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Faculty of Tropical AgriScience

Marking behavior of guanacos

Bachelor thesis

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Declaration

I hereby declare I wrote my bachelor thesis "Marking behavior of guanacos" myself and I have used only sources cited in text and list of references. I agree that my work will be accessible for future studying purposes in the library of CULS.

Prague, 15th April 2016 ……...

Jana Kalitová

Acknowledgement

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Abstract

The aim of my thesis was to expand the knowledge about territoriality and olfactory communication of lama guanaco (*Lama gLama guanicoe* , Müller, 1776) and analyze the influence of seasonality and reproduction on spatial utilization of latrines, and evaluate interactions, order and behavior in relation to marking behavior. Data were obtained by direct observation of two groups of lama guanaco at Czech University of Life Sciences Farm Estate at Lány in 80 hours. I have not found any significant effect on distance from herd during excretion. This could be caused by lower number of records or changes in behavior caused by the division of the enclosure into two paddocks. There was weak significance that animal will sniff after marking according to place where animal excreted, equally was weak significance that animal will sniff before marking. Hypothesis that animal will sniff at latrines with higher probability before marking after another animal has not been confirmed. Neither hypothesis that animal will sniff at latrines with higher probability after marking has been confirmed.

Key words: guanaco, communication, territoriality

Abstrakt

Cílem mé práce bylo rozšíření poznání o teritorialitě a olfaktorické komunikaci lam guanako (*Lama gLama guanicoe,* Müller, 1776) a analýza vlivu sezónnosti a reprodukce na prostorové využívání „záchodků“ a hodnocení interakcí, pořadí a chovaní ve vztahu ke značkovacímu chování. Data jsem získala přímým pozorováním dvou skupin lam guanako na farmě Školního zemědělského podniku ČZU v Lánech v rozsahu 80 hodin. Nenašla jsem žádný významný vliv na vzdálenost od stáda během vyměšování. Může to být způsobeno nižším počtem pozorování nebo změnami chování na základě rozdělení výběhu na dva výběhy. Byl zjištěn slabý význam, že zvíře bude očichávat místo po značkování na základě místa, stejně tak byl zjištěn slabý význam, že zvíře bude očichávat místo před značkováním. Hypotéza, že zvíře bude očichávat záchodek s vyšší pravděpodobností před značkováním po dalším zvířeti nebyla potvrzena a ani hypotéza, že zvíře bude očichávat záchodek s vyšší pravděpodobností po značkování, nebyla potvrzena.

Klíčová slova: guanako, komunikace, teritorialita

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1. INTRODUCTION

Olfactory communication plays important role in the lives in mammals (Ewer, 1968). Guanacos are social creatures sending messages to protect their family and saveguard territory (Hoffman and Kaehler,1993). They communicate by body language, vocalization and by scent markin (Hoffman, 2005). Marking, i.e. defecation, in certain places, so called "latrines", is one of the attributes of territoriality of lama guanaco (*Lama guanicoe*) (Filipczyková, 2009). Scent-marking occurs in a similar form in both territorial and dominance mating systems and argued against a simple link with area defense (Gosling, 2001). The latrines in are frequented by territorial males and females in his harem but also by individuals standing outside the territory (Hoffman a Kaehler, 1993). Urine is an important medium for semiochemical communication, because it contains compounds that fluctuate with reproductive and social statu (Albone, 1984). Guanaco is dominant arid land ungulate of South America (Franklin and Grigione, 2005) and belongs to the group known as South American Camelids (San Martin and Bryant, 1989). It holds economic potential for ITS meat (Pérez, 2000) and wool production (Franklin and Johnson, 1994).

On experience gained during my practices at Czech University of Life Sciences Farm Estate at Lány I chose the topic of my bachelor thesis. I found guanacos interesting animals and I would like to clarify something more about their behavior. The results of the study may help further research regarding the marking behavior guanaco llamas.

2. LITERATURE REVIEW

2.1. Guanaco (*Lama glama guanicoe* , Müller, 1776)

2.1.1. History of Camelidae

Fossil records of the family Camelidae is originated in the Great Plains of western North American 9 - 11 million years ago. About 3 million years ago toward the end of the Tertiary period, one branch (*Camelus*) of this family migrated across land bridges at the Bering Straits into Eurasia, to give rise to the present day camels of Africa and Central Asia. In the Ice age, the other branch reached South America and gave rise to the present day lama species (Brown, 2000).

2.1.2. Description

Guanaco (*Lama gLama guanicoe* , Müller, 1776) belongs to family Camelidae, order Artiodactyla, class Mammalia (Marin *et al.*, 2007). It is one of two wild Neotropical camelids and progenitor of domestic llama (*Lama glama*) and it is dominant arid land ungulate of South America (Franklin and Grigione, 2005). Guanaco belongs to the group known as South American Camelids (SAC). They are separated from other ruminants into the infraorder Tylopoda (pad footed) because of their difference in morphology of stomach, absence of antlers or horns, and the replacement of hooves with callous pads ending in toenails (San Martin and Bryant, 1989). All guanacos have similar pelage coloration varying from dark reddish brown (in the southern population) to lighter brown with ocher yellow tones (in the northern variety). The chest, belly and internal portion of the legs are more or less pure white (picture 1). The head is grey to black with white around the lips, eyes and borders of ears (Wheeler, 2012). They are smaller than llamas, they weight is between 100 and 125 kilograms and stand about 150 centimeters high (Hoffman and Kaehler, 1993). Both sexes look alike, they are identical in coloration and similar in body size (Raedeke, 1979). Guanaco has 37 pairs of chromosomes and could be interbreeding with another three species of SAC

(llama, *Lama glama glama*; alpaca, *Vicugna pacos* and vicugna, *Vicugna vicugna*) (Smith, 1994).

Picture 1: Guanaco (Lama glama guanicoe)

2.1.3. Distribution

Guanaco was historically the dominant and most common large mammalian herbivore on the Patagonian steppe (Franklin and Grigione, 2005). Human activities such as sheep ranching and intensive hunting, either legal or illegal, have been regarded as the main causes for the dramatic decreases in distribution and abundances of guanacos during the last century (Donadio and Buskirk, 2006). Patagonia, its current population density has been estimated over 450 000 individuals on the continental part of the region. That number represents > 70% of the total world population of guanacos (Maté *et al.*, 2005). Guanaco is found in a wide variety of habitats including deserts, shrublands, grasslands, clumped savannahs and forests. Guanaco´s distribution spans from dry west-facing slopes of the Andes in northern Peru down the coast to central Chile, the arid east slopes of southern Andes, across the Patagonian foothills and plains, and onto the islands of Tierra del Fuego and Navarino (Franklin and Grigione, 2005). Ninety percent live in southern Argentina and southern Chile where they are found in deserts, beech forests and their preferred grasslands at elevations from sea level to 4,200 meters (Hoffman and Kaehler, 1993). The guanaco´s wide and successful distribution has been made possible by its flexible social organization and adaptable

ecology. Some populations are sedentary and others migratory and its versatile foraging strategies include being both grazers (grasses and herbs) and browsers (shrubs and trees). Habitation of dry environments is surely related to its ability to go for long periods without drinking water when forage moisture is sufficient, and its observed capacity to drink brackish and saline water, including water from ocean surf and tide pools. On the high plateau, cold deserts of Patagonia in southern Chile, the guanaco is the only wild ungulate (Franklin and Grigione, 2005).

2.1.4. Use of guanacos

Guanaco holds economic potential for its meat, which is an important source of protein for the Andean population (Pérez *et al.*, 2000) and wool production (Franklin and Johnson, 1994). The fineness and high economic value of the guanaco fiber make this species an alternative to sheep (Maté *et al.*, 2005). 80% of the total population is utilized (20% legally and the remainder illegally). A proportion of fibre from guanaco farms results from individuals captured in the wild as newborns and raised in captivity, while other proportion of the fibre comes from capturing, shearing and release of individuals in wild populations (wild management). According to Warthová (2012) lama has a number of properties that can benefit in their favor. Strange anatomical arrangement of limbs allows them to move safely in various terrain. Their elastic callouses on the bottom side hooves prevent the destruction of vegetation and the soil surface so they do not rip like goats, sheep or and horses who have sharp hooves. Guanacos are also used as to carry freight (Smith, 1994).

2.2. Reproduction of guanacos

2.2.1. Puberty

Males start showing sexual desire as early as 1 year of age, but normal copulation is not possible, because of shedding of the penopreputial adhesions (Fernández-Baca, 1993). At 2 years of age, 70% of the males are free of the adhesions, and 100% at 3 years of age. Females are sexually receptive at 12 month of age (Sumar, 1996).

2.2.2. Reproductive interests

According to Clutton-Brock *et al.* (1982) male and female guanacos differ in their budgets as a result of differences in their reproductive interests. Female reproductive success will depend mainly on ability to acquire and transfer nutritional resources to the offspring. For most herbivores, this ability is likely to be related to the rate and efficiency of food collection and processing. In contrast, male can enhance their fitness by monopolizing access to breeding females, intrasexual competition is expected to be intense and to affect male time allocation.

2.2.3. Reproductive season

Guanacos in their natural habitat in the highlands of Peru breed from December to March, because these are the warmest month of the year when rainfall is sufficient and green forage abundant. In peasant community farms, where males and females are together all year, the birth and breeding times fall within this range. Observations in various zoological parks around the world also indicate that they are capable of year-round breeding (Sumar, 1996). If males and females are kept separately and allowed to copulate at infrequent occasions, then both sexes are sexually active for whole year. During the breeding season and in the absence of males, females remain in heat for periods extending for up to 36 days, with only occasional periods of anestrus lasting no longer than 48 hours (Brown, 2000). Environmental factors responsible for the onset and cessation of sexual activity under natural conditions are not clearly defined (Sumar, 1996). Females do not have regular periods of sexual receptivity accompanied by spontaneous ovulation of mature ova and they become sexually receptive shortly after giving birth. (Pollard *et al.*, 1994). Ovulation in camelids is induced by penile penetration of the vagina and cervix, and not from mere mounting of the females by males (Brown, 2000). Ovulation is reported to occasionally occur spontaneously at the height of the breeding season in about 5% of llamas (England, 1971). Ovulation can also be induced in alpacas and llamas by treatment with gonadotrophic hormones (Brown, 2000).

2.2.4. Mating behavior

Guanacos exhibit a resource-defense-polygyny mating system (Sarno *et al.*, 2003). Courtship of guanacos begins with the male actively pursuing receptive females and attempting to mount those (Brown, 2000). The male shows an active, and sometimes aggressive attitude during mating in contrast to the passive attitude of the female. Females in estrus show a peculiar behavior pattern in the presence of the male. They either readily assume the copulating position when approached by the male, get close to a mating couple and adopt the copulation posture, or just stand nearby. Occasionally, some females in estrus may mount other females. Non-estrous females strongly reject the male by spitting, kicking, and running away (Fernández-Baca, 1993). The initial male contact was with receptive females approximately equally as often as with nonreceptive females (Lichtenwelmer *et al.*, 1998). According to England *et al*. (1971) is mating behavior divided into courting and copulatory phases. In the courting phase, the male chases the female. This may last for only a few seconds when the female is receptive (Fernández-Baca, 1993). When female accept male, female takes a prone or seated position on her brisket with her pelvis elevates and permits the male to straddle her from behind. Male´s head is above and slightly behind of the female. Male´s elbows hold her at the shoulders and his forefeet are on the ground (Brown, 2000). The length of the copulation varied from shorter than 10 minutes, in some individuals to longer than 45 rain in others (England *et al.*, 1971). During copulation, the mail vocalizes, making a "guttural" sound called "orgling". Female remains quiet (Brown, 2000).

Picture 2: Mating guanacos

2.2.5. Pregnancy and parturition

Pregnancy lasts from 342 to 350 days (Brown, 2000). Rectal palpation is possible as early as 30 days, but is limited by pelvic size and fat deposition in the pelvic inlet. Parturition is generally quick and easy (Sumar, 1996). The majority of females give birth in the standing (Brown, 2000) and most of births occur between 07:00 and 13:00h h. This adaptation gives the newborn called cria the best chance to get warm and dry before the cold of night, when even the summer, freezing temperatures are common at altitude. Guanacos appear to be able to delay birthing for hours or days to avoid giving birth during the night or on cold days (Sumar, 1996). According to Fowler (2010) the fetus should be delivered within 45 – 60 minutes after fluid has first appeared at vulva in case there is no problem during parturition. In captivity problems during parturition are rare (Hoffman, 2005). Some births can take 60 – 90 minutes, even up to 2 hours with first delivery. The placenta is usually expelled within 2 hours after birth. Unlike the others ruminant, guanaco mothers do not eat afterbirth, nor lick their young or even free them from the membranes (Brown 2000).

2.2.6. Suckling

Lactation is the most energetically expensive behavior (Zapata *et al.*, 2009a). Milk production will normally increase in the mother over the first days after birth and cria must obtain passive immunity through ingesting colostrums in the milk (Brown, 2000). Young guanacos, called chulengo, suckle less frequently and spent more time grazing as they grow older (Prescott, 1981). Weaning usually takes place when they are about 7–9 months of age (Brown, 2000).

2.2.6.1. Allonursing and allosuckling

Allonursing is provision of milk to non-offspring by females, involves a potential cost to their own offspring, allosuckling, the suckling from females other than their own mother may allow offspring to compensate for previous deficiencies in maternal milk (Zapata *et al*., 2010). Allosuckling is frequently reported as a common behavior on many ungulate species (Víchová and Bartoš, 2005). It is reported a case of allosuckling of a free-ranging guanaco calf. The transfer of milk or any other form of parental care to unrelated offspring by a female could reduce the amount of nutrient available to her current young or increase the transmission of internal and external pathogens to her (Zapata *et al.*, 2009b). The milk intake from a non-maternal female is believed to be beneficial for the allosuckling infant (Víchová and Bartoš, 2005).

2.3. Social organization

Lama populations are socially organized into family groups, bachelor male groups, and solo males. Family groups are composed of an adult male, several females, and their offspring less than one-year old (Franklin, 1980). Normally the size of a guanaco family group varies between five and thirteen adult animals with an average of 2.9 young. Outside the breeding season, guanaco group composition varies according to environmental conditions (Gonzáles *et al.*, 2006). Life in society involves benefits and costs associated with group formation, which has profound impacts on the stability of the interactions among participants in the social group over time (Correa *et al.*,

2013). Guanaco herd are well-defined social units (Hoffman and Kaehler, 1993). Living as a group conveys benefits related to the optimization of scarce resources (food, space and refuges) and /or measurable decreases in predation risks, increased parasitism and disease transmission and competition for reproduction opportunities (Correa *et al.*, 2013).

2.4. Communication

According to Hoffman and Kaehler (1993) guanacos are social creatures sending messages to protect their family group and safeguard territory. Communication becomes a tool to maintain and protect the family group and safeguard territory. Guanacos communicate by body postures, vocalization and by scent communication. For each situation is combination of position of ears, tail, neck, head, body posture and vocalization. These types of communication are important for territorial males acting as a gatekeeper to predators and lesser males, for females to create their own internal linear hierarchies too (Hoffman, 2005).

When strange male approaches, the territorial male stands rigidly, his tail held high, neck bent in a slight "S" shape, ears pinned back and nose tilted skyward, in what has been termed a broadside display because the guanaco doing it often stands broadside to the animal he is trying to intimidate. From as far as a mile away, the territorial male can give the warning that violence awaits any intruding guanaco and the family group can prepare for the danger by standing close together, while territorial male patrolling herd against predator. If male finds predator, he sounds the "call alarm" (Hoffman, 2005).

Picture 3: Territorial male

2.4.1. Olfactory communication

Olfactory communication plays an important role in the lives in mammals (Ewer, 1968). Mammals commonly use urine and faeces in communication (Jordan *et al*., 2016). Urinary excretion of metabolic by-products undoubtedly plays an important role in olfactory communication. These excreted urinary compounds may aid in the conspecific identification of social status, reproductive readiness, or in recognition of individuals (Gasset, 1999). Olfactory signals facilitate communication in many mammalian species. Urine is an important medium for semiochemical communication because it contains compounds that fluctuate with reproductive and social status (Albone 1984).

Another form of scent communication is called flehmen. This refers to the peculiar way males inhale and sniff dung or urine of females to determine their reproductive status. The male sniff a pile, tilts his head to a vertical position and loudly inhales. Inhaling in this manner helps him assess the female´s reproductive condition (Hoffman and Kaehler, 1993).

2.5. Territoriality

2.5.1. Territorial behavior

Territory is defended area from which an individual or group of mutually tolerant individuals actively excludes competitor from a specific resource (Maher and Lott, 1995). Territoriality is a widespread behavioral trait in mammals, particularly among ungulates (Owen-Smith, 1977). An adult guanaco male defends a territory where a group of females and their offspring feed, from the intrusion of other males, although female herding has been occasionally observed as well. Female usually form highly cohesive and synchronized units in terms of behavior while the territorial male tends to remain distant from the group. Territorial displays, and eventually male fights, are triggered when a peripheral male trespass the territory borders, and these interactions are more common during the mating season. Although the intensity of territorial behavior can vary between seasons and populations, male vigilant behavior is expected to be a conspicuous component of intrasexual competition (Marino and Baldi, 2008).

2.5.2. Territoriality during the season

According to Young and Franklin (2004) males established non-overlapping territories during austral spring in preparation for summer birthing and mating seasons. Males are typically found in 1 of 3 social group types during the territorial season (1 October – 15 March). First type of group, solo territorial males, have been established territory with other guanacos rarely present. Family groups consist of a territorial male, adult females and, some yearlings (1- 2 years old), and individuals younger 1 year, called chulengos. Male groups are composed of immature and mature non-territorial males (Ortega and Franklin, 1995), and can include yearlings recently evicted from family groups and old or injured males. Male groups are found in distinct male group zones, which include almost 20% of the entire summer range (Young and Franklin, 2004).

2.5.3. Scent Marking

Marking behavior in mammals is often stated to be ‘territorial’ or, more specifically, to play a role in territorial defense (Johnson, 1973). Scent-marking is a ubiquitous form of olfactory signaling in male mammals and both territorial males in resource-defense mating systems and dominant males in dominance mating systems scent-mark (Gosling and Roberts, 2001). Scent marking, as a means of territorial defense, is a common behavior in ungulates. Marking frequency is limited by the supply of scent materials: glandular secretions, urine and faces (Sun, 1994). Marking is uniquely among social signals, scent marks are placed on objects in the environment, often in the absence of any receiver, and may only be detected much later, often in the absence of signaler. Signalers are often not present to reinforce their scent signals in the way that is possible for visual or auditory signals and often they cannot know whether a mark will be detected or who the receiver will be. Scent marks may often be degraded before they can be detected for example by rain (Gosling and Roberts, 2001).

Picture 4: One of latrines (guanacos scent communication site) in paddock

Dung-pilling behavior is typical among the South American camelids and is notable where males and females, adults and young urinate and defecate in a defended area (Vilá, 1994). Faeces may be ideal substances for scent marking because they have a minimal energetic cost to the signaler (Brashars and Arcese, 1999). According to Filipczyková (2009) marking behavior is one of the ways, how guanacos show their

territoriality. Males mark their territorial borders with dung piles that are recognizable to other guanacos. The dung piles serve as signposts advertising to other guanacos that a particular territory is already occupied (Hoffman and Kaehler, 1993). The lamoids of South America tend to defecate and urinate in communal piles. Many of these piles have been used year after year and are quite large (up to three meters in diameter, and 20 to 30 centimeters in depth). Communal piles are used by all members of social groups. The communal piles do a little to keep other conspecifics out. Piles function to keep the band within its territority, by providing information on the location of territorial boundaries (Raedeke, 1979). Territorial males mark with faeces more often, and also defecate only on established dung piles along borders (Brashars and Arcese, 1999).

Picture 5: Urinating guanaco

3. AIMS

Extend the knowledge about territoriality and olfactory communication and analyze the influence of seasonality and reproduction on spatial utilization of latrines, and evaluate interactions, order and behavior in relation to marking behavior.

3.1. Hypothesis

1. Probability of sniffing before marking will be higher than probability of not sniffing.
2. Probability of sniffing before marking at latrines visited by more animals will be higher where defecate for the first time.
3. Probability of sniffing after marking will be higher than probability of not sniffing.
4. Probability of sniffing after marking at latrines visited by more animals will be higher than at places where defecate for the first time.
5. Adult male guanacos will use further latrines often than latrines closer to herd.

4. MATERIAL AND METHODS

4.1. Observed animals

I collected my data in two herds located in Lány. I observed these herds from November 2015 to March 2016. Number of guanacos was changed during my observation. During my observation there was constant number of guanacos in the first herd. In second herd, there were at the beginning only five animals (4 males and 1 female). At the end of year 2015 came two new male guanacos from Tierpark Berlin and five guanacos (1 male and 4 females) from Opel Zoo Kronberg. On January 2016 were two males isolated from the herd due to their aggressiveness towards younger guanacos.

Table 1: List of guanacos herd no. 1

Number	Color of ear tag	Sex	Birthdate	From
1	Blue	F	14.6.1991	Zoo Brno
2	Orange	F	17.10.2000	Zoo Brno
4	Yellow	F	1.9.2007	Zoo Brno
5	Red	M	2008	Zoo Jihlava
7	Yellow	F	16.10.2011	Lány
13	Red	F	13.7.2009	Kotrba
15	Pink	F	16.7.2010	Kotrba
28	Pink	F	21.5.2015	Lány
29	Yellow	M	22.6.2015	Lány
31	Yellow	M	1.7.2015	Lány
30	Pink	F	14.7.2015	Lány
32	Yellow	M	4.9.2015	Lány

Table 2: List of guanacos herd no. 2

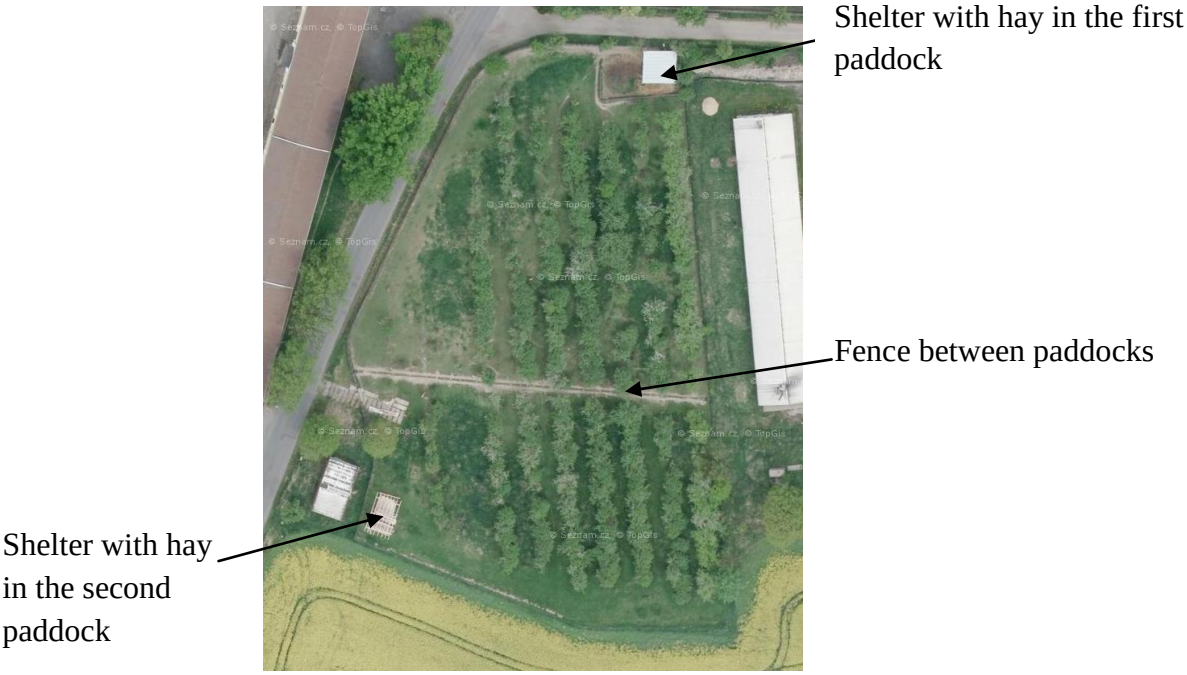
Number	Color of ear tag	Sex	Birthdate	From
16	Yellow	M	22.6.2013	Lány
18	Orange	M	10.9.2013	Lány
24	Green	F	7.6.2014	Lány
25	Yellow	M	23.6.2014	Lány
26	Pink	M	24.8.2014	Lány
B1	Red	M	26.7.2014	Tierpark Berlin
B2	Red	M	13.4.2014	Tierpark Berlin
O1	Red	M	12.5.2015	Opel Zoo Kronberg
O2	Pink	F	12.6.2015	Opel Zoo Kronberg
O3	Pink	F	12.5.2014	Opel Zoo Kronberg
O4	Pink	F	22.6.2014	Opel Zoo Kronberg
O5	Pink	F	8.7.2013	Opel Zoo Kronberg

Male number 5 is sire of all guanacos born in Lány. Female number 1 is mother of 30 and 24. Female number 2 is mother of 28 and 18. Female number 4 is mother of 7 and 32. Female 7 is mother of 16, 25 and 31. Female 13 is mother of individual 29. Female 15 is mother of 26.

Females have ear tag in left ear and males have ear tag in right ear.

4.2. Place of observation

I made my observations at Czech University of Life Sciences Farm Estate at Lány, Czech Republic, established in 2009. This place is outdoor enclosure area placed at apple orchard. This area is divided into two separated paddocks. First paddock is from two sides surrounded by roads and from one side by meadows. Second paddock is from one side surrounded by road and from two sides by meadows. There is shared fence between both paddocks.



Picture 6: Aerial photo of paddock in Lány

The picture shows aerial look of paddock in Lány. In the picture we can see fence divided the whole paddock into two smaller paddocks. In each paddock is placed shelter where guanacos can find hay, water and mineral lick.

Feeding was carried out by hay and pasture *ad libitum*. Water and mineral lick was there also available to free access. In each paddock is placed shelter with hay (picture 7 and 8).

Picture 7: Shelter with hay in first paddock

Picture 8: Shelter with hay in second paddock

4.3. Data analysis

All the statistical procedures were done in SAS System V 9.4 (SAS Inst. Inc., Cary, NC). The probability of sniffing before and after excretion was tested using the logistic regression model (LR, GENMOD procedure). Tested class factors were 'type of excretion' (urination, defecation, both), 'place of excretion' (communal at shelter, toilet, paddock). To account for repeated measures, the identity of the guanaco was included as a random factor in the repeated statement.

The associations between the 'distance of marking animal from the herd' treated as predicted values and the fixed effects of class variables 'sniffing before at use toilet' (yes, no), 'adult male' (yes, no), 'type of excretion' (urination, defecation, both) were tested using a Generalized Linear Mixed Model (GLMM) with MIXED procedure. The full model with all the factors and interactions was iterated until with excluding not significant factors until to get best fitting model. The 'distance of marking animal from the herd' was included as a dependent variable. The significance of each fixed factor in the GLMM was assessed using an F-test. The least-squares-means (LSMEANs) were used to find differences between the tested fixed effects. The animal identity was used to treat for repeated measures. For multiple comparisons we used the Tukey-Kramer

adjustment. The normality of data distribution was tested by ‘UNIVARIATE’ statement.

5. RESULTS

Within 80 hours, during 16 days of observation, I received total of 193 records of excretion. From this number it was 42 cases of urination, 45 cases of defecation and in 106 cases it was both urination and defecation. I watched a total of 57 scent marking after other individuals. From this number it was 33 cases of marking after by both urination and defecation, 15 cases of marking after by defecation and 9 cases of marking after by urination.

On sunny days and on weekends there were a lot of people behind the fence feeding guanacos. During this time they did change behavior. They did not behave naturally and excrete less. This hypothesis was not tested

5.1. Sniffing before marking according to type of marking

The hypothesis that animals will sniff at latrines with higher probability before marking after another animal has not been confirmed (Fig 1). The probability that the animal will sniff before urination was 67 %, before defecation 53.5% and before when excreted urine and defecate at once was only 42 %. ($\chi 2 = 4.28$; DF = 2; $p = 0.1178$).

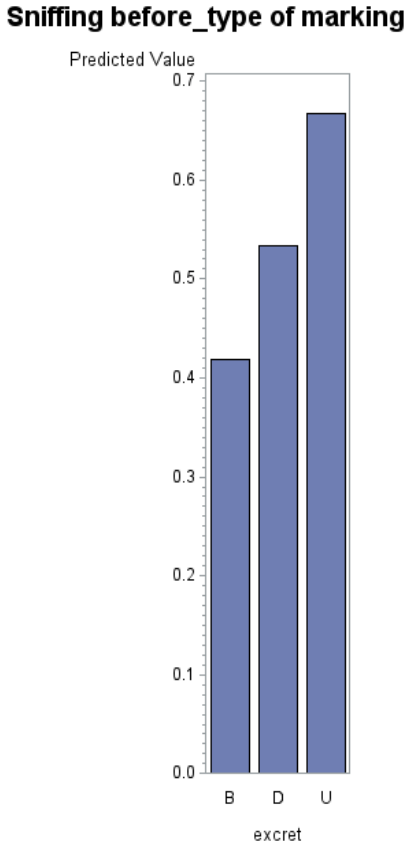


Fig. 1: Sniffing before marking according to type of marking (B- urination and defecation at once, D- defecation, U- urination).

5.2. Sniffing before marking according to place

There was weak trend for sniffing before marking according to place where animals excreted (Fig 2). The probability that the animal will sniff before at latrine was 44.5 %, paddock 63.5% and at shelter was 51 %. ($\chi 2 = 4.74$; DF = 2; p = 0.1178).

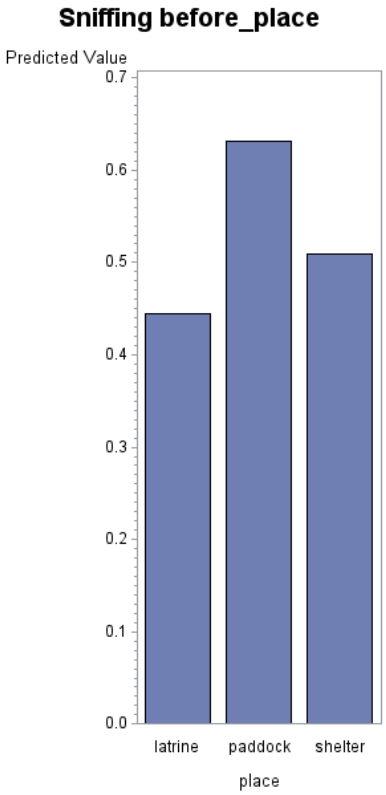


Fig. 2: Sniffing before marking according to place of marking (latrine- place where animals excrete frequently located at paddock , paddock- place where excreted for the first time, shelter- communal place close shelter where animals excrete in great extant).

5.3. Sniffing after marking according to type of marking

The hypothesis that animals will sniff after marking at latrines with higher probability before marking after another animal has not been confirmed (Fig 3). The probability that the animal will sniff before urination was 30.5 %, before defecation 22 % and before when excreted urine and defecate at once was only 25 %. ($\chi 2 = 0.78$; DF = 2; p = 0.6772).

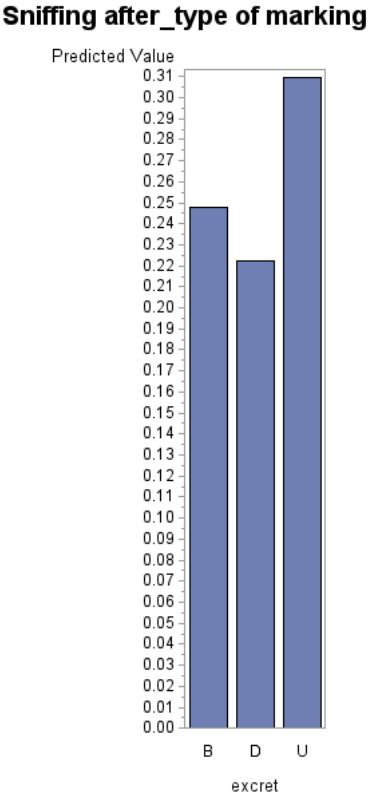


Fig. 3: Sniffing after marking according to type of marking (B- urination and defecation at once, D- defecation, U- urination).

5.4. Sniffing after marking according to place of marking

There was weak significance that animal will sniff after marking according to place where animals excreted (Fig 4). The probability that the animal will sniff after at latrine was 31.3 %, paddock 23.5% and at shelter was 16.5 %. ($\chi 2 = 6.47$; DF = 2; $p = 0.0394$).

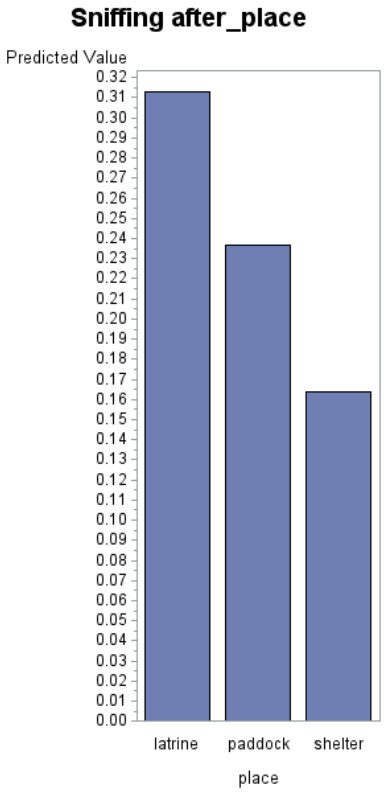


Fig. 4: Sniffing after marking according to place of marking (latrine- place where animals excrete frequently located at paddock , paddock- place where excreted for the first time, shelter- communal place close shelter where animals excrete in great extant).

5.5. Distance from the herd during scent marking behavior

There was not found any significant effect on distance from the herd during excretion, i.e. nor if the adult male was excreted ($F_{1,165}$ = 2.59; p = 0.11), nor type of excretion ($F_{2,165}$ = 0.18; p = 0.84) and even when animal sniff before use the toilet ($F_{1,165}$ = 0.01; p = 0.95).

6. DISCUSSION

Comparision of my results with other thesis

I would like to compare my results with master thesis of Tereza Hartlová (Reproductive behaviour and non-vocal communication in captive guanacos (*Lama guanicoe*), 2014).. Following the obtained results it is possible to discuss over these topics.

Sniffing before marking

Hartlová (2014) did not confirm the hypothesis that probability of sniffing before will be higher than probability of not sniffing before marking, which means there is no difference between sniffing before and not sniffing before.

Sniffing after marking

Sniffing after marking has no essential influence on the marking behavior, according to Hartlová (2014) there is no difference between the sniffing after and not sniffing after.

Distance from herd during scent marking

According to results of Hartlová (2014) if male marked after he was in longer distance from the herd than others marking after individuals. The main difference between our results could be in number of observation, or changing number of animals in Lány or by the division of the enclosure into two paddocks.

6. CONCLUSION

In my bachelor thesis I described the communication and marking behavior of guanacos (*Lama guanicoe*). Marking behavior is very important way of communication among these animals. My research was focused on scent marking behavior and communication.

Based on the results I have not found any significant effect on distance from herd during excretion. There was weak significance that animal will sniff after marking according to place where animal excreted, equally was weak significance that animal will sniff before marking. Hypothesis that animal will sniff at latrines with higher probability before marking after another animal has not been confirmed. Neither hypothesis that animal will sniff at latrines with higher probability after marking has been confirmed.

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8. ANNEXES

Annex 1: Table for marking observation records

Date:		Observation from - to:			Observer:		Weather:			
Animal	Time	Order on toilet	Behavior before	Excretion	Behavior after	Presence of another animal - identity	Place of toilet	Size of toilet	Other animals	Distance from herd

Annex 2: Table for interactions records

Date:		Observation from - to:			Observer:		Weather:				
Animal - initiator	Time - beginning	Time - finish	Behavior	Interaction with/recipient	Ears position	Tail position	Vocalization	Relative position of interacting animals	Place	Other animals	Distance from herd