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(Phacochoerus africanus) i Kenya*

Frida Svemer

Etologi och djurskyddsprogrammet



Photo: Frida Svemer

Sveriges lantbruksuniversitet
Institutionen för husdjurens miljö och hälsa
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Frida Svemer

Studentarbete 340, Skara 2010

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kurskod EX0520**

Handledare: Jens Jung

Institutionen för husdjurens miljö och hälsa, Box 234, 532 23 Skara

Examinator: Jenny Loberg

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

Avdelningen för etologi och djurskydd

Box 234, 532 23 SKARA

E-post: hmh@slu.se, **Hemsida:** www.hmh.slu.se

I denna serie publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

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1 ABSTRACT

Warthogs live under natural conditions in matriarchal groups, bachelor groups and yearling groups. Just like all pig species do warthogs have a complex behaviour repertoire.

The semi-wild warthog population at Kichwa Tembo Lodge, outside Masai Mara National Reserve, lives in a fenced area with access to food all over the year and is protected from predators.

The aim of this study was to observe the male warthogs' mating behaviour and their hierarchy during the mating season. I identified eight males and observed their behaviour for five days, using continuous sampling.

To calculate the boars' hierarchy I designed an index by summing how many times they had performed the behaviours attack, defend, threat and walk away. With the help of that score I ranked the boars. The two most successful boars in terms of mating had two completely different strategies towards other boars. One was an aggressive one whereas the other one was a sneaker, avoiding other boars.

I found that a behaviour called tractor sound, a sound used by males possible to court females, strongly was correlated with courtship ($r=0.932$; $p=0.001$). The boar pressing his head against the sow's back was strongly correlated with copulating ($r=0.953$; $p<0.001$). This means that these behaviours occur when boars are courtesan sows.

The behaviours that are most significant to courtesan and copulating are tractor sound and head against back. There is definitely a hierarchy among the boars during mating season.

2 SAMMANFATTNING

Vårtsvin lever i matriarkala grupper, ungarlsgrupper och grupper med årsungar. Precis som alla grisarter så har vårtsvinen ett komplext beteenderegister.

Den halvvida vårtvinspopulationen på Kichwa Tembo Lodge, utanför Masai Mara National Reserve, lever i ett inhägnat område med tillgång till mat året runt och är skyddade från rovdjur.

Syftet med den här studien var att observera vårtvinshanarnas parningsbeteenden och deras hierarki under parningssäsongen. Jag identifierade åtta galtar och observerade deras beteenden under fem dagar, med kontinuerlig beteende registrering.

För att beräkna galtarnas hierarki designade jag ett index genom att summera hur många gånger de hade utfört beteendena attack, försvar, hot och gå ifrån. Med hjälp av den summan rankade jag galtarna. De två mest framgångsrika galtarna i avseende parning hade två helt olika strategier mot andra galtar. En var aggressiv medan den andra var en smitare, och undvek andra galtar.

Jag såg att ett beteende som kallas traktorljud, ett ljud som används av galtarna för att uppvakta suggorna, var starkt korrelerat med uppvaktning ($r=0,932$; $p=0,001$). Galten trycker sitt huvud mot suggans rygg är starkt korrelerat med parning ($r=0,953$; $p<0,001$). Det här betyder att de här beteendena sker när galtar uppvaktar suggor.

Beteendena som är mest signifikanta vid uppvaktning och parning är traktorljudet och huvud mot rygg. Det är definitivt en hierarki mellan galtarna under parningssäsong.

3 INTRODUCTION

The common warthog (*Phacochoerus africanus*) is distributed widely over Africa (d'Huart & Grubb, 2001). They graze on vegetation during the day and spend their nights in burrows (d'Huart & Grubb, 2001). Unlike the desert warthog (*P. aethiopicus*), the common warthog has incisors and lives under relatively ruthless environment like *Acacia Commiphora* savanna woodland, subdesertic scrubland and steppes (d'Huart & Grubb, 2001). Muwanika et al. (2003) found that there are no physical barriers between the two species; their interpretation is that it is geological events like climate and habitat shifts that separate them.

3.1 Group structure

Under natural conditions, warthogs live in four different types of social groups; lone adult males, bachelor groups, yearling groups and matriarchal groups. The lone adults usually live solitary but are occasionally sighted grazing near other types of groups. Bachelor groups consist of two or three males from one year and older. Solitary males can occasionally form small bachelor groups while grazing. A yearling group contains only yearlings and no other age groups, often siblings and sometimes other yearlings of both sexes. When the farrow groups of mixed sexes break up, the yearling males become lone adults or form a bachelor group. The matriarchal groups consist of one or more females with juveniles and can sometimes even consist of yearling females. These groups can be quite stable for relatively long periods. During the mating season do the group structures change, especially for the lone adults who join the matriarchal groups and the bachelor groups who split up (Somers et al., 1995; White et al., 2010). Neither females nor males defend a territory and every group has overlapping home ranges. However, each warthog compete every night for burrows (Plesner Jensen et al., 1999). Boshe (1981) showed that the mean group size is about 3-4 individuals.

3.2 Social behaviour

3.2.1 Allogrooming

Allogrooming is when warthogs rub, nibble and/or lick each other. The most common form is when one warthog nibble the skin and hair on the ventral area with its incisors. It is more observed among females than among males. They usually invite allogrooming by lying down and sometimes roll over (Somers et al., 1995).

3.2.2 Greeting

When warthogs greet to each other they use naso-nasal or naso-oral contacts. Greeting is often followed by playing, fighting or separation of the two warthogs (Somers et al., 1995).

3.2.3 Agonistic behaviour

Agonistic behaviours consist of several steps from a threat and may continue to serious and violent fighting. A threat begins with a lateral display, piloerection and lifted tail. They also raise their head. Then warthogs approach head-on and sniff each other similar to greeting, which follows by head to head fight. That involves pushing and sometimes tossing movements of the head. They can also stand apart and rush against each other from a distance of 0.5 to 1 meter and make contact. Some warthogs are submissive and retreat when they are standing in front of another threatening warthog. The submissive one will lower its head and sometimes go down on its carpals or lie down, pointing its ears backwards. Some warthogs just retreat by move away from another after being approached or fighting. Outside the mating season no fighting is observed between adult males (Somers et al., 1995).

3.2.4 Hierarchy

The dominance hierarchy in domestic pigs, *Sus scrofa*, is a social structure which is established after forceful fighting when unacquainted pigs are brought together (Meese & Ewbank, 1973). Both European wild boars and feral males actively compete for access to an estrous sow (Graves, 1984). Tanida et al. (1991) saw that domestic boars select their mating partners rather than randomly courting their mates. The selection in multi-sire mating is not only determined by mate preference but as well by social dominance among boars.

3.3 Sexual behaviour

Female warthogs reach sexual maturity at about 20 months of age (Boshe, 1981). The domestic pig has an estrus period of 18-24 days. The ovulation starts 24-36 hours after an estrus begins (Dalín & Einarsson, 1990). As foreplay the boar does a grunting sound by clamping his jaws and causing his tusks to clack, generating enormous amounts of saliva (Dalín & Einarsson, 1990; Graves, 1984). Then he walks beside the sow and nudges her along her sides (Dalín & Einarsson, 1990). The females' receptivity to mating increases with the intensity of the boar's odor and saliva (Perry et al., 1980). Mating behaviours and other events follows a diurnal pattern with a peak in the morning and one during the afternoon. There is almost no mating during the dark hours (Grigoriadis et al., 2000). In Selous Game Reserve, Tanzania, Boshe saw in his study 1981 that warthogs have a gestation period of around 160 days; their gestation period starts around March to May and farrowing takes place in August to October.

3.3.1 Promiscuity

Warthogs are promiscuous, i.e. both males and females mate with more than one partner (Tanida et al., 1989, Somers et al., 1995). Kongsted & Hermansen (2008) studied sows in a pen and saw that every sow copulated for an average of five times per estrus. Females may do so to protect their juveniles (Pedersen et al., 2003). The males would be uncertain of the

paternity and prevent them from gaining benefit by killing juveniles not considered to be their own (Pedersen et al., 2003). It is the highest sow and boar in the hierarchy that gets the most copulations (Pedersen et al., 2003). During copulation a transparent, gelatinous vaginal plug is left in the females. It forms a barrier in the cervix and vagina to minimize leakage of the ejaculate. The plug can also lower the chances of succeeding insemination by other males (Somers et al., 1995).

3.4 Aim of the study

The aim of this study was to see what kind of mating behaviours the male warthogs perform. I also wanted to analyze the hierarchy among the males during mating season. Another aim for this study was to see if it was feasible, and then use my study-design for a bigger study. To my knowledge has no one else has done any study of warthog mating behaviour; I chose this topic to contribute for further understanding of warthogs and their behaviour.

My particular questions to answer were the following:

1. Which behaviours occur when the boars court the sows?
2. How is the hierarchy among the males during mating season?
3. Do the boars highest in hierarchy have the highest mating success?

4 MATERIAL AND METHODS

4.1 Animals

I observed semi-wild warthogs living at Kichwa Tembo Lodge, a lodge located right outside the northwest border of the Masai Mara National Reserve. The lodge has a fence against larger animals but the warthogs can walk in and out. The warthogs have been living at the camp site since its opening in 1982 and the staff at Kichwa Tembo thinks that they had around 30 warthogs living there. I was there for seven days in March 2010 and observed the males' mating behaviour and their hierarchy during the mating season, two days for testing the methods and five days for observation.

4.1.1 Identification

I photographed every male from the side and from the front and noted down what was specific about them like the tusks, scars, specifics and black spot under their eyes. In total I identified eight males; see Table 1. I also used the two first days to identify the eight males, with the help of two local masai field assistants.

Table 1. Identification of the boars at Kichwa Tembo.

Male nr	Identification
1.	Left ear is gone, right tusk is shorter, broken.
2.	No tail, left tusk is shorter, broken.
3.	No fur on his back.
4.	Very short tusks, about 5 cm and slim belly, walks very straight with right rear leg.
5.	Long and thin tusks, right tusk shorter, broken.
6.	Long and thin tusks, uneven, limping on left foreleg
7.	Very short tusks, about 6 cm and round belly.
8.	Very short tusks, has a scar high up on right rear leg

4.2 Ethogram

To design an ethogram I observed the warthogs for two days to get a picture of what behaviours that occurred. I also adapted an ethogram from Eguchi et al. (1999). For definitions of the behaviours see Table 2.

Table 2. The behaviours that I recorded, their shortenings and definitions.

Behaviour	Shortening	Explanation
Attacking	AT	Attacking another male, piloerection and tail lifted
Copulating	CP	When the male has his penis in the female's vagina
Courtesy	CO	Male running after female or stands right beside her
Defending	D	Defending itself when being attacked
Head against head	HH	Pressing their heads against each other
Marking	M	Urinating on female's urine after smelling it
Pressing head against spine	HBA	Male pressing his head against female's spine
Pressing head against bottom	HBH	Male pressing his head against female's bottom, under her tail
Riding	RI	When a male rides on a female but does not have his penis in her vagina
Riding attempt	RA	Attempt to ride on a female
Threatening	TH	Threatening another male, piloerection and tail uplifted
Tractor sound	TS	A special sound that male makes while courtesing the female. Sounds like an old tractor.
Walking away	W	Walk away from another male

4.3 Data collection

I observed them on the front lawn of the lodge; this place was chosen since it seemed to be the preferred meeting place of the warthogs for social interactions. As a sampling method I used continuous behaviour sampling between 07:00 and 12:00 hours and again between 14:00 and 17:00 hours. Every time the warthogs performed one of the behaviours from my ethogram I wrote it down. If the warthog took a break from the behaviour for more than 5 seconds or interrupted that behaviour with a different one I wrote it down as a new recording. I noted every time a male directed a certain behaviour against another male or female, and I noted which male performed it.

4.4 Data analysis

I used Microsoft Excel to enter my data and then Minitab 15 for analyzing the data. I used Pearson correlation test to show correlations between certain behaviours. Since a total of 36 correlations were calculated, mass significance had to be avoided. I used Bonferroni correction to eliminate false correlations. To calculate the hierarchy among males I designed a weighted index. The formula was $I=2AT+2D+T-W$, i.e. twice recordings of attacking plus twice recordings of defending plus once recordings of threatening minus once recordings of walking away. I considered attacking and defending is more active behaviours, therefore I took them twice. However, there are arguments for another way of calculation the index (see discussion), so I calculated even an unweighted index as $I=AT+D+T-W$.

5 RESULTS

5.1 Mating behaviour

With Bonferroni a got a p-value of $p < 0.0014$ and can see that only two correlations is true, head against back (HBA) with copulating (CP) and tractor sound (TS) with courtship (CO). When the boar pressed his head against the sows back this behavior was highly correlated with copulating ($r=0.953$; $p < 0.001$, Table 3). Tractor sound was highly correlated with courtship ($r=0.932$; $p=0.001$).

Table 3. Pearsons' correlation between the male warthogs mating behaviour. The upper value is the r-value and the lower the corresponding p-value. CO = courtesan, CP = copulating, HH = head against head, HBA = head against back, HBH = head against behind, M = marking, RA = ridning attempt, RI = riding and TS = tractor sound.

	CO	CP	HH	HBA	HBH	M	RA	RI
CP	0.495 0.212							
HH	0.546 0.162	0.240 0.568						
HBA	0.610 0.108	0.953 0.000	0.137 0.746					
HBH	0.783 0.021	0.765 0.027	0.766 0.027	0.701 0.053				
M	-0.081 0.848	0.445 0.269	-0.080 0.850	0.402 0.323	0.084 0.844			
RA	0.773 0.025	0.812 0.014	0.295 0.478	0.845 0.008	0.784 0.021	0.032 0.940		
RI	0.088 0.836	0.840 0.009	0.181 0.668	0.712 0.047	0.513 0.193	0.732 0.039	0.476 0.233	
TS	0.932 0.001	0.566 0.143	0.414 0.308	0.710 0.049	0.741 0.035	-0.133 0.754	0.764 0.027	0.120 0.778

5.2 Hierarchy

In index 1 male number 3 got the highest score, 45 points, male number 1 got the second highest, 23, and male number 6 got the third highest, 18. Male number 8 also got a positive

score, 8; whilst the rest got negative scores (see Table 4). The same ranking is found in index 2.

Table 4. Recordings of male warthogs performing a specific behaviour against another male warthog. Index 1 was calculated by $2AT+2D+T-W$. Index 2 was calculated by $AT+D+T-W$. Active column was calculated as $A+D+T+W$. Sorted by Index 1.

Male nr	Attack	Defend	Threat	Walk away	INDEX 1	INDEX 2	ACTIVE
3	10	0	25	0	45	35	35
1	6	0	11	0	23	17	17
6	9	0	10	10	18	9	29
8	6	1	4	10	8	1	21
7	8	3	8	31	-1	-12	50
2	1	0	0	7	-5	-6	8
5	0	1	4	18	-12	-13	23
4	1	2	7	33	-20	-23	43

The correlation between copulating and index 1 was strongly positive (0.487) but not statistically significant with Pearson correlation test. Table 5 shows that the boar that got the highest hierarchy score got the most copulations but also a boar that didn't get a good score.

Table 5. Hierarchy score compared to the amount of times the boar copulated. Sorted by Copulating.

Male nr	Index 1	Index 2	Active	Copulating
3	45	35	35	2
7	-1	-12	50	2
4	-20	-23	43	1
1	23	17	17	0
6	18	9	29	0
8	8	1	21	0
2	-5	-6	8	0
5	-12	-13	23	0

6 DISCUSSION

6.1 Mating behaviour

As Dalin & Einarsson (1990) recorded does the boar make that clapping sound that I called tractor sound when he courts the sow. I suggest that the boars do that to partly get the sows attention; it might partly be some sort of signal that starts some reactions in the sows. The foamy saliva that Graves (1984) wrote about I did not see; I saw some saliva in the corner of their mouths but that was not foamy. I do not think that the saliva have any contribution to the courtship of the sow; It suggest that it is just a side effect of the teeth clapping.

When a boar is laying his head against a sows back he is testing to see where in estrus she is, if she is ready to mate and will get a standing reflex (Eguchi et al., 1999). If she is not ready to mate she walks away when he puts his head on her back or tries to ride her. If the sow is showing some sign of standing reflex (Langendijk et al., 2000; Gäde et al., 2008) when the boar presses his head against her back the boar makes a riding attempt. However, often it never goes longer than to an attempt because she doesn't seem to be ready. If the sow shows a little sign of standing reflex but then walks away the boar sticks around by her side and keep trying until she is ready (personal observations). I also saw that the boars can be quite persistent when they are courting a sow, it almost looks like harassment. I got a very strong correlation between head against back and copulating and from that I can see that almost always when the boar puts his head against the sows' back it leads to copulating. As mentioned earlier I think it is because when he notices that she is starting to get into estrus he sticks around by her side and chases away all the other boars. What I saw when I did my observations was that the boar never left the sows shadow until he had mated with her, and even then he stayed for a few more hours to make sure that no one else got to mate with her. The sows main reason to mate with several boars is to make sure that they wont know who the father is. Infanticide is killing of conspecific young and has been documented in more than 100 species of mammals (Agrell et al., 1998).

As soon as the sow started to allow the boar to ride on her it almost always leads to copulating. The reason that I did not get a strong correlation can be that the boar gets disrupted when he is trying to copulate with her by other boars. As soon as a boar is riding a sow I saw that all the boars that was in the nearby came to look and try to disrupt.

The boars' odor and saliva increases the females' receptivity to mating (Perry et al., 1980) and the more boars there are the likelihood of transmitting more odors and saliva from boars to sows increase (Tanida et al., 1989). From that I draw the conclusion that it would be in the boars' interest that he is not alone with the sows, but he must be the one to mate with her when she is ready to mate. Tanida et al. (1989) got the same result in their study in multi-sire mating system. As long as there is more than one boar per box the courtship behaviour per boar was longer and there was more mounting per boar as well.

Since there is not that much research done in warthog mating behaviour, I used literature from domestic pigs and European wild boars (*Sus scrofa*). Eguchi et al (1999) found some differences in courtship behaviour between wild boars and domestic pigs. In domestic pigs the key sexual behaviour is nosing meanwhile the key sexual behaviour for wild boars is sniffing. The wild boars courtship behaviour is more fixed and compared to domestic pigs' proceeds more step by step (Eguchi et al, 1999). According to Niall Anderson (personal communication, 2010-04-23), manager at Kichwa Tembo, the group structure have very few changes over the year. Hence, males and females live together throughout the year,

which is unnatural. This can be due to the fact that the area is fenced so there are not any predators and they have access to a large amount of food. Therefore I cannot conclude that the behaviours the warthogs I observed did is the same for wild living warthogs in Masai Mara.

According to White and Cameron (2009) one main factor in burrow choice in warthogs is protection from predators. That might be one of the biggest reasons why the warthogs prefer to stay at Kichwa Tembo's fenced area where they sleep under human-made constructions or even cars instead of burrows.

6.2 Hierarchy

I designed an index to calculate the hierarchy among the boars. To get a hierarchy index that is based upon agonistic and antagonistic behaviours I took the recordings they had attacked another boar times two and did the same with defending, adding those two. Then I added when they had threatened another boar to the sum, and from that I subtracted the times they had walked away. With that equation I got a score that I used to rank the boars. To compare index one I calculated a second index but without doubling attacking and defending. When I compared the two indexes I saw that the four boars that had the highest score were the same in both indexes. I also designed another index of how active the boars were, when I added all the times the boars had done the behaviours attack, defend, threat and walk away. I got two diverse scores from the three different indexes. However, I do not think that the third index is quite representative, because it shows more about how active they are, without consideration about agonistic and antagonistic behaviours.

As you can see in Table 5 the two boars that had the most copulations had very different scores. Boar 3 got the highest score in index 1 and index 2 but the third score in index active. In contrary, did boar 7 get a low score in the two first indexes and the highest score in the active score, simply because he walked away from the other boars most times. Even though he wasn't the one who was the highest in rank he did copulate with two sows. Reichard et al. (2007) found that high reproductive success of dominant males is because they monopolizing the access to the females. Tanida et al. (1989) and Somers et al. (1995) saw that warthogs are promiscuous which means that both sexes choose their partners. Females' choice does not always discriminate between dominant and subordinate males (Reichard et al., 2007).

When I arrived to Kichwa Tembo the mating season had already started. So when I was observing the warthogs I did not see that many fights or aggressive behaviours. My explanation is that the boars had already set their hierarchy before I came. During my second day observing I saw a new boar, number eight, and immediately it was much more action, both among the boars and the sows. If I would do this study again I would make sure that I was at the area before the mating season started so that I could compare the hierarchy before and during mating season. As well as to be able to see what behaviours and signs they use to establish hierarchy. Since the warthogs live together all year over at the area, both males and females, it is hard to know if there is much fighting over the females or if it is the same hierarchy over the year.

As warthogs naturally live in small groups of 3-5 sows with their piglets (Turner & Edwards, 2004), I imagine that it is some intrications during from time to time. However, I never observed the sows and hence I do not know how they are divided in smaller groups.

However, from what I could see were some sows always together. My guess would be that the warthogs that live at Kichwa Tembo area have their own groupings but closer together.

Pedersen et al. (2003) saw that it was the highest sow and boar in the hierarchy that gets the most copulations. den Boer (1999) described the phrase survival of the fittest; it implies that individual properties are either favorable or injurious under certain conditions. The sneakers are not high ranked and I think that sometimes might the sow see some qualities in lower ranked boars that she likes more and that might be why they get to copulate. If the boars and the sows only would chose the highest ranked then they might miss some qualities that can get lost in generations.

Turner and Edwards (2004) looked at hierarchy establishment with large group size in domestic pigs. They found that the energetic cost for establishing dominance relationships is increasing with group size. It is likely to apply this to the group of warthogs at Kichwa Tembo. From the photographs that I took to identify the boars I can see that the males that had the highest hierarchy are also the slimmest.

6.3 Methods

I think my methods worked very well for my questions. It might be to recognize the hierarchy because animals have so subtle signals that we humans do not always see or interpretate right. To get the hierarchy in a group you have to record who the transmitter is and who the recipient is. To calculate the data you get to get an accurate hierarchy is not easy, it can be done in many ways and interpreted in many others. Puppe et al. (2008) did a linear hierarchy among domestic pigs at different stages in production. It was a comparative analysis of the social hierarchy and they observed agonistic interactions and sociometric values and would be interesting to use the same methods in warthogs.

6.4 Future research

For a larger study I would follow the group that lives at Kichwa Tembo for a longer time and start about a month before the mating season to be sure to get all of the mating behaviours. In order to o get the frequency you can use my sampling record but if you want the duration it would be necessary to make adjustments. It would be interesting to get the duration of the behaviours to see which are most important and to see what behaviour that follow another.

7 CONCLUSIONS

The behaviours that are most significant to courtesan and copulating are tractor sound and head against back. The warthogs perform more behaviours but I did not have enough time to observe them to get significant results regarding the behaviours.

There is definitely a hierarchy among the boars during mating season. But since I arrived to the area when the mating season had already begun I think I missed out of their settlement.

I think it needs to be more research about warthogs mating behaviour since there is almost nothing done.

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