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**Scent Communication and Marking in Captive Guanacos – Behavioural
Study**

Bachelor Thesis

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Declaration

I hereby declare I wrote my bachelor thesis “The Scent Communication and Marking in Captive Guanacos – Behavioural Study” myself and have used only sources cited in the text and the list of references. I agree that my work will be accessible for future studying purposes in the library of CULS.

Prague, 18th April 2019

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Daniel Stehlíček

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Abstract

This literature review is summarising communication behaviour of llamas as it reviews scents and marking. Guanaco are actually one of a very few mammals that are making specific latrines (dung piles) that play an important role in the territorial arrangement and behaviour, those habits are summarised and described in the thesis. Apart from the communication of llamas, the thesis deals with the Camelidae order genus and its reproduction. During the research, various resources coming mostly from the research of llamas in captivity not only at Czech University of Life Sciences Farm Estate at Lány and from the Prague Zoo, but also from the wild nature in the South America. Thus, the thesis summarizes knowledge that might also help with breeding in captivity. Among them, information that might help with an early hierarchy indication and possible development of young individuals within captivity guanaco are included. As a consequence of these information, male guanacos play an important role within the herd that is not limited to a competition with other male guanacos but intervenes relations with female. Furthermore, the frequency of occurrence of male guanacos around the latrines, it is possible to evaluate their status within the hierarchy of the herd. With respect to the behaviour, identification and early separation of these individuals is important so we can prevent the harm to individuals within a breed.

Key words: guanaco, communication, marking

Abstrakt

Tato literární rešerše shrnuje komunikaci lam guanaco, která sumarizuje především jejich pachové a značkové zvyky. Lamy guanaco vytváří specifické defekační místa (dung piles), které hrají důležitou roli v jejich uspořádání teritoria, tato práce pak tyto zvyky sumarizuje a dále rozebírá. Mimo komunikaci se práce taktéž zabývá taxonomií rodu camelidae a reprodukci. Při práci na této rešerši byly využity zdroje především z výzkumu v zajetí, a to nejen ze školní farmy v Lánech a ze stáda v Pražské zoo, ale také z volné přírody Jižní Ameriky. Právě proto tato práce obsahuje informace, které mohou napomoci při chovu i v zajetí. Mezi ně patří zejména informace, které mohou pomoci pro včasnou indikaci hierarchie stáda v rámci chovu. Z těchto informací vyplynulo, že pohlaví hraje zcela zásadní roli, na kterou je nutno brát ohled při správném uspořádání výběhu a při celkové organizaci chovu. Bylo zjištěno, že samci hrají v chovu zcela zásadní roli, která se neomezuje čistě na soupeření v rámci pohlaví, ale zasahuje rovněž i do vztahů se samicemi a případně mláďaty. V návaznosti na zjištěné poznatky tak lze posoudit, kdy je možné samce jak starší, tak mladší ponechat ve stádu a kdy je možné je oddělit či vyřadit z chovu, a to tak, aby se předcházelo napadání mláďat a samic způsobené výše popsaným chováním samců. Podle frekvence výskytu samců v blízkosti defekačních míst, lze posoudit i jejich možné postavení v hierarchii v rámci stáda. S ohledem na toto chování je nutno identifikovat tyto jedince a včas je oddělit od chovu, tak aby se předešlo poškozování jedinců v rámci chovu.

Klíčová slova: guanako, komunikace, značkování

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1. Introduction

Guanaco is one of the two wild species of family Camelidae, *Lama glama guanicoe* (Müller 1776) and *Vicugna vicugna* (Molina 1782). *Lama guanaco* is a dominant arid land ungulate of the Andes in South America (Franklin & Grigione 2005). Marking behaviour and scent communication is very important for the lives of these mammals (Ralls & Ewer 2006). The excreted of guanaco define reproductive alert, social status and discern of individuals (Gasset 1999). However, guanaco is a very territorial species and uses specific defecation latrines, which are called dung-piles. These places have an important scent marking role (Estes 1991). Dung-piles are shaped and maintained primarily by males with a certain territory only, while other guanacos of different sex and age categories produce only single fecal pellets (Ezenwa 2004). Communication, hierarchy and territoriality are a widespread phenomenon which has not been fully investigated yet. Those aspects have various forms and I would like to deal with them since literary sources often differ and are contradictory. The thesis can be also used for possible breeds of guanaco llamas. The thesis summarises some basic characteristics connected to the proximity to dung piles in captivity and in the wild nature. Among them, the remarking of dung piles after or before other animals, using of latrines of both female and male guanacos as well as guanacos of all ages. Those findings might be helpful to the revelation of hierarchy within a bred.

In the first part of this thesis, the history of family Camelidae, clarification taxonomy of family Camelidae and distribution are described in more details. Breed species, the use of them for production are addressed as well.

The second part deals with the reproduction of camelid, which includes reproduction season, puberty and parturition. The reproduction season is important in hierarchy and communication role, the animals are more aggressive and change mainly in their behaviour.

Lastly, the thesis deals with communication, which comprises: defecation marking, olfactory, scent, vocal and visual communication.

2. Literature review

2.1. *Lama glama guanicoe*

2.1.1. History of the Camelidae order

The ancestors of the Camelidae family originate from The Great Plains of Western North America. According to fossil records, their origins can be traced back to 9-11 million years ago and their extinction to the Ice Age period. However, approximately 3 million years ago, part of the Camelidae family migrated across the land bridge at the Bering Straits to Euroasia. This migration resulted in the occurrence of camels in Africa and Central Asia. Another branch came to South America much later, during the Ice Age. In that period, roughly 3 million years ago, the amount of the lama species rose dramatically (Brown 2000).

Today's family of Camelidae consists of two Old World species (Camelini tribe) and four New World species (Lamini tribe). Although, none of the two tribes of Camelini and Lamini exists at present as they are believed to be extinct in the area of North America. Nevertheless, representatives of the New World genera – Lama and Vicuna – emerged earlier than 2 million years ago (Stanley et al. 1994)

2.1.2. Description and taxonomy of *Camelidae*

The Camelidae family is a member of the Artiodactyla order (having an even number of toes). They fall under the Tylopoda suborder (pad or callus of the foot). The reason for that is that the members of the Camelidae family have a three-part of stomach (Vallenas & Stevens 2017) which differs them from the majority of the order (San Martin & Bryant 1989). The second reason for such distinction and modulation from the majority of the order is the absence of horns. The third difference is related to their legs, as they don't have hooves that are common within the order. Instead, they have pads endings (San Martin & Bryant 1989).

Table 1 Differences between guanaco and vicugna (Franklin 1983c)

Characteristic	Guanaco	Vicugna
Territory	It is primarily males, which control feeding territories the whole year in sedentary population. Territories of family or male groups are only seasonal in migrating population. Exceptionally, male groups invade the territory of family groups. Dung-piles sometimes used by male.	Throughout the year, they have separate feeding and sleeping territories for family groups. Types of territory are divided into three groups that are permanent, marginal and mobile family groups. Male groups invade family groups zone. Across all age and sexual individuals used dung piles and male defence territory.
Percentage of social groups	Family 55%, male 41%, solo males 4%, mixed groups and female.	Family 76%, male 24%, solo males <1%.
Characters of family group	Arrangement and group size is seasonally variable. Low control by male. Low to moderate compactness influenced by season. Linear hierarchy less strict (adult male: adult female: offspring). High female independence and aggression, unusual male leadership.	Controlled by male, group size and arrangement is constant. Linear hierarchy (adult male: adult females: offspring). Male leadership. Low female independence.
Weight	100-120 kg	45-55 kg
Occurrence	Arid slopes of the Andes and Patagonia to 4 250 m elevation. Windy, dry, cold with snow cover.	Central Andes around 3 700- 4900 m elevation. Dry, cold, without snow cover. Growing season predictable.
Feeding	Periodic drinker, browser, grazer	Obligate drinker, grazer
Behaviour environment correlations	Family group size is regulated by male, but not correlated with forage availability	Family group size is regulated by male correlated with forage availability.

There are two groups of the Camelidae family, one group belongs to the Old World group and contains *Camelus dromedarius* (one humped camels) and *Camelus bactrianus* (two humped camels). These two groups of camels originally occurred in the arid and semi-arid areas extending from Central Asia to Manchuria. The New World camelids contain two domestic species of llamas, *Lama glama* (llama) and *Vicugna pacos* (alpaca), and two wild species *Lama glama guanicoe* (guanaco) and *Vicugna vicugna* (vicuna) (Smith et al. 1994).

Two breeds of alpaca are bred for wool production. The first one is the huacaya, which is the most common breed and is characterized by long crimped thread similar to that of Lincoln sheep. The second alpaca is the Suri. Suri has a thread that is straight and with little crimp (San Martin & Bryant 1989). Alpaca is also used for the production of cashmere fibre and meat for local people (Brown 2000).

Each of the species mentioned above has a powder-fluffy tail, long flexible neck, thin legs, goggle eyes and long eyelashes (Hoffman & Kaehler 1993). All the species have 37 pairs of chromosomes (Brown 2000) and every species of the *Camelidae* family can interbreed (Smith et al. 1994). The huarizo and the paco-vicuna are their hybrid counterparts from the New world. The huarizo is the most frequently occurring hybrid and is the result of the male llama and female alpaca crossbreeding. The crossbreeding of female llama and male alpaca is also possible the resulting hybrid would then be called a Misti. The paco-vicuna is a hybrid, which arose from the interbreeding male vicuna and female alpaca (Rosati et al. 2004). The huarizo and the paco-vicuna are good fleece producers (Brown 2000). An animal produced by the cross-breeding of two hybrids is infertile (Fernández-Baca 1993).

Guanaco (*Lama glama guanicoe*) (Müller 1776) is a species from the wild Camelidae family (Smith et al. 1994) and the largest animal of *Artiodactyla* order from South America. All guanacos have comparable crimped pelage that has coloration varying from dark sandy brown to brightly brown (in the Southern population) to ochre yellow tones (in the Northern population). The inside of the legs are resembling immaculate white as well as belly and chest parts. The head is grey tint with white colour around the lips, eyes and between the ears (Wheeler 2012).

Guanacos stand about 110 and 120 cm at the withers of adult animals, their head is like that of a camel, with long, tapered ears and deeply cleft and significantly mobile lips. They have different teeth, males have longer canines than females. Guanacos are dissimilar from vicunas by being

larger, by having callosities of the forelimbs, and by the absence of the vicuna characteristic white or yellowish bib (Eisenberg & Redford 2000). The length of guanacos ranges from 167 cm to 210 cm, from the tip of the nose to the base of the tail. Adult animals have about 120 kg to 130 kg of live weight (Wheeler 2012).

Guanacos still live the longest in captivity, their average age is 28 years in captivity or in the wild (Franklin 2011). The longest known lifespan is 33 years in captivity (Tacutu 2013).

2.1.3. Distribution

The guanaco is the most dominant camelid in the region of South America and one of two wild species currently living there. It occurs mainly in the northern part of Peru, in Bolivia, throughout Chile (in the Andes) and across the area of Patagonia in southern part of Argentina and Chile and in the area of Tierra del Fuego. However, this mammalian herbivore was originally occupying the southern part of the continent and lived in the sea altitude varying from sea level up to 4,500 metres. Guanacos also historically occupied a wide habitats including the hardpan desert shrublands and grasslands (Franklin & Johnson 1994).

The twentieth century is linked to a massive reduction of the guanaco population caused mainly by an intense hunting of either legal, and illegal nature. Additionally, guanacos faced a graze-related conflicts with the sheep-based society (Wheeler 2012). Today, the Argentine Patagonia is occupied by nearly half a million of guanacos which is more than two thirds of the total world population (Maté et al. 2005).

The distinction into subspecies of guanacos is made in a simple way as it has been described by size, colour and distribution (González et al. 2006).

With regards to the distribution, we can distinct *Lama glama guanicoe* (Müller 1776) as a subspecies occurring in the area of Patagonia, Tierra del Fuego and in the parts of Argentina southwest from the thirty fifth degree of the southern latitude. The other subspecies are *L. g. huanacos* (Molina 1782) which is located in the Chilean Andes between twenty second and thirty eighth degree of the southern latitude (Cunazza 1992), *L. g. cacsilensis* (Lönnerberg 1913) (Lönnerberg 1913) occurring in the high altitude of the western slope of the Andes between eighth degree of

the southern latitude to eighteenth degree thirtieth minute of the southern latitude in the area of Peru and Northern Chile (Torres 1992), the last subspecies is *L. g. voglii* (Krumbiegel 1944) occupying the area of north-western Paraguay, south-eastern Bolivia and eastern slope of Argentina occurring between the twenty-first and thirty-second degree of the southern latitude (Torres 1992). In South America, there is an estimated population of 550,000 animals and about 3,000 are contemplated endangered in Peru (Franklin 2005).

Guanacos are known for their flexible social organization and adaptation to different ecosystems. Dry locations are among these ecosystems since they have the ability to do a proper water management and they are well-known for surviving long periods without any water or for surviving in difficult life conditions including the receiving of the brackish and saline water from the ocean surf or tide pools (Franklin & Grigione 2005).

2.2. Reproduction of camelids

2.2.1. Puberty

Young males are showing interest in females as early as they are born. However, they are unable to mate because their penis is adhered to the prepuce during puberty and is not completely loosened until its end. This is affected by the plane of nutrition (Fernández-Baca 1993). However, this can be a dominant characteristic for other ruminants too.

The same is true for other ruminants. Alpaca males have adhered to the prepuce only in 8% until 1 year of age, whereas at 2 years of age their weight reaches about 50 kg and males are competent to the mating in 70 % of the cases. It is desirable when it happens earlier. In common practice, males are used for sexual reproduction from 3 years of age. It has been found that alpacas can breed up to 18 times per day during the breeding season, especially at the beginning (Sumar 1985).

As for the majority of females, their sexual susceptibility begins as early as at 12-14 months of age, although ovarian activity appears earlier – within 10 months when the ovarian follicles

grow 5 mm in height. The onset of puberty is extensively influenced by the environment, also predominantly by nutritional factors presumably the attainment of 60% of adult body weight, which is about 33 kg. There is also a relationship between the adult's weight in mating and its subsequent birth rate (Brown 2000). Poor environment in Peru obviously has a detrimental effect on the maturing of females as they are not able to breed until they are two years old (Koford 2006).

2.2.2. Reproduction season

There are different researches with regards to the breeding season of alpacas. It's evident that llamas behave differently depending on the environment and the managing of the breed where they are kept. The most common reproduction period is between November and April in wild. According to one of the researches, the reproduction period depends on various factors such as the season, temperature and winter periods (Sumar 1985; Brown 2000; Koford 2006). Males and females are together within the indigenous areas of Peru's farms all year round and reproduction occurs between December and March; and parturition culminates during the early January to April. At farms where females and males are kept separately, breeding occurs during the period between January and March, which means that the parturition takes place from January to April the following year. When females and males are together in the herd for a longer period of time, there may be reducing effect on their sexual activities. However, when males are allowed to penetrate into a new herd of females, their activities are renewed immediately (Brown 2000). In a separate herd, males can be admitted occasionally, which makes them sexually active throughout the year (Sumar 1985) and females can be gravid during the year (Brown 2000) because their follicles are rip during all year and are competent to ovulation (Smith et al. 1994). It is likely that the season is not an important factor, or has only little effect on ovulation, fertilisation rate or embryonic development of guanaco (Fernández-Baca 1993). However, it was discovered that female alpacas in New Zealand have reduced receptivity and mating time is brief in the spring (Pollard et al. 1993). Humidity, temperature, light or feed intake and other visual or olfactory stimuli get involved on start-up and switch off mechanism via the central nervous system (Fernández-Baca 1993). It is well known that guanacos have resource-defense-polygyny mating system (Parraguez et al. 1997).

The copulation act of guanacos that takes place in a supine position varies and takes between 10 to 50 minutes (Fernández-Baca 1993). Receptive females assume the prone position after a period of effort made by a male guanaco (Sumar 1996). The males of guanacos commence courtship, they actively look for accessible females and try to fix the contact (Brown 2000). The gestation takes about 345 days. The ovulation commences approximately 26 hours after copulation (Fernández-Baca 1993). Guanacos female are pertained to uniparous animal (Parraguez et al. 1997), thus, only one egg is shed during an ovulation (Brown 2000). The egg is developed in corpus luteum within 1-4 days (Pollard et al. 1994).

2.2.3. Parturition

In appropriate environmental conditions, the reproduction cycle is improved and the same goes for mating and early lactation especially after the rainy season. The timing of birth is related to the area of occurrence. Parturitions are underway from April to June in the northern areas of Peru (Franklin 1975). In the Chilean Patagonia parturitions are occurring later as they are beginning in the middle of November and end at the end of January, while in the Bolivian Chaco start in June and finish in August (WCS 2004). In the arid area of Chile, mainly on the northern coast, parturitions are seen during the whole year, but most commonly take place from July to December. Neonatal time in the Andes of northern Chile occurs in August, but more commonly from November and February (González et al. 2006). Forty nine percent of births in Torres del Paine National Park occur in early December (Garay et al. 1995), whereas in Tierra del Fuego eighty five percent of births occur in mid-December and last until the end of January (Raedeke 1979).

During the parturition, no problems appear when the fetus is delivered within 45-60 minutes after the fluid has first appeared at vulva (Fowler & Bravo 2013). The parturitions in captivity is exceptionally problematic (Hoffman 2005). Parturitions last for about sixty to ninety minutes. When a female gives birth for the first time, it can take up to 2 hours. Placenta is excluded approximately 2 hours after birth. Compared to other ruminants, guanacos do not eat placenta after parturition, and they do not lick their cubs (Brown 2000).

2.3. Territorial behaviour

The group of guanacos can be categorized into three social organizations: territorial family groups, large non-territorial bachelors, mixed groups and solo males in wild environment. Guanaco family groups comprise an adult male, one or more females with young off-springs and in such case an adult male is defending its territory. All females stay within the same male territory all year round but on rare occasions they seasonally join migratory ones (Franklin 1983b).

The social organizations of guanacos are important as they collaborate to obtain food or defend themselves against predators. The social structure is important for the detection of population biology, fitness, gene flows and spatial pattern and scale (Whitehead 2008). Guanacos are not bound to a certain area, they are rather migrating from one to another across other different areas (Hoffman & Kaehler 1993). Offsprings are separated from their mother when they reach the age of 6-8 months, but adult females can become pregnant within 2 weeks after parturition and the gestation take about 11 months. Enforced weaning unburden the pregnant female of not only the nutritioning of a suckling but also of the competition for pasture with young grazing animals, and of inbreeding (Pollard et al. 1993). Once a year before the mating season, territorial males banish yearlings (Hoffman & Kaehler 1993). Territorial males are defensive and aggressive, and they can be potentially injurious to juveniles in the form of pitting, biting, chasing and trying to smother juveniles (Sarno et al. 2003).

2.3.1. Defecation marking and scent communication

Some of polygynous ungulates have territorially defensive behaviour (Jarman 1974). A great many of these territorial species make constant defecation places, which are called dung-piles or latrines serve an important scent marking role (Estes 1991). It is observed that these dung-piles are being created and maintained by males with a certain territory only, whereas remainder of the sex and age categories produce only single feces pellets (Ezenwa 2004). In Hartlová thesis (Hartlová 2014) observed that just defecation is most used for marking, than urination.

The dung-piles are supposedly used only mainly by guanaco males and on rare occasions by females. It is the main function and indication of guanaco territory behaviour. It is a well known fact that guanacos are very expansive and flexible species and live in diverse environments. As a result of that, there are differences in defecating among various environment population of guanaco (Marino 2010).

Guanaco and vicuna carry out localized defecation – striking dung-piles and forming latrines. These piles are 1- 3m in average and look like a large circular dung heap, fresh and darker in the middle and gradually going pale on the periphery (Marino 2018).

Dung-piles are not a territorial manifestation of territory demarcation. Young guanacos and females do not participate in marking the territory or in defence, but they tend to use the dung-pile often. It was found that guanacos and vicuna of all age classes and both sexes are defecating only on piles and they are one of the few ungulates which use traditional distinctive piles for urination and defecation (Brbiana & Vila 1994).

According to Vilá (1994), dung-piles may not only be related to male territorial displays but can also serve to keep the herd in one territory and keep the herd organization across all age and hierarchy individuals. It is also likely that dung-piles do not hold other individuals that do not belong to a territorial male and his herd (Franklin 1983a)

In the reproduction season, animals leave the territorial herd and join a larger herd where they are mixed across all social and age classes congregate. Social organization here is less rigid. Females can often join and leave the groups (Franklin 1983b). However, the territorial males in

sedentary herd can attack or pursue females willing to leave the herd as well as outsiders that are ready to enter their territory (Marino 2012)

Apart from the scent-marking role of dung-piles, there is another reason for forming these piles by large herbivores. These permanent defecation sites are formed for antiparasitic reasons as the herbivores are avoiding defecation sites during grazing and thus prevent themselves from ingesting faecal-orally-transmissible parasites, which could otherwise subsequently return to the body of the animal (Taylor 1954).

2.3.2. Olfactory communication

The scent is important for communication and lives among mammals (Ralls & Ewer 2006). Additionally, they use urine and urinary excretions for communication (Jordan et al. 2015). Urinary excretions are identifying of social status, reproductive alert and discern of individuals (Gasset 1999). Urine contains chemicals from which reproductive ability or social status can be recognized (Albone 2005). Another means of scent communication is flehmen, used by males to sense female's reproductive state by inhaling and sniffing the dung or urine of females. The males bend forward their head above a dung-pile and loudly inhales (Hoffman & Kaehler 1993).

2.3.3. Vocal communication

Vocalization of guanacos is very common. The most frequent kind of vocalization is humming, which is used very often by all individuals of a family group. There are many vocalizations observed in the communication of guanacos. Males make a grunting sound that is called orgling during mating season and that is just one of many guanaco vocalizations (Hoffman & Kaehler 1993). Humming is often common in family group but it is important in what context it is used. When the sound is low it is a sign that the young individual is near the mother and calls her often. Another vocalisation is used by chulengos when they are separated or in need of suckling – it is a hum with a high pitched ending. Territory male can give warning vocal signals when the herd is in danger. The herd stays close together and territorial male is patrolling his herd against the predator. In the case the male finds the predator, he lowers the sound of the alarm call (Hoffman 2005).

2.3.4. Visual communication

Typical for guanaco visual communication are the following features: spitting, chest cramming, tail pointing, submissive crouching, body posturing and locomotion displays. Guanacos use two kinds of spitting – mild (mouth to spit) or severe (content of stomach) (Hoffman & Kaehler 1993). In order for the animal to use spitting, it must be threatened, and during spit, it has to be oriented and elevate his head towards another animal, with ears held back (Pollard et al. 1995).

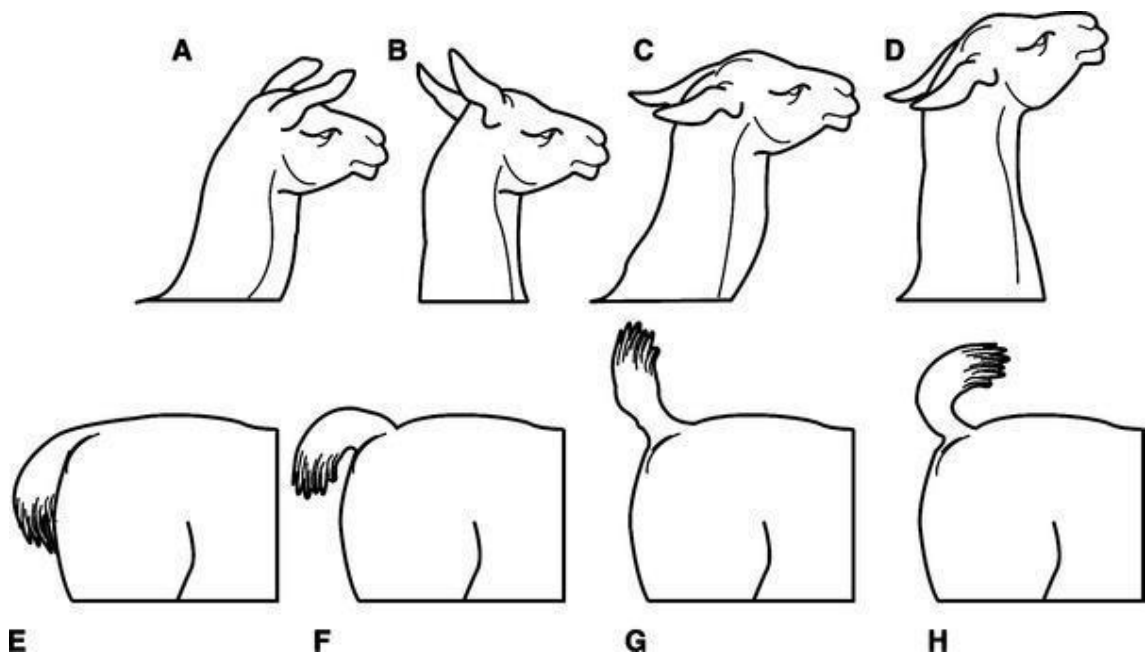
Another visual communication is the position of ears, which refers to the animal's actual frame of mind. When it occurs in an alert situation, it rotates its ears forward toward whatever has piqued its curiosity (Hoffman 2005). In casual relaxed situation, the animal holds its ears straight up or slightly back. When the ears are in a forward position, it gives an alarm signal; when in horizontal position with the lift of a chin, it shows an aggressive situation. A menacing guanaco uses a continuum of ear position for control and warning of a young male (chulengo) to take its play elsewhere (Hoffman & Kaehler 1993).

The most important are the positions of the animal's tail, because it tells us much information about a guanaco's mood. Moderate aggression or alertness is indicated by the tail

being slightly elevated, but below horizontal. During an escalating situation, the tail can be in a horizontal position and curve above horizontal or vertical. In principle, the higher the tail is the higher the degree of aggression. When the animal is obedient it curves its tail forward over the back (Fowler 2010).

The posture and position of the neck is typical for territorial and adult males, which are spending much of their time guarding the territory. Young males are often using submissive crouch, which is a posture in which they reside lowering their head, crouching slightly, curving the neck toward the ground, flipping the tail into the back (Hoffman & Kaehler 1993). When a male is threatening a herd with a territorial male, it stands firmly, tail bent high, its neck forming an “s” structure, ears bend back and nose tilted upward, which is a so-called “broadside display” position (Hoffman 2005b). When the fight between a territorial male and another male is about to take place, then the male will most commonly defend itself by spitting, chestbutting, biting by its canine teeth and neck wrestling, and may end up on the ground (Hoffman & Kaehler 1993).

Figure 1 Lama tail and ear positions: A, usual vigilant; B, negligible aggressive; C, truculent; D, extreme truculent; E, usual leisure; F, alert tail posture; G, alarm tail posture; H, truculent tail posture or submissive tail posture (Fowler 2016).



3. Aim of the thesis

Summarize and compare data on communication, behaviour during marking, and hierarchy in guanaco in captivity and in the wild.

Prediction:

1. Sniffing before marking of other animals is more probable than after
2. Sniffing after marking of other animals is more probable than before
3. Distance from the herd will affect the marking
4. Dung piles might be used as a mark
5. Guanacos might be bred in a denser concentration
6. Adult males will use dung piles more often than other individuals
7. Adult males use dung piles more often than bachelor males
8. Females and young use dung piles more frequently than other individuals

4. Methods

In this literature research, the citation style of Conservation Biology was used. The articles contained in this work come mainly from the Web of Science; there were also used databases as ScienceDirect and Scopus. The keywords used in searching for the articles were: dung pile, guanaco, marking, communication. There were composed articles aimed at guanaco non-vocal communication, marking, olfactory communication and others the thesis summarised results of various studies into charts and tables that are separated into two main sections – breeds in captivity and breeds in the wild nature. Tracked characters were sniffing, marking after other animals, distance of individuals from breeds and usage of latrines by guanacos of all ages and gender. Literary review is divided into three parts: *llama glama guanicoe*, reproduction of Camelidae and territorial behaviour. The author has collected and compared about 60 sources for this research. This bachelor thesis was created in collaboration with the citation manager of Mendeley.

5. Results and Discussion

I summarize and categorize information into two tables, in which I distinguish animals living in captivity and in natural conditions (free ranging guanacos), mainly because many recent works on the topic have not been discussed yet.

Table 1 summarizes information from the observations of two guanaco herds living in captivity. Hartlová (Hartlová 2014) gathered the data during 2012 in the period from October to December and from 2013 to 2014 between January-February. One of the two herds is from the Prague Zoo and the second herd is from the farm at Lány. Another researcher Kalitová (Kalitová 2016) observed the herds from November 2015 to March 2016 at the farm at Lány. This herd was divided into two by a fence and during the year of 2015 there was a change in the herd.

The first column compares whether the animals will sniff before marking of other animals or will not. In both these observations, the probability was low and neither was confirmed. The second column describes the situation from the opposite side –whether the animal will sniff after another animal. The probability that it will sniff after another animal observed in Hartlová's thesis (Hartlová 2014) was 64% and will not sniff 58%. This has not been confirmed neither here nor in Kalitová's thesis (Kalitová 2016). The probability in Kalitová's thesis (Kalitová 2016) was 30,5% after urination, 22% after defecation and 25% altogether.

Last column resolved the issue of the distance from the herd during the scent marking. This is only one observation where the thesis differed. Hartlová (Hartlová 2014) observes that the distance from the herd may have an impact on the marking behaviour whereas Kalitová (Kalitová 2016) observes that the distance from the herd does not play any role in marking behaviour.

Table 3 describes the guanacos of eastern Patagonia and Peru in free ranging. The theses were researching in guanaco natural conditions. This table summarizes the information about behaviour of adult male and his relation to dung-piles. The first column discusses whether adult males use dung-piles and with what probability. Marino (Marino 2018) was observing guanacos from 2007 to 2008 and discovered that adult males used dung piles with 90% high probability, also that seasonal factors have no effect on defecation. On the other hand, Franklin (Franklin

1983a) wrote that a guanaco's defecating on a dung pile during aggressive interaction when it is stopped by another animal is more probable than on a daily basis like feeding or moving.

The second column surveys whether the territorial male will use a dung pile more often than a bachelor male. Only Marino (Marino 2018) researches this hypothesis and his observations confirm that there is a high probability that males will use the dung pile more often than the bachelor. However, Franklin (Franklin 1983b) insinuates that during mating season and territory defences bachelor males use dung piles very often.

The last column of the table 3 explores whether females and young guanacos will use a dung pile. This is interesting because they do not participate in the territorial defence but Marino (Marino 2018) reported that guanaco females and the young frequently visited dung piles. In contrast, Vilá (Bribiana & Vila 1994) described that only vicugna all of ages used dung piles. On the other hand, Franklin (Franklin 1983a) writes in his thesis that only guanaco males used dung piles regularly, while females and the young used them only in rare situations and the young were interestingly smelling or consumed fecal pellets. Franklin (Franklin 1983b) mentions in his study that dung piles have mainly kept insiders in the territory rather than outsiders outside of the territory.

From the behaviour of these llamas, it is concluded that most of individuals are using dung piles. Consequently, such behaviour altogether with the location of dung piles might help with a coop logistic. One of the advantages of dung piles is the fact that they are placed on one place and can be used for a possible use in fertilization. Moreover, from those findings, it can be deducted that llamas might be in captivity in a higher concentration in contrast to other farm animals since the grazing will not be supersaturated by nutrients and manure would not be harmful to it with regards to the antiparasitic view.

Table 2 Marking of guanaco in captivity

Source	Sniffing before marking of another animals	Sniffing after marking of another animals	Distance from the herd during scent marking
(Hartlová 2014)	Animal will sniff was 62% probability and for no probability was 50%	Animal will sniff was 64% and than will not sniff was 58%	Male who did not marked after was closer to herd in comparison to situation when he was scent marking after another animal
(Kalitová 2016)	Animal was sniff before urination 67%, before defecation 53,5% and altogether was 42%	Animal will sniff after marking was urination 30,5%, defecation 22% and altogether was 25%	There was no significant difference in distance from the herd during marking

Table 3 Exploiting dung piles of guanaco in the wild

Source	Adult males used dung-piles	Adult males used dung-piles more often than bachelor males	Females and young's used dung -piles
(Marino 2018)	Males defecated in dung-piles 90% of the time	Territorial males used dung- piles more often than non-territorial males. Territorial males used dung-piles average 70% of the time.	Young and females used dung-piles frequently, in 80% of the time defecation-urination events.
(Franklin 1983a)	Males used dung-piles 52% of the time during the daily casual activities (feeding and moving). During aggression interactions with other animal used dung-piles 78% of the time when they stopped on the piles	No findings	Only guanacos males regularly used piles. During observations adult females were seen only twice during two years. Two years to eliminate on piles young about 3 weeks old stopped on piles and interestingly smelled and consumed fecal pellets.

6. Conclusion

The content of this work mainly concerns olfactory communication and markings, which are very important for maintaining hierarchy in captive herds and their territory, but also for the survival of these animals in the wild. Several basic types of behaviour in the vicinity of a dung pile were summarized, including sniffing and marking. As for animals in captivity, information about sniffing before or after other animals was summarized here, yet not sufficiently confirmed. Distance from the herd during scent marking in one case was confirmed but in another unproved. As for guanacos in wild, their use of dung piles was examined. It was found that adult males use dung piles very often than bachelor males, and that females and young guanacos use dung piles as well. It was confirmed than adult males use dung pil. This information can be important for distinguishing the animals' hierarchy in captivity herds, and someday maybe for preventing aggression among individuals, especially repression against other animals. In conclusion, I would like to mention that these topics are not sufficiently surveyed and should be explored in more detail and different herd formation, especially in the case of guanacos living in captivity.

7. References

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