The influence of active bomas on habitat choice of the common warthog (Phacochoerus africanus)

Aktiva bomas inverkan på vårtsvins habitatval

Pärerik Thorp

Sveriges Lantbruksuniversitet **Skara 2012** **Studentarbete 387**
Institutionen för husdjurens miljö och hälsa
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Pärerik Thorp

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Handledare: Jenny Yngvesson, Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, Box 234, 532 23 SKARA
Biträdande handledare: Jens Jung, Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa,, Box 234, 532 23 SKARA

Examinator: Lena Lidfors, Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, Box 234, 532 23 SKARA

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Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens miljö och hälsa
Box 234, 532 23 SKARA
E-post: hmh@slu.se, **Hemsida:** www.slu.se/husdjurmiljohalsa

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Summary

The common warthog *(Phachocoerus africanus)* is a relatively long-legged pig with noticeable curved tusks, a short neck and three pairs of facial warts. It has four recognized subspecies. The common warthog is a non-migratory ungulate living on the African savannah. It is a hindgut fermenter and predominantly dependent on high-quality foods. It prefers open areas for grazing but use bushes for cover. Warthogs prefer former bomas because of the nutrient enrichment that has occurred there and they also distribute their faeces close to their feeding grounds. Warthogs are a pioneer species when it comes to recolonizing abandoned bomas. Warthogs are bearers of several diseases harmful to livestock and are therefore often chased from active bomas. The aim of this study was to investigate how active bomas influence the habitat choice of warthogs. The study was carried out in the Maasai Mara National Reserve and the adjoining Koyake group ranch, in august 2003 and May-June 2004, using well defined study areas; transects. Results showed that warthogs favour the transects farthest away from the bomas. Warthogs probably favour the security of grazing among other species in order to avoid being caught by predators. Other herbivores might also feed on plant species less attractive to warthogs and thereby allowing plant species that warthogs favour to grow.

Sammanfattning

Vårtsvinet är en gris med relativt långa ben, iögonfallande svängda betar, kort nacke och tre par ansiktsvårtor. Den har fyra erkända underarter. Vårtsvinet är ett klövdjur som lever på den afrikanska savannen och den migrerar inte. Den är en grovtarmsjäsare och är till största delen beroende av bete av hög kvalitet. Den föredrar öppna ytor för att beta men använder buskage till skydd. Vårtsvin dras till bomas på grund av den näringsberikning som har skett där och de distribuerar även sin avföring nära sina födoplatser. Vårtsvin är en pionjärart när det gäller att återkolonisera övergivna bomas. Vårtsvin bär på flera sjukdomar som boskap riskerar att smittas av och blir därför ofta bort jagade från bomas. Syftet med den här studien var att undersöka hur aktiva bomas påverkar vårtsvinets habitatval. Studien gjordes i Maasai Mara National Reserve och den bredvid liggande Koyake group ranch i augusti 2003 och maj-juni 2004 med hjälp av väldefinierade observationsområden; transekter. Resultatet visar att vårtsvin föredrar de transekter som ligger längst ifrån bomas. Vårtsvinen föredrar troligen att beta bland andra arter för att undvika att bli tagna av rovdjur. Andra växtätare betar möjligen också bort växtlighet som är mindre attraktiv för vårtsvin vilket lämnar rum för arter som de föredrar.

Introduction

The common warthog *(Phachocoerus africanus)* is a relatively long-legged pig with noticeable curved tusks and a short neck (Kingdon, 2001). It has three pairs of facial warts, or callosities, that consist of thickened skin with connective tissue to protect eyes, jaws and muzzle. These warts also act as protection during tusk-wrestling or pushing fights. It runs with a distinctive high trot, back straight and its narrow tail held vertically (Kingdon, 2001). Due to this, it has jokingly been referred to as `radio-controlled pig´. It is diurnal and takes shelter during the night or from predators in burrows, usually aardvark *(Orycteropus afer)* holes (Vercammen & Mason, 1993).

A typical warthog family unit consists of one to three females, usually a mother and her adult daughters and between 2 to 5 offspring. The males leave their natal groups before the age of two and live solitary or in loose bachelor groups (Vercammen & Mason, 1993). Warthogs have a high reproductive potential and can quite easily rebound from large population losses (Mason, 1990).

The common warthog has four recognized subspecies: Northern warthog *(P. a. africanus)*, Eritrean warthog *(P. a. aeliani)*, Central African warthog *(P. a. massaicus)* and Southern warthog *(P. a. sundevallii)* (Vercammen & Mason, 1993). There is also the Desert warthog *(P. aethiopicus),* a separate species, that according to d'Huart and Grubbs (2001), lives on grassland steppes on altitudes up to 500 meters above sea level while the common warthog also is found on shrubland steppes at altitudes of up to 3000 m (Vercammen & Mason, 1993). In this thesis, I use the term warthog when referring to the common warthog *(Phachocoerus africanus)*.

The warthog is a non-migratory ungulate that lives on the African savannah (Mason, 1990). It has a specialized hindgut and stomach where fermentation can take place. (Boomer & Boyse 2003) and is predominantly a grazer which depends on high-quality food but will also eat sedges, fallen fruits, certain forbs and occasionally faeces and animal foods. Warthogs regularly eat soil, presumably for minerals (Kingdon, 2001). It has a flexible diet which can explain their wide distribution on the African savannah (Vercammen & Mason, 1993). While warthogs prefer open areas for feeding, they also use bushes for cover (Treydte, 2006) While feeding it drops to its knees and usually proceeds to graze in this manner, with their hindquarters raised (Kingdon, 2001).

Bomas are settlements on the African savannah were the maasai people live and keep their livestock in bush-ringed or fenced paddocks over night to protect them from predators (Stelfox, 1986). The areas around bomas are attractive grazing grounds for warthog because of the high-quality pasture that is found there (Treydte et al. 2006) but warthogs also compete with livestock for food (Vercammen & Mason, 1993). Warthogs are pioneer species when it comes to re-colonizing abandoned bomas (Treydte et al. 2006) but as bearers of harmful diseases such as the tick-borne African swine fever virus and rinderpest (Vercammen & Mason, 1993) they are often chased away from the bomas or shot (Treydte et al. 2006). They are also the preferred host of tse-tse flies (Vercammen & Mason, 1993). According to Treydte (2006) some warthogs persist close to the bomas despite being chased away and hunted in order to gain access to favoured grazing grounds and this is why they are among the first species to colonize abandoned bomas. Human settlements may have a big impact on wildlife, either it attracts wildlife by giving them an alternative source of food or by changing the composition of the species growing in the vicinity, or the settlements repels them through hunting or by changing the landscape into something less attractive to wildlife.

Treydte et al. (2006) and Augustine (2003) have both found that warthogs favour open areas close to abandoned cattle ranches or bomas, mainly because of the nutrient enrichment that has occurred there, with grass species growing that are preferable to warthogs, e.g. *Cyodon*, *Panicum* and *Brachiara*. This also creates a positive feedback loop where the faeces from warthogs and other animals that graze on these areas, is adding nourishment to the ground. Warthogs distribute their faeces close to their grazing areas. These nutrient-enriched patches can persist for a very long time after ranching has ended. The author mentioned above have also found, based on faecal analyses, that warthog activity is highest in areas with a low grass layer and high proportion of forbs (herb and legume species). With the onset of the dry season, warthogs largely switch to eating a higher proportion of roots, rhizomes and shoot bases in order to increase the amount of protein and carbohydrates, therefore habitats that contain this kind of vegetation become important to warthogs (Rodgers, 1984)

Aim of the study

The aim of this study was to investigate how active bomas influence the habitat choice of warthogs. Since other studies have shown that warthogs are pioneer species in populating abandoned bomas and that many of the plant species that warthogs prefer grows there, I consider it interesting to look in to how the active bomas influence the habitat choice of warthogs since I have only found research on the influence of abandoned bomas or cattle ranches. I hypothesize that warthogs will be attracted to the bomas because of the change in plant species composition around the bomas. Livestock faeces will add nutrients to the soil and this will make plants favoured by warthogs grow there.

Material and methods

Study area

The study was carried out in the Maasai Mara National Reserve (MMNR) and the adjoining group ranch, Koyake GR, in South-western Kenya (1°20´S, 35°08´E). The reserve borders the Serengeti National Park in Tanzania, and is a part of the same ecosystem. The study area covered ground rich in grass, both within and outside the park, hence the effect of livestock grazing was evident. In order to describe seasonal variations and its changing conditions two seasons were chosen. The observations were conducted during December 2003 and May-June 2004, because of the great difference in grass quality and grass availability between the seasons.

Selection of transects

Transects were defined as areas a 1000 m long and 300 m wide (i.e. 0.3 km^2), with central points of 0.5 km (T1), 3 km (T2) and 5.5 km (T3) away from bomas. The central points were selected to create a gradually reduced impact of humans and livestock. The transect areas consisted of open grassland with no or few trees and shrubs, and topography chosen to allow good visibility.

12 bomas was considered sufficient to answer the question of effect of bomas on wildlife. In total 36 transects, three per boma, were included in the study. When the transect closest to the boma (T1) was selected, the following ecological features were recorded; soil type, termite hills, stones and vicinity to permanent water, shrubs and woodlands. Thereafter, the T2 and T3 transects of the focal boma were chosen in order to match the same ecological criteria as T1, as closely as possible.

Recording method

Observations were made from the roof of a car, equipped with a GPS. The car followed the central line of the transect (hereafter called transect line), alternating the starting point between both ends. To prevent startling the warthogs on the first part of the transect, observations started when the car was 200 meters from the start or end point, aligned with the transect line. When there was a boma, river, hill or other physical obstacle that did not allow driving directly to the transect, the transect was approached from the side, usually in a 45º angle.

Data collection was systematically carried out on the three types of transects (T1, T2 and T3) every second hour evenly spread over day and night on both occasions. For each observation recordings of exact time, light intensity, weather, temperature, humidity, and phase of the moon were taken.

All animals encountered on the transect were included in the data collection. The number of warthogs on the transect was counted and noted. The distance from the car to the animal was recorded with Leica© Rangemaster CRF 1200. The presence of people, cars, and livestock were recorded when within 300 m from the transect line. To record the impact of man and its livestock in the transect areas, a herd or gathering was recorded as one unit, independent of the number of individuals.

Position of the animals
The position of the animals was recorded in detail to enable calculation of number of animals per area unit. The distance between the car and an animal (or a cluster of animals) was measured. To calculate the distance between the transect line and the animal at a 90° angle, a protractor was used to determine the angle between the animal's position and the transect line. This angle, together with the distance between the car and the start point of the transect (not of the drive), was used to calculate the exact position of the animals on the transect. Calculations were made using sines law:

$$a = \sin v \times b$$

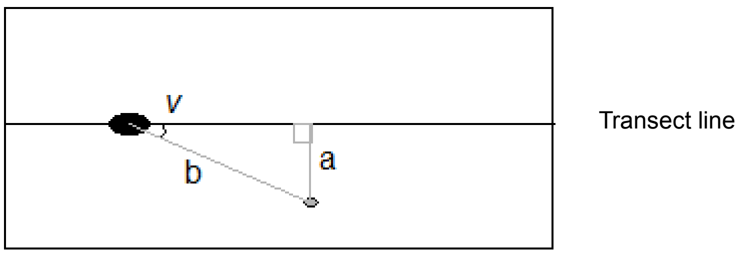

Fig. 1. *Sketch of a transect area, explaining how to calculate the distance between the transect line and the observed animal. Using the law of sines with the measured angle* v *and the distance* b *from car to animal, the distance* a *was calculated*.

Animals found to be more than 150 m from the transect line were excluded from the data, as they were not present within the transect area. If the centre of a cluster of animals were located outside the transect all animals in the cluster were excluded. Likewise, when the cluster centre was located inside the transect all animals were included.

Minimising the impact of recorders on animals' behaviour
To minimize the impact of the observers, a flexible way of driving and observing was adapted. Larger groups of animals on areas with short grass seemed to be less affected than single animals in high grass which had to be recorded from a greater distance.

Statistical analysis
The collected data was sorted in Microsoft Excel® and analysed in MiniTab®. The data was tested for normal distribution using the Anderson-Darling test and were found not to be normal distributed. In the statistical analysis, the non-parametric Kruskal-Wallis rank sum test was used to test for statistical significance. To test if animals were missed due to human and/or environmental factors, the mean distance of all animals were calculated. If all animals were seen, they should be evenly distributed over the transect, and the mean value of distance from the transect line should be approximately 75 meters.

Results

I have combined the observations from august 2003 and may-june 2004 to get a larger sample size.

The results show that no warthogs were found on the T1 transects i.e. the transects closest to the bomas. It also shows that warthogs show a significantly higher preference for the T3 transects over the T2 transects (N=48, p=0,041, df=1, H=4,17, z=±2,04) Median value for T2 was 0,000 and for T3 0,315. When testing for significance between the T1 and T2 transect I found that warthogs also show a significantly higher preference for the T2 transects (N=48, p=0,048, df=1, H=3,92, z=±1,98). Median value for T1=0,000.

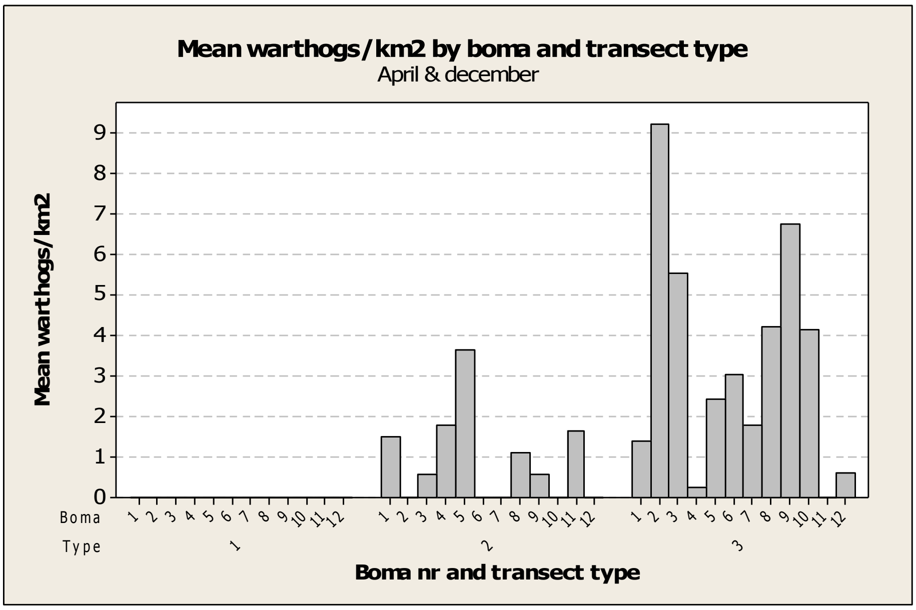

Fig 2. *Bar chart of mean warthogs/km2 by boma and transect type.*

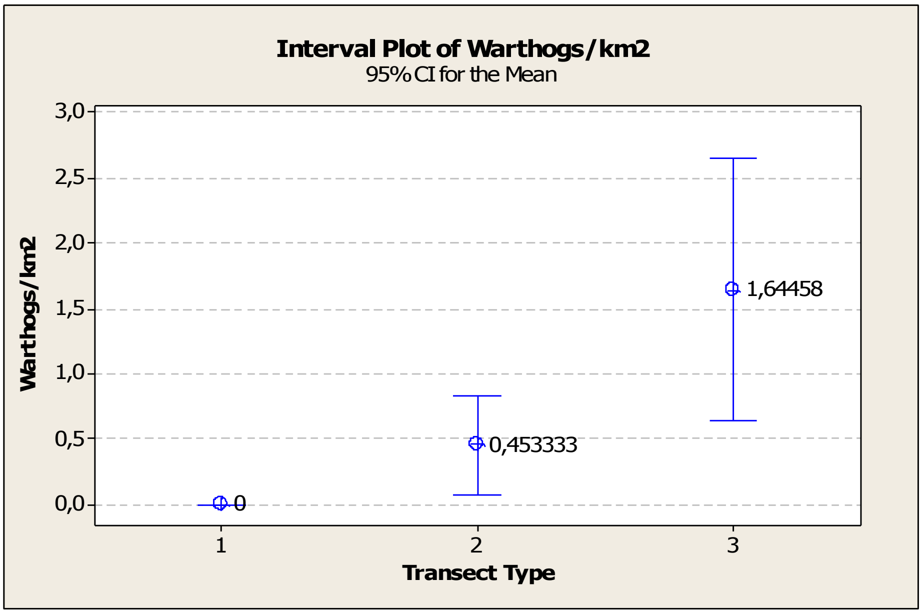

Fig 3. *Mean values of warthogs/km2 with standard deviance by transect type at 95% CI of mean.*

The mean value for the T2 transects is 0,453 warthogs/km2 with a StDev of 0.895 and for the T3 transect the mean value is 1.645 with a StDev of 2.389. No warthogs were found on the T1 transects therefore the mean and StDev are 0.

Discussion

The fact that warthogs seems to avoid going close to the bomas indicates that there is some factor that makes the areas around the bomas unattractive to them. As I already mentioned, warthogs might be hunted for meat in some areas. It is unlikely that this occurs in the study area though, as it is taboo to hunt wildlife among the maasai population (personal communication, James Kaigil 090310), although it can not be ruled out that this occurs to a small extent. In the MMNR hunting is prohibited so I have to assume that this is respected.

Since warthogs are bearers of several diseases that livestock is susceptible to it may be likely that they are chased from the bomas. According to a maasai (personal communication, James Kaigil.090315), warthogs are sometimes hunted and killed by small boys living in the bomas to provide food for their dogs. The driving away and hunting for dog food of warthogs could to some part explain the results but it seems improbable that this is the whole explanation. The hunting pressure would have to be quite severe to keep all warthogs away from these areas and since the end points of the T1 transects are at least a kilometre away from the bomas the pressure would probably decrease with the distance from the bomas and some warthogs would be found at least at the far end of the transect.

Warthogs compete with livestock for food and the case might be that the livestock have used up most of the grazing opportunities around the bomas and therefore no warthogs are attracted there and goes to seek pasture at other places. In May-June the grass layer is lower around the bomas and the T1 transects than it is around the T2 and T3 transects. In December this difference is much less pronounced (Personal communication, Jens Jung). This is one of the reasons for choosing these two observations periods. I expected there two be a difference between the two observation periods since grass more attractive to warthogs would grow close to the bomas in May-June, but as I have shown there were none.

All of the T1 transects are located outside of the park and the T2 and T3 transects are located inside the park. No warthogs were found on any of the T1 transects, this would indicate that warthogs avoid going outside the park. Livestock are not allowed in the park but I have personally witnessed cattle grazing inside the border so this occurs anyway, although probably to a small extent. The data suggests that warthogs avoid areas inhabited by humans, the reason for this is not clear but, as the author mentioned above hunting pressure might be one reason. Sinclair (1985) suggests that warthogs employs a mixed evolutionary stable strategy to cope with the pressure of both predation and interspecific competition but he also shows that interspecific competition is not the dominating evolutionary process of the ungulate community. Since warthogs are attracted to short grass with high nutritional value (Treydte et al. 2006) it was a bit surprising that warthogs favoured the T3 transects over the T2 transects since the T2 transects ought to have contained grass more attractive to warthogs e.g. shorter grass, at least during May-June. Grazers of large body size may facilitate the availability of grass for smaller species (Farnsworth et al., 2000) this could also be a possible explanation to the results. Warthogs could be staying close to other grazers in order to gain access to higher quality forage while at the same time gaining protection from predators and also having the benefit of their warning systems.

Human activity seems to have a big impact on the habitat choice of warthogs. In my experience warthogs are cautious animals with a flight distance larger than most other animals in the MMNR . This might help explain why it keeps its distance from human settlements.
Most of the warthogs were found on the T3 transects and that must mean that they can meet their nutritional requirements in these areas and with the advantage of not running the risk of being pursued by humans. Other species that graze the savannah could be feeding on plant species that is less favoured by warthogs, leaving room for species that appeal to warthogs more and therefore drawing them to these areas. Most of the bomas are located outside of the MMNR and all of the T3

transects are located inside. This means that there is no hunting pressure from humans around the T3 transects but there might be around the T1 transects. To some part this could explain the distribution of warthogs in the study area. A more detailed analysis of the surrounding landscape, the vegetation and probably the density of other species is needed to be able to answer this question.

It has been suggested that interspecific competition plays an important role in the habitat choices of grazing species in Kenya, e.g. Impala, Zebra and Heartbeest, but animals of different species may also stay together for mutual protection from predators (Sinclair, 1985). This may be a key factor in interpreting the results in this study. The animals must weigh the benefits of having access to high quality forage against the cost of being less protected from predators, and in this case it seems warthogs choose protection over grass quality. Since different species use the same kind of strategy, the habitat might be acceptable for many species both from a security perspective and from a forage perspective. The different species might help each other in sustaining a grass quality suitable for different needs.

Conclusions

Warthogs clearly avoid active bomas. Human activities disturb them in some way, either indirectly by allowing their livestock to feed around the bomas and thereby removing the grazing opportunities for warthogs, or directly by hunting them or chasing them away. Warthogs probably graze among other species to gain access to protection from predators and other species also feed in the same place which makes species that warthogs favour grow there.

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Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science
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