

**Horn Measurements of Sable Antelope (*Hippotragus niger*) and Their Value in  
Age Determination**

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## DECLARATION

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I, Anndri Garrett, student number 95061411 hereby declare that this dissertation, "Horn Measurements of Sable Antelope (*Hippotragus niger*) and Their Value in Age Determination", is submitted in accordance with the requirement for the Master in Veterinary Science degree at the University of Pretoria, is my own original work and has not previously been submitted to any other institution of higher learning. All sources cited or quoted in this research paper are indicated and acknowledged with a comprehensive list of references.

## ETHICS STATEMENT

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I further declare that I received ethics clearance for this study from the University of Pretoria Animal Ethics Committee on the 26 March 2018 (project V020-18). I have adhered to the ethical standards stipulated in the University of Pretoria's *Code of Ethics for Researchers* and the *Policy guidelines for responsible research*.

Signature  (Dr Anndri Garrett)

Date 8 February 2021

## DEDICATION

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I dedicate this research study to my husband, Greg, and to our children, William and Aila, for all their support and sacrifices.

## ACKNOWLEDGEMENTS

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I am deeply grateful to the following people for their contributions towards this research study. Without their inputs it would not have been possible.

- Professor Gerhard Steenkamp who acted as my research supervisor - I could not have asked for anybody better. Thank you for always making time. Thank you for your endless patience and understanding. And for using your knowledge and experience to help others, like myself, further their aspirations.
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- My parents for providing me with a good education and opportunities many could never dream of.
- Sister Michelle Cruywagen for assisting with processing of samples.

## SUMMARY

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The objective of this study was to describe the macroscopically observed horn growth of sable antelope and to evaluate several horn measurements in terms of its suitable use for accurate, individual age determination in this species.

One hundred and eighty-eight male and one hundred and fifty-five female sable antelope served as subject animals for this cross-sectional observational study. The animals are farmed in the Northern Cape Province, South Africa.

Horn measurement data was recorded for sable antelope of known age whilst they were routinely chemically immobilized for management purposes. The data sets were individually identified by recording existing ear tag numbers and/or microchip numbers of the subject animals. The dates of data collections were recorded in order to calculate the age of the subject animal in days on the day of data collection. The following measurements were taken and recorded on a field list:

- Smooth tip length (unridged section of initial horn growth)
- Total horn length
- Number of horn ridges
- Horn base circumference
- Secondary/Postmature horn growth section length

Horn measurements excluding growth check counts were recorded for 343 sable antelope, of which 188 were male and 155 were female. Measurements were recorded for left and right horns of the same individual. Multiple observations were recorded at different ages for the same individuals, resulting in a total number of observations as follows: Tip length, female (n = 288), male (n= 341); total horn length,

female (n = 367), male (n = 457); number of ridges, female (n = 293), male (n = 349) and horn base circumference, female (n = 289), male (n = 377). The age range for female sable antelope was 127 days to 6242 days and for males 301 days to 2669 days. There were 48 recorded lengths of the secondary/postmature growth sections available as well as 38 counts of growth checks, all for mature female sable antelope. Measurements were done in inches as per the game industry standard and then converted to centimetres using a factor of 2,54 for purposes of statistical analysis. Any abnormalities were recorded on the form used to record all field data. Data was split into a male and female group.

Horn growth check counts were done photographically for mature female sable antelope. The number of growth checks was recorded together with the ear tag number read from the photograph, and the photograph date was used to determine the age of the individual at the time that the photograph was taken. A sufficient number of suitable photographs of mature animals was only available for female sable antelope, as males are either sold for breeding or hunting purposes once maturity is reached.

Subjective incisor evaluation also formed part of the routine clinical examination, although it did not form part of this study. In many instances, this included taking a photographic record of the incisor teeth, particularly in mature animals.

## **Results**

There was a strong correlation between total horn length and age in both male and female sable antelope (female ( $r^2 = 0.949$ ) and male ( $r^2 = 0.911$ )). There was also a strong correlation between the number of horn ridges and age for both male and

female sable antelope (female ( $r^2 = 0.949$ ) and male ( $r^2 = 0.911$ ). Exponential regression models were developed for male and female sable antelopes to predict an individual animal's age based on horn length. Because the number of horn ridges exhibited multicollinearity with the horn lengths, it was not included as an explanatory variable in these models. Although the fitted regression models explained 96% of the variation in the males' ages and 85% of the variation in the females' ages, large prediction errors of more than 1 000 days in the ages for some sable antelopes indicated that accurate individual age prediction with these models is not possible.

In mature female sable antelope, growth checks were present in 84% of individuals for which suitable photographs were on record ( $n = 38$ ). Out of the 32 individuals with clear growth checks, 31 could be accurately aged to within a year or less of actual age based on the number of growth checks present.

## **Conclusion**

The total horn length of sable antelope can be useful to determine the average age within the population for any specific horn length, but cannot be used to accurately determine the age of the individual animal. The previously published dental eruption pattern remains the most accurate practical method to determine age up to the point of complete dental eruption.

Growth checks counts in the secondary/postmature growth section were found to be useful for age determination in mature female sable antelope. A limitation on this

finding was that clearly distinguishable growth checks were not always present in all mature female sable antelope.

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## LIST OF ABBREVIATIONS & DEFINITIONS

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LH	Left horn
RH	Right horn
cm	Centimeter
mm	Millimeter
LSU	Large stock unit
Field age	Age determined by means of a suitable method for use in the field, without access to a laboratory and without the use of invasive procedure causing damage to the horn. Can be used on living or dead specimens.
Deciduous horn	First layer of bovid horn with clear matrix, which is shed later in life
Exfoliation	Shedding of deciduous horn

# 1. INTRODUCTION

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The Sable antelope (*Hippotragus niger*, Harris 1838) belongs to the family Bovidae and genus *Hippotragus* (1). Both males and females have horns. Male sable antelopes' horns are generally longer and have greater volume than those of females (2, 3). Sable antelope are farmed extensively on private land in South Africa.

Age determination of antelope is important in order to study growth and development of a species, whereas specific age determination of the individual animal has largely been of academic value. In recent times, game ranching in South Africa has evolved into an economically significant industry and certain individual antelope, including some sable antelope, currently has substantial economic value, coupled largely to their relative horn size (4).

Veterinarians working with privately owned antelope are occasionally requested to accurately age individual antelope when the age is unknown. Literature reviews yielded valuable studies documenting body growth and development of sable antelope (2, 5). Grobler found that microscopic counting of annually formed keratin layers on transverse sections of horn was the only accurate way of determining age in sable (6). This method had also been described by Miura to be accurate (albeit on sagittal horn sections) in Japanese serow (*Capricornis crispus*) (7). Unfortunately, due to the facts that the horn needs to be sacrificed and that the method requires very thin horn sections and microscopy, it is not suitable as field age method. Grobler published dental eruption charts for sable antelope and found these accurate in determining age to within six months of actual age up until the point when eruption

was complete at around four years of age (2). He found dental attrition to be a poor predictor of actual age in mature animals due to the degree individual variation, which can be expected to be even more varied between different populations from different geographic areas with different vegetation. Another method of age determination which is widely used in many bovid species is the counting of annually formed “growth checks”. These are transverse sulci formed annually on the horn when horn growth slows down during the dry season. Simpson did determine that growth checks were present in 91% of 23 mature sable skulls examined by him, but did not attempt to link the number of checks to the age of the individuals (3).

There is thus a need to find an accurate field method for individual age determination in live sable antelope. Alternatively, if this proves not to be possible, veterinarians and other role players in the game ranching industry should be discouraged to ascribe a specific age to an individual sable antelope based on horn measurements in cases where the age is not known (by means of recording birth date of an identifiable individual).

## 2. JUSTIFICATION

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### 2.1 LITERATURE REVIEW

#### 2.1.1 Horn structure and growth

Bovid horns develop from ossicones and overlying skin and skin outgrowths (8). These true horns are not shed annually, and growth is continuous throughout the life of the animal (3, 9, 10). Bovid horns consist of a highly mineralised, vascularised, porous bony core covered by a keratinised sheath (9, 11-13). In sheep and goats, the bony core of the horn is short and blunt (14), whilst sable antelope have a long, slender bony core. The bony core morphology of cattle is intermediate between these two (9).

The soft tissue layer joining the keratin sheath to the bony core of cattle horn consists of stratified squamous epithelium towards the horn sheath, with a thin layer of highly vascularised underlying dermis which is loosely arranged and composed of irregularly oriented collagen fibres and stray fat cells (15). Histologically, the keratinised horn sheath is formed similarly to skin (14). The stratified squamous epithelial layer produces the keratin sheath. The thin dermis and underlying sub-dermis extends to the deeply situated bony core (15). Growth of the keratin sheath occurs by proliferation of germinal cells (9, 11) in the basal layer of the epithelium which become progressively flattened as they mature and eventually reach the horn surface (14). By this time these cells are flat and clear and contain no nuclei (14). The horn keratin has a laminar structure (as opposed to filamentous structure in hair and wool) and consists of flattened, non-vital epithelial cells filled with  $\alpha$ -keratin (16). The end product are long, hollow keratin fibres chemically bonded to an amorphous keratin matrix which forms lamellae (11). The keratin tubules extend longitudinally (Fig. 2.1)

along the length of the horn, whereas the keratin lamellae have a radial orientation (Fig. 2.2). Bonded together they form the horn sheath. Ogilby, as referenced by O'Gara (1975), referred to the first horn formed as "young horn". The permanent horn develops underneath the young horn, which covers it like a scabbard (14). As the permanent horn grows, it carries the young horn upward, severing it from the blood vessels and nerves which initially supplied it with nutrients. The young horn eventually dries up and exfoliates in strips (14). Ogilby described this process in bovids, and cited oryxes and kobs as examples of animals which shed their first horn. He did not specify in which species he observed this (14) whereas Grobler reported it to also occur in duiker (*Sylvicapra grimmia*), waterbuck (*Kobus ellipsiprymnus*) and steenbok (*Raphicerus campestris*) (2).

Grobler (1979) described the horn structure of sable antelope as a series of stacked cones, and divided horn growth into three phases in this species:

1. Formation and subsequent exfoliation of deciduous horn;
2. Primary permanent horn growth (rapid growth)
3. Secondary/postmature permanent horn growth (slow growth) (6)

In sable antelope calves, the first visible protrusion of horn, called the horn bud, begins to show in the frontal area of the skull around two months of age and the growth is rapid (2). A single layer (cone) of deciduous horn with clear matrix is the first horn to form (6). The first permanent horn with pigmented matrix start to form underneath the deciduous cone around four months of age (2). The deciduous layer was reported to be exfoliated around 20-24 months of age after the first cone of permanent horn has formed underneath the deciduous horn layer (2, 6). This first section of horn formed by the first permanent layer covered by the deciduous layer is a smooth, spear-like

section of horn without distinct ridges or annuli. This is commonly referred to in the ranching industry as the horn tip.

Several layers (cones) of permanent horn are subsequently formed with the external surface of the sheath distinctly transversely ridged - with a clear sulcus between each two neighbouring ridges (2). The sulci do not sink below the surface of the shaft of the horn; the ridges rather protrude beyond the surface of the horn shaft. These ridges are referred to in previous publications as “primary annuli” (1) “lateral ridging” (3) and “bumps” (2) and will subsequently be referred to as “ridges” in this study. This section of growth also happens rapidly, and the cones are firmly attached to each other to form the horn sheath (6).

Secondary/postmature growth starts from four years of age in both male and female sable antelope (2). It occurs significantly slower compared to the primary growth section and it is not distinctly ridged (2, 6). This secondary/postmature growth section can show clear, annually formed sulci, referred to as “growth checks” in previous studies (3, 7, 10, 17, 18).



**Figure 2.9:** A close-up photograph of the right horn of an adult male sable antelope. Longitudinal horn tubule orientation is clearly visible on the surface of the keratin sheath.



**Figure 2.10:** A close-up photo of a sagittal view of the left horn of an adult male sable to illustrate the radial orientation of keratin lamellae.

In the mature sable antelope (male and female), three distinct sections of horn growth can be observed (Fig. 2.3):

- The smooth (unridged), spear-like horn tip
- The clearly ridged primary horn growth section
- The unridged, secondary/postmature horn growth section adjacent to the horn base. It may have indistinct ridging, and mostly has transverse sulci referred to as “growth checks”, but these are not always present (2)



**Figure 2.11:** A lateral view of the left horn of a mature sable bull showing unridged secondary/postmature horn section (red line), primary, ridged horn growth (yellow line) and the smooth (unridged) horn tip (blue line).

### 2.1.2 Potential effect of external factors on horn growth and development

Apart from age and genetics, there are external factors known to influence the animal to reach its horn length potential:

#### **Nutrition and Competition**

Hoefs and Nowlan found that a captive population of Dall's sheep rams receiving high quality nutritional supplementation at seven years of age had an 83% higher horn volume mass ( $2\,750\text{ cm}^3$  vs  $1\,500\text{ cm}^3$ ) when compared to a free-ranging population with high population density and limited available nutrition (19). The captive population originated out of the free-ranging population; thus, genetic variation can largely be disregarded as cause for the disparity. From their study, it seems clear that

nutrition and possibly social competition are examples of external factors which can have a significant influence on horn growth (19). Contrary to this, Crosmar et.al. found no significant effect of availability of forage on trophy size in impala (*Aepyceros melampus*), greater kudu (*Tragelaphus strepsiceros*) and sable antelope, but it is possible that the variation in availability was not significant enough to have had an effect (20). In bighorn rams (*Ovis canadensis*) increased population density had a negative effect on horn growth of rams (21).

### **Maternal effect**

The ability of the mother to provide for her young has an effect on growth and development of her offspring (22). Mothers reduce reproductive output during times of resource scarcity in order to retain sufficient body condition (22). During periods of food scarcity (or other causes of a negative energy balance) the resulting reduction in allocation of resources to her young can have a life-long effect on the ability of her offspring to reach its genetic potential in body and horn size (22). In case of a poor start, compensatory growth later in life will not make up for the lost growth.

### **Photoperiod**

Photoperiod modulates the regulation of horn growth during the mating season in Iberian ibex (*Capra pyrenaica*) (23).

## **2.1.3 Usefulness of horn shape, maximum length and ridge count in age determination of non-spiral horned African antelope**

Between 1972 and 1979, Grobler gathered very detailed body measurements (including various horn measurements) of forty-eight sable antelope that were

identified at birth and subsequently released. He did the same for eight semi free-range captive sable antelope, and nine free-range known-age sable antelope in the Rhodes Matopos National Park in Zimbabwe. His objective was to determine whether any of these measurements could be used to determine age in sable antelope. In sable antelope, like other horned bovid species, the horns of males and females develop and grow continuously throughout the life of the individual animal (24). This characteristic feature motivated Grobler to consider continuous horn growth as the ideal variable for age determination (2). He studied horn growth patterns of sable antelope in depth in order to assess different techniques to accurately determine age (2).

Horn length did not prove valuable in determining the individual's age in Grobler's studies. This confirmed the findings of Simpson (1971), that variation in horn length between individuals of various African antelope species (including sable antelope) was too large to be of much value in determining the individual's age (3). This was especially problematic when assessing individuals from different geographic locations (3).

The shape and horn length of adult impala (*Aepyceros melampus*) are poorly related to the individual's age as the range in horn length and annuli is too varied to accurately determine age to within a year of the animal's actual age (25). In the Defassa waterbuck (*Kobus defassa ugandae*) horn length and number of ridges were useful in ageing waterbuck males up to three years of age but not beyond (26).

#### 2.1.4 Age determination methods

There are four methods of age determination commonly applied in many species of North American, European and Asiatic bovids. These are:

- Dental eruption and attrition (26, 27)
- Cementum line count in sectioned teeth (7, 26)
- Macroscopic annual growth check count (3, 7)
- Microscopic counting of stacked layers in keratinised horn sheath (7, 28)

### **Dental eruption and attrition**

Also called the "jaw board method" (26), compares dental eruption and attrition of the individual to that in a series of age groups with eruption and attrition established to be typical for the specific group (27). Dental eruption and attrition is only accurate for age determination in sable antelope up to four years of age to within six months of actual age (2) (Tables 2.1, 2.2). After four years of age, at which stage the animal has a full set of teeth, dental attrition is not an accurate age determination method. Five year old animals were aged correctly in only 75% of cases (2) and six to nine year old sable antelope could only be aged correctly in 60-65% of animals (2). This correlated to the findings of a previous study in the Defassa waterbuck (*Kobus defassa ugandae*) where 42.8% of five year old animal (n=7) and 26.1% of six to nine year old animals (n = 69) were correctly aged based on dental attrition of all permanent teeth (26). In a study on age determination of blue wildebeest (*Connochaetes taurinus*) in Zululand, Attwell (1980) found that when attrition of all teeth were considered together, only 68.2% will show the same wear pattern at the same age (29).

**Table 2.1:** Description of the permanent dental eruption pattern of mandibular teeth of sable antelope. (Adapted from: Grobler J. Body Growth and Age Determination of the Sable Hippotragus niger niger (Harris, 1838). Koedoe. 1980;23:131-56).

Age (months)	Molar 1	Molar 2	Molar 3	Incisor 1	Incisor 2	Incisor 3	Canine 1	Pre-molars
6-10	✓							
10-14	✓	✓						
14-18	✓	✓	✓					
18-24	✓	✓	✓	✓				
22-28	✓	✓	✓	✓	✓			
28-34	✓	✓	✓	✓	✓	✓		
34-40	✓	✓	✓	✓	✓	✓	✓	
34-42	✓	✓	✓	✓	✓	✓	✓	start
44 +	✓	✓	✓	✓	✓	✓	✓	✓

**Table 2.2:** Description of the permanent dental eruption pattern of maxillary teeth of sable antelope. (Adapted from: Grobler J. Body Growth and Age Determination of the Sable Hippotragus niger niger (Harris, 1838). Koedoe. 1980;23:131-56).

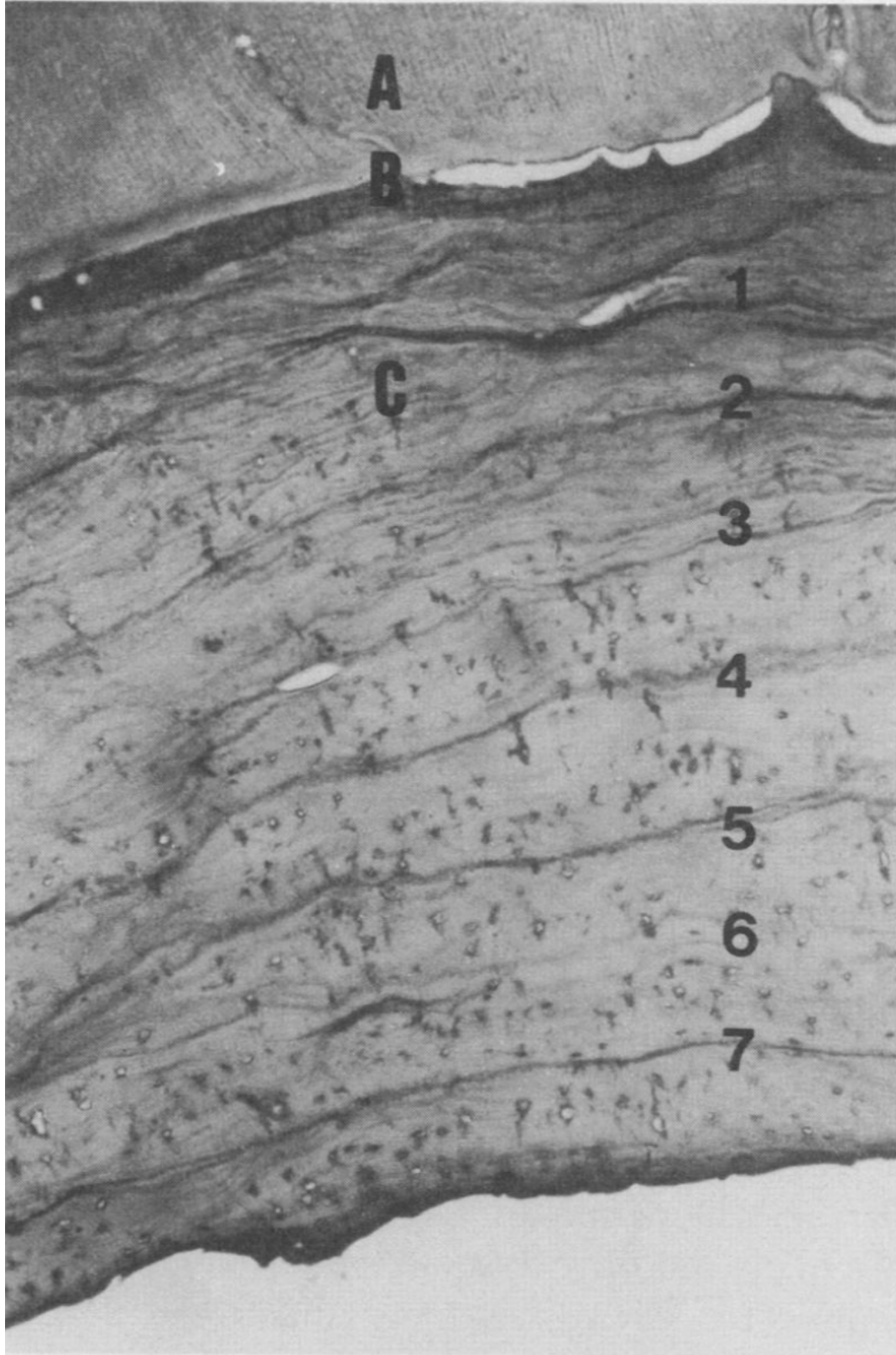
Age (months)	Molar 1	Molar 2	Molar 3	Premolars
6-13	✓			
10-15	✓	✓		
14-19	✓	✓	✓	
16-24	✓	✓	✓	✓
22-28	✓	✓	✓	
28-34	✓	✓	✓	
34-40	✓	✓	✓	
34-42	✓	✓	✓	start
44 +	✓	✓	✓	✓

### **Cementum line count in sectioned teeth**

Rhythmical mineralisation of the cementum matrix in teeth leaves incremental lines in the cementum visible on microscopic examination (26) (Fig. 2.4). Incisor teeth and the cementum pad underlying the crown of the first molar teeth are commonly used when examining the cementum lines in ungulates (30). The technique of determining age by counting these incremental cementum lines was initially developed by Laws in 1953 for use in marine mammals (30). Spinage (1973) subsequently investigated its application in ageing African antelope species (29). The technique is based on the principle that calcification rhythm may be disturbed to form prominent incremental lines during periods of drastic change in nutrition, which in free range animals as a rule occur seasonally and is more pronounced further away from the equator. These lines have been proven an accurate technique to determine age in many mammalian species including some African antelope (27, 30), North American (28, 30, 31) and European ungulates (30) as well as the Japanese serow (*Capricornis crispus*) (7). Some bovid species, for example impala (*Aepyceros melampus*), however do not show clear cementum lines (25).

It is a laborious and cumbersome method as it can only be applied on an extracted tooth and thus not of value as field method for ageing live animals.

Hall-Martin, in personal communication with Grobler, confirmed sable teeth to show clear dental annuli, however, only 67% (14/21) sable teeth showed annulations corresponding correctly with their ages (2).



**Figure 2.12:** A sagittal section of the first mandibular molar of a 7 2/3 -year-old known-age Japanese serow. A- dentine, B- dentino-cemental interface, C- cementum composed of seven dark-staining annuli (1-7) deposited during periods of reduced growth. (From: Miura S. Horn and cementum annulations as age criteria in Japanese Serow. *Journal of Wildlife Management*. 1985;49(1):152-6).

### **Macroscopic annual growth check count**

This method relies on counting the transverse sulci formed annually in the horn sheath of the secondary/postmature growth section during the dry season (32), when horn growth slows down drastically (10, 17, 33-35) (Figs. 2.5, 2.6). The section between two such "growth checks" corresponds to one year of horn growth in European mouflon (*Ovis gmelini musimon*) (17).

It is a simple, non-invasive method and has the advantage of being useful as field method for age determination in live animals. This method can also be done photographically using good quality photographs of the horn. Similar to cementum annuli count, this method also proved accurate in several other North-American, European and Asiatic ungulates (3, 7, 10, 17, 18) such as Japanese Serow (*Capricornis crispus*) (7), Bighorn sheep (*Ovis canadensis*) (18), Dall sheep (*Ovis dalli*) and Rocky Mountain goat (*Oreamnos americanus*) (3).

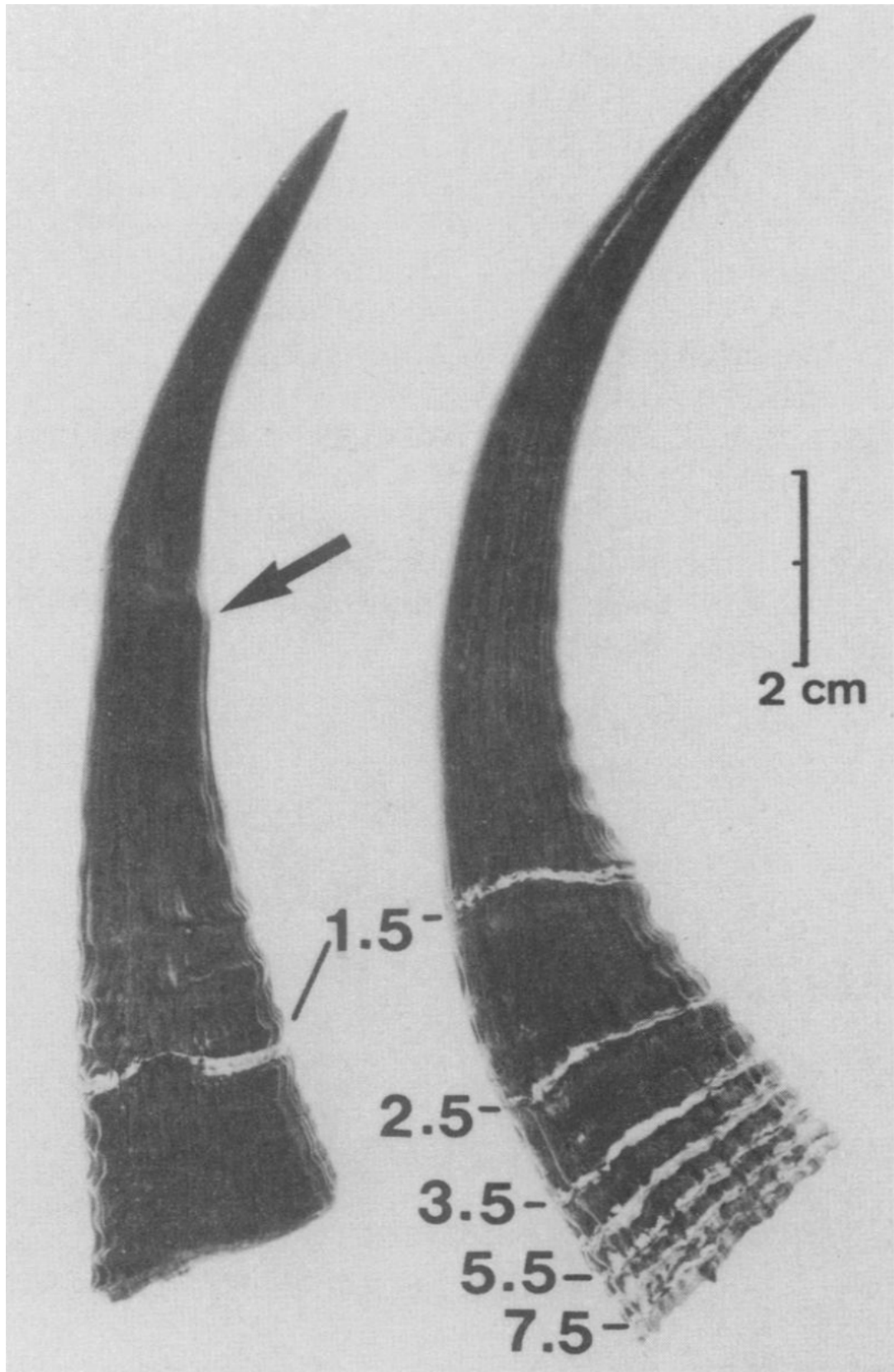
According to Simpson, the general horn growth characteristics, and specifically the formation of annual growth checks described for many bovid species of the subfamily Caprinae as well as for domestic cattle, also applies in African antelope. The growth checks of tropical animals, however, are not as distinct as those observed in temperate region bovids (17).

Simpson assessed 23 mature sable antelope skulls (18 male and five female) to determine whether growth checks could be observed as circumferential sulci caused by growth discontinuations close to the horn base on the external horn surface of the secondary/postmature, unridged growth section. He found that these growth checks were present in 91% of the 23 sets of horns (3). Simpson also noticed the presence

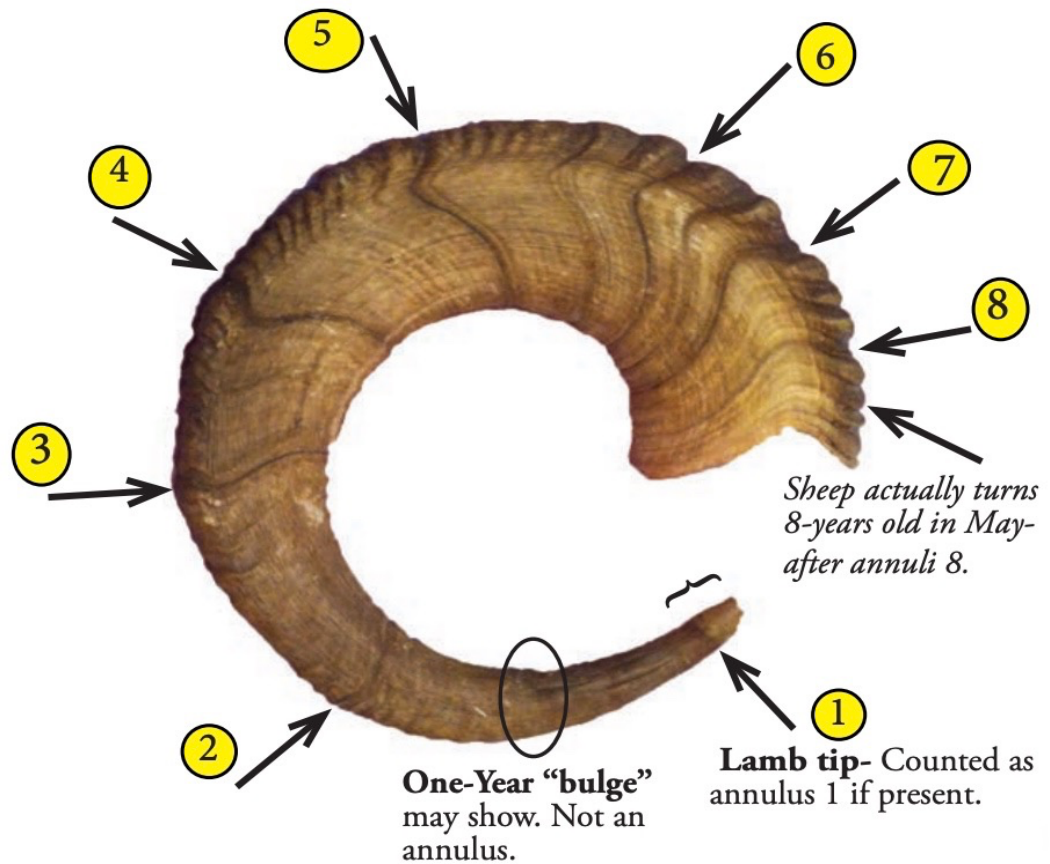
of some lesser striations which could easily be distinguished from the better defined annual growth checks when present, especially where both horns could be evaluated together (3). Although Simpson determined growth checks to be present in most mature sable antelope, he did not attempt to correlate the number of growth checks with the animals' ages (which were unknown for the skulls he examined) (3).

Simpson did find an accurate correlation between age and growth check counts in kudu (*Tragelaphus strepsiceros*), bushbuck (*Tragelaphus scriptus*) and eland (*Taurotragus oryx*) (17) up to approximately eight years of age, but substantially less so thereafter (17).

The main disadvantage of this method is that in some cases the growth checks can be indistinct and consequently affecting the accuracy of the count (18, 36). Miura's study of approximately 1000 Japanese serow, showed approximately 2% of the animals could not be aged due to this problem (7). This method is only useful in age determination of mature animals as the growth checks (when present) are found in the secondary/postmature growth section. When animals are kept under artificial conditions, where feed is always abundant, these annual growth checks may not even form at all because growth checks form due to arrest in horn growth during seasonal periods of food scarcity (10, 17, 33-35).



**Figure 2.13:** The true age rings on the horns of Japanese serows are characterised by deep grooves with sharp edges that continue around the horn. Horn on the left is aged at 2.5 years and on the right at 8.5 years old. The arrow indicated a swelling formed during the 1st winter of life. The first ring was formed during the 2nd winter of life, and one more ring was formed each winter thereafter. (From: Miura S. Horn and cementum annulations as age criteria in Japanese Serow. *Journal of Wildlife Management*. 1985;49(1):152-6).

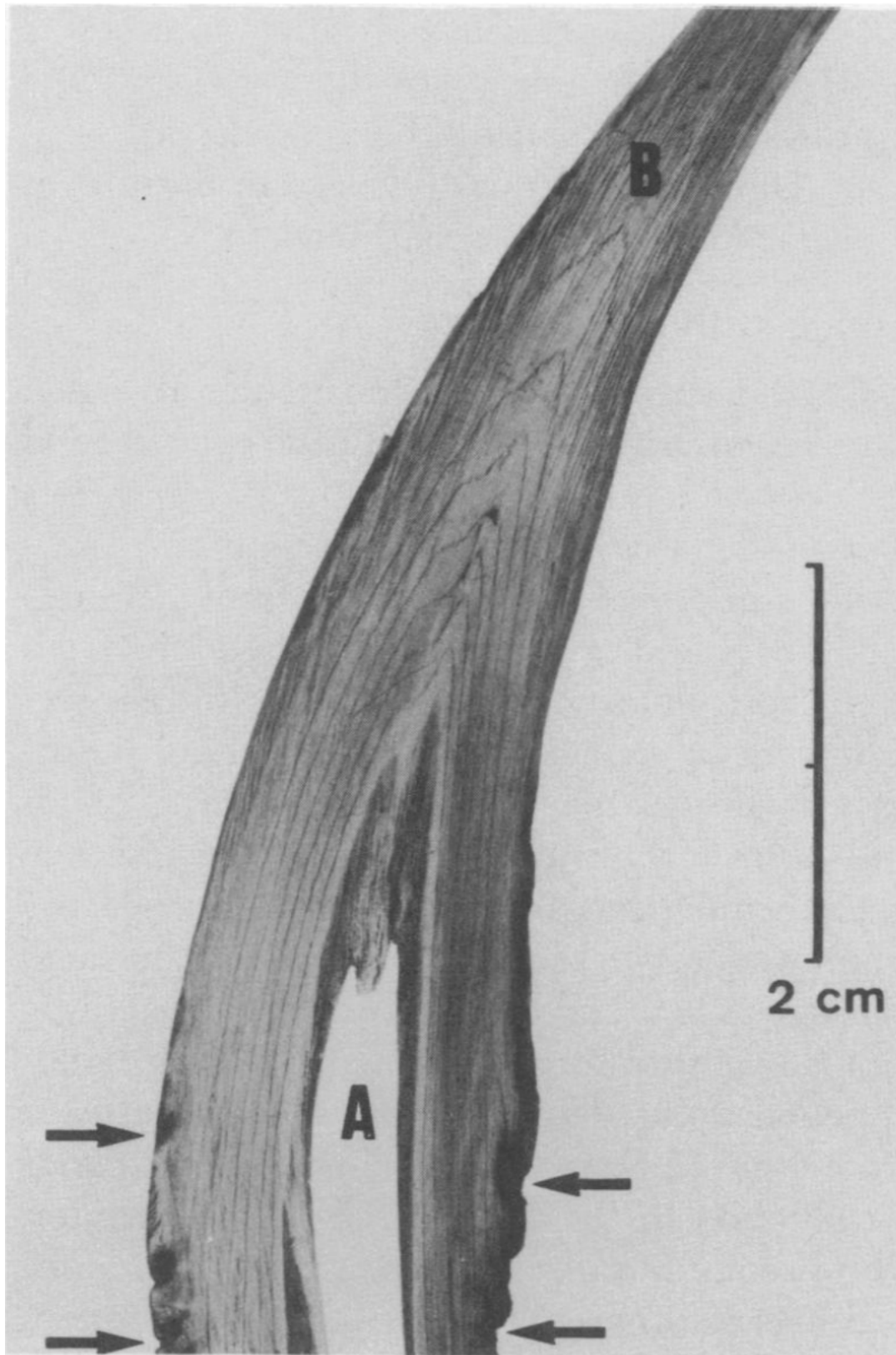


**Figure 2.14:** The right horn of an eight-year-old Dall sheep ram indicating true growth checks with numbers from one to eight. (From: S Bethune CB, M Harrington, T Hollis, T Kavalok, T Lohuis, K Romanoff, M Taras, J, Want CW, B Wendling. Dall Sheep Hunting Full-Curl Identification Guide: Alaska Department of Fish and Game Division of Wildlife Conservation; 2017 (Available from: <https://www.wafwa.org/Documents>).

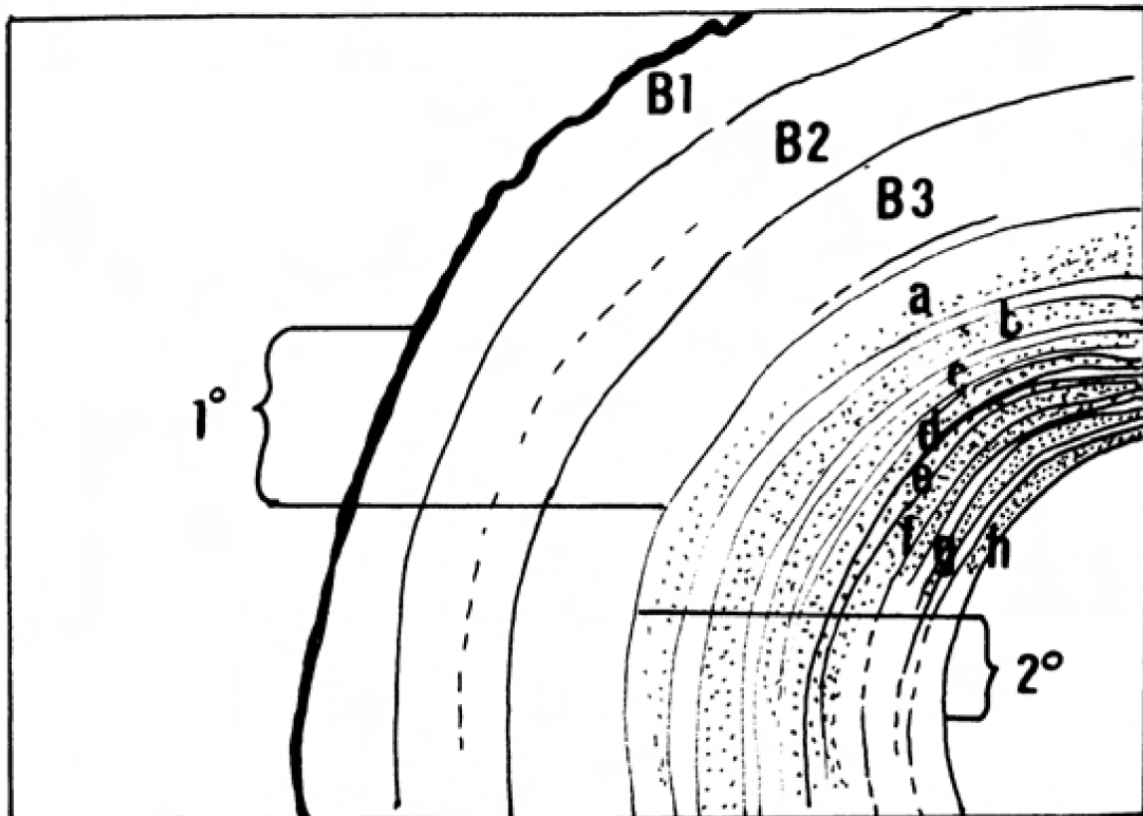
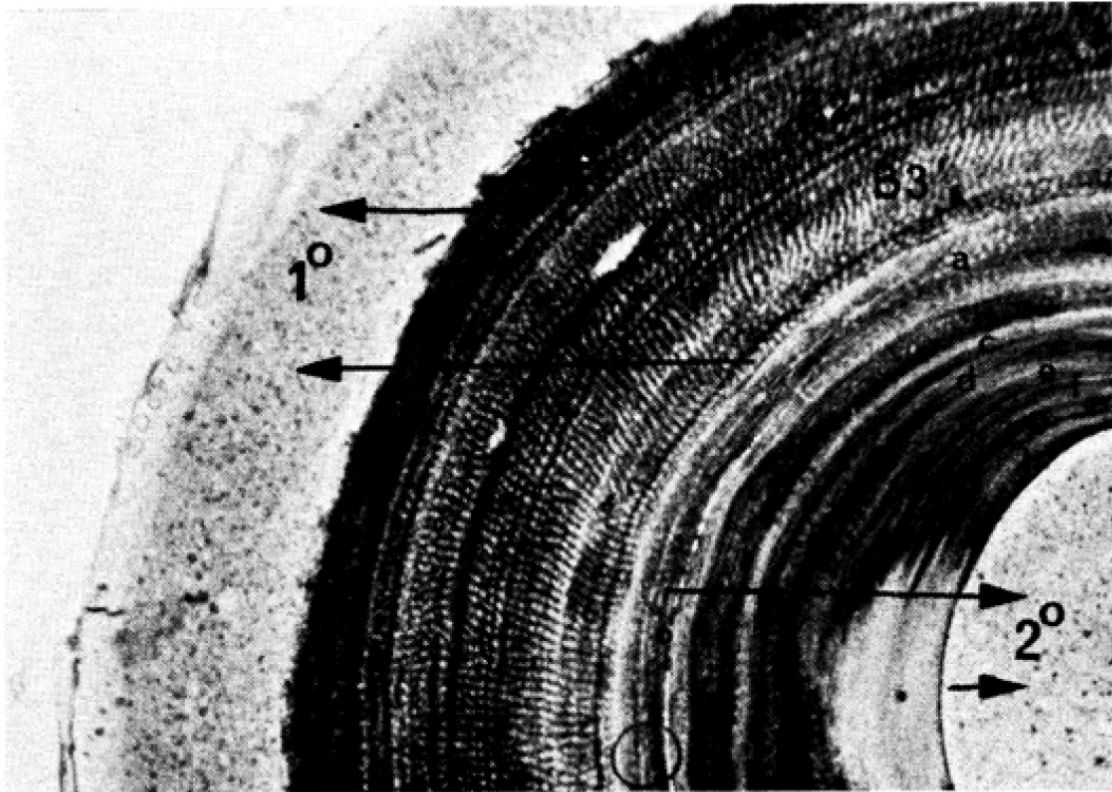
### Microscopic counting of stacked layers in keratinised horn sheath

Bovid horns consist of stacked keratinised cones, one forming annually (6). On histological examination of a sagittal or transverse horn section, these cones present as distinct lines (6, 7). Counting these stacked V-shaped layers in the keratin sheath as seen on sagittal sections of the horn of Japanese serow (*Capricornis crispus*), corresponded with cementum annuli and horn segment counts (segments between annual growth checks), and thus can be used to accurately age this species (7) (Fig. 2.7). These findings were confirmed for wild sheep (*Ovis dalli*) (28).

In 95% of mature sable skulls, the number of lines formed by cones were clear and corresponded well with age when transverse horn sections (about two thirds from the proximal horn tip) were examined (2) (Fig. 2.8). In the other 5%, the lines were not clear. This method seems to be promising to accurately determine absolute age, but because the horn needs to be removed in order to prepare sections for microscopic examination, it is not possible to use this method in the field for age determination of live animals.



**Figure 2.15:** A sagittal view of the horn of a Japanese serow. A – the cavity of the horn core. B- the growth layers connected to growth checks (arrows). (From: Miura S. Horn and Cementum Annulation as Age Criteria in Japanese Serow. *The Journal of Wildlife Management*. 1985;49(1):152-6).



**Figure 2.16:** A transverse section of a mature sable horn showing primary permanent growth ( $1^\circ$ ) and advanced secondary growth ( $2^\circ$ ). Growth checks in the latter are indicated in lettering (a-h). (From: Grobler J. The Use of Horn Sections to Determine the Age of Sable *Hippotragus niger*. Koedoe. 1979; 22:219-23).

In the two separate studies by Grobler and Simpson the length and ridges of sable could not be used to determine individual age accurately as the number of ridges and horn lengths were too varied to reliably place animals in correct age groups (2, 3) but the sample sizes in both these studies were very small and needs further investigation. Growth checks are present in most mature sable antelope, but its utility in age determination of this species is yet to be established. The one method which was accurate for age determination, was the microscopic counting of horn cones, which unfortunately is not a suitable field method, plus the horns cannot be preserved *in situ* when this method is applied.

The objective of this study was to further examine the relationship between specific horn measurements and age in sable antelope. All subject animals were born and bred on the same farm and kept under the same management system with well recorded birth dates.

## 2.2 PROBLEM STATEMENT

From the literature, it is clear that counting the annual growth lines microscopically on sagittal or transverse horn sections provided the only reliable way of accurate age determination in individual mature sable antelope (2). An accurate field method of age determination in live sable antelope where the horns need to be preserved is needed.

The purpose of this study is to determine if specifically defined horn measurements, can be used to develop a field method for accurate age determination in male and female sable antelope whilst preserving the horns.

## 2.3 AIM

This study aims to describe the normal macroscopically observed horn growth of known aged sable antelope. Furthermore we would like to evaluate the usefulness of the described horn measurements in correctly predicting the age of the animals.

## 2.4 HYPOTHESES

H0: Horn smooth tip length can be used as field method for accurate age determination in a sable antelope individual.

H1: Horn smooth tip length cannot be used as field method for accurate age determination in a sable antelope individual

H0: Total horn length can be used as field method for accurate age determination in a sable antelope individual.

H1: Total horn length cannot be used as field method for accurate age determination in a sable antelope individual.

H0: Horn ridges can be used as field method for accurate age determination in a sable antelope individual.

H1: Horn ridges cannot be used as field method for accurate age determination in a sable antelope individual.

H0: Horn base circumference can be used as field method for accurate age determination in a sable antelope individual.

H1: Horn base circumference cannot be used as field method for accurate age determination in a sable antelope individual.

H0: Postmature horn growth length can be used as field method for accurate age determination in a sable antelope individual.

H1: Postmature horn growth length cannot be used as field method for accurate age determination in a sable antelope individual.

H0: Postmature horn growth checks can be used for accurate age determination in a sable antelope individual.

H1: Postmature horn growth checks cannot be used for accurate age determination in a sable antelope individual.

## 2.5 BENEFITS

The study will determine the suitability of specific sable horn measurements for age determination of the individual animal in the field. This will provide valuable information to wildlife veterinarians, conservationists and game breeders.

### 3. MATERIALS AND METHODS

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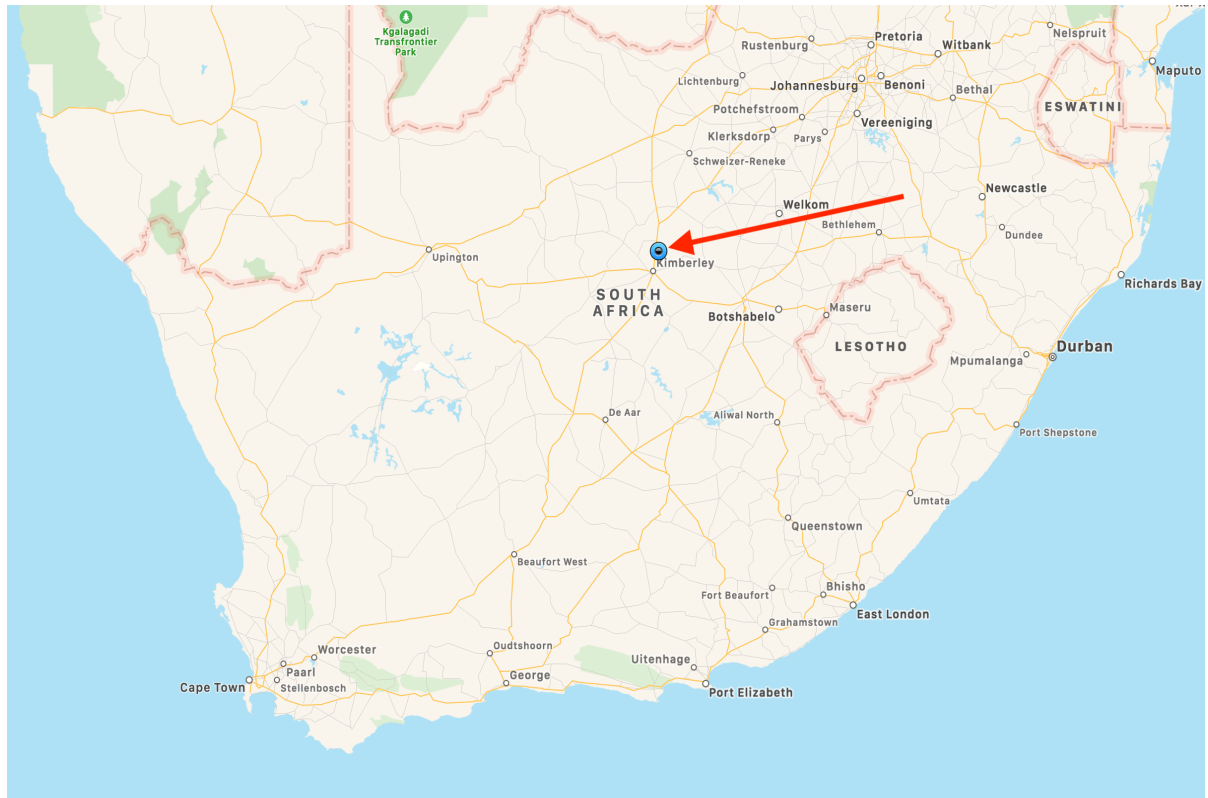
Horn measurements were collected during routine chemical immobilisation of sable antelope for management purposes on the principal investigator's property. Photographic horn data had been collected annually for management purposes and was made available for examination.

#### 3.1 STUDY DESIGN

The study design is a cross sectional observational study.

#### 3.2 STUDY ANIMALS AND LOCATION

Sable antelope with recorded, accurate birth dates, born on the farm "Brakpan" in the Kimberley area, Northern Cape Province, South Africa, were used in the study (Fig. 3.1).



**Figure 3.1:** A map of South Africa with the location of the subject farm indicated by a red arrow.

The farm is managed according to a carrying capacity of one large stock unit per twelve hectares. 2,2 sable antelope are calculated to be the equivalent of one large LSU (37). The subject farm falls in the summer rainfall area and the climate is one of extreme heat in summer and extreme cold in winter. During the wet season, a self-formulated dietary phosphate supplement is made available to the animals at water sources in the form of a self-compounded lick. In the dry season, a self-formulated protein and energy-rich dietary supplement that is mixed on the farm is fed on a daily basis. Maize, lucerne, urea and molasses form the basis of the winter ration. Animals get the bulk of their roughage intake from natural grazing even during the dry season. As the entire farm is managed according to carrying capacity, with stock made up roughly of 60% sable antelope and 40% roan antelope, the population density per hectare is kept consistent, regardless of camp sizes, which vary in size from

approximately 40 ha to 400 ha. The specific population of sable antelope has been closed on the female side since 1992. Seven pregnant cows and an adult bull were imported from Malawi in 1991, and six more pregnant females were imported from Zimbabwe in 1992. The Malawian bull was used on all females for the first three years, and new bulls were bought in every three years from other breeders all over South Africa and introduced to the herd. Efforts were made to obtain bulls unrelated to the herd. In 2001 a second herd was founded in a separate camp on the same property with all females originating from the original herd. Records of pedigree had been kept for each individual sable antelope since 2002. In 2012 a third breeding herd was founded on the same basis, and a fourth in 2016. Animals from all four herds form part of the study. Animals from all four herds are thus related to each other and managed under the same conditions, in the same geographic area. Only one breeding bull is used per herd, and all bull calves are removed from the breeding herds by the age of 18 months in order to prevent aggressive behaviour from the adult breeding bull towards youngsters. Calving dates are recorded for all cows and heifers. Calves are chemically immobilised between the ages of four weeks and three months of age, and ear tagged with a unique number, as well as being microchipped. An EDTA blood sample is collected for each calf and frozen in case DNA confirmation of parentage would ever be required, or in case mitochondrial DNA origin testing needed to be done, for instance when animals are to be exported to Namibia. Using binoculars, calves (now identifiable by ear tag number) are matched to their dams whilst suckling. Once matched, the calving date of the dam is ascribed to the calf as its birth date and recorded as such on its individual record.

There have been individual cases of inbreeding on the subject farm, mostly where a sire would mate its own female offspring during her first breeding season. This

practice is allowed on occasion as it is seen to be in line with what might happen in nature, but care has always been taken to ensure that the subsequent breeding bull used on such inbred offspring, would be an unrelated bull bought in from a fellow breeder. The coefficient of inbreeding is defined as “the probability that two alleles at a randomly chosen locus are identical by descent... the mathematical probability that the alleles have come from a common ancestor” (38). The inbreeding coefficient of the offspring produced from an inbred individual mated to an unrelated bull immediately reverts to zero, as it is impossible by descent to inherit the same allele at the same locus from unrelated parents .

The population is thus believed to have a broad genetic basis based on the records of pedigree which shows that care is taken to consistently introduce unrelated bulls at regular intervals (usually every three years). Young bulls are moved to bull camps where bulls of ages varying from 11 months to seven years are kept together.

### 3.3 SAMPLE SIZE

One hundred and eighty-eight male and one hundred and fifty-five female sable antelope of known age, immobilized between 2010 – 2019 formed part of the study. Some of the animals were immobilized more than once during this time period and the measurements were recorded at each instance.

### 3.4 DATA CAPTURE

A 2-month-old sable calf was immobilised for management reasons and the frontal skull area examined at the time. Photo-records of 15 sable of each year-group until 5-years-old were examined to test the validity of data reported by Grobler (1980) on exfoliation of deciduous horn. This was done for both genders. The horn of a 4-year-old sable bull which died due to fighting with other bulls was sectioned longitudinally and macroscopic findings were recorded.

It is standard practice on the subject farm that every immobilised animal also has its incisors subjectively evaluated as part of the clinical examination. In most instances a digital cellular phone photograph is taken of the anterior aspect of the incisors, at the same time ensuring that the ear tag of the animal is visible in the photo in order to identify the individual from the photo. No dental measurements were taken, and no other dental data was collected for purposes of this study.

Horn measurements were collected during the time that the animals were immobilised (with the exception of growth check counts, which were counted from photo records). The Pneudart 389 cartridge fired dart system (Pneudart, 15223 Route 87 Highway, Williamsport, PA 17701, USA) was used for longer-range shots (typically over 30m range). For close range shots, the 13mm Facilitator gas gun (Professional Wildlife Equipment, 18 Blesbok Street, Koedoespoort Pretoria, South Africa) was used. These systems have been used for more than eighteen years on the subject farm. Two cubic centimetre Pneudart darts with a one-inch needle and wire or gel barb is the author's preferred dart for adult sable antelope and used with both systems. Drugs used to effect immobilisation are a combination of etorphine (Captivon, Wildlife

Pharmaceuticals (Pty) Ltd, 38 Wilkens Rd, Rocky Drift, White River 1240, Mpumalanga, South Africa), thianil (A3080, Wildlife Pharmaceuticals (Pty) Ltd, 38 Wilkens Rd, Rocky Drift, White River 1240, Mpumalanga, South Africa), xylazine (Xylazine 1g, V-tech (Pty) Ltd, Corner Douglas Road and, Old Pretoria Rd, Midrand, Johannesburg, 1685) and azaperone (Stressnil, Janssen Pharmaceuticals (Pty) Ltd, Building 6, Country Club Estate, 21 Woodlands Dr, Woodmead, Johannesburg, 2191) (Table 3.1).

**Table 3.1:** Drug combinations and dosages in mg used to immobilize different ages of sable antelope.

Age	Immobilisation Drugs				Reversal Drugs	
	Etorphine	Thianil	Azaperone	Xylazine	Naltrexone	Atipamezole
12-<24month male	0,75	0,75	24	6	23	3
12-<24 month female	0,75	0,75	20	5	23	2,5
24-<30 month male	1,5	1,5	36	8	45	4
24-<30 month female	1,5	2	32	7	50	3,5
30-<48 month male	2	2,5	40	10	65	5
30-<48 month female	2	2	36	8	60	4
≥48 month male	3	3	48	12	90	6
≥48 month female	2	2,5	40	10	65	5

Additional sedatives/tranquilisers were not administered unless the animals were darted for translocation purposes. In these cases, the indicated combination of azaperone (Azaperone 50mg/ml, V-tech (Pty) Ltd, Corner Douglas Road and, Old Pretoria Rd, Midrand, Johannesburg, 1685) and zuclopenthixol acetate (Zuclopenthixol acetate 100mg/ml, V-tech (Pty) Ltd, Corner Douglas Road and, Old Pretoria Rd, Midrand, Johannesburg, 1685) was used. Administering a combination of naltrexone (Trexonil 50mg/ml, Wildlife Pharmaceuticals (Pty) Ltd, 38 Wilkens Rd, Rocky Drift, White River 1240, Mpumalanga, South Africa) and atipamezole (Atipamezole 50mg/ml, V-tech (Pty) Ltd, Corner Douglas Road and, Old Pretoria Rd, Midrand, Johannesburg, 1685) reversed immobilisation. Animals were routinely administered an injectable form of a 1% doramectin formulation (Dectomax, Zoetis South Africa (Pty) Ltd, 6th Floor, North Wing, 90 Rivonia Road, Sandton, 2196) and

dipped with a 1% flumethrin pour on cattle dip (Drastic Deadline, Bayer, 27 Wrench Road, Isando, South Africa) at the time of data capture.

The following relevant data was collected and recorded on a data capture sheet referred to as a “field list” (Fig. 3.2):

1. Ear tag no and colour of tag
2. Microchip number
3. Smooth (unridged) tip lengths
4. Total horn lengths
5. Horn ridge counts on primary horn growth section
6. Secondary/postmature growth section length
7. Horn base circumferences

VELDLYS																				
Datum	Id	Mikroskyfienommer	Milt-siek Decto max Deadl	Leng te van lyf	Leng te voor been	Bul test omtrek	Ringe links	Ringe regs	Punt L	Punt R	T-T	Dikte L	Dikte R	Leng te L	Leng te R	Post	Bloed & hare	Foto		
7/9/19	1	SARLE SUN BETA	✓											46"						
9/10/19	2	PK41W 710315510	✓	53	19	22cm	38	34	6 1/2	6 1/2	16 1/2	9 1/2	9 1/2	30 1/2	30 1/2	-	✓	✓		
BP trap	10/11/19	3	8527-RG	✓													✓			
		4	MISSED DART																	
BV	21/10/19	5	PK41B 9003200356962	✓	-	-	-	26	26	7	7	10 1/2	6 1/2	6 1/2	23 1/2	23 1/2	1 1/2	✓	✓	Draagtig
	"	6	PK41B 90035000355010	✓	-	-	-	31	29	6	5 1/2	9 1/2	6 1/2	6 1/2	24 1/2	23 1/2	1 1/2	✓	✓	Draagtig
	"	7	PK311B 90025000355021	✓	-	-	-	31	28	5 1/2	6	10 1/2	6 1/2	6 1/2	24 1/2	24 1/2	1 1/2	✓	✓	Draagtig
WV	"	8	PK314B 4C42350053	✓	-	-	-	25	25	6 1/2	6 1/2	10 1/2	7	7	22	21 1/2	-	✓	✓	Draagtig
	"	9	PK414B 4C421C6D7D	✓	-	-	-	25	25	6 1/2	5 1/2	11 1/2	7	7	23	23	-	✓	✓	Draagtig
*MEAS FOR KRIEK AUCTOR	"	10	BK414R 90032002308694	✓	-	-	-	25	25	7	7	10 1/2	7	7	22 1/2	22 1/2	-	✓	✓	Draagtig
	"	11	BK413B NO CHIP FOUND	✓	-	-	-	32	31	5 1/2	6 1/2	14	6 1/2	6 1/2	26 1/2	26 1/2	-	✓	✓	Draagtig
	"	12	PK414B 4C420D2120	✓	-	-	-	29	30	6 1/2	6 1/2	8	6 1/2	6 1/2	24	24 1/2	-	✓	✓	Draagtig
	"	13	MISSED DART																	
	"	14	FAILED DART																	
BV	22/11/19	15	PK41B 90035000355030	✓	-	-	-	29	28	6 1/2	6 1/2	15	6	6	25 1/2	25 1/2	3	✓	✓	Draagtig
	"	16	PK411B 90025000355022	✓	-	-	-	27	26	6 1/2	6 1/2	12	6 1/2	6 1/2	24 1/2	24 1/2	2 1/2	✓	✓	Draagtig
	23/11/19	17	PK412B 9003200264133	✓	-	-	-	32	31	8 1/2	8 1/2	12	6 1/2	6 1/2	30 1/2	30	2	✓	✓	Draagtig
WV	"	18	SK4-126	✓	-	-	-	36	36	8 1/2	8 1/2	15 1/2	6 1/2	6 1/2	30 1/2	30 1/2	1 1/2	✓	✓	GEKLEEF NO 13 DART 4-6/19

**Figure 3.2:** An example of a field list. "Datum" means "Date". "Id" means "Identity". "Miltsiekte" means "Anthrax vaccine.", "Lengte van lyf" means "Length of body". "Bul testikel omtrek" means Bull scrotal circumference". "Ringe links" means "Ridges left horn". "Ringe regs" means "Ridges right horn". "Punt L" means "Tip length left horn". "Punt R" means "Tip length right horn". "T-T" means "distance between two horn tips". "Dikte L" means "Base circumference left horn". "Base R" means "Base circumference right horn". "Lengte L" means "total length left horn". "Lengte R" means "Total length right horn". "Post" means "length of postmature horn growth". "Bloed en hare" means "Blood and hair collected for DNA". "Foto" means "Photo taken".

The data collection was performed as follows:

### Length of smooth (unridged) tip

This is the length of the first, smooth (unridged) horn growth, measured from the junction between the smooth and ridged growth section, to the apex of the horn, measured along the anterior aspect (Fig. 3.3) as defined by Van Rooyen *et al* (2016).



**Figure 3.3:** An anterior view of the horns of a twenty-two-month-old sable bull with the red arrow on the left horn indicating how the smooth horn tip would be measured.

## Total horn length

Measuring horn length in sable antelope is straight forward compared to some of the spiral horn antelope species. Starting at the base of the horn at the junction of the dermis with the horn in the frontal area of the skull, the anterior surface is followed on the median aspect with a steel measuring tape until the apex of the horn is reached and the total length is recorded for each horn (Fig. 3.4) (39). A metal tape was used, as fabric or other pliable tape measures can be inadvertently pushed in between rings, increasing the actual measurement.

Measurements were recorded in inches (consistent with common practice in game industry) down to the closest 1/16 of an inch. Measurements were converted to mm for purposes of statistical analyses using the following formula:

One inch = 2.54 cm.



**Figure 3.4:** An anterior view of the horns of a ten-year-old sable cow with the green line on her right horn indicating the total horn length as it would be measured with a steel tape along the median anterior surface.

### Horn ridge count (primary growth section)

Horn ridges were counted at the antero-medial aspect of both horns and recorded for each. (Fig. 3.5).



**Figure 3.5:** An anterior view of the horns of an adult sable bull. The yellow line depicts the antero-medial plane where ridges were counted, and the red arrows indicate examples of branching of ridges.

## Secondary/postmature horn growth length

This variable was also measured along the anterior aspect of the horn. The measurement was taken from the base at the junction with the dermis in the frontal area of the skull to the start of the ridged horn section at the junction between primary horn growth and secondary/postmature horn growth (Fig. 3.6).



**Figure 3.6:** An anterior view of the horns of a seventeen-year-old sable cow with the yellow line on each horn indicating how the length of the secondary/postmature horn growth section would be measured.

## Horn base circumference

The circumference of each horn was measured at the base of the horn just distal to the junction between horn and dermis. This was measured not with a steel tape, but either with a steel cable with a marker which is then removed to be measured against a steel tape, or by using a flexible measuring tape (Fig. 3.7).



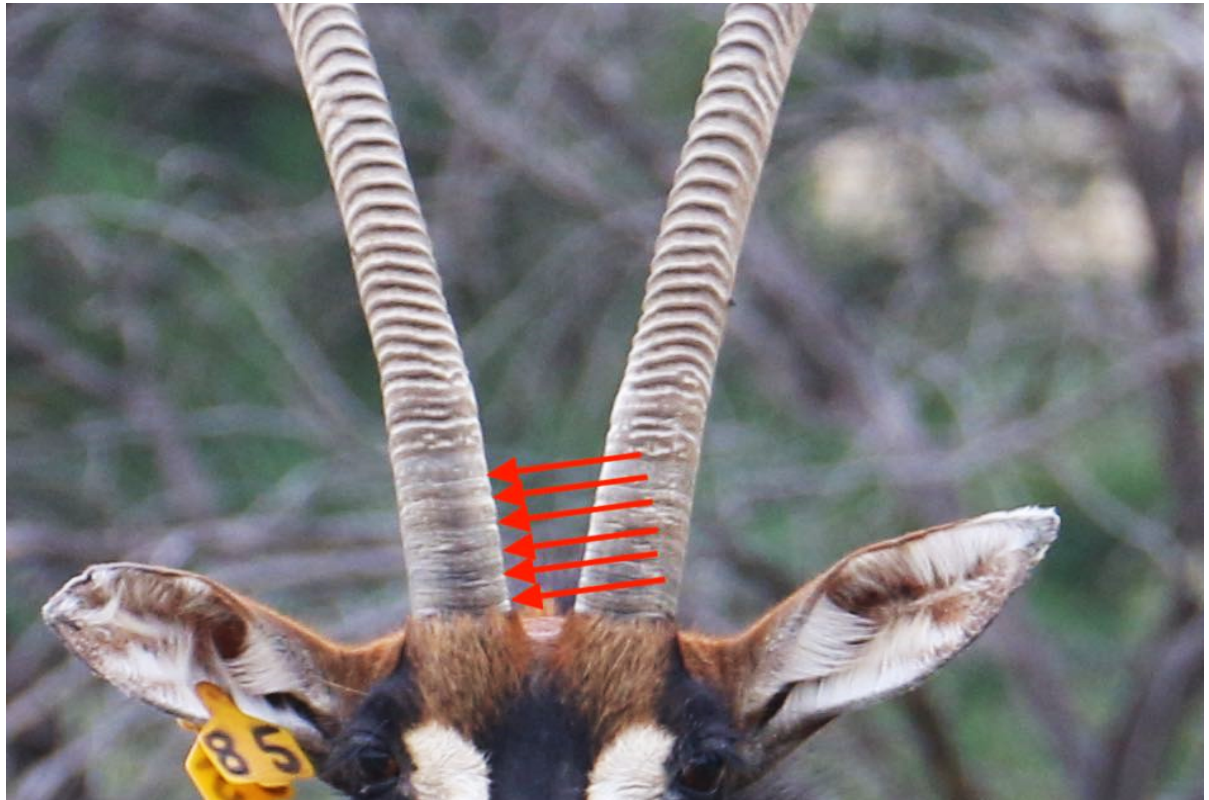
**Figure 3.7:** A lateral view of the left horn of a four-year-old sable bull with a flexible tape measure used to measure the horn base circumference, measuring eleven inches in this instance.

## **Growth check count in secondary/postmature growth section**

This is the only variable not recorded during immobilisation. Growth check counts in the secondary/postmature growth section were only performed in female sable antelope, as there was a lack of available photo records of mature sable bulls to evaluate this. The counts were performed photographically using high resolution digital photographs taken with a Canon EOS 70D camera with Canon EF 70-300mm f/4-5.6L IS USM Lens (Canon South Africa (Pty) Ltd Head Office, 1st Floor, Block C, Southdowns office park Corner of Karee & John Vorster Drive Southdowns, Centurion, 0062, Tel: +27 12 675 4900).

The digital photo databank of the farming operation comprising of over 45 000 photos taken of the farmed animals since 2009 was used and suitable (clear, focused photographs with the right angle and exposure to show growth checks clearly) were selected of female sable antelope that were four years of age or older when the photograph was taken. Photographs were only used if the ear tag number of the subject animal was legible in the photo.

The photograph of the section of unridged secondary/postmature horn growth was examined for the presence of annual growth checks (Fig. 3.8) and the count recorded (Annexure 5). If no clear checks could be distinguished, it was noted. If a suitable photograph was available of a cow older than five years and showing no secondary/postmature growth, it was also noted.



**Figure 3.8:** An anterior view of an eleven-year-old sable cow with red arrows indicating the annual growth checks observed in the secondary/postmature horn growth section. In this example there are six growth checks present.

### 3.5 STATISTICAL ANALYSIS

The following data observations were divided into gender groups and processed separately: Smooth tip length, total horn length, ridge count, secondary/postmature horn length, horn base circumference.

The maximum of the left and right horn measurements was determined for each measurement of each attribute.

Since the data was not normally distributed the non-parametric Wilcoxon signed rank test was performed to test for significant differences between the left horn and the right horn measurements.

The relationship between the explanatory variables and age was increasing but not linear, therefore it was transformed to a linear relationship by calculating the natural logarithm for each attribute as well as age.

Spearman's rank correlation coefficient was then used to describe the relationship between the natural logarithm of the known age in days as dependent variable and the natural logarithm of each of the explanatory variables.

An exponential regression model was fitted to predict an individual animal's age based on horn length. The prediction interval was calculated to determine the range of age of the individual animal (with 95% confidence intervals) as predicted by the maximum horn length.

The statistical analyses were performed with Version 9.4 of the SAS System for Windows (SAS Institute, Cary, North Carolina, USA) and IBM SPSS Statistics for Windows, Version 25.0 (IBM Corporation, New York, New York, USA).

The number of growth checks did not form part of the above statistical analyses. Growth check counts could only be performed on female sable antelope as there were an inadequate number of mature male sable available for examination. Growth check counts done from photo records were tabled together with the animal's ID (ear tag number) and real age. The estimated age based on the number of growth checks was calculated as five years (the average age at which secondary/postmature growth first became apparent in female sable antelope) plus the number of growth checks. The result was then compared to the known age, and classed as one of the following:

**Table 3.2:** Categories of results of growth check analyses in mature female sable antelope

<b>Could Not Be Aged</b>	<b>Good</b>	<b>Fair</b>	<b>Poor</b>
Either no growth checks, or no clear postmature growth was observed	Estimated age within 12 months of known age	Estimated age within 13-18 months of known age	Estimated age more than 18 months more or less than known age

## 4. RESULTS

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### 4.1 OBSERVATIONAL DATA

Horn buds were found to be visible in the frontal skull area of a 2-month-old male sable calf (Fig. 4.1).



**Figure 4.1:** A two-month-old sable bull calf. The horn buds are visible in the frontal skull area.

From here growth happened fast to form the unridged, spear-like horn tip. The first ridge appears from around ten months of age. The growth of the ridged section continues rapidly. Exfoliation of the outer horn layer occurs at around 18 months of age (Figs. 4.2, 4.3) and was also observed to happen on the ridged section of adult animals (Fig. 4.4, 4.5).



**Figure 4.2:** A photo of the horns of a nineteen-month-old sable heifer illustrating the onset of exfoliation of the deciduous horn layer clearly visible at the horn apices.



**Figure 4.3:** The horns of an eighteen-month-old sable heifer with exfoliation of the deciduous horn layer clearly visible on her left horn tip.

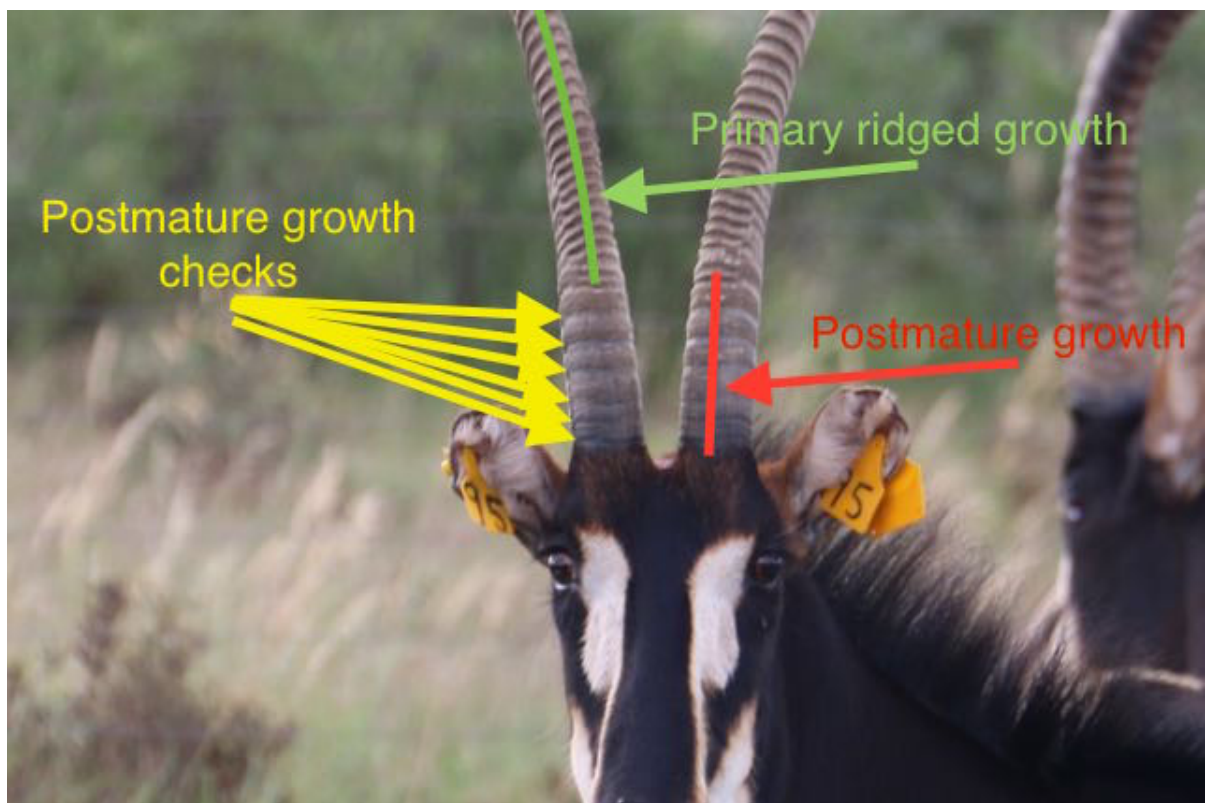


**Figure 4.4:** A frontal view of a five-year-old sable bull showing exfoliation of the outer layer of the horn of the ridged horn section.



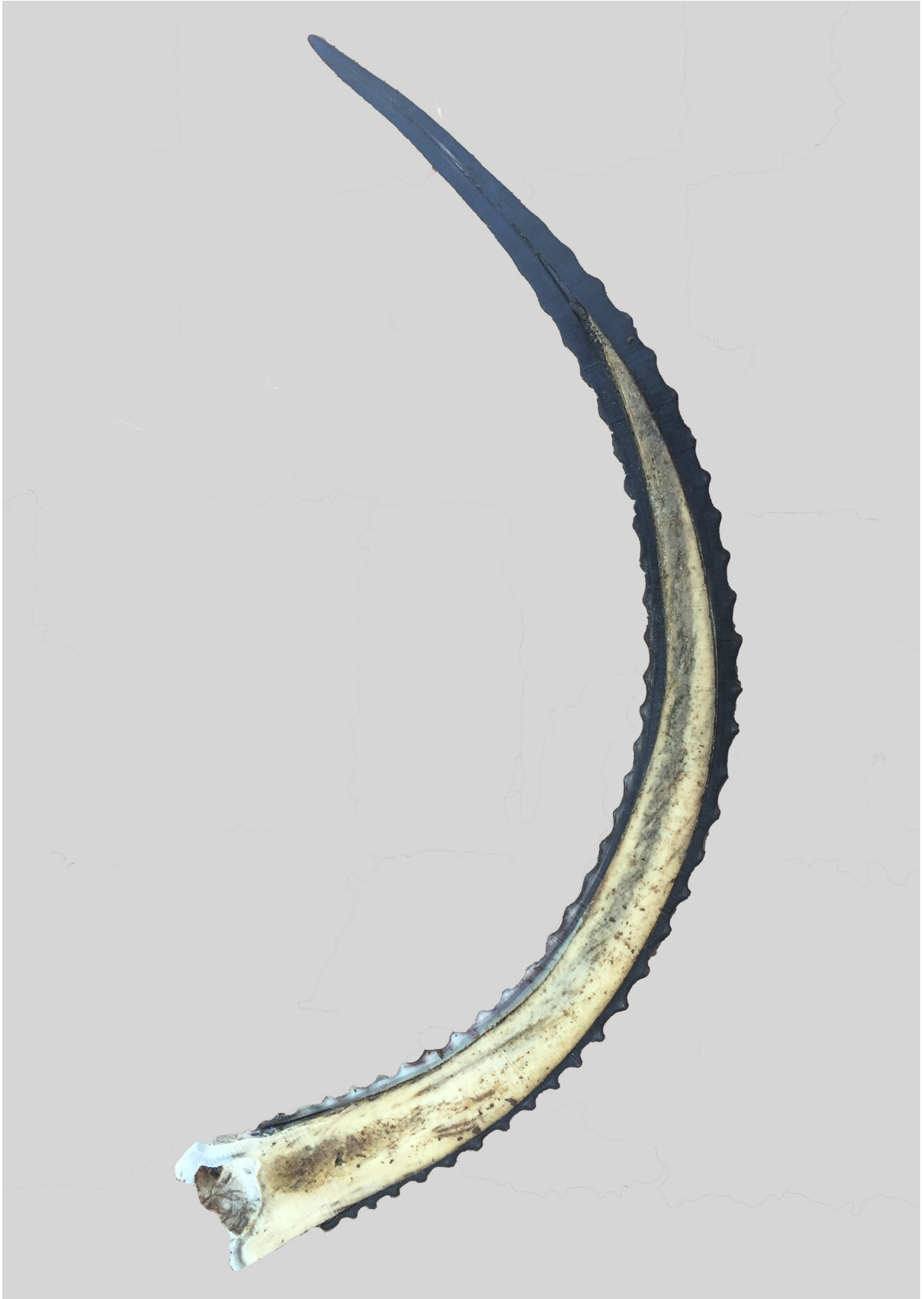
**Figure 4.5:** A frontal view of a three-year-old sable female with exfoliation of the outer horn layer visible in the ridged horn section.

The secondary/postmature growth section became visible from approximately five years of age in sable cows. Growth at this point is usually very slow compared to the growth of the horn tip and ridged horn growth sections. The secondary/postmature growth section may or may not contain discernible growth checks, and may or may not show a degree of ridged formations as well (Fig. 4.6).



**Figure 4.6:** A frontal view of a one-year-old sable cow with red line showing secondary/postmature horn growth section and yellow arrows showing growth checks. Primary, ridged horn growth is indicated by the green line on the right horn.

Examination of a midline sagittal section of the horn of a four-year-old sable bull showed that the bony core extended from the base of the horn to roughly the junction of the smooth tip with the start of the ridged horn section (Fig. 4.7)



**Figure 4.7:** A midline sagittal view of an adult male sable horn showing the extent of the bony core, covered by the keratin sheath.

Horn measurements (tip length, total length, number of ridges and horn base circumference) **excluding length of secondary/postmature growth section and growth checks** were recorded for 343 sable antelope, of which 188 were male and 155 were female. Measurements were recorded for left and right horns of the same individual. Multiple observations were recorded at different ages for the same individuals, resulting in a total number of observations of 367 for females and 457 for males. Total number of observations were as follows: Tip length, female (n = 288), male (n= 341); horn length, female (n = 367), male (n = 457); horn ridges, female (n = 293), male (n = 349) and horn base circumference, female (n = 289), male (n = 377). The age range for female sable antelope was 127 days to 6242 days and for males 301 days to 2669 days. Observations which were found to contain abnormalities, such as a broken horn or developmental abnormality, were excluded. Some observations were not complete, for example it consisted only of horn length but number of ridges was not recorded. These observations were still logged for the variables which were indeed recorded. Due to a lack of mature male subject animals, secondary/postmature horn length and growth checks could only be investigated in female sable antelope. There were 48 recorded lengths of the secondary/postmature growth sections available for mature female sable antelope and 38 counts of growth checks for mature female sable antelope. Unlike all the other measurements, the secondary/postmature growth length had only been recorded for one horn of each individual.

## 4.2 JUSTIFICATION FOR USING THE MAXIMUM MEASUREMENT FOR EACH DATA SET

The non-parametric Wilcoxon signed rank test was applied and showed that there was no significant statistical difference between left and right measurements for both male and female groups for the examined independent horn measurements. It was decided to use the measurements of the longer horn for subsequent analyses.

**Table 4.1:** Descriptive statistics for left and right horn measurements and age of female and male sable antelope.

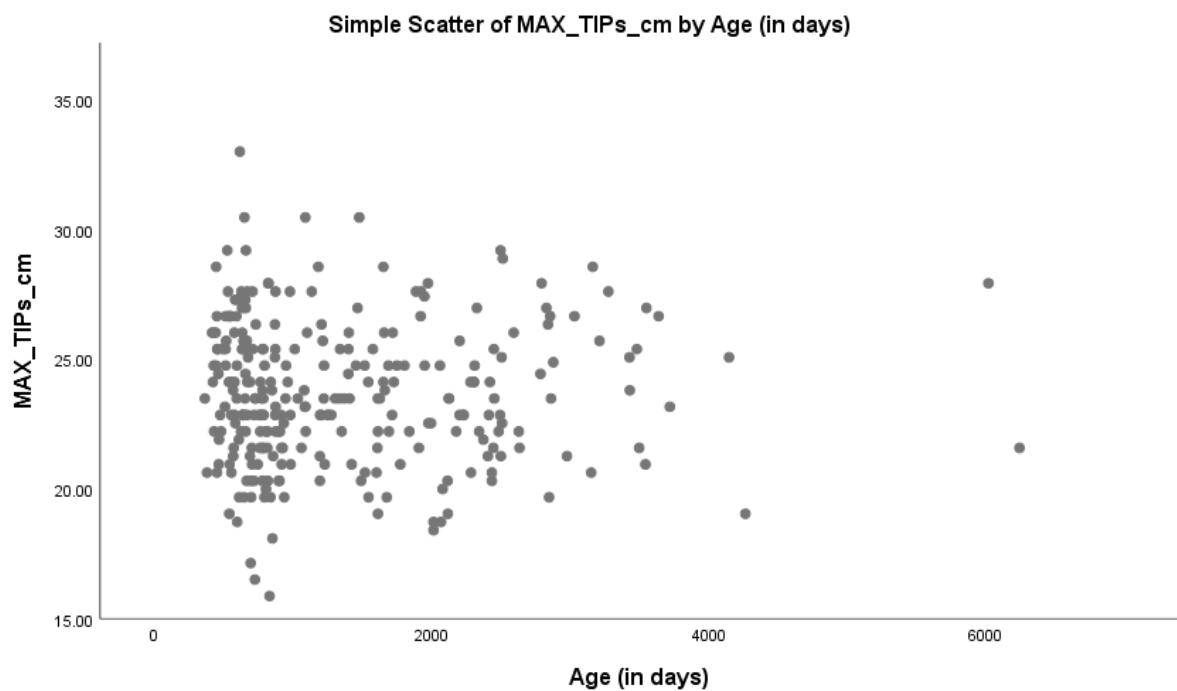
	LEFT HORN TIP LENGTH (cm)	RIGHT HORN TIP LENGTH (cm)	LEFT HORN LENGTH (cm)	RIGHT HORN LENGTH (cm)	LEFT HORN RIDGES	RIGHT HORN RIDGES	LEFT HORN BASE (cm)	RIGHT HORN BASE (cm)	AGE (Days)	POST- MATURE HORN LENGTH
	Females									
<b>N</b>	288	288	365	360	293	292	289	288	367	48
<b>Mean</b>	23.41	23.29	56.03	56.74	19.93	19.91	16.88	16.85	1327.57	6.11
<b>Std deviation</b>	2.75	2.74	18.49	17.63	10.19	10.27	1.13	1.11	940.06	3.54
<b>75% Q3</b>	25.40	25.24	71.12	71.12	73.66	73.66	17.78	17.78	1975	7.30
<b>50% Median</b>	23.33	22.94	56.52	56.99	48.26	46.99	16.83	16.83	948	5.08
<b>25% Q1</b>	21.59	21.27	43.82	43.97	25.40	26.67	16.51	16.51	640	3.81
<b>Min</b>	15.88	15.88	9.53	10.16	1.00	1.00	11.43	11.43	127	1.91
<b>Max</b>	33.02	33.02	92.08	90.33	42.00	42.00	19.69	19.69	6242	18.10
	Males									
<b>N</b>	341	341	456	401	350	349	378	368	457	n/a
<b>Mean</b>	27.72	27.54	76.48	79.09	20.69	20.79	22.73	22.80	1114.25	n/a
<b>Std deviation</b>	3.30	3.33	31.81	31.66	13.64	13.63	3.43	3.43	599.63	n/a
<b>75% Q3</b>	29.85	29.85	104.78	104.78	32	33	25.40	25.40	1580	n/a
<b>50% Median</b>	27.62	27.31	94.14	96.52	27	27	24.13	24.23	1271	n/a
<b>25% Q1</b>	25.40	25.08	40.48	40.96	4	4	19.69	19.69	444	n/a
<b>Min</b>	24.13	24.13	1	1	12.70	12.70	19.69	19.69	301	n/a
<b>Max</b>	120.65	120.02	40	42	27.31	27.63	38.74	39.37	2669	n/a

## 4.3 NATURE AND STRENGTH OF THE RELATIONSHIP OF HORN MEASUREMENTS VS AGE

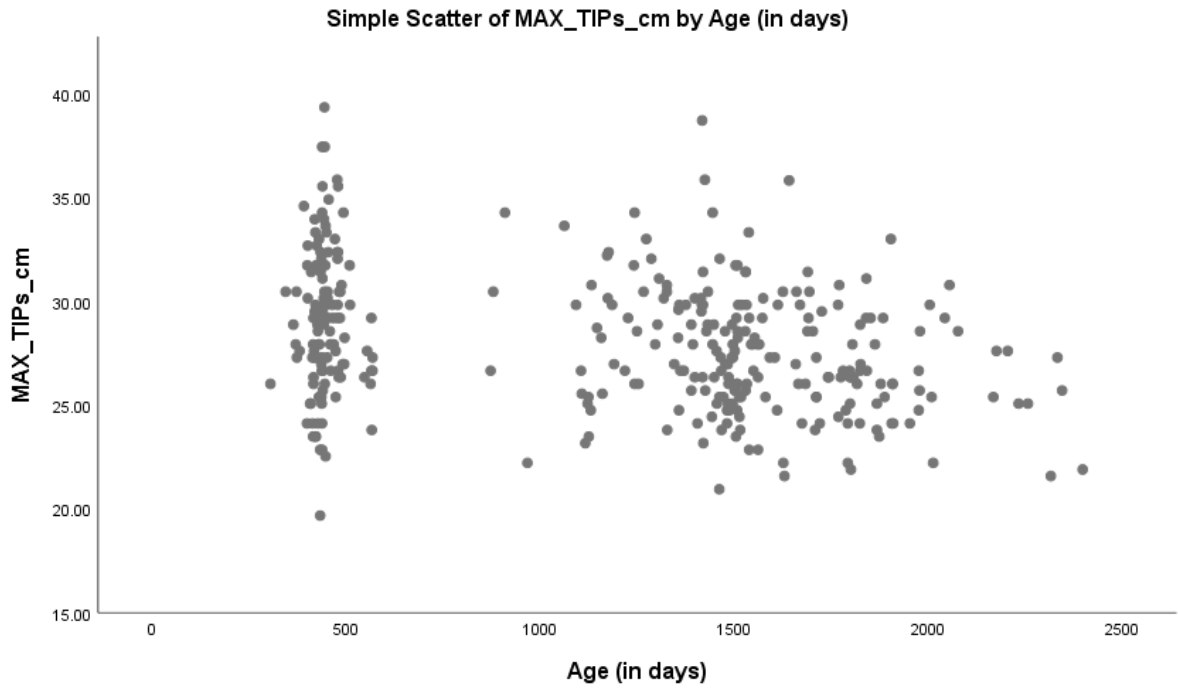
Scatter plots for the maximum measurement of each of the explanatory variables versus known age in days showed the following relationships between the horn measurements and age:

### 4.3.1 Maximum horn tip length vs age:

There is a very poor relationship between maximum horn tip length and age for both female and male sable antelope (Figs. 4.8, 4.9).



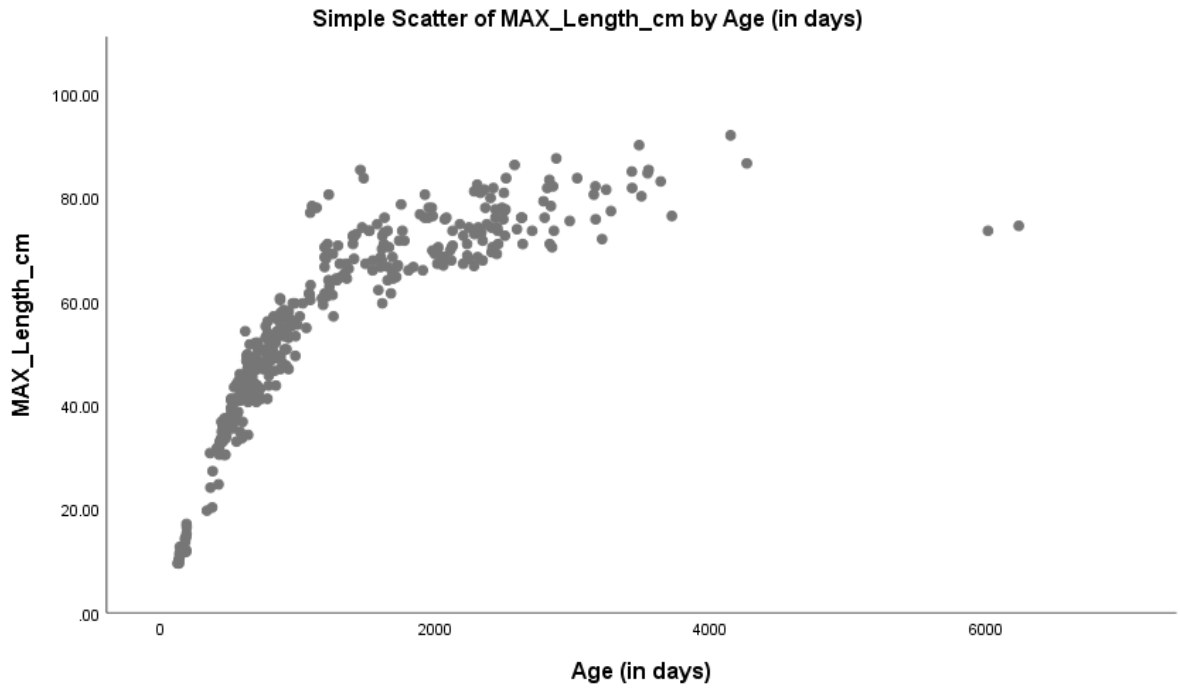
**Figure 4.8:** Female sable antelope maximum horn tip length vs age



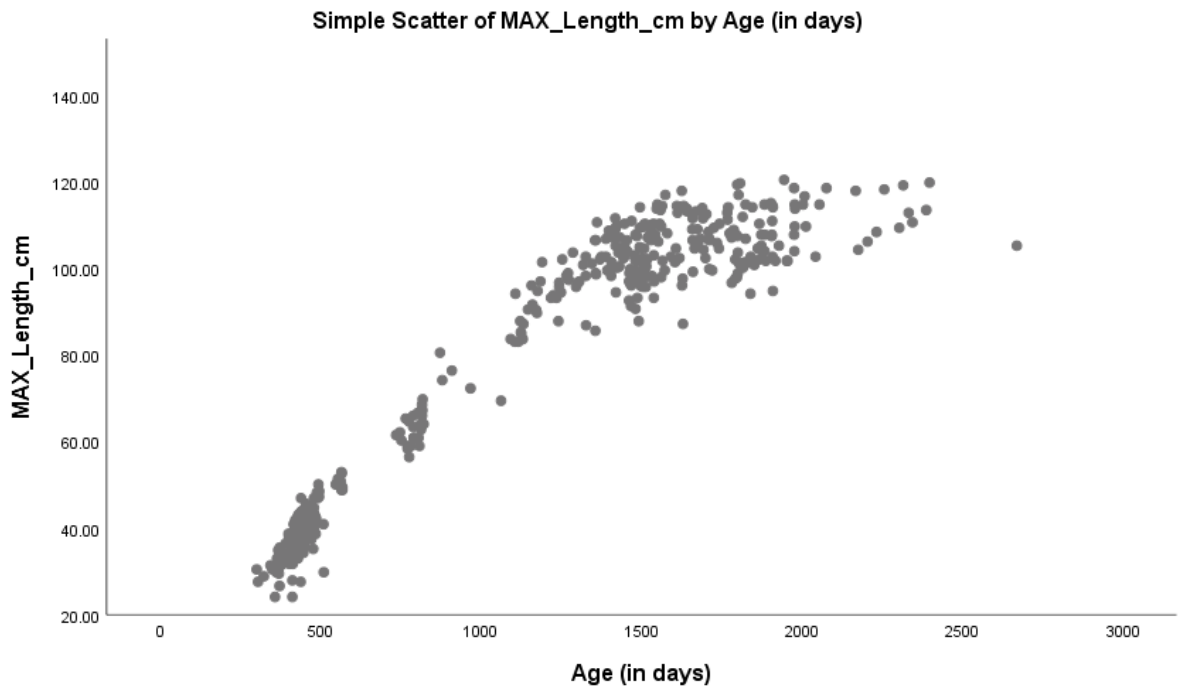
**Figure 4.9:** Male sable antelope maximum horn tip length vs age

#### 4.3.2 Maximum horn length vs age

There exists a strong, non-linear relationship between maximum horn length with age in both female and male sable antelope (Figs. 4.10, 4.11)



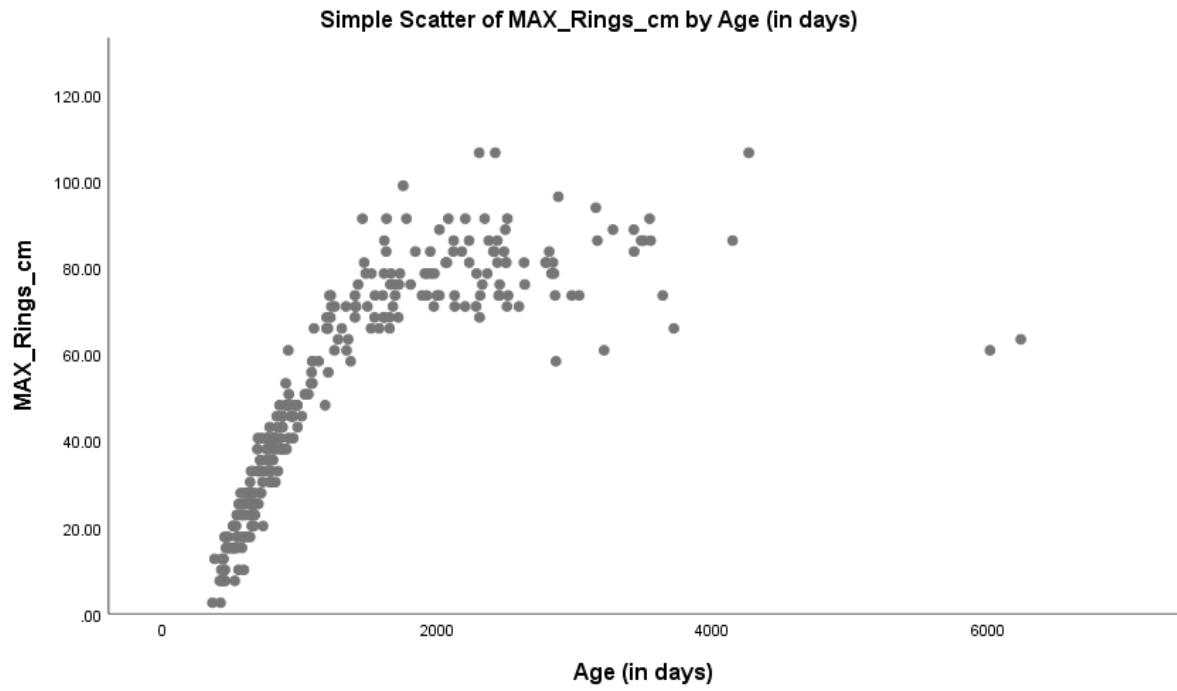
**Figure 4.10:** Female sable antelope maximum horn length vs age



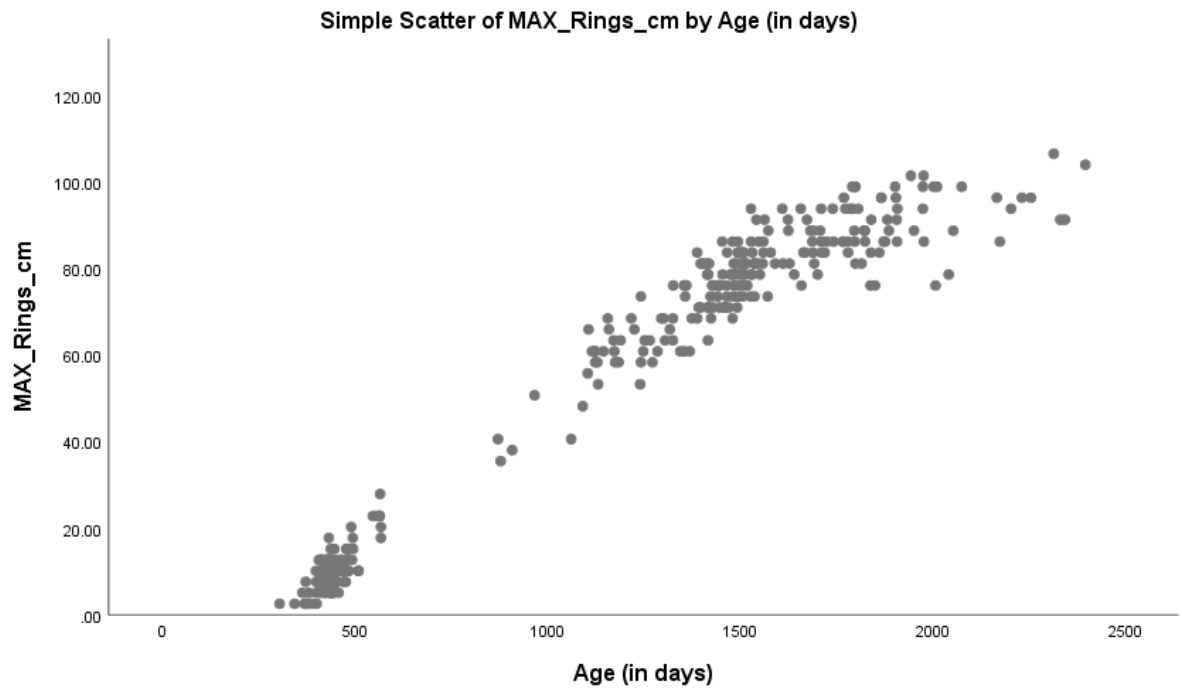
**Figure 4.11:** Male sable antelope maximum horn length vs age

### 4.3.3 Maximum horn ridges vs age

A strong, non-linear relationship was found between maximum number of horn ridges and age for both female and male sable antelope (Figs. 4.12, 4.13)



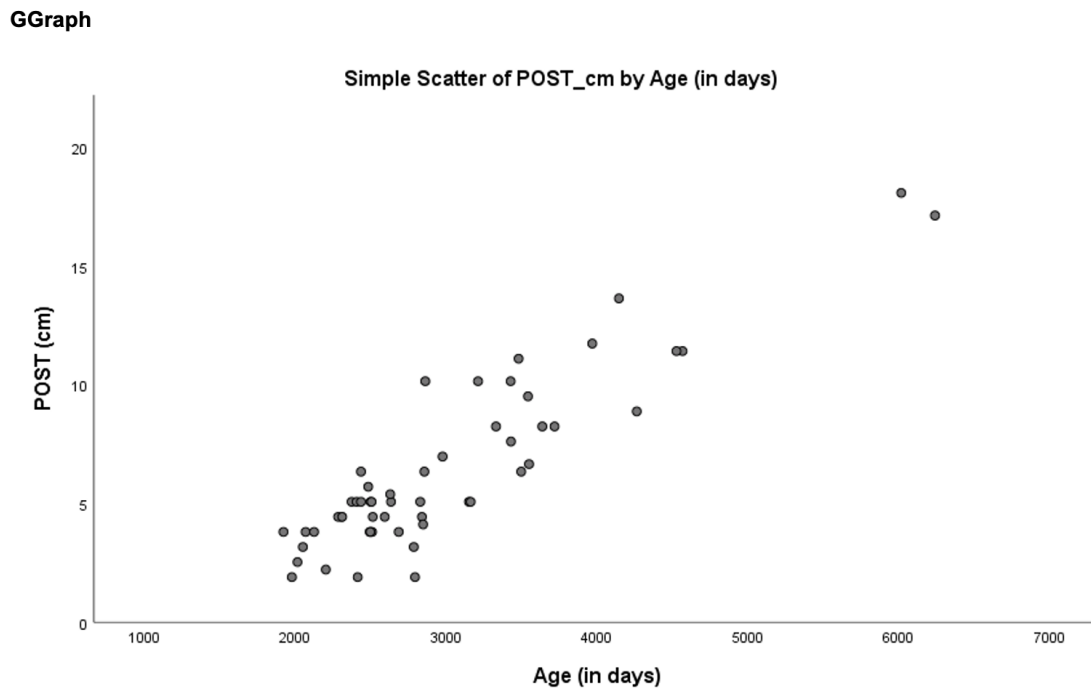
**Figure 4.12:** Female sable antelope maximum horn ridges vs age



**Figure 4.13:** Male sable antelope maximum horn ridges vs age

#### 4.3.4 Secondary/postmature growth section length vs age

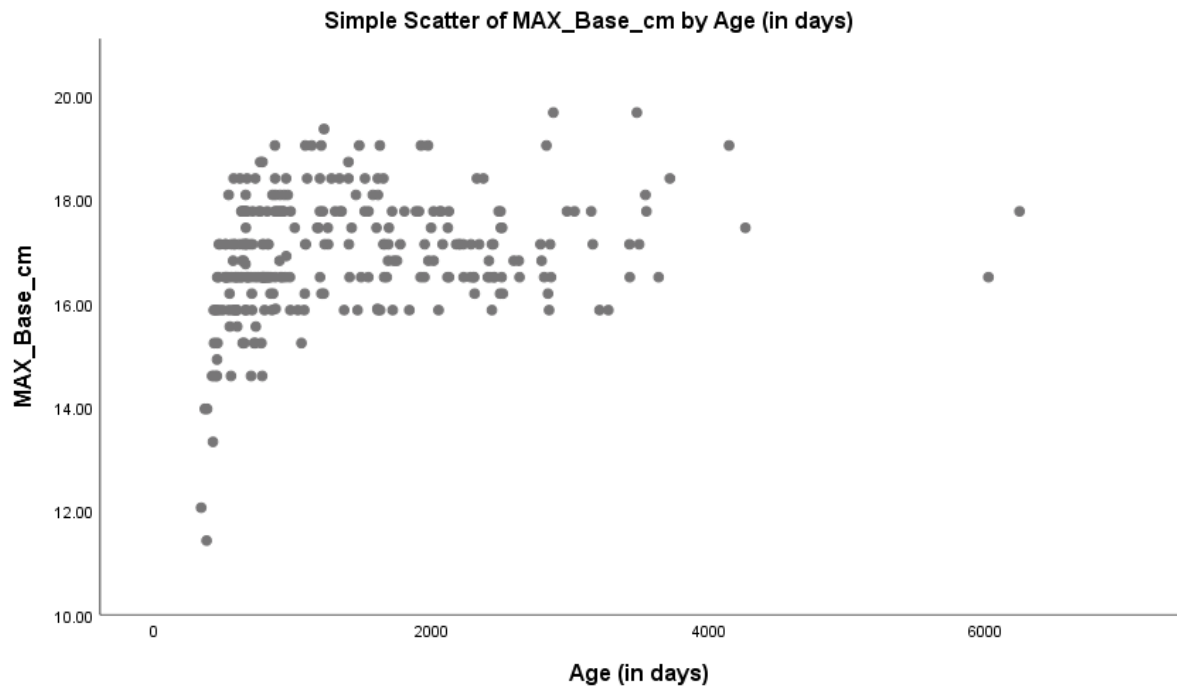
The secondary/postmature growth section length showed a very poor relationship with age for female sable antelope and was not investigated in male sable antelope (Fig. 4.14).



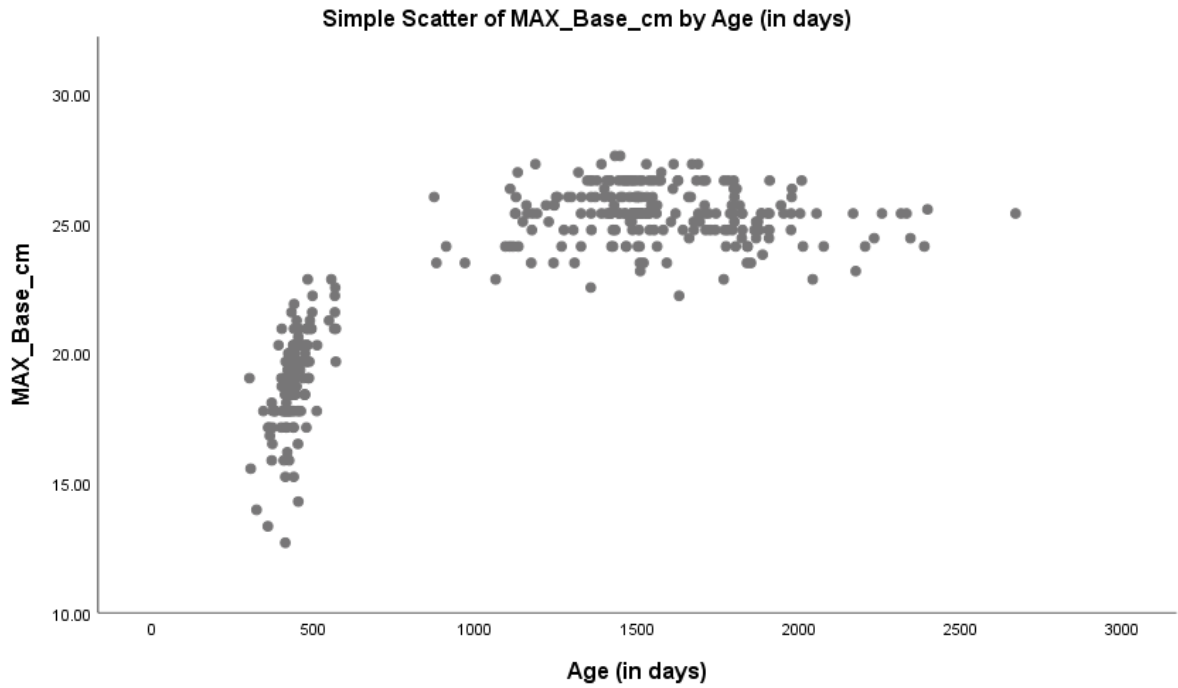
**Figure 4.14:** Female sable postmature horn growth length vs age

#### 4.3.5 Maximum horn base vs age

The maximum horn base circumference showed a very poor relationship with age for both female and male sable antelope (Figs. 4.15, 4.16)



**Figure 4.15:** Female sable antelope maximum horn base vs age



**Figure 4.16:** Male sable antelope maximum horn base vs age

The natural logarithm of each of the horn measurements as well as for age were calculated to convert the above relationships to a linear form in order to fit the regression model used to test accuracy of predicting the age of the animal. Spearman's rank correlation coefficient was used as the data was not normally distributed.

The findings are summarised in Tables 4.2 and 4.3:

**Table 4.2:** Female and male sable antelope: Mean, standard deviation, median, minimum and maximum values for all natural logarithm variables excluding odd cases.

Variable	N	Mean	Std Dev	Median	Minimum	Maximum	Label
Females							
Age_Ln	367	6.93715	0.75144	6.85435	4.84419	8.73906	ln(Age in days)
LENGTH_In	367	3.95331	0.44648	4.04568	2.25392	4.52260	
BASE_In	289	2.82325	0.06868	2.82301	2.43624	2.97986	
RINGS_In	293	3.74591	0.66996	3.87660	0.93216	4.66983	
TIP_In	288	3.14887	0.11650	3.15679	2.76475	3.49711	
Males							
Age_Ln	457	6.83629	0.63199	7.14756	5.70711	7.88946	ln(Age in days)
LENGTH_In	457	4.23444	0.48518	4.54645	3.18346	4.79289	
BASE_In	377	3.11178	0.16089	3.18346	2.54160	3.30707	
RINGS_In	349	3.55237	1.07567	4.22800	0.93216	4.64574	
TIP_In	341	3.31816	0.11470	3.30707	2.97986	3.64851	

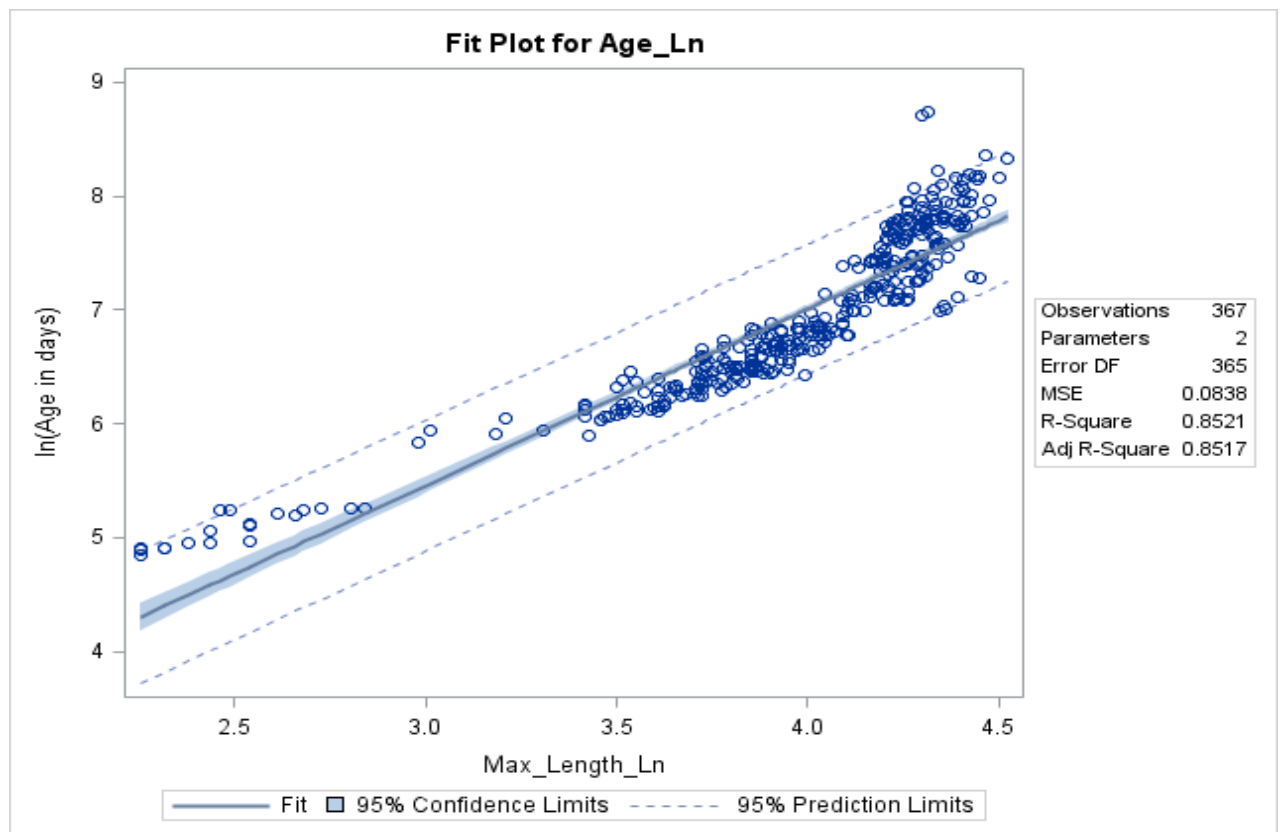
**Table 4.3:** Female and Male Sable Antelope Spearman Correlation Coefficients

	Age_Ln	LENGTH_In	BASE_In	RINGS_In	TIP_In
Female					
<b>Age_Ln</b>	1.00000	0.94937	0.32205	0.94021	-0.06821
<b>ln(Age in days)</b>		<.0001	<.0001	<.0001	0.2485
	367	367	289	293	288
<b>Max_Length_In</b>	0.94937	1.00000	0.45144	0.93888	0.05048
	<.0001		<.0001	<.0001	0.3934
	367	367	289	293	288
<b>Base_In</b>	0.32205	0.45144	1.00000	0.36120	0.01465
	<.0001	<.0001		<.0001	0.8072
	289	289	289	284	280
<b>Rings_In</b>	0.94021	0.93888	0.36120	1.00000	-0.14694
	<.0001	<.0001	<.0001		0.0125
	293	293	284	293	288
<b>Tip_In</b>	-0.06821	0.05048	0.01465	-0.14694	1.00000
	0.2485	0.3934	0.8072	0.0125	
	288	288	280	288	288
Male					
<b>Age_Ln</b>	1.00000	0.91087	0.73367	0.94187	-0.29294
<b>ln(Age in days)</b>		<.0001	<.0001	<.0001	<.0001
	457	457	377	349	341

	Age_Ln	LENGTH_In	BASE_In	RINGS_In	TIP_In
<b>Max_Length_Ln</b>	0.91087	1.00000	0.81348	0.88678	-0.13144
	<.0001		<.0001	<.0001	0.0151
	457	457	377	349	341
<b>Base_In</b>	0.73367	0.81348	1.00000	0.73526	-0.23786
	<.0001	<.0001		<.0001	<.0001
	377	377	377	348	340
<b>Rings_In</b>	0.94187	0.88678	0.73526	1.00000	-0.41324
	<.0001	<.0001	<.0001		<.0001
	349	349	348	349	339
<b>Tip_In</b>	-0.29294	-0.13144	-0.23786	-0.41324	1.00000
	<.0001	0.0151	<.0001	<.0001	
	341	341	340	339	341

## 4.4 PREDICTION OF AGE

As maximum horn length had the strongest correlation with age ( $r = 0.949$  (female sable) and  $r = 0.911$  (male sable)), the prediction interval for age was calculated as explained by maximum horn length measurement of an individual. The confidence interval was also calculated (Figs. 4.17, 4.18).



**Figure 4.17:** Prediction and confidence intervals for age in female sable antelope as explained by maximum horn length of an individual animal



**Figure 4.18:** Prediction and confidence intervals for age in male sable antelope as explained by maximum horn length of an individual animal

The 95% prediction interval for individual prediction is significantly wider than the 95% confidence interval for mean prediction (Figs. 4.17, 4.18). A table for each gender group of sable antelope was formulated based on the prediction interval to show in practice how wide the 95% predicted age interval would be as explained by the maximum horn measurement of the individual (Annexures 1,2). The real data sets used for the study were tested to illustrate how accurate the predictions would be compared to the known age. The age prediction of the first five female sable bulls from the prediction tables (Annexures 1,2) representing different age groups (year-old, two-year-old, three-year-old, four-year-old and five-year old) were tabled as example of accuracy (Table. 4.4)

**Table 4.4:** Examples for the different age groups of male and female sable showing predicted individual age explained by the horn length observation

Obs no	Gender	Observed Age (days)	Observed horn length (cm)	Predicted Age Based on Length (days)		Predicted Age (days)
				Lower 95% limit	Upper 95% limit	
8	Female	364	30,8	257,03	805,29	454,96
12	Female	785	50,8	559,92	1750,40	990,00
2	Female	1091	77,15	1071,06	3352,29	1894,86
4	Female	1480	83,82	1217,92	3814,25	2155,33
13	Female	1979	69,85	918,00	2871,82	1623,60
27	Male	344	31,43	265,36	438,91	341,28
12	Male	765	65,41	676,34	1117,11	869,22
13	Male	1122	87,95	986,83	1630,11	1268,26
14	Male	1455	104,14	1224,03	2022,72	1573,41
16	Male	1798	107,63	1276,66	2109,70	1641,06

It is clear from the examples that the maximum horn measurement of an individual sable antelope (male or female) does not provide an accurate prediction of the individual's age as the 96% prediction interval is too wide.

## 4.5 POSTMATURE GROWTH CHECKS

Growth checks (when present) form in secondary/postmature horn growth section. As there was an insufficient number of records of mature male sable this variable was only examined for female sable antelope. Thirty eight female sable antelope were found to meet the criteria necessary to be able to consider their growth check counts as variable to predict their age (Table 4.5). Interpretation of the result is portrayed under Table 4.6.

**Table 4.5:** Results of examination of female sable antelope horn growth check counts and prediction of age as well as actual age

No	Approx Age at Onset of Postmature Growth (Years)	Number of		Estimated Age (years)	Result
		Growth Checks	Age (years)		
1	Unknown	None	16	-	Cannot Age
2	Unknown	4	7	+2	Poor
3	5	6	11	0	Good
4	Unknown	6	11	0	Good
5	5	7	12	0	Good
6	Unknown	8	13	0	Good
7	5,5	2	8	-0,5	Good
8	5	7	11,75	+0,25	Good
9	Unknown	5	9	+1	Good
10	Unknown	5	8	+1	Good
11	5	3	7,5	+0,5	Good
12	5	5,5	10,83	-0,33	Good
13	5,5	4	9,58	-0,58	Good
14	5	2,5	7,17	+0,37	Good
15	5	7	11,75	+,-,25	Good
16	5	2	7	0	Good
17	5	1,5	6,5	0	Good

No	Approx Age at Onset of Postmature Growth (Years)	Number of			Result
		Growth Checks	Age (years)	Estimated Age (years)	
18	5	5	10	0	Good
19	5,5	4	9,83	-0,83	Good
20	5,5	4	9	0	Good
21	5	2	6,5	+0,5	Good
22	5	None			Cannot Age
23	5	3	9	-1	Good
24	Unknown	None			Cannot Age
25	4,5	3	7,5	+0,5	Good
26	3,5	7	11	+1	Good
27	5,5	1	6,5	+0,5	Good
28	None	None			Cannot Age
29	None	None			Cannot Age
30	5	2	7	7	Good
31	Unknown	2	6	7	Good
32	5	2	6	7	Good
33	5	2	7	7	Good
34	5	1,5	7	6,5	Good
35	5	2	8	7	Good
36	Unknown	1	6,5	6	Good
37	5	2	8	7	Good
38	4,5	2	8	7	Good

**Table 4.6:** Summary of findings of horn growth check analyses of mature female sable antelope

n = 38			
Could not be aged = 5		Could be aged = 33	
No clear postmature growth	No clear growth checks	Within 12 months of actual age	Not within 12 months of actual age
2	3	32	1

Thus six out of 38 mature females could not be aged based on growth checks, two because there was no clear secondary/postmature horn growth and four because they did not have clear growth checks in the secondary/postmature growth section.

Thirty one of 38 mature females could be aged to within 12 months of actual age based on growth checks. Only one female which showed clearly discernible growth checks could not be aged to within one year of actual age.

## 5. DISCUSSION

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The aim of the study was to do describe the observed horn growth in sable antelope and to determine if it was possible to accurately determine the age of an individual sable antelope based on horn measurements which can be counted or measured in the field.

This study was conducted on a closed group of animals born and raised on the same farm where selection is applied for greater horn length (amongst other selection criteria). The variance in horn measurements in the national sable population is thus expected to be broader than what was found in this study.

The detailed description of horn growth as recorded by Grobler and Simpson was found to be in agreement with observations made in this study, with the following exceptions:

Grobler reported that exfoliation of deciduous horn commences around 16 months of age and is completed by 20-24 months of age, although “actual annulation flakes of deciduous horn may still be present after this.” (2) The author’s observations agree with the reported age of onset, but observed that exfoliation of the superficial layer is often apparent in the ridged primary growth horn section of adult male and female sable antelope (Figs. 5.1, 5.2).



**Figure 5.1:** An anterior close-up view of horn base of a five-year-old sable bull showing exfoliation of the superficial horn layer of the ridged horn section.



**Figure 5.2:** An oblique view of the horns of a three-year-old sable cow showing exfoliation of the distal section of ridged horn growth.

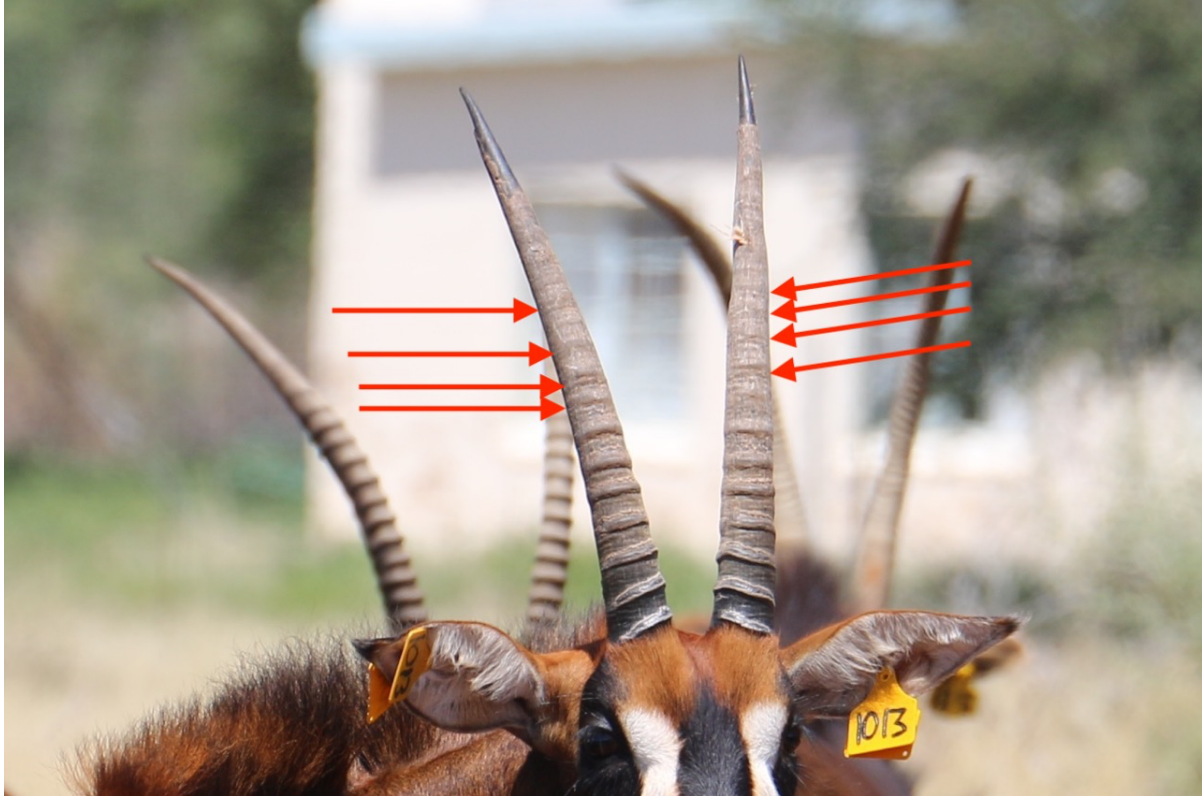
Currently where the age of a sable antelope is unknown, veterinarians and breeders/captors use incisor eruption combined with evaluation of horn length and ridge count according to the individual's experience in order to determine subadult and young sable antelope's age. For older adult and mature animals, incisor attrition combined with evaluation of horn length, ridge count and presence/length of secondary/postmature horn growth is evaluated, again according to personal experience.

Evaluation of premolar and molar dental eruption is not practical without the use of specialist dental equipment, as the mouth of sable antelope cannot open wide enough to simply inspect the back of the mouth only using a light source. Furthermore, the eruption of premolar and molar teeth is only useful in ageing subadult and young sable antelope, as eruption is completed by approximately four years of age (2).

Grobler reported the only reliable method for age determination in adult and mature sable antelope to be the counting of keratin layers microscopically (2). This method is not of practical use as field method for age determination of living adult sable antelope where the horns need to be preserved.

The smooth tip length is difficult to consistently measure accurately, especially when there are different investigators taking measurements, for the same reason as why there often is inconsistency in ridge count, namely that it can be very difficult to be sure what constitutes the first ridge (Fig. 5.3). Since the tip length reaches its maximum length as soon as the ridged horn growth section starts to form, it is

unsuitable to be used for age prediction as there is no correlation with age from the time that the tip has finished growing (around ten months-of-age).



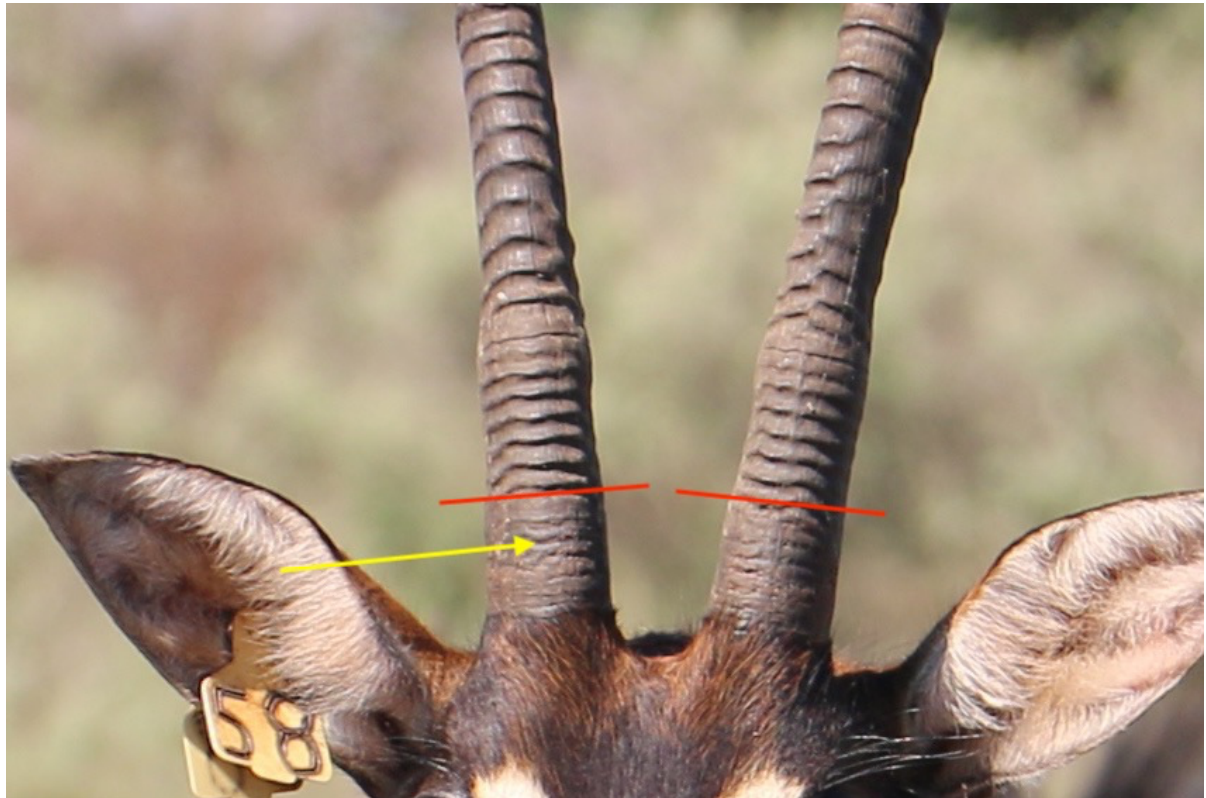
**Figure 5.3:** An anterior view of a twenty-month-old sable heifer. The arrows indicate unclear ridges which may or may not be counted depending on personal interpretation.

The use of total horn length as age predictor would make an ideal field method, as the only instrument needed to measure horn length is a steel tape. Sable antelope have easy horns to measure correctly compared to spiral-horned antelope and after minimal training consistent measurements between different investigators are possible. The use of horn length to calculate age was found to be accurate in determining the average age for the population for any specific horn length, but not accurate in predicting the specific age of the individual (Table 7). The mentioned limitation of the study, namely that all of the subject animals originate from one farm, provides reason to believe that the variation in age prediction will be even wider when

applied to a less homogenous population with unrelated individuals kept under different management conditions and different geographic locations.

Similar to total horn length, the use of the horn ridge count would theoretically make an ideal field method, and taking into consideration the strong correlation between age and horn ridge count, it seems like the ideal variable. In sable antelope horn ridges often branch and for consistency in method the ridge counts were made at the antero-medial aspect of the two horns as the author found it to be the aspect with the lowest occurrence of branching of ridges. In spite of this, in practice the author saw that different investigators got different ridge counts for the the same subject individual, due to branching of ridges (Fig. 3.5), and also because different investigators might have different interpretations as to which “bump” should be counted as the first ridge (Fig. 5.3). There is no literature on how to determine the first ridge where counting should commence. Similarly, in some cases there might be slight ridging of the secondary/postmature growth section, which may be confused with true ridging of the primary growth section (Fig. 5.4). For these reasons, ridge counts are much more prone to variation depending on personal experience and interpretation of the investigator

Statistically, the combined use of horn ridge count and total horn length was not possible because of the multicollinearity between thee explanatory variables. As the counting of horn ridges was found to yield much less consistent results (especially between different investigators) compared to measuring total horn length in sable antelope, horn length was found to be the superior variable to use over ridge count.



**Figure 5.4:** Anterior view of the horn base of a six-year-old sable cow. The red lines mark the transition between primary and secondary/postmature horn growth sections. The yellow arrow indicates slight ridging of the secondary/postmature horn growth section, which may be confused with true ridging of the primary growth section.

Horn base measurements were not found to be a good variable to use for age prediction as there was a poor correlation with age. The advantage of using horn base measurement would be its ease and little chance of variation between investigators. Another practical finding in the field is that although horn base circumference does increase with age, it typically happens so only up to the point where primary ridged growth ends. Horn base circumference is always measured at the junction of the horn with dermis at the base of the horn adjacent to the skull. As the horn grows, the horn base measurement changes. Initially, it will increase in circumference as the base is formed by the growing smooth tip. It continues to increase in diameter as the primary, ridged growth forms the horn base. Finally, in the mature animal the unridged, secondary/postmature horn growth forms the horn

base, and at this point the base circumference is often found to get smaller. The peak and subsequent decrease in horn base circumference can be explained due to the horn ridges found in the primary, ridged horn section, protruding beyond the horn shaft, increasing the horn base circumference and which are absent in the secondary/postmature horn growth section.

In mature sable females, 81.6% could be aged to within 12 months of actual age by means of counting growth checks (n=38). This method has the obvious limitation that it is not of any use in younger animals, as the checks only form in the postmature horn growth section.

It is unclear why the first section of horn growth is unridged, why the next section becomes ridged, and again why the secondary/postmature horn growth section is unridged. The onset of secondary/postmature horn growth section cannot be explained by the onset of sexual maturity, as they do not coincide. Grobler reported the onset of sexual maturity to be around two years of age in females, and three years in males (5).

The incisor eruption pattern and age at eruption as described by Grobler (2) thus remains the most accurate way of determining age in subadult and young adult sable antelope. Dental attrition however, is described to be an unreliable predictor of age (2) and thus the practice of age determination based on dental wear after the animal has a full set of erupted teeth, should be discouraged.

The method of counting the stacked keratinized horn cones histologically on transverse sections of horn in Japanese Serow (7) was shown by Grobler to also accurately predict age in 95% of sable antelope examined by him in this way (2), but this method is not a suitable method for use in living animals where the horns need to be preserved.

The use of horn measurements on their own or combined still does not provide a reliable field age determination method for adult sable antelope. Future research should complement the current dental eruption and horn length systems as we believe age determination can only be accurate in sable when a combination of different measurements are incorporated.

Future research could possibly also bring clarity on the many unanswered questions regarding horn growth and development. For example: why is the initial horn growth unridged? What causes ridging of horn to start from around ten months-of-age? Why does ridging stop at around four-to-five years of age, well beyond reaching sexual maturity at two years for females and three years for males as reported by Grobler (5)? Why do some ridges only extend to the anterior aspect of the horn and others extend around the full circumference of the horn shaft? Why do some ridges branch?

## 6. CONCLUSION

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The macroscopically observed growth pattern of sable antelope has been described in detail by Grobler. The findings of this study agreed with his reports, apart from the exfoliation of the first horn, which Grobler found to be complete by 24 months of age, whereas the author observed it to continue in adult animals.

This study proved that there exists a strong correlation between total horn length and total number of horn ridges with age in sable antelope. The combined use of horn length and number of horn ridges to explain age was however not possible, due to the multicollinearity among these two explanatory variables. Therefore only horn length was further investigated seeing that it is a much more consistent variable in terms of results obtained between different investigators gaining field data.

In this study, the total horn length was not useful to accurately predict the age of an individual animal statistically, but was useful in predicting the average age of the population for a specific horn length (Figs. 4.17, 4.18).

The use of growth checks observed in the secondary/postmature horn section was useful in determining the age of female individuals, in those instances where age determination was possible (clearly discernible growth checks are present in the secondary/postmature growth section). This variable was not investigated in male sable antelope due to lack of data and needs to be investigated in future. Growth checks form when horn growth is arrested annually in the dry season. Thus factors possibly affecting the development of growth checks need to be further investigated before this method is advocated, as many captive populations kept under more

artificial management practices compared to the subject population might show different development of these growth checks, or no growth checks at all.

In conclusion, this study proved that there is a good correlation between horn length and age of sable antelope. This correlation is however not strong enough to use horn length as a reliable predictor of actual (specific) age of an individual.

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## 9. ANNEXURES

### Annexure 1: Animal ethics committee approval form

 <b>UNIVERSITEIT VAN PRETORIA</b> <b>UNIVERSITY OF PRETORIA</b> <b>YUNIBESITHI YA PRETORIA</b>	
<b>Animal Ethics Committee</b>	
PROJECT TITLE	Horn growth and development of Sable antelope and its value in age determination
PROJECT NUMBER	V020-18
RESEARCHER/PRINCIPAL INVESTIGATOR	Dr. A Garrett
STUDENT NUMBER (where applicable)	U_95061411
DISSERTATION/THESIS SUBMITTED FOR	MSc
ANIMAL SPECIES	Sable antelope ( <i>Hippotragus niger niger</i> )
NUMBER OF SAMPLES	5-10 horns
Approval period to use animals for research/testing purposes	March 2018 – March 2019
SUPERVISOR	Prof. G Steenkamp
<p><b>KINDLY NOTE:</b></p> <p>Should there be a change in the species or number of animal/s required, or the experimental procedure/s - please submit an amendment form to the UP Animal Ethics Committee for approval before commencing with the experiment</p>	
<b>APPROVED (With conditions)</b>	Date 26 March 2018
CHAIRMAN: UP Animal Ethics Committee	Signature 
<p><b>CONDITIONS:</b> A letter of the HoD has to be submitted for the use of samples            Informed Consent from owners must be submitted.            Please indicate where these horns have be obtained from</p>	
S4285-15	



**Annexure 3:** Prediction interval for age of an individual female sable antelope as explained by the maximum horn measurement of the individual

Obs	MAX_Length_cm	Age (in days)	Dependent	Predicted	Predicted	Std	95% CL Mean		95% CL Predict		95% CL Predict	
	Observed	Observed	Variable	Value	Value	Error			Predicted confidence limits in LN		Predicted confidence limits in real age days	
			In(Age in days in column C)	Using the regression model	After transforming the ln values in column E to real age in days	Mean			for individual horn lengths		for individual horn lengths	
				In(Age in days)		Predict			Lower	Upper	Lower	Upper
1	54,29	619	6,43	7,001	1097,73	0,0152	6,9711	7,0308	6,431	7,5709	620,79	1940,89
2	77,15	1091	6,99	7,5469	1894,86	0,0201	7,5073	7,5865	6,9764	8,1174	1071,06	3352,29
3	78,11	1137	7,04	7,5659	1931,21	0,0204	7,5258	7,6061	6,9954	8,1365	1091,60	3416,94
4	83,82	1480	7,3	7,6757	2155,33	0,0221	7,6322	7,7191	7,1049	8,2465	1217,92	3814,25
5	11,75	189	5,24	4,6229	101,79	0,0527	4,5193	4,7265	4,0444	5,2014	57,08	181,53
6	68,58	1196	7,09	7,3639	1577,98	0,0177	7,329	7,3988	6,7937	7,9341	892,21	2790,85
7	32,07	430	6,06	6,183	484,44	0,0223	6,139	6,2269	5,6121	6,7538	273,72	857,31
8	30,8	364	5,9	6,1202	454,96	0,0234	6,0742	6,1661	5,5492	6,6912	257,03	805,29
9	37,47	467	6,15	6,4246	616,83	0,0188	6,3877	6,4616	5,8543	6,995	348,73	1091,16
10	68,58	2308	7,74	7,3639	1577,98	0,0177	7,329	7,3988	6,7937	7,9341	892,21	2790,85
11	69,22	2447	7,8	7,3782	1600,71	0,0179	7,343	7,4134	6,808	7,9485	905,06	2831,32
12	50,8	785	6,67	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
13	69,85	1979	7,59	7,3924	1623,60	0,0181	7,3569	7,428	6,8222	7,9627	918,00	2871,82
14	69,85	2108	7,65	7,3924	1623,60	0,0181	7,3569	7,428	6,8222	7,9627	918,00	2871,82
15	30,48	472	6,16	6,1041	447,69	0,0236	6,0576	6,1505	5,533	6,6751	252,90	792,43
16	43,82	788	6,67	6,6679	786,74	0,0162	6,636	6,6997	6,0978	7,2379	444,88	1391,17

17	47,63	917	6,82	6,7974	895,52	0,0154	6,7671	6,8277	6,2275	7,3674	506,49	1583,51
18	49,53	983	6,89	6,8583	951,75	0,0152	6,8284	6,8882	6,2884	7,4283	538,29	1682,94
19	19,69	340	5,83	5,4248	226,97	0,0363	5,3535	5,4962	4,8512	5,9984	127,89	402,78
20	33,02	555	6,32	6,2284	506,94	0,0216	6,1859	6,2709	5,6577	6,7992	286,49	897,13
21	40,64	700	6,55	6,551	699,94	0,0173	6,517	6,585	5,9808	7,1212	395,76	1237,94
22	50,8	905	6,81	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
23	67,95	1611	7,38	7,3495	1555,42	0,0176	7,3149	7,384	6,7793	7,9196	879,45	2750,67
24	42,55	595	6,39	6,6222	751,60	0,0166	6,5895	6,6548	6,0521	7,1923	425,00	1329,16
25	56,2	782	6,66	7,0545	1158,06	0,0153	7,0244	7,0847	6,4846	7,6245	654,98	2047,76
26	36,51	464	6,14	6,3846	592,65	0,0193	6,3466	6,4226	5,8142	6,955	335,02	1048,38
27	39,69	520	6,25	6,5142	674,65	0,0177	6,4794	6,549	5,944	7,0844	381,46	1193,21
28	45,09	660	6,49	6,7123	822,46	0,0159	6,681	6,7435	6,1423	7,2823	465,12	1454,33
29	52,07	807	6,69	6,936	1028,65	0,0151	6,9063	6,9657	6,3661	7,506	581,78	1818,92
30	53,34	854	6,75	6,9735	1067,95	0,0151	6,9437	7,0032	6,4036	7,5434	604,02	1888,24
31	56,2	955	6,86	7,0545	1158,06	0,0153	7,0244	7,0847	6,4846	7,6245	654,98	2047,76
32	73,03	2286	7,73	7,4615	1739,76	0,0189	7,4242	7,4987	6,8911	8,0318	983,48	3077,28
33	30,48	458	6,13	6,1041	447,69	0,0236	6,0576	6,1505	5,533	6,6751	252,90	792,43
34	41,91	673	6,51	6,5988	734,21	0,0168	6,5657	6,6319	6,0287	7,1689	415,17	1298,42
35	48,9	818	6,71	6,8383	932,90	0,0153	6,8083	6,8683	6,2684	7,4082	527,63	1649,45
36	61,6	1197	7,09	7,197	1335,42	0,0161	7,1653	7,2288	6,627	7,767	755,21	2361,38
37	66,99	1729	7,46	7,3275	1521,57	0,0173	7,2934	7,3616	6,7574	7,8977	860,40	2691,09
38	69,22	1998	7,6	7,3782	1600,71	0,0179	7,343	7,4134	6,808	7,9485	905,06	2831,32
39	38,74	540	6,29	6,4764	649,63	0,0181	6,4407	6,5121	5,9062	7,0467	367,31	1149,06
40	44,13	692	6,54	6,6791	795,60	0,0161	6,6474	6,7108	6,1091	7,2491	449,93	1406,84
41	70,17	2016	7,61	7,3995	1635,17	0,0182	7,3637	7,4352	6,8292	7,9697	924,45	2891,99
42	46,99	678	6,52	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
43	68,58	1604	7,38	7,3639	1577,98	0,0177	7,329	7,3988	6,7937	7,9341	892,21	2790,85
44	12,7	164	5,1	4,744	114,89	0,0502	4,6453	4,8426	4,1664	5,3216	64,48	204,71

45	34,29	483	6,18	6,2871	537,59	0,0207	6,2463	6,3278	5,7165	6,8577	303,84	951,18
46	53,34	928	6,83	6,9735	1067,95	0,0151	6,9437	7,0032	6,4036	7,5434	604,02	1888,24
47	55,25	767	6,64	7,028	1127,77	0,0152	6,998	7,058	6,4581	7,5979	637,85	1994,00
48	60,33	873	6,77	7,1647	1292,97	0,0159	7,1334	7,1959	6,5946	7,7347	731,14	2286,32
49	9,53	134	4,9	4,2971	73,49	0,0595	4,18	4,4141	3,716	4,8781	41,10	131,38
50	33,66	454	6,12	6,258	522,17	0,0212	6,2164	6,2996	5,6874	6,8287	295,13	923,99
51	49,21	859	6,76	6,8484	942,37	0,0152	6,8184	6,8783	6,2784	7,4183	532,94	1666,20
52	49,85	635	6,45	6,8683	961,31	0,0152	6,8384	6,8981	6,2983	7,4382	543,65	1699,69
53	46,04	579	6,36	6,7447	849,54	0,0157	6,7139	6,7756	6,1748	7,3147	480,49	1502,22
54	66,36	1371	7,22	7,3127	1499,22	0,0172	7,2789	7,3465	6,7426	7,8829	847,76	2651,55
55	73,66	2863	7,96	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
56	48,26	719	6,58	6,818	914,15	0,0153	6,7878	6,8481	6,248	7,3879	516,98	1616,31
57	12,07	189	5,24	4,6643	106,09	0,0518	4,5624	4,7662	4,0861	5,2425	59,51	189,14
58	56,52	854	6,75	7,0633	1168,29	0,0154	7,0331	7,0935	6,4934	7,6332	660,77	2065,65
59	16,51	193	5,26	5,1516	172,71	0,0418	5,0694	5,2337	4,5765	5,7266	97,17	306,92
60	36,2	453	6,12	6,3711	584,70	0,0195	6,3327	6,4094	5,8006	6,9415	330,50	1034,32
61	43,18	727	6,59	6,6452	769,08	0,0164	6,613	6,6774	6,0751	7,2152	434,89	1359,95
62	46,67	833	6,73	6,766	867,83	0,0156	6,7354	6,7966	6,1961	7,336	490,83	1534,56
63	43,18	574	6,35	6,6452	769,08	0,0164	6,613	6,6774	6,0751	7,2152	434,89	1359,95
64	49,21	652	6,48	6,8484	942,37	0,0152	6,8184	6,8783	6,2784	7,4183	532,94	1666,20
65	74,93	1578	7,36	7,5015	1810,76	0,0195	7,4632	7,5398	6,931	8,0719	1023,52	3203,18
66	40,96	516	6,25	6,5631	708,46	0,0172	6,5293	6,5969	5,993	7,1332	400,61	1252,88
67	41,91	581	6,36	6,5988	734,21	0,0168	6,5657	6,6319	6,0287	7,1689	415,17	1298,42
68	38,1	511	6,24	6,4507	633,15	0,0185	6,4144	6,487	5,8804	7,021	357,95	1119,91
69	41,28	575	6,35	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
70	13,65	183	5,21	4,8563	128,55	0,0478	4,7623	4,9504	4,2795	5,4332	72,20	228,88
71	50,8	797	6,68	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
72	52,07	840	6,73	6,936	1028,65	0,0151	6,9063	6,9657	6,3661	7,506	581,78	1818,92

73	40,64	545	6,3	6,551	699,94	0,0173	6,517	6,585	5,9808	7,1212	395,76	1237,94
74	45,09	611	6,42	6,7123	822,46	0,0159	6,681	6,7435	6,1423	7,2823	465,12	1454,33
75	60,64	1177	7,07	7,1728	1303,49	0,016	7,1414	7,2042	6,6028	7,7428	737,16	2304,92
76	43,5	598	6,39	6,6566	777,90	0,0163	6,6245	6,6886	6,0865	7,2266	439,88	1375,54
77	63,18	1094	7	7,2366	1389,36	0,0165	7,2042	7,2689	6,6665	7,8066	785,64	2456,76
78	78,11	2364	7,77	7,5659	1931,21	0,0204	7,5258	7,6061	6,9954	8,1365	1091,60	3416,94
79	71,12	2231	7,71	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
80	71,12	2457	7,81	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
81	76,2	1950	7,58	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21
82	78,42	2841	7,95	7,5723	1943,61	0,0205	7,5319	7,6126	7,0017	8,1428	1098,50	3438,53
83	71,12	2636	7,88	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
84	71,12	2832	7,95	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
85	64,14	1654	7,41	7,2598	1421,97	0,0167	7,227	7,2926	6,6897	7,8299	804,08	2514,68
86	64,77	1717	7,45	7,2751	1443,90	0,0168	7,242	7,3082	6,705	7,8452	816,48	2553,45
87	66,68	1841	7,52	7,3201	1510,35	0,0173	7,2862	7,3541	6,75	7,8903	854,06	2671,25
88	68,58	2052	7,63	7,3639	1577,98	0,0177	7,329	7,3988	6,7937	7,9341	892,21	2790,85
89	68,9	2233	7,71	7,3711	1589,38	0,0178	7,336	7,4061	6,8009	7,9413	898,66	2811,01
90	69,53	2409	7,79	7,3853	1612,11	0,018	7,3499	7,4207	6,8151	7,9556	911,51	2851,50
91	73,66	6018	8,7	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
92	74,61	6242	8,74	7,4949	1798,84	0,0194	7,4567	7,533	6,9245	8,0653	1016,89	3182,11
93	71,12	1217	7,1	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
94	85,09	3429	8,14	7,699	2206,14	0,0225	7,6549	7,7432	7,1282	8,2699	1246,63	3904,56
95	80,65	3153	8,06	7,6157	2029,82	0,0211	7,5741	7,6573	7,045	8,1863	1147,11	3591,41
96	53,34	774	6,65	6,9735	1067,95	0,0151	6,9437	7,0032	6,4036	7,5434	604,02	1888,24
97	36,83	472	6,16	6,3981	600,70	0,0191	6,3604	6,4357	5,8277	6,9685	339,58	1062,63
98	50,8	788	6,67	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
99	64,45	1357	7,21	7,2675	1432,96	0,0167	7,2346	7,3004	6,6974	7,8376	810,30	2534,12
100	68,58	2062	7,63	7,3639	1577,98	0,0177	7,329	7,3988	6,7937	7,9341	892,21	2790,85

101	47,63	656	6,49	6,7974	895,52	0,0154	6,7671	6,8277	6,2275	7,3674	506,49	1583,51
102	66,68	1196	7,09	7,3201	1510,35	0,0173	7,2862	7,3541	6,75	7,8903	854,06	2671,25
103	70,8	1293	7,16	7,4135	1658,22	0,0183	7,3774	7,4495	6,8432	7,9837	937,48	2932,76
104	73,34	1629	7,4	7,4682	1751,45	0,019	7,4308	7,5056	6,8978	8,0386	990,09	3098,27
105	73,66	1761	7,47	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
106	33,02	456	6,12	6,2284	506,94	0,0216	6,1859	6,2709	5,6577	6,7992	286,49	897,13
107	44,45	671	6,51	6,6902	804,48	0,016	6,6587	6,7218	6,1202	7,2602	454,96	1422,54
108	53,02	816	6,7	6,9642	1058,07	0,0151	6,9345	6,9939	6,3943	7,5341	598,42	1870,76
109	69,22	1217	7,1	7,3782	1600,71	0,0179	7,343	7,4134	6,808	7,9485	905,06	2831,32
110	75,88	2070	7,64	7,5211	1846,60	0,0198	7,4822	7,56	6,9506	8,0916	1043,78	3266,91
111	36,83	543	6,3	6,3981	600,70	0,0191	6,3604	6,4357	5,8277	6,9685	339,58	1062,63
112	33,66	477	6,17	6,258	522,17	0,0212	6,2164	6,2996	5,6874	6,8287	295,13	923,99
113	65,09	1337	7,2	7,2827	1454,91	0,0169	7,2495	7,3159	6,7126	7,8528	822,71	2572,93
114	61,6	1083	6,99	7,197	1335,42	0,0161	7,1653	7,2288	6,627	7,767	755,21	2361,38
115	38,42	558	6,32	6,4636	641,37	0,0183	6,4276	6,4996	5,8934	7,0339	362,64	1134,45
116	41,28	622	6,43	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
117	10,16	135	4,91	4,3973	81,23	0,0574	4,2844	4,5102	3,8171	4,9776	45,47	145,13
118	53,34	898	6,8	6,9735	1067,95	0,0151	6,9437	7,0032	6,4036	7,5434	604,02	1888,24
119	53,02	766	6,64	6,9642	1058,07	0,0151	6,9345	6,9939	6,3943	7,5341	598,42	1870,76
120	57,15	872	6,77	7,0807	1188,80	0,0154	7,0503	7,111	6,5107	7,6506	672,30	2101,91
121	10,8	142	4,96	4,4915	89,26	0,0554	4,3825	4,6005	3,912	5,071	50,00	159,33
122	58,42	899	6,8	7,1148	1230,04	0,0156	7,0841	7,1455	6,5448	7,6848	695,62	2175,03
123	45,4	647	6,47	6,7232	831,47	0,0158	6,6921	6,7543	6,1532	7,2932	470,22	1470,27
124	44,77	570	6,35	6,7013	813,46	0,016	6,6699	6,7327	6,1313	7,2713	460,03	1438,42
125	74,93	2179	7,69	7,5015	1810,76	0,0195	7,4632	7,5398	6,931	8,0719	1023,52	3203,18
126	76,2	2631	7,88	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21
127	78,11	1952	7,58	7,5659	1931,21	0,0204	7,5258	7,6061	6,9954	8,1365	1091,60	3416,94
128	82,23	2857	7,96	7,646	2092,26	0,0216	7,6034	7,6885	7,0752	8,2167	1182,28	3702,26

129	83,19	3639	8,2	7,6638	2129,84	0,0219	7,6208	7,7069	7,0931	8,2346	1203,63	3769,13
130	59,69	1615	7,39	7,1482	1271,81	0,0158	7,1172	7,1793	6,5782	7,7182	719,24	2248,91
131	61,6	1678	7,43	7,197	1335,42	0,0161	7,1653	7,2288	6,627	7,767	755,21	2361,38
132	70,49	1664	7,42	7,4065	1646,65	0,0182	7,3706	7,4424	6,8362	7,9767	930,94	2912,30
133	75,88	2495	7,82	7,5211	1846,60	0,0198	7,4822	7,56	6,9506	8,0916	1043,78	3266,91
134	77,47	3277	8,09	7,5533	1907,03	0,0202	7,5135	7,593	6,9827	8,1238	1077,82	3373,82
135	81,92	3431	8,14	7,6399	2079,54	0,0215	7,5976	7,6823	7,0692	8,2107	1175,21	3680,12
136	65,41	1341	7,2	7,2903	1466,01	0,017	7,2569	7,3236	6,7201	7,8604	828,90	2592,56
137	48,9	774	6,65	6,8383	932,90	0,0153	6,8083	6,8683	6,2684	7,4082	527,63	1649,45
138	64,14	1286	7,16	7,2598	1421,97	0,0167	7,227	7,2926	6,6897	7,8299	804,08	2514,68
139	37,47	481	6,18	6,4246	616,83	0,0188	6,3877	6,4616	5,8543	6,995	348,73	1091,16
140	52,07	797	6,68	6,936	1028,65	0,0151	6,9063	6,9657	6,3661	7,506	581,78	1818,92
141	74,3	1468	7,29	7,4883	1787,01	0,0193	7,4503	7,5262	6,9178	8,0587	1010,10	3161,18
142	76,2	1631	7,4	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21
143	78,74	1752	7,47	7,5785	1955,69	0,0206	7,538	7,619	7,0079	8,1491	1105,33	3460,26
144	82,55	2305	7,74	7,6519	2104,64	0,0217	7,6092	7,6946	7,0812	8,2227	1189,39	3724,55
145	81,92	2422	7,79	7,6399	2079,54	0,0215	7,5976	7,6823	7,0692	8,2107	1175,21	3680,12
146	41,91	664	6,5	6,5988	734,21	0,0168	6,5657	6,6319	6,0287	7,1689	415,17	1298,42
147	66,04	1545	7,34	7,3053	1488,17	0,0171	7,2716	7,3389	6,7351	7,8754	841,43	2631,74
148	34,93	448	6,1	6,3156	553,13	0,0203	6,2756	6,3555	5,745	6,8861	312,62	978,58
149	46,99	663	6,5	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
150	72,39	1405	7,25	7,4479	1716,26	0,0188	7,411	7,4848	6,8776	8,0182	970,29	3035,71
151	72,71	1402	7,25	7,4547	1727,97	0,0189	7,4176	7,4918	6,8843	8,0251	976,82	3056,73
152	77,47	2501	7,82	7,5533	1907,03	0,0202	7,5135	7,593	6,9827	8,1238	1077,82	3373,82
153	49,53	876	6,78	6,8583	951,75	0,0152	6,8284	6,8882	6,2884	7,4283	538,29	1682,94
154	54,93	1063	6,97	7,019	1117,67	0,0152	6,9891	7,049	6,4491	7,589	632,13	1976,34
155	48,58	627	6,44	6,8282	923,53	0,0153	6,7981	6,8582	6,2582	7,3981	522,28	1632,88
156	45,72	670	6,51	6,734	840,50	0,0157	6,703	6,765	6,164	7,304	475,33	1486,23

157	64,45	1279	7,15	7,2675	1432,96	0,0167	7,2346	7,3004	6,6974	7,8376	810,30	2534,12
158	12,7	166	5,11	4,744	114,89	0,0502	4,6453	4,8426	4,1664	5,3216	64,48	204,71
159	33,02	433	6,07	6,2284	506,94	0,0216	6,1859	6,2709	5,6577	6,7992	286,49	897,13
160	40,96	586	6,37	6,5631	708,46	0,0172	6,5293	6,5969	5,993	7,1332	400,61	1252,88
161	54,61	908	6,81	7,01	1107,65	0,0152	6,9802	7,0399	6,4401	7,58	626,47	1958,63
162	39,37	515	6,24	6,5017	666,27	0,0178	6,4666	6,5368	5,9315	7,0719	376,72	1178,38
163	11,43	141	4,95	4,5803	97,54	0,0536	4,4749	4,6857	4,0015	5,1591	54,68	174,01
164	47,63	659	6,49	6,7974	895,52	0,0154	6,7671	6,8277	6,2275	7,3674	506,49	1583,51
165	80,01	2402	7,78	7,6034	2005,00	0,021	7,5622	7,6446	7,0328	8,174	1133,20	3547,51
166	84,77	3544	8,17	7,6932	2193,38	0,0224	7,6492	7,7372	7,1224	8,2641	1239,42	3881,98
167	86,68	4265	8,36	7,7277	2270,37	0,0229	7,6827	7,7728	7,1568	8,2987	1282,80	4018,64
168	67,31	2203	7,7	7,3349	1532,87	0,0174	7,3006	7,3691	6,7647	7,905	866,71	2710,80
169	66,89	2282	7,73	7,3251	1517,93	0,0173	7,291	7,3591	6,7549	7,8952	858,25	2684,37
170	67,95	2345	7,76	7,3495	1555,42	0,0176	7,3149	7,384	6,7793	7,9196	879,45	2750,67
171	80,65	1925	7,56	7,6157	2029,82	0,0211	7,5741	7,6573	7,045	8,1863	1147,11	3591,41
172	81,28	2283	7,73	7,6279	2054,73	0,0213	7,5859	7,6698	7,0572	8,1985	1161,19	3635,49
173	83,5	2830	7,95	7,6698	2142,65	0,022	7,6265	7,713	7,099	8,2405	1210,76	3791,44
174	85,41	3551	8,17	7,7048	2218,97	0,0226	7,6605	7,7492	7,1339	8,2757	1253,76	3927,27
175	78,11	2485	7,82	7,5659	1931,21	0,0204	7,5258	7,6061	6,9954	8,1365	1091,60	3416,94
176	80,33	3499	8,16	7,6095	2017,27	0,0211	7,5681	7,6509	7,0389	8,1802	1140,13	3569,57
177	60,96	1208	7,1	7,1809	1314,09	0,016	7,1494	7,2124	6,6109	7,7509	743,15	2323,66
178	62,23	1587	7,37	7,213	1356,96	0,0163	7,181	7,2449	6,6429	7,783	767,32	2399,46
179	73,66	2126	7,66	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
180	73,66	2454	7,81	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
181	50,8	758	6,63	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
182	56,52	952	6,86	7,0633	1168,29	0,0154	7,0331	7,0935	6,4934	7,6332	660,77	2065,65
183	74,3	2245	7,72	7,4883	1787,01	0,0193	7,4503	7,5262	6,9178	8,0587	1010,10	3161,18
184	74,93	2375	7,77	7,5015	1810,76	0,0195	7,4632	7,5398	6,931	8,0719	1023,52	3203,18

185	36,83	507	6,23	6,3981	600,70	0,0191	6,3604	6,4357	5,8277	6,9685	339,58	1062,63
186	50,17	823	6,71	6,8781	970,78	0,0152	6,8483	6,9079	6,3082	7,4481	549,06	1716,60
187	55,25	953	6,86	7,028	1127,77	0,0152	6,998	7,058	6,4581	7,5979	637,85	1994,00
188	57,15	1015	6,92	7,0807	1188,80	0,0154	7,0503	7,111	6,5107	7,6506	672,30	2101,91
189	72,71	2507	7,83	7,4547	1727,97	0,0189	7,4176	7,4918	6,8843	8,0251	976,82	3056,73
190	43,18	665	6,5	6,6452	769,08	0,0164	6,613	6,6774	6,0751	7,2152	434,89	1359,95
191	50,17	807	6,69	6,8781	970,78	0,0152	6,8483	6,9079	6,3082	7,4481	549,06	1716,60
192	55,88	948	6,85	7,0457	1147,91	0,0153	7,0157	7,0758	6,4758	7,6157	649,24	2029,82
193	31,75	419	6,04	6,1675	476,99	0,0226	6,1231	6,2119	5,5966	6,7384	269,51	844,21
194	42,55	634	6,45	6,6222	751,60	0,0166	6,5895	6,6548	6,0521	7,1923	425,00	1329,16
195	61,28	1087	6,99	7,189	1324,78	0,0161	7,1574	7,2206	6,619	7,759	749,20	2342,56
196	68,58	1690	7,43	7,3639	1577,98	0,0177	7,329	7,3988	6,7937	7,9341	892,21	2790,85
197	61,28	1253	7,13	7,189	1324,78	0,0161	7,1574	7,2206	6,619	7,759	749,20	2342,56
198	65,41	1688	7,43	7,2903	1466,01	0,017	7,2569	7,3236	6,7201	7,8604	828,90	2592,56
199	77,79	2510	7,83	7,5596	1919,08	0,0203	7,5197	7,5996	6,9891	8,1302	1084,74	3395,48
200	54,29	850	6,75	7,001	1097,73	0,0152	6,9711	7,0308	6,431	7,5709	620,79	1940,89
201	59,69	1037	6,94	7,1482	1271,81	0,0158	7,1172	7,1793	6,5782	7,7182	719,24	2248,91
202	50,48	764	6,64	6,8879	980,34	0,0151	6,8581	6,9177	6,318	7,4579	554,46	1733,50
203	59,69	964	6,87	7,1482	1271,81	0,0158	7,1172	7,1793	6,5782	7,7182	719,24	2248,91
204	12,7	143	4,96	4,744	114,89	0,0502	4,6453	4,8426	4,1664	5,3216	64,48	204,71
205	44,13	557	6,32	6,6791	795,60	0,0161	6,6474	6,7108	6,1091	7,2491	449,93	1406,84
206	27,31	382	5,95	5,9332	377,36	0,0266	5,8809	5,9855	5,3616	6,5047	213,07	668,28
207	10,16	136	4,91	4,3973	81,23	0,0574	4,2844	4,5102	3,8171	4,9776	45,47	145,13
208	46,99	661	6,49	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
209	43,82	662	6,5	6,6679	786,74	0,0162	6,636	6,6997	6,0978	7,2379	444,88	1391,17
210	67,95	2117	7,66	7,3495	1555,42	0,0176	7,3149	7,384	6,7793	7,9196	879,45	2750,67
211	70,49	2849	7,95	7,4065	1646,65	0,0182	7,3706	7,4424	6,8362	7,9767	930,94	2912,30
212	76,52	3720	8,22	7,534	1870,57	0,0199	7,4948	7,5733	6,9636	8,1045	1057,43	3309,33

213	73,98	2594	7,86	7,4816	1775,08	0,0192	7,4438	7,5194	6,9112	8,052	1003,45	3140,07
214	73,66	2704	7,9	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
215	66,68	1659	7,41	7,3201	1510,35	0,0173	7,2862	7,3541	6,75	7,8903	854,06	2671,25
216	66,68	1721	7,45	7,3201	1510,35	0,0173	7,2862	7,3541	6,75	7,8903	854,06	2671,25
217	72,07	3213	8,07	7,4411	1704,62	0,0187	7,4043	7,4778	6,8707	8,0114	963,62	3015,14
218	67,31	1306	7,17	7,3349	1532,87	0,0174	7,3006	7,3691	6,7647	7,905	866,71	2710,80
219	74,3	2312	7,75	7,4883	1787,01	0,0193	7,4503	7,5262	6,9178	8,0587	1010,10	3161,18
220	74,3	2451	7,8	7,4883	1787,01	0,0193	7,4503	7,5262	6,9178	8,0587	1010,10	3161,18
221	30,48	474	6,16	6,1041	447,69	0,0236	6,0576	6,1505	5,533	6,6751	252,90	792,43
222	45,72	790	6,67	6,734	840,50	0,0157	6,703	6,765	6,164	7,304	475,33	1486,23
223	50,8	919	6,82	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
224	53,34	985	6,89	6,9735	1067,95	0,0151	6,9437	7,0032	6,4036	7,5434	604,02	1888,24
225	40,64	639	6,46	6,551	699,94	0,0173	6,517	6,585	5,9808	7,1212	395,76	1237,94
226	43,82	707	6,56	6,6679	786,74	0,0162	6,636	6,6997	6,0978	7,2379	444,88	1391,17
227	46,99	781	6,66	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
228	53,02	933	6,84	6,9642	1058,07	0,0151	6,9345	6,9939	6,3943	7,5341	598,42	1870,76
229	60,33	1092	7	7,1647	1292,97	0,0159	7,1334	7,1959	6,5946	7,7347	731,14	2286,32
230	70,17	1613	7,39	7,3995	1635,17	0,0182	7,3637	7,4352	6,8292	7,9697	924,45	2891,99
231	71,76	1737	7,46	7,4342	1692,90	0,0186	7,3976	7,4708	6,8639	8,0045	957,09	2994,40
232	30,48	430	6,06	6,1041	447,69	0,0236	6,0576	6,1505	5,533	6,6751	252,90	792,43
233	41,28	645	6,47	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
234	48,26	790	6,67	6,818	914,15	0,0153	6,7878	6,8481	6,248	7,3879	516,98	1616,31
235	55,56	996	6,9	7,0369	1137,85	0,0153	7,0069	7,0669	6,467	7,6068	643,55	2011,83
236	66,04	1806	7,5	7,3053	1488,17	0,0171	7,2716	7,3389	6,7351	7,8754	841,43	2631,74
237	70,49	2415	7,79	7,4065	1646,65	0,0182	7,3706	7,4424	6,8362	7,9767	930,94	2912,30
238	57,79	875	6,77	7,0978	1209,30	0,0155	7,0673	7,1283	6,5279	7,6678	683,96	2138,37
239	78,42	1104	7,01	7,5723	1943,61	0,0205	7,5319	7,6126	7,0017	8,1428	1098,50	3438,53
240	80,65	1226	7,11	7,6157	2029,82	0,0211	7,5741	7,6573	7,045	8,1863	1147,11	3591,41

241	85,41	1456	7,28	7,7048	2218,97	0,0226	7,6605	7,7492	7,1339	8,2757	1253,76	3927,27
242	50,17	769	6,65	6,8781	970,78	0,0152	6,8483	6,9079	6,3082	7,4481	549,06	1716,60
243	36,83	446	6,1	6,3981	600,70	0,0191	6,3604	6,4357	5,8277	6,9685	339,58	1062,63
244	72,71	1615	7,39	7,4547	1727,97	0,0189	7,4176	7,4918	6,8843	8,0251	976,82	3056,73
245	11,43	157	5,06	4,5803	97,54	0,0536	4,4749	4,6857	4,0015	5,1591	54,68	174,01
246	40,96	571	6,35	6,5631	708,46	0,0172	6,5293	6,5969	5,993	7,1332	400,61	1252,88
247	62,87	1231	7,12	7,2287	1378,43	0,0164	7,1965	7,261	6,6587	7,7988	779,54	2437,68
248	52,07	710	6,57	6,936	1028,65	0,0151	6,9063	6,9657	6,3661	7,506	581,78	1818,92
249	57,15	825	6,72	7,0807	1188,80	0,0154	7,0503	7,111	6,5107	7,6506	672,30	2101,91
250	9,53	136	4,91	4,2971	73,49	0,0595	4,18	4,4141	3,716	4,8781	41,10	131,38
251	46,99	646	6,47	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
252	36,83	600	6,4	6,3981	600,70	0,0191	6,3604	6,4357	5,8277	6,9685	339,58	1062,63
253	70,49	2119	7,66	7,4065	1646,65	0,0182	7,3706	7,4424	6,8362	7,9767	930,94	2912,30
254	71,76	2345	7,76	7,4342	1692,90	0,0186	7,3976	7,4708	6,8639	8,0045	957,09	2994,40
255	77,79	2437	7,8	7,5596	1919,08	0,0203	7,5197	7,5996	6,9891	8,1302	1084,74	3395,48
256	77,79	2478	7,82	7,5596	1919,08	0,0203	7,5197	7,5996	6,9891	8,1302	1084,74	3395,48
257	81,6	3243	8,08	7,6339	2067,10	0,0214	7,5918	7,676	7,0632	8,2046	1168,18	3657,74
258	76,2	1923	7,56	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21
259	76,52	1981	7,59	7,534	1870,57	0,0199	7,4948	7,5733	6,9636	8,1045	1057,43	3309,33
260	67,31	1353	7,21	7,3349	1532,87	0,0174	7,3006	7,3691	6,7647	7,905	866,71	2710,80
261	32,39	432	6,07	6,1983	491,91	0,0221	6,1548	6,2417	5,6275	6,7691	277,97	870,53
262	46,99	748	6,62	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
263	64,77	1316	7,18	7,2751	1443,90	0,0168	7,242	7,3082	6,705	7,8452	816,48	2553,45
264	70,49	2022	7,61	7,4065	1646,65	0,0182	7,3706	7,4424	6,8362	7,9767	930,94	2912,30
265	70,8	2127	7,66	7,4135	1658,22	0,0183	7,3774	7,4495	6,8432	7,9837	937,48	2932,76
266	33,66	445	6,1	6,258	522,17	0,0212	6,2164	6,2996	5,6874	6,8287	295,13	923,99
267	45,09	668	6,5	6,7123	822,46	0,0159	6,681	6,7435	6,1423	7,2823	465,12	1454,33
268	76,2	2795	7,94	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21

269	24,77	425	6,05	5,7815	324,25	0,0294	5,7237	5,8393	5,2094	6,3536	182,98	574,56
270	34,29	640	6,46	6,2871	537,59	0,0207	6,2463	6,3278	5,7165	6,8577	303,84	951,18
271	41,28	780	6,66	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
272	43,82	842	6,74	6,6679	786,74	0,0162	6,636	6,6997	6,0978	7,2379	444,88	1391,17
273	46,99	934	6,84	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
274	68,26	1410	7,25	7,3567	1566,66	0,0177	7,322	7,3914	6,7865	7,9269	885,81	2770,82
275	74,3	2408	7,79	7,4883	1787,01	0,0193	7,4503	7,5262	6,9178	8,0587	1010,10	3161,18
276	57,15	921	6,83	7,0807	1188,80	0,0154	7,0503	7,111	6,5107	7,6506	672,30	2101,91
277	73,03	1425	7,26	7,4615	1739,76	0,0189	7,4242	7,4987	6,8911	8,0318	983,48	3077,28
278	49,53	629	6,44	6,8583	951,75	0,0152	6,8284	6,8882	6,2884	7,4283	538,29	1682,94
279	48,26	730	6,59	6,818	914,15	0,0153	6,7878	6,8481	6,248	7,3879	516,98	1616,31
280	64,14	1224	7,11	7,2598	1421,97	0,0167	7,227	7,2926	6,6897	7,8299	804,08	2514,68
281	15,24	192	5,26	5,0272	152,51	0,0443	4,9401	5,1144	4,4515	5,603	85,76	271,24
282	53,34	939	6,84	6,9735	1067,95	0,0151	6,9437	7,0032	6,4036	7,5434	604,02	1888,24
283	40,64	533	6,28	6,551	699,94	0,0173	6,517	6,585	5,9808	7,1212	395,76	1237,94
284	9,53	127	4,84	4,2971	73,49	0,0595	4,18	4,4141	3,716	4,8781	41,10	131,38
285	46,99	635	6,45	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
286	80,96	2499	7,82	7,6218	2042,23	0,0212	7,58	7,6635	7,0511	8,1924	1154,13	3613,38
287	82,23	3164	8,06	7,646	2092,26	0,0216	7,6034	7,6885	7,0752	8,2167	1182,28	3702,26
288	72,71	2204	7,7	7,4547	1727,97	0,0189	7,4176	7,4918	6,8843	8,0251	976,82	3056,73
289	73,34	2335	7,76	7,4682	1751,45	0,019	7,4308	7,5056	6,8978	8,0386	990,09	3098,27
290	64,45	1694	7,43	7,2675	1432,96	0,0167	7,2346	7,3004	6,6974	7,8376	810,30	2534,12
291	66,04	1910	7,55	7,3053	1488,17	0,0171	7,2716	7,3389	6,7351	7,8754	841,43	2631,74
292	66,99	2059	7,63	7,3275	1521,57	0,0173	7,2934	7,3616	6,7574	7,8977	860,40	2691,09
293	31,75	414	6,03	6,1675	476,99	0,0226	6,1231	6,2119	5,5966	6,7384	269,51	844,21
294	48,26	730	6,59	6,818	914,15	0,0153	6,7878	6,8481	6,248	7,3879	516,98	1616,31
295	71,12	1402	7,25	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
296	45,09	660	6,49	6,7123	822,46	0,0159	6,681	6,7435	6,1423	7,2823	465,12	1454,33

297	73,66	1519	7,33	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
298	79,38	2787	7,93	7,591	1980,29	0,0208	7,5502	7,6319	7,0204	8,1616	1119,23	3503,79
299	38,1	557	6,32	6,4507	633,15	0,0185	6,4144	6,487	5,8804	7,021	357,95	1119,91
300	38,74	568	6,34	6,4764	649,63	0,0181	6,4407	6,5121	5,9062	7,0467	367,31	1149,06
301	47,63	672	6,51	6,7974	895,52	0,0154	6,7671	6,8277	6,2275	7,3674	506,49	1583,51
302	56,2	876	6,78	7,0545	1158,06	0,0153	7,0244	7,0847	6,4846	7,6245	654,98	2047,76
303	57,15	1260	7,14	7,0807	1188,80	0,0154	7,0503	7,111	6,5107	7,6506	672,30	2101,91
304	66,68	1602	7,38	7,3201	1510,35	0,0173	7,2862	7,3541	6,75	7,8903	854,06	2671,25
305	53,98	782	6,66	6,9919	1087,79	0,0152	6,9621	7,0217	6,4219	7,5618	615,17	1923,30
306	73,66	1521	7,33	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
307	49,53	697	6,55	6,8583	951,75	0,0152	6,8284	6,8882	6,2884	7,4283	538,29	1682,94
308	37,47	496	6,21	6,4246	616,83	0,0188	6,3877	6,4616	5,8543	6,995	348,73	1091,16
309	45,09	658	6,49	6,7123	822,46	0,0159	6,681	6,7435	6,1423	7,2823	465,12	1454,33
310	46,99	697	6,55	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
311	14,61	189	5,24	4,9611	142,75	0,0457	4,8713	5,0509	4,3849	5,5373	80,23	253,99
312	58,1	936	6,84	7,1063	1219,63	0,0156	7,0758	7,1369	6,5364	7,6763	689,80	2156,63
313	46,99	705	6,56	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
314	51,44	820	6,71	6,917	1009,29	0,0151	6,8873	6,9467	6,3471	7,4869	570,83	1784,51
315	81,92	2814	7,94	7,6399	2079,54	0,0215	7,5976	7,6823	7,0692	8,2107	1175,21	3680,12
316	73,66	1654	7,41	7,4749	1763,23	0,0191	7,4373	7,5125	6,9045	8,0453	996,75	3119,10
317	76,84	1889	7,54	7,5405	1882,77	0,02	7,5011	7,5799	6,97	8,111	1064,22	3330,91
318	78,11	1975	7,59	7,5659	1931,21	0,0204	7,5258	7,6061	6,9954	8,1365	1091,60	3416,94
319	80,96	2328	7,75	7,6218	2042,23	0,0212	7,58	7,6635	7,0511	8,1924	1154,13	3613,38
320	81,6	2357	7,77	7,6339	2067,10	0,0214	7,5918	7,676	7,0632	8,2046	1168,18	3657,74
321	83,82	3032	8,02	7,6757	2155,33	0,0221	7,6322	7,7191	7,1049	8,2465	1217,92	3814,25
322	83,82	2515	7,83	7,6757	2155,33	0,0221	7,6322	7,7191	7,1049	8,2465	1217,92	3814,25
323	75,57	2978	8	7,5146	1834,63	0,0197	7,4759	7,5533	6,9441	8,085	1037,01	3245,42
324	75,88	3166	8,06	7,5211	1846,60	0,0198	7,4822	7,56	6,9506	8,0916	1043,78	3266,91

325	20,32	379	5,94	5,4742	238,46	0,0353	5,4047	5,5436	4,9008	6,0475	134,40	423,05
326	33,66	594	6,39	6,258	522,17	0,0212	6,2164	6,2996	5,6874	6,8287	295,13	923,99
327	41,28	734	6,6	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
328	48,26	888	6,79	6,818	914,15	0,0153	6,7878	6,8481	6,248	7,3879	516,98	1616,31
329	71,76	1776	7,48	7,4342	1692,90	0,0186	7,3976	7,4708	6,8639	8,0045	957,09	2994,40
330	44,77	650	6,48	6,7013	813,46	0,016	6,6699	6,7327	6,1313	7,2713	460,03	1438,42
331	59,69	980	6,89	7,1482	1271,81	0,0158	7,1172	7,1793	6,5782	7,7182	719,24	2248,91
332	71,12	1627	7,39	7,4204	1669,70	0,0184	7,3842	7,4566	6,8501	7,9907	943,98	2953,36
333	60,64	872	6,77	7,1728	1303,49	0,016	7,1414	7,2042	6,6028	7,7428	737,16	2304,92
334	70,49	1196	7,09	7,4065	1646,65	0,0182	7,3706	7,4424	6,8362	7,9767	930,94	2912,30
335	41,28	547	6,3	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
336	51,75	651	6,48	6,9265	1018,92	0,0151	6,8968	6,9562	6,3566	7,4965	576,28	1801,73
337	52,07	693	6,54	6,936	1028,65	0,0151	6,9063	6,9657	6,3661	7,506	581,78	1818,92
338	14,29	181	5,2	4,927	137,96	0,0464	4,8358	5,0182	4,3506	5,5034	77,52	245,53
339	41,91	585	6,37	6,5988	734,21	0,0168	6,5657	6,6319	6,0287	7,1689	415,17	1298,42
340	34,93	469	6,15	6,3156	553,13	0,0203	6,2756	6,3555	5,745	6,8861	312,62	978,58
341	54,93	876	6,78	7,019	1117,67	0,0152	6,9891	7,049	6,4491	7,589	632,13	1976,34
342	43,5	538	6,29	6,6566	777,90	0,0163	6,6245	6,6886	6,0865	7,2266	439,88	1375,54
343	67,31	2016	7,61	7,3349	1532,87	0,0174	7,3006	7,3691	6,7647	7,905	866,71	2710,80
344	68,26	2242	7,72	7,3567	1566,66	0,0177	7,322	7,3914	6,7865	7,9269	885,81	2770,82
345	67,31	1493	7,31	7,3349	1532,87	0,0174	7,3006	7,3691	6,7647	7,905	866,71	2710,80
346	67,95	1547	7,34	7,3495	1555,42	0,0176	7,3149	7,384	6,7793	7,9196	879,45	2750,67
347	76,2	2081	7,64	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21
348	24,13	366	5,9	5,7411	311,41	0,0301	5,6819	5,8004	5,1689	6,3134	175,72	551,92
349	34,93	581	6,36	6,3156	553,13	0,0203	6,2756	6,3555	5,745	6,8861	312,62	978,58
350	41,66	721	6,58	6,5894	727,34	0,0169	6,5561	6,6226	6,0193	7,1595	411,29	1286,27
351	46,99	875	6,77	6,7766	877,08	0,0155	6,7461	6,8071	6,2066	7,3465	496,01	1550,76
352	35,56	528	6,27	6,3436	568,84	0,0199	6,3044	6,3827	5,7731	6,914	321,53	1006,26

<b>353</b>	<b>59,37</b>	<b>1185</b>	7,08	7,1399	1261,30	0,0157	7,109	7,1709	6,5699	7,7099	713,30	2230,32
<b>354</b>	<b>41,91</b>	<b>614</b>	6,42	6,5988	734,21	0,0168	6,5657	6,6319	6,0287	7,1689	415,17	1298,42
<b>355</b>	<b>47,94</b>	<b>640</b>	6,46	6,8077	904,79	0,0154	6,7775	6,838	6,2378	7,3777	511,73	1599,91
<b>356</b>	<b>68,26</b>	<b>1206</b>	7,1	7,3567	1566,66	0,0177	7,322	7,3914	6,7865	7,9269	885,81	2770,82
<b>357</b>	<b>17,15</b>	<b>192</b>	5,26	5,2102	183,13	0,0406	5,1304	5,29	4,6355	5,7849	103,08	325,35
<b>358</b>	<b>45,4</b>	<b>596</b>	6,39	6,7232	831,47	0,0158	6,6921	6,7543	6,1532	7,2932	470,22	1470,27
<b>359</b>	<b>69,22</b>	<b>1256</b>	7,14	7,3782	1600,71	0,0179	7,343	7,4134	6,808	7,9485	905,06	2831,32
<b>360</b>	<b>41,28</b>	<b>516</b>	6,25	6,5751	717,02	0,017	6,5416	6,6086	6,005	7,1452	405,45	1268,00
<b>361</b>	<b>50,8</b>	<b>712</b>	6,57	6,8977	990,00	0,0151	6,8679	6,9274	6,3278	7,4676	559,92	1750,40
<b>362</b>	<b>86,36</b>	<b>2577</b>	7,85	7,722	2257,47	0,0228	7,6771	7,7669	7,1511	8,2929	1275,51	3995,40
<b>363</b>	<b>87,63</b>	<b>2880</b>	7,97	7,7447	2309,30	0,0232	7,6991	7,7903	7,1737	8,3157	1304,66	4087,55
<b>364</b>	<b>90,17</b>	<b>3482</b>	8,16	7,7891	2414,14	0,0239	7,742	7,8362	7,218	8,3602	1363,76	4273,55
<b>365</b>	<b>92,08</b>	<b>4147</b>	8,33	7,8216	2493,89	0,0245	7,7734	7,8698	7,2504	8,3928	1408,67	4415,16
<b>366</b>	<b>76,2</b>	<b>2437</b>	7,8	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21
<b>367</b>	<b>76,2</b>	<b>2625</b>	7,87	7,5276	1858,64	0,0199	7,4886	7,5666	6,9571	8,0981	1050,58	3288,21

**Annexure 4:** Prediction interval for age of an individual male sable antelope as explained by the maximum horn measurement of the individual

Obs	MAX_Length_cm	Age in days	Dependent	Predicted	Predicted	Std	95% CL Mean		95% CL Predict		95% CL Predict	
			Variable	Value	Value	Error						
	Observed	Observed	In(Age in days in column C)	for Age using the regression model	for Age after transforming the ln values in column E to real age in days	Mean			Predicted confidence limits in LN		Predicted confidence limits in real age days	
						Predict			for individual horn lengths		for individual horn lengths	
									Lower limit	Upper limit	Lower limit	Upper limit
1	35,24	410	6,02	5,9787	394,93	0,0102	5,9586	5,9987	5,7272	6,2301	307,11	507,81
2	37,47	442	6,09	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
3	64,14	821	6,71	6,7426	847,76	0,006034	6,7307	6,7544	6,4917	6,9935	659,64	1089,53
4	93,35	1235	7,12	7,2214	1368,40	0,007029	7,2076	7,2352	6,9704	7,4724	1064,65	1758,82
5	34,29	434	6,07	5,9437	381,34	0,0105	5,9231	5,9643	5,6922	6,1952	296,55	490,39
6	98,11	1512	7,32	7,2849	1458,12	0,007371	7,2704	7,2994	7,0339	7,536	1134,45	1874,32
7	43,18	477	6,17	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
8	102,24	1792	7,49	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
9	41,91	437	6,08	6,1997	492,60	0,008562	6,1829	6,2166	5,9485	6,4509	383,18	633,27
10	109,22	1674	7,42	7,4218	1672,04	0,008216	7,4057	7,438	7,1707	7,673	1300,75	2149,52
11	102,24	1515	7,32	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
12	65,41	765	6,64	6,7676	869,22	0,006003	6,7558	6,7794	6,5167	7,0185	676,34	1117,11
13	87,95	1122	7,02	7,1454	1268,26	0,00667	7,1323	7,1585	6,8945	7,3964	986,83	1630,11
14	104,14	1455	7,28	7,361	1573,41	0,007825	7,3457	7,3764	7,1099	7,6122	1224,03	2022,72

15	107	1711	7,44	7,3956	1628,80	0,008044	7,3798	7,4114	7,1444	7,6467	1266,99	2093,72
16	107,63	1798	7,49	7,4031	1641,06	0,008093	7,3872	7,419	7,152	7,6543	1276,66	2109,70
17	107,95	1906	7,55	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
18	33,02	426	6,05	5,8956	363,43	0,0109	5,8742	5,9169	5,644	6,1471	282,59	467,36
19	60,96	805	6,69	6,6778	794,57	0,006159	6,6657	6,6899	6,4269	6,9287	618,25	1021,17
20	97,16	1493	7,31	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
21	100,33	1816	7,5	7,3135	1500,42	0,007536	7,2987	7,3283	7,0624	7,5646	1167,24	1928,70
22	36,2	438	6,08	6,0127	408,59	0,009937	5,9932	6,0322	5,7613	6,2641	317,76	525,37
23	95,89	1513	7,32	7,2557	1416,15	0,007209	7,2415	7,2698	7,0046	7,5067	1101,69	1820,20
24	40,96	509	6,23	6,1704	478,38	0,008767	6,1532	6,1876	5,9192	6,4216	372,11	614,99
25	95,89	1296	7,17	7,2557	1416,15	0,007209	7,2415	7,2698	7,0046	7,5067	1101,69	1820,20
26	107,95	1884	7,54	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
27	31,43	344	5,84	5,8327	341,28	0,0114	5,8104	5,8551	5,5811	6,0843	265,36	438,91
28	100,97	1318	7,18	7,3215	1512,47	0,007584	7,3066	7,3364	7,0705	7,5726	1176,74	1944,19
29	102,87	1375	7,23	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
30	39,37	429	6,06	6,12	454,86	0,00913	6,102	6,1379	5,8687	6,3713	353,79	584,82
31	106,68	1454	7,28	7,3918	1622,62	0,00802	7,376	7,4076	7,1407	7,6429	1262,31	2085,78
32	109,22	1658	7,41	7,4218	1672,04	0,008216	7,4057	7,438	7,1707	7,673	1300,75	2149,52
33	109,54	1494	7,31	7,4255	1678,24	0,008241	7,4093	7,4417	7,1744	7,6767	1305,58	2157,49
34	110,49	1556	7,35	7,4366	1696,97	0,008315	7,4202	7,4529	7,1854	7,6877	1320,02	2181,35
35	113,35	1688	7,43	7,4691	1753,03	0,008537	7,4524	7,4859	7,2179	7,7203	1363,62	2253,64
36	114,3	1845	7,52	7,4798	1771,89	0,008611	7,4629	7,4967	7,2286	7,731	1378,29	2277,88
37	114,94	1883	7,54	7,4869	1784,51	0,00866	7,4699	7,5039	7,2357	7,7381	1388,11	2294,11
38	114,94	2054	7,63	7,4869	1784,51	0,00866	7,4699	7,5039	7,2357	7,7381	1388,11	2294,11
39	113,03	2332	7,75	7,4656	1746,90	0,008512	7,4488	7,4823	7,2144	7,7168	1358,86	2245,76
40	61,6	735	6,6	6,691	805,13	0,006128	6,679	6,7031	6,4401	6,9419	626,47	1034,73
41	83,82	1092	7	7,0841	1192,85	0,006427	7,0715	7,0967	6,8331	7,3351	928,06	1533,18
42	100,33	1425	7,26	7,3135	1500,42	0,007536	7,2987	7,3283	7,0624	7,5646	1167,24	1928,70

43	103,19	1538	7,34	7,3493	1555,11	0,007752	7,3341	7,3646	7,0982	7,6004	1209,79	1999,00
44	104,46	2175	7,68	7,3649	1579,56	0,007849	7,3495	7,3804	7,1138	7,616	1228,81	2030,42
45	34,54	412	6,02	5,9531	384,94	0,0104	5,9327	5,9736	5,7017	6,2046	299,38	495,02
46	60,96	791	6,67	6,6778	794,57	0,006159	6,6657	6,6899	6,4269	6,9287	618,25	1021,17
47	99,7	1483	7,3	7,3054	1488,32	0,007489	7,2907	7,3201	7,0543	7,5565	1157,83	1913,14
48	101,6	1604	7,38	7,3295	1524,62	0,007632	7,3145	7,3445	7,0785	7,5806	1186,19	1959,80
49	102,55	1699	7,44	7,3414	1542,87	0,007704	7,3263	7,3566	7,0904	7,5925	1200,39	1983,27
50	103,82	1800	7,5	7,3572	1567,44	0,0078	7,3418	7,3725	7,106	7,6083	1219,26	2014,85
51	104,14	1877	7,54	7,361	1573,41	0,007825	7,3457	7,3764	7,1099	7,6122	1224,03	2022,72
52	33,66	429	6,06	5,9199	372,37	0,0107	5,8989	5,9408	5,6684	6,1714	289,57	478,86
53	100,97	1507	7,32	7,3215	1512,47	0,007584	7,3066	7,3364	7,0705	7,5726	1176,74	1944,19
54	105,41	1873	7,54	7,3765	1597,99	0,007922	7,3609	7,3921	7,1254	7,6276	1243,15	2054,11
55	33,02	407	6,01	5,8956	363,43	0,0109	5,8742	5,9169	5,644	6,1471	282,59	467,36
56	40,64	482	6,18	6,1605	473,66	0,008838	6,1431	6,1779	5,9093	6,4117	368,45	608,93
57	98,11	1797	7,49	7,2849	1458,12	0,007371	7,2704	7,2994	7,0339	7,536	1134,45	1874,32
58	30,8	370	5,91	5,8067	332,52	0,0116	5,7839	5,8294	5,555	6,0583	258,53	427,65
59	101,6	1406	7,25	7,3295	1524,62	0,007632	7,3145	7,3445	7,0785	7,5806	1186,19	1959,80
60	38,1	436	6,08	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
61	102,87	2042	7,62	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
62	34,29	392	5,97	5,9437	381,34	0,0105	5,9231	5,9643	5,6922	6,1952	296,55	490,39
63	97,16	1306	7,17	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
64	98,43	1326	7,19	7,289	1464,11	0,007394	7,2745	7,3036	7,038	7,5401	1139,11	1882,02
65	106,36	1552	7,35	7,388	1616,47	0,007995	7,3723	7,4037	7,1369	7,6391	1257,52	2077,87
66	105,41	1675	7,42	7,3765	1597,99	0,007922	7,3609	7,3921	7,1254	7,6276	1243,15	2054,11
67	107,95	1794	7,49	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
68	36,83	437	6,08	6,0349	417,76	0,009766	6,0157	6,0541	5,7835	6,2863	324,89	537,16
69	66,04	816	6,7	6,7799	879,98	0,005991	6,7682	6,7917	6,529	7,0308	684,71	1130,93
70	104,78	1508	7,32	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36

71	109,06	1787	7,49	7,42	1669,03	0,008204	7,4038	7,4361	7,1688	7,6711	1298,29	2145,44
72	40,64	426	6,05	6,1605	473,66	0,008838	6,1431	6,1779	5,9093	6,4117	368,45	608,93
73	102,55	1501	7,31	7,3414	1542,87	0,007704	7,3263	7,3566	7,0904	7,5925	1200,39	1983,27
74	104,78	1607	7,38	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36
75	109,86	1977	7,59	7,4292	1684,46	0,008266	7,413	7,4455	7,178	7,6804	1310,29	2165,49
76	34,29	424	6,05	5,9437	381,34	0,0105	5,9231	5,9643	5,6922	6,1952	296,55	490,39
77	109,86	1503	7,32	7,4292	1684,46	0,008266	7,413	7,4455	7,178	7,6804	1310,29	2165,49
78	113,35	1642	7,4	7,4691	1753,03	0,008537	7,4524	7,4859	7,2179	7,7203	1363,62	2253,64
79	114,14	1689	7,43	7,478	1768,70	0,008598	7,4611	7,4949	7,2268	7,7292	1375,81	2273,78
80	117,16	1802	7,5	7,5113	1828,59	0,008832	7,494	7,5287	7,2601	7,7626	1422,40	2351,01
81	118,75	2076	7,64	7,5285	1860,31	0,008955	7,5109	7,5461	7,2772	7,7797	1446,93	2391,56
82	40,64	471	6,15	6,1605	473,66	0,008838	6,1431	6,1779	5,9093	6,4117	368,45	608,93
83	102,55	1444	7,28	7,3414	1542,87	0,007704	7,3263	7,3566	7,0904	7,5925	1200,39	1983,27
84	106,68	1711	7,44	7,3918	1622,62	0,00802	7,376	7,4076	7,1407	7,6429	1262,31	2085,78
85	107,95	1481	7,3	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
86	29,53	370	5,91	5,7529	315,10	0,012	5,7293	5,7766	5,5012	6,0047	244,99	405,33
87	108,27	1580	7,37	7,4106	1653,42	0,008143	7,3946	7,4266	7,1595	7,6618	1286,27	2125,58
88	37,78	433	6,07	6,0675	431,60	0,009519	6,0488	6,0862	5,8161	6,3188	335,66	554,91
89	83,82	1130	7,03	7,0841	1192,85	0,006427	7,0715	7,0967	6,8331	7,3351	928,06	1533,18
90	30,48	350	5,86	5,7934	328,13	0,0117	5,7705	5,8164	5,5418	6,0451	255,14	422,04
91	99,7	1720	7,45	7,3054	1488,32	0,007489	7,2907	7,3201	7,0543	7,5565	1157,83	1913,14
92	101,92	1952	7,58	7,3335	1530,73	0,007656	7,3185	7,3486	7,0824	7,5846	1190,82	1967,66
93	96,2	1468	7,29	7,2599	1422,11	0,007232	7,2457	7,2741	7,0089	7,5109	1106,44	1827,86
94	34,29	446	6,1	5,9437	381,34	0,0105	5,9231	5,9643	5,6922	6,1952	296,55	490,39
95	85,73	1356	7,21	7,1128	1227,58	0,006535	7,0999	7,1256	6,8618	7,3637	955,08	1577,66
96	94,3	1839	7,52	7,2344	1386,31	0,007095	7,2204	7,2483	6,9834	7,4854	1078,58	1781,84
97	94,93	1909	7,55	7,2429	1398,14	0,00714	7,2289	7,257	6,9919	7,494	1087,79	1797,23
98	38,1	435	6,08	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88

99	67,31	814	6,7	6,8042	901,63	0,005974	6,7925	6,816	6,5533	7,0551	701,56	1158,75
100	90,49	1172	7,07	7,1818	1315,27	0,006834	7,1683	7,1952	6,9308	7,4328	1023,31	1690,53
101	101,6	1508	7,32	7,3295	1524,62	0,007632	7,3145	7,3445	7,0785	7,5806	1186,19	1959,80
102	101,92	1565	7,36	7,3335	1530,73	0,007656	7,3185	7,3486	7,0824	7,5846	1190,82	1967,66
103	37,47	437	6,08	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
104	100,65	1515	7,32	7,3175	1506,43	0,00756	7,3027	7,3324	7,0664	7,5686	1171,92	1936,43
105	102,55	1618	7,39	7,3414	1542,87	0,007704	7,3263	7,3566	7,0904	7,5925	1200,39	1983,27
106	37,47	411	6,02	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
107	97,16	1493	7,31	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
108	37,78	454	6,12	6,0675	431,60	0,009519	6,0488	6,0862	5,8161	6,3188	335,66	554,91
109	26,67	372	5,92	5,6231	276,75	0,0131	5,5973	5,6489	5,3711	5,875	215,10	356,02
110	99,7	1393	7,24	7,3054	1488,32	0,007489	7,2907	7,3201	7,0543	7,5565	1157,83	1913,14
111	35,24	418	6,04	5,9787	394,93	0,0102	5,9586	5,9987	5,7272	6,2301	307,11	507,81
112	83,19	1116	7,02	7,0744	1181,33	0,006393	7,0618	7,087	6,8235	7,3254	919,20	1518,38
113	39,37	452	6,11	6,12	454,86	0,00913	6,102	6,1379	5,8687	6,3713	353,79	584,82
114	93,98	1226	7,11	7,2301	1380,36	0,007073	7,2162	7,244	6,9791	7,4811	1073,95	1774,19
115	96,84	1302	7,17	7,2683	1434,11	0,007278	7,254	7,2826	7,0172	7,5193	1115,66	1843,28
116	98,81	1358	7,21	7,294	1471,44	0,007422	7,2794	7,3086	7,0429	7,545	1144,70	1891,26
117	102,87	1591	7,37	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
118	106,36	2204	7,7	7,388	1616,47	0,007995	7,3723	7,4037	7,1369	7,6391	1257,52	2077,87
119	33,02	409	6,01	5,8956	363,43	0,0109	5,8742	5,9169	5,644	6,1471	282,59	467,36
120	63,5	788	6,67	6,7299	837,06	0,006054	6,718	6,7418	6,479	6,9808	651,32	1075,78
121	97,16	1477	7,3	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
122	97,16	1539	7,34	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
123	38,1	429	6,06	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
124	98,43	1504	7,32	7,289	1464,11	0,007394	7,2745	7,3036	7,038	7,5401	1139,11	1882,02
125	36,83	450	6,11	6,0349	417,76	0,009766	6,0157	6,0541	5,7835	6,2863	324,89	537,16
126	98,43	1532	7,33	7,289	1464,11	0,007394	7,2745	7,3036	7,038	7,5401	1139,11	1882,02

127	100,01	1711	7,44	7,3094	1494,28	0,007512	7,2947	7,3242	7,0584	7,5605	1162,58	1920,81
128	101,28	1811	7,5	7,3255	1518,53	0,007608	7,3106	7,3405	7,0745	7,5766	1181,45	1951,98
129	102,87	1908	7,55	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
130	39,37	462	6,14	6,12	454,86	0,00913	6,102	6,1379	5,8687	6,3713	353,79	584,82
131	93,35	1487	7,3	7,2214	1368,40	0,007029	7,2076	7,2352	6,9704	7,4724	1064,65	1758,82
132	30,48	359	5,88	5,7934	328,13	0,0117	5,7705	5,8164	5,5418	6,0451	255,14	422,04
133	104,78	1665	7,42	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36
134	106,05	1735	7,46	7,3842	1610,34	0,007971	7,3685	7,3998	7,133	7,6353	1252,63	2069,99
135	37,15	427	6,06	6,0458	422,34	0,009683	6,0268	6,0649	5,7945	6,2972	328,49	543,05
136	85,09	1125	7,03	7,1033	1215,97	0,006498	7,0905	7,1161	6,8523	7,3542	946,05	1562,75
137	38,74	437	6,08	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
138	39,37	433	6,07	6,12	454,86	0,00913	6,102	6,1379	5,8687	6,3713	353,79	584,82
139	41,91	445	6,1	6,1997	492,60	0,008562	6,1829	6,2166	5,9485	6,4509	383,18	633,27
140	99,06	1357	7,21	7,2972	1476,16	0,007441	7,2826	7,3119	7,0462	7,5483	1148,49	1897,51
141	107,63	1905	7,55	7,4031	1641,06	0,008093	7,3872	7,419	7,152	7,6543	1276,66	2109,70
142	108,59	2232	7,71	7,4144	1659,71	0,008167	7,3983	7,4304	7,1632	7,6655	1291,04	2133,46
143	109,54	2303	7,74	7,4255	1678,24	0,008241	7,4093	7,4417	7,1744	7,6767	1305,58	2157,49
144	31,75	403	6	5,8455	345,68	0,0113	5,8234	5,8677	5,5939	6,0971	268,78	444,57
145	90,81	1481	7,3	7,1862	1321,07	0,006855	7,1728	7,1997	6,9352	7,4372	1027,82	1697,99
146	24,13	412	6,02	5,4954	243,57	0,0142	5,4674	5,5234	5,2432	5,7476	189,27	313,44
147	69,53	1062	6,97	6,8457	939,83	0,005967	6,8339	6,8574	6,5948	7,0966	731,28	1207,85
148	87,95	1491	7,31	7,1454	1268,26	0,00667	7,1323	7,1585	6,8945	7,3964	986,83	1630,11
149	37,47	471	6,15	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
150	96,2	1496	7,31	7,2599	1422,11	0,007232	7,2457	7,2741	7,0089	7,5109	1106,44	1827,86
151	43,18	431	6,07	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
152	80,65	872	6,77	7,0348	1135,47	0,006266	7,0225	7,0471	6,7839	7,2858	883,51	1459,43
153	102,24	1253	7,13	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
154	106,68	1357	7,21	7,3918	1622,62	0,00802	7,376	7,4076	7,1407	7,6429	1262,31	2085,78

155	109,86	1507	7,32	7,4292	1684,46	0,008266	7,413	7,4455	7,178	7,6804	1310,29	2165,49
156	114,62	1908	7,55	7,4834	1778,28	0,008635	7,4664	7,5003	7,2321	7,7346	1383,12	2286,09
157	38,74	426	6,05	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
158	85,41	1124	7,02	7,108	1221,70	0,006517	7,0952	7,1208	6,8571	7,359	950,61	1570,27
159	35,56	373	5,92	5,9901	399,45	0,0101	5,9702	6,01	5,7387	6,2415	310,66	513,63
160	110,81	1361	7,22	7,4402	1703,09	0,008339	7,4238	7,4566	7,1891	7,6914	1324,91	2189,44
161	114,94	1549	7,35	7,4869	1784,51	0,00866	7,4699	7,5039	7,2357	7,7381	1388,11	2294,11
162	119,54	1798	7,49	7,537	1876,19	0,009017	7,5193	7,5547	7,2857	7,7883	1459,28	2412,21
163	120,65	1944	7,57	7,5488	1898,46	0,009102	7,5309	7,5667	7,2975	7,8001	1476,60	2440,85
164	31,75	380	5,94	5,8455	345,68	0,0113	5,8234	5,8677	5,5939	6,0971	268,78	444,57
165	40,32	473	6,16	6,1505	468,95	0,008909	6,133	6,168	5,8992	6,4017	364,75	602,87
166	99,7	1398	7,24	7,3054	1488,32	0,007489	7,2907	7,3201	7,0543	7,5565	1157,83	1913,14
167	41,59	442	6,09	6,19	487,85	0,00863	6,1731	6,207	5,9388	6,4413	379,48	627,22
168	29,85	362	5,89	5,7666	319,45	0,0119	5,7432	5,79	5,5149	6,0183	248,37	410,88
169	100,97	1851	7,52	7,3215	1512,47	0,007584	7,3066	7,3364	7,0705	7,5726	1176,74	1944,19
170	34,29	411	6,02	5,9437	381,34	0,0105	5,9231	5,9643	5,6922	6,1952	296,55	490,39
171	60,96	790	6,67	6,6778	794,57	0,006159	6,6657	6,6899	6,4269	6,9287	618,25	1021,17
172	98,43	1484	7,3	7,289	1464,11	0,007394	7,2745	7,3036	7,038	7,5401	1139,11	1882,02
173	102,24	1867	7,53	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
174	35,56	415	6,03	5,9901	399,45	0,0101	5,9702	6,01	5,7387	6,2415	310,66	513,63
175	104,78	1496	7,31	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36
176	107,32	1780	7,48	7,3994	1635,00	0,008069	7,3835	7,4152	7,1482	7,6505	1271,81	2101,70
177	107,95	1873	7,54	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
178	35,24	477	6,17	5,9787	394,93	0,0102	5,9586	5,9987	5,7272	6,2301	307,11	507,81
179	97,79	1792	7,49	7,2808	1452,15	0,007347	7,2663	7,2952	7,0297	7,5318	1129,69	1866,46
180	34,93	425	6,05	5,9671	390,37	0,0103	5,9469	5,9874	5,7157	6,2186	303,60	502,00
181	109,06	1417	7,26	7,42	1669,03	0,008204	7,4038	7,4361	7,1688	7,6711	1298,29	2145,44
182	111,13	1469	7,29	7,4439	1709,40	0,008364	7,4274	7,4603	7,1927	7,695	1329,69	2197,33

183	114,62	1631	7,4	7,4834	1778,28	0,008635	7,4664	7,5003	7,2321	7,7346	1383,12	2286,09
184	38,1	438	6,08	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
185	108,27	1774	7,48	7,4106	1653,42	0,008143	7,3946	7,4266	7,1595	7,6618	1286,27	2125,58
186	37,47	458	6,13	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
187	43,5	478	6,17	6,2472	516,56	0,00824	6,231	6,2634	5,996	6,4983	401,82	664,01
188	102,87	1326	7,19	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
189	34,29	372	5,92	5,9437	381,34	0,0105	5,9231	5,9643	5,6922	6,1952	296,55	490,39
190	107,32	1432	7,27	7,3994	1635,00	0,008069	7,3835	7,4152	7,1482	7,6505	1271,81	2101,70
191	43,18	452	6,11	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
192	40,01	421	6,04	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
193	40,01	439	6,08	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
194	69,85	818	6,71	6,8515	945,30	0,005968	6,8398	6,8632	6,6006	7,1024	735,54	1214,88
195	94,93	1176	7,07	7,2429	1398,14	0,00714	7,2289	7,257	6,9919	7,494	1087,79	1797,23
196	110,49	1510	7,32	7,4366	1696,97	0,008315	7,4202	7,4529	7,1854	7,6877	1320,02	2181,35
197	111,76	1691	7,43	7,4511	1721,76	0,008413	7,4346	7,4677	7,2	7,7023	1339,43	2213,43
198	113,67	2387	7,78	7,4727	1759,35	0,008561	7,4559	7,4895	7,2215	7,7239	1368,54	2261,76
199	31,75	413	6,02	5,8455	345,68	0,0113	5,8234	5,8677	5,5939	6,0971	268,78	444,57
200	97,79	1485	7,3	7,2808	1452,15	0,007347	7,2663	7,2952	7,0297	7,5318	1129,69	1866,46
201	38,74	485	6,18	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
202	96,2	1626	7,39	7,2599	1422,11	0,007232	7,2457	7,2741	7,0089	7,5109	1106,44	1827,86
203	99,06	1800	7,5	7,2972	1476,16	0,007441	7,2826	7,3119	7,0462	7,5483	1148,49	1897,51
204	40,64	430	6,06	6,1605	473,66	0,008838	6,1431	6,1779	5,9093	6,4117	368,45	608,93
205	103,82	1286	7,16	7,3572	1567,44	0,0078	7,3418	7,3725	7,106	7,6083	1219,26	2014,85
206	109,54	1419	7,26	7,4255	1678,24	0,008241	7,4093	7,4417	7,1744	7,6767	1305,58	2157,49
207	113,67	1559	7,35	7,4727	1759,35	0,008561	7,4559	7,4895	7,2215	7,7239	1368,54	2261,76
208	118,75	1975	7,59	7,5285	1860,31	0,008955	7,5109	7,5461	7,2772	7,7797	1446,93	2391,56
209	118,11	2167	7,68	7,5217	1847,71	0,008906	7,5041	7,5392	7,2704	7,7729	1437,13	2375,35
210	118,43	2256	7,72	7,5251	1854,00	0,008931	7,5075	7,5426	7,2738	7,7763	1442,02	2383,44

211	24,13	358	5,88	5,4954	243,57	0,0142	5,4674	5,5234	5,2432	5,7476	189,27	313,44
212	104,46	1693	7,43	7,3649	1579,56	0,007849	7,3495	7,3804	7,1138	7,616	1228,81	2030,42
213	39,05	440	6,09	6,1096	450,16	0,009206	6,0916	6,1277	5,8584	6,3609	350,16	578,77
214	48,9	568	6,34	6,3964	599,68	0,007322	6,382	6,4108	6,1454	6,6475	466,57	770,85
215	41,91	421	6,04	6,1997	492,60	0,008562	6,1829	6,2166	5,9485	6,4509	383,18	633,27
216	53,02	565	6,34	6,4998	665,01	0,006792	6,4865	6,5132	6,2488	6,7508	517,39	854,74
217	94,3	1107	7,01	7,2344	1386,31	0,007095	7,2204	7,2483	6,9834	7,4854	1078,58	1781,84
218	40,01	437	6,08	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
219	38,42	421	6,04	6,0887	440,85	0,00936	6,0703	6,1071	5,8374	6,34	342,89	566,80
220	37,47	419	6,04	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
221	41,28	437	6,08	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
222	68,58	816	6,7	6,8281	923,43	0,005966	6,8164	6,8398	6,5772	7,079	718,52	1186,78
223	89,85	1174	7,07	7,1728	1303,49	0,006792	7,1594	7,1861	6,9218	7,4238	1014,14	1675,39
224	101,28	1505	7,32	7,3255	1518,53	0,007608	7,3106	7,3405	7,0745	7,5766	1181,45	1951,98
225	104,14	1883	7,54	7,361	1573,41	0,007825	7,3457	7,3764	7,1099	7,6122	1224,03	2022,72
226	104,14	1976	7,59	7,361	1573,41	0,007825	7,3457	7,3764	7,1099	7,6122	1224,03	2022,72
227	35,56	435	6,08	5,9901	399,45	0,0101	5,9702	6,01	5,7387	6,2415	310,66	513,63
228	104,78	1741	7,46	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36
229	38,42	436	6,08	6,0887	440,85	0,00936	6,0703	6,1071	5,8374	6,34	342,89	566,80
230	107	1683	7,43	7,3956	1628,80	0,008044	7,3798	7,4114	7,1444	7,6467	1266,99	2093,72
231	39,69	423	6,05	6,1302	459,53	0,009055	6,1124	6,148	5,879	6,3815	357,45	590,81
232	108,9	1398	7,24	7,4181	1665,87	0,008192	7,402	7,4342	7,1669	7,6693	1295,82	2141,58
233	114,94	1824	7,51	7,4869	1784,51	0,00866	7,4699	7,5039	7,2357	7,7381	1388,11	2294,11
234	39,05	468	6,15	6,1096	450,16	0,009206	6,0916	6,1277	5,8584	6,3609	350,16	578,77
235	43,18	452	6,11	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
236	100,65	1431	7,27	7,3175	1506,43	0,00756	7,3027	7,3324	7,0664	7,5686	1171,92	1936,43
237	37,47	432	6,07	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
238	33,02	364	5,9	5,8956	363,43	0,0109	5,8742	5,9169	5,644	6,1471	282,59	467,36

239	40,96	416	6,03	6,1704	478,38	0,008767	6,1532	6,1876	5,9192	6,4216	372,11	614,99
240	41,28	434	6,07	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
241	62,87	813	6,7	6,7171	826,42	0,006076	6,7051	6,729	6,4661	6,968	642,97	1062,10
242	99,06	1501	7,31	7,2972	1476,16	0,007441	7,2826	7,3119	7,0462	7,5483	1148,49	1897,51
243	101,92	1887	7,54	7,3335	1530,73	0,007656	7,3185	7,3486	7,0824	7,5846	1190,82	1967,66
244	101,92	1955	7,58	7,3335	1530,73	0,007656	7,3185	7,3486	7,0824	7,5846	1190,82	1967,66
245	27,94	412	6,02	5,6824	293,65	0,0126	5,6576	5,7073	5,4306	5,9343	228,29	377,78
246	87,95	1241	7,12	7,1454	1268,26	0,00667	7,1323	7,1585	6,8945	7,3964	986,83	1630,11
247	41,28	444	6,1	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
248	105,41	1419	7,26	7,3765	1597,99	0,007922	7,3609	7,3921	7,1254	7,6276	1243,15	2054,11
249	107,63	1485	7,3	7,4031	1641,06	0,008093	7,3872	7,419	7,152	7,6543	1276,66	2109,70
250	44,13	444	6,1	6,2657	526,21	0,008118	6,2497	6,2816	6,0145	6,5168	409,32	676,41
251	110,17	1424	7,26	7,4329	1690,70	0,00829	7,4166	7,4492	7,1817	7,6841	1315,14	2173,51
252	113,98	1641	7,4	7,4763	1765,70	0,008586	7,4594	7,4931	7,2251	7,7275	1373,48	2269,92
253	40,01	477	6,17	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
254	96,84	1243	7,13	7,2683	1434,11	0,007278	7,254	7,2826	7,0172	7,5193	1115,66	1843,28
255	109,86	1529	7,33	7,4292	1684,46	0,008266	7,413	7,4455	7,178	7,6804	1310,29	2165,49
256	42,86	442	6,09	6,2284	506,94	0,008366	6,212	6,2449	5,9772	6,4796	394,33	651,71
257	114,62	1564	7,36	7,4834	1778,28	0,008635	7,4664	7,5003	7,2321	7,7346	1383,12	2286,09
258	114,62	1610	7,38	7,4834	1778,28	0,008635	7,4664	7,5003	7,2321	7,7346	1383,12	2286,09
259	38,1	438	6,08	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
260	37,47	409	6,01	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
261	66,04	788	6,67	6,7799	879,98	0,005991	6,7682	6,7917	6,529	7,0308	684,71	1130,93
262	90,65	1146	7,04	7,184	1318,17	0,006844	7,1705	7,1974	6,933	7,435	1025,57	1694,26
263	103,19	1476	7,3	7,3493	1555,11	0,007752	7,3341	7,3646	7,0982	7,6004	1209,79	1999,00
264	104,78	1862	7,53	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36
265	105,41	1928	7,56	7,3765	1597,99	0,007922	7,3609	7,3921	7,1254	7,6276	1243,15	2054,11
266	31,75	381	5,94	5,8455	345,68	0,0113	5,8234	5,8677	5,5939	6,0971	268,78	444,57

267	99,06	1462	7,29	7,2972	1476,16	0,007441	7,2826	7,3119	7,0462	7,5483	1148,49	1897,51
268	99,38	1660	7,41	7,3013	1482,23	0,007465	7,2867	7,316	7,0503	7,5524	1153,20	1905,31
269	101,28	1825	7,51	7,3255	1518,53	0,007608	7,3106	7,3405	7,0745	7,5766	1181,45	1951,98
270	38,1	438	6,08	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
271	74,3	879	6,78	6,9302	1022,70	0,006034	6,9183	6,9421	6,6793	7,1811	795,76	1314,35
272	97,47	1273	7,15	7,2766	1446,06	0,007324	7,2622	7,291	7,0256	7,5277	1125,07	1858,83
273	104,78	1448	7,28	7,3688	1585,73	0,007873	7,3533	7,3843	7,1177	7,6199	1233,61	2038,36
274	108,59	1708	7,44	7,4144	1659,71	0,008167	7,3983	7,4304	7,1632	7,6655	1291,04	2133,46
275	110,49	1867	7,53	7,4366	1696,97	0,008315	7,4202	7,4529	7,1854	7,6877	1320,02	2181,35
276	109,86	2012	7,61	7,4292	1684,46	0,008266	7,413	7,4455	7,178	7,6804	1310,29	2165,49
277	41,28	445	6,1	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
278	105,09	1442	7,27	7,3727	1591,93	0,007898	7,3571	7,3882	7,1215	7,6238	1238,31	2046,32
279	111,44	1768	7,48	7,4475	1715,57	0,008389	7,431	7,464	7,1963	7,6987	1334,48	2205,48
280	114,3	1909	7,55	7,4798	1771,89	0,008611	7,4629	7,4967	7,2286	7,731	1378,29	2277,88
281	41,91	464	6,14	6,1997	492,60	0,008562	6,1829	6,2166	5,9485	6,4509	383,18	633,27
282	95,89	1243	7,13	7,2557	1416,15	0,007209	7,2415	7,2698	7,0046	7,5067	1101,69	1820,20
283	102,87	1389	7,24	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
284	106,68	1529	7,33	7,3918	1622,62	0,00802	7,376	7,4076	7,1407	7,6429	1262,31	2085,78
285	43,5	438	6,08	6,2472	516,56	0,00824	6,231	6,2634	5,996	6,4983	401,82	664,01
286	97,16	1185	7,08	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
287	113,03	1612	7,39	7,4656	1746,90	0,008512	7,4488	7,4823	7,2144	7,7168	1358,86	2245,76
288	113,35	1669	7,42	7,4691	1753,03	0,008537	7,4524	7,4859	7,2179	7,7203	1363,62	2253,64
289	42,55	441	6,09	6,2189	502,15	0,00843	6,2024	6,2355	5,9678	6,4701	390,65	645,55
290	35,56	413	6,02	5,9901	399,45	0,0101	5,9702	6,01	5,7387	6,2415	310,66	513,63
291	38,1	443	6,09	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
292	38,74	438	6,08	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
293	67,31	817	6,71	6,8042	901,63	0,005974	6,7925	6,816	6,5533	7,0551	701,56	1158,75
294	99,38	1509	7,32	7,3013	1482,23	0,007465	7,2867	7,316	7,0503	7,5524	1153,20	1905,31

295	29,85	510	6,23	5,7666	319,45	0,0119	5,7432	5,79	5,5149	6,0183	248,37	410,88
296	101,28	1345	7,2	7,3255	1518,53	0,007608	7,3106	7,3405	7,0745	7,5766	1181,45	1951,98
297	102,24	1370	7,22	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
298	38,74	460	6,13	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
299	42,23	478	6,17	6,2094	497,40	0,008496	6,1927	6,2261	5,9582	6,4606	386,91	639,44
300	100,33	1415	7,25	7,3135	1500,42	0,007536	7,2987	7,3283	7,0624	7,5646	1167,24	1928,70
301	40,32	449	6,11	6,1505	468,95	0,008909	6,133	6,168	5,8992	6,4017	364,75	602,87
302	27,62	438	6,08	5,6679	289,43	0,0128	5,6428	5,6929	5,416	5,9197	224,98	372,30
303	36,83	417	6,03	6,0349	417,76	0,009766	6,0157	6,0541	5,7835	6,2863	324,89	537,16
304	40,64	440	6,09	6,1605	473,66	0,008838	6,1431	6,1779	5,9093	6,4117	368,45	608,93
305	37,47	423	6,05	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
306	66,68	802	6,69	6,7921	890,78	0,005981	6,7804	6,8039	6,5412	7,043	693,12	1144,82
307	91,76	1160	7,06	7,1995	1338,76	0,006919	7,1859	7,2131	6,9485	7,4505	1041,59	1720,72
308	105,09	1494	7,31	7,3727	1591,93	0,007898	7,3571	7,3882	7,1215	7,6238	1238,31	2046,32
309	106,68	1659	7,41	7,3918	1622,62	0,00802	7,376	7,4076	7,1407	7,6429	1262,31	2085,78
310	36,2	416	6,03	6,0127	408,59	0,009937	5,9932	6,0322	5,7613	6,2641	317,76	525,37
311	43,18	471	6,15	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
312	109,22	1416	7,26	7,4218	1672,04	0,008216	7,4057	7,438	7,1707	7,673	1300,75	2149,52
313	113,98	1547	7,34	7,4763	1765,70	0,008586	7,4594	7,4931	7,2251	7,7275	1373,48	2269,92
314	119,86	1807	7,5	7,5404	1882,58	0,009041	7,5226	7,5581	7,2891	7,7916	1464,25	2420,19
315	119,38	2315	7,75	7,5353	1873,01	0,009004	7,5176	7,553	7,284	7,7866	1456,80	2408,12
316	120,02	2397	7,78	7,5421	1885,79	0,009053	7,5243	7,5599	7,2908	7,7933	1466,74	2424,30
317	42,86	459	6,13	6,2284	506,94	0,008366	6,212	6,2449	5,9772	6,4796	394,33	651,71
318	110,49	1447	7,28	7,4366	1696,97	0,008315	7,4202	7,4529	7,1854	7,6877	1320,02	2181,35
319	112,71	1702	7,44	7,462	1740,63	0,008487	7,4453	7,4787	7,2108	7,7132	1353,98	2237,69
320	43,18	481	6,18	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
321	41,28	439	6,08	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
322	109,86	1561	7,35	7,4292	1684,46	0,008266	7,413	7,4455	7,178	7,6804	1310,29	2165,49

323	40,64	439	6,08	6,1605	473,66	0,008838	6,1431	6,1779	5,9093	6,4117	368,45	608,93
324	36,2	422	6,05	6,0127	408,59	0,009937	5,9932	6,0322	5,7613	6,2641	317,76	525,37
325	33,02	429	6,06	5,8956	363,43	0,0109	5,8742	5,9169	5,644	6,1471	282,59	467,36
326	59,06	808	6,69	6,6373	763,03	0,006267	6,625	6,6496	6,3864	6,8882	593,72	980,63
327	95,89	1503	7,32	7,2557	1416,15	0,007209	7,2415	7,2698	7,0046	7,5067	1101,69	1820,20
328	97,79	1628	7,4	7,2808	1452,15	0,007347	7,2663	7,2952	7,0297	7,5318	1129,69	1866,46
329	105,41	2669	7,89	7,3765	1597,99	0,007922	7,3609	7,3921	7,1254	7,6276	1243,15	2054,11
330	38,1	401	5,99	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
331	107	1389	7,24	7,3956	1628,80	0,008044	7,3798	7,4114	7,1444	7,6467	1266,99	2093,72
332	108,9	1528	7,33	7,4181	1665,87	0,008192	7,402	7,4342	7,1669	7,6693	1295,82	2141,58
333	113,98	1978	7,59	7,4763	1765,70	0,008586	7,4594	7,4931	7,2251	7,7275	1373,48	2269,92
334	42,55	484	6,18	6,2189	502,15	0,00843	6,2024	6,2355	5,9678	6,4701	390,65	645,55
335	93,35	1218	7,1	7,2214	1368,40	0,007029	7,2076	7,2352	6,9704	7,4724	1064,65	1758,82
336	42,23	443	6,09	6,2094	497,40	0,008496	6,1927	6,2261	5,9582	6,4606	386,91	639,44
337	101,6	1190	7,08	7,3295	1524,62	0,007632	7,3145	7,3445	7,0785	7,5806	1186,19	1959,80
338	111,76	1418	7,26	7,4511	1721,76	0,008413	7,4346	7,4677	7,2	7,7023	1339,43	2213,43
339	38,74	400	5,99	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
340	40,96	419	6,04	6,1704	478,38	0,008767	6,1532	6,1876	5,9192	6,4216	372,11	614,99
341	35,56	433	6,07	5,9901	399,45	0,0101	5,9702	6,01	5,7387	6,2415	310,66	513,63
342	64,14	812	6,7	6,7426	847,76	0,006034	6,7307	6,7544	6,4917	6,9935	659,64	1089,53
343	99,7	1507	7,32	7,3054	1488,32	0,007489	7,2907	7,3201	7,0543	7,5565	1157,83	1913,14
344	101,6	1823	7,51	7,3295	1524,62	0,007632	7,3145	7,3445	7,0785	7,5806	1186,19	1959,80
345	35,56	451	6,11	5,9901	399,45	0,0101	5,9702	6,01	5,7387	6,2415	310,66	513,63
346	109,54	1725	7,45	7,4255	1678,24	0,008241	7,4093	7,4417	7,1744	7,6767	1305,58	2157,49
347	111,13	1907	7,55	7,4439	1709,40	0,008364	7,4274	7,4603	7,1927	7,695	1329,69	2197,33
348	110,81	2344	7,76	7,4402	1703,09	0,008339	7,4238	7,4566	7,1891	7,6914	1324,91	2189,44
349	45,09	466	6,14	6,2929	540,72	0,007942	6,2773	6,3085	6,0418	6,544	420,65	695,06
350	96,2	1157	7,05	7,2599	1422,11	0,007232	7,2457	7,2741	7,0089	7,5109	1106,44	1827,86

351	107,95	1543	7,34	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
352	34,61	440	6,09	5,9555	385,87	0,0104	5,9351	5,9759	5,704	6,2069	300,07	496,16
353	94,62	1420	7,26	7,2387	1392,28	0,007118	7,2247	7,2527	6,9876	7,4897	1083,12	1789,52
354	98,11	1561	7,35	7,2849	1458,12	0,007371	7,2704	7,2994	7,0339	7,536	1134,45	1874,32
355	42,86	447	6,1	6,2284	506,94	0,008366	6,212	6,2449	5,9772	6,4796	394,33	651,71
356	42,23	486	6,19	6,2094	497,40	0,008496	6,1927	6,2261	5,9582	6,4606	386,91	639,44
357	98,43	1405	7,25	7,289	1464,11	0,007394	7,2745	7,3036	7,038	7,5401	1139,11	1882,02
358	101,92	1481	7,3	7,3335	1530,73	0,007656	7,3185	7,3486	7,0824	7,5846	1190,82	1967,66
359	43,82	455	6,12	6,2565	521,39	0,008179	6,2404	6,2725	6,0053	6,5076	405,57	670,22
360	36,2	421	6,04	6,0127	408,59	0,009937	5,9932	6,0322	5,7613	6,2641	317,76	525,37
361	46,99	439	6,08	6,3457	570,04	0,007616	6,3308	6,3607	6,0946	6,5968	443,46	732,75
362	50,17	547	6,3	6,4291	619,62	0,007143	6,4151	6,4432	6,1781	6,6802	482,08	796,48
363	40,01	436	6,08	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
364	106,68	1355	7,21	7,3918	1622,62	0,00802	7,376	7,4076	7,1407	7,6429	1262,31	2085,78
365	114,3	1495	7,31	7,4798	1771,89	0,008611	7,4629	7,4967	7,2286	7,731	1378,29	2277,88
366	40,01	448	6,1	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
367	103,82	1428	7,26	7,3572	1567,44	0,0078	7,3418	7,3725	7,106	7,6083	1219,26	2014,85
368	42,55	428	6,06	6,2189	502,15	0,00843	6,2024	6,2355	5,9678	6,4701	390,65	645,55
369	37,47	430	6,06	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
370	51,44	554	6,32	6,461	639,70	0,006979	6,4473	6,4747	6,21	6,712	497,70	822,21
371	36,83	401	5,99	6,0349	417,76	0,009766	6,0157	6,0541	5,7835	6,2863	324,89	537,16
372	94,62	1249	7,13	7,2387	1392,28	0,007118	7,2247	7,2527	6,9876	7,4897	1083,12	1789,52
373	45,72	454	6,12	6,3108	550,49	0,00783	6,2954	6,3261	6,0597	6,5619	428,25	707,61
374	117,16	1574	7,36	7,5113	1828,59	0,008832	7,494	7,5287	7,2601	7,7626	1422,40	2351,01
375	118,11	1625	7,39	7,5217	1847,71	0,008906	7,5041	7,5392	7,2704	7,7729	1437,13	2375,35
376	33,34	399	5,99	5,9078	367,90	0,0108	5,8866	5,9289	5,6563	6,1593	286,09	473,10
377	40,32	424	6,05	6,1505	468,95	0,008909	6,133	6,168	5,8992	6,4017	364,75	602,87
378	76,52	909	6,81	6,9678	1061,88	0,006099	6,9558	6,9798	6,7169	7,2187	826,25	1364,71

379	50,8	563	6,33	6,4452	629,67	0,007059	6,4313	6,4591	6,1942	6,6962	489,90	809,32
380	48,58	496	6,21	6,3881	594,73	0,007368	6,3736	6,4026	6,1371	6,6392	462,71	764,48
381	43,5	446	6,1	6,2472	516,56	0,00824	6,231	6,2634	5,996	6,4983	401,82	664,01
382	39,37	416	6,03	6,12	454,86	0,00913	6,102	6,1379	5,8687	6,3713	353,79	584,82
383	43,82	439	6,08	6,2565	521,39	0,008179	6,2404	6,2725	6,0053	6,5076	405,57	670,22
384	48,9	565	6,34	6,3964	599,68	0,007322	6,382	6,4108	6,1454	6,6475	466,57	770,85
385	41,28	426	6,05	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
386	28,89	323	5,78	5,7252	306,49	0,0123	5,7011	5,7493	5,4734	5,977	238,27	394,26
387	38,74	427	6,06	6,0992	445,50	0,009283	6,081	6,1175	5,8479	6,3505	346,51	572,78
388	52,71	566	6,34	6,4922	659,97	0,006828	6,4787	6,5056	6,2412	6,7431	513,47	848,19
389	46,99	479	6,17	6,3457	570,04	0,007616	6,3308	6,3607	6,0946	6,5968	443,46	732,75
390	33,02	407	6,01	5,8956	363,43	0,0109	5,8742	5,9169	5,644	6,1471	282,59	467,36
391	87	1327	7,19	7,1315	1250,75	0,006611	7,1185	7,1445	6,8806	7,3825	973,21	1607,60
392	91,44	1467	7,29	7,1951	1332,88	0,006898	7,1816	7,2087	6,9441	7,4461	1037,01	1713,17
393	40,01	434	6,07	6,1404	464,24	0,008982	6,1227	6,158	5,8891	6,3916	361,08	596,81
394	47,31	495	6,2	6,3543	574,96	0,007564	6,3394	6,3692	6,1032	6,6054	447,29	739,08
395	37,47	413	6,02	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
396	39,69	434	6,07	6,1302	459,53	0,009055	6,1124	6,148	5,879	6,3815	357,45	590,81
397	48,26	488	6,19	6,3797	589,75	0,007416	6,3652	6,3943	6,1287	6,6308	458,84	758,09
398	36,83	409	6,01	6,0349	417,76	0,009766	6,0157	6,0541	5,7835	6,2863	324,89	537,16
399	39,69	473	6,16	6,1302	459,53	0,009055	6,1124	6,148	5,879	6,3815	357,45	590,81
400	41,28	445	6,1	6,1803	483,14	0,008698	6,1632	6,1974	5,9291	6,4315	375,82	621,10
401	43,18	479	6,17	6,2378	511,73	0,008303	6,2215	6,2542	5,9867	6,489	398,10	657,87
402	36,51	415	6,03	6,0238	413,15	0,009851	6,0045	6,0432	5,7725	6,2752	321,34	531,23
403	50,17	493	6,2	6,4291	619,62	0,007143	6,4151	6,4432	6,1781	6,6802	482,08	796,48
404	38,1	447	6,1	6,0781	436,20	0,009439	6,0596	6,0967	5,8268	6,3295	339,27	560,88
405	49,53	568	6,34	6,4129	609,66	0,007231	6,3987	6,4271	6,1618	6,6639	474,28	783,60
406	46,99	491	6,2	6,3457	570,04	0,007616	6,3308	6,3607	6,0946	6,5968	443,46	732,75

407	27,62	305	5,72	5,6679	289,43	0,0128	5,6428	5,6929	5,416	5,9197	224,98	372,30
408	30,48	301	5,71	5,7934	328,13	0,0117	5,7705	5,8164	5,5418	6,0451	255,14	422,04
409	36,2	415	6,03	6,0127	408,59	0,009937	5,9932	6,0322	5,7613	6,2641	317,76	525,37
410	87,31	1629	7,4	7,1362	1256,64	0,006631	7,1232	7,1492	6,8852	7,3872	977,70	1615,18
411	59,06	782	6,66	6,6373	763,03	0,006267	6,625	6,6496	6,3864	6,8882	593,72	980,63
412	97,16	1472	7,29	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
413	99,7	1572	7,36	7,3054	1488,32	0,007489	7,2907	7,3201	7,0543	7,5565	1157,83	1913,14
414	56,52	776	6,65	6,5812	721,40	0,006454	6,5685	6,5939	6,3302	6,8322	561,27	927,23
415	96,52	1466	7,29	7,2641	1428,10	0,007255	7,2498	7,2784	7,0131	7,5151	1111,09	1835,55
416	102,24	1841	7,52	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
417	101,92	1917	7,56	7,3335	1530,73	0,007656	7,3185	7,3486	7,0824	7,5846	1190,82	1967,66
418	99,06	1271	7,15	7,2972	1476,16	0,007441	7,2826	7,3119	7,0462	7,5483	1148,49	1897,51
419	111,76	1659	7,41	7,4511	1721,76	0,008413	7,4346	7,4677	7,2	7,7023	1339,43	2213,43
420	116,84	2008	7,6	7,5079	1822,38	0,008808	7,4905	7,5252	7,2566	7,7591	1417,43	2342,80
421	64,77	775	6,65	6,7551	858,43	0,006017	6,7433	6,767	6,5042	7,0061	667,94	1103,34
422	87,31	1132	7,03	7,1362	1256,64	0,006631	7,1232	7,1492	6,8852	7,3872	977,70	1615,18
423	100,01	1465	7,29	7,3094	1494,28	0,007512	7,2947	7,3242	7,0584	7,5605	1162,58	1920,81
424	102,87	1840	7,52	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
425	107,95	1531	7,33	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
426	110,49	1743	7,46	7,4366	1696,97	0,008315	7,4202	7,4529	7,1854	7,6877	1320,02	2181,35
427	112,08	1815	7,5	7,4548	1728,14	0,008438	7,4382	7,4713	7,2036	7,7059	1344,26	2221,42
428	59,06	771	6,65	6,6373	763,03	0,006267	6,625	6,6496	6,3864	6,8882	593,72	980,63
429	97,16	1461	7,29	7,2725	1440,15	0,007301	7,2581	7,2868	7,0214	7,5235	1120,35	1851,03
430	101,28	1804	7,5	7,3255	1518,53	0,007608	7,3106	7,3405	7,0745	7,5766	1181,45	1951,98
431	34,93	368	5,91	5,9671	390,37	0,0103	5,9469	5,9874	5,7157	6,2186	303,60	502,00
432	62,23	747	6,62	6,7041	815,74	0,006101	6,6921	6,7161	6,4532	6,955	634,73	1048,38
433	83,19	1105	7,01	7,0744	1181,33	0,006393	7,0618	7,087	6,8235	7,3254	919,20	1518,38
434	93,35	1538	7,34	7,2214	1368,40	0,007029	7,2076	7,2352	6,9704	7,4724	1064,65	1758,82

435	110,17	1529	7,33	7,4329	1690,70	0,00829	7,4166	7,4492	7,1817	7,6841	1315,14	2173,51
436	114,3	1770	7,48	7,4798	1771,89	0,008611	7,4629	7,4967	7,2286	7,731	1378,29	2277,88
437	114,94	2003	7,6	7,4869	1784,51	0,00866	7,4699	7,5039	7,2357	7,7381	1388,11	2294,11
438	58,42	771	6,65	6,6235	752,57	0,006309	6,6111	6,6359	6,3726	6,8744	585,58	967,19
439	92,71	1461	7,29	7,2127	1356,55	0,006984	7,199	7,2264	6,9617	7,4637	1055,43	1743,59
440	96,84	1781	7,48	7,2683	1434,11	0,007278	7,254	7,2826	7,0172	7,5193	1115,66	1843,28
441	32,39	373	5,92	5,8708	354,53	0,0111	5,8491	5,8925	5,6192	6,1224	275,67	455,96
442	60,33	752	6,62	6,6644	783,99	0,006192	6,6523	6,6766	6,4135	6,9154	610,03	1007,67
443	102,87	1444	7,28	7,3454	1549,05	0,007728	7,3302	7,3606	7,0943	7,5965	1205,08	1991,21
444	107	1824	7,51	7,3956	1628,80	0,008044	7,3798	7,4114	7,1444	7,6467	1266,99	2093,72
445	37,47	442	6,09	6,0567	426,96	0,009601	6,0378	6,0756	5,8054	6,308	332,09	548,95
446	102,24	1517	7,32	7,3375	1536,87	0,00768	7,3224	7,3526	7,0864	7,5886	1195,60	1975,55
447	107,95	1975	7,59	7,4069	1647,31	0,008118	7,3909	7,4228	7,1557	7,658	1281,39	2117,52
448	36,51	391	5,97	6,0238	413,15	0,009851	6,0045	6,0432	5,7725	6,2752	321,34	531,23
449	107,32	1414	7,25	7,3994	1635,00	0,008069	7,3835	7,4152	7,1482	7,6505	1271,81	2101,70
450	110,49	1537	7,34	7,4366	1696,97	0,008315	7,4202	7,4529	7,1854	7,6877	1320,02	2181,35
451	115,25	1903	7,55	7,4904	1790,77	0,008685	7,4733	7,5075	7,2392	7,7416	1392,98	2302,15
452	98,43	1266	7,14	7,289	1464,11	0,007394	7,2745	7,3036	7,038	7,5401	1139,11	1882,02
453	107,32	1519	7,33	7,3994	1635,00	0,008069	7,3835	7,4152	7,1482	7,6505	1271,81	2101,70
454	113,03	1767	7,48	7,4656	1746,90	0,008512	7,4488	7,4823	7,2144	7,7168	1358,86	2245,76
455	114,94	1977	7,59	7,4869	1784,51	0,00866	7,4699	7,5039	7,2357	7,7381	1388,11	2294,11
456	72,39	967	6,87	6,8971	989,40	0,005995	6,8853	6,9088	6,6461	7,148	769,78	1271,56
457	44,77	479	6,17	6,2839	535,87	0,008	6,2682	6,2996	6,0328	6,535	416,88	688,83

**Annexure 5:** Postmature growth check raw data

No	Ear Tag No	Approx Age in Years at Onset of Postmature Growth	Number of Growth Checks	Age (years)	Predicted Age (years)	Over - estimate d (years)	Under estimated (years)	GOOD (12 months or less)	FAIR (13-18 months)	POOR (>18 months)	Cannot Age
1	1-97B	Unknown	None	16							1
2	7-5G	Unknown	4	7	9	2				1	
3	3-5w	5	6	11	11	0		1			
4	8-5G	unknown	6	11	11	0		1			
5	9-5G	5	7	12	12	0		1			
6	1-6G	unknown	8	13	13	0		1			
7	7B-6G	5,5	2	8	7		0,5	1			
8	4-6G	5	7	11,75	12	0,25		1			
9	2-6B	unknown	5	9	10	1		1			
10	4-6B	unknown	5	8	9	1		1			0
11	1-7W	5	3	7,5	8	0,5		1			
12	2-7G	5	5,5	10,83	10,5		0,33	1			
13	1-7G	5,5	4	9,58	9		0,58	1			
14	2-7B	5	2,5	7,17	7,5	0,37		1			
15	3-7W	5	7	11,75	12	0,25		1			
16	4-7B	5	2	7	7	0		1			
17	9-7B	5	1,5	6,5	6,5	0		1			
18	6-8G	5	5	10	10	0		1			

No	Ear Tag No	Approx Age in Years at Onset of Postmature Growth	Number of Growth Checks	Age (years)	Predicted Age (years)	Over - estimate d (years)	Under estimated (years)	GOOD (12 months or less)	FAIR (13-18 months)	POOR (>18 months)	Cannot Age
19	2-8G	5,5	4	9,83	9		0,83	1			
20	3-8W	5,5	4	9	9	0		1			
21	1-8W	5	2	6,5	7	0,5		1			
22	3-9G	5	None								1
23	1-9W	5	3	9	8	0	1	1			
24	7-9G	unknown	None								1
25	1-9B	4,5	3	7,5	8	0,5		1			
26	9-9G	3,5	7	11	12	1		1			
27	7-10G	5,5	1	6,5	6		0,5	1			
28	6-11B	no clear postmature growth	None								1
29	7-11B	no clear postmature growth	None								1
30	1-12G	5	2	7	7	0		1			
31	1-12B	unknown	2	6	7	1		1			
32	6-12B	5	2	6	7	1		1			
33	4-12G	5	2	7	7	0		1			
34	3-12B	5	1,5	7	6,5		0,5	1			

No	Ear Tag No	Approx Age in Years at Onset of Postmature Growth	Number of Growth Checks	Age (years)	Predicted Age (years)	Over - estimate d (years)	Under estimated (years)	GOOD (12 months or less)	FAIR (13-18 months)	POOR (>18 months)	Cannot Age
35	8-12B	5	2	8	7		1	1			
36	9-12B	unknown	1	6,5	6		0,5	1			
37	6-12G	5	2	8	7		1	1			
38	5-12G	4,5	2	8	7		1	1			
<b>TOTAL</b>								32	0	1	5