A spatio-temporal analysis of important hunting species' trophy size in north-eastern Namibia

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Declaration

I, Matthew Healey Walters, hereby declare that the work contained in the thesis entitled: *A spatio-temporal analysis of important hunting species' trophy size in north-eastern Namibia* is my own original work and that I have not previously in its entirety or in part submitted it at any university or higher education institution for the award of a degree.

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List of acronyms

CBNRM – Community-Based Natural Resource Management

CITES – Convention on International Trade in Endangered Species

IUCN – International Union for the Conservation of Nature

KAZA TFCA– Kavango Zambezi Transfrontier Conservation Area

MEFT – Ministry of Environment, Forestry and Tourism

NACSO – Namibian Association of CBNRM Support Organisations

NAPHA – Namibian Professional Hunter's Association

NGO – Non-governmental Organisation

SCI – Safari Club International

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Abstract

Within the last twenty years, Namibia has become a leading model of biodiversity conservation, largely due to its Community-Based Natural Resource Management (CBNRM) model and its allocation of large areas of land towards biodiversity conservation. The CBNRM model is largely based on the rights of communal conservancies to benefit from the wildlife that is present on their land; one such right is to receive meat and revenue from trophy hunting. However, the marketability of desirable trophy animals is dependent on the consistent presence of larger trophy individuals within wildlife populations. The global trophy hunting industry is highly competitive, with larger trophies in each species being sought by premium paying hunters. Over-hunting in specific populations, however, may lead to an unsustainable trophy operation. A negative trophy measurement trend over time may be indicative of overhunting since the preferred trophy genetic trait is selectively removed from the gene-pool by hunters. Three commonly hunted trophy species of Namibia's north-eastern landscape, namely, buffalo (*Syncerus caffer*), roan (*Hippotragus equinus*), and sable (*Hippotragus niger*), along with the common nationally hunted species, kudu (*Tragelaphus strepsiceros*), were selected in this study to determine the effects of hunting upon the trophy measurements between 2011 and 2015. The buffalo and roan measurements showed signs of non-significant positive growth trends. The sable trophy measurements show a non-significant negative growth trend, and the kudu trophy measurements showed a significant negative growth trend across Namibia over the 5 years. Though the study provided some insight into the trophy measurement trends for each land-use type (communal conservancies, national parks, and private farms), the distribution of the animals hunted, and the numbers of animals hunted, there are still many variables that could be factored into determining the influence on trophy measurement trends (e.g. game count numbers, rainfall, drought, migration, hunter's experience, trophy market, predation, fire patterns, rabies, etc.). Namibia can still prove its sustainability if it also makes age-related scoring as a methodology for trophy scoring, and the creation and management of a web-based database to capture the essential details of hunted animals could assist with eliminating data entry errors and with the standardizing of a Namibian approach to redefining trophy quality.

Keywords: trophy, hunting, buffalo, roan, sable, kudu, trophy size

Chapter 1: Introduction and literature study

1.1 Hunting as sustainable land use and conservation benefit

1.1.1 Globally

Hunting has been recognized as a useful tool across the globe in terms of its economics, its ecological influences, and its sociological benefits (Gallo and Pejchar, 2016). Trophy hunting is a viable economic activity that adds value to the presence of the wildlife; a fact made clear by trophy hunting that draws more income per client than normal tourism (Lindsey et al., 2007b; Munn et al., 2010; PACEC, 2006). The reinvestment into wildlife protection and the contribution towards anti-poaching efforts from hunters themselves has contributed towards species conservation in a bulk of the countries where sport hunting is practiced (Lindsey et al., 2007b).

Sociologically, hunting can create an enabling environment for hunters from diverse backgrounds. Hunting has played a role in enabling women empowerment since it is a popular pastime in North America and Europe (Heberlein et al., 2008). Also, hunting is embedded as a tradition in many cultures, so a continuation of these hunting practices does have a significant impact on the livelihoods of those practicing it (Arnett and Southwick, 2015).

Besides the reinvestment of funding into conservation through hunting (either from taxes or from direct contributions) (Arnett and Southwick, 2015), there are also the added ecological contributions that hunting can make. Hunting can have a lesser impact on the environment, when compared to other development opportunities, in terms of disturbance, fossil fuel use, and infrastructure development; also, trophy hunting (if well managed) only ever utilizes 2-5% of the male population in a designated area, making it mostly a sustainable practice (Lindsey et al., 2007a). This is primarily since low numbers or high paying hunters practice the sport, and their ethics are aligned with nature-friendly impacts (Gunn, 2001). Bothma (2016) also mentions that the recent increase in population due to wildlife ranching in countries such as South Africa, has led to an increase in record trophy sizes being registered in the Rowland Ward, South African and SCI record books by hunters that hunt in South Africa (thereby showing that suitable management of wildlife can boost the reputation of countries that practice sound conservation policies).

1.1.2 Namibia

The activity of trophy hunting as an economic model for wildlife utilization prior to the granting of greater rights for the wildlife to private landowners, began in 1959 (Erb, 2004). With the advent of CBNRM after the Amendment Act of 1996 (Jones and Weaver, 2009; MET/NACSO, 2020), wildlife population numbers in Namibia's Kunene and Zambezi Regions have increased due to the incentives that were created for sustainable wildlife utilization by residents on communal land. This was primarily based on the premise that if landowners or custodians have the right to manage, benefit

from and utilize wildlife resources (if the values of the resource are competitive with the uses of the other land uses), then the sustainable use of the resource would be defended by that community (Baldus and Wadsack, 2008; Lindsey et al., 2007b; Ministry of Environment and Tourism, 2013). This also adds to the Social Exchange Theory which hypothesizes that "humans will tend to strive for a positive outcome through the maximization of benefits and the minimization of the costs when attempting to engage freely in an exchange" (Mbaiwa, 2018). Therefore, as a means of unlocking wildlife value to communities, trophy hunting is permitted, which generates substantial revenue to communal conservancies throughout Namibia (Naidoo et al., 2016); trophy hunting is defined as the recreational hunting that targets the desired physical characteristics of the target species (e.g. horn size) (Cooney et al., 2017). Due to the increased regulations and incentives to conserve wildlife, there has been a marked increase in the wildlife numbers of Namibia, owing to a more successful CBNRM model (Anderson and Mehta, 2013) (Namibia and South Africa being the main exception in the general trend within Africa) (Bond et al., 2004), and this, in turn, has encouraged the steady presence of hunters within the country. A great determinant of the success of the trophy hunting industry is the variety of species on offer, along with the trophy size expected (Von Brandis and Reilly, 2007).

Trophy hunting within Namibia takes place in three land-use types, namely, national parks, communal conservancies, and private land (Bond et al., 2004; MET/NACSO, 2020). Both communal conservancies and national parks are on state land and are managed by community-elected committees and the Ministry of Environment, Forestry and Tourism (MEFT) respectively. Private land consists mainly of commercial farming land or private game farms and is managed by an individual or a group of individuals (Mendelsohn et al., 2002).

In 1980, the Namibian trophy hunting industry generated N$ 4.4 million from the private landowner level and gradually rose to N$ 134 million in 2000 (Humavindu and Barnes, 2003). Currently, the trophy hunting industry on private land in Namibia generates an estimated N$ 450 million per annum (McNamara et al., 2015); and the scale of trophy hunting can be illustrated by the fact that between 2013 and 2017, Namibia was the second-largest exporter of mammalian trophies, mainly to the United States and Germany (CITES, 2020). As can be seen in Figure 1, the benefits that communal conservancies generated from trophy hunting rose from N$ 405,349 in 1998 to N$ 39.6 million in 2018 (MET/NACSO, 2020).

Close to half of the communal conservancies generate benefits only from hunting and most of the remaining conservancies generate benefits through both hunting and tourism (IUCN, 2016). By way of illustration, in 2013, the hunting of 29 wildlife species within the conservancies generated a total of US$ 1,671,379 (IUCN, 2016) – which highlights the importance of hunting towards the provisioning of funds that could be utilized in conservation efforts within the communal conservancies of Namibia. Besides, the potential high value of the trophy hunting industry towards conservation, hunting also

contributes to maintaining of wilderness areas (which are set aside for the purpose hunting and maintaining of wildlife populations) (Knezevic, 2009); as evidenced by the zonation within Namibia's communal conservancies that maintain exclusive wildlife core areas (MET/NACSO, 2020). There is pressure from sectors of government and agriculture to convert such areas into higher intensity farming units if conservancy benefits are insufficient (Weaver and Skyer, 2003).

Overall, trophy hunting does not form a significant portion of the nation's GDP, as it only features an approximate of 0.27% of Namibia's GDP (Koot, 2019); but it is inextricably linked to the tourism industry, with it contributing to over 14% of the total tourist revenue to the country (Humavindu and Barnes, 2003). It is also one of the few income-generating activities in rural Namibian communities (MET/NACSO, 2020), which are known to be within the most poverty-stricken areas in the country (Mendelsohn et al., 2002; MET/NACSO, 2020).

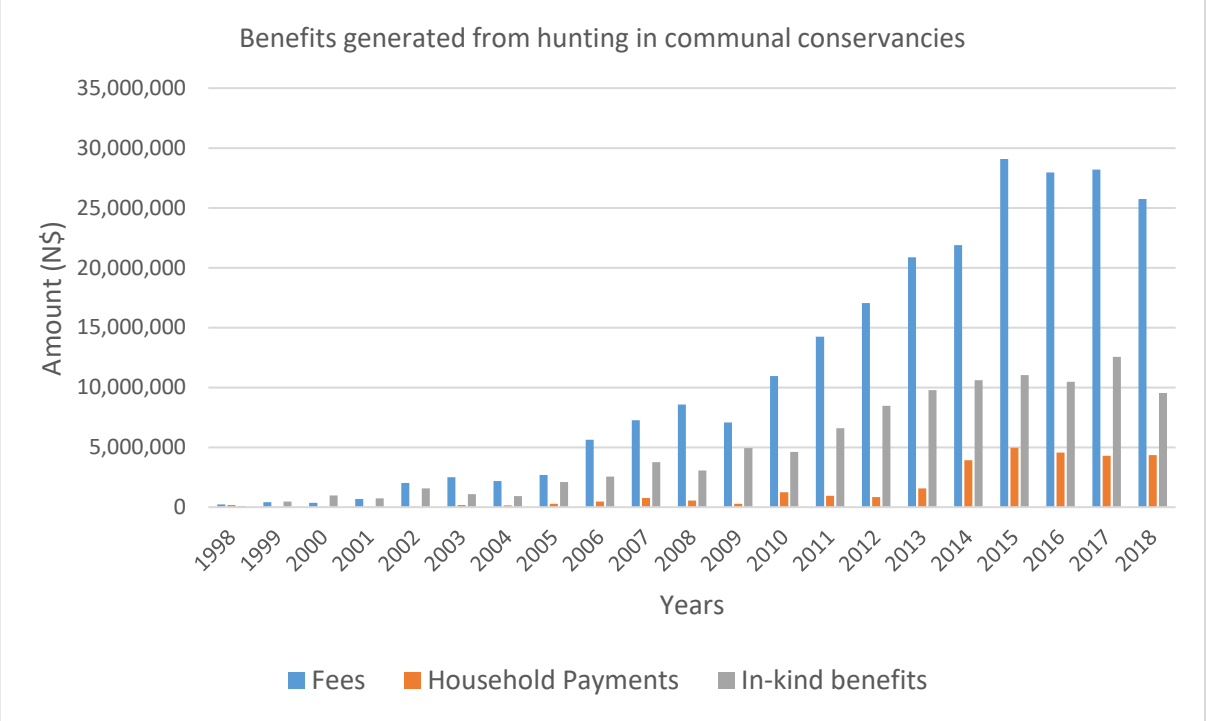

Figure 1: Benefits from trophy hunting in conservancies (MET/NACSO, 2020)

A brief analysis of the north-eastern conservancies (Zambezi, Kavango East, and Otjozondjupa Regions) serves to illustrate the importance of large charismatic wildlife to the functioning of the conservancies. Elsewhere in the country (such as the Kunene Region of Namibia) most conservancies generate most of their income from joint venture tourism, most of the conservancies that are financially self-sustaining within the Zambezi, Kavango East and Otjozondjupa Regions rely almost exclusively on trophy hunting to produce a sizable percentage of the income (Figure 2) (MET/NACSO, 2020). For example, in 2018, Nyae Nyae Conservancy generated a total of N$ 5.29 million from trophy hunting fees, which contributed towards 71% of the conservancy's total income; similarly, Balyerwa Conservancy generated a total of N$ 1.64 million from trophy hunting, which consists of 72% of the

conservancy's total income. Therefore, one can conclude that trophy hunting is important to the very functioning of certain conservancies within Namibia. This becomes even more apparent in areas where there is very low tourism potential, but where there are sizable populations of wildlife species (IUCN, 2016).

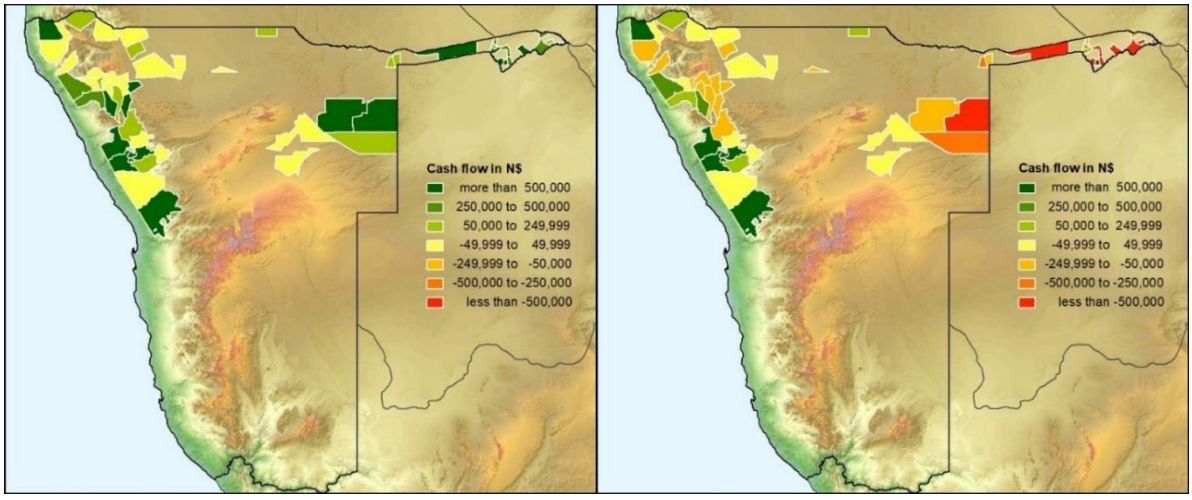

Figure 2: Cash flow in 2018 with hunting included (left) and with hunting absent (right) (MET/NACSO, 2020)

There are spin-offs that are associated with the utilization of trophy hunting as a source of income for the conservancies. Besides the more obvious means for which the money can be used (i.e. payment of the salaries of the game guards, covering the operating costs of the conservancy, etc.), trophy hunting creates a tangible nutritional benefit which is felt by most conservancy members across the country: the often unattainable commodity of meat (MET/NACSO, 2020). Also, trophy hunting creates the incentive to implement anti-poaching measures, because the utilization of game species as an economic asset attaches value to the free-roaming animals, which in turn causes members to tolerate poaching less (since it's essentially a theft of the resources that they are attempting to collectively deter). In addition, trophy hunting does manage Human-Wildlife Conflict to a certain level (McNamara et al., 2015), since it can aid in removing an individual problem-causing animal, and in turn, the money generated from the hunting of the problem-causing animal can be resourced towards offset payments for damages caused or the payment for mitigation methods (Ministry of Environment and Tourism, 2018). However, the management of problem-causing animals in such a manner should not be used liberally, given the reputational and ecological repercussions that could follow (Treves and Karanth, 2003).

1.2 Background of the study

Trophy hunting is the selective hunting of wild animal species for recreation or sport where products such as the skins or horns are kept as a trophy/memorial (Alam, 2008). It is a global practice that is most closely associated with the colonial legacy of the British Empire and that of the hunting tradition

and conservation efforts of Theodore Roosevelt (Holechek and Valdez, 2018; McNamara et al., 2015; Sheikh and Bermejo, 2019). An essential component of trophy hunting is the use of the scoring systems, such as the measuring systems outlined by Rowland Ward or the Safari Club International (SCI) (van Rooyen et al., 2016) – enabling hunters to outcompete each other for the largest trophy per species. The creation of the measuring system has inevitably led to a fair degree of competitiveness within the trophy hunting community, as some hunters strive to find the bigger trophy (Von Brandis and Reilly, 2007) that might be recorded in the Rowland Ward or SCI Record Books.

However, there is a growing negative sentiment towards trophy hunting mainly as it is deemed detrimental to rare and endangered species and because to hunt an animal for sport is being increasingly perceived as questionable on ethical grounds (Di Minin et al., 2016; Lindsey et al., 2007a; Sheikh and Bermejo, 2019). Besides the concerns regarding the ecological impacts of trophy hunting, there are some added concerns regarding corruption in third world states that might siphon off intended funds (from trophy fees) from their intended beneficiaries (Packer et al., 2011). Notwithstanding, trophy hunting is a popular, and, in some countries, a growing pastime (Watts et al., 2017).

On the other hand, with pressure towards trophy hunting increasing, and given Namibia's current stance on maximising its trophy hunting industry, alternative methods of measuring sustainability and impacts need to be addressed to quantitatively measure its long-term sustainability. The relevant question for Namibia in this regard is whether it can prove its current sustainability with its trophy measurement trends and whether it can help inform on the trophy setting in general.

Across the globe, multiple studies have been conducted to ascertain the sustainability of hunting and its influence on trophy size. A study was conducted on roe deer (*Capreolus* capreolus) in the Baltic region (Balčiauskas et al., 2017) and the conclusion was that the low trophy size in certain areas could be attributed to the hunting of individuals that had not yet matured (hence the need for an age limit). The study of bighorn sheep (*Covis canadensis*) in Arizona (Pigeon et al., 2016) attributed the decline in trophy sizes to the hunting of younger individuals with faster-growing or longer horns (Festa-Bianchet et al., 2004), or the overall overharvesting. Similarly, a study of the trophy size trends of Stone's sheep (*Ovis dalli*) in Canada over a period of four decades indicated that there was a decline in early horn growth and males harvested in areas where there was a strong selective hunting pressure (Douhard et al., 2016).

On the other hand, the assessment of trophy sizes in different regions of the world served to illustrate that the influence of trophy size was sometimes more due to several factors rather than a simple offtake of the larger trophy animals. Long-term trends of trophy size have been measured in several countries as was the case of the red deer (*Cervus elaphus*) in Hungary (Rivrud et al., 2013), where it

was proven the long term hunting did not necessarily have an adverse effect on the population of red deer (despite there being a century of utilization). A study of antler size of moose (*Alces* alces) in Alaska initially suggested that the increased harvesting of older males led to a reduction in the overall trophy size (Schmidt et al., 2007), however, the same study concluded that the result also had to take into account the density dependence of physical condition and the reduced age structure amongst adult males. However, similar studies indicate that not all reductions in trophy sizes are a result of overharvesting or inbreeding depression but can act as a synergistic effect along with a number of other environmental factors (Hedrick, 2011).

Several case studies have proven that illegal overhunting was a driving cause in the downward trend of trophy size in certain areas of the African continent; as was certainly proven by the reduction of the trophy sizes of African elephant in Kenya (Chiyo et al., 2015). Nevertheless, trophy hunting is not the sole contributor of reduced trophy sizes even with the presence of selective hunting, as it was discovered in the elephants of Addo, South Africa, where the increased frequency of "tusklessness" was attributed to underlying "genetic drift" (Whitehouse, 2002).

Various studies of trophy hunting (with a specific emphasis on trophy sizes and trends) and its effects, especially upon wild ungulate species, were also found within the African continent. One notable study was conducted in Tanzania (Wilfred, 2012), where data from 2006 to 2010 showed that mean trophy size, with the exception of warthog (*Phacochoerus africanus*), showed only slight changes, with most of the sample species remaining just above the threshold of their minimum trophy limits. Other studies within the Selous Game Reserve of Tanzania confirmed that the trophy size of buffalo, lion, leopard, elephant, and hippo (*Hippopotamus amphibious*) had significantly declined largely due to trophy hunting since poaching incidents were relatively few (Songorwa and du Toit, 2007); a follow-up study determined that the trophy size for the same species, in addition to impala (*Aepyceros melampus*) and greater kudu, were declining possibly due to unregulated hunting (Malembeka, 2013). A similar study in Zimbabwe (Crosmary et al., 2013), determined that the trophy sizes of more commonly hunted species experienced some form of decline; but a decline of 6% seen in sable could mainly be attributed to hunting pressures associated with their high-value status. In Zimbabwe, the study of the trophy sizes for impala, kudu, and sable revealed that there was a reduction in the population size, due to illegal off-take, and a reduction in the trophy size, possibly as a result of reduced diet size and the loss of genetic variability (Muposhi et al., 2015). Another study in Zimbabwe in Sengwa Wildlife Research Area revealed that the trophy size for elephant, buffalo, and lion were on the decline (with lion being the only species which did not show a significant difference in the variations observed) (Patmore et al., 2015). Additionally, further studies in south-eastern Zimbabwe proved that there was a decrease in the measurements for buffalo, whereas there was an increase in the trophy size of elephants and leopards, and a stable trend for kudu trophies (Jeke et al., 2019). Some studies

in South Africa have also been able to draw conclusions pertaining to general stabilized trends and declines as seen within the different provinces of South Africa (Von Brandis and Reilly, 2008, 2007).

Currently, the permitting requirements for hunting in Namibia necessitates landowners or custodians to monitor wildlife population numbers and offtake and to subsequently report these to the MEFT (*Nature Conservation Ordinance No. 4 1975*, n.d.). The adherence to these requirements is captured from information gathered by professional hunters operating on commercial farms and within communal conservancies. Communal conservancies use the event book monitoring system, which gives a rough estimate of wildlife populations throughout the year as observed by the conservancy game guards, along with the actual offtake of species for trophy, own-use, and problem-animal-control (MET/NACSO, 2020). Furthermore, the MEFT, along with several supporting NGOs, are responsible for the annual game counts which corroborate the estimates in most of the gazetted communal conservancies. This allows the MEFT to determine estimated sustainable quotas of wildlife for hunting.

1.3 Ecological impact of hunting

1.3.1 On populations

Several examples illustrate the impact of hunting intensity on the trophy size and the health of the population. For instance, the decline of the Dorcas gazelles (*Gazella dorcas*) and the Nubian bustard (*Neotis nuba*) in the 1980s was largely attributed to overhunting by largely upper-class hunters that originated from wealthier states outside of the Sahel (Newby, 1990). A study of the saiga antelope (*Saiga tatarica*), demonstrates that the excessive selection of males for their horns (i.e. sex-biased poaching) can have a detrimental effect on the population dynamics of a species due to a reduced fecundity resulting from the absence of males (Milner-Gulland et al., 2003).

Also, it would seem that the trophy hunting of felids (Family Felidae: e.g. lions, leopards, cheetah, etc.) could have a large impact on the overall population size and growth (Packer et al., 2011). The trophy hunting of lions (*Panthera leo*) has proven to be quite harmful as the removal of the dominant male leads to the infanticide of the offspring of the hunted lion by the emerging dominant males; there is also evidence to suggest that the hunting of lionesses can lead to increased vulnerability of cubs to the above-mentioned infanticidal males (Lindsey et al., 2013a; Packer et al., 2011). A study conducted in Zambia attempted to determine the trend of lion trophy sizes with their population decline (Chomba et al., 2014), but the results were inconclusive. Some negative influences on leopard (*Panthera pardus*) populations were observed in areas where trophy hunting is practiced, however, this may also be largely due to other factors besides selective hunting such as retaliatory killing (Packer et al., 2011; Swanepoel et al., 2011).

Within the overall context of species that migrate across various countries, trophy hunting can potentially be more detrimental when the species being hunted frequently crosses international

borders and the hunting quotas and regulations of each country (which could be influenced by limited data) are not based upon common trans-frontier population management (Selier et al., 2014). What has been determined in African elephants (*Loxodonta africana*) is that there is a reduced fecundity within the female populations as a result of the extreme pressures of poaching, which inevitably leads to a skewed sex ratio and disturbed social structure (Milner et al., 2007); therefore, trophy hunting that coexists with poaching within an area can lead to decrease in population (that will be correlated in the trophy sizes of the remaining younger animals).

Though not considered as serious as overhunting, the introduction of alien species for hunting could have a negative effect on the native fauna (disease, predation, hybridization, and competition) (Carpio et al., 2017). An example of this would be the introduction of black wildebeest (*Connochaetes gnu*) into the range of blue wildebeest (*Connochaetes taurinus*), which could potentially lead to hybridization between the two species (Grobler et al., 2018). Alien species for the purposes of hunting has become increasingly evident in Namibia (Blackmore, 2017), but is not the focus of this study.

Although hunting or over-hunting has been a key contributor to the decline of some species, most of these declines would be attributed to either subsistence hunting or illegal poaching (either for meat or for profit as in the case of rhinoceros and elephants), but up until today, no population has been driven to extinction exclusively by trophy hunting (Palazy et al., 2012; Sheikh and Bermejo, 2019).

1.3.2 On genetic traits of huntable species

There are the general concerns among wildlife and conservation scientists that excessive trophy hunting may lead to a reduced level of genetic fitness within animal populations (due to the hereditary nature of trophy size) (Coltman et al., 2003; Pelletier et al., 2012; Pigeon et al., 2016). This has potential within the Namibian CBNRM model due to the actual off-take which is determined mainly through game count estimates (with the addition of other variables such as drought forecasts, professional hunter reports, etc.) but does not currently take into account the variance in trophy size. Furthermore, as is the case in the various countries that still practice trophy hunting, the estimates for population size are very often inaccurate (Chase-Grey, 2011; Lindsey et al., 2013, 2007a), and this, in principle, could lead to overharvesting. Trophy overharvesting, and the associated generational decline in trophy size, are of concern for the long-term viability of high-value species (e.g. elephant, buffalo, roan and sable) trophies (Muposhi et al., 2015).

Nevertheless, trophy hunting has been studied in-depth due to the concerns surrounding the selective hunting of mostly healthy male animals and the resulting effects on the genetic fitness of the remaining populations (Coltman et al., 2003; Lindsey et al., 2007a; Mysterud and Bischof, 2010). Most arguments against the use of trophy hunting as a sustainable management tool focus on the point of removal of a healthy breeding male (reverse natural selection) as a detrimental impact on the population on a

genetic level; though at the same time, on a demographic scale, the skewed sex ratio of the species leading to a rise in the female population could unintentionally lead to an unnatural population growth (Ginsberg and Milner-Gulland, 1994; Milner et al., 2007).

There are several sources in literature which suggest that there is very rarely a state of urgency given the loss of genetic material due to trophy hunting since the effects of hunting produces a sex- and age-specific mortality pattern similar to those of a natural environment (which alludes to there being fewer long-term evolutionary consequences in comparison to unusual mortality patterns) (Harris et al., 2002). Also, there is evidence that trophy hunting does not have an adverse effect on the gene pool, based primarily on the research on cervids (e.g. deer) and bovids (e.g. buffalo) that concludes that desirable genes are often present in females and young males (i.e. normally the largest proportion of the population that forms the least likely targets for trophy hunters) (Lockwood et al., 2007; Webb et al., 2012).

1.4 Population health, conservation status, and economic value of the species selected for this study

This study focussed on the four species in Table 1. The reasons for the selection of these trophy species are due to their high economic value (Palazy et al., 2012) and due to their presence within the north-eastern regions of Namibia (Skinner and Chimimba, 2005). As mentioned in Table 1, kudu are abundant (NACSO, n.d.) and they are one of the most common and popular trophy species (Damm, 2005) due to their size and their spiral horns.

Table 1: Summary of population, status, and economic value of the study species' in Namibia

Species	**Buffalo (*Syncerus caffer*)**	**Roan (*Hippotragus equinus*)**	**Sable (*Hippotragus niger)***	**Kudu (*Tragelaphus strepsiceros*)**
Population Size	Estimated to be over 6,000 ((Chase, 2007; Kasiringua et al., 2017))	At least 800 (Lindsey, 2011; NNF, 2008)	At least 1200 (Lindsey, 2011; NNF, 2008)	Estimated to be over 345,000 (Lindsey, 2011; NACSO, n.d.)
Distribution in Namibia	Zambezi and Kavango Regions, Nyae Nyae, and Waterberg. (Skinner and Chimimba, 2005)	Zambezi and Kavango Regions, Nyae Nyae, Waterberg, partially in Etosha, and scattered	Zambezi and Kavango Regions, Waterberg, partially in Etosha, and scattered distribution	Present in almost all areas within Namibia, except within heavily settled areas and true desert.

Species	Buffalo (*Syncerus caffer*)	Roan (*Hippotragus equinus*)	Sable (*Hippotragus niger)*	Kudu (*Tragelaphus strepsiceros*)
		distribution across various game farms. (Martin, 2003; Skinner and Chimimba, 2005)	across various game farms. (Martin, 2003; Skinner and Chimimba, 2005)	(Skinner and Chimimba, 2005)
IUCN Conservation Status	Near Threatened (IUCN, 2019a)	Least Concern (IUCN, 2019b)	Least Concern (IUCN, 2019c)	Least Concern (IUCN, 2019d)
Namibian Conservation Status (Nature Conservation Ordinance No. 4, 1975)	Huntable	Protected	Protected	Huntable
Average Trophy Fees to Conservancies* **(2011-2015)**	US$ 5,602	US$ 5,486	US$ 6,125	US$ 536
Average Trophy Value (2011-2015)	N$ 84,210 US$ 6,592** (MacLaren et al., 2019)	N$ 82,052 US$ 6,423 (MacLaren et al., 2019)	N$ 94,617 US$ 7,407 (MacLaren et al., 2019)	N$ 16,157 US$ 1,264 (MacLaren et al., 2019)

1.5 Problem statement

In general, it would appear that there is a lot less literature that has been published on the effects of trophy hunting on African fauna in comparison to the studies conducted in the United States or Europe, and most information on African trophy hunting exists within unpublished grey literature (Irandu and

* Average trophy fees were ascertained from the amounts stipulated in the hunting contracts between the hunting operators and the conservancies.

** Using the 2015 exchange rate of 12.773953

Esther, 2016). Though the studies within South Africa can add valued guidance towards the potential studies regarding trophy size in Namibia, it serves to highlight that Namibia has not yet produced enough academic writings to advocate for the sound management of wildlife populations in the light of quantified trophy size data. What is evidently missing is the justification of the annual quota setting based upon the evidence given by the annual trophy hunting data submitted by trophy hunters themselves. Currently, the quotas are based upon the actual trends in wildlife numbers (but also includes the recommendation of the conservancy members or the hunters themselves) rather than the trophy sizes being produced – a factor that unquestionably influences the economic and ecological sustainability of the CBNRM programme. However, despite the fact that there is no long-term genetic and morphological evidence to ascertain the impact of trophy hunting in Namibia, there has been a sufficient number of journal articles and literature reviews produced to support trophy hunting in Namibia, both from an economic (Humavindu and Barnes, 2003) and a social point of view (Naidoo et al., 2016).

Several pitfalls for the support of trophy hunting are compounded by the fact that it is far easier to support trophy hunting as a means of benefitting an endangered species than finding the relevant evidence to validate those claims (Grijalva, 2016). It is also apparent that most of the arguments to support the use of trophy hunting is reliant on the economic incentives produced by trophy hunting or the perceptions of the community towards hunting (Grijalva, 2016; Naidoo et al., 2016). Given the circumstances, it can be safely argued that unregulated trophy hunting coupled with poor habitat management and corruption can in fact be detrimental to the management of wildlife populations (Crosmary et al., 2015). Although records of trophy sizes and numbers are meticulously kept by MEFT, very few analyses of this information over time to confirm or refute claims of trophy overharvesting in Namibia have been conducted.

Perceptions of unsustainable hunting quotas will add to negative sentiments by anti-hunting lobby groups from animal rights activists (Di Minin et al., 2016; Sorensen, 2015; Treves and Karanth, 2003). The outcome of a potential ban of trophy hunting exports would discourage foreign hunters from hunting in Namibia and, inevitably, many of the conservation activities within the communal conservancies would be non-viable, as conservancies would not be able to cover their operational costs (Cooney et al., 2017; NACSO, 2015). This would likely result in the decline of the wildlife populations within the affected communal areas (Cooney et al., 2017; Weber et al., 2015; Mbaiwa, 2018), as the loss of this major source of income would create a burden within the local communities to conserve the wildlife species. This would be especially detrimental when considering that Namibia is classified as a middle-income country, meaning that there will a significant decline in biodiversity expenditure by government, donors and private sector (a decline which is projected be 24% between

2014/2015 and 2020/2021) (Harper-Simmonds et al., 2014). Therefore, such perceptions can only be refuted through an empirical investigation of the hypotheses that are freely purported in the media.

1.6 Aims and objectives

The overall aim of this study was to use trophy size trends over time as a proxy to assess the sustainability of the current trophy hunting numbers for selected high-value and popular hunting species. Once the trends were determined overall and per hunting area, recommendations towards the sustainable utilization of these species were made.

The tasks that were completed whilst accomplishing the objective of this project were:

- Acquiring the relevant trophy sizes from the professional hunters' reports (as provided by the MEFT) particularly for the following animals: buffalo, sable, and roan (with any additional benchmark species being allocated during the course of the research period).
- Collecting the relevant trophy data from the MEFT, particularly for buffalo (due to a lack of clarity in the trophy record measurements specific to Rowland Ward and SCI).
- Analysing the database that covers a minimum of the last five years of trophy hunting which includes the date of the hunt, hunter, origin of the hunter, permit number, species, species sex, trophy size, and area. In the communal conservancies, prioritization (due to the number of high-value species) was given to the Kavango East Region, the Zambezi Region and a portion of the Otjozondjupa Region, along with an additional inclusion of Bwabwata National Park.
- Gathering relevant population size estimates and quota setting per conservancy as a means of correlating the trends in trophy data with the population size and the population offtake.
- Determining the areas that show a decline or increase in trophy size and the possible reasons thereof.
- Providing recommendations towards the improvement of the trophy quantity and size and thereby improve the system of adaptive management already in place, and to possibly aid in the development of the electronic database (including records from 1975 to the present).

Chapter 2: Methodology and study area

2.1 Description of the study area

The database of trophy records primarily focused on the communal conservancies and national parks situated within the north-eastern regions of Namibia (i.e. the Namibian component of the Kavango-Zambezi Transfrontier Conservation Area [KAZA TFCA]) (MET/NACSO, 2020). The conservancies (Figure 3) that were the primary focus of the study are listed in Table 2 below.

Table 2: Communal conservancies and study species presence

Communal Conservancies and Protected Areas	Region	Size (km^2)	Species hunted			
			Buffalo	Roan	Sable	Kudu
Balyerwa	Zambezi	225	Yes	Yes	Yes	Yes
Bamunu	Zambezi	555	Yes	No	No	No
Dzoti	Zambezi	287	Yes	Yes	Yes	Yes
George Mukoya	Kavango East	486	No	Yes	No	Yes
Kabulabula	Zambezi	89	Yes	No	No	No
Kasika	Zambezi	147	Yes	No	No	No
Kwandu	Zambezi	189	No	No	No	Yes
Mashi	Zambezi	297	Yes	Yes	Yes	Yes
Mayuni	Zambezi	151	No	No	No	Yes
Muduva Nyangana	Kavango East	615	No	Yes	No	Yes
Nyae Nyae	Otjozondjupa	8,992	Yes	Yes	No	Yes
Salambala	Zambezi	930	Yes	No	No	Yes
Sobbe	Zambezi	391	Yes	Yes	Yes	Yes
Wuparo	Zambezi	148	Yes	Yes	Yes	Yes
Bwabwata National Park	Kavango East and Zambezi	6,277	Yes	Yes	Yes	Yes
Waterberg Plateau Park	Otjozondjupa	396	Yes	Yes	Yes	Yes

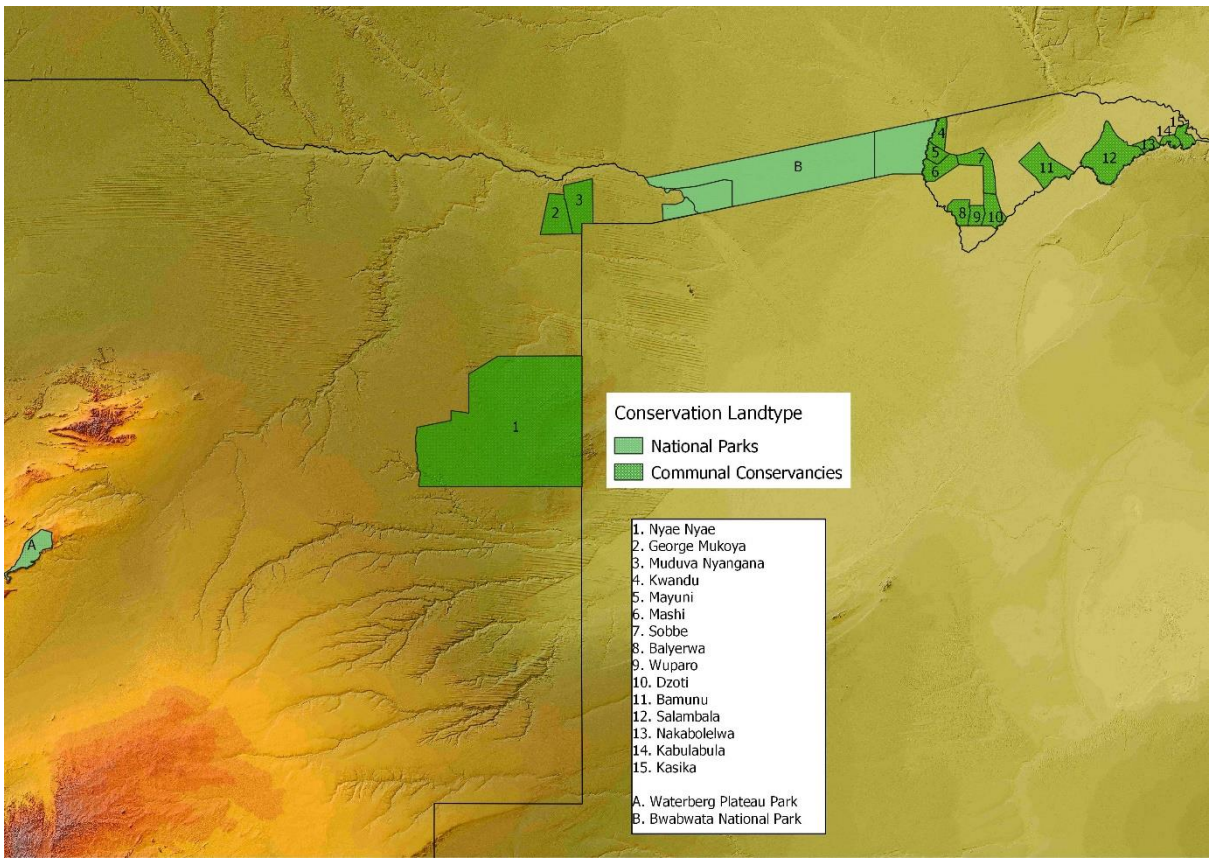

Figure 3: Study sites[*]

In general, the biome type of north-eastern Namibia can be described as broad-leafed savannah, which is interspersed with riparian woodlands that are influenced by the Kavango, Kwando, Linyanti, Chobe and Zambezi Rivers; the specific vegetation type of the study area can be described as Northern Kalahari, North-eastern Kalahari Woodland, Riverine Woodlands and Islands, Eastern Drainage, Caprivi Mopane Woodland, and Caprivi Floodplains (Mendelsohn et al., 2002). These areas are ideal habitats for buffalo, roan, and sable, due to the presence of the wetlands and the dense vegetation that supports the behavioural ecology of these three key species (Bothma et al., 2016b; du Toit, 2016; Skinner and Chimimba, 2005). The dominant soils of the general study area can be divided into ferralic arenosols, eutric fluvisols, dystric regosols, and petric calcisols (Mendelsohn et al., 2002). The average temperature of the study area is 20°C and the average annual rainfall ranges from 350-400 mm (at Waterberg) to more than 600mm (Zambezi Region). This makes this study the least arid in comparison to the western and the southern regions of the country, which consequently results in a higher biomass production (both in terms of natural fauna and flora).

2.2 Study species

This study focussed on the four species: buffalo, roan, sable, and kudu. The reasons for the selection of these trophy species are due to their high economic value (Palazy et al., 2012) and due to their

[*] Roan, sable, and kudu were also analysed outside of the study sites as part of the national focus.

presence within the north-eastern regions of Namibia (Skinner and Chimimba, 2005). As mentioned in Table 1, kudu are abundant (NACSO, n.d.) and they are one of the most common and popular trophy species (Damm, 2005) due to their size and their spiral horns. Though the main focus of the study was to get a complete picture of the north-eastern conservancies and national parks, the small sample size of roan and sable data would not allow for any conclusive analysis. Therefore, during the course of the study, it was decided to look at the roan, sable and kudu species that were trophy hunted across the national landscape (i.e. both on state and private land). The sample size of buffalo for the north-eastern conservancies and parks (current veterinary legislation does not allow for the ownership of buffalo on private land) (Lindsey et al., 2013b) was large enough to run statistical analysis.

2.3 Methods and description of data collection

All data compiled was collected from the MEFT's database for the annual hunter's return forms. For the period 2011-2015, over 130,800 data entries for hunted species were submitted and then entered onto an excel spreadsheet by the Permit Office of the Ministry. Each of the annual hunter's return forms (Appendix A) gives specific information regarding the locality of the hunt, the type of land use, the year, the nationality and name of the hunter, the permit number, the species hunted and the applicable measurements of the trophy of the animal hunted.

Within Southern Africa, there are three official methods of trophy measurement in Southern Africa which can be used to recognize trophy size (van Rooyen et al., 2016). These trophy measurements are the Rowland Ward system, the SCI system, and the South African system. Each measurement system makes key use of specific measurements such as horn length, horn circumference, and skull size, etc. Any trophy which is considered a record-sized trophy can be added to either the Rowland Ward or the SCI record books. These record books also include the date, the hunting outfit, the name of the operator, the name of the client, and the origin of the hunt (Von Brandis, 2004). The publication of these records is considered essential in marketing a region, as international hunters are more likely to hunt in areas where the largest animals were shot.

The SCI measuring system is the most commonly used and was the basis of the study. The measurement for each species is illustrated in Figures 4, 5, and 6 below (Schwabland and Barnhart, 2016). Each trophy is given a score, which is the sum of the prescribed measurements (e.g. in the case of roan and sable, the measurements of the total horn lengths and the base circumference widths of each horn are added to give the total score). The minimum scores for entry into the SCI Record Book and for the minimum trophy size score control for the four study species are listed in the Tables 3 and 4 below.

Table 3: SCI minimum scores for entry into SCI Record Book

Species	Minimum Score (inches)	World Record (inches)
Buffalo	101	141
Roan	67	85
Sable	96	121 ⅜
Kudu	121	155 ⅜

Table 4: Minimum scores for clearance as trophy exports from Namibia

Species	Minimum Exportable Score (cm)	Minimum Exportable Score (inches)
Buffalo	229	90.16
Roan	151	59.45
Sable	229	90.16
Kudu	276	108.66

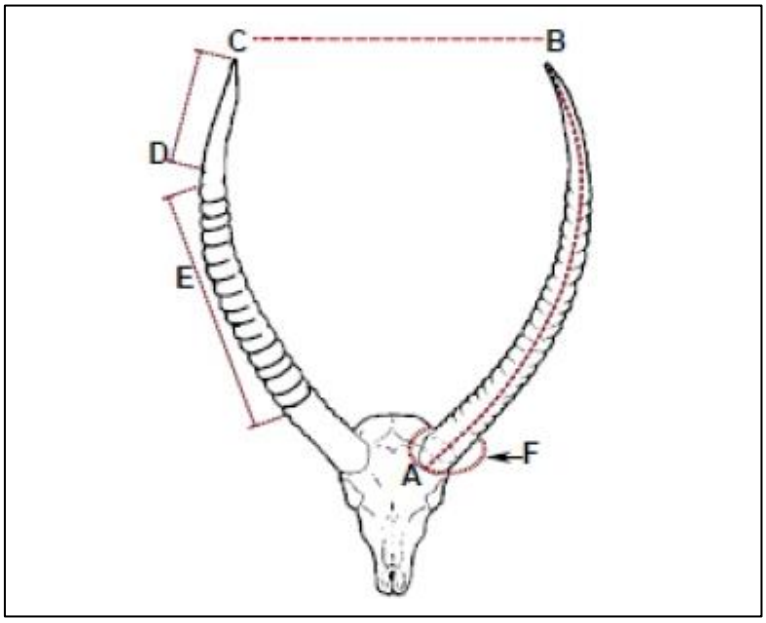

Figure 4: SCI measurement method for simple-horned antelope

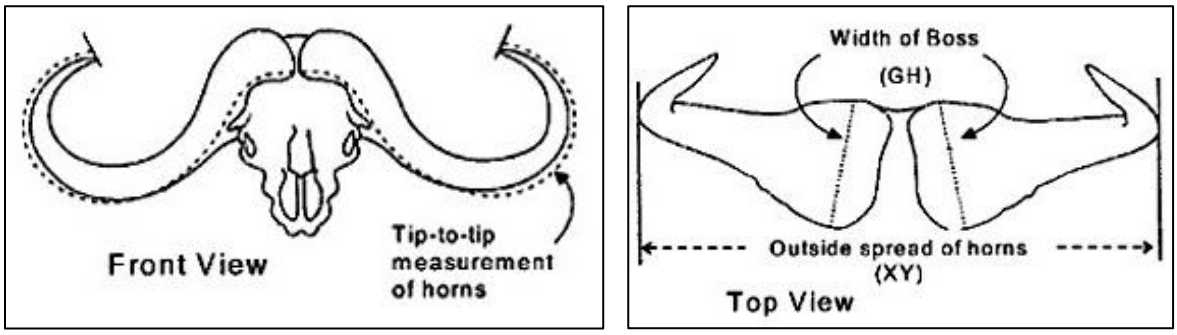

Figure 5: SCI measurement method for African buffalo

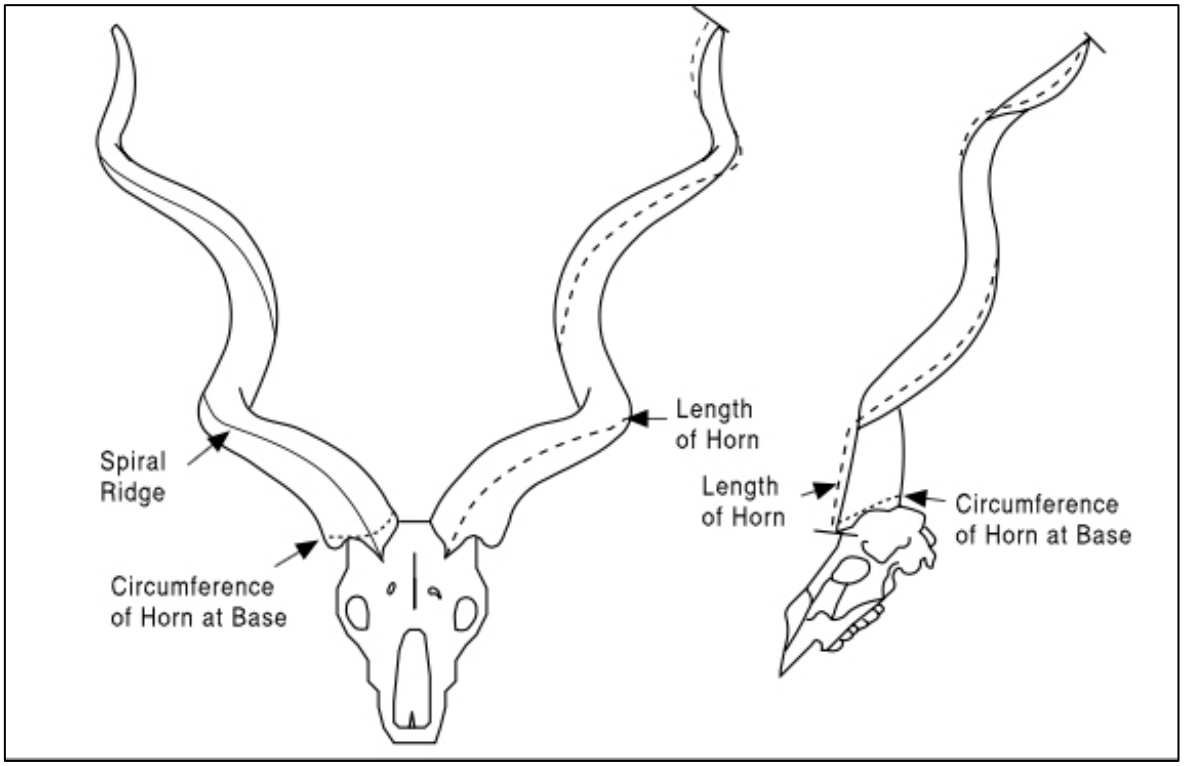

Figure 6: SCI measurement method for spiral-horned antelope

Even though the database was quite detailed and extensive, much had to be done to clean the dataset (e.g. correct values that had obviously been mistyped, etc.) and reorganise it for the purposes of classifying the data according to region and to provide clarity between the measurements which were presumably either a Rowland Ward measurement or an SCI measurement.

Due to the smaller sample size of roan and sable numbers in communal conservancies, it was decided to run an analysis of the trophy size nationally, rather than just for the communal conservancies. This in turn allowed for a comparative analysis of the trophy size between roan and sable trophies on either

the north-eastern communal conservancies/national parks or the private farms south of the veterinary fence*.

To investigate whether the perception of hunting trends by hunters corresponded with the data analysis, interviews were conducted with 38 professional hunters, who have operated within several of the communal conservancies and private farms. Most questions were directed towards understanding their perceptions on the trends in the trophy size and to compare their perceptions to the quantitative analysis of the trophy measurements. The structured questionnaire (Appendix B) was compiled and handed out at the Namibian Professional Hunting Association (NAPHA) annual general meeting— which, due to the request to keep the questionnaire as succinct as possible, allowed for thirteen questions. Most questions were closed questions that were designed to better understand the nationwide trophy size and population trends. One open question at the end of the questionnaire gave the opportunity to the hunters to provide alternative methods of assessing trophy quality. There are currently over 350 registered members of NAPHA (NAPHA, 2019), hence the sample size of 11% was considered adequate since this was not the primary focus of the overall study.

2.4 Descriptions of the analysis

For each of the four study species, a qualitative assessment of annual trends of the number of animals hunted was conducted. Additionally, several graphs display the number of trophies according to their SCI score.

A one-way non-parametric test was necessary to test for the significance in the annual variation per species; but only after the Shapiro-Wilks test for normality (Shapiro et al., 1968) was conducted on the total scores. However, all of the data that was analysed, for all four study species, proved to be not normally distributed (Appendix C). The Kruskal-Wallis test (Katz and McSweeney, 1980) was consequently conducted to test for any statistical significance on the data that proved to be non-parametric using Statistica® Version 10 for Windows (StatSoft, 2011).

Any statistical analysis for trophy size that yielded a significant difference ($p>0.95$) for a dataset was subsequently tested using the Tukey post hoc test (Tukey, 1949) to determine the significance between variables.

* A fence that was erected to keep livestock and large game that may be carriers of foot-and-mouth disease and lung sickness separate from the largely disease-free populations to the south (Mendelsohn, 2002).

Chapter 3: Results

3.1 Numbers, areas, and years in which trophies of species were hunted

Across the target study area, buffalo are the most commonly hunted species, with a total of 330 individuals being trophy hunted in the years 2011-2015. In comparison (though not part of this study), elephants are the second most commonly hunted species in the Zambezi Region with a total of 309 being hunted in the years 2011 to 2015. A summary of the hunted species for the whole of Namibia is summarized in Table 6.

Roan and sable are more common as hunted species in commercial farming compared to national parks or communal conservancies. In comparison, of the entire study period, 59 roan and 51 sable were hunted in the communal conservancies or protected areas in contrast to the 145 roan and the 328 sable that were hunted on private farms. The general trends of trophy sizes are summarized accordingly in Table 5. Specifics on the extent and significance of the differences are provided in sections 3.1.1 to 3.1.4 and 3.4.1 to 3.4.4 below.

Table 5: Summary of trophy size trends according to species and land use

Species	Overall size trends in Namibia	Trophy size trends in communal conservancies	Trophy size trends in national parks	Trophy size trends in private farms	Dominant hunter nationalities
Buffalo	Increasing	Increasing	Increasing	N/A	USA
Roan	Increasing	Increasing	Increasing	Increasing	USA
Sable	Decreasing	Decreasing	Decreasing	Decreasing	USA
Kudu	Decreasing	Decreasing	Decreasing	Decreasing	USA

Table 6: Trend in the most commonly hunted Namibia species and the % difference between 2011 and 2015

Species	2011	2012	2013	2014	2015	Grand Total	% difference (2011-2015)
Gemsbok	5,064	5,026	4,554	4,106	3,701	22,451	-26.92%
Warthog	3,621	3,810	3,677	2,972	2,850	16,930	-21.29%
Springbok	2,819	2,808	2,423	2,452	2,096	12,598	-25.65%
Kudu*	2,605	2,689	2,373	1,640	1,530	10,837	-41.27%

* Records without locations and/or incomplete measurements were not used in this study.

Species	2011	2012	2013	2014	2015	Grand Total	% difference (2011-2015)
Red Hartebeest	2,233	2,277	1,995	1,736	1,608	9,849	-27.99%
Mountain Zebra	1,543	1,734	1,621	1,470	1,298	7,666	-15.88%
Blue Wildebeest	1,467	1,625	1,465	1,490	1,335	7,382	-9.00%
Impala	1,206	1,217	1,191	1,166	1,126	5,906	-6.63%
Black Wildebeest	1,012	979	948	1,040	947	4,926	-6.42%
Eland	1,009	938	1,003	787	742	4,479	-26.46%
Steenbok	902	927	865	743	641	4,078	-28.94%
Blesbok	1,061	903	730	706	603	4,003	-43.17%
Plains Zebra	620	623	742	662	570	3,217	-8.06%
Jackal	510	530	400	453	434	2,327	-14.90%
Waterbuck	384	467	438	433	446	2,168	16.15%
Baboon	358	463	530	386	403	2,140	12.57%
Duiker	307	325	392	239	298	1,561	-2.93%
Ostrich	182	194	163	151	111	801	-39.01%
Giraffe	170	143	143	120	131	707	-22.94%
Damara Dik Dik	114	126	146	111	140	637	22.81%
Leopard	119	130	104	124	141	618	18.49%
Klipspringer	132	113	87	89	87	508	-34.09%
Cheetah	94	91	69	72	100	426	6.38%
Elephant	80	79	79	85	83	406	3.75%
Buffalo*	68	70	72	85	85	380	25%
Sable*	51	62	70	57	73	313	43.14%
Caracal	77	73	52	57	45	304	-41.56%
Black-faced Impala	41	35	62	58	61	257	48.78%
Spotted Hyaena	44	32	38	17	32	163	-27.27%
Hippo	29	29	31	32	31	152	6.90%
Nyala	35	25	27	27	31	145	-11.43%
Lechwe	19	18	28	35	41	141	115.79%
Roan*	19	27	33	23	33	135	73.68%
Porcupine	26	27	35	14	20	122	-23.08%
Brown Hyaena	14	22	16	38	25	115	78.57%
African Wild Cat	20	21	23	10	17	91	-15.00%
Honey Badger	11	17	27	11	24	90	118.18%

Species	2011	2012	2013	2014	2015	Grand Total	% difference (2011-2015)
Crocodile	11	16	17	14	12	70	9.09%
Aardvark	14	17	20	4	7	62	-50.00%
Genet	14	29	14	1		58	-92.86%
Guinea Fowl	7	17	9	15	3	51	-57.14%

3.1.1 Buffalo

Overall, within communal conservancies, there were 295 buffalo that were placed on the quota for trophies, and of that 295 buffalo, 237 were successfully hunted. The number allocated on the quota against the actual offtake is shown in Table 7. Between 2011 and 2015, the number of buffalo hunted in communal conservancies rose from 28 to 63, representing a 225% increase in the number of buffalo hunted in communal conservancies.

Table 7: Annual quota for buffalo in communal conservancies and the actual offtake

Year	Trophy quota*	Actual offtake according to MEFT trophy data	Own-use quota	Actual offtake according to Event Book data	Total quota	Total offtake
2011	49	28	10	6	59	34
2012	49	46	10	16	59	62
2013	49	47	10	22	59	69
2014	74	53	44	23	118	76
2015	74	63	44	26	118	89
Total	295	237	118	93	413	330

A review of Figure 7 below shows that there has been a substantial increase in the number of buffalo hunted nationally over the study period, with a bulk of the trophies hunted within the communal conservancies. On the other hand, the numbers hunted in the national parks seem to have shown a slight decrease over time. Of all the trophy hunts, 83% (n=237) were conducted within communal conservancies. Figures 8 and 9 respectively provide spatial representation regarding the largest trophies hunted in Namibia and the distribution of record trophies within Namibia.

* The quota is the calculated offtake that the conservancies are allowed to utilize either for trophy animals or own-use animals based upon the adaptive management process of quota setting (MET/NACSO, 2020).

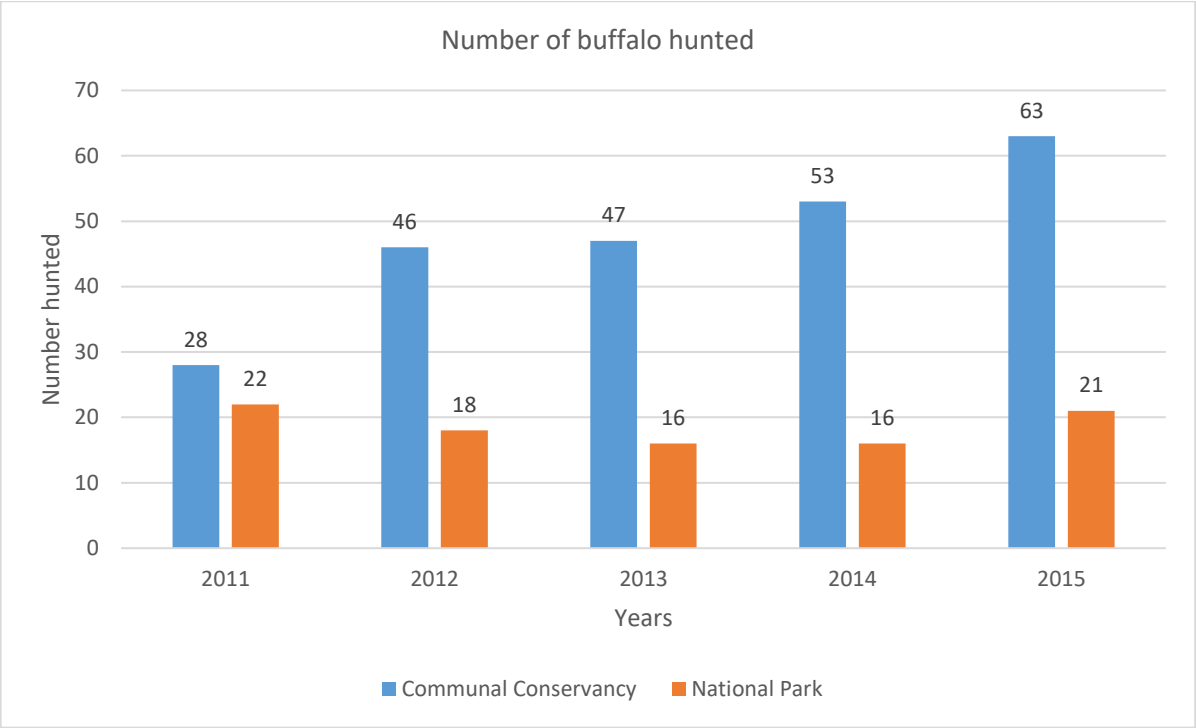

Figure 7: Number of buffalo hunted nationally over the study period

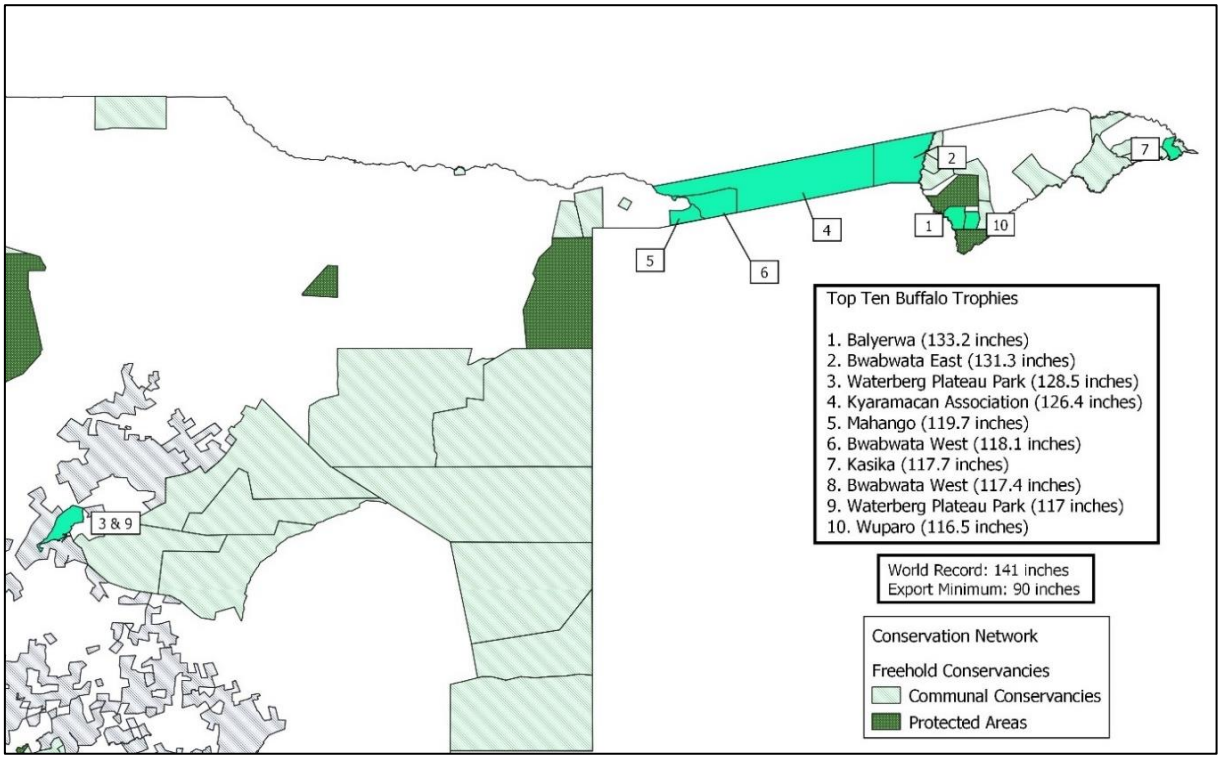

Figure 8: Spatial representation of the top ten buffalo trophies hunted

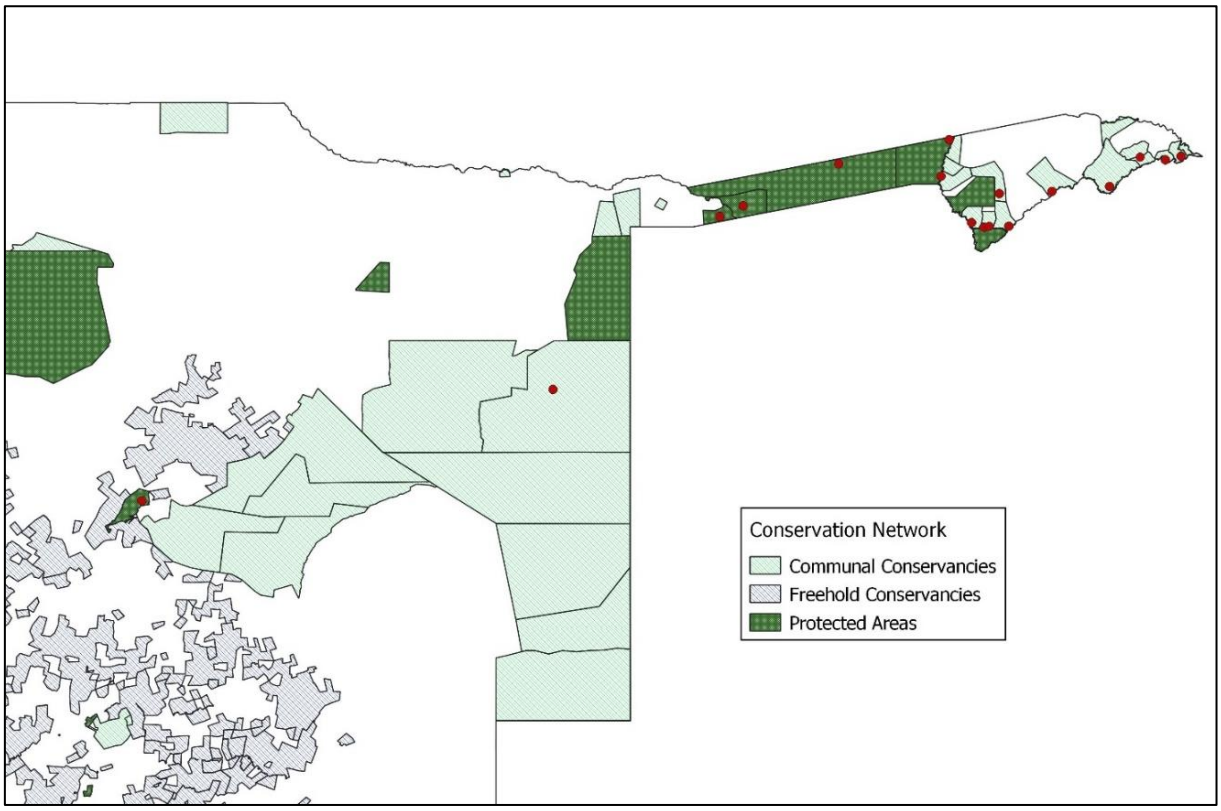

Figure 9: Location of all buffalo hunts

The comparison between the nationality of trophy hunters is essential in understanding the dynamics that influence the possible reasons being observed in the total scores that were attained. For instance, it indicates the preference of certain cultural groups (in terms of trophy size) and in which county most of the market appeal for each species can be found.

Hunters from 29 different countries hunted buffalo during the study period (Table 8). There was noticeable increase in the number of hunters from the USA, Germany, and Austria, with most other nationalities showing no noteworthy signs of an increased number of hunters.

Table 8: Buffalo hunted per hunter's origin

Hunter Nationalities	Year					Grand Total*	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
USA	13	17	28	30	45	133 (40.3%)	26.6	11.22
Germany	5	16	6	12	19	58 (17.57%)	11.6	5.46
Unknown	5	6	7	4	0	22 (6.66%)	4.4	2.42
Namibia	7	2	3	3	3	18 (5.45%)	3.6	1.74
Russia	8	4	1	5	0	18 (5.45%)	3.6	2.87

* The percentage for each nationality out of the total number that was hunted is represented in-between brackets.

Hunter Nationalities	Year					Grand Total*	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
Austria	0	1	2	2	5	10 (3.03%)	2.0	1.67
France	0	1	5	1	2	9 (2.73%)	1.8	1.72
Canada	1	0	2	1	5	9 (2.73%)	1.8	1.72
RSA	2	3	2	1	0	8 (2.42%)	1.6	1.02
Hungary	6	0	0	0	1	7 (2.12%)	1.4	2.33
Finland	0	1	2	2	0	5 (1.52%)	1.0	0.89
Sweden	0	0	1	3	0	4 (1.21%)	0.8	1.17
Mexico	2	0	1	0	1	4 (1.21%)	0.8	0.75
Switzerland	0	2	0	1	0	3 (0.91%)	0.6	0.80
Bulgaria	0	3	0	0	0	3 (0.91%)	0.6	1.20
El Salvador	0	0	1	1	0	2 (0.61%)	0.4	0.49
Poland	0	0	0	2	0	2 (0.61%)	0.4	0.80
Argentina	0	2	0	0	0	2 (0.61%)	0.4	0.80
Norway	0	1	1	0	0	2 (0.61%)	0.4	0.49
Saudi Arabia	0	0	0	1	1	2 (0.61%)	0.4	0.49
Ukraine	0	1	0	0	0	1 (0.3%)	0.2	0.40
UK	0	0	0	0	1	1 (0.3%)	0.2	0.40
Italy	0	1	0	0	0	1 (0.3%)	0.2	0.40
Denmark	0	1	0	0	0	1 (0.3%)	0.2	0.40
China	0	1	0	0	0	1 (0.3%)	0.2	0.40
Spain	1	0	0	0	0	1 (0.3%)	0.2	0.40
Czech Republic	0	1	0	0	0	1 (0.3%)	0.2	0.40
Australia	0	0	0	0	1	1 (0.3%)	0.2	0.40
Netherlands	0	0	1	0	0	1 (0.3%)	0.2	0.40
Grand Total	**50**	**64**	**63**	**69**	**84**	**330**	**66.0**	**10.97**

Based on the analysis of trophy score (categorized by the hunter origin) (Figures 10 and 11), an overall picture of the preference for buffalo trophy scores emerged. Hunters from North America and Europe showed a large variance in the sizes of trophies hunted (Figure 11) Hunters from the United States and Germany were responsible for shooting record trophy bulls, but on average hunters from the United States focussed on achieving a higher SCI score – as opposed to the German hunters, who averaged lower than the hunters from Russia, Hungary, and even that of Namibian hunters. There were a

number of hunters from unknown locations due to the failure to record some of the hunters' origins in the annual returns form.

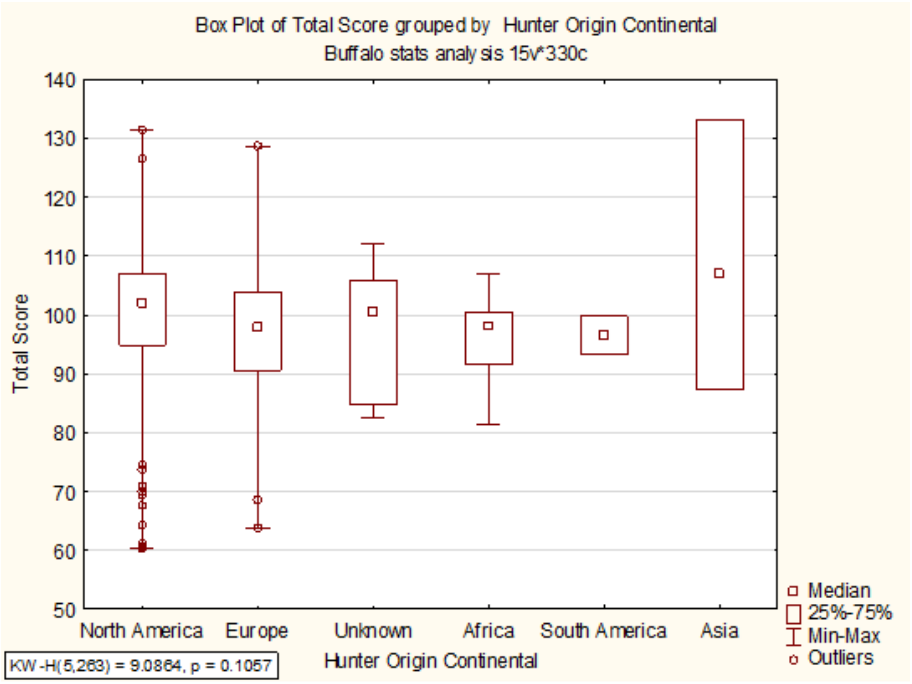

Figure 10: Buffalo score averages categorized by hunter nationality

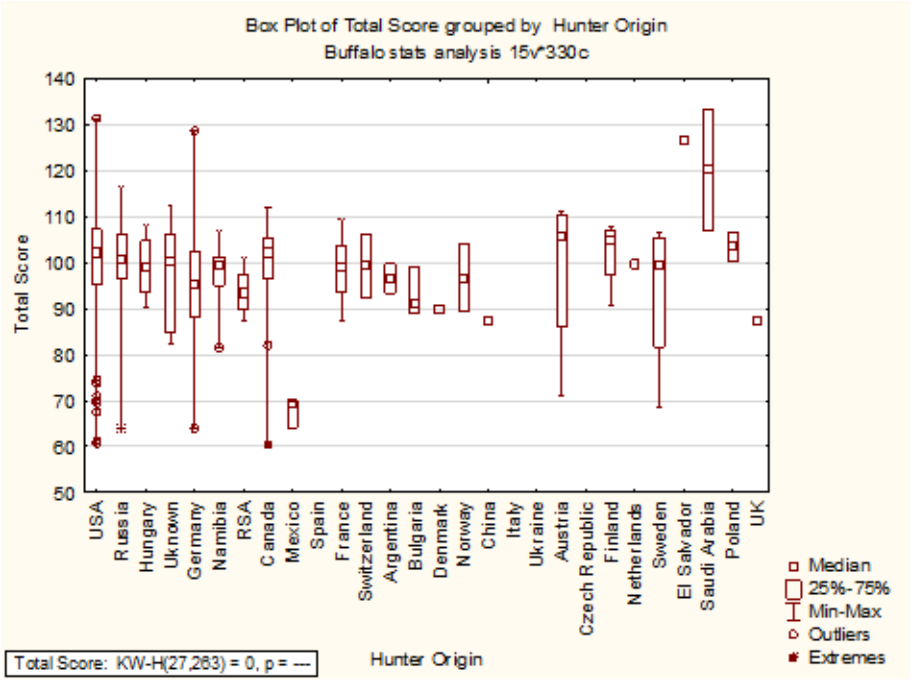

Figure 11: Buffalo score averages categorized by continent of hunter origin

3.1.2 Roan

During the study period, a total of only 68 roan were placed on quota within the communal conservancies; and of the 68, a total of 39 (57%) were successfully hunted. As can be seen in Table 9, the number of roan hunted rose slightly from 5 to 9 individuals representing a 180% increase.

Table 9: Annual quota for roan in communal conservancies and the actual offtake

Year	Trophy quota	Actual offtake according to MEFT trophy data	Own-use quota	Actual offtake according to Event Book data	Total quota	Total offtake
2011	15	5	0	4	15	9
2012	15	8	0	0	15	8
2013	15	9	0	0	15	9
2014	12	8	0	0	12	8
2015	11	9	0	0	11	9
Total	68	39	0	4	68	43

Though the numbers hunted never exceeded the 33 individuals in 2013 and 2015, it's apparent that a bulk of the numbers were hunted on private farms (Figure 12). The lowest number of animals hunted per year were recorded in the national parks. Also, during the course of the study, the number of roan that were successfully hunted within communal conservancies (n=39) accounted for 28% of all reported trophy hunts during the study period. Figures 13 and 14 provide a spatial overview of the top ten trophies recorded and the distribution of all hunts.

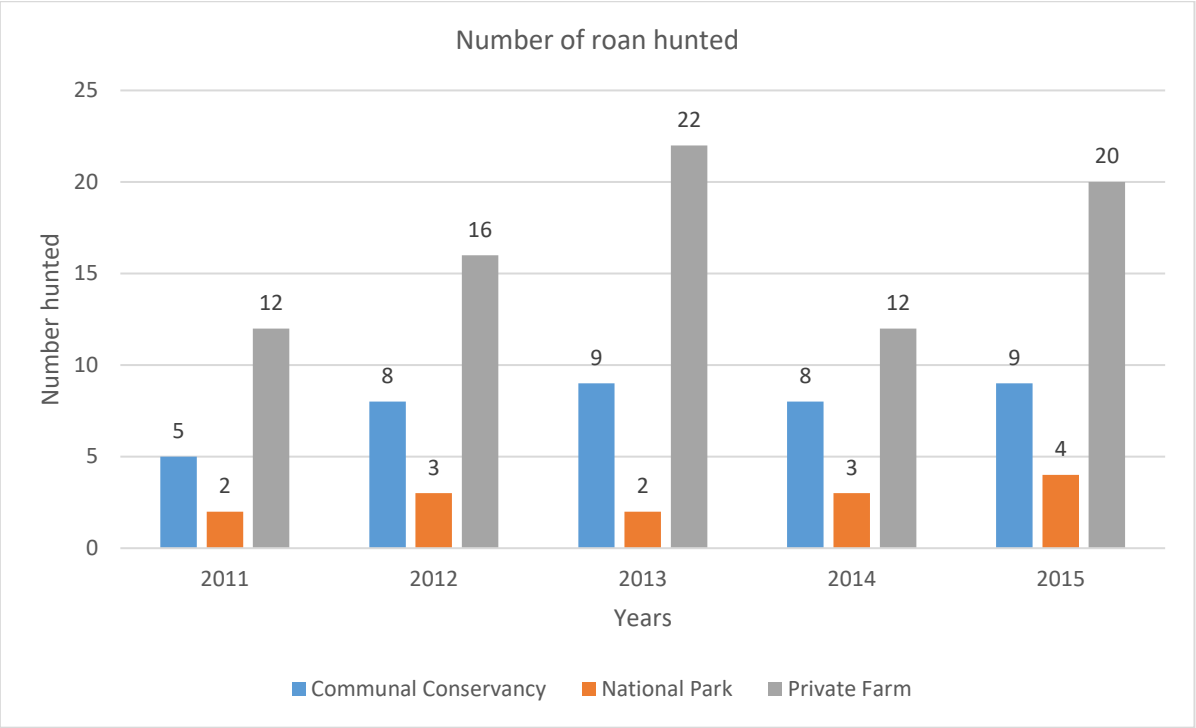

Figure 12: Number of roan hunted nationally during the study period

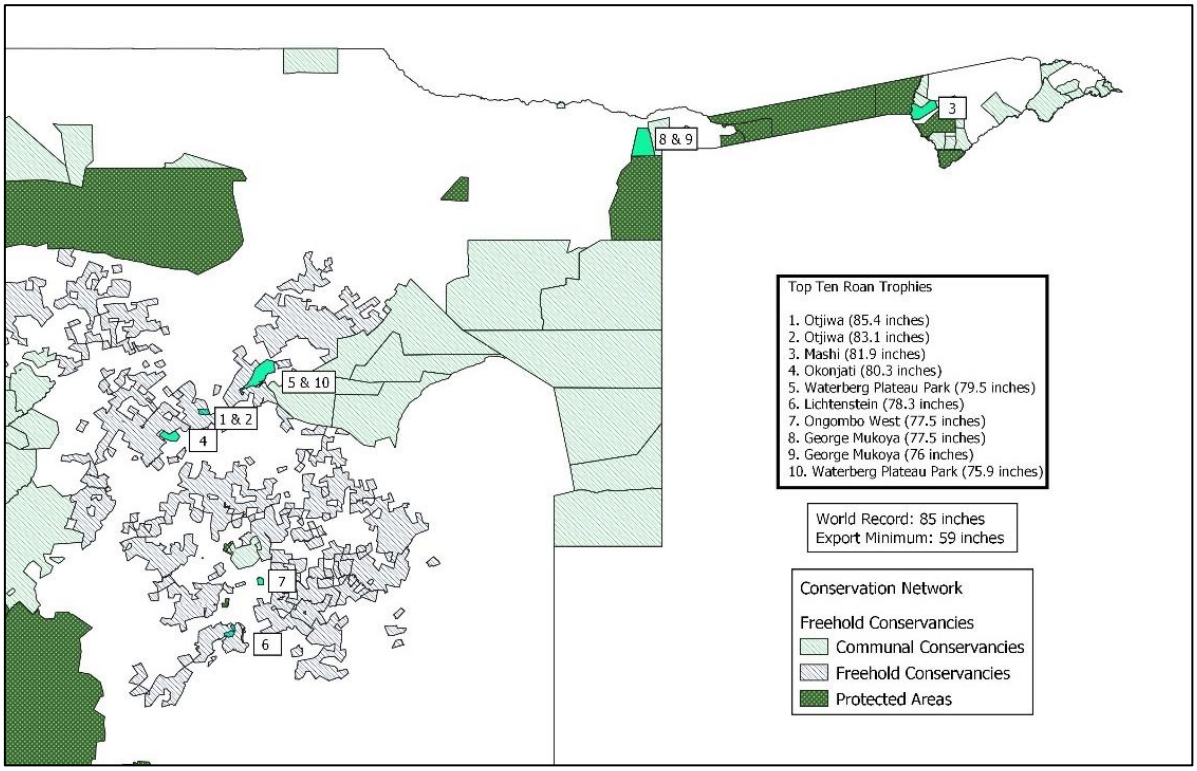

Figure 13: Spatial representation of the top ten roan trophies hunted

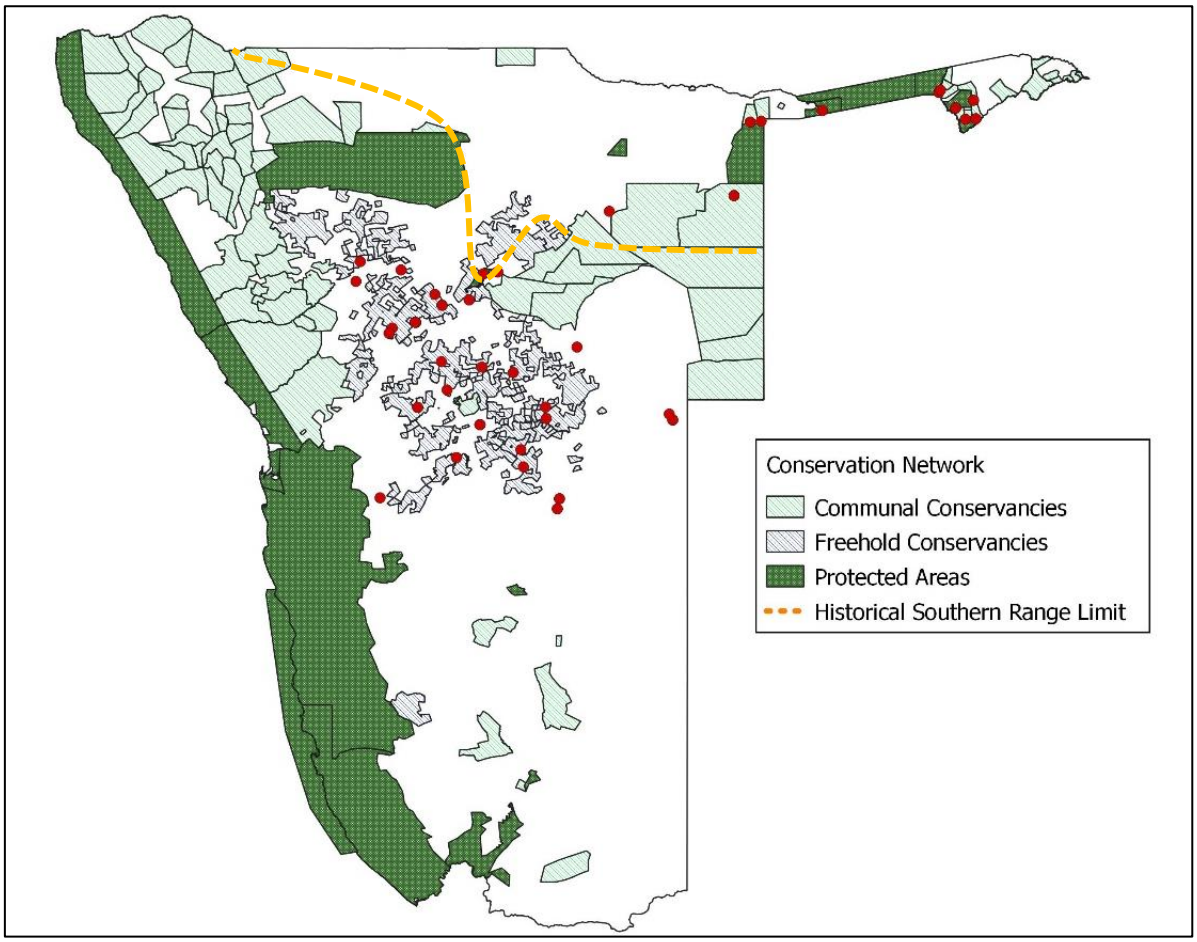

Figure 14: Location of all roan hunts

In contrast to the previous study animal, the number of nationalities represented in the trophy hunting of roan amounted to 20 nationalities (Table 10). No significant trend was displayed in the hunter origins, besides the point that the hunters from the USA and Germany tend to dominate in the hunting of roan across the entirety of Namibia.

Table 10: Roan hunted per hunter's origin

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
USA	10	14	12	11	18	65 (48.14%)	13.0	2.83
Germany	2	5	11	3	3	24 (17.77%)	4.8	3.25
Russia	1	0	1	2	2	6 (4.44%)	1.2	0.75
Austria	0	1	1	1	3	6 (4.44%)	1.2	0.98
Unknown	1	2	1	1	0	5 (3.7%)	1.0	0.63
Namibia	1	0	1	1	1	4 (2.96%)	0.8	0.40
Hungary	0	0	2	0	1	3 (2.22%)	0.6	0.80
Switzerland	0	1	0	0	1	2 (1.48%)	0.4	0.49

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
Spain	0	0	1	0	1	2 (1.48%)	0.4	0.49
Thailand	0	0	1	1	0	2 (1.48%)	0.4	0.49
Canada	0	1	0	0	1	2 (1.48%)	0.4	0.49
RSA	2	0	0	0	0	2 (1.48%)	0.4	0.80
Ukraine	0	0	1	0	1	2 (1.48%)	0.4	0.49
Norway	0	1	0	1	0	2 (1.48%)	0.4	0.49
Romania	1	0	0	1	0	2 (1.48%)	0.4	0.49
France	1	0	0	0	0	1 (0.74%)	0.2	0.40
Italy	0	1	0	0	0	1 (0.74%)	0.2	0.40
Saudi Arabia	0	0	0	1	0	1 (0.74%)	0.2	0.40
Argentina	0	0	1	0	0	1 (0.74%)	0.2	0.40
Sweden	0	1	0	0	0	1 (0.74%)	0.2	0.40
Mexico	0	0	0	0	1	1 (0.74%)	0.2	0.40
Grand Total	**19**	**27**	**33**	**23**	**33**	**135**	**27.0**	**5.51**

According to Figures 15, hunters from the United States, Germany, Sweden, Austria, and Mexico (only one data point in this case) were responsible for shooting record trophy bulls; which is furthermore reflected in the continental origins of the hunters (Figure 16). Variance in trophy size for hunters from the USA and Russia was high. The hunters from Africa and Asia shot smaller trophies. No significant differences were however detected overall.

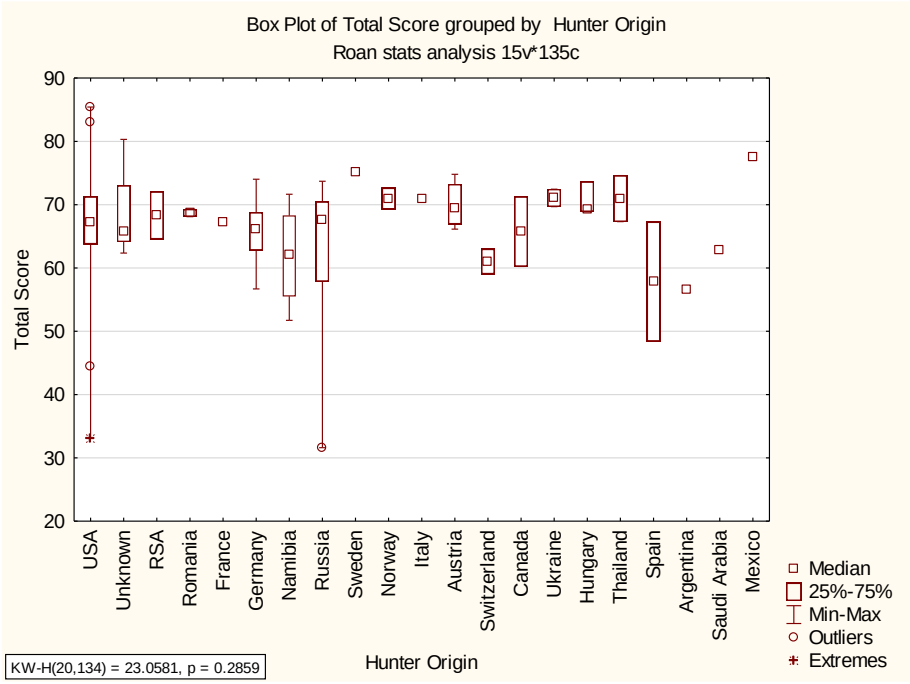

Figure 15: Roan average scores categorized by hunter nationality

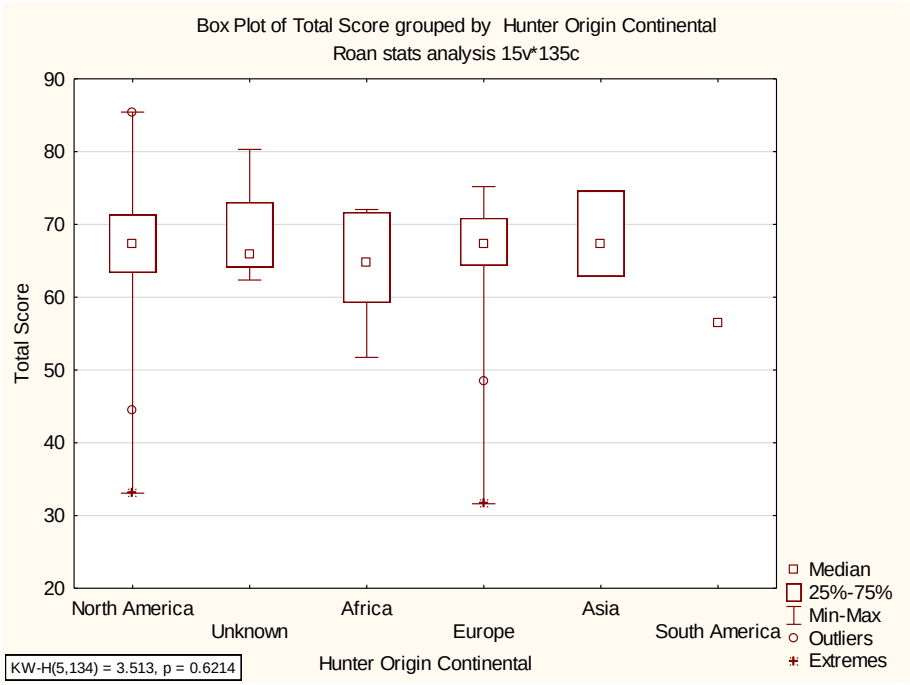

Figure 16: Roan average scores categorized by continent of hunter origin

3.1.3 Sable

From 2011 to 2015, only 20 sable were placed on quota within communal conservancies. Of these, only 8 animals were successfully hunted, which represents 40% of the entire trophy quota (Table 11).

Table 11: Annual quota for sable in communal conservancies and the actual offtake

Year	Trophy quota	Actual offtake according to MEFT trophy data	Own-use quota	Actual offtake according to Event Book data	Total quota	Total offtake
2011	4	1	0	0	4	1
2012	4	0	0	0	4	0
2013	4	5	0	0	4	5
2014	6	1	0	0	6	1
2015	2	1	0	0	2	1
Total	20	8	0	0	20	8

Based on the figures provided below, the number of sable hunted nationally tends to exceed that of roan. However, one still has to take into account that the sample size of sable tends to be small (as was also the case with roan), which will inevitably prevent any definitive conclusions being made regarding the number of sable hunted in areas such as the communal conservancies and the national parks. However, it is clear that there was an increase in the number of sable hunted, with 48 being hunted nationally in 2011 to 73 being hunted in 2015.

Most of the sable hunted in Namibia were hunted on private farms; the subsequent increase in the number hunted was therefore mainly observed on this land-use type, with 44 being hunted in 2011 and 64 being hunted in 2015 (Figure 17). In context, the number of sable hunted on communal conservancies is negligible in comparison to that of the national parks, since in most years there was only one sable hunted per year in the north-eastern communal conservancies. Figures 18 and 19 display the top record trophies and the distribution of all hunts respectively.

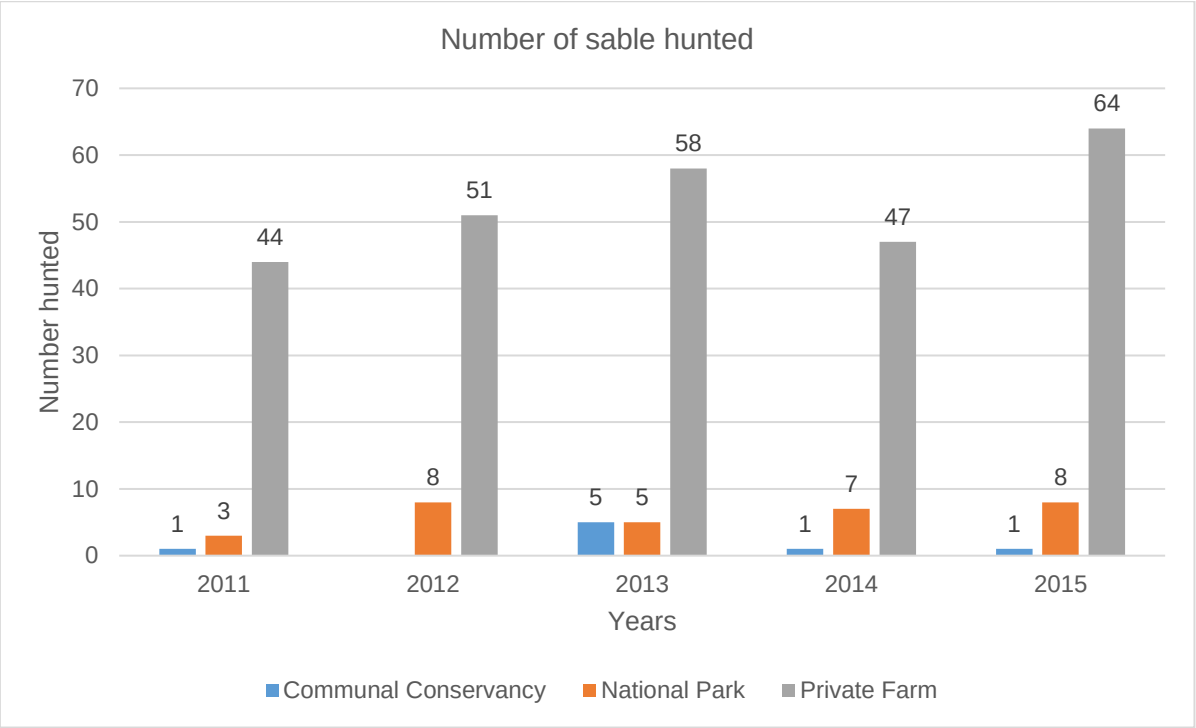

Figure 17: Number of sable hunted in nationally during the study period

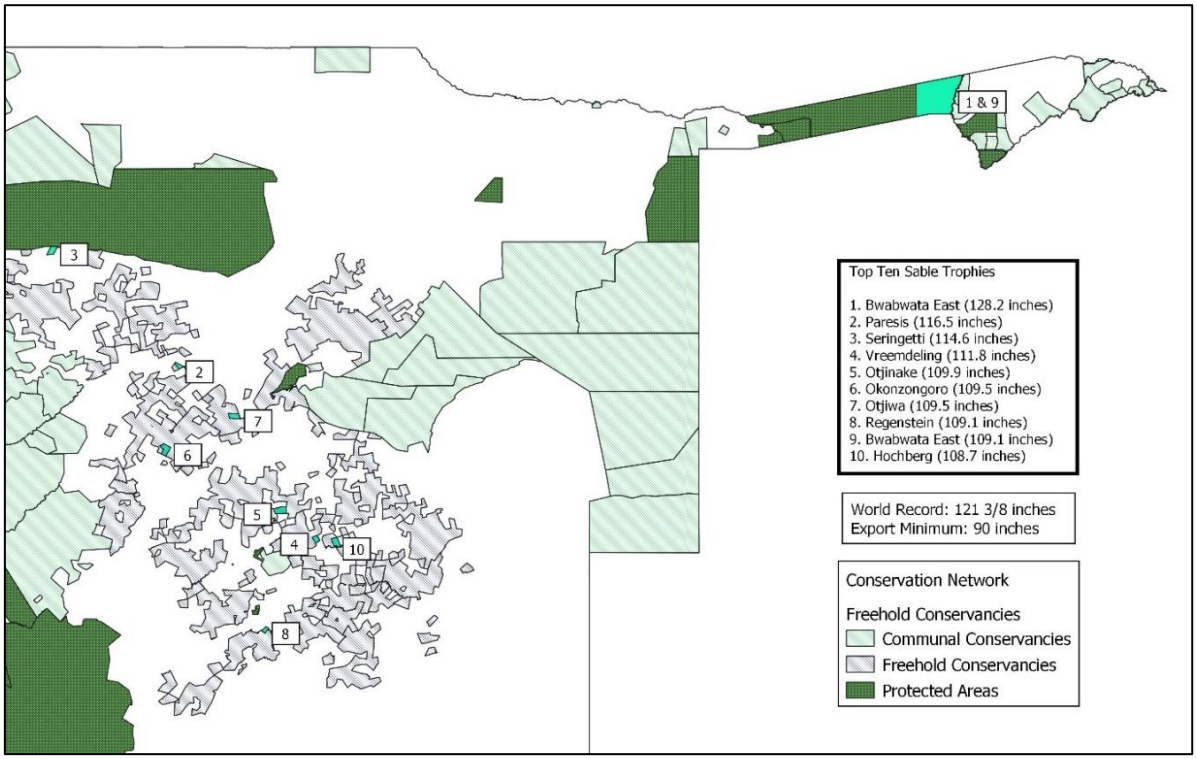

Figure 18: Spatial representation of the top ten sable trophies hunted

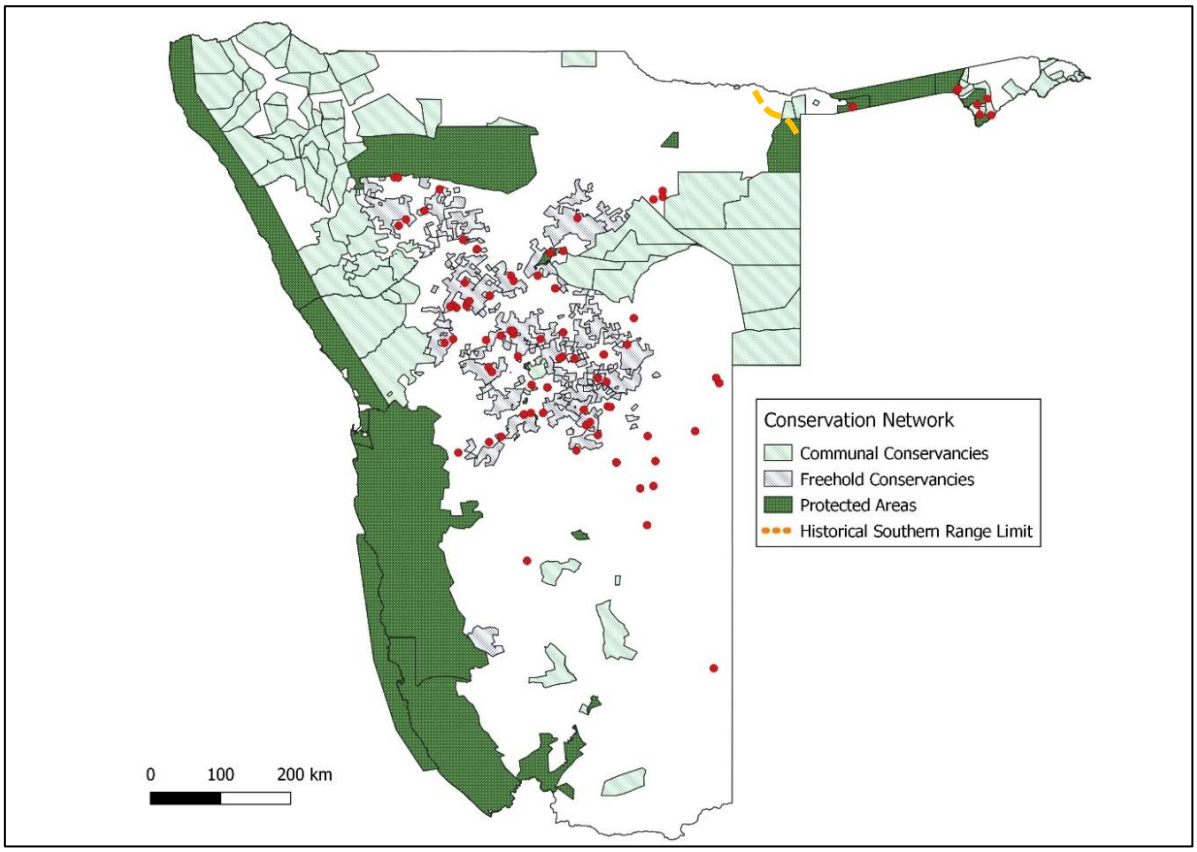

Figure 19: Location of all sable hunts

As with most of the other species, most of the sable hunted within the study period, were hunted by hunters from the United States, Germany, and Austria (Table 12). There were a total of 27 nationalities that partook in the trophy hunting of sable during the study period.

Table 12: Sable hunted per hunter's origin

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
USA	20	21	29	25	34	129 (42.57%)	25.8	5.19
Germany	4	14	13	8	13	52 (17.16%)	10.4	3.83
Austria	4	4	4	5	4	21 (6.93%)	4.2	0.40
Russia	2	3	4	3	5	17 (5.61%)	3.4	1.02
Slovakia	3	3	6	2	0	14 (4.62%)	2.8	1.94
France	0	3	2	0	6	11 (3.63%)	2.2	2.23
Hungary	5	0	1	1	1	8 (2.64%)	1.6	1.74
Ukraine	1	3	0	0	1	5 (1.65%)	1.0	1.10
Canada	1	0	2	1	1	5 (1.65%)	1.0	0.63

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
Czech Republic	2	1	0	0	2	5 (1.65%)	1.0	0.89
Latvia	0	0	4	0	0	4 (1.32%)	0.8	1.60
Turkey	0	0	0	3	0	3 (0.99%)	0.6	1.20
Bulgaria	1	1	1	0	0	3 (0.99%)	0.6	0.49
Mexico	0	0	0	2	1	3 (0.99%)	0.6	0.80
Italy	1	1	0	0	1	3 (0.99%)	0.6	0.49
Spain	1	1	0	0	1	3 (0.99%)	0.6	0.49
Australia	0	0	0	0	2	2 (0.66%)	0.4	0.80
Unknown	0	1	0	1	0	2 (0.66%)	0.4	0.49
Sweden	0	0	1	0	1	2 (0.66%)	0.4	0.49
Poland	0	2	0	0	0	2 (0.66%)	0.4	0.80
Namibia	0	0	0	2	0	2 (0.66%)	0.4	0.80
Monaco	0	0	0	1	0	1 (0.33%)	0.2	0.40
Netherlands	0	0	0	1	0	1 (0.33%)	0.2	0.40
China	0	1	0	0	0	1 (0.33%)	0.2	0.40
Switzerland	1	0	0	0	0	1 (0.33%)	0.2	0.40
Norway	1	0	0	0	0	1 (0.33%)	0.2	0.40
Romania	1	0	0	0	0	1 (0.33%)	0.2	0.40
UAE	0	0	1	0	0	1 (0.33%)	0.2	0.40
Grand Total	**48**	**59**	**68**	**55**	**73**	**303**	**60.6**	**8.96**

The nationalities that were responsible for the hunting of bigger trophies (Figure 20) were individuals from the United States and Russia specifically. Again, the hunters from Europe and North America (Figure 21), were responsible for claiming the larger trophies, while the hunters from Africa, Asia and Oceania claimed the smallest trophies. There were however no significant differences in the sizes of trophies per hunter origin.

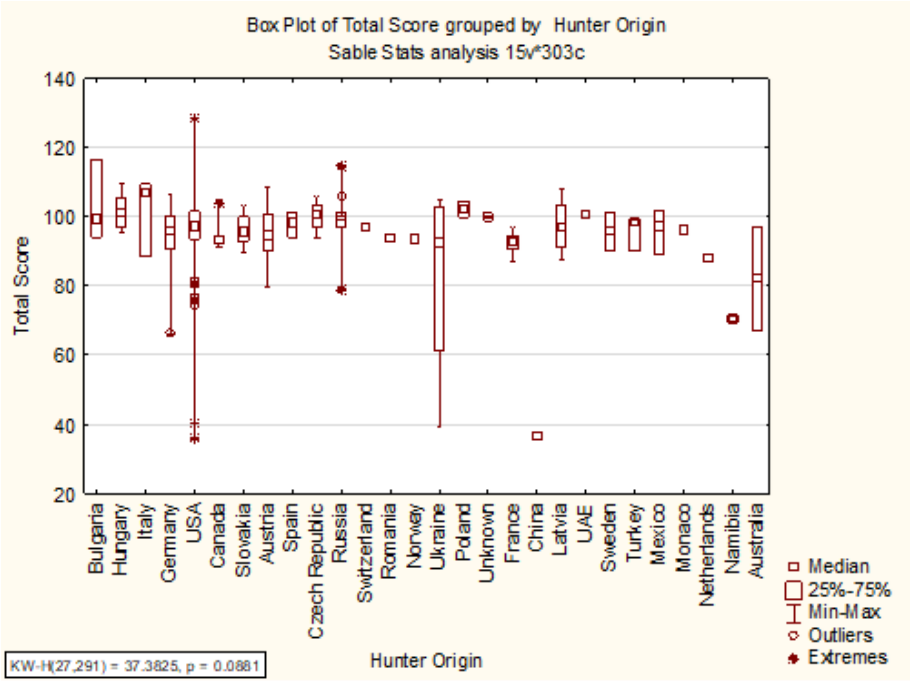

Figure 20: Sable score averages categorized according to hunter nationality

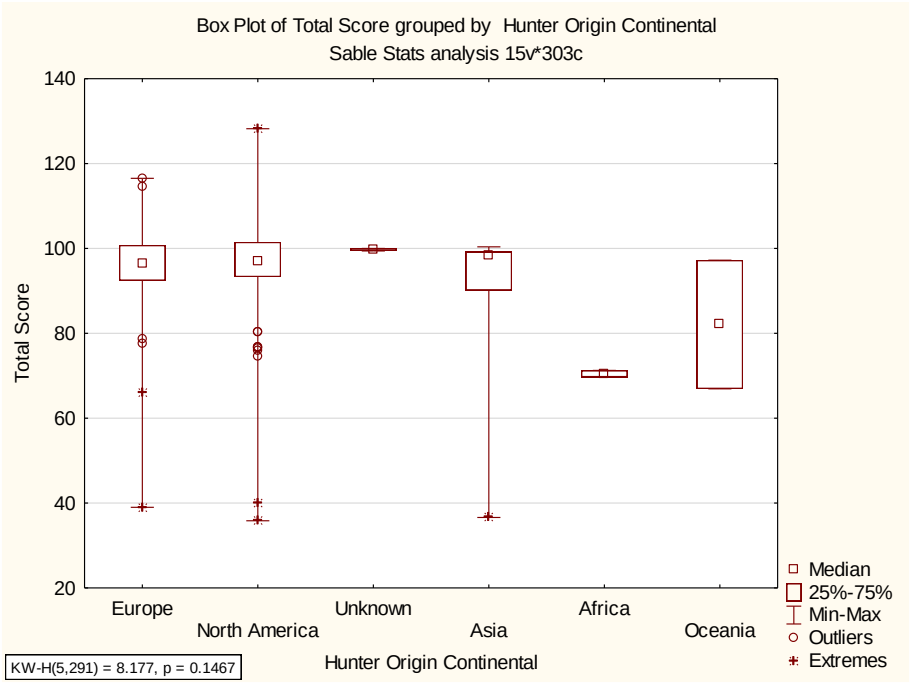

Figure 21: Sable score averages categorized by continent of hunter origin

3.1.4 Kudu

During the course of the study period, a total of 804 kudu were placed on quota in communal conservancies, and of this number, a total of 201 kudu were successfully hunted (representing 25% of the allocated quota). As can be seen in Table 13, the number of kudu hunted within all communal conservancies decreased slightly from 41 individuals to 37 – which represents a -9.7% decrease in the number of kudu hunted.

Table 13: Annual quota for kudu in communal conservancies and the actual offtake

Years	Trophy quota	Actual offtake according to MEFT trophy data	Own-use quota	Actual offtake according to Event Book data	Total quota	Total offtake
2011	194	41	293	69	487	110
2012	147	50	144	84	291	134
2013	136	45	210	128	346	173
2014	144	28	228	109	372	137
2015	183	37	279	103	462	140
Total	804	201	1154	493	1958	694

Based on the records of the number of animals hunted across all land-use types (Figure 22), there has been a noticeable decline in the number of animals hunted. This could be an indicator of reduced availability of kudu, especially on the private farms, where the numbers hunted declined from 2,222 to 1,446 (which correlates with reduced trophy size for private farms). The number hunted on the communal conservancies showed a slight decrease, but as in the case of the private farms, the overall trophy size correlates with the decline in trophy size in communal conservancies. The only land use that has experienced an increase in hunting of kudu are the national parks, however the rate of trophy size decline is higher in this land use than the other two land uses. Of all the trophy hunts conducted, 0.01% (n=92) were conducted within north-eastern communal conservancies, while 0.015% (n=159) were hunted in remaining communal conservancies. The spatial distribution of the top ten records for kudu and the distribution for kudu hunts are displayed in Figures 23 and 24.

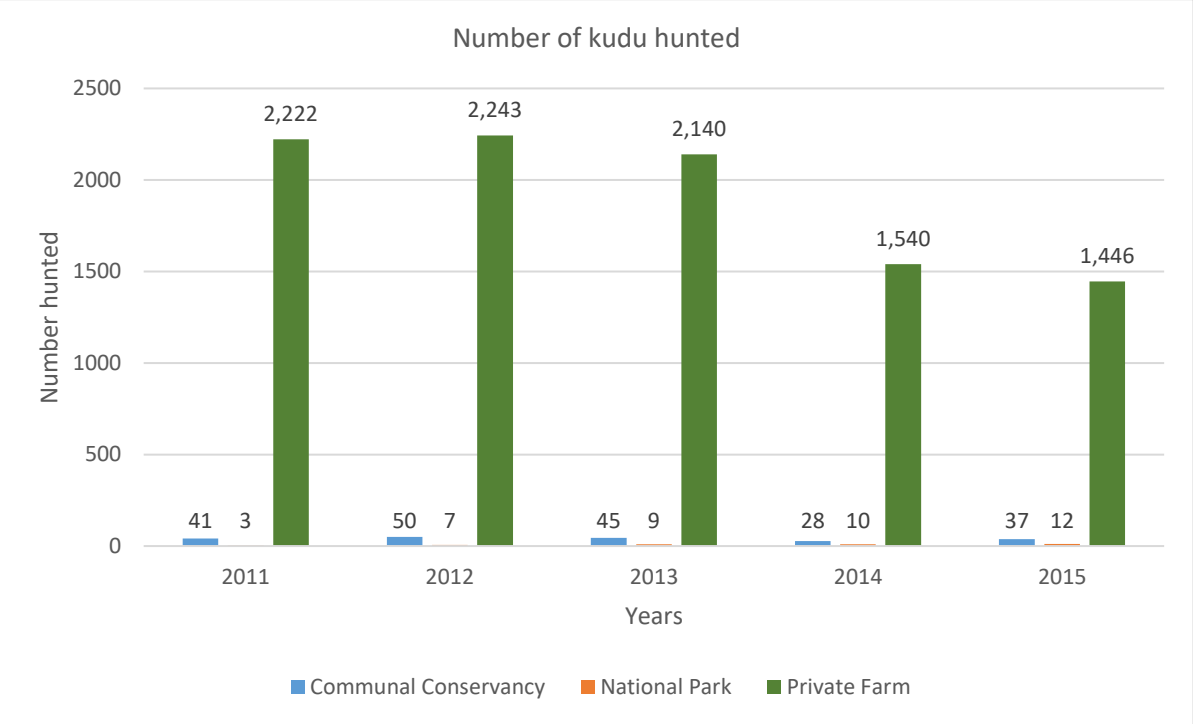

Figure 22: The number of kudu hunted nationally in 2011-2015

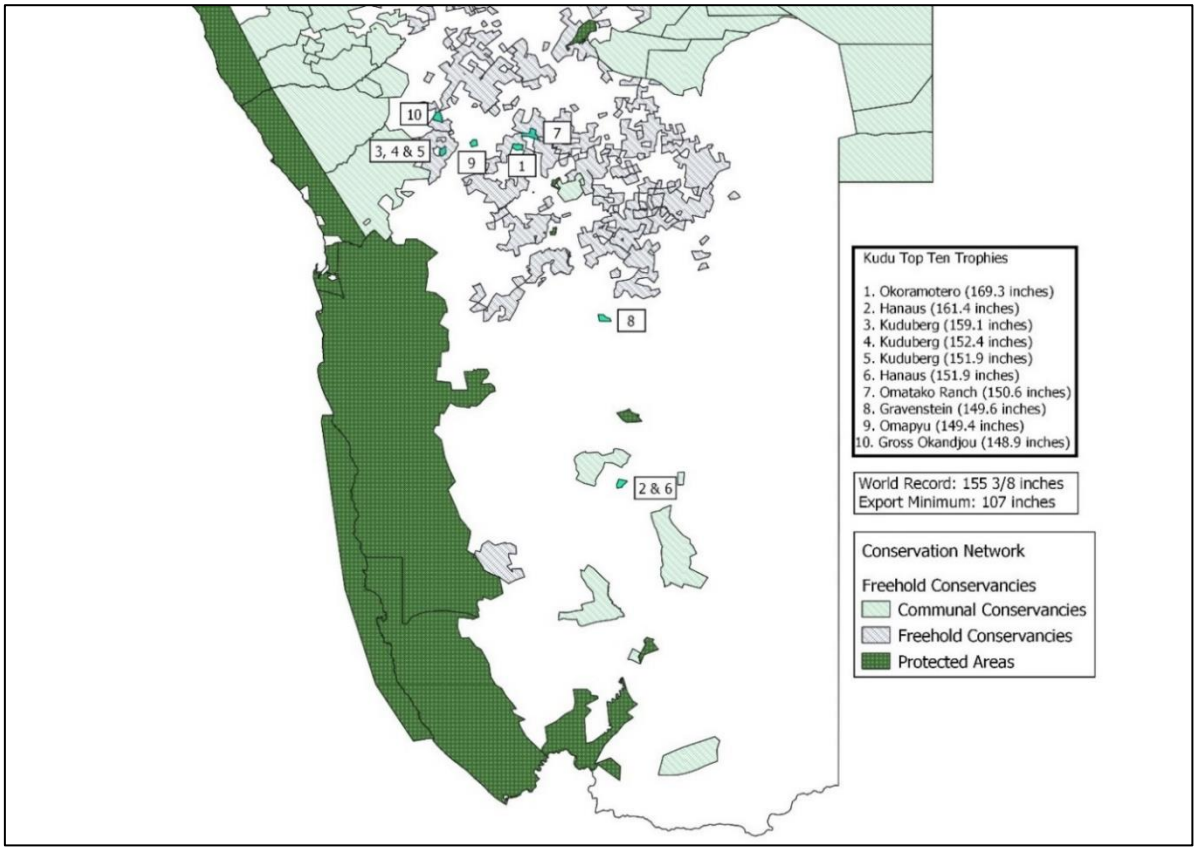

Figure 23: Spatial representation of top ten kudu trophies hunted

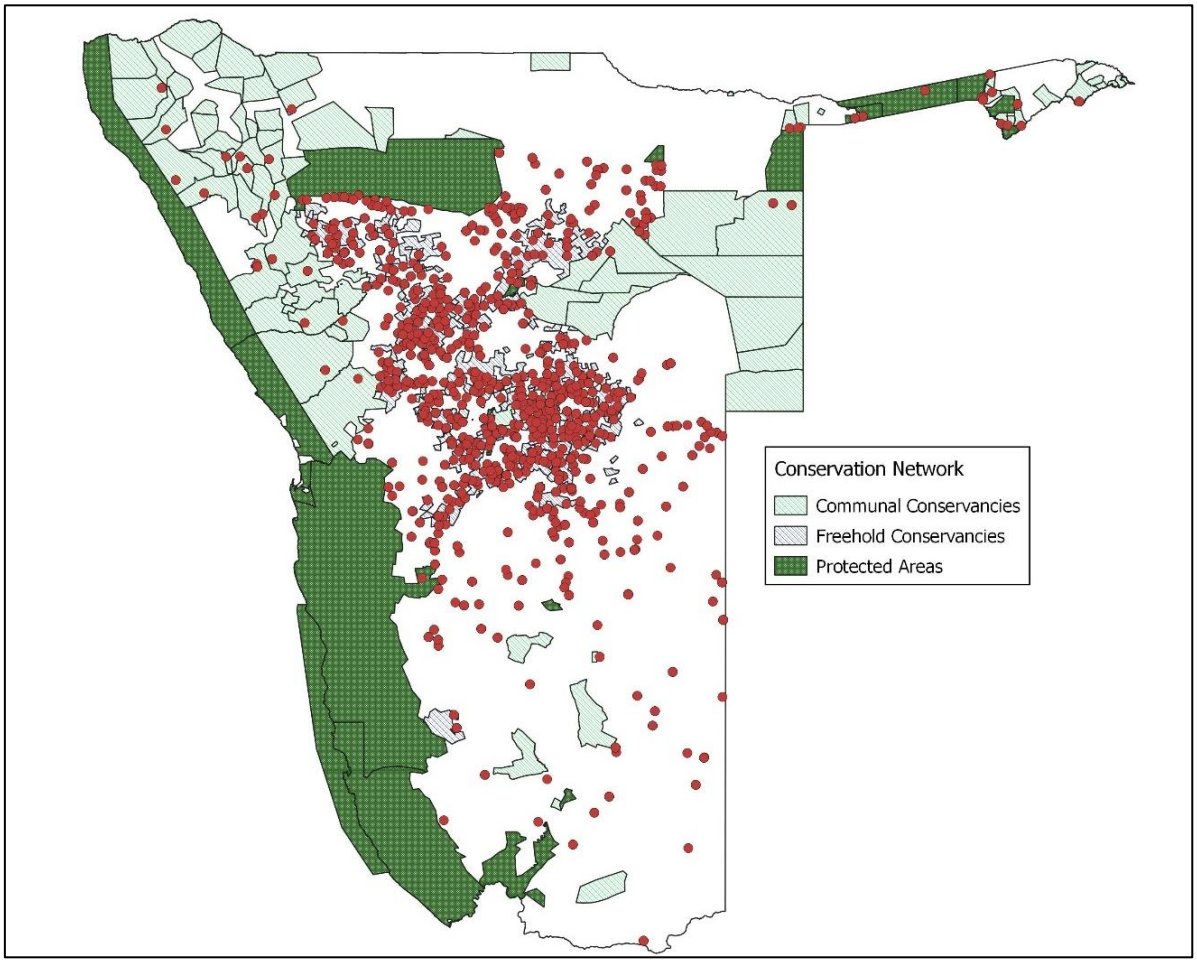

Figure 24: Location of all kudu hunts

As within most of the other study species, the highest number of kudu hunted within Namibia were claimed by the hunters that originated mainly from the USA, Germany, and Austria (Table 14). It should be noted, however, that there was a fair level of decline in the number of kudu hunted from the year 2013 onwards due to the influence of rabies and drought on the kudu population (Section 4.2.4).

Table 14: Kudu hunted per hunter's origin

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
USA	688	627	666	529	469	2,979 (30.23%)	595.8	83.60
Germany	428	559	506	342	329	2,164 (21.97%)	432.8	89.81
Austria	180	220	164	92	120	776 (7.88%)	155.2	45.00
France	125	117	113	82	80	517 (5.24%)	103.4	18.70
Hungary	71	62	65	92	101	391 (3.97%)	78.2	15.48
Russia	84	80	68	38	25	295 (2.99%)	59.0	23.43

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
Canada	40	45	73	43	30	231 (2.34%)	46.2	14.36
Sweden	36	45	49	35	51	216 (2.19%)	43.2	6.58
Spain	82	41	32	26	26	207 (2.10%)	41.4	21.03
Denmark	66	41	30	25	21	183 (1.86%)	36.6	16.16
Italy	31	40	20	28	29	148 (1.5%)	29.6	6.41
Argentina	40	32	28	29	18	147 (1.49%)	29.4	7.09
Czech Republic	34	25	28	13	15	115 (1.17%)	23.0	7.92
Slovakia	27	31	22	14	19	113 (1.15%)	22.6	5.95
Poland	22	32	30	14	14	112 (1.14%)	22.4	7.63
Norway	34	31	18	13	14	110 (1.12%)	22.0	8.79
Mauritius	29	21	25	13	14	102 (1.03%)	20.4	6.18
Switzerland	11	31	26	14	16	98 (0.99%)	19.6	7.61
Finland	37	17	22	10	4	90 (0.91%)	18.0	11.30
Australia	19	17	22	11	12	81 (0.82%)	16.2	4.17
Bulgaria	19	17	18	9	7	70 (0.71%)	14.0	4.98
Belgium	10	19	17	9	13	68 (0.69%)	13.6	3.88
RSA	13	21	15	7	9	65 (0.65%)	13.0	4.90
Mexico	23	13	8	8	10	62 (0.63%)	12.4	5.61
UK	11	9	11	16	10	57 (0.58%)	11.4	2.42
Unknown	28	5	19	1	3	56 (0.57%)	11.2	10.51
Romania	3	10	19	10	2	44 (0.45%)	8.8	6.11
Netherlands	9	13	7	7	4	40 (0.41%)	8.0	2.97
Ukraine	3	16	13	3	4	39 (0.40%)	7.8	5.56
Slovenia	12	6	4	1	4	27 (0.27%)	5.4	3.67
New Zealand	8	3	4	3	8	26 (0.26%)	5.2	2.32
Namibia	4	11	4	4	1	24 (0.24%)	4.8	3.31
Latvia	3	5	9	1	1	19 (0.19%)	3.8	2.99
Croatia	3	8	3	5	0	19 (0.19%)	3.8	2.64
Brazil	4	6	4	3	1	18 (0.18%)	3.6	1.62
Serbia	3	4	3	5	0	15 (0.15%)	3.0	1.67
Luxembourg	1	0	3	8	2	14 (0.14%)	2.8	2.79
Portugal	1	3	2	3	4	13 (0.13%)	2.6	1.02

Hunter Nationalities	Years					Grand Total	Mean	Standard Deviation
	2011	2012	2013	2014	2015			
Estonia	6	4	0	0	2	12 (0.12%)	2.4	2.33
Turkey	3	1	2	3	1	10 (0.1%)	2.0	0.89
Lithuania	2	1	3	3	1	10 (0.1%)	2.0	0.89
Iceland	0	0	4	2	1	7 (0.07%)	1.4	1.50
Angola	3	2	0	1	0	6 (0.06%)	1.2	1.17
India	1	0	1	0	3	5 (0.05%)	1.0	1.10
Reunion	0	0	1	2	1	4 (0.04%)	0.8	0.75
Belarus	0	2	2	0	0	4 (0.04%)	0.8	0.98
Venezuela	1	0	2	1	0	4 (0.04%)	0.8	0.75
Kazakhstan	1	2	0	1	0	4 (0.04%)	0.8	0.75
Chile	0	0	2	0	2	4 (0.04%)	0.8	0.98
Qatar	3	0	0	0	0	3 (0.03%)	0.6	1.20
Bosnia	0	0	2	0	1	3 (0.03%)	0.6	0.80
Uruguay	0	0	0	1	2	3 (0.03%)	0.6	0.80
El Salvador	0	2	0	0	1	3 (0.03%)	0.6	0.80
China	0	0	1	1	1	3 (0.03%)	0.6	0.49
Thailand	0	0	1	1	0	2 (0.02%)	0.4	0.49
Greece	2	0	0	0	0	2 (0.02%)	0.4	0.80
Lebanon	1	0	0	1	0	2 (0.02%)	0.4	0.49
Israel	0	0	1	0	0	1 (0.01%)	0.2	0.40
Singapore	1	0	0	0	0	1 (0.01%)	0.2	0.40
New Caledonia	0	0	1	0	0	1 (0.01%)	0.2	0.40
Cyprus	0	0	0	1	0	1 (0.01%)	0.2	0.40
Montenegro	0	1	0	0	0	1 (0.01%)	0.2	0.40
Saudi Arabia	0	1	0	0	0	1 (0.01%)	0.2	0.40
Bahrain	0	0	0	0	1	1 (0.01%)	0.2	0.40
UAE	0	0	1	0	0	1 (0.01%)	0.2	0.40
Monaco	0	0	0	1	0	1 (0.01%)	0.2	0.40
Panama	0	1	0	0	0	1 (0.01%)	0.2	0.40
Grand Total	**2,266**	**2,300**	**2,194**	**1,585**	**1,507**	**9,852**	**1970.4**	**349.08**

Unlike the previous three study species, the number of nationalities involved in the hunting of kudu proved to be far more extensive (Figure 25), hence the stronger emphasis of “continental” rather than

the “country” as a means of determining the selection of trophies during the study period. As can be seen in the graphs below, the hunters from North America and Europe (Figure 26) claimed the higher record trophies during the study period (biggest records per year according to hunter origin are recorded in Appendix D). The hunters from Africa had the highest median, whereas the hunters from Asia had the lowest median. The statistical analysis shows that there was a significant difference ($p<0.05$) in Figures 25 and 26.

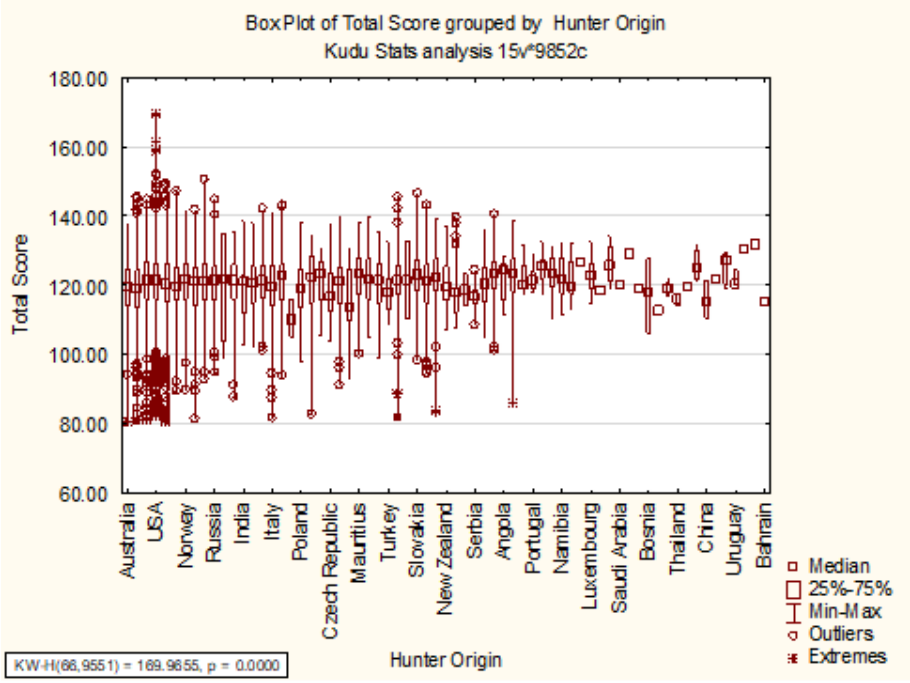

Figure 25: Trophy scores according to country of hunter origin

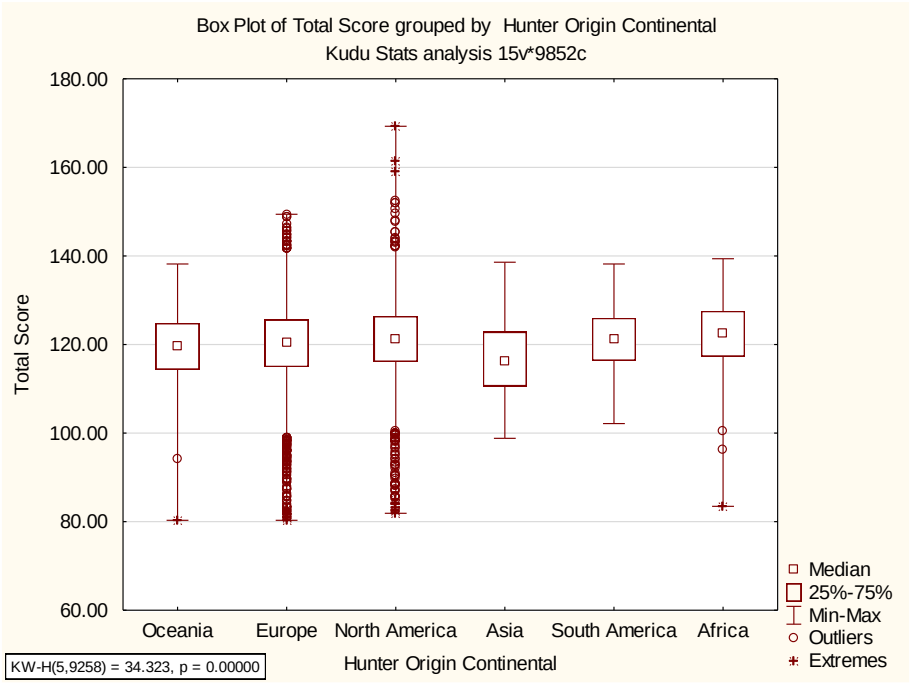

Figure 26: Trophy scores according to the continent of hunter origin

3.2 Trophy measurement trends over time

3.2.1 Buffalo

The mean score for buffalo that were hunted in Namibia was 98.12 inches with a standard deviation of 12 inches, and, as can be seen in Figure 27, the highest numbers of scores achieved nationally were within the range of 101-106 inches (red line indicates the trophy minimum for entry into the SCI Record Book and the blue line denotes the minimum exportable measurement). Furthermore, 119 of the 263 (45%) quantified scores were eligible for entry into the SCI Record Book. The highest number of scores achieved within communal conservancies (Figure 28) were within the range of 101-106 inches; 73 of the 180 (41%) quantified scores were eligible for entry into the SCI Record Book. The highest number of scores achieved within national parks (Figure 28) were within the range of 101-106 inches; 46 of the 83 (55%) quantified scores were eligible for entry into the SCI Record Book.

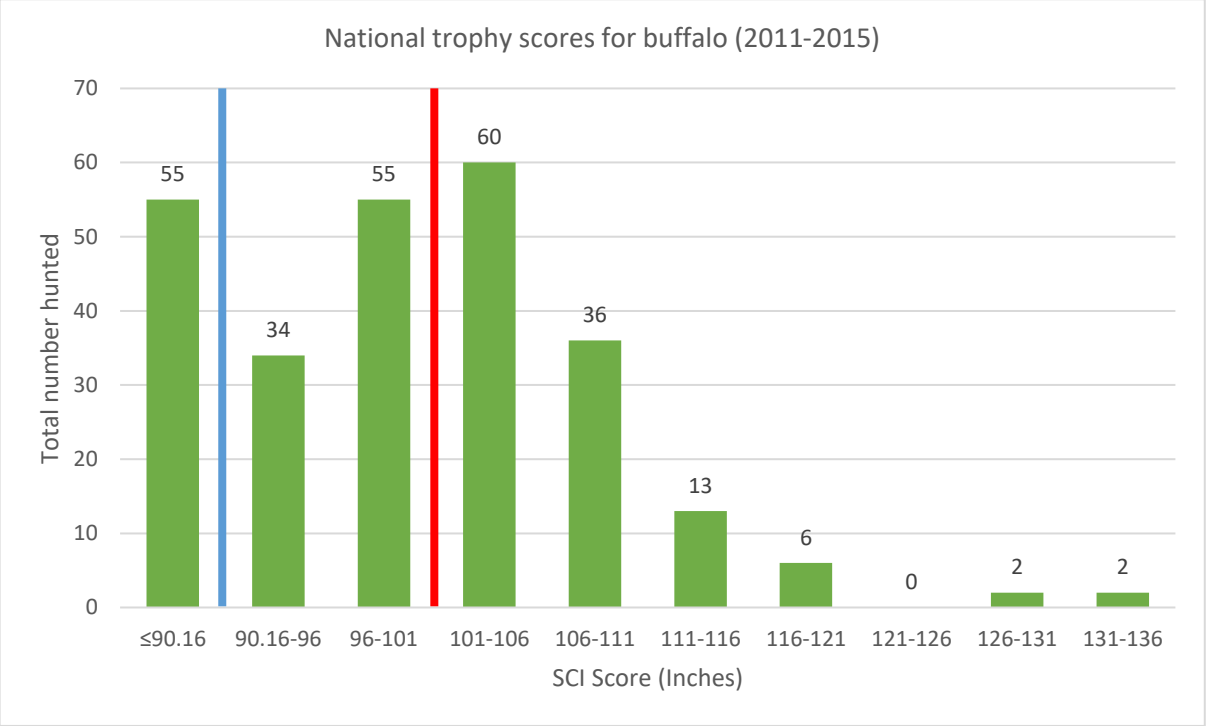

Figure 27: Range of SCI scores for buffalo countrywide (red line indicates SCI threshold score and blue line indicates minimum exportable value)

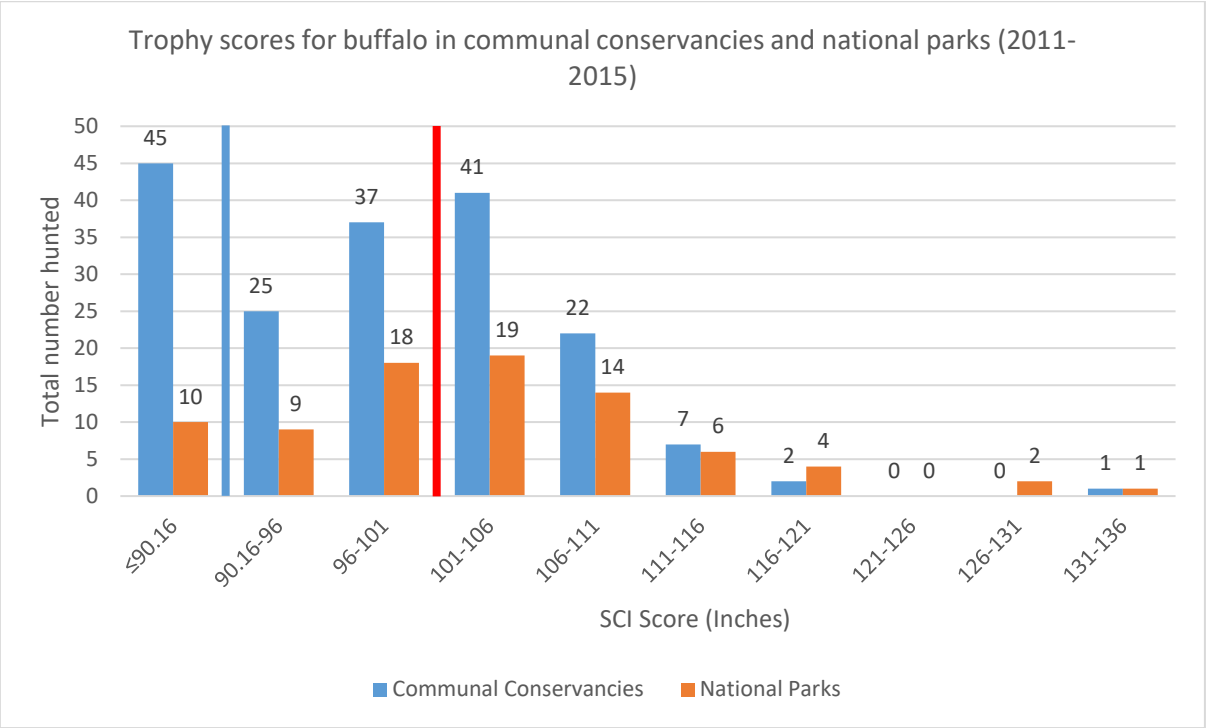

Figure 28: Range of SCI scores for buffalo in communal conservancies and national parks (red line indicates SCI threshold score and blue line indicates minimum exportable value)

3.2.2 Roan

The minimum measurement for record entry into the SCI record book (specifically for roan) is 67 inches. A close analysis of the graphs below indicates that the highest average of the trophies hunted nationally (Figure 30) within the six-year period had a score between 67 and 72 inches; 73 of the 138 (53%) quantified scores were eligible for entry into the SCI Record Book. For this study period, the mean average score for roan trophies was 66.84 inches with a standard deviation of 7.61 inches. The highest average trophy scores taken within the communal conservancies (Figure 30) were within the 62 and 67-inch threshold; additionally, only 15 of the 38 (39%) trophies hunted within the communal conservancies were eligible for entry into the SCI Record Book. As seen in Figure 30, a closer look at the various land uses indicate that the national parks (in the face of the low offtake rate) also have a majority of the trophy measurements within the 67 and 72-inch range (7 of the 14 quantified scores, i.e. 50%, were eligible for entry into the SCI Record Book). However, the number of roan trophies above and below the 67-inch threshold are exactly equal. Clearly, the highest average for trophies hunted within private farms (Figure 30) were within the range of 67 and 72 inches, and 52 of the 86 (60%) trophies hunted were above the 67-inch threshold.

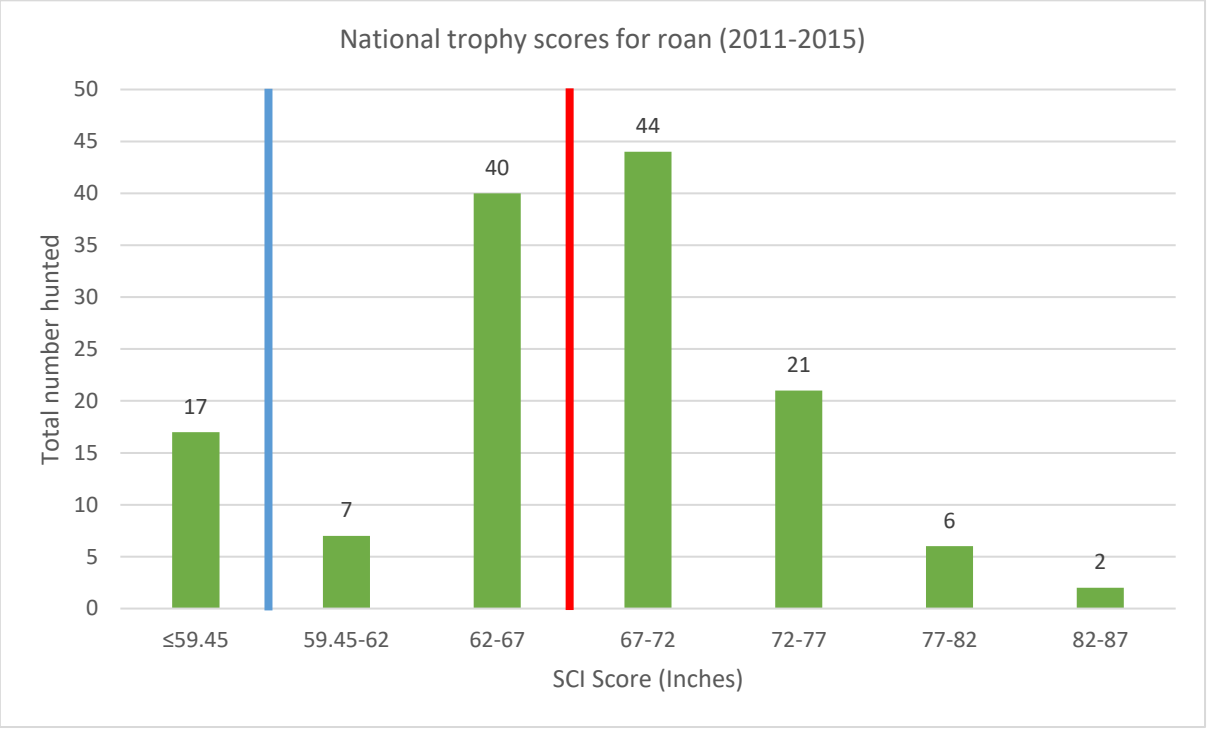

Figure 29: Range of SCI scores for roan countrywide (red line indicates SCI threshold score and blue line indicates minimum exportable value)

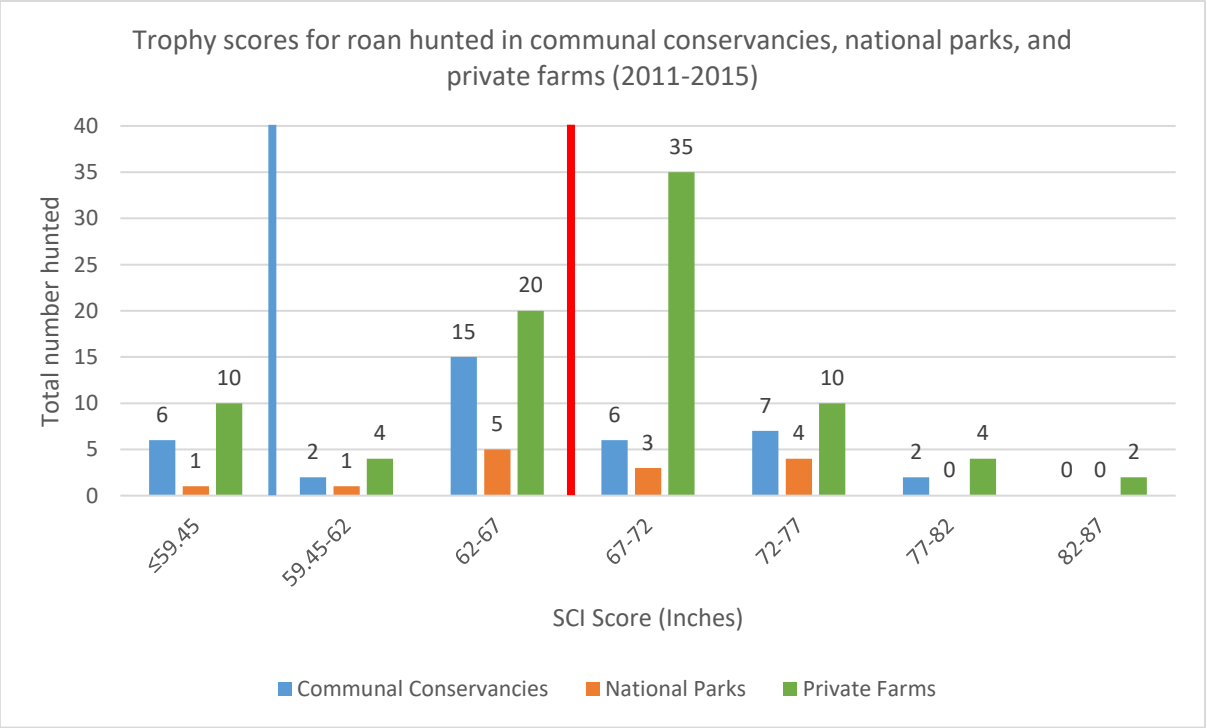

Figure 30: Range of SCI scores for roan in communal conservancies, national parks, and private farms (red line indicates SCI threshold score and blue line indicates minimum exportable value)

3.2.3 Sable

Based on the SCI scoring system, only trophies that measure above 96 inches are eligible for entry into the record book. According to the data analysed, most of the trophies sampled nationally were over the 96-inch threshold (57%), with most of these records being sourced from private farms; the mean average for sable trophy scores were 95.6 inches with a standard deviation of 10.34 inches. The scoring range that seemed to be common nationally (Figure 31) was the 96-101 score range with 96 individuals being measured in this range. Of the 299 individuals that were measured, 171 were above the SCI record book threshold (57% of the recorded entries). Due to the low number of individuals hunted in communal conservancies, this data were pooled with those of the national parks (Figure 32). The highest number of scores achieved in the two land-use types were within the range of 96-101 inches. Furthermore, 22 of the 38 (58%) quantified scores were eligible for entry into the SCI Record Book. The more common range of measured trophy scores within private farms (Figure 32) was in the 96-101 range. Of the 261 that were measured on private farms, 149 individuals were above SCI Record Book entry threshold (57% of the records).

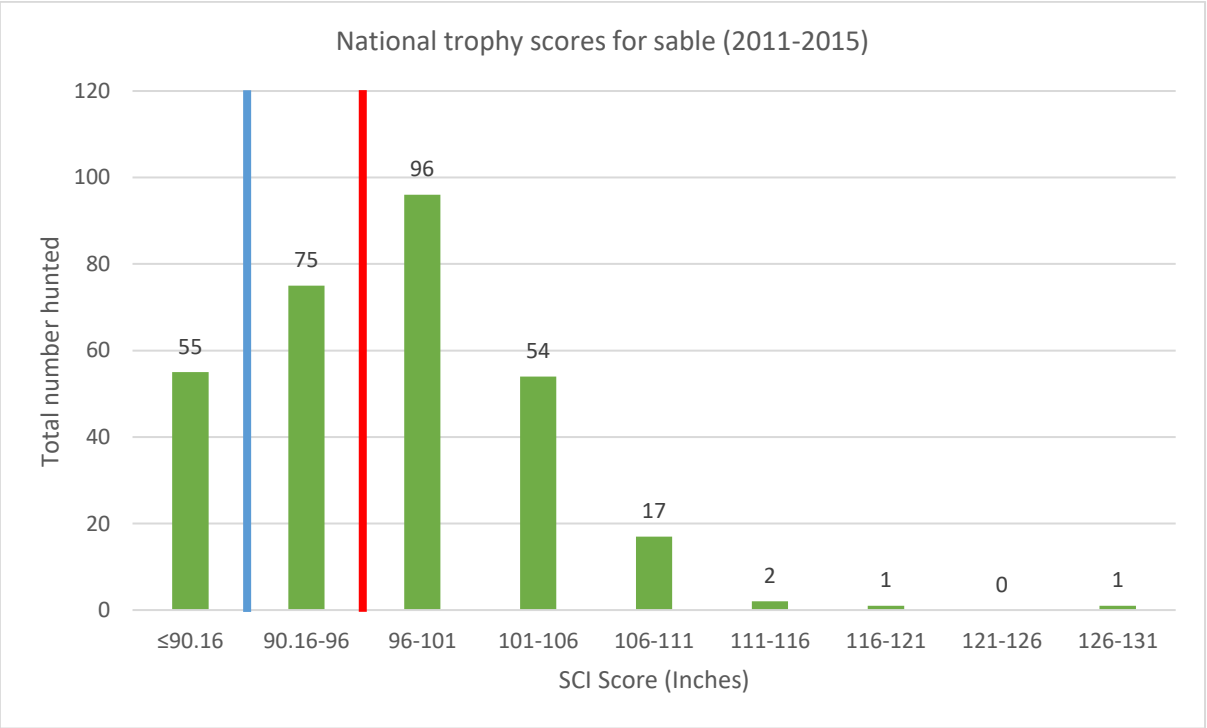

Figure 31: Range of SCI scores for sable countrywide (red line indicates SCI threshold score and blue line indicates minimum exportable value)

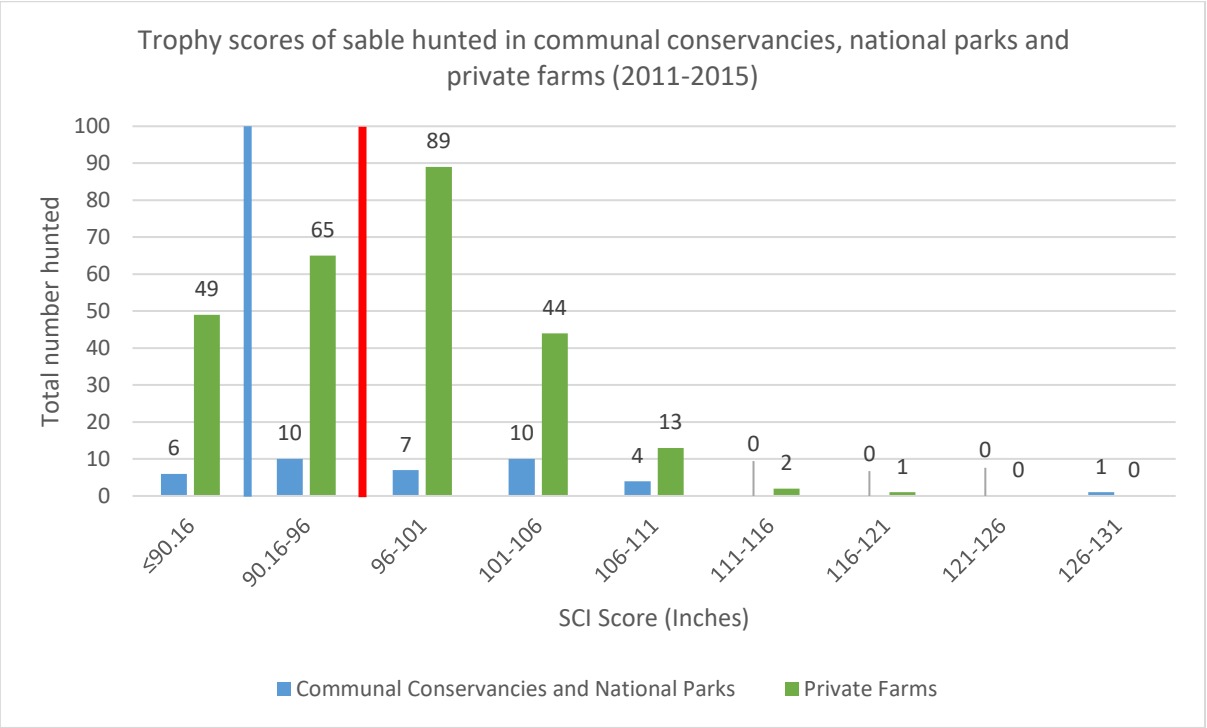

Figure 32: Range of SCI scores for sable in communal conservancies, national parks, and private farms (red line indicates SCI threshold score and blue line indicates minimum exportable value)

3.2.4 Kudu

The minimum trophy measurement for the SCI Record Book is 121 inches. The number of trophies above the 121-inch minimum entry record is 4,691 of a total of 9,533 trophy measurements, which makes up 49.2% of the total trophies measured during this period (Figure 33); the mean trophy size was 119.04 inches with a standard deviation of 11.38 inches.

Of the kudu trophy hunts, 188 trophy measurements were taken of kudus that were hunted within the communal conservancies (Figure 34), and 62.2% of measured trophies qualify for entry into the SCI record book. In the national parks, where the hunts were even fewer than that of the communal conservancies, 39 kudus were hunted; of which, 32 were above the 121-inch record minimum (82% of all trophy measurements for national parks).

Within private farmland, most of the trophy measurements were measured in the 121-126 range (Figure 34). However, of the 9,306 trophies hunted on private farms, 4,542 of the measurements were above the 121-inch record entry minimum (this accounts for 48.8% of all measurements).

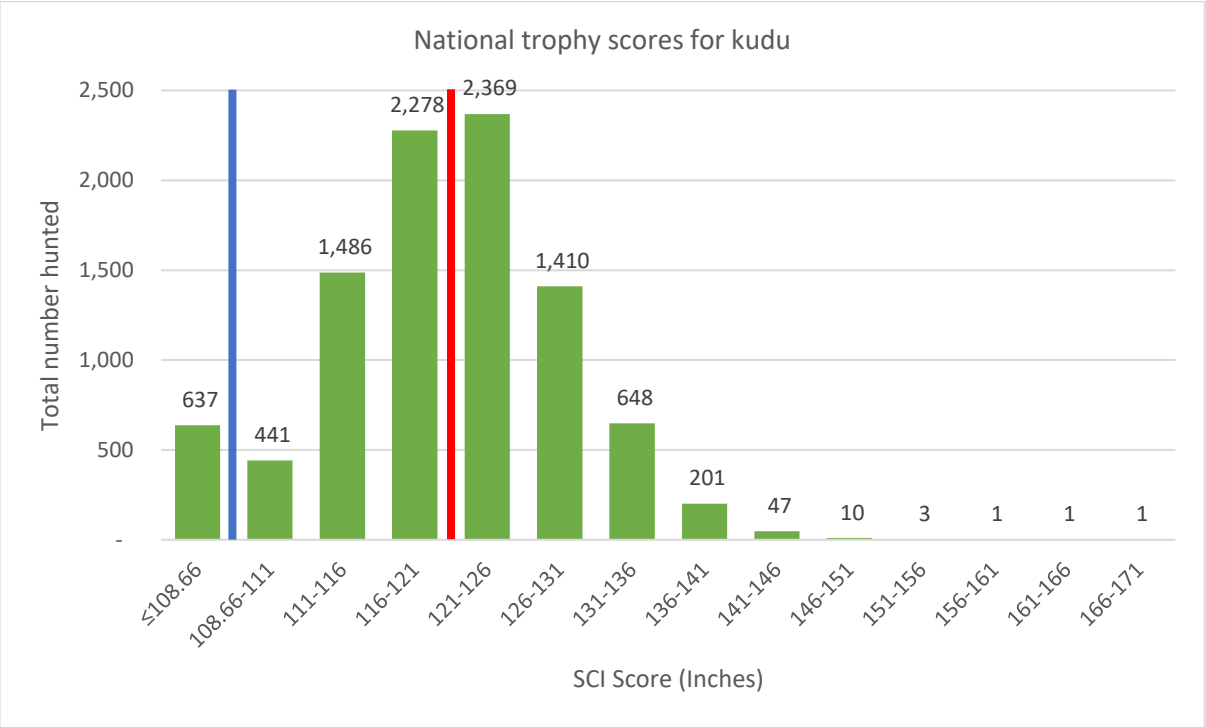

Figure 33: Range of SCI scores for kudu countrywide (red line indicates SCI threshold score and blue line indicates minimum exportable value)

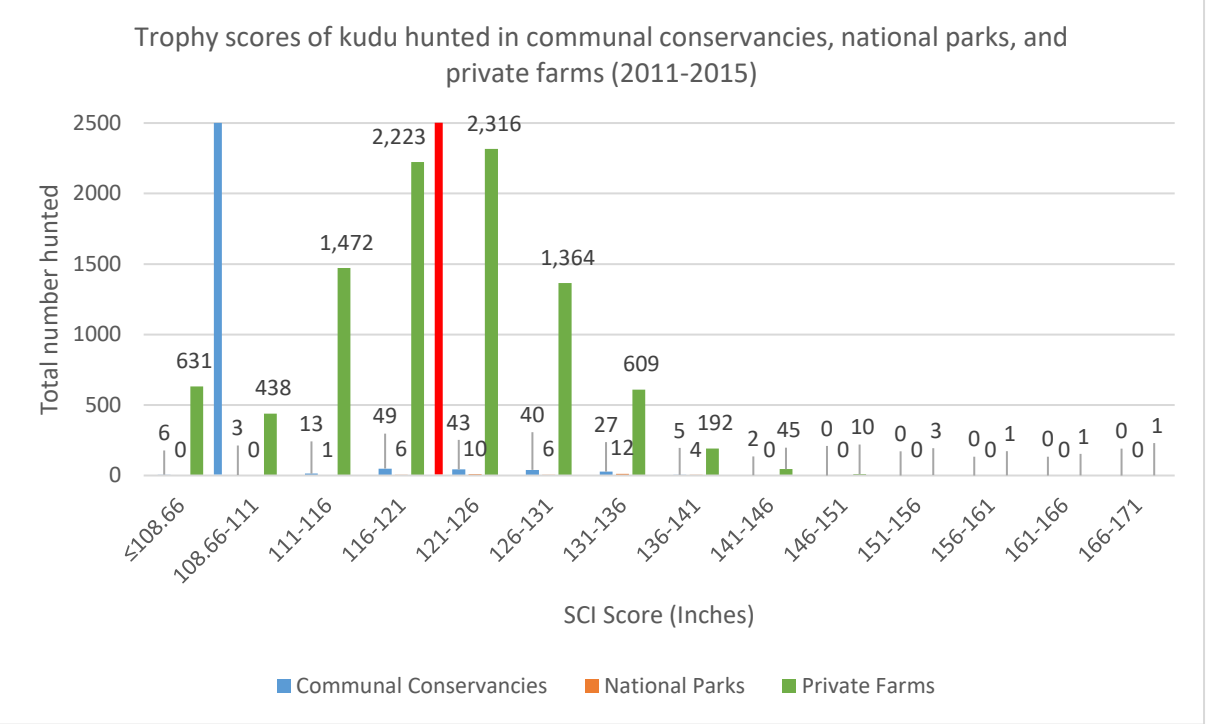

Figure 34: Range of SCI scores for kudu in communal conservancies, national parks, and private farms (red line indicates SCI threshold and blue line indicates minimum exportable value)

3.3 Comparative trophy measurement trends per geographic area

The results for buffalo indicate that certain areas had a higher average of trophy measurements in relation to other localities. The locality that seemed to have the highest average was the Bwabwata National Park (Table 15). It should also be noted that certain communal conservancies also tended to have a higher than average trophy measurement score (e.g. Kabulabula, Balyerwa, Wuparo, Sobbe, and Dzoti), and most of these communal conservancies were directly adjacent to protected areas (MET/NACSO, 2020) that had a substantial buffalo population (Ministry of Environment and Tourism, 2010).

Table 15: Comparison of mean trophy scores (SCI) for buffalo trophies

Locality	Years				
	2011	**2012**	**2013**	**2014**	**2015**
Bwabwata National Park	100.1	99.1	102.2	105.2	100.7
Kabulabula	-	107.8	99.6	97.1	104.7
Balyerwa	-	101.4	93.1	103.9	107.3
Waterberg Plateau Park	105.1	-	-	88.0	100.5
Wuparo	100.9	100.5	95.5	101.4	96.0
Sobbe	94.1	100.1	88.6	97.5	105.9
Dzoti	100.8	84.4	97.7	105.7	97.2
Nyae Nyae	75.2	-	105.9	98.5	102.9
Salambala	90.6	93.3	-	-	-
Mashi	91.3	-	-	103.1	84.4
Kasika	87.6	97.2	60.6	109.7	79.3
Bamunu	72.3	89.7	85.2	95.5	86.7
Nakabolelwa	-	-	-	-	61.0
Communal Conservancy/National Parks Combined Average	**96.5**	**98.7**	**96.8**	**102.0**	**96.6**

As can be seen in Table 16, the higher averages scored for roan trophies were either in national parks or communal conservancies. However, some areas were noticeably lower in average measurements such as Mashi and Wuparo. When viewing the land-use types, it becomes quite apparent that the trophy scores for private farms are fairly higher in comparison to the areas that consist of free-roaming populations, which may be indicative of the intensive game breeding (Blackmore, 2017).

Table 16: Comparison of mean trophy scores (SCI) for roan trophies

Locality	Years				
	2011	**2012**	**2013**	**2014**	**2015**
George Mukoya	-	-	-	76.02	77.52
Waterberg Plateau Park	66.34	-	-	-	79.53
Muduva Nyangana	-	-	-	-	66.77
Nyae Nyae	-	67.72	64.72	69.78	65.16
Sobbe	73.03	64.13	62.36	65.83	-
Bwabwata National Park	-	60.30	65.06	68.18	68.41
Balyerwa	66.50	60.43	67.28	62.87	69.13
Dzoti	64.84	64.57	-	-	58.39
Wuparo	59.25	63.78	51.73	65.16	64.96
Mashi	66.54	57.52	-	-	-
Communal Conservancy/National Parks Combined Average	**66.12**	**62.21**	**63.51**	**68.50**	**67.86**
Private Farm	**64.9**	**67.5**	**66.1**	**69.3**	**69.8**

According to the statistical analysis of the trophy measurements, the overall trends indicate that there is a decline in the trophy sizes of sable in all land-use types. The most severe declines were either in the national parks or the communal conservancies. However, the rise of the intensive wildlife breeding has not led to a convincing explosion of trophy size trends for sable on private farms (as can be seen in the average values in Table 17).

Table 17: Comparison of mean trophy scores (SCI) for sable trophies

Locality	Years				
	2011	**2012**	**2013**	**2014**	**2015**
Wuparo	-	-	103.15	-	-
Waterberg Plateau Park	103.07	-	-	-	100.00
Bwabwata National Park	106.30	97.12	99.91	102.59	97.62
Balyerwa	92.60	-	-	-	-
Dzoti	-	-	86.22	91.93	89.37
Sobbe	-	-	87.80	-	-
Mashi	-	-	40.16	-	-

Locality	Years				
	2011	2012	2013	2014	2015
Communal Conservancy/National Parks Combined Average	**101.26**	**97.12**	**90.76**	**101.26**	**97.23**
Private Farms	**96.12**	**95.35**	**96.61**	**93.82**	**94.96**

Similar to sable, there was also an overall decline in the trophy measurement size for kudu in all three land-use types. Most of the higher mean trophy values for kudu were hunted in the arid north-western conservancies, rather than in the north-east. Also, it would seem that there was a higher mean value of trophy scores on open systems of the communal conservancies and national parks than within the private farmlands (Table 18). This could still indicate that the communal conservancies were not yet adversely affected by the drought and rabies as the central regions of Namibia (Scott et al., 2012).

Table 18: Comparison of mean trophy scores (SCI) for kudu trophies

Locality	Year				
	2011	2012	2013	2014	2015
Tsiseb	129.13	132.28	-	-	-
Orupupa	-	130.51	-	-	-
Bwabwata National Park	132.15	128.26	130.49	130.45	127.53
Omatendeka	126.08	-	117.72	-	134.45
Okangundumba	-	126.97	-	-	-
Ozondundu	127.95	122.44	132.48	-	-
≠Khoadi-//Hôas	123.49	131.18	132.72	122.06	124.48
//Huab	127.32	124.67	126.14	119.69	124.61
Okondjombo	-	-	125.39	-	-
Muduva Nyangana	-	-	-	-	125.20
Orupembe	-	-	124.70	-	124.54
Sorris Sorris	129.53	-	118.11	-	-
Otjambangu	126.18	122.24	-	-	-
Salambala	-	123.43	-	-	-
Torra	119.40	125.62	128.87	120.47	120.67
Puros	131.89	120.08	-	118.11	-
Namib Naukluft Park	-	-	-	123.23	-
Nyae Nyae	121.46	134.61	124.88	114.37	117.28

Locality	Year				
	2011	**2012**	**2013**	**2014**	**2015**
Anabeb	124.37	125.20	-	123.03	120.75
Sobbe	121.00	-	116.73	132.68	-
Wuparo	120.08	130.51	122.05	119.29	118.70
Uukwaluudhi	126.77	-	-	116.54	-
Ehi-Rovipuka	129.27	115.35	123.49	129.53	114.83
Mayuni	-	-	-	120.28	-
Mahango Park	-	-	-	118.10	121.65
Kwandu	-	-	-	-	119.69
Balyerwa	-	-	-	-	119.09
Mashi	134.25	121.77	-	-	106.69
Khaudum North Complex	117.72	-	-	-	-
Dzoti	106.69	126.38	-	-	118.50
Sesfontein	-	-	-	112.20	-
Communal Conservancy/National Parks Combined Average	**124.66**	**124.95**	**126.56**	**122.39**	**122.45**
All Private Farms	**120.27**	**120.92**	**120.75**	**119.92**	**119.82**

3.4 Trophy measurement trends per geographic area and land-use type

3.4.1 Buffalo

Buffalo trophy score was significantly dependent on the overall boss length of the horn (Table 19). The total score is not largely dependent on the width of the boss widths (at their widest point). This is, however, largely indicative of the reliance of the boss length as the larger determinant of the bigger trophy size (which certainly will play a large part in the selection of the animals when they are hunted).

Table 19: Correlation of buffalo trophy measurements

Variable	Correlations (Buffalo stats analysis) Marked correlations are significant at p < .05000 N=263 (Casewise deletion of missing data)					
	Means	Std. Dev.	Horn Length (R)	Left Base Circumference (R)	Right Base Circumference (R)	Total Score (R)
Horn Length	177.3516	28.99687	1.000000	-0.119530	-0.121667	0.897513
Left Base Circumference	35.9252	6.80385	-0.119530	1.000000	0.989660	0.329403
Right Base Circumference	35.9541	6.77357	-0.121667	0.989660	1.000000	0.327360
Total Score	98.1224	12.00145	0.897513	0.329403	0.327360	1.000000

There was no significant difference in buffalo SCI score between either of the five years of the study period. Even the trends in the overall score seems to reflect stable and yet slightly increasing trophy sizes over the 5 years (Figure 35).

3.4.1.1 Nationally

Two separate tests were conducted: one which included the lower extremes and outliers for total score (Figure 35) and one which only included scores above the minimum acceptable trophy size (Figure 36). Both graphs indicate that there is an increased trend in the total score for the study period; however, with there being no lower variables in Figure 36, the increased trend for Figure 36 is noticeably higher. The statistical analysis of Figure 35, with a p-value of 0.4237, indicates that there is no significant difference between the years. The highest total score was recorded in 2014, whereas the lowest outlier value was recorded in 2013. With the exclusion of non-exportable trophy values in Figure 36, the p-value of 0.4443 indicates that there is still no significant difference between the total scores.

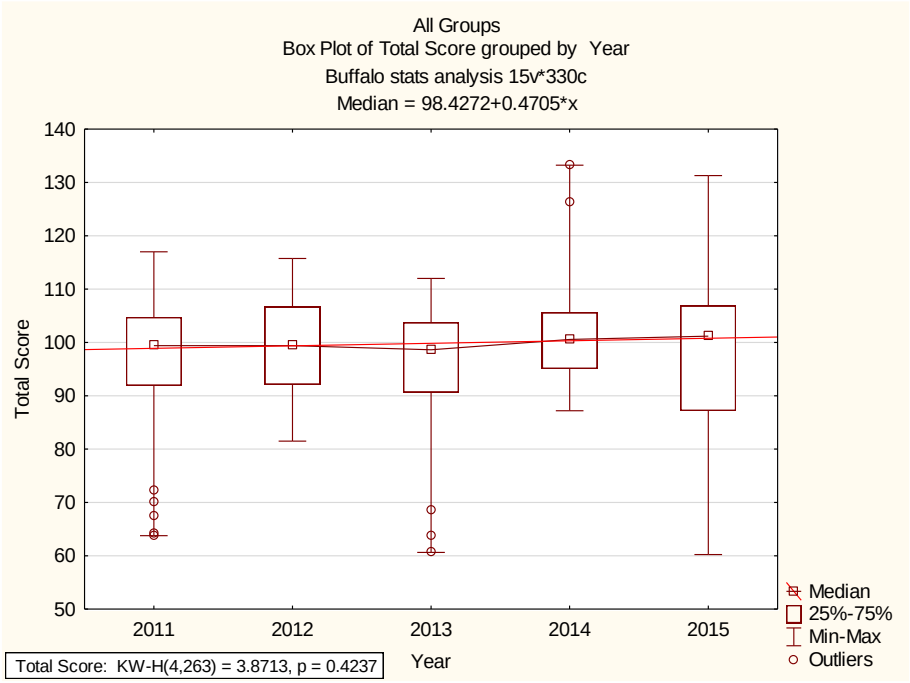

Figure 35: Buffalo trophy size over five years (2011-2015) in all land-use types

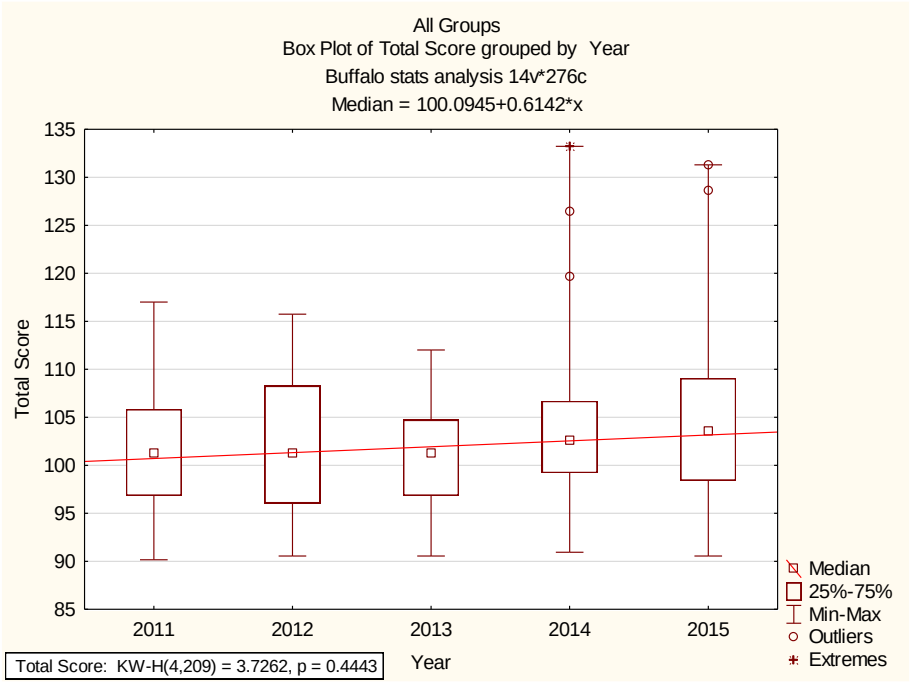

Figure 36: Buffalo trophy size over five years (2011-2015) in all land-use types (low outliers excluded)

3.4.1.2 Communal conservancies and national parks

Both the total score analyses for communal conservancies (Figure 37), with a p-value of 0.1446, and national parks (Figure 38), p-value of 0.7189, indicate that there is no significant difference between the years and that there is an increased trend in the size of the trophies within the study period. However, the rate of trophy size increases from year to year is slower than in national parks (which had negative offtake rate within the study period); proof of this difference in increase can be seen in

Figures 37 and 38, where the median trend for communal conservancies is equal to 97.97 as opposed to the national parks median trend that is equal to 98.83. The highest total score in any communal conservancy was recorded in the year 2014, where the record buffalo (in Balyerwa Conservancy) measured at 133.23 inches; whereas, in 2013, the lowest score recorded was 60.63 inches (in Kasika Conservancy). The highest total score for national parks was recorded in the year 2015 at 131.3 inches in Bwabwata East, whereas the lowest value was recorded in the year 2015, measuring 60.24 inches in Mahango.

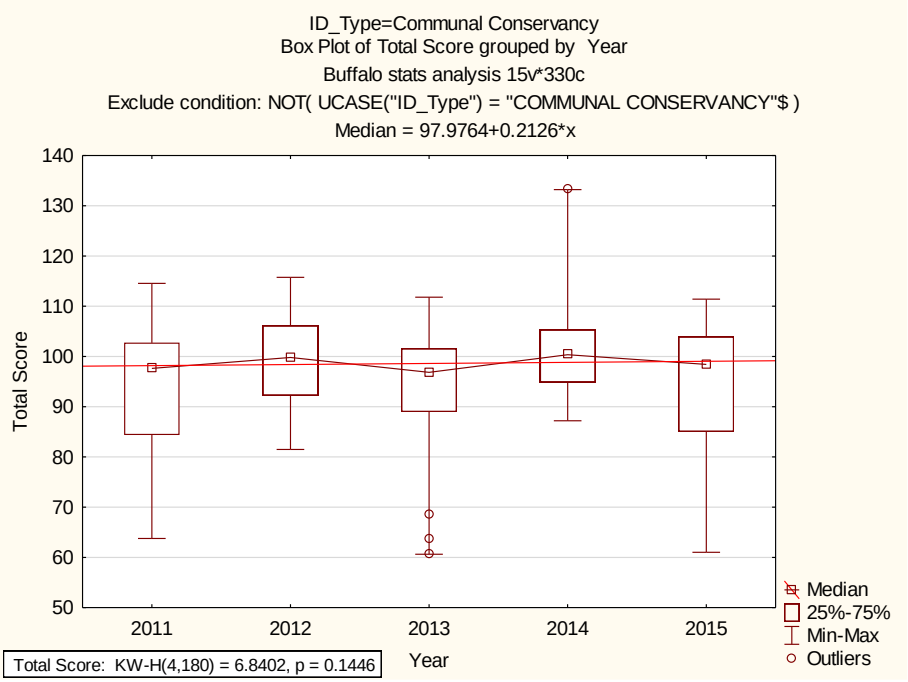

Figure 37: Buffalo trophy size over five years (2011-2015) in communal conservancies

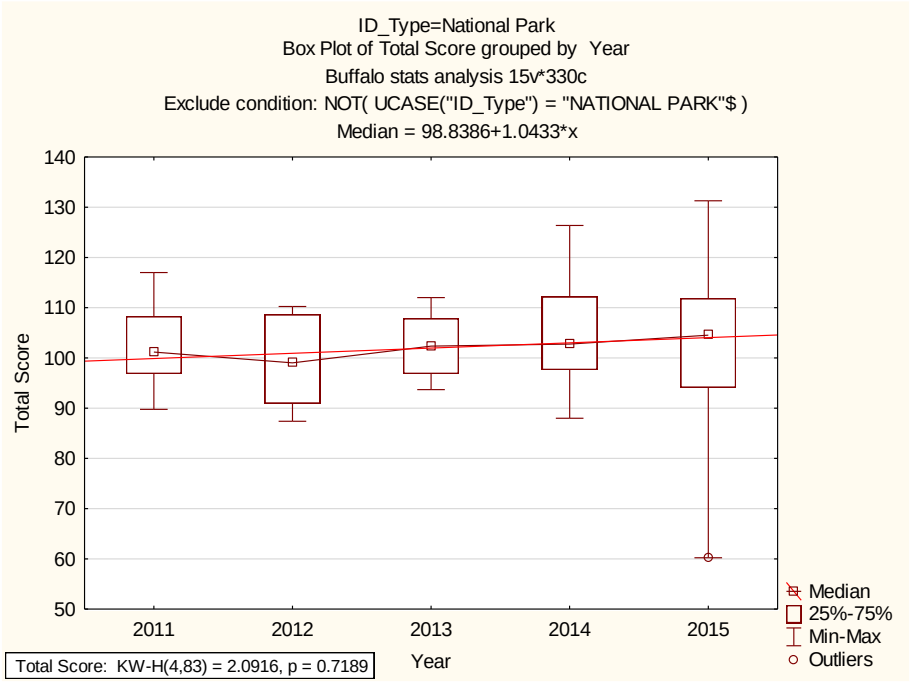

Figure 38: Buffalo trophy size over five years (2011-2015) in national parks

3.4.2 Roan

3.4.2.1 Nationally

Similar to the buffalo data analysis (Section 3.4.1.1), two sets of values were tested using the Kruskal-Wallis test. The first analysis includes a set of values were the unchanged raw data, and the second analysis includes the values that are above Namibia's minimum threshold for exportable trophies; which in the case of roan is a record that is greater than or equal 59.45 inches. In Figures 39 and 40, the respective p-values of 0.1224 and 0.2124, indicate that there is no statistical significance between the years and that the trophy value trends for roan is stable and increasing.

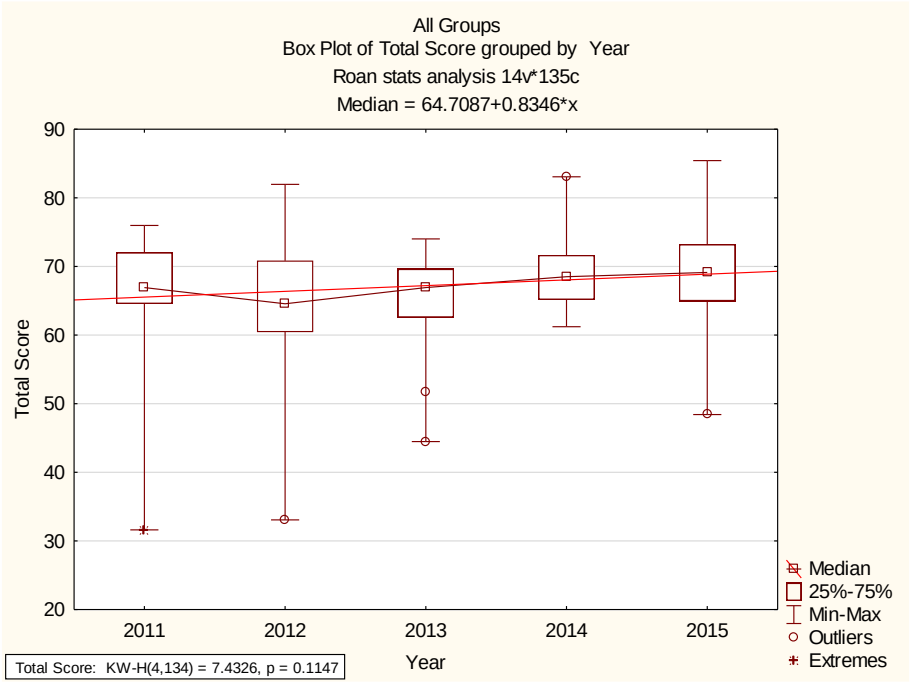

Figure 39: Roan trophy size over five years (2011-2015) in all land-use types

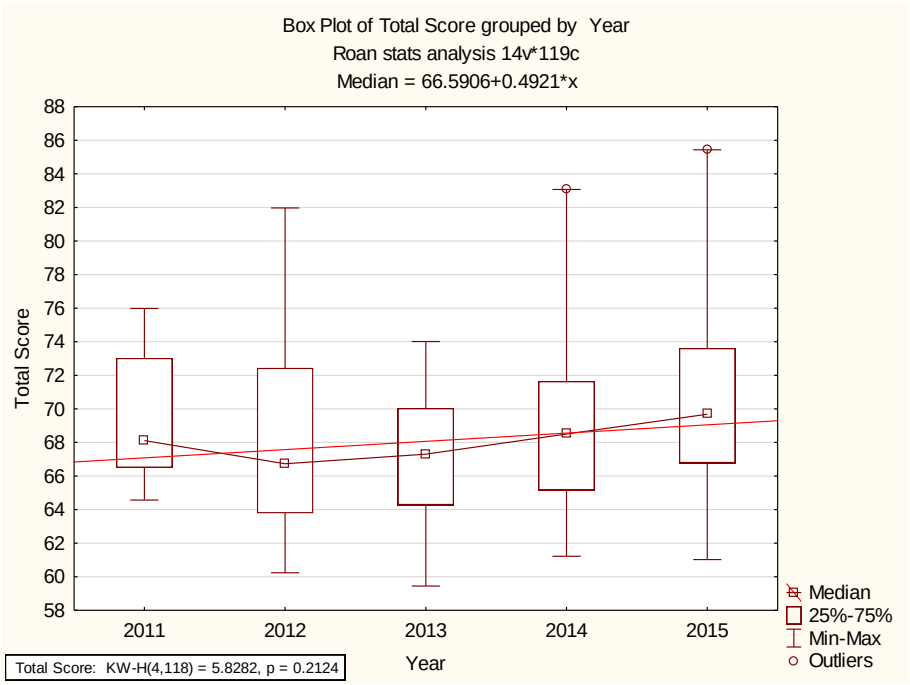

Figure 40: Roan trophy size over five years (2011-2015) in all land-use types (low outliers excluded)

3.4.2.2 Communal conservancies, national parks, and private farms

There was a strong positive correlation between the trend in trophy size against the number of roan that were hunted in national parks and communal conservancies. In terms of the communal conservancies, there was an increase in the overall trophy size (Median= 65.13); which, despite small number hunted, correlated with the increased number which were being hunted. The national parks, on the other hand, showed a higher increase in the overall trophy size (Median=60.23), which seems

to be a reflection of the lower offtake of roan (versus that of the communal conservancies). The private farms seemed to show a slight increase in the trophy size (Median=66.96), and overall, the trophy size seemed to indicate that there are bigger trophy sizes of roan on private land than those within the national parks and communal conservancies (even though the rate of trophy size improvement was higher within the national parks). Figure 41 shows that, with a p-value of 0.7305, there was no significant difference in the trophy values between the years in communal conservancies. The highest trophy record for the aforementioned land-use type, measured at 81.96 inches, which was hunted in the year 2012 in Mashi Conservancy, and lowest outlier measurement was recorded at 33 inches in Mashi Conservancy. Similarly, the p-value of 0.2820 in national parks indicates that there was no significant difference between the years (Figure 42). Additionally, the highest trophy recorded in the parks (79.5 inches) was recorded in the year 2015 in the Waterberg Plateau Park, and the lowest value lay at 56.6 inches in Bwabwata National Park. Also, with a p-value of 0.3312, there was no significant difference between the years on private farms (Figure 43). In terms of private farms, therefore, the highest trophy record (85.4 inches) was recorded in the year 2015 on the farm Otjiwa, and the lowest outlier value was recorded at 31.6 inches, in 2011, on Ongombo West.

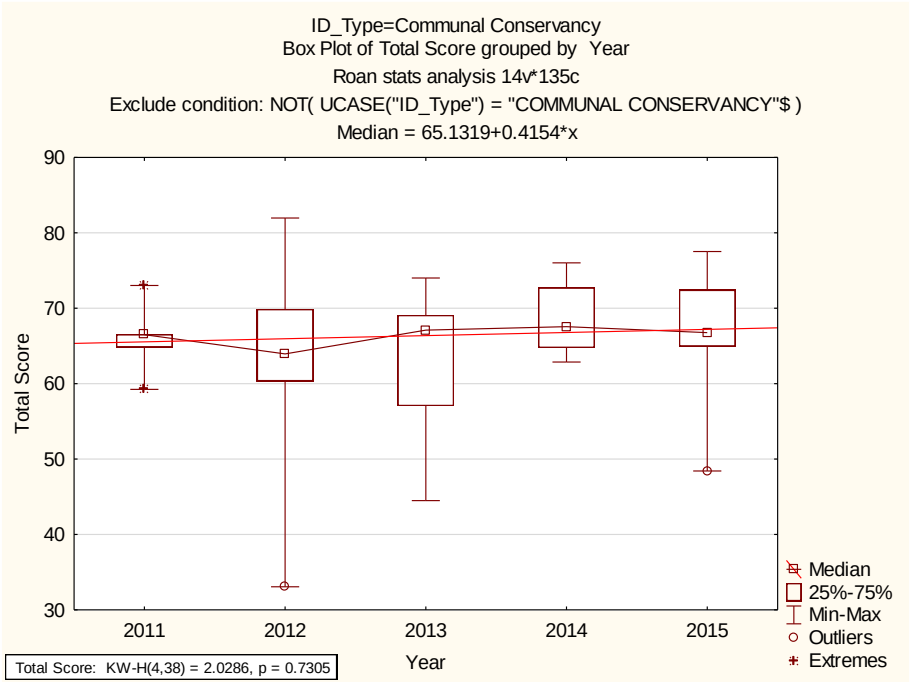

Figure 41: Roan trophy size over five years (2011-2015) in communal conservancies

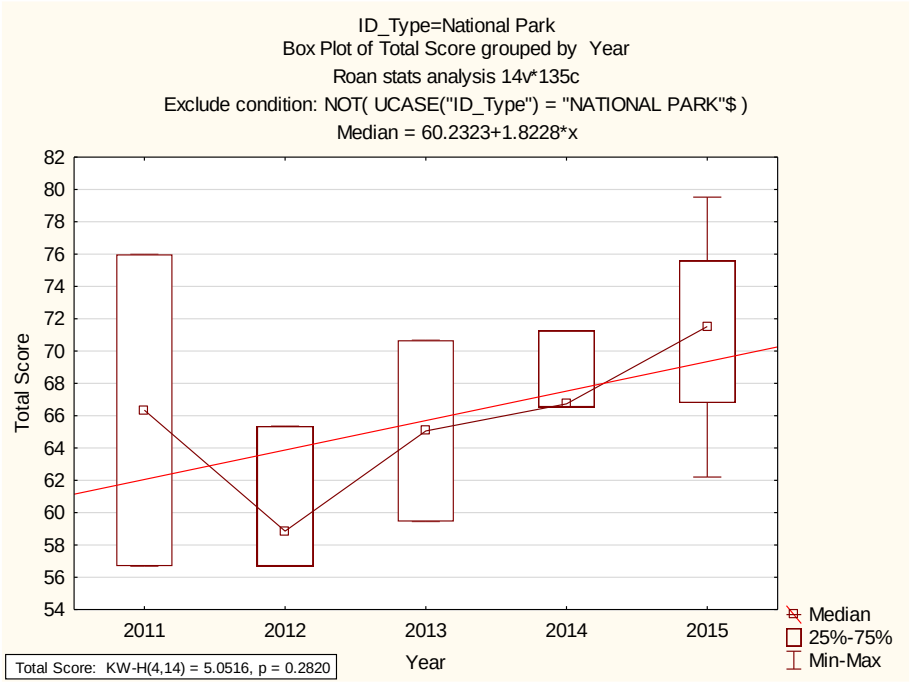

Figure 42: Roan trophy size over five years (2011-2015) in national parks

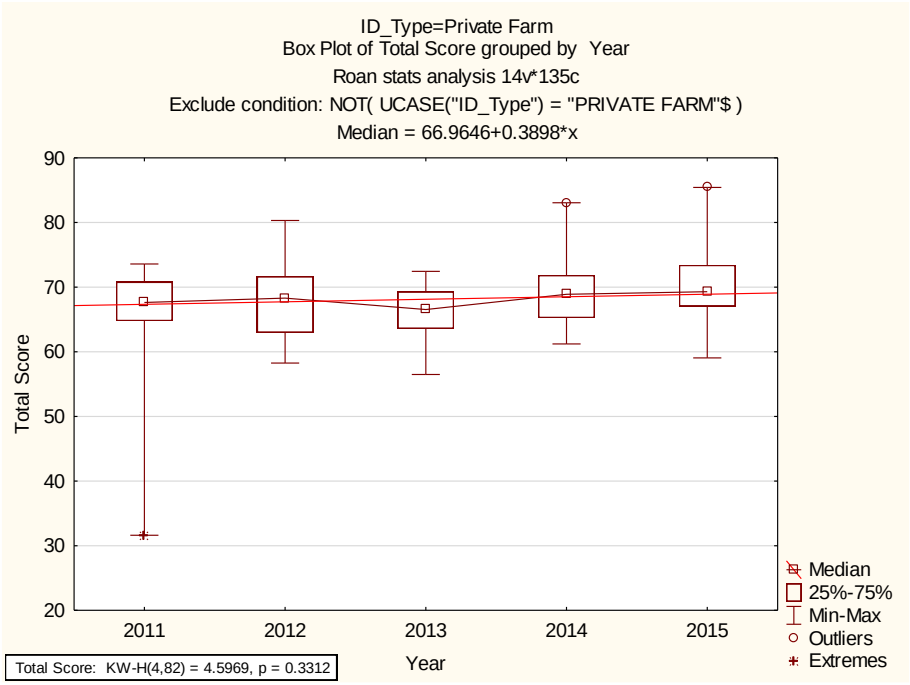

Figure 43: Roan trophy size over five years (2011-2015) on private farms

3.4.3 Sable

3.4.3.1 Nationally

Overall trophy size seems to be decreasing across the study period. As can be seen in Figures 44 and 45, with respective p-values of 0.7579 (non-exportable included) and 0.5386 (non-exportable excluded) there is no statistical significance for both figures. However, when comparing all the sable trophies it is interesting to note that there seems to be a negative growth trend in the overall trophy values; Figure 44 shows a median value of 97.38, and the Figure 45 below shows a median value of 98.91. When comparing annual trophy size for communal conservancies only, there was a slight increase in trophy size over time, but again the difference was not significant between any of five years (p=0.6700) since there were only eight individuals hunted (Figure 46).

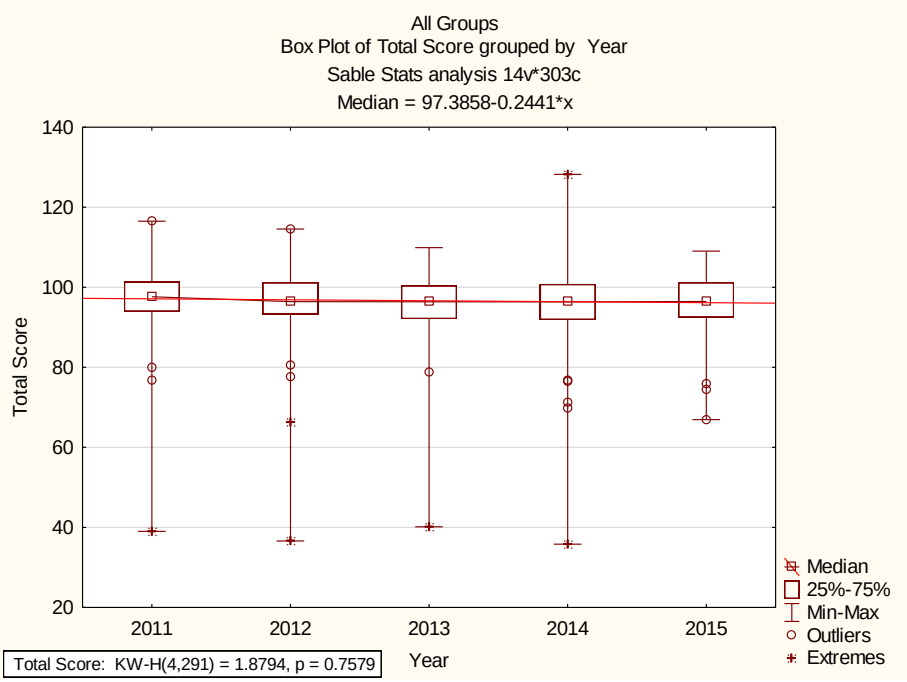

Figure 44: Sable trophy size over five years (2011-2015) in all land-use types

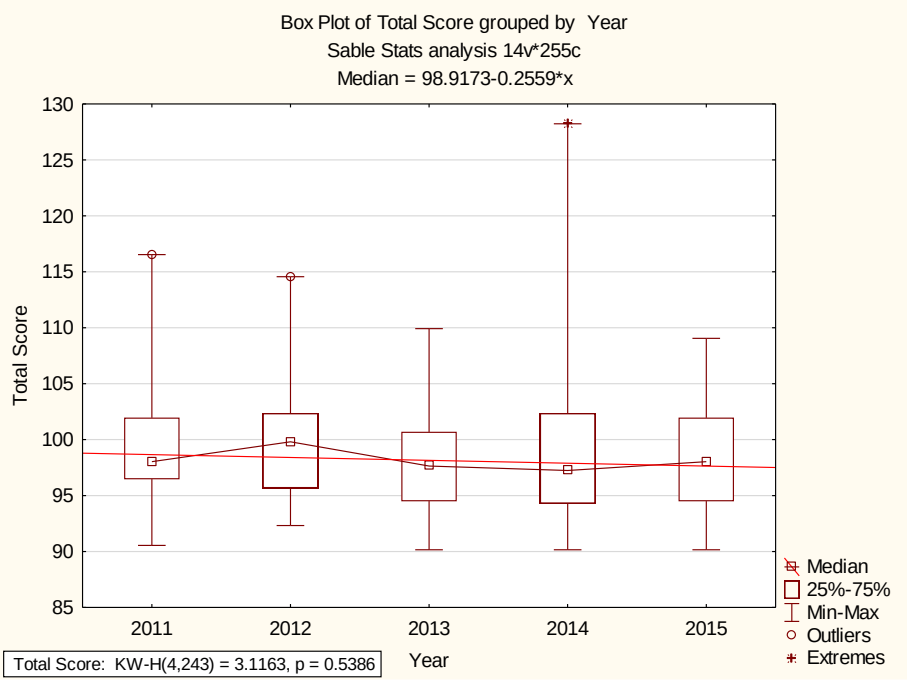

Figure 45: Sable trophy size over five years (2011-2015) in all land-use types (low outliers excluded)

3.4.3.2 Communal conservancies, national parks, and private farms

A separate analysis of the different land uses seemingly formed a correlation between the number of sable hunted and the overall trophy size trends. Within the national parks (where there was a higher number of sable hunted), there was an overall negative growth trend (evidenced by the median=103.27), versus that of the communal conservancies (with the lower rate of utilization), which had an increased trophy size trend (but with a median=85.69). Nevertheless, there is no doubt that between the two land uses the national parks (Figure 47) had a higher trophy size than that of the communal conservancies (Figure 46). In the private farms (Figure 48), the overall trophy size showed a negative growth rate within the study period (evidenced by the median=97.32) – this was a contrast to the trends shown in that of roan, where the offtake was lower than that of sable, but where the trophy size was increasing. In terms of communal conservancies, the p-value of 0.670 indicates that there was no significant difference in the trophy size. Furthermore, the largest trophy hunted during this period was in hunted in Wuparo at 103.15 inches and smallest trophy (however it's not clear whether this a mistake in data entry, i.e. inches instead of centimetres) was hunted in Mashi at 40.16 inches. With a p-value of 0.5717, there was no significant difference between the trophy scores in national parks. The biggest trophy hunted in national parks during this period was hunted in Bwabwata East (128.2 inches) and the lowest score recorded was in Mahango (80.3 inches). Similarly, with a p-value of 0.7891, there is no significant difference in the trophy scores on private farms. The biggest trophy hunted on a farm during this period was on the farm Paresis in 2011 (116.5 inches) and the lowest score achieved was on the farm Ongombo West in 2014 (35.8 inches).

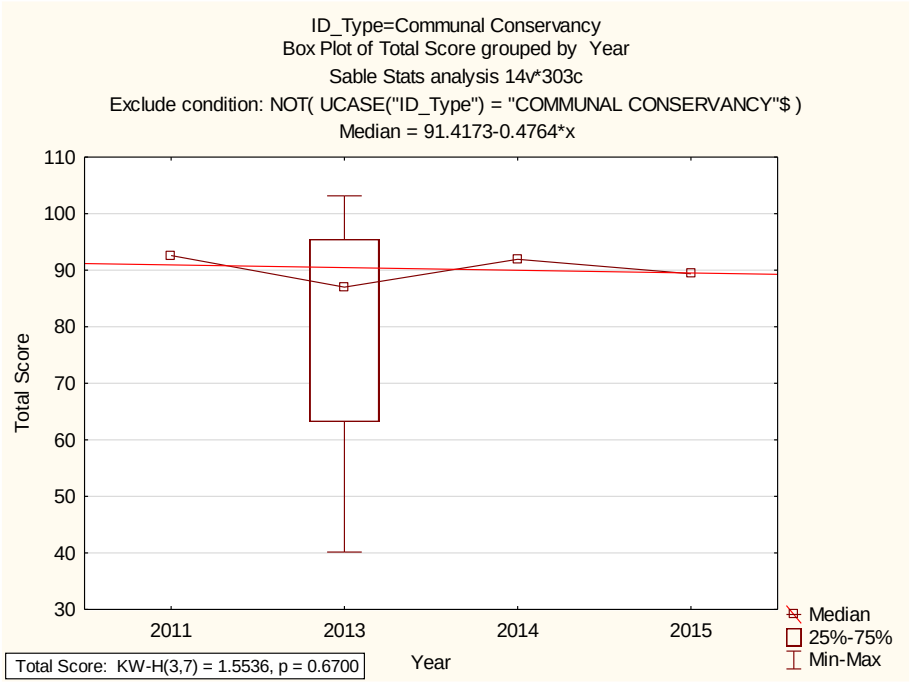

Figure 46: Sable trophy size over five years (2011-2015) in communal conservancies

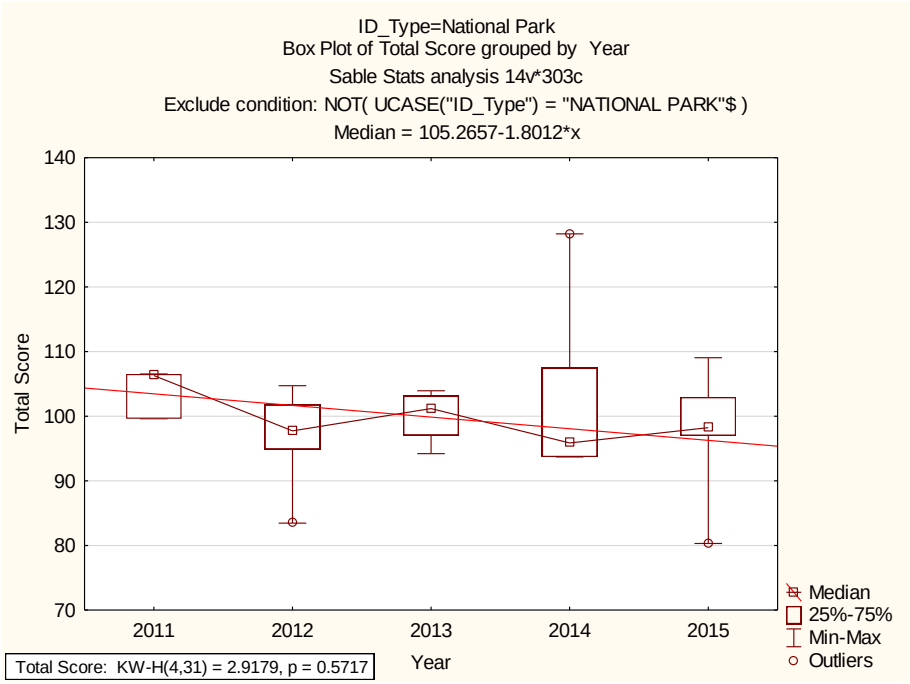

Figure 47: Sable trophy size over five years (2011-2015) in national parks

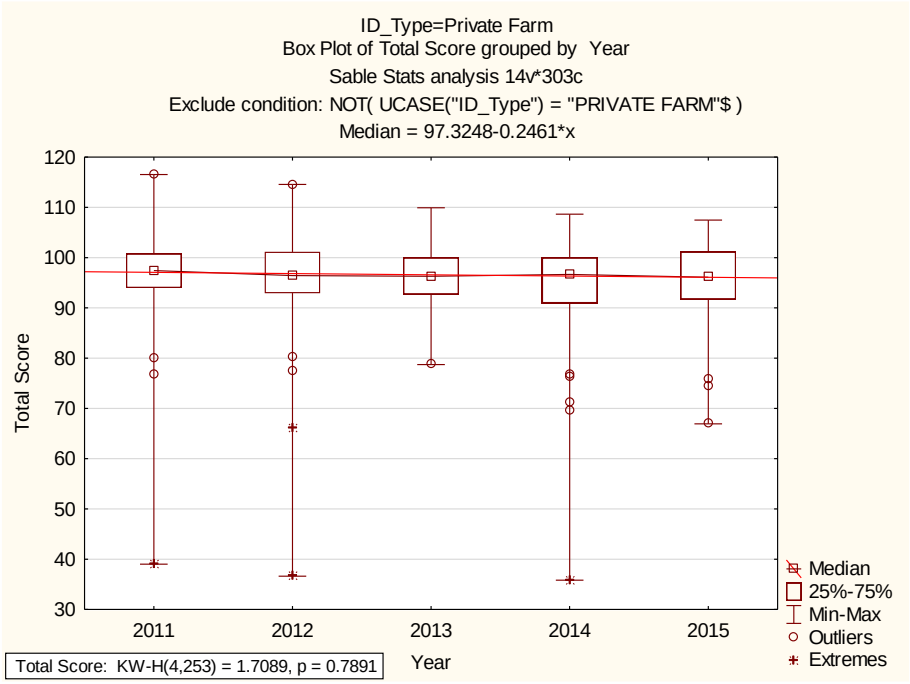

Figure 48: Sable trophy size over five years (2011-2015) on private farms

3.4.4 Kudu

3.4.4.1 Nationally

An analysis of Figures 49 and 50, below will indicate that there is an overall negative growth trend even with the exclusion of non-exportable trophies. In Figure 49, the median value of 121.55 indicates a highly significant negative size trend over the years ($p<0.001$). Similarly, even with the lower outliers and extremes eliminated, the median (122.24) of Figure 50 indicates a negative growth trend, and the p-value of 0.00000 indicates that the results are statistically significant.

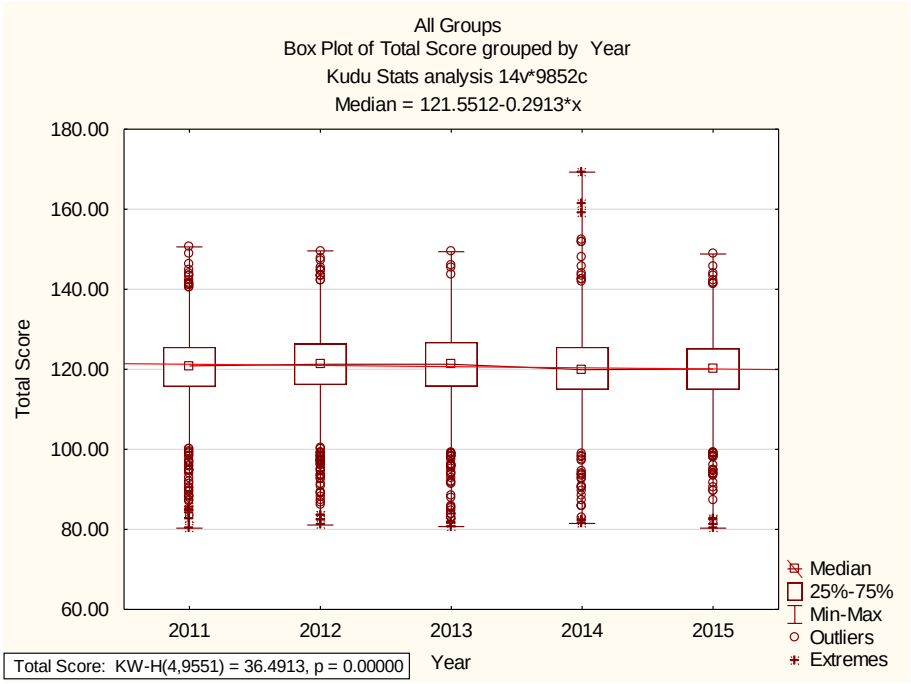

Figure 49: Kudu trophy size over five years (2011-2015) in all land-use types

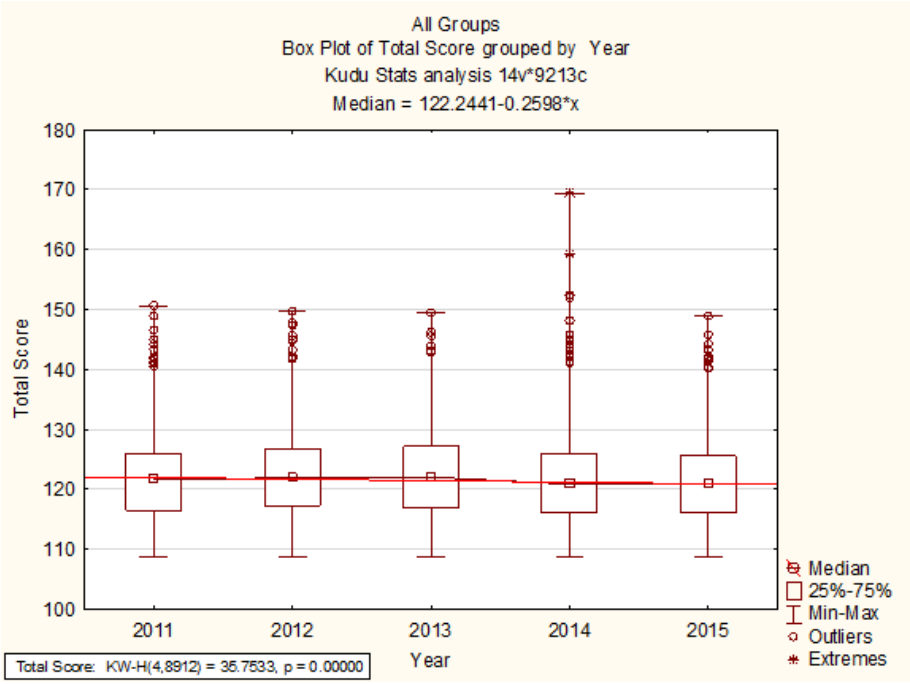

Figure 50: Kudu trophy size over five years (2011-2015) in all land-use types (low outliers excluded)

3.4.4.2 Communal conservancies, national parks, and private farms

When separated, there was an overall decline in trophy measurements in all three land-use types. With a median value of 126.24, the communal conservancies (Figure 51), showed a much slower rate of decline of trophy measurements than the other land uses; the p-value (0.0660) indicates that there was no statistical significance during the study period. Within the conservancies, the highest trophy measurement (142.9 inches) was in //Huab Conservancy, and the lowest outlier score (94.5 inches)

was recorded in Ehi-Rovipuka Conservancy. The national parks (Figure 52), with a median value of 137.24, had a severe decline in their kudu trophy measurements. The low number of animals hunted means that the year-on-year decline could not be significantly proven (p=0.37). The highest trophy score for national parks was observed in 2013 in Bwabwata National Park (139.37 inches), and the lowest score was observed in 2014 in Mahango/Bwabwata National Park (112.95 inches). The year-on-year decline in kudu trophy size within private farms (Figure 53) was highly significant (p<0.001). Details of significance between specific years are provided in Tables 20 and 21. The negative growth trend within private farms is less severe than the trend within the communal conservancies (though not as severe as national parks). The biggest recorded trophy that was hunted on a farm was hunted in 2014 on Farm Okoromatero (169 inches), and the lowest score was recorded in 2015 on Farm Groenboom (80.31 inches).

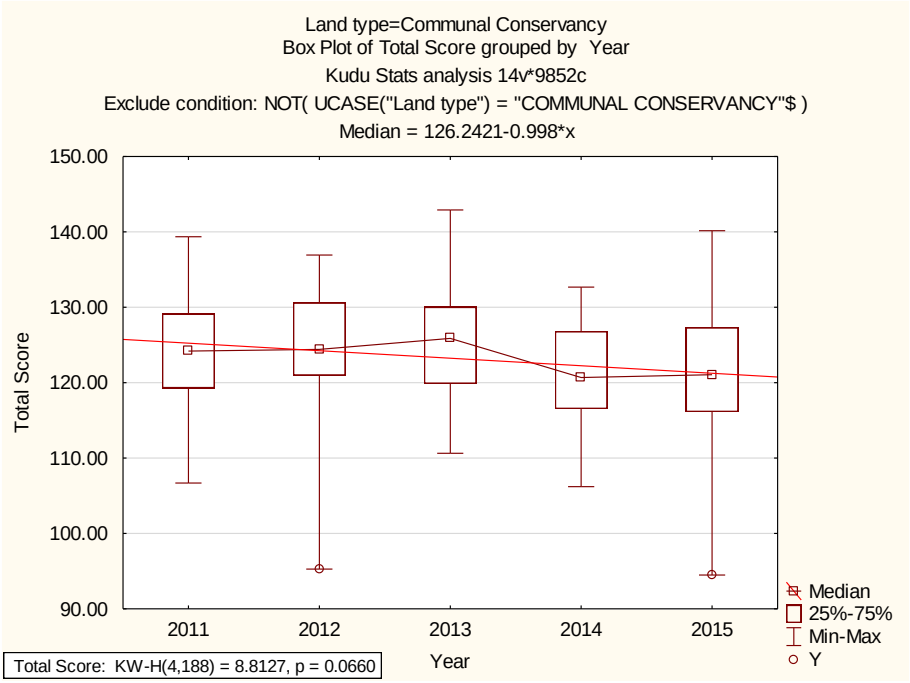

Figure 51: Kudu trophy size over five years (2011-2015) in communal conservancies

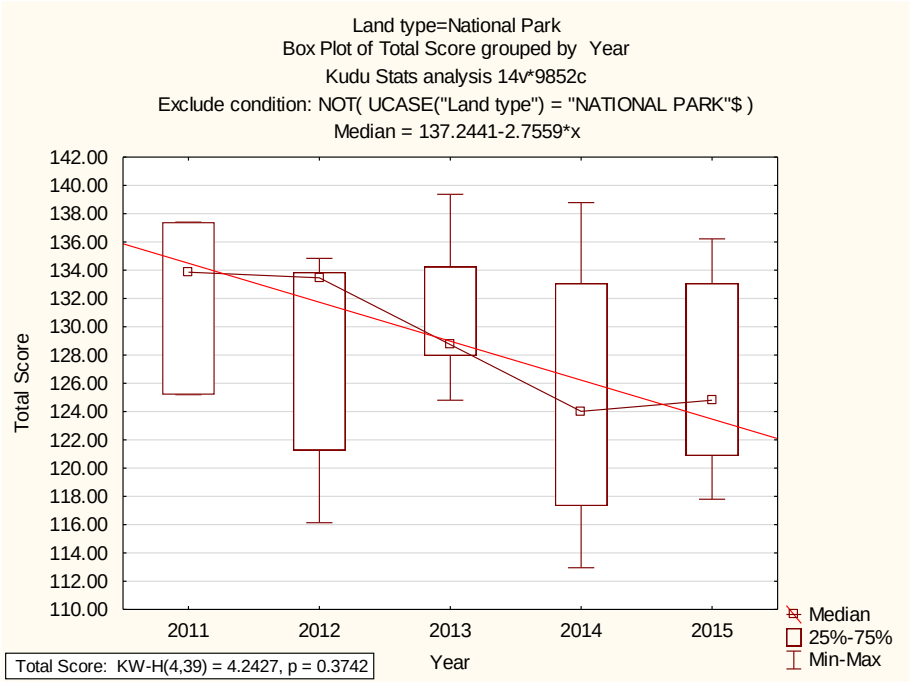

Figure 52: Kudu trophy size over five years (2011-2015) in national parks

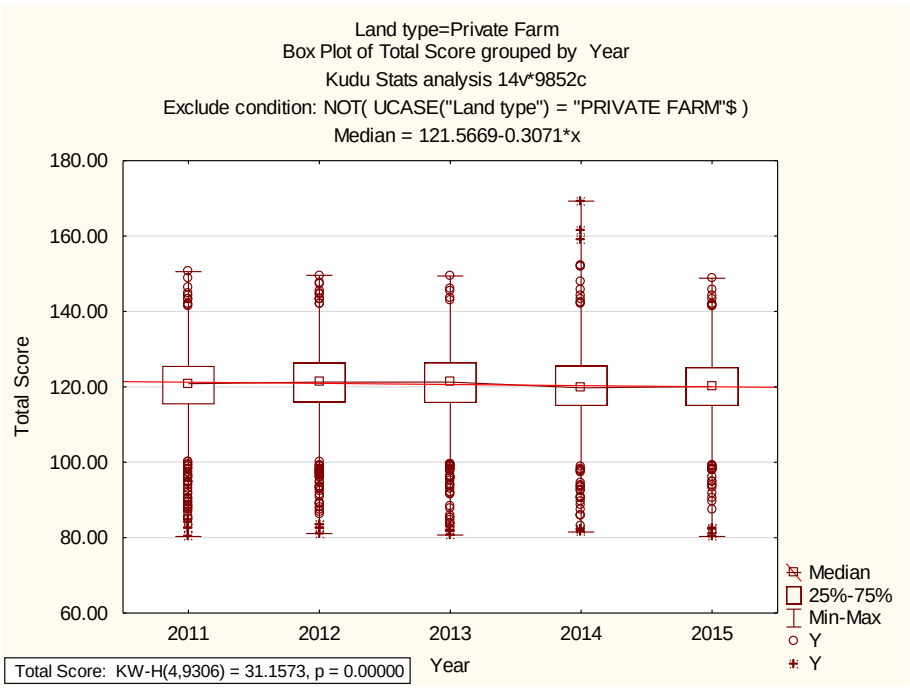

Figure 53: Kudu trophy size over five years (2011-2015) on private farms

Having observed that there is a significant difference within the data (especially within the data captured on private farms), the areas of significance needed to be determined. Therefore, the Tukey Post Hoc Test was used to identify the areas of significant difference. As can be seen in Tables 20 and 21 below, the areas of significance were observed between the year 2012 and the years 2014 and 2015; additionally, there was a significant difference between the year 2013 and the years 2014 and 2015.

Table 20: Tukey post hoc test for national data

Cell No.	All Groups Tukey HSD test; variable Total Score (Kudu Stats analysis) Approximate Probabilities for Post Hoc Tests Error: Between MSe = 73.921, df = 9543.0 Year	{1} (120.35)	{2} (121.02)	{3} (120.90)	{4} (119.98)	{5} (119.84)
1	2011		0.074563	0.226296	0.697614	0.399810
2	2012	0.074563		0.990412	0.002610	0.000470
3	2013	0.226296	0.990412		0.012848	0.002799
4	2014	0.697614	0.002610	0.012848		0.991642
5	2015	0.399810	0.000470	0.002799	0.991642	

Table 21: Tukey post hoc test for private farm data

Cell No.	Land type=Private Farm Tukey HSD test; variable Total Score (Kudu Stats analysis) Approximate Probabilities for Post Hoc Tests Error: Between MSe = 73.791, df = 9298.0 Year	{1} (120.27)	{2} (120.92)	{3} (120.76)	{4} (119.92)	{5} (119.83)
1	2011		0.093359	0.343453	0.747315	0.562322
2	2012	0.093359		0.973596	0.004872	0.001907
3	2013	0.343453	0.973596		0.032489	0.014544
4	2014	0.747315	0.004872	0.032489		0.998435
5	2015	0.562322	0.001907	0.014544	0.998435	

3.5 Hunter's perceptions

Respondents mostly had hunting experience of over 15 years (79% of the respondents) covering most of the study area (Figure 54).

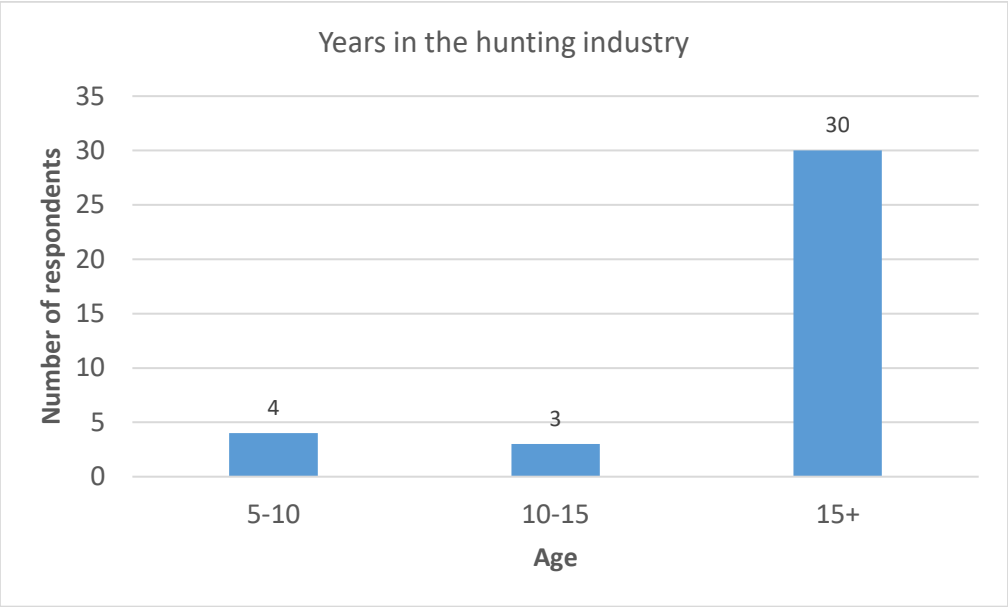

Figure 54: Hunting experience of NAPHA members

When considering the trophy size trends within conservancies and national parks (Figure 55), 26% of the hunters perceived that the buffalo trophy size was increasing, 47% claimed that the trophy size trends were stable, and the remaining 26% felt that trophy sizes were decreasing. In terms of roan, 38% of the hunters felt that the trophy sizes had increased, and the remaining 62% perceived that trophy sizes were stable. With sable, 25% of the hunters felt that the trophy sizes were increasing and the remaining 75% claimed that the trophy sizes were simply stable. In contrast to the other species, it was felt by only 13% of the hunters that the kudu trophy sizes had increased, 56% believed that the trophy sizes were stable, and the remaining 31% perceived that the trophy sizes had decreased. This reflects the quantitative assessment for trophy size in buffalo (Section 3.4.1.2, Figures 37 and 38), roan (Section 3.4.2.2, Figures 41 and 42), and kudu (Section 3.4.4.2, Figures 51 and 52), but contradicts the quantitative trend identified for sable (Section 3..3.2, Figures 46 and 47).

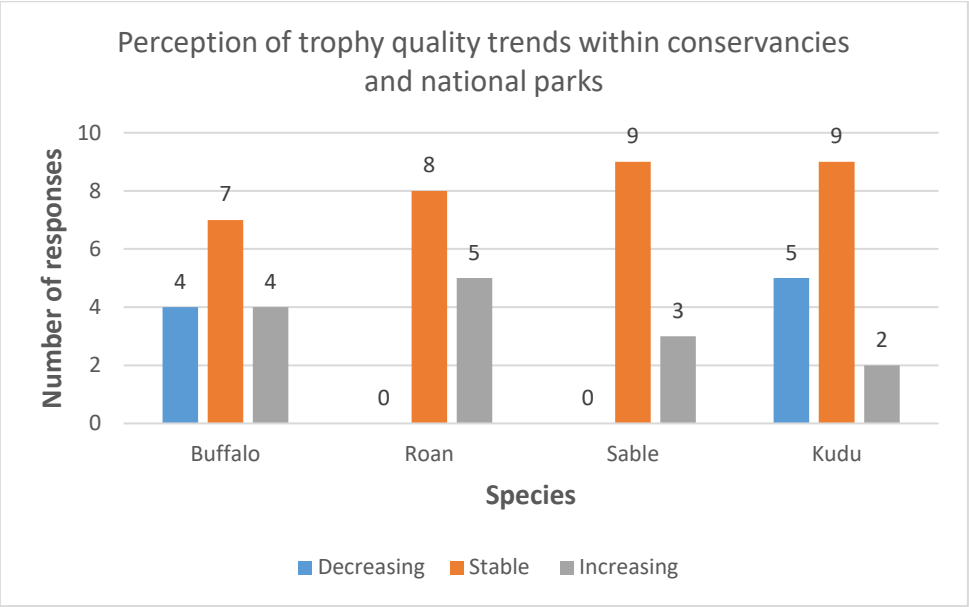

Figure 55: Hunter perceptions of trophy size within communal conservancies and national parks

When considering the trophy size only private farms (Figure 56), 63% of the hunters felt that the trophy sizes of roan had increased, 31% claimed that the sizes were stable, and the remaining 6% perceived that trophy sizes were decreasing. In terms of sable, 70% of the hunters felt that the trophy sizes were increasing, 18% of the hunters claimed that the trophy sizes were stable, and the remaining 12% considered the sizes to be on the decrease. With kudu, only 19% of the hunters believed that the kudu trophy sizes had increased, 46% claimed that the trophy sizes were stable, and as much as 35% claimed that the trophy sizes had decreased. This largely reflects the quantitative assessment roan (Section 3.4.2.2, Figure 43), and kudu (Section 3.4.4.2, Figures 53), but strongly contradicts the quantitative trend identified for sable (Section 3.4.3.2, Figures 48).

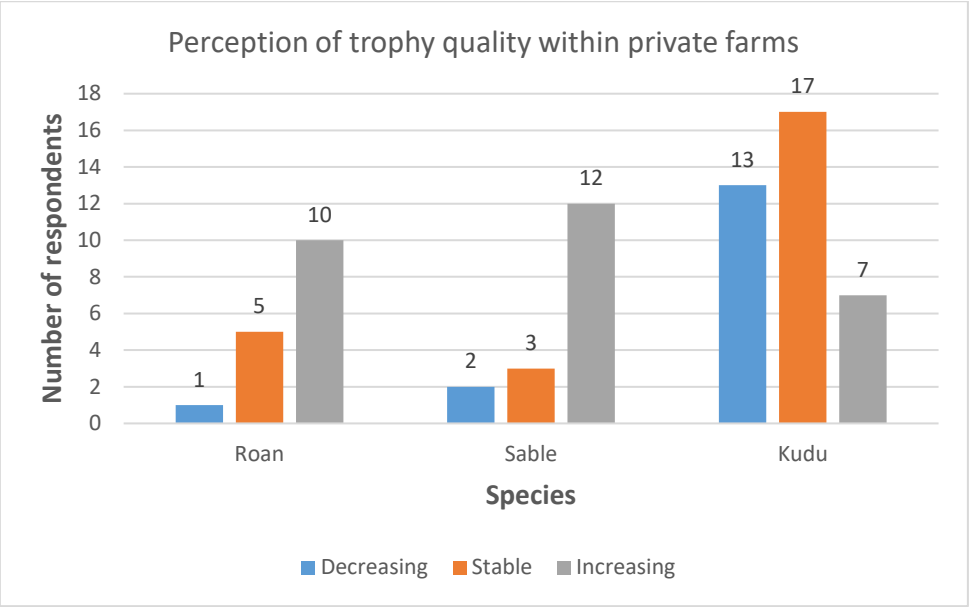

Figure 56: Hunter perceptions of trophy size on private farms

Finally, when asked whether trophy measurements would be a useful means of determining trophy quotas (Figure 57), 66% of the responses indicated that it was still a useful means determining the trends (and consequently the quota offtake for allocated species), 14% indicated that it wasn't a useful method, and 20% simply stated it had potential. However, a fair number of responses indicated that a more age-related method should be made use of – since, as most personal correspondence with hunters suggested, larger measurements may not necessarily mean a healthier population; it could also mean that younger animals are being hunted.

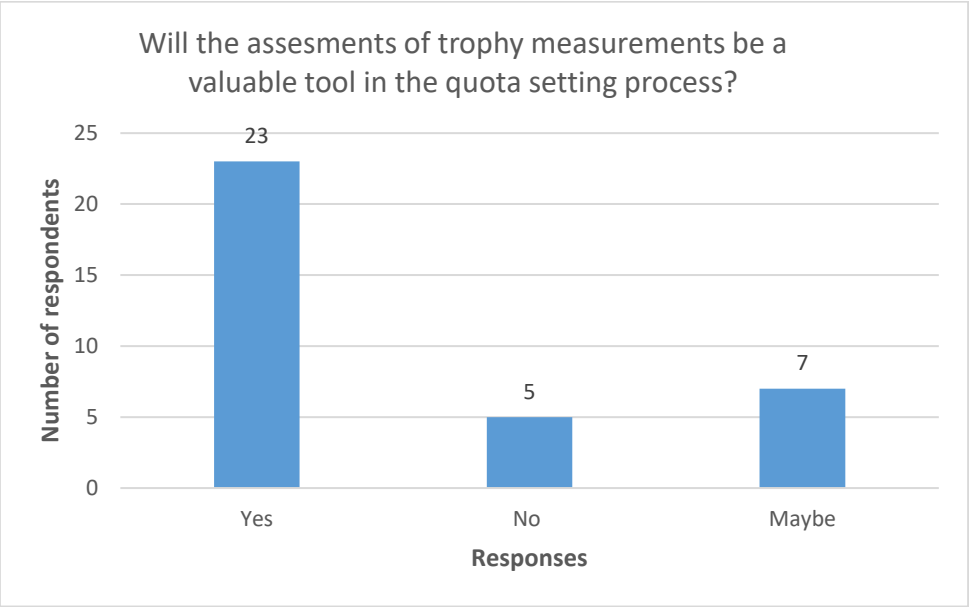

Figure 57: Hunter perceptions of trophy measurements as a quota setting method

Chapter 4: Discussion

4.1 Numbers hunted and the areas where they were hunted

4.1.1 Species popularity

Buffalo were certainly not one of the most commonly (possibly due to limited supply) hunted species during the course of the study period in terms of the national scale of hunting (Table 6). Buffalo ranked 25th as the most hunted animal within Namibia. However, in the north-eastern communal conservancies, the Bwabwata National Park, and the Waterberg Plateau Park, buffalo accounted for 21.95% of the trophies (followed by elephant at 19.66%). Buffalo was considered to be the most popular trophy animal to hunt in Africa, among American hunters (Lindsey et al., 2006). It is a popular trophy animal (du Toit, 2016) due to it being classed as a dangerous game species (Lindsey et al., 2007b), with considerable adventure and prestige being associated with a buffalo hunt (Gandy and Reilly, 2004). Across Africa, the most popular destinations to hunt buffalo are Tanzania (Lindsey, 2008) and South Africa (Lindsey, 2008; Lindsey et al., 2007b). South Africa does not have the same constraints as Namibia in the supply of trophy buffalo due to the intensive breeding land-units that ensure a healthy supply of trophies (Nel, 2015). Private ownership of buffalo is also prohibited within Namibia to prevent disease transfer to cattle, which is in accordance with European Union (EU) requirements (Tekleghiorghis et al., 2016). Within Namibia buffalo only occur in the unconstrained parks and conservancies of north-eastern Namibia (Skinner and Chimimba, 2005) and Waterberg Plateau Park (Kasiringua et al., 2017; Winterbach, 1998) – which allows a more natural hunting experience for purist hunters. Purist hunting is normally perceived as the hunting of a species without any added unfair advantages that make the movements or behaviours of the hunted animal predictable (e.g. hunting within enclosures, use of bait/salt licks, the habituation of animals to humans, or the use of vehicles to outmanoeuvre the hunted animals) (Schroeder, 2018; Von Brandis and Reilly, 2008); hunters often pay a premium for this hunting experience.

Roan, alongside sable, tends to be a popular hunting species due to its high-value status in recent years (Van der Merwe et al., 2004). Roan and sable populations recovered from historical lows in the 1980s (Harrington et al., 1999; McLoughlin and Owen-Smith, 2003; Owen-Smith et al., 2012) due to them being intensively bred by commercial farmers due to the apparent importance of breeding and the supply of diversity for trophy hunting (Bothma et al., 2016b; Palazy et al., 2012; Rethman et al., 1996; Van der Merwe and Saayman, 2005). This was followed by a period where both species were bred intensively specifically for increased horn sizes mostly in South Africa (Nel, 2015; Taylor et al., 2020), but also in Namibia (Blackmore, 2017) (e.g. roan trophy bull that was sold for N$ 1,000,000) (New Era, 2015). However, the species is still somewhat rare in Namibia (Havemann et al., 2016; IUCN, 2019b; Martin, 2003), even though the recent range expansion, due to intensive breeding, has made the species a common sight in comparison to the years prior to intensive game farming (Section 3.1.2,

Figure 14). Within Namibia, roan was 34th on the list of most hunted game animals within the study period (Table 6). However, when the focus shifts to just north-eastern parks and conservancies, roan becomes the 16th most popular animal to hunt (above even the sable in that particular area). There seems to be a slight increase from the 19 roan hunted in 2011 to the 33 that were hunted in 2015 (which is a stark contrast when compared to the other species that fall within the scope of this study). This, however, might provide insight into the impact of low-level hunting on the trophy size trends in high-value species (Palazy et al., 2012).

Sable generally tended to be more popular as a trophy species than roan. However, as with roan, sable do not seem to feature as a popular species to hunt in Namibia, both nationally (26th on the list of hunted animals within Namibia) and within the north-eastern national parks and communal conservancies (23rd on the list of hunted animals in north-eastern parks and communal conservancies). This presents a contrast to other countries where the popularity of sable-hunting hunting is unquestionable (Crosmary et al., 2013; Lindsey et al., 2007b). Generally, the low numbers hunted in communal conservancies can be attributed to the availability of suitable habitat (Bothma et al., 2016b; Martin, 2003; NNF, 2008) and consequently the current population numbers, though it adds value due to its rarity (Palazy et al., 2012), cannot be harvested at the same level as the game farms that can afford to stock at higher densities (Capon, 2012). Based on the minimum estimate of 1,200 individuals (2008 survey) (NNF, 2008), it being a species that is rare and not commonly hunted in Namibia is well-founded. Nevertheless, intensive game breeding has seen an increased number of sable being introduced beyond its natural range in Namibia (Section 3.1.3, Figure 19). This continued range expansion, similar to roan, is largely due to the lucrative game breeding industry (evidenced, in 2016, by the sale of a male bull of Zambian bloodline for N$ 530,000) (Namibia Economist, 2016). As seen in Figure 58, this resulted in a sudden rise in live sale prices for both roan and sable (Hauptfleisch, in prep.) in 2014, but the eventual decline in those prices (e.g. the average value of over N$ 500,000 for sable in 2014 versus the 2019-value of under N$11,287) does perhaps indicate that the intensive breeding of roan and sable has not led to the desired product for the hunting industry; which is perhaps further evidenced by the declining trophy sizes of sable on private farms (Section 3.4.3, Figure 48).

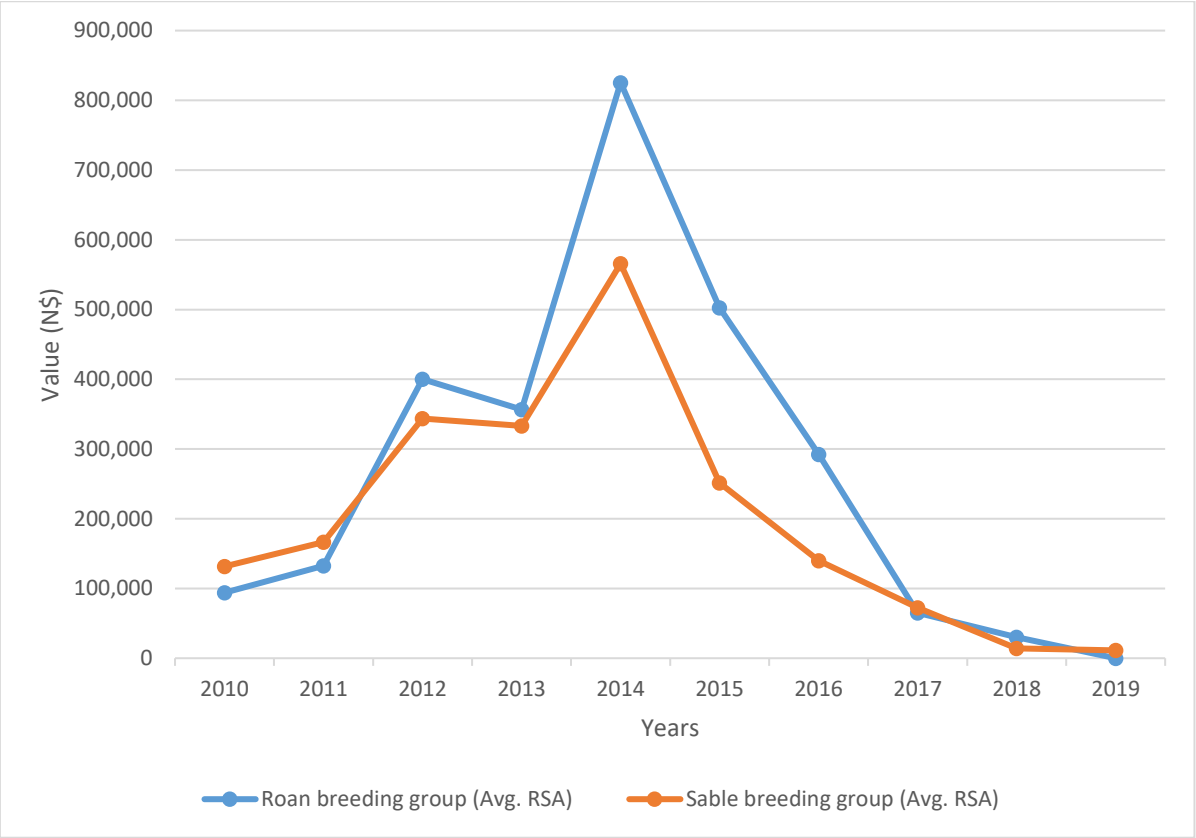

Figure 58: Average auction prices for roan and sable (2010-2019) (Hauptfleisch, in prep.)

In terms of the desirability of kudu as trophy animals, a review of Table 6 below places kudu as the fourth-most commonly hunted trophy animal in Namibia (which is preceded only by gemsbok, warthog, and springbok). Added to this, kudu are one of the most popular hunting species for meat in Namibia (Schalkwyk et al., 2010). The desirability of kudu in Namibia as a huntable species is probably linked to them being common and also due to the desirability of their large horn size that sets them apart as a charismatic species (Crosmary et al., 2013). This has led to the auctioning of kudu bulls with desirable traits within Namibia and to neighbouring countries (Schalkwyk et al., 2010); which may have resulted in record trophies being observed in southern Namibia (despite the low kudu population density in these areas), as seen in Figure 24. Kudu was considered to be one of the more popular species to hunt according to United States outfitters and clients after buffalo and leopard (Lindsey et al., 2006). Part of the reason for this, besides its desirable horn traits (Crosmary et al., 2013), seems to be due to kudu being a popular species to hunt amongst the more inexperienced hunters (whereas experienced hunters seemed to prefer the rarer antelope species) (Lindsey et al., 2006) since the likelihood of successfully hunting this generally common antelope is high.

4.1.2 Geographic distribution of hunts

Significantly fewer wildlife were trophy hunted on communal conservancies and parks compared to private hunting farms according to this study. However, the availability of trophy buffalo is limited to communal conservancies and national parks (Figure 59), since private ownership of buffalo is prohibited (Lindsey et al., 2013b). The location that recorded the most (n=83) buffalo hunted during the study period was the Bwabwata National Park, follow by Wuparo Conservancy (n=58), likely due to the high population of buffalo in the adjacent Mudumu and Nkasa Rupara National Parks (Ministry of Environment and Tourism, 2010) as well as the movement between Namibia and Botswana (Naidoo et al., 2016). Both areas provide suitable habitat for buffalo (Furstenberg, 2010) due to the ideal vegetation and the presence of the nearby wetlands (Mendelsohn et al., 2002; Ministry of Environment and Tourism, 2010).

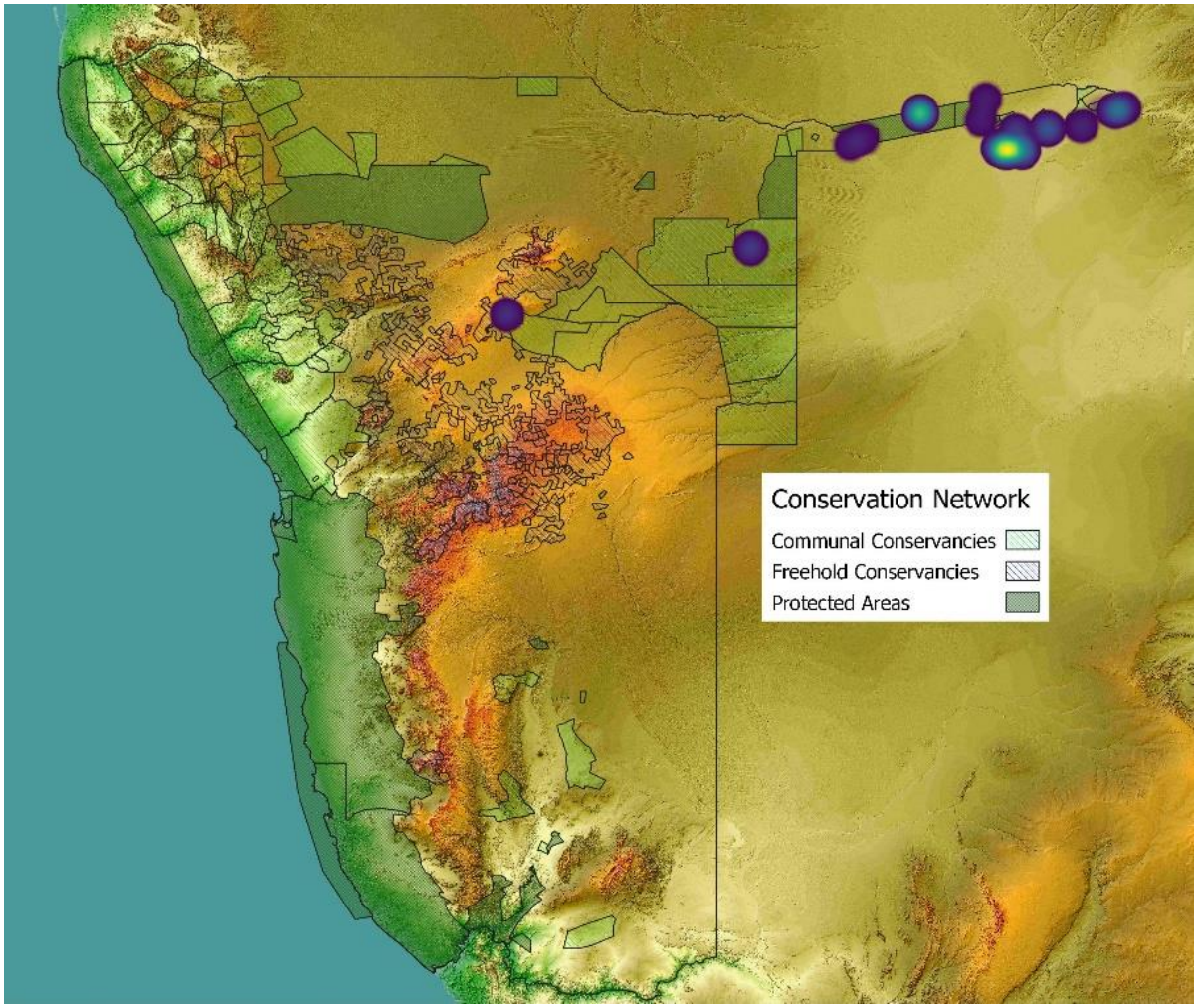

Figure 59: Predominant areas for buffalo hunting.

For roan, the location where they were hunted most on communal conservancies, as seen in Figure 60, was in Nyae Nyae Conservancy (n=15) and within national parks, the popular location tended to be in Bwabwata National Park (n=11), where the tall grass biome and wetlands (Mendelsohn et al., 2002)

provide suitable habitat for forage and reproduction (Havemann et al., 2016; Martin, 2003; McLoughlin and Owen-Smith, 2003). Within private farms, the predominant location for hunting roan was on the farm Okanjati (n=14) in the Otjozondjupa Region, which was also the farm that claimed the 4th largest trophy during this study period. Intensive breeding of preferable genetic traits associated with large trophies is practiced commonly in the private farming areas (Blackmore, 2017). The sale of large roan bulls in game auctions (Section 4.1.1) illustrates this.

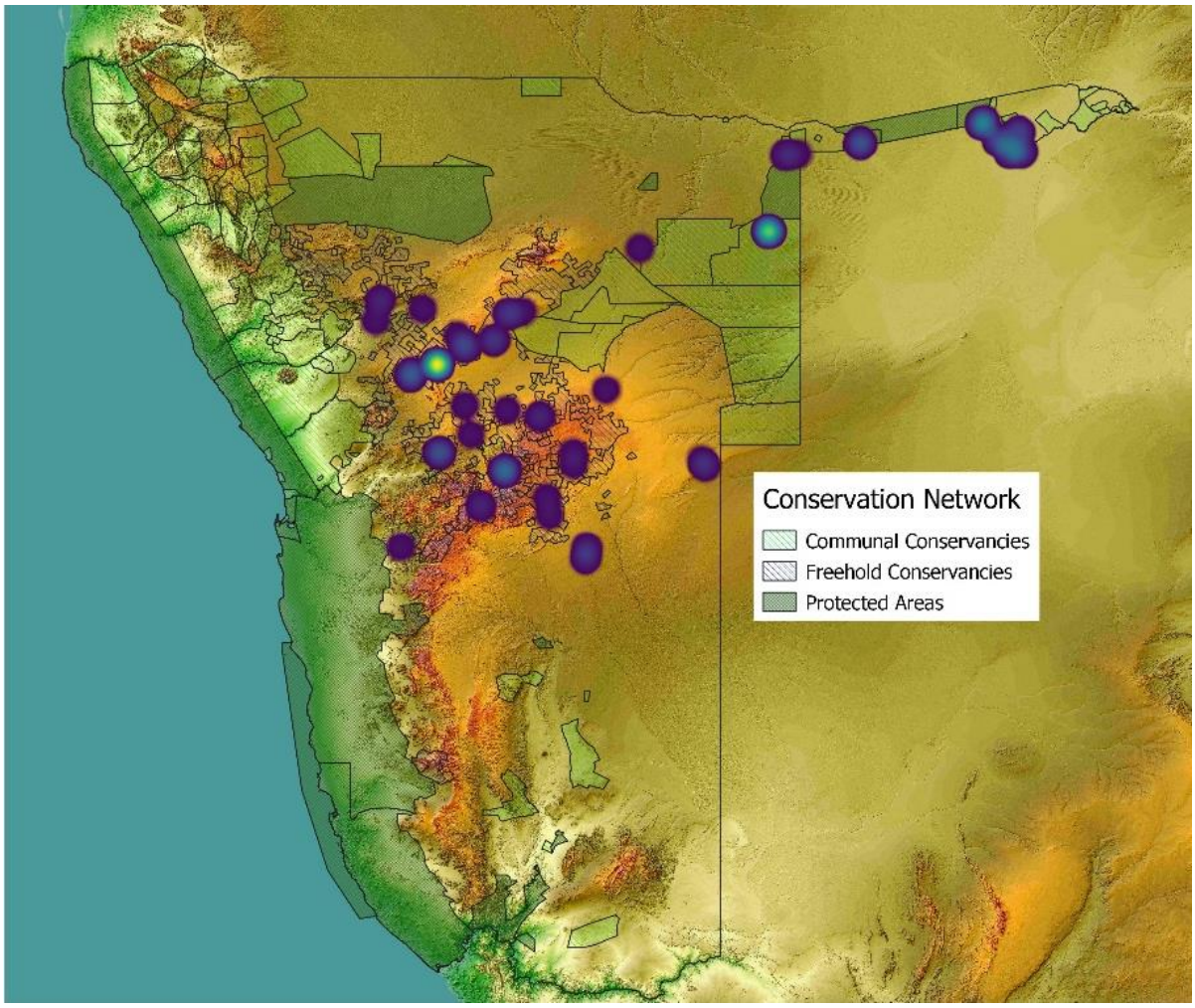

Figure 60: Predominant areas for roan hunting.

For sable, as seen in Figure 61, the predominant hunting area in the parks was within the Kwando Core area of the Bwabwata National Park (n=27) and within the communal conservancies, the predominant area for sable hunting was within Dzoti (n=3). The likely reason for the national park being a predominant area for hunting is the habitat suitability for these wetland species (Capon, 2012; Martin, 2003; Skinner and Chimimba, 2005), since the core wildlife areas for both Bwabwata and Dzoti are on the Kwando River and Linyanti River respectively (Mendelsohn et al., 2002; Ministry of Environment and Tourism, 2010). On the private farms, the farm that featured predominantly for sable hunting was Okamohoro (n=16). Sable are a species that have been intensively and artificially bred specifically due

to their rarity and their horn length, a trend that is commonly seen in South Africa (Nel, 2015). However, its perceived value for breeding has also been noted in Namibia (Section 4.1.1).

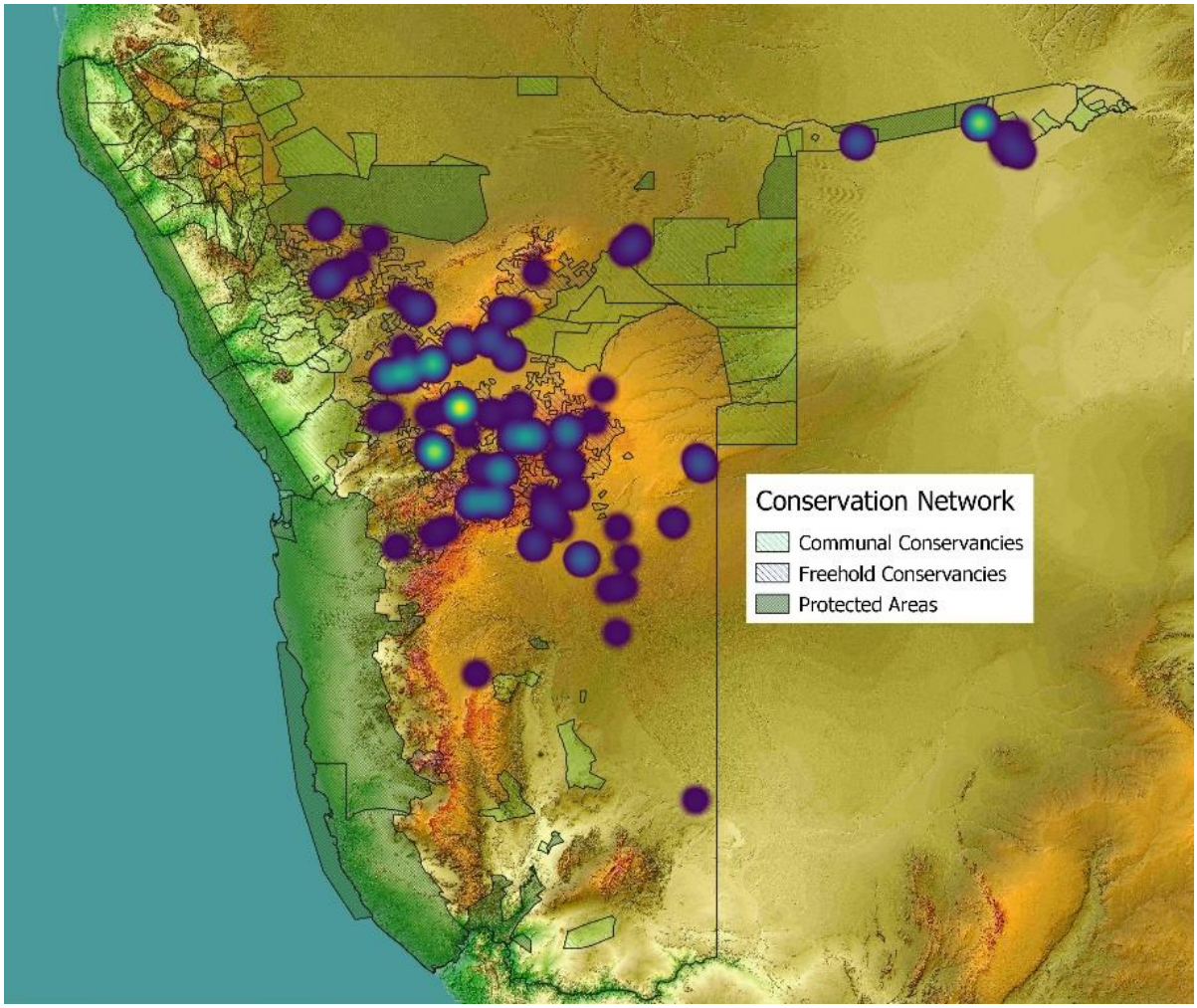

Figure 61: Predominant areas for sable hunting.

In the north-eastern parks and communal conservancies, the predominant areas for hunting kudu were in Nyae Nyae Conservancy (n=17) and in Bwabwata National Park (n=67); but within the national CBNRM landscape the area that was predominant in terms of kudu hunts was Torra Conservancy (n=37); both Nyae Nyae and Bwabwata have thick woodlands (Mendelsohn et al., 2002) that support the dietary needs of kudu (Skinner and Chimimba, 2005). On private farms, the predominant farm for kudu hunting was on farm Zelda (n=176) in the Omaheke Region, which is likely due to it being an exclusive game farm area. Kudu were largely hunted in the commercial farm areas in the central regions of Namibia (Figure 62) This correlates with their high density within that area (Mendelsohn et al., 2002) and their preference for areas dominated by the shrub and tree savannas (Bothma et al., 2016b; Skinner and Chimimba, 2005).

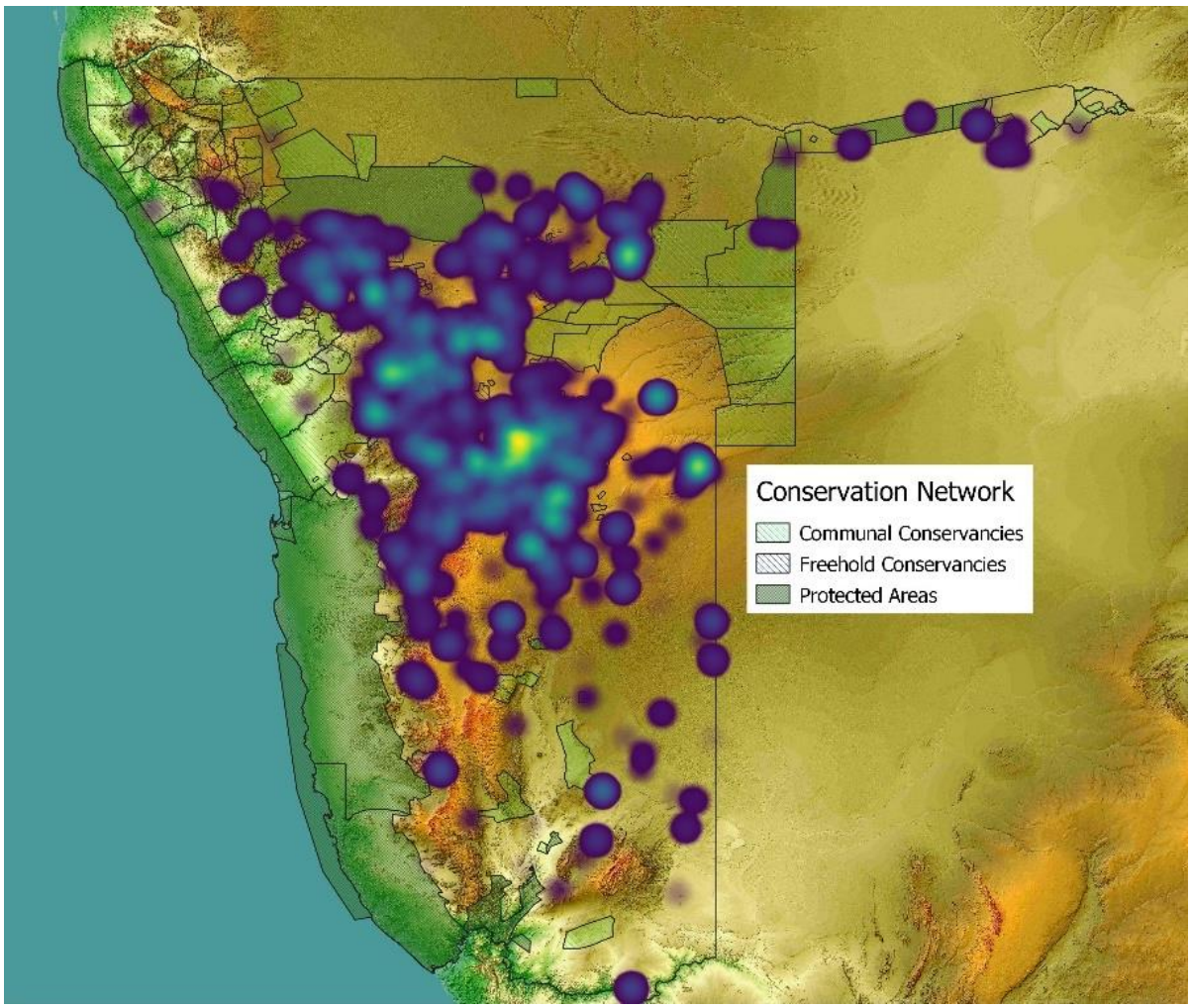

Figure 62: Predominant areas for kudu hunting.

4.1.3 Trends over time

Of the four species selected for this study, two of the rare animals (buffalo and roan) showed stable or increasing trends in trophy size of the study period. The more common species, but also the most hunted species (kudu) showed an alarming decrease in trophy size over time due to the drought and rabies.

The total number of buffalo hunted over the study period increased, which is probably a reflection of the increased number of buffalo that were put on quota -- which was most likely influenced by the addition of two new communal conservancies with buffalo that were gazetted in 2014 (namely Nakabolelwa and Lusese). There has been a marked increase in the number of buffalo hunted over the years. This is due to the increased number of buffalo that were made available on quota as well as the buffalo's popularity as dangerous game.

In comparison to other high-value species, roan did not receive a high quota allocation within the north-eastern communal conservancies of Namibia. There was a slight decrease in the number of roan allocated on trophy hunting quotas within communal conservancies (this coincided with an increase in

the number of roan hunted), and this might have been brought about by the game count estimations and subsequent quota readjustments for those respective years. The estimated in Bwabwata and the Zambezi conservancies were 1,789 (NACSO, 2012a) and in 2015 it was 1192 (NACSO, 2015a, 2015b). However, the hunting of roan antelope remained fairly constant yet minimal during the study period. The low quota utilization in north-eastern Namibia may be due to the easy availability of roan on game farms in central Namibia (Figure 15) and their distance from Namibia's central point of entry (Mendelsohn et al., 2002).

The sable quota also shares some similarities with the roan quota since sable are rare within the communal conservancies. The number of sable being allocated on the quota seems to be rather erratic, even though the number of gazetted communal conservancies increased between 2006 and 2015. The quota being allocated is probably a response to the number of sable observed on game counts (estimated at 1,494 in 2012 and 2,355 in 2015) (NACSO, 2012a, 2015a, 2015b) or via other means of counting methodology (e.g. aerial wetland surveys and fixed foot patrols) (MET/NACSO, 2020). There was no real observable decline in the number of sable being hunted since the hunting within communal conservancies and parks were somewhat sporadic and also since there was a noticeable increase in the number hunted on private farms. This presents itself as a slight contrast to Zimbabwe where there has been a noticeable decline in sable populations, with some of these declines being attributed to increased predation (Capon, 2012; Crosmary et al., 2015).

The number of kudu made available for hunting within communal conservancies across the country was increased despite the decreased population estimates for the north-western and north-eastern communal conservancies. There was a 16.4% decrease in kudu based on the 2012 and 2015 game counts in north-western (NACSO, 2015c, 2012b) and north-eastern Namibia (NACSO, 2015a, 2015b, 2012a). However, it is clearly noticeable that kudu, as a species, is a highly utilized and popular species for trophy hunting in Namibia (Lindsey et al., 2007b; MacLaren et al., 2019). There have been no recent official game counts on private farms to ascertain whether there has indeed been an increase in the number of kudus despite the persistent drought conditions and the outbreaks of rabies. The presence of rabies within kudu has to date only been described in Namibia (Scott et al., 2012), and the social behaviour of kudu along with the mouth lesions caused by their browsing of thorn-bushes has contributed to the spread of rabies in kudu (Mansfield et al., 2006). There is no evidence to suggest that kudu bulls are affected more severely by the virus than female kudu (Tubbesing, 2016).

4.2 Trophy measurement trends

4.2.1 Buffalo

Overall, the general indication of the trophy size, despite the increased quotas for buffalo, is that the overall trophy size is stable to increasing. This is reflected by the perceptions of several interviewed

trophy hunters that the overall size of buffalo trophies is increasing. This may be influenced by the fact that though the resident population of buffalo for the Zambezi is approximately 5,000 (Chase, 2007; NACSO, 2015a), there may be a fair level of movement between Botswana and Namibia (Naidoo et al., 2014), with Botswana having an estimated population of 40,000 buffalo (Chase, 2017). The standard percentage of trophy size animals in a buffalo population is estimated at 8% (du Toit et al., 2016). Therefore, this migratory effect has probably led to an increased hunting success over the past years (i.e. more buffalo from different areas to replenish good trophy specimens).

There are two apparent preferences of trophies that are sought after by most hunters that hunt buffalo, and these are either trophies that have a "drop" or that are "flat". The "flat" trophies do not tend to have as much of a long boss length and therefore will not have much of a higher score than those with a "drop" (Alam, 2008; Jeke et al., 2019). However, it should be noted that even though the appearance of trophy measurements during the study period indicates a positive growth trend, care should be taken to assess whether the measurement size is not linked to the age of the individual animals – the danger here is that what appears to be good measurements might be a product of the hunting of younger individuals or bulls that are in their prime (Gandy and Reilly, 2004; Jeke et al., 2019) since horn sizes tend to decrease after 67-72 months of age (Lepori et al., 2019). For sustainable trophy hunting, it is always preferable to hunt post-reproductive animals, after their genetic traits have already been transferred to the next generations (Coltman et al., 2003; Whitman et al., 2004).

It also seems that the horn size of buffalo is often correlated to the openness of the environment and the nutrition available (du Toit, 2016), along with the health of the individual animals (Ezenwa and Jolles, 2008). Also, the population size of buffalo (a probable influence on the frequency of large horn sizes) tend to be positively correlated with the rainfall, as it secures their food supply (du Toit, 2016). Therefore, further studies within Namibia will need to consider the long-term influence of rainfall, among other variables, on the population health of the species. Also, buffalo tend to be reservoirs of foot-and-mouth disease and corridor disease (with bovine tuberculosis emerging as a third major disease being hosted by these bovids) (du Toit, 2016), which might need a comparative study of the effects of these disease on trophy size.

The increase of the average trophy measurements within the communal conservancies and the national parks are somewhat a contrast to what is being experienced elsewhere in Africa. Within north-west Zimbabwe, where there was a quota uptake of over 75% there was a significant decline within the trophy measurements of buffalo (Ngorima and Mhlanga, 2015); even though the uptake of the quota was close to 80% in Namibia, there was not a severe decline as what was experienced within Sengwa Wildlife Research Area. Additionally, within south-eastern Zimbabwe, there has also been a noticeable negative trend observed for buffalo trophy measurements (Jeke et al., 2019). The same decline experienced in Zimbabwe was experienced over a longer continuous period in the Selous Game

Reserve, Tanzania (Malembeka, 2013; Songorwa and du Toit, 2007) due to largely unregulated trophy hunting.

4.2.2 Roan

The roan measurements that were assessed did not warrant any concern in terms of negative trends. As with the statistical results in sable, the roan trophy measurement figures are inconclusive as a standalone figure due to the small sample size. The higher trophy size, mostly attributed to private game farms, may be due to the intensive breeding programmes using large trophy size genetic traits within certain private game reserves (Nel, 2015) and because the communal conservancies and national parks do tend to have a lower density of roan present than within many private game reserves (Martin, 2003). Even though there was a higher (and increasing) number of roan hunted on private farms (Lindsey, 2011; NNF, 2008), this did not seem to affect the trophy size, since there was an overall positive trend in trophy size on private farms. Even though the social structures of roan suggests that they take much longer to recover from losing herd members (be it to predation, poaching or legal hunting) (Havemann et al., 2016), the increasing trophy trend seems to indicate the population of roan are either stable or that there is a fair amount recruitment taking place (either through natural births and slowed mortalities or through the purchasing of roan herds for private game farms). This may be due to the nature of current game farming practices that allows for the selective manipulation of trophy size on the relatively smaller private farms (Blackmore, 2017; Damm, 2005; Von Brandis and Reilly, 2007). However, the absence of large predators, which would normally not be allowed to coexist in the same areas where commercial farmers wish to protect their interests, can lead to a natural population growth rate of close to 26% (Bothma et al., 2016b).

4.2.3 Sable

There is a noticeably larger average of trophies hunted on private game farms in comparison to the communal conservancies; and this could largely be due to the influence of intensive breeding for the selection of larger animals (Blackmore, 2017; Nel, 2015). Generally, the concern of intensive game farming practices would have been that breeding of smaller populations within closed off units of land would lead to inbreeding and smaller trophy size; on the other hand, as indicated in other studies, this did not seem to be the case (Josling et al., 2019). Additionally, the game farms would have a higher advantage in the marketability of their product since they would more likely to assure that their enclosed system would yield an easier hunt and they would normally ensure that to safeguard their costly investment, most predators are absent from the area where these animals are kept (Damm, 2005). The national parks still seem to have a bigger advantage in terms of the average trophy size, and this could be a result of the larger area size and that very few large trophies have been hunted in the past. Yet, based on the statistical analysis, there is a steeper decline in the trophy horn measurements in the national parks than in any of the other land-uses. If trophy size is therefore truly

an indication of population health, the trends might be similar to those of the greater Hwange conservation area, where the sable population did not seem to thrive in the national parks (coincidentally the elephant population thrives within the national parks, but further studies need to be conducted to determine whether elephant density has an effect on sable populations) (Crosmary et al., 2015); nevertheless, predation may not necessarily be the culprit where the trophy measurements in this study period are concerned. Some studies mention that sable are reliant on open woodlands and grasslands for the purposes of reproduction (Bothma et al., 2016b; Capon, 2012; Crosmary et al., 2015; Skinner and Chimimba, 2005), but, if sable are under hunting pressure, they will relocate to the safety of closed woodlands (Ndaimani et al., 2014)—which is not as freely available in communal conservancies as is it is in the national parks (Mendelsohn et al., 2002). As observed within the statistical analysis, there are extremely low trophy score values, which may seemingly be the cause of some of the observed declines. However, the analysis for trophies that are greater than or equal to the minimum exportable scores indicates that there would still be a negative trend irrespective of the presence of low outliers and extremes. Since most sable bulls tend to become post-reproductive after 10 years of age (Bothma et al., 2016b), a more valuable research question could be posed in future to determine the ratio of trophy bulls hunted over the age of 10 years compared to those in their prime (under 10 years).

4.2.4 Kudu

The noticeable decline in trophy size of kudu across the country can be supported by the fact that they make a desirable trophy species (Lindsey et al., 2007b) and that they have been made vulnerable to rabies outbreaks in the last few decades (Mansfield et al., 2006). Yet, due to the popularity of kudu as a trophy species, in Namibia, it has been noted in previous studies that kudus of the age gap of 4.5 to 11.5 years are highly likely to be selected by trophy hunters in fenced-off game farms (Annighöfer and Schütz, 2011). In reference to the rabies epidemic, not all incidents of kudu succumbing to rabies is reported, therefore no exact accurate numbers can be given to show a correlation between the decreasing kudu trophy measurements and the number of rabies incidences. Nonetheless, before 2011, it has been estimated by members of the commercial conservancies that there was a loss of between 30% and 70% between the years 2002 and 2011 (Scott et al., 2012). On the other hand, some research into the nationwide effects of rabies in mammals across Namibia (Table 22), suggests that kudu mortalities may have reached a peak in the year 2013 (Rainer Hassel, personal communication, 2018), which incidentally preceded the observed steep decrease in the number of kudu hunted in 2014-2015 (opposed to the numbers seen 2011-2013). The experience of wildlife veterinarians suggests that rabies affects both kudu bulls and cow-calf herds equally (Tubbesing, 2016).

Table 22: Reported rabies cases (Rainer Hassel, personal communication, 2018)

Species	Years				
	2011	**2012**	**2013**	**2014**	**2015**
Cattle	69	81	115	101	106
Dogs	101	113	102	84	94
Goats	14	14	23	20	25
Sheep	3	4	4	2	2
Equines	4	4	4	3	5
Cats	9	18	8	15	4
Other domestic	1	-	1	3	2
Total domestic	**201**	**234**	**257**	**228**	**238**
Kudu	39	37	99	55	41
Jackal	14	7	11	3	3
Eland	2	3	6	6	9
Honey Badger	-	-	-	1	-
Bat eared fox	3	-	-	1	1
Other wildlife	1	2	5	2	2
Total wildlife	**59**	**49**	**121**	**68**	**56**
Total	**260**	**283**	**378**	**296**	**294**

4.3 Sustainability of trophy hunting

Trophy measurement trends are used to monitor the sustainability of trophy hunting (Ngorima and Mhlanga, 2015; Von Brandis, 2004; Von Brandis and Reilly, 2007). A decrease in trophy measurements usually means that the genetic trait for larger measurements is being removed from the gene pool (Coltman et al., 2003; Mysterud and Bischof, 2010). This results from either too many large male animals being removed (Jeke et al., 2019) or too many younger animals are being hunted before their traits are transferred to the next generation (Gandy and Reilly, 2004). It also indicates that larger animals are still being found by hunters in these areas within the time that the trophy hunter has available to hunt (Bothma et al., 2016a).

4.4 Perception within the trophy hunting industry

The general responses from the professional hunters themselves largely seemed to indicate that there was some correlation with what was observed in the statistical analysis. For buffalo, 46.6% of the respondents indicated that the trophy quality of buffalo was stable; 26.6% indicated that the trophy quality was increasing whereas another 26.6% of the responses indicated that the trophy quality was

decreasing. This largely corresponds with the increased trophy measurements observed in both national parks and communal conservancies. The perceptions of the reduced trophy quality stem from the concerns regarding the hunting of younger individuals that are selected due to their wider horn spread (Jeke et al., 2019) -- which is a phenomenon that has been observed within South Africa, hence the recommendation for accurate ageing to be incorporated that favours the harvesting of older "broomed" individuals (Gandy and Reilly, 2004).

Roan measurement analyses also shared similarities with what the hunters perceived. The responses indicated that 61.5% of hunters thought that the trophy quality was stable within communal conservancies and national parks and another 38.5% suggested that the trophy quality was in fact increasing. When reviewing the responses for roan on private farms, 62.5% of the respondents claimed that trophy quality was in fact increasing, another 31.5% claimed that the trophy quality was stable and the remaining 6.3% claimed that the quality was decreasing. This corresponds largely with what was determined in the statistical analysis where the general trends showed an increase on both private and state land.

The responses to the sable trophy quality perceptions were the only responses of the four study species that did not truly reflect what the statistical analyses suggested. Within the communal conservancies and national parks, 25% of the responses indicated that there was an increase in the trophy quality while the remaining 75% claimed that the trend of trophy measurements was stable. On private land, about 70.6% of the respondents felt that the sable trophy size was increasing, about 17.6% claimed that the trophy quality was stable and about 11.8% claimed that the trophy quality was decreasing. This certainly did not reflect the results of the statistical analysis, where there was a fairly steep decline in the trend of trophy measurements in the national parks and smaller negative trends within communal conservancies and private farms. Perhaps the perceptions of hunters are based on the observed increase of trophy bulls that have been traded on live auctions within Namibia over the recent years (Blackmore, 2017). This may fuel the perception that there is an ever-growing number of individual sable bulls that have desirable trophy traits. Nevertheless, this may mean that the respondents have not considered the actual trophy quality of the animals that were hunted.

The responses on the kudu trophy data showed an interesting insight into the hunter's perceptions regarding the decline of the trophy quality: in this scenario, most hunters indicated that the kudu trophy measurements were either stable or on the decrease. In reference to the communal conservancies and national parks, 12.5% indicated that the trophy measurements were increasing, 56.25% claimed that the trends were stable and the remaining 31.25% indicated that the trophy quality was declining. With regards to private farms, 18.9% claimed that the kudu trophy measurements were increasing, another 45.9% described that the trophy quality was stable and another 35.2% claimed that trophy measurements were decreasing. Though this not an exact match to what was ascertained

within the analysis, the larger percentage that claimed a decrease rather than an increase certainly does give an accurate confirmation of the results. When queried on the causes for the declines in kudu population numbers, and consequently the trophy quality, most responses indicated that disease, namely rabies, was the main reason for the decline in the kudu population, which consequently reduced the number of individuals with desirable horn sizes.

The importance of perceptions that stems from social sciences is becoming increasingly significant in conservation and environmental management (Bennett, 2016). Even though there are well-known limitations regarding interviewees' perceptions (i.e. subjectivity), most responses do tend to reflect scientific data.

Accordingly, the professional hunters' perceptions should be viewed in an informative light since hunters are observant towards the needs of their clients and the market conditions. Hunters would normally respond to the supply of a species rarity by increasing the prices accordingly (Hall et al., 2008) and by marketing it in countries where rare species are sought after and where there is a willingness to pay higher prices (Lindsey et al., 2006). Also, hunters are aware that trophy size and purist hunting is important amongst certain hunting cultures, and consequently, most professional hunters would make full use of this knowledge when marketing at international shows (Von Brandis and Reilly, 2007). This response is often seen amongst Namibian hunters who advertise free-roaming animals since it appeals to purist hunting principle of a fair chase and the hunting of wildlife in their natural environment (Estreux Safaris, 2009; Jamy Traut Hunting Safaris, 2019; Peters, 2019).

4.5 Critique of official trophy measurement data

In compliance with the Nature Conservation Ordinance (*Nature Conservation Ordinance No. 4 1975*, n.d.) professional hunters accompanying trophy hunters are required to submit detailed records of each trophy hunt to the MEFT in the form of annual hunter return forms. The hard copy form data are then entered electronically by technicians in the MEFT. This study found that many problems arise within the electronic copy. Most errors are clear typing errors, whereas others are simply the lack of clarity in certain data entries. Using the sable trophy measurement data as an example, is quite clear by the outliers and extremes, that there is either ongoing flawed data capture/entry, or there are some management decisions at work that cannot be captured with the usual data capture method. These errors resulted in 9.14% of all trophy measurements being excluded from this study. By examining Figure 63 below two sets of unexplained extremes were identified: extremes that fall below the minimum exportable trophy measurement of 90.16 inches and those that exceed any recent recognition within the reputable record books (considering that the current world record for sable is 121 inches) (Rowland Ward, 2019). Given that the record of 128 inches was hunted within the Bwabwata National Park by an American citizen, it's highly likely that such a score should have been mentioned within the SCI, Rowland Ward, and NAPHA records, but was not. Other studies (within

medical settings) have reported that the entering of data manually can produce errors of between 0.34% and 1.24% (Barchard and Pace, 2008).

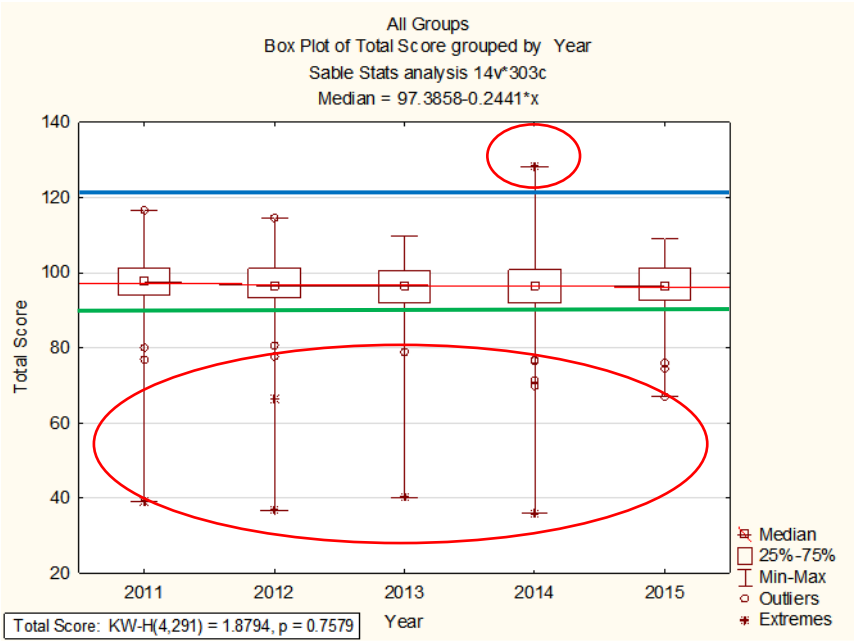

Figure 63: Questionable outliers and extremes in sable total scores.

One of the key challenges identified with the study species of this thesis was the apparent small sample size associated with roan and sable (within the communal conservancies). This is mainly due to the low numbers of the species present within the communal conservancies at present and due to the perceived national rarity (hence the low quota allocation for the communal conservancies). However, this challenge was remedied by combining the trophy values of roan and sable in the communal conservancies with roan and sable that had been hunted in private farms and reserves. The value of monitoring the data, although being few, is to inform the appropriate management institutions of the trends even though the trends are not scientifically significant. Managers can still use the data for adaptive management (Paterson et al., 2008; Walters and Hilborn, 1978).

In the hunter return forms, there seems to be no specification as to whether the data has been entered according to Rowland Ward or SCI measure systems (Rowland Ward, 2019; Schwabland and Barnhart, 2016; van Rooyen et al., 2016). This made it periodically challenging when it came to the analysis of the buffalo data. In relation to this, there is no clear specification as to whether the measurements were taken in inches or in centimetres (the hunters need to specify this on the return forms), which had to be deduced from the range of measurements sized known for each species (Skinner and Chimimba, 2005). This may in part have been the cause of some of the extremes and outliers observed within the statistical analysis.

Additionally, more can be done to add spatial value to the data. It would be recommendable to add the region of Namibia where the trophies were shot. Also, in the context of private farms, it would be an added benefit to distinguish between the private farms that are either stand-alone farms or those that are part of a freehold conservancy. Not only will this provide clarity outside the context of this thesis, but it might provide valid evidence that could be used for further research in the freehold conservancy model of Namibia (Lindsey, 2011).

There also seems to be a lack of willingness to share certain data, as can be seen in the gaps within the buffalo trophy data. Often, no measurements are given on the returns forms specifically with regards to elephant, since the MEFT will measure the ivory prior to it being exported. However, this is also the case with the many measurements of the other species within the database. Hunting is a sensitive subject (McNamara et al., 2015), and the reluctance of Namibian authorities to share hunting data stems from the extensive criticism of trophy hunting (Coltman et al., 2003; Di Minin et al., 2016; IUCN, 2016; Lindsey et al., 2006; Sorensen, 2015).

Chapter 5: Conclusions

The study indicated that trophy measurements for buffalo and roan were stable to decreasing. This was found across all areas indicating that hunting of these species for the study period was indeed sustainable. For kudu and sable, however, the trophy measurements were decreasing across all three land-use types, which indicates that adaptive management is needed to ensure the sustainability of hunting for these two species.

The largest trophies for buffalo were found in the north-eastern conservancies (specifically Balyerwa) and Bwabwata National Park. For roan, the largest trophies for Namibia were recorded mainly on private farms. In terms of sable, the reported top trophy was recorded in Bwabwata National Park, but a majority of the largest trophies were hunted on private farms. The largest trophies for kudu were all hunted on private farms mainly in central Namibia.

The study also found that hunters' perceptions of trophy trends do closely follow the empirical data (except with regards to the sable trophy size trends), indicating that their opinions are important to use when considering trophy hunting sustainability.

Recommendations

There is still much that needs to be done to first ensure that the data that is being collected is trustworthy and that it can be confidently be used to make management decisions. However, even though measurements will still be held as the standard determinant of trophy quality in Namibia due to its marketability to foreign trophy hunters, age needs to be considered as an additional measure of trophy quality (Gandy and Reilly, 2004). During this study, it became noticeable that the determination of trophy quotas should not be limited to the study of trophy trends alone (this was based mainly on the inconclusive results seen in the small sample size of the sable population). In these circumstances, it might be preferable to incorporate a system modelling mechanism that would lead to the better quota allocation of the particularly high-value and rare species.

Some specific recommendations are provided below:

- The enforcement of correct trophy values, both in terms of measurements and age, (maybe followed with a condition of no new hunting permits to be issued in the face on non-compliance).
- Additional studies of age-related trophies need to be undertaken – to help facilitate the value of true conservation hunting (taking out post-reproductive males rather than the males with the highest trophy score).
- This study mainly sought to discover the trends in the high-value species of the north-eastern regions of Namibia, and the possible influences on these trends between the different land

uses. However, further studies should be conducted to link the trends with some important variables (e.g. rainfall, trends in poaching, the vegetation type that allows for visibility, fire frequency, trophy trends in other native ranges, the human population density in the local and international ranges, the density of large carnivores in home ranges of the study species, the hunting experience of the professional hunters involved, the movement of species in open systems, and the economic drivers in trophy desirability). Because to assume that the trends in trophy size is determined merely by the number of animals being hunted would be "causation due to correlation"—an error in thinking that should be avoided (Aldrich, 1995).

- A recommended approach for the creation of a semi-automated database would entail the replication of a similar dataset that is currently in use. This semi-automated database would replace the current Microsoft Excel Spreadsheet. Within the database (Figure 64) the manual input can be limited to specific drop-down menus or character length (e.g. a measurement for sable horn length cannot exceed 200 cm) – which will help reduce typographical errors. Also, the database could provide verification if compulsory images were to be uploaded.

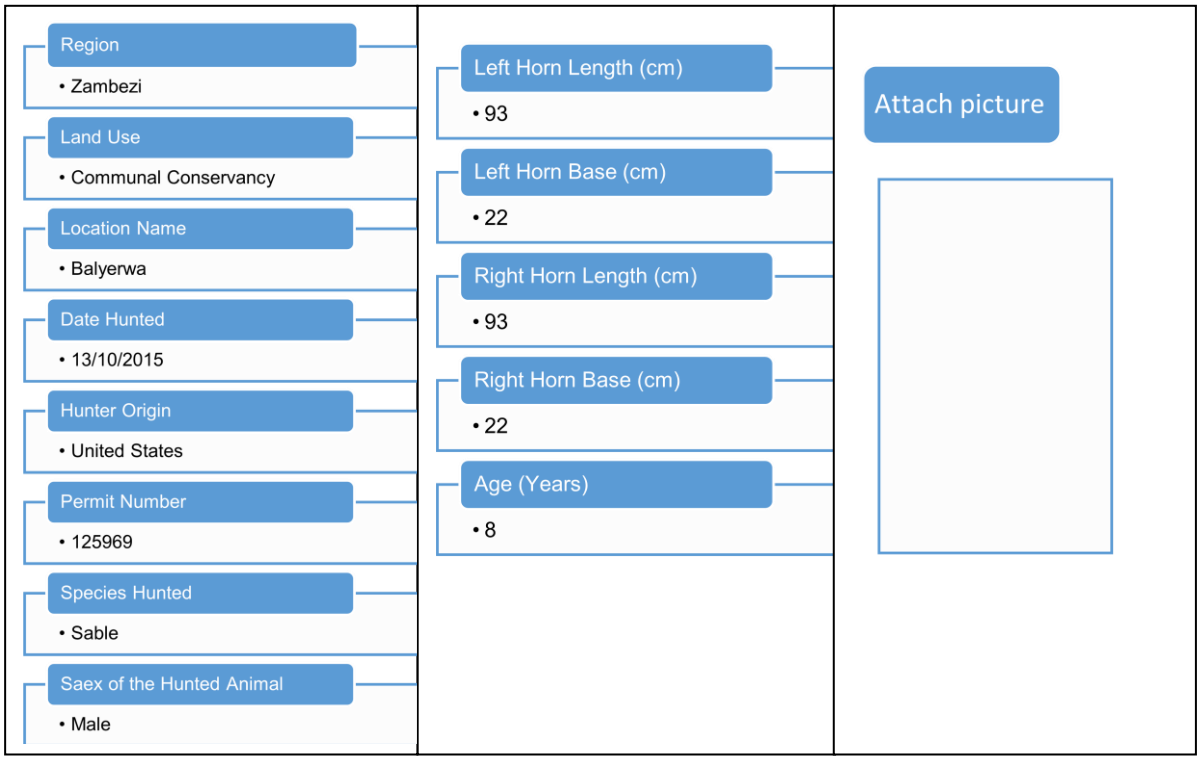

Figure 64: Database interface example.

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Appendix A

REPUBLIC OF NAMIBIA

MINISTRY OF ENVIRONMENT AND TOURISM

Directorate of Scientific Services
Private Bag 13306
Phillip Troskie Building
c/o Dr. Kenneth David Kaunda and
Robert Mugabe Avenue, Eros
WINDHOEK
NAMIBIA

ANNUAL RETURN – TROPHY HUNTING

This information must be submitted at the end of every November of every calendar year to the permit office

Name of Guide_____

Please mark with X where appropriate

☐ **Big Game Professional Hunter**

☐ **Professional Hunter**

☐ **Master Hunting Guide**

☐ **Hunting Guide**

Postal Address_____

Residential Address_____

Hunting farm / Safari / Guest farm_____

_____ Signature

_____ Date

SUMMARY OF COUNTRIES

Country	Number of hunters	Country	Number of hunters	Country	Number of hunters
Angola		Poland			
Argentina		Peru			
Australia		Portugal			
Austria		Qatar			
Belgium		Romania			
Brazil		Russia			
Bulgaria		Saudi Arabia			
Canada		Scotland			
China		Serbia			
Costa Rica		Slovakia			
Croatia		Slovenia			
Czech Republic		South Africa			
Denmark		Spain			
Egypt		Sweden			
Ecuador		Switzerland			
Estonia		Turkey			
Finland		United Arab Emirates			
France		United Kingdom			
Germany		Ukraine			
Greece		United States of America			
Hungary		Venezuela			
India		**Other:**			
Ireland					
Italy					
Latvia					
Lithuania					
Luxemburg					
Macedonia					
Mauritius					
Mexico					
Namibia					
Netherlands					
New Mexico					
New Zealand					
Norway					
Paraguay					

NUMBER OF TROPHY ANIMALS UTILIZED

Species	Number Utilized	Unit Cost (N$)	Total Cost (N$)	Species	Number Utilized	Unit Cost (N$)	Total Cost (N$)
Black backed jackal				Spotted hyaena			
Black faced impala				Springbok			
Black rhino				Steenbok			
Black wildebeest				Tsessebe			
Blesbok				Warthog			
Blue wildebeest				Waterbuck			
Brown hyaena				White rhino			
Buffalo				**Other:**			
Caracal							
Chacma baboon							
Cheetah							
Common impala							
Crocodile							
Damara dik-dik							
Duiker							
Eland							
Elephant							
Giraffe							
Hippopotamus							
Klipspringer							
Kudu							
Leopard							
Lion							
Mountain's zebra (Hartmann)							
Nyala							
Oryx							
Ostrich							
Plain's zebra (Burchell's)							
Red hartebeest							
Red lechwe							
Reedbuck							
Roan antelope							
Rock hyrax							
Sable antelope							

NUMBER OF HUNTABLE GAME BIRDS UTILIZED

Species	Number Utilized	Unit Cost (N$)	Total Cost (N$)
Guinea fowl			
Namaqua sandgrouse			
Kurrichane buttonquail			
Common quail			
Harlequin quail			
Crested francolin			
Redbilled francolin			
Swainson's francolin			
Orange River francolin			
White faced duck			
Egyptian goose			
Cape teal			
Hottentot teal			
Redbilled teal			
Turtle dove			
Laughing dove			
Rock pigeon			
Burchell's sandgrouse			
Doublebanded sandgrouse			

TROPHY HUNTING ANNUAL RETURN - TROPHY MEASUREMENTS *(Please complete this part, important for determining trophy quality)*

Date	Name of client	County of origin	Permit Number	Species	Sex	Horn measurements (cm)				Farm name and number	District
						Length (L)	Length (R)	Base (L)	Base (R)		

Please indicate which of these measurements are above the minimum Rowland Ward

_____
Signature

_____
Date

Appendix B

1. Please indicate how long (years) you have been active in the hunting industry.

- ◯ 0-5
- ◯ 5-10
- ◯ 10-15
- ◯ 15+

2. Which of the following four species have you hunted in communal conservancies or national parks?

- ☐ Buffalo
- ☐ Roan
- ☐ Sable
- ☐ Kudu

3. Which of the following species have you hunted in private farms?

- ☐ Roan
- ☐ Sable
- ☐ Kudu

4. In communal conservancies, rank the hunting effort for each of the individual species.

	Difficult	Moderate	Easy
Buffalo	◯	◯	◯
Roan	◯	◯	◯
Sable	◯	◯	◯
Kudu	◯	◯	◯

5. In private farms, rank the hunting effort for each of the individual species.

	Difficult	Moderate	Easy
Roan	◯	◯	◯
Sable	◯	◯	◯
Kudu	◯	◯	◯

6. Based on your knowledge and/or experience, indicate the trophy quality trends for the period 2011-2015 for the following species on communal conservancies/national parks.

	Decreasing	Stable	Increasing
Buffalo	○	○	○
Roan	○	○	○
Sable	○	○	○
Kudu	○	○	○

7. Indicate the population trends in communal conservancies/national parks for the following species for the period 2011-2015.

	Decreasing	Stable	Increasing
Buffalo	○	○	○
Roan	○	○	○
Sable	○	○	○
Kudu	○	○	○

8. Based on your knowledge and/or experience, indicate the trophy quality trends for the following species within private farms for the period 2011-2015.

	Decreasing	Stable	Increasing
Roan	○	○	○
Sable	○	○	○
Kudu	○	○	○

9. Indicate the population trends for the selected species on private farms for the period 2011-2015.

	Decreasing	Stable	Increasing
Roan	○	○	○
Sable	○	○	○
Kudu	○	○	○

10. If there is an overall decrease in the trophy quality or population numbers of kudu, please indicate the factors responsible for the decline.

	Strongly disagree				Strongly agree
Rainfall or climate	◯	◯	◯	◯	◯
Overhunting	◯	◯	◯	◯	◯
Human encroachment	◯	◯	◯	◯	◯
Increased predation	◯	◯	◯	◯	◯
Disease	◯	◯	◯	◯	◯
Migration patters	◯	◯	◯	◯	◯

Are there other factors influencing the decline?

11. Is the current trophy hunting quota for the buffalo, roan, sable and kudu in communal conservancies sustainable?

	Yes	No	Undecided
Buffalo	◯	◯	◯
Roan	◯	◯	◯
Sable	◯	◯	◯
Kudu	◯	◯	◯

12. Assessments of trophy measurements over time for the informing of quota setting would be valuable tool?

- ◯ Yes
- ◯ No
- ◯ Maybe

13. What other possible methods besides game counts and assessments of trophy quality could be used to inform a sustainable quota setting process?

Appendix C

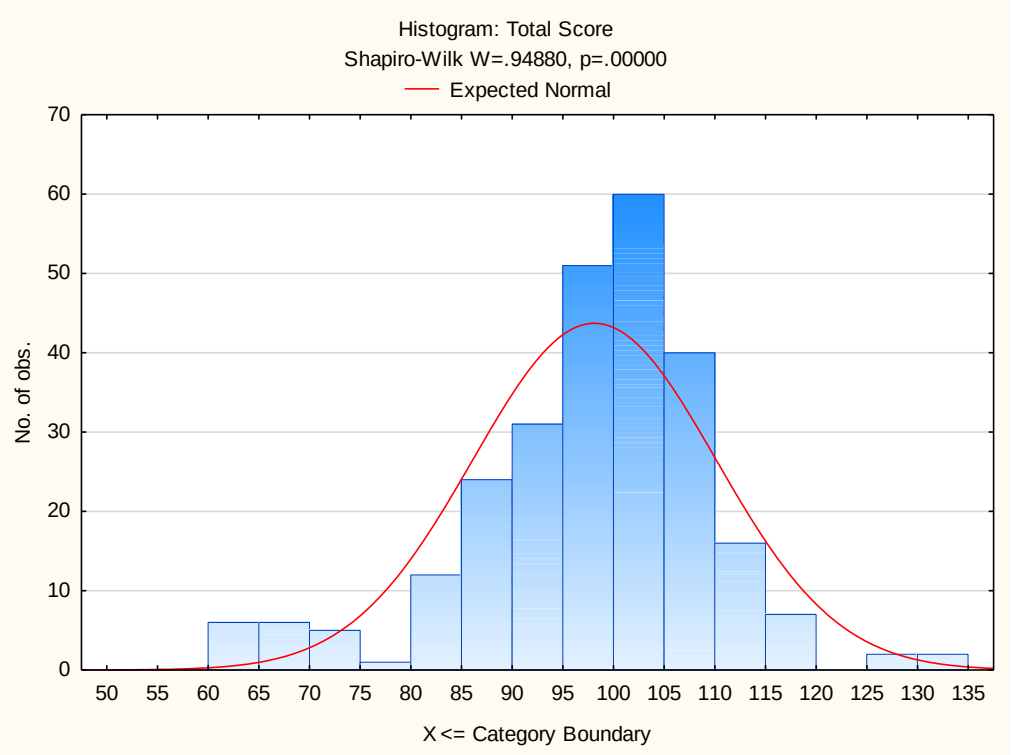

Figure C1: Shapiro-Wilk W Test for buffalo total scores.

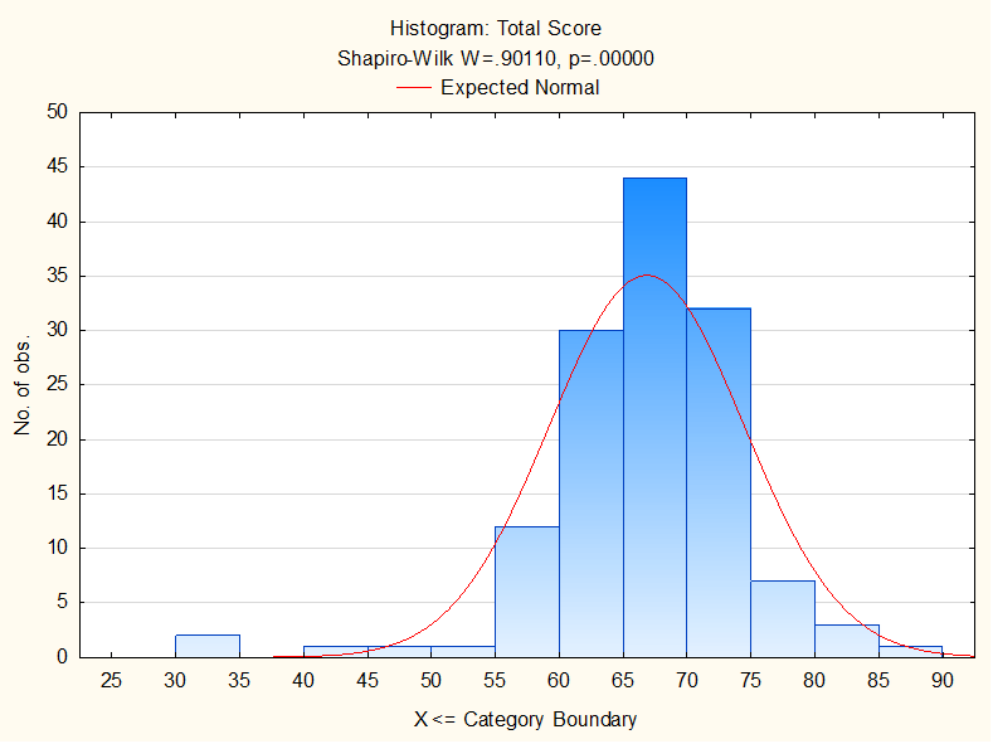

Figure C2: Shapiro-Wilk W Test for roan total scores.

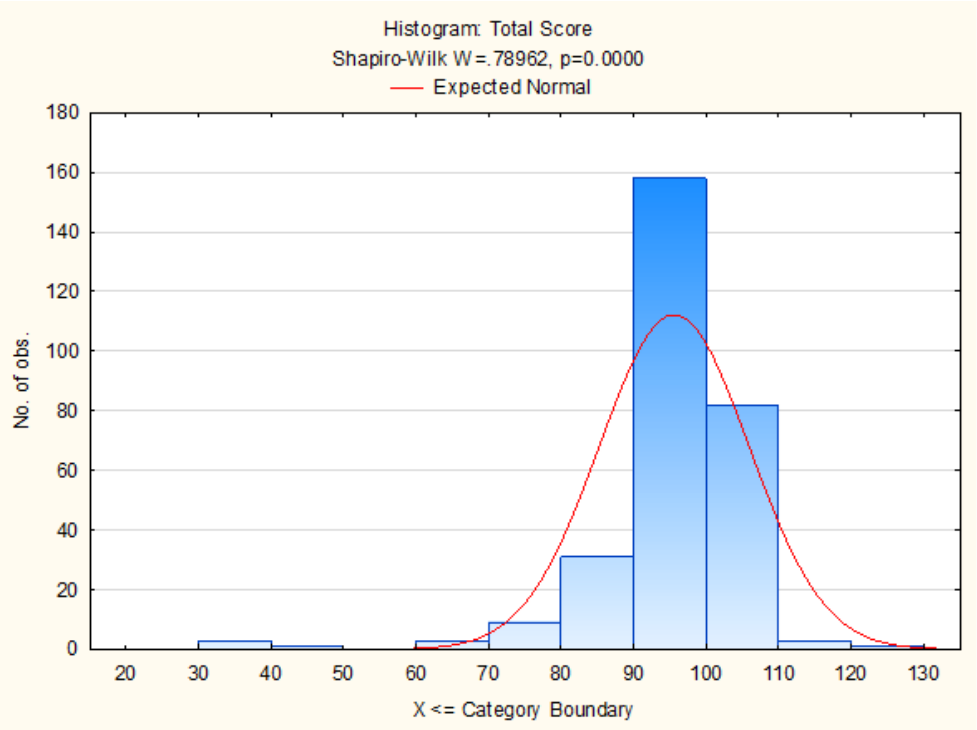

Figure C3: Shapiro-Wilk W Test for sable total scores.

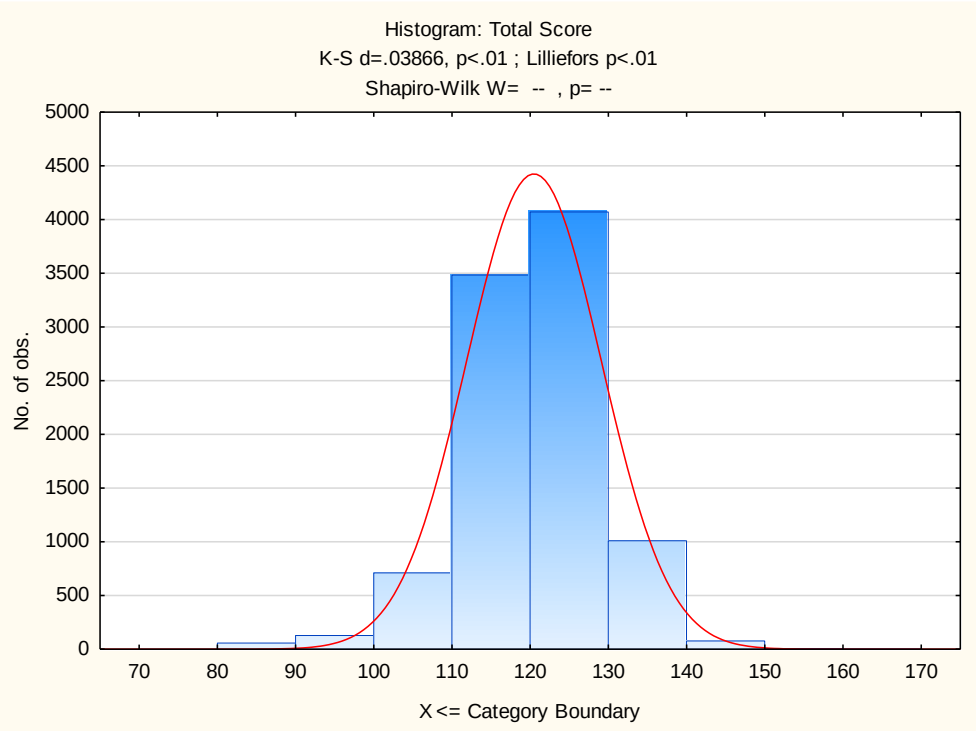

Figure C4: Lilliefors corrected K-S test and Shapiro-Wilk W test for kudu total scores.

Appendix D

Country of origin	Years					Trophy Record
	2011	2012	2013	2014	2015	
USA	144.09	149.61	143.70	169.29	143.31	169.29
Mexico	150.59	131.50	142.13	129.92	128.35	150.59
Germany	148.90	143.31	149.41	145.67	148.82	149.41
Spain	138.58	147.24	131.10	131.10	133.07	147.24
Slovakia	146.46	136.22	135.31	134.25	140.16	146.46
Austria	143.31	144.69	141.54	137.80	145.67	145.67
Canada	142.13	136.22	145.47	138.19	130.31	145.47
France	143.31	144.88	140.55	135.43	133.07	144.88
Russia	144.88	140.35	133.86	133.46	126.38	144.88
Switzerland	126.77	143.31	132.68	132.28	133.86	143.31
Finland	128.15	143.31	142.91	139.76	122.83	143.31
Sweden	130.71	138.98	136.61	135.04	142.13	142.13
Norway	139.37	135.83	128.35	139.76	141.73	141.73
Denmark	141.73	135.43	134.06	141.14	139.57	141.73
Italy	133.07	138.19	141.54	141.34	127.17	141.54
Romania	131.50	131.93	140.55	130.91	132.48	140.55
Hungary	137.01	136.22	140.16	136.22	140.31	140.31
Bulgaria	135.43	134.84	137.40	139.96	134.25	139.96
Ukraine	137.80	122.64	139.76	129.13	127.95	139.76
RSA	129.13	134.06	139.37	129.92	130.31	139.37
Netherlands	127.17	138.58	133.07	131.10	119.69	138.58
India	102.76		138.58		122.83	138.58
Australia	138.19	133.46	136.22	128.74	128.74	138.19
Argentina	135.04	138.19	131.50	132.09	136.22	138.19
Poland	132.28	131.26	138.19	126.77	132.87	138.19
Mauritius	135.43	137.99	136.61	127.95	133.07	137.99
Czech Republic	137.80	137.40	131.89	128.94	137.01	137.80
New Zealand	131.10	136.85	124.02	119.69	126.97	136.85
UK	136.61	134.65	136.02	129.53	135.43	136.61
Uknown	135.04	130.83	133.86	132.68	135.43	135.43
Belgium	128.74	135.43	131.85	129.92	129.53	135.43
Kazakhstan	98.82	134.84		108.66		134.84

Country of origin	Years					Trophy Record
	2011	2012	2013	2014	2015	
Belarus		134.25	127.56			134.25
Latvia	120.87	130.71	134.06	124.02	128.35	134.06
Turkey	122.05	132.68	125.59	115.35		132.68
Greece	132.68					132.68
Brazil	127.17	127.56	129.92	131.89	132.68	132.68
Luxembourg	129.53		132.68	120.16	126.38	132.68
Chile			122.20		132.28	132.28
Lithuania	129.13	116.14	118.11	132.28	126.77	132.28
Cyprus				131.89		131.89
Namibia	128.35	131.89	130.31	129.06		131.89
Croatia	129.13	131.69	124.41	127.17		131.69
Venezuela	117.72		120.08	131.50		131.50
Monaco				130.31		130.31
Estonia	130.31	127.56			117.52	130.31
Slovenia	129.53	130.31	128.54	113.62	110.04	130.31
Iceland			129.53	120.47	129.13	129.53
Portugal	119.29	121.46	120.08	129.13	126.77	129.13
Montenegro		129.06				129.06
Angola	126.38	128.54		111.50		128.54
Bosnia			118.11		127.56	127.56
Singapore	126.38					126.38
Uruguay				120.04	124.41	124.41
Serbia	118.50	114.80	124.41	118.50		124.41
Lebanon	114.37			123.23		123.23
Reunion			116.93	119.29	122.05	122.05
New Caledonia			121.65			121.65
China			121.26	114.99	110.63	121.26
Saudi Arabia		120.08				120.08
UAE			119.29			119.29
El Salvador					118.90	118.90
Panama		118.50				118.50
Thailand			117.72	114.37		117.72

Country of origin	Years					Trophy Record
	2011	2012	2013	2014	2015	
Qatar	116.14					116.14
Bahrain					115.35	115.35
Israel			112.60			112.60
Grand Total	**150.59**	**149.61**	**149.41**	**169.29**	**148.82**	**169.29**