 line 13 – done
Page 81 line 1 Page 73 line 19 – done
Page 81 line 4 Page 73 line 20 – changed, added
Page 80 line 4,5,7 Page 74 line 1-3 – explained previously
Page 74 line 10-11 Page 74 line 3-4 – done
Page 74 line 10-11 Page 74 line 4 – done

Page 74 line 5 – in table

Page 74 line 9 – noted, did not change after discussion with supervisors

Page 74 line 10 – noted, did not change after discussion with supervisors since it was mentioned that abdominal body temperature are used as the base temperature for body temperature measurement

Page 82 line 11,13 Page 74 line 11 – noted, did not change after discussion with supervisors. In table it is 30 minutes and in figure shown an example of 60 minutes

Page 74 line 14 – noted, did not change after discussion with supervisors

Page 86 line 3,5 Page 74 line 18 – speculative according to what is observed in figure

Page 86 line 3,5 Page 74 line 19 – speculative according to what is observed in figure

Page 74 line 20 – deleted, figure are only illustrative of nature and therefore must be considered as such during interpretation

Page 86 line 4,8 Page 74 line 22 – rephrased. The figure are only illustrative, to show different abdominal body temperature patterns, and must be interpreted keeping that in mind.

Page 83 Page 75 – done

- noted, did not change since this is the name of the analysis
- Explained in data analysis
- done
- done, changed
- changed
- I could obtain a larger data set from the short chase data

Page 84 Page 76 – done

- done
- noted, did not change after discussion with supervisors
- illustrative purposes, noted, did not change after discussion with supervisors
- done

Page 85 Page 77 – noted, did not change after discussion with supervisors, added

explained body temperature referred to as abdominal temperature as base temperature was standardized, arrive at boma 60 minutes prior to capture, working in an around the

boma

at 30 minutes prior to capture

Page 86 line 7,8 Page 78 line 1 – speculative according to figure

Page 86 line 8 Page 78 line 2 – done

Page 86 line 20 Page 78 line 4 – rephrased, only example of blesbok response overall

Page 86 line 16 Page 78 line 5-8 – done

noted, decided not to change after discussion with supervisors

Rephrased results and discussion so that it points out that positive TRI simply show that body temperature was higher the hour before capture than an hour and a half before capture, which might be due to human presence but this remains speculative since larger data sets is necessary and must be done in conjunction with behavioral observations to make definite conclusions

Page 78 line 9 – see rephrased in previous comment

Page 78 line 10-13 – deleted. Only show different TRI temperatures for each trial with no statistical support and therefore it is only speculative until further investigation

Page 78 line 18 – deleted

Page 78 line 18-21 – deleted

Page 87, page 86 line 20 Page 79 – see rephrased in previous comment. Only show different TRI temperatures for each trial with no statistical support and therefore it is only speculative until further investigation

Nets were erected after the darting trials but before the net capture trials.

Noted, decided to keep as is. . Only show different TRI temperatures for each trial with no statistical support and therefore it is only speculative until further investigation

Page 88 Page 80 – corrected

- done
- Decided to keep as is, after discussion with supervisors
- done

Page 89 line 12 Page 81 line 1-8 – data in table, decided to keep as is, after discussion with supervisors

Page 81 line 4- delete

Page 81 line 15 – delete

Page 92 line 1Page 81 line 17 – done

Page 92 line 6 Page 81 line 17-22 – speculative, not used as a basis. Just for comparison since no baseline data are available for blesbok

- only available

Page 82 – added table in results section of repeated measures of annova

- impala (n = 5) and blesbok (n = 3)
- Noted but kept as is after discussion with supervisors
- The exclusion of data is limited since sample sizes were so small but the extreme outliers were excluded

Page 92 line 10 Page 83 line 2 – done

Page 92 line 14 Page 83 line 4 – Each correlation has four points per animal, to show differences between trials. When interpreting figure, this must be kept in mind and therefore no statistical assumptions must be made from the figure but rather seen as descriptive statistics.

Page 92 Page 84 – Each correlation has four points per animal, to show differences between trials. When interpreting figure, this must be kept in mind and therefore no statistical assumptions must be made from the figure but rather seen as descriptive statistics.

Page 94 Page 85 – noted, did not change after discussion with supervisors

Page 95,96 line3 Page 86 – done

- Each correlation has four points per animal, to show differences between trials. When interpreting figure, this must be kept in mind and therefore no statistical assumptions must be made from the figure but rather seen as descriptive statistics.

Page 96 line 14 Page 87 – added table in results section. When interpreting the results of the table, it must be kept in mind that the two trial variations for each capture method were grouped.

done

- Noted, but decided to keep as is after discussion with supervisors

Page 96 line 13 Page 88 – added

Page 98 line 2 Page 89 line 2 – done

Page 98 line 2 Page 89 line 3 – done

Page 98 line 12,13 Page 89 line 12 – done

Page 98 line 12,13 Page 89 line 13 – done

Page 98 line 15 Page 89 line 14 – done

Page 98 line 17 Page 89 line 16 – done

Page 98 line 21,23 Page 89 line 18 – done

Page 98 line 23 Page 89 line 20 – done

Page 99 line 1 Page 89 line 22 – done

Page 89 line 23 – deleted

Page 89 line 24 – rephrased, deleted

Page 99 line 3,4 Page 90 line 2 – rephrased

Page 99 line 5 Page 90 line 4 – done
Page 99 line 6 Page 90 line 5 – done
Page 99 line 14 Page 90 line 10 – done
Page 99 line 21 Page 90 line 14 – cameras on bomas, added
Page 99 line 21 Page 90 line 15-17 – rephrased
 Page 90 line 19 – deleted
 Page 91 line 2-4 – deleted
Page 100 line 15 Page 91 line 14-16 – changed
Page 100 line 19 Page 91 line 17 – changed
Page 100 line 25 Page 91 line 22 - done
Page 100 line 25 Page 91 line 23 – they did, not as total catecholamines but as adrenaline and noradrenaline
Page 100 line 25 Page 91 line 23-24 – noted but not deleted according to supervisor discussion
Page 101 line 5 Page 92 line 2-3 – done
Page 101 line 7 Page 92 line 4 – done
 Page 92 line 5-6 – delete
Page 101 line 22 Page 92 line 22 – rephrased, added
Page 102 line 9 Page 93 line 4 – done
 Page 93 line 17-18 – deleted
Page 102 line 24 Page 93 line 21-24 – done
 Page 94 line 1-2 – included
 Page 94 line 9-11 – deleted
 Page 94 line 22 – deleted
Page 104 line 4 Page 95 line 1 – done
 Page 95 line 2 – deleted
 Page 95 line 15 – added
Page 104 line 20 Page 95 line 15-16 – done
Page 104 line 21 Page 95 line 17 - done
Page 105 line 1 Page 95 line 21 – done
Page 105 line 4 Page 95 line 24 - done
Page 105 line 12 Page 96 line 6 – done
Page 105 line 19 Page 96 line 11 - done
 Page 96 line 12 – done, did not measure all the same variables
Page 105 line 19 Page 96 line 15 - done
Page 105 line 2 Page 96 line 23 – remote measurements taken after recumbency not by a remote
Page 105 line 5 Page 96 line 24 – done
Page 105 line 12 Page 97 line 1-2 – done
Page 105 line 20 Page 97 line 4-5 – done
Page 105 line 12 Page 97 line 7 – refer to methods
Page 105 line 15 Page 97 line 9 – done
Page 105 line 20 Page 97 line 9-12 – moved
Page 105 line 17 Page 97 line 12 – Nwe
 - done
Page 108 line 19 Page 97 line 23 – done
Page 108 line 19 Page 98 line 8 – done
 Page 98 line 8-9 – changed
Page 107 line 11 Page 98 line 10 – changed structure and moved
 Page 98 line 13 - Nwe
Page 107 line 20 Page 98 line 16 - done
Page 107 line 22 Page 98 line 17 – changed sentence to explain better
 Page 98 line 23 - Nwe

Page 99 line 1 - Nwe
Page 108 line 8 Page 99 line 2-3 – done
Page 108 line 9 Page 99 line 4 – yes, not significant different
Page 108 line 14 Page 99 line 7-8 – done
Page 108 line 11 Page 99 line 8-10 – added
Page 109 line 12 Page 99 line 20 – changed
Page 109 line 17 Page 100 line 1 – done
Page 109 line 18 Page 100 line 2 – done
 Page 100 line 10-13 – deleted, new paragraph
 Page 100 line 13 – deleted
Page 110 line 7 Page 100 line 16 – done
Page 110 line 10 Page 100 line 18 – done
Page 110 line 14 Page 100 line 22-23 – done
 Page 100 line 23-25 – deleted, done
Page 110 line 19 Page 101 line 2 – changed, added
Page 110 line 21 Page 101 line 5 – done
Page 110 line 23 Page 101 line 6-7 – rephrased
Page 111 line 4 Page 101 line 10 – done
Page 111 line 9 Page 101 line 15 – done
Page 111 line 9 Page 101 line 16 – done
Page 111 line 14 Page 101 line 18-19 – rephrased
Page 111 line 18 Page 101 line 23 – done
Page 111 line 18 Page 102 line 2 – just speculative comparison since no control data available for
 blesbok, not deducting any major conclusions based on the data
Page 112 line 4 Page 102 line 5 – done
Page 112 line 4-5 Page 102 line 6-8 – changed
Page 112 Page 102 line 8-10 – yes
 Page 102 line 13-15 – rephrased
Page 112 line 17 Page 102 line 15-18 –rephrased
Page 112 line 21 Page 102 line 20 - done
Page 112 Page 103 – note, decided to keep as is after discussion with supervisors
Page 112 line 1 Page 104 line 1-11 – note, decided to keep as is after discussion with supervisors
Page 112 line 7 Page 104 line 4 - Nwe
Page 112 line 4 Page 104 line 7 - Nwe
Page 112 line 5 Page 104 line 8-11 – note, decided to keep as is after discussion with supervisors
Page 112 line 10 Page 104 line 11 - Nwe
Page 114 line 18 Page 104 line 15 - note, decided to keep as is after discussion with supervisors
Page 114 line 22 Page 104 line 21 – rephrased
Page 114 line 19 Page 105 line 1-4 – changed
Page 115 line 2 Page 105 line 6 - done
Page 115 line 3 Page 105 line 7 – done
Page 115 line 4 Page 105 line 8 – done
Page 115 line 16 Page 105 line 19 – done
Page 116 line 2 Page 106 line 5-6 – done

Results chapter 4:

Page 118 line 7 Page 108 line 5 – done
Page 118 line 7 Page 108 line 8 – done
Page 118 line 10 Page 108 line 10 – done
Page 118 line 13 Page 108 line 12 – added

Page 118 line 13 Page 108 line 13 – rephrased
 Page 108 line 14 – done
Page 118 line 15-25 Page 108 line 14-17 – done
Page 118 line 15-25 Page 108 line 14-25 – changed
Page 118 line 15-25 Page 108 line 18 – done
Page 118 line 15-25 Page 108 line 22 – rephrased
Page 118 line 23 Page 108 line 23 – done
Page 118 line 23 Page 108 line 24 – rephrased
 Page 108 – done
Page 118 line 24 Page 109 line 1 – done, rephrased
Page 118 line 25 Page 109 line 1-2 - rephrased
Page 120 line 2 Page 109 line 5 – changed
Page 121 line 2 Page 109 line 9-11 – not just magnitude, also not quick enough response and variability with placement
Page 120 line 11 Page 109 line 12 – done
Page 120 line 12 Page 109 line 14 – changed
 Page 109 line 9-24 – note, decided to keep as is after discussion with supervisors
Page 118 line 25,119 Page 110 – done
Page 119 line 1 Page 111 line 1 – yes but added influence of the presence of faeces
 Page 111 line 2 – done
Page 121 line 12 Page 111 line 8 – done
Page 121 line 14 Page 111 line 16 – done
Page 121 line 14 Page 111 – done
Page 122 line 8 Page 112 line 2 – did not additive effect, just activity. Leith showed that activity was not the cause but just additive
Page 122 line 23 Page 112 line 16 – done
Page 123 line 2-6 Page 112 line 18 – done
 Page 112 – note, decided to keep as is after discussion with supervisors
Page 124 Page 113 – note, decided to keep as is after discussion with supervisors
Page 123 line 9 Page 114 line 2 – logger description, methods section
Page 123 line 15 Page 114 line 7 – changed
Page 125 line 1 Page 114 line 9 – changed
 Page 114 – note, decided to keep in methods section after discussion with supervisors
Page 125 line 11 Page 114 line 18 – done
Page 125 line 14 Page 114 line 21 – changed
Page 128 line 1 Page 116 line 5-8 - added
Page 128 line 8 Page 116 line 12 – rephrased
Page 128 line 9 Page 116 line 13 – done
Page 128 line 11 Page 116 – done
Page 129 line 2 Page 118 line 3-8 – done, yes
Page 129 line 5 Page 118 line 8 – note, keep as is after discussion with supervisors
Page 129 line 13,17 Page 118 line 14 – capture procedure
 Page 118 line 14&18 – note, keep as is after discussion with supervisors. Most data only for darting due to logger failure
 Page 118 line 13-22 – decided to include normal day data for baseline purposes
Page 130 line 5 Page 119 line 2-6 – only activity data for 3 animals of each species
 - each animal over 5 consecutive days, then mean
Page 130 line 6 Page 119 line 6-9 –rephrase.
Page 130 line 11,12 Page 119 line 9-13 –3 blesbok (and similarly for impala) chased for the same time and using same procedure since only the short chase + dart trial were used
 - rephrased

Page 130 line 21 Page 119 line 18 - short chase

Page 130 line 20 Page 119 line 21 – Bland-Altman, used standard data for all trails, so only used 5 animals since that is the n at the end of all 4 trials

Page 130 line 23 Page 119 line 1 – Bland-Altman, used standard data for all trails, so only used 5 animals since that is the n at the end of all 4 trials

Page 131 line 3 Page 120 line 5 – done

Page 131 line 8 Page 120 line 9 – done

Page 120 line 10-11 – changed

Page 131 line 13 Page 120 line 14-16 – done

Page 120 – note, decided to keep as is after discussion with supervisors

Page 132 Page 121 – done

Page 133 Page 122 – done

Page 123 line 1-4 – noted

Page 134 line 5 Page 123 line 5-6 – changed

Page 134 line 9 Page 123 line 9 – done

Page 134 line 10 Page 123 line 10 –6 and 7 since I had the data for these animals before the trials started

Page 123 line 16-19 – note, decided to keep as is after discussion with supervisors

Page 134 line 21 Page 123 line 19 – done

Page 134 line 21 Page 123 line 19-23 - done

Page 138 line 1 Page 123 line 21 – done

Page 135 Page 124 - done

Page 136 Page 125 – note, decided to keep as is after discussion with supervisors

- changed

Page 137 Page 126 – too many data points for adding SD, discussed with supervisors

Page 138 Page 127 –too many data points for adding SD, discussed with supervisors

- checked accuracy
- maximum activity recorded by each logger, then calculated the each measurement as a percentage of that maximum. Done for each logger individually, as described in methods section
- done

Page 134 line 21 Page 128 – not run with short dart, do not have data for all the individuals for long chase trials

- noted, decided to keep as is after discussion with supervisors

Page 139 line 9 Page 129 line 6 – done

Page 141 Page 130 – done

- Note, decided not to after discussion with supervisors
- short chase

Page 142 Page 131 line 3 – rephrased

Page 131 line 2-8 – deleted

Page 142 line 7,8 Page 131 line 15 – done

Page 142 line 9,12 Page 131 line 16 – done

Page 142 line 10 Page 131 line 17 – done

Page 131 line 18 – deleted

Page 142 line 15 Page 131 line 22 – done

Page 142 line 16 Page 131 line 23 – done

Page 142 line 21 Page 132 line 6 – yes, muscle temperature increase enough during stress but just keep in mind that the rise would be less in the early morning since muscle temperature is below abdominal temperature

Page 142 line 23 Page 132 line 6-7 – done

Page 143 line 2 Page 132 line 11 – changed

Page 143 line 12 Page 132 line 19 – done
Page 143 line 15 Page 132 line 21 - done
 Page 132 line 21-22 – short dart, deleted
Page 143 line 15 Page 132 line 23 – done
Page 143 line 20 Page 133 line 1 – because at high body temperatures (hyperthermia during capture), the two measurements are close
Page 144 line 7 Page 133 line 12 – just for the study purposes
 Page 133 line 16 – yes this is active muscles. Further investigation into muscle temperature in different muscle groups is necessary
Page 144 line 17 Page 133 line 21 – rephrased
 Page 134 line 1 – added
 Page 134 line 3 – deleted
Page 145 line 4 Page 134 line 7 – done
Page 145 line 7 Page 134 line 8 – added
 Page 134 line 9 – done
Page 145 line 6 Page 134 line 14 – done
Page 145 line 1-10 Page 134 line 6-20 – changed
Page 145 line 22 Page 135 line 6 – done
Page 145 line 24 Page 135 line 8 – done
Page 146 line 10 Page 135 line 18-19 – not for my study, as showed by Dr. Leith Meyer
Page 147 line 7-9 Page 136 line 16 – additive effect as showed by Dr. Leith Meyer, not part of my study
Page 147 line 12 Page 136 line 18 – done
Page 148 line 1 Page 137 line 8-10 – done, added

Results chapter 5:

Page 150 line 9 Page 139 line 9 – done
Page 150 line 10 Page 139 line 10 - done
Page 150 line 14 Page 139 line 14 – done
 Page 139 line 16 – deleted
 Page 139 line 19 – deleted
Page 150 line 20 Page 139 line 20 – rephrased
Page 150 line 23 Page 139 line 22 – done
Page 151 line 8 Page 140 line 8 – done
 Page 140 line 15 – deleted
 Page 140 line 21 – done
 Page 141 line 1 – deleted, decided to leave as is after discussion with supervisors
 Page 141 line 16-19 – deleted
Page 153 line 9 Page 142 line 18 – added to be thorough
Page 153 line 11 Page 142 line 20 – done
 Page 143 line 1-3 – deleted
Page 153 line 19-20 Page 143 line 8-11 – done
Page 154 line 7 Page 143 line 15 – I only had 2 samples for some of the results and therefore were forced to use the test
Page 154 line 4 Page 143 – for some of the animals that died, I only had one blood sample, therefore I used time 0 blood samples for the surviving individuals and the one blood sample for each of the individuals that died.
Page 154 line 14 Page 144 line 5 – time of dart
Page 154 line 18 Page 144 line 8 – done
Page 156 line 2 Page 144 line 13-15 – done

Page 156 line 8 Page 144 line 23 – blood samples were post death but abdominal temperatures were stopped at death

Page 155 Page 145 – changed, added

Page 157 Page 146 –SD

- done

- up to death

Page 147 line 4-6 – deleted

Page 153 line 20 Page 146 line 7-16 – done

Page 147 line 17 – done

Page 157 line 2 Page 147 line 18 – before animals died

Page 153 line 22, page 154 line 2 Page 147 line 20 - done

Page 158 Page 148 – rephrased

Page 160 Page 149 – rephrased

Page 159 line 9 Page 150 – changed

Page 159 line 12 Page 150 line 2 – temperature at time of death

Page 150 line 10 – noted, decided to keep as is after discussion with supervisors

Page 159 line 21 Page 150 line 10-20 –noted, decided to keep as is after discussion with supervisors.

adjusted

done

Page 150 line 20-21 – could not rerun the assay

Page 163 line 9 Page 150 line 21-23 – thoroughness

Page 161 Page 151 – I already admitted to the problems surrounding the sampling and that I have included the post death samples even though we are aware that change occur after death. I also stated that any deductions made are therefore subject to the fact that the post death sampling exerted an influence on the result

Page 162 Page 152 - I already admitted to the problems surrounding the sampling and that I have included the post death samples even though we are aware that change occur after death. I also stated that any deductions made are therefore subject to the fact that the post death sampling exerted an influence on the result

- done

Page 163 line 14,17 Page 153 line 2 & 5 – done

Page 163 line 19 Page 153 – done

Page 164 line 7 Page 154 line 6 – rephrased

Page 164 line 13 Page 154 line 11 – no

Page 164 line 15 Page 154 line 13 changed

Page 164 line 13 Page 154 line 14 –added,

- noted but just threshold temperature, decided to keep as is after discussion with supervisors

Page 164 Page 154 line 15-20 – noted, decided to keep as is after discussion with supervisors

- done

Page 164 Page 154 line 21-24 – noted but just threshold temperature, decided to keep as is after discussion with supervisors

Page 165 line 20 Page 155 line 5-8 - noted but just threshold temperature, decided to keep as is after discussion with supervisors

Page 165 line 20 Page 155 line 16 – done

Page 165 line 19 Page 155 line 17 – done

Page 155 line 23 – it is possible

Page 166 line 8 Page 156 line 2 – done

Page 166 line 10 Page 156 line 5 – done

Page 156 line 7-10 – deleted

Page 166 Page 156 line 13-14 – include for thoroughness

Page 166 line 14 Page 156 line 16 – deleted

Page 166 line 18 Page 156 line 19-23 – I already admitted to the problems surrounding the sampling and that I have included the post death samples even though we are aware that change occur after death. I also stated that any deductions made are therefore subject to the fact that the post death sampling exerted an influence on the result

Page 166 line 23 Page 157 line 1 -changed

- some animals more sensitive or prone to a high rise in temperature
- rephrased

Page 167 line 3 Page 157 line 5-7 – added

Page 167 line 13 Page 157 line 13 - done

Page 167 line 14 Page 157 line 14-16 – just mention it to say that it was relative constant with no extreme changes

Page 167 line 18 Page 157 line 19-21 – rephrased

Page 167 line 23 Page 158 line 1-3 – added

Page 168 line 4 Page 158 line 3 – done

Page 168 line 11 Page 158 line 7 – done

Page 168 line 14 Page 158 line 10 - done

Page 168 line 15 Page 158 line 11 – waited longer before exposure to experimental trials

Page 168 line 19 Page 158 line 12-14 – added

Page 169 line 8 Page 158 line 20-24 – I already admitted to the problems surrounding the sampling and that I have included the post death samples even though we are aware that change occur after death. I also stated that any deductions made are therefore subject to the fact that the post death sampling exerted an influence on the result. Decided not to reanalyze after discussion with supervisors

Page 159 line 1 - Nwe

Page 170 line 3 Page 159 line 10-16 – I already admitted to the problems surrounding the sampling and that I have included the post death samples even though we are aware that change occur after death. I also stated that any deductions made are therefore subject to the fact that the post death sampling exerted an influence on the result. Decided not to reanalyze after discussion with supervisors

Page 170 line 10 Page 159 line 23-25 – changed, rephrased

Page 160 line 1 – deleted

Page 170 line 13 Page 160 line 1-3 – rephrased

Page 170 line 15 Page 160 line 3 - done

Page 170 line 18,19,21 Page 160 line 5-7 – rephrased

- done

Page 171 line 4 Page 10 line 12 – changed

Page 171 line 9,10 Page 10 line 15-17 – I already admitted to the problems surrounding the sampling and that I have included the post death samples even though we are aware that change occur after death. I also stated that any deductions made are therefore subject to the fact that the post death sampling exerted an influence on the result. Decided not to reanalyze after discussion with supervisors

Page 10 line 18-20 – deleted

Page 10 line 21-23 – moved

Page 161 line 1-10 - deleted

Page 172 line 1 Page 161 line 12-13 – done

Page 161line 13 - Nwe

Page 161 line 14 – deleted

Page 172 line 15 Page 162 line 1 – just speculative, added “according to references”

Page 172 line 15,16 Page 162 line 2 – done

Page 172 line 17 Page 162 line 3 – changed

Page 172 line 21 Page 162 line 7 - done

- Nwe

Page 162 line 8 – done

Page 172 line 23 Page 162 line 10 – done

Page 172 Page 162 – done

Conclusion:

Page 175 line 8 Page 164 line 8 – done

Page 175 line 18 Page 164 line 18 - done

Page 176 line 15 Page 165 line 15 – done

Page 176 line 17 Page 165 line 16 - done

Page 176 line 18 Page 165 line 17 – done

Page 176 line 19 Page 165 line 18 - done

Page 176 line 25 Page 165 line 23 – restrained animals for only 20 minutes

Page 177 line 4 Page 166 line 3- done

Page 177 line 11 Page 166 line 11 – rephrased

Page 177 line 13 Page 166 line 12 – rephrased

Page 177 line 17 Page 166 line 15-17 – changed

Page 177 line 21 Page 166 line 19-23 – rephrased and explained

Page 178 line 1 Page 166 line 23 – done

Page 178 line 3 Page 166 line 25 – rephrased, decided not to do additional analysis after discussion with supervisors

Page 177 line 24 Page 167 line 1 – looked at activity at a short chase and then dart

Page 178 line 4 Page 167 line 1-3 done

Page 178 line 11 Page 167 line 7 – done

Page 178 line 13 Page 167 line 10-11 – done

Page 178 line 16 Page 167 line 13-17 – done

Page 178 line 21 Page 167 line 19 – done

Page 178 line 23 Page 167 line 21 – done

Page 179 line 2 Page 167 line 24 – added but entire discussion on its own. Not relevant for my study, after discussion with supervisors.

Page 179 line 6 Page 168 line 1 – done

Page 179 line 8 Page 168 line 4 – rephrased

Page 178 line 4 Page 168 line 6-8 – done

Page 179 line 9 Page 168 line 10-16 – done

Page 179 line 9 Page 168 line 10 – done

Page 179 line 12 Page 168 line 12 - done

Page 179 line 14 Page 168 line 13 – rephrased. Treatment with Selenium has showed some positive effect. Feeding Diazepam in mealtime prior to capture.

Page 179 line 18 Page 168 line 18 – done

Page 179 line 18 Page 168 line 20 – see above

Page 170 – ethics number is appropriate as decided after discussion with supervisors

Page 171-172 done, did not add doxapram, since it was only administered in an emergency situation

Page 173-191 – All errors in reference list has been fixed