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The social organization of eland: How to measure quality of grouping in captivity?

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3. Analysis of literature
4. Conclusions

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Certification

I, Jana Husarovičová, declare that this Bachelor thesis, submitted in partial fulfilment of requirements for the degree of Bc, in Institute of Tropics and Subtropics of the Czech University of Life Sciences Prague, is wholly my own work unless otherwise referenced or acknowledged.

Prague, May 22 2008 ……

Signature

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Abstract

Social organization affects at all animals living in groups. Eland (*Taurotragus oryx*) is a typical gregarious animal. The herds of over 100 animals have been detected. Social form is absolutely necessary fur such big society to work well, it means to execute everyday needs. Every animal in a herd has its duty. This work is mainly focused on hierarchical settlement in a herd and relations among individuals. Next, there are presented some factors influencing the animal behaviour.

Key words: Eland, social organization, hierarchy, behaviour, herd

Abstrakt

Sociální organizace se vyskytuje u všech zvířat, která žijí ve stádě. Antilopa losí (*Taurotragus oryx*) je typickým stádovým zvířetem. Byla pozorována stáda o více než 100 kusů. Aby mohla takto početná společnost fungovat, tzn. vykonávat každodenní potřeby, je sociální uspořádání nutností. Každé zvíře ve stádě zastává určitou funkci. Tato práce je zaměřena především na hierarchické uspořádání ve stádě a vztahy mezi jedinci. Dále jsou zde uváděny některé faktory, které ovlivňují chování zvířat.

Klíčová slova: Antilopa losí, sociální uspořádání, hierarchie, chování, stádo

CONTENT

1 INTRODUCTION

The eland (*Taurotragus oryx*) along with the giant eland (*Taurotragus derbianus*) are the largest African antelopes. Shoulder height is about 1.5 m, but maximum can be to 1.7 m and live-weight of males both eland species being up to 900 kg (Underwood 1975). They have shorter robust neck and limbs, which giving a more cow-like appearance (Kingdon 1982).

Their anatomically-physiological resemblance to cattle and broad adaptability is one by of reasons of farming eland in the Czech Republic. Experimental eland farm at Lány under supervision of Institute of Tropics and Subtropics, Czech University of Live Science Prague, presently verifying, whether it is possible to use this animal like potential source of lean healthy red meat as complementary to cattle husbandry for Europe. This farm was established in autumn 2002 in Březová near Kutná Hora and presently it´s a part of school´s agricultural Estate in Lány since April 2006. It is the largest herd of elands kept in captivity in the Czech Republic. The herd consists of 35 elands (February 2008).

The eland can by keeping for meat and milk production. Antelope meat is of high quality, with high dietetic value, it contains less fat and cholesterol and it is easily digestible. Milk of elands as compared with cow's milk contains more fat and proteins (Treus and Kravchenko 1968).

The eland is very docile and easy to tame (Lambrecht 1983). Thus, eland was proposed by Food and Agriculture Organisation for domestication in Africa (Scherf 2000). Adaptability, tolerance and modesty are positive preconditions for their domestication. They adapt to high temperatures typical for African climate, and also temperatures close to 0 °C, which are prevailing during winter season of temperate climate (Kotrba et al 2007). They tend to deal well with temporary water shortage (Taylor 1969) and are less picky on pasture quality (Nge'the and Box 1976).

Breeding of elands in captivity can have negative aspects as well. Natural behaviour of free ranging can be suppressed in captivity. If we want healthy, satisfied and economically productive animals, we must provide appropriate condition for eland well being to express their natural behaviour. Therefore it is necessary to study their social relationship and behaviour to evaluate quantity and quality of natural behaviour.

This work should contribute to knowledge of captive eland's social behaviour to monitor, evaluate and later provide proper conditions for farming of eland in the Czech Republic.

2 AIM OF THESIS

Various aspects of social behaviour can be observed in the wild as well in captivity. The behaviour of wild animals in comparison to captive ones can be highly different because of different living environment, but can has a lot of similarities in quality and quantity of visual displays. Captive breeding of eland and their possible domestication process must fulfil animals well being, so therefore is very important to have measurable behavioural parameters to compare their expression in wild and captivity to prevent social problems as is aggressiveness among adult males, social misbalance or grouping of not equal age and sex classes etc. The knowledge and study of natural behaviour of eland in wild as well in captivity can increase our ability to breed them successfully in captivity under appropriate technology and bring us possibilities to measure and control effectiveness of our decisions. Therefore the aim of this bachelor thesis is at least partly review and describe present knowledge about eland's (*Taurotragus oryx*) social organization and behaviour and should be followed by experimentation in future during my diploma thesis.

3 LITERATURE REVIEW

3.1 Taxonomy of eland

Regnum: *Animalia*

Subregnum: *Metazoa* - metazoon

Phyllum: *Chordata* - chordates

Subphyllum: *Vertebrata* – vertebrates

Classis: *Mammalia* – mammals

Subclassis: *Theria* – viviparous

Superordo: *Placentalia (Paraxonia)*

Ordo: *Artiodactyla* – artiodactyls

Subordo: *Ruminantia* – ruminants *(Pecora)*

Superfamilia: *Bovoidea*

Familia: *Bovidae*

Subfamilia: *Tragelapinae* – bushbucks

(Anděra 1999).

3.2 General characteristics

The eland is the largest African antelope (Dollman and Burlace 1928), with males being larger than females (Underwood 1979). Eland (*Taurotragus oryx*) is belived to be slightly smaller than the giant eland, *T. Derbianus* (Pappas 2002). Bud other authors – Dollman and Burlace (1928), Estes (1991) and Treus (1983) shows that elands are the biggest

African antelope and with their biological, morphological and physiological characteristic, it is more related an ox (*Bos taurus*) than to an antelope (Makovcová 2005). Underwood wrote in 1975 that their resemblance to buffalo extends to the animals general appearance - in fact the Masai hunt buffalo and eland for food on the basis of their cow-like appearance.

The eland forms transient group between antelopes and bovids (Treus 1983).Currently the eland adherent to species *Taurotragus oryx* (Pallas 1766) with three subspecies: *T. oryx oryx, T. oryx livingstonei and T. oryx pattersonianus* (Underwood 1975). According to Treus (1983) there have been five subspecies: Western Sudanese *T. oryx derbianus Gray 1848*, East Sudanese *T. oryx gigas Heuglin*, South African *T. oryx Pallas* , *T. oryx livinstonii Sclater* and East African *T. oryx pattersonianus Lidekker.*

There are a few mammals in which the size and appearance of the sexes differs so greatly. An old male can weigh up to 942 kg (Pappas, 2002) and may be twice as heavy as an adult female (Kindon 1982).

3.2.1 Height and weight

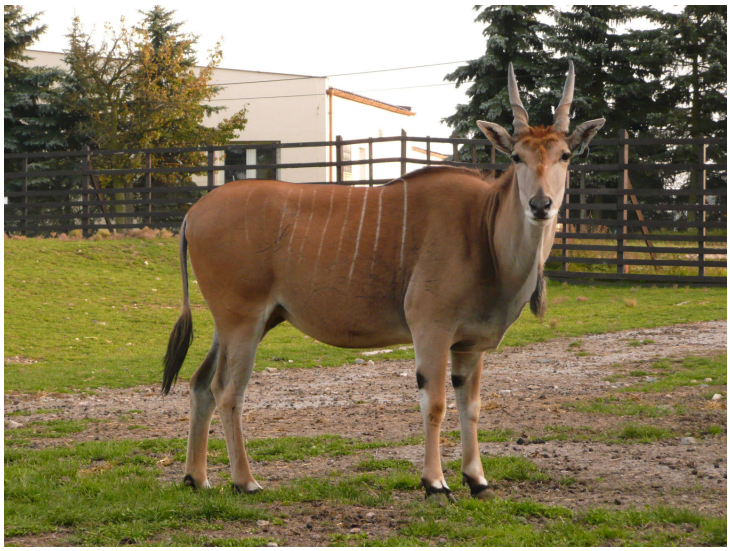
Shoulder height averages 163 cm (range, 151-183 cm; no sample size given) for males and 142 cm (range, 125-153 cm; no sample size given) for females. Body mass averages 500-600 kg (range, 450-942 kg; no sample size given) for males and 340-445 kg (range, 317-470 kg; no sample size given) for females (Pappas 2002), but Kingdon (1982) reported that averages height of males is 150 cm (135-178 cm) and 135 cm (125-150 cm) for females and averages weight 690 kg (400-942 kg) for males and 450 kg (390-595 kg) for females. Tail is 60 cm (range; 54-75 cm) long and is tufted at tip (Kingdon 1982).

3.2.2 Pelage, colouring

Pelage colour varies from dark grey-brown to reddish-brown, and males tend to turn blue-grey as they age (Pappas 2002). Estes (1991) describe that colour of eland is individually and geographically variable, general colour is tawny, darkening with age.

The eland has 2-15 transverse lateral white stripes (Pappas 2002). According to Estes (1991) even 10-16 white stripes. Pelage colour and prominence of stripes vary throughout distributional range and among subspecies (see pic. 1 and 2). Hair colour is lighter and stripes are less pronounced on animals in the southern area of the range as compared with animals in northern areas. All eland have a black spot on the posterior upper region of the forelegs, along with a dark dorsal stripe running down the dorsum (Pappas 2002).

Pic. 1 Elands without stripes in Giant's castle reserve SAR (*T. oryx oryx*)



Pic. 2 Eland with stripes originated from Karamoja Uganda (*T. oryx pattersonianus*)

3.2.3 Dewlap

For both sexes is typical throat dewlap with tuft of dark hair (Kingdon 1982). At the males the dewlap enlarges until it is like a curtain hanging from the centre of throat to below the level of the knees, which gives a grotesque visual emphasis to the forequarters. The concentration of weight on the forequarters in elands probably influences the greater size of the forehooves. The dewlap might have tactile and thermoregulatory function (Kindon 1982).

Both stripes and dewlap tuft differ from one animal to another, which makes visual recognition of individuals easier, not only for the human observer bud presumably for the eland as well (Kingdon 1982).

3.2.4 Head

Head is short and comparatively small (Estes 1991). Ears are small, narrow and pointed (Underwood 1975). Kingdon (1982) typed that their hearing is also good but the pinnae of their ears are greatly reduced in comparison with those of bongo, kudu or buffaloes. Muzzle is small and pointed instead of being blunt and broad as in cattle and buffaloes.

Both sexes of *T. oryx* have spiralled horns (1-2 tight spirals – Estes 1991), bud horns of males are shorter, thicker, and have tighter, more pronounced spirals. Horn length of males averages 54 cm (range; 43-67 cm). Horns of females are longer, thinner, and average 60,5 cm (range; 51-69,6 cm) (Pappas 2002). But Kingdon (1982) reported that length of horns can be up to 102 cm. The horns grow very fast; they are rather soft to the age of six months and are easily distorted. The shafts of the horns tend to be mostly parallel in females and may be mostly divergent in males but there is considerable variation in the angle, length, thickness and twist of horns.

The hair on its forehead and nose changes its length and colour from time to time. From being short and sandy the hair becomes chestnut and then black extending down the nose into a double tuft as it develops. The skin in this area is thick and may be glandular; in any event it sometimes overhangs and distorts the upper lids of the eyes (Kindon 1982). Hilman (1987) has seen a black double tuft decline to a single chestnut tuft and this

reversibility implies that the development of the tuft is under hormonal control. At the females is hair tuft very much smaller or totally is missing.

Pic. 3 Male of eland

Pic. 4 Female of eland

(Source: http://www.profimedia.cz)

3.3 Distribution

The eland in its present form is known to have existed in Africa during the Upper Pleistocene era and from that time onward the species was probably widely distributed throughout the continent (Littlejohn 1968).

Eland live throughout one-third of Africa. The northern limit of their range cuts northeast through Angola, and southern Zaire (today Democratic Republic of the Congo) and then north include Tanzania, Kenya, and southern Somalia (Pappas 2002).

Littlejohn (1968) wrote that the present distribution of the eland (*T. oryx*) includes the following countries: Sudan, Uganda, Ethiopia, Kenya, Belgian Congo, Tanzania, Zambia, Rhodesia, Angola, S.W. Africa, Botswana, Malawi and Mozambique. In the Republic of South Africa, apart from a few on private farms, eland do not exist outside National Parks and Provincial Reserves.

Pic. 5 Map of eland's distribution (Redrawn from IEA, 1998)

(Source: http://www.ultimateungulate.com/Artiodactyla/Taurotragus_oryx.html)

3.4 Ecology

The eland is one of the most adaptable of antelopes, equally at home in subdesert, acacia savanna, *miombo* woodland [1], floodplain, and mountains up to 4600 m. It does not venture into the desert and avoids dense forest (Estes 1991).

Eland have been classified both as intermediate feeders, preferring forbs along with foliage of shrubs and trees, and as browsers that have adapted to grazing. Eland may graze during the rainy season, when grasses are plentiful, bud browse more during drier winter months (Pappas 2002).

Also Hofmann (1973) described as that of an intermediate type is adapted to a low fibre, high protein diet (Kindon 1982).

Although the eland is less desert-adapted than the addax or oryx and some of the gazelles, it can go indefinitely without drinking. Physiological studies have shown that water-deprived elands allow their body temperature to rise as much 7°C during the day, letting the cooler night time temperature cool them down again (Taylor and Lyman, 1967). But currently is it disproved (Kotrba 2008 personal communication). Elands thereby avoid sacrificing water for evaporative cooling. Water loss is further reduced by concentrating the urine, excreting dry faeces, lowering the metabolic rate, breathing slower and deeper, and by seeking shade in the heat of the day. In all these respects the eland is less efficient than the desert antelopes (Estes 1991).

Population densities and mortality rates are often affected by food supply, predation, disease, and presence of humans putting up fences for cattle, ranchers disturb natural migration routes of eland. This affects access to an adequate food supply. Also, drought-related mortality is common after several seasons of below average rainfall. Eland, particularly calves, are vulnerable to attacks by wild dogs (*Lycaon pictus*), lions (*Panthera leo*), cheetahs (*Ascinonyx jubatus*), and spotted hyenas (*Crocuta crocuta*). Although an eland can live for 25 years, average life expectancy is 15-20 years (Pappas 2002).

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[1] *Miombo* woodlands form a broad belt across south-central Africa, running from Angola in the west to Tanzania to the east. These woodlands are dominated by trees of subfamily *Caesalpinioideae*, particularly *Miombo* (*Brachystegia*), *Julbernardia* and *Isoberlinia*, which are rarely found outside *Miombo* woodlands. (Source: http://en.wikipedia.org/wiki/Miombo)

3.5 The social organization of eland

Estes (1991) described the eland like gregarious and nomadic animal, which do not show territorial behaviour. Also Hillman (1988) recorded that no evidence was found to show that eland are territorial.

Treus (1983) stated that life in open condition be joined by generation big groups and like highly social type animal, has eland slants to itinerancy and migration.

3.5.1 Composition and structure of herds

To eland form herds, in which are all together female, calves and several males, among them is fixed and very often linear hierarchy (Treus 1983). Pappas (2002) wrote that females and juveniles tend to stay close together, whereas males form smaller herds or wander individually. Kingdon (1982) stated about possibility to see even groups compounded from animals of same sex or groups of calves all of similar ages. Estes (1991) stated that it can be see herds composed entirely of calves and juveniles and conversely, unisexual or bisexual groups consisting of adults only.

The young calves tend to stay in close subgroups, so-called nurseries. These groups are formed by calves born in current year and yearlings - worse mature broods, which fall behind in growth (Makovcová 2005).

Also Treus (1983) described the nursery like coalition of calves, which are always in the centre of herd. Interesting is that, young ones born in the current year stay close for a one-two years old animals, who are looked after them. Most often in nursery we find young ones that are not well-developed with retarded growth, born in the previous year. It was observed in a nursery of elands, which stayed under restraint of several adults, while other adult were away.

Underwood (1975) observed the nursery herd consisted mainly of young animals, who generally remained together through the winter to form the basis for the next year´s nursery herd. The subgroups were at the beginning very mixed based on age/sex class membership, but tended to become more homogenous during winter. The mixed groups included calves yearlings and subadult groups.

The close association of calves begins at an early age and in terms of time spend together calves are more attached to other calves than to their mothers (Kingdon 1982).

Also Estes (1991) stated that young calves may in fact be more attached to one another that to their own mothers. They maintain the least social distance (under 1 m), play, often lick one another and lie in contact. Social distance increases with age, to 4,5 m in juveniles and 11 m in adults, indicating that sociability declines. Although members of the same age and sex class continue to associate (except older male) but approaches within 2 m usually provoke aggression. Consequently eland herds tend to spread out except for cluster of young animals.

Calves differ strongly with adults in frequency of grooming and licking, whereas adult have minimum physical contact. However, this does not leave its mark in the form of lasting bonds between individuals in adult life (Kingdon 1982).

Hillman (1987) observed most subadults occurred mainly in calf-containing groups, and less in the mixed all-adult groups. Yearlings were mainly in calf-containing groups. It was evident that as eland matured, the subadult animals began to form smaller all-adult groups. Females then returned to the large nursery groups, while males join very small all-male groups.

Mature females are mostly aggregated into groups with calves and less often in all-adult groups of both sexes. Exceptionally it is possible to find a female alone (Makovcová 2005). Hillman (1987) stated that less than 1% of adult female population were seen to be solitary. The others are components of nursery and all-adult groups.

Adult males are, as usual, the least sociable class (Estes 1991). Also Pappas (2002) stated that males form smaller herds or wander individually. The males join group of females when they are in oestrus. Kingdon (1982) observed that adult bulls are seldom found in number exceeding six or seven, which may be because relative rank is easily and quickly established in a small group.

Hillman (1987) during his observation divided adult males into 2 categories – grey and brown males. Grey males were fully matured animals that had developed all their secondary sexual characteristics. These included an over all grey coloration, thick muscular neck, a thin pendulous dewlap and loss of the spinal mane and dewlap tuft. Brown males were a fawn-brown colour and had not developed the physical characteristics of grey males. Grey males

were always dominant over brown, though the brown males were almost the same size. He described that adult male eland were seen mainly in all-adult, and especially all-male groups. There was a slight predominance of the younger brown over older grey adult males in the mixed all-adult, juvenile and calf-containing groups, whereas grey males were predominant in all-male groups. Only 1-6% of all of brown males seen were alone.

Examples of relationships in herd

a) Mother x calf

Taurotragus oryx belong to species for which is typical so-called concealment (hiding) of young The calf is hidden in a high grass, is convolute, the head is lay up on ground and ears are nestle up to head (see pic. 6 and 7).. Time of concealment is about 5-7 days (Treus 1983).

In accordance with Kingdon (1982) is time of concealment about two weeks and only during this time is calf totally dependent on the mother. The mother visits it twice a day and the calf suck for about three minutes, following which it is very active and playful for a period of time that increases each day.

After feed the mother lead on calf to new place. The calf follows her for a short time, after it stops and lies down. Grazing mother observe the place of hidden calf from a distance, remember the place and leaves into herd. Distance between mother and place of lie range from 200 metres to 1.5 kilometres (Treus 1983)

Also Pappas (2002) stated that mothers conceal their calves during the first two weeks of life. Further he described communication and interaction between calf and mother. Early maternal interactions involve nose trusting, licking, chewing, and a variety of vocalizations. These vocalizations include moods, clicks, and grunts from the mother, and bleats and whimpers from the calf.

After conceal period are calves introduced to the herd and begin socializing with other caws and calves (Pappas 2002). This social milieu is essential characteristics of which are carried on into adult life (Kingdon 1982).

When mother bring the calf into herd after conceal period, almost any member of herd interest oneself about the calf, take a sniff it and touch it by flat face of horns. Some members lick it. Only sporadically the aggressive behaviour occurs. The mother is calm and pushes away other individuals only in the case of aggression towards the calf (Treus 1983).

Pic. 6 The concealment at paddock

Pic. 7 The concealment in stable

b) Female x female

Among females as well as among males there has been clear hierarchy (Kingdon 1982). The dominant female not necessarily has to be the strongest and largest cow but she has a lot of experience, which result from number of calves. The female attain status by fights and threats, but in contrast with males, the fights are shorter and more cruel (Treus 1983).

The females, as mentioned above, are most often seen in groups with calves or in all-adult groups.

Underwood (1975) observed that there is a slight drop in the number of companions in the herd in August/September, presumably because of parturient cows seeking isolation. As the cows come together to form a single nursery herd, the number of companions again increases.

c) Male x male

The juvenile males form a very small all-male groups so called juvenile or bachelor groups. After some time the juvenile herd break up to two or three smaller groups which are composed from several individuals (Treus 1983).

The leader of juvenile group is the strongest and the biggest male. His dominance is proved in the fights. In juvenile groups was observed more frequent fights than in other herds. It is thereby that there are animals of the same age and weight (Treus 1983).

Mature males were not found in bachelor group, but could be found in apparently amicable association with any other males. As many as 13 adult males were seen together in the presence of adult female (Hillman 1987).

Hillman (1987) studied the length of association among individuals according to age categories of eland. He found out that the longest period were between adult females and calves. Slightly shorter associations were recorded between yearlings . Male-male associations were next in duration, lasting an average of 15 – 20 days, female-female about 10 days, and male-female for 7-8 days.

Adults of both sex normally occupied small groups consisting of between three to five eland of one sex only, and ten to twelve eland of mixed sexes. Males did not change this grouping tendency with other males, regardless of the social context. Females, however, tended to occur together in larger numbers as soon as there were young eland present, particularly calves. Young eland tended to occur together in much larger numbers than adult, inversely related to their age and therefore size.

The eland demonstrates a social organization typical of the *Tragelaphini*, but that is modified by its much larger body size compared with other members of the tribe, and seasonal occupation of open grassland habitats (Hillman 1987).

3.5.1.1 Hierarchy

Gregarious animals engage in social interactions that lead to the establishment of dominance hierarchy (Wirtu et al. 2004). Hierarchy is an order which governs the mutual relations of group of animals of one species. Dominance behaviour can be observation in all groups of *T. oryx*. Every member of herd has own hierarchical position (Treus 1983).

According to McFarland (1998) the hierarchy means that the animals create a social grading when the group is together for a sufficient period. The result of this organization are clarify relationships of dominance and subordination and minimal of physical aggressive events. Each individual is in a way ranked in the herd, it means that each member has specific social grading. His rank makes it possible to behave only just as it results from his status (Botto 1984).

Komárek (1971) stated that sequences of individuals are results of mutual fights at males and at females too. Leadership position can obtain only the strongest and the most capable animals. The animals on the highest position lead and protect the herd against predators and other danger. Leading role of dominants in the herd can be utilized at domestic animals. For example, at sheep or livestock is possible to regulate only leader animal and the others go at him.

Hierarchy in the herd is not unchangeable because relationships between members are regularly changed. To knowledge of own position within the herd is based on the ability to recognize individuals within the herd (cattle can recognize 50 - 70 individuals) and the ability

to remember outcomes of are basic prerequisites for forming hierarchy in a herd (McFarland, 1998).

The hierarchy in turn determines the animal's access to resources such as space and food, and mating opportunities. Interactions leading to the establishment and maintenance of hierarchies can be stressful to subordinate animals, and also result in serious or fatal injuries. Social rank can also alter behavioural, physiological, biochemical and anatomical parameters and can affect overall health and reproductive performance in many mammals (Wirtu et al. 2004).

Treus (1983) described the social behaviour of semi-domesticate elands in Askania Nova. He stated that after multi-annual observation is possible divided the members of herd into two groups. The animals of first group are well-distinguishable and conspicuous. They have good bodily structure and they vary from others with bright colouring, posture, activity, fleshiness, good appetite etc. Dominant and animals of higher hierarchy level, which serve to obtain important functions in the herd are exempt from this group. They are most successful during reproduction of the group/ population.

Animals of lower hierarchy level are at first sight inconspicuous. They are appropriately to badly fleshy, they have gleam less pelage and exterior deficiencies, they are often sick, have deferred reactions and bad appetite etc. The males of this group practically stay away of reproduction. Deputies of both sexes are on lower hierarchy level. In case of emergency they are vulnerable to predators. (Treus 1983).

Treus (1983) also observed that redistributing of position in herd which is connected with progress or decline of present hierarchic sequences proceed every year. It was seen also shift at hierarchical step depending on age and maturity.

According to Sova (1981) which studied behaviour of cattle the new herd members must fight for their position in the herd. Generally at formation of hierarchy following factors are important: weight, age, size of horns, temperament, aggressiveness and skills.

Cransac and Aulagnier (1996) published that age and dominance often correlated. They reported that prime age adult males and females are dominant within the herd of domestic cattle (*Bos taurus*). Other factors are important determinants of dominance, particularly body weight in female of bison (*B. bison*), reindeer (*Rangifer tarandus*), chamois

(*Rupicapra* sp.*)*, and Cuvier's gazelle (*Gazella cuvieri*), as well as horn length in chamois (*Rupicapra* sp.*)*.

In eland, Kiley-Worthington (1977) suggested that, together with age, matrilineal genealogy has an important effect on dominance relationships. In their study, when was observed a captive herd of 13 elands, they demonstrated that age, although an important factor, can not completely explain the hierarchical of captive eland. Matrilineal genealogy has a significant influence on dominance relationships. According to some authors inheritance of dominance is obvious, whereas according to Capitanio (1991) dominance is not heritable. Drews (1993) proposed that dominance can not be inherited because it is a "property of individuals", however some aspects, such as aggressiveness could be heritable. In fact, physical characteristics which are often correlated with dominance are indeed inheritable.

Wirtu et al. (2004) observed the dominance hierarchy of a group of adult female kept in captivity. They stated that in their study, in contrast previous studies (have shown that age and matrilineal genealogy affect dominance hierarchy in the eland (Cransac and Aulagnier 1996, Kiley-Worthington 1977), body weight (which is also influenced by age) had no effect. They observed that the least dominant female (weighing 333 kg) did not have the lowest body weight, and at the same time the heaviest female (weighing 415 kg) was not the most dominant. During their research, they also noticed the relationship between the frequency of aggressiveness among the female and social rank. Domestic cows on low social rank are more aggressive toward their subordinates, while those of high rank are less aggressive. In contrast, the most dominant females of sable antelope (*Hippotragus niger*), domestic goats (*Capra hircus*), and naked-mole rats (*Heterocephalus glaber*) are the most aggressive.

Social status, as was said, can affect intake of feed, reproductive activities and productivity, and possibly the overall health of an individual. For example, both low- and high-ranking domestic goats produce less milk and deliver lighter offspring than goats of intermediate social rank. In contrast to goats, dominant dairy cows produce more milk than subordinates. Subordinate cows have reduced sexual motivation compared to dominant females, which interferes with daily oestrous detection. In red deer, social rank influences the rate of increase progesterone after ovulation and also affects the sex ratio of offspring, with dominance favouring the birth of males. Social subordination has also been reported to significantly reduce the level of ovulation-associated hormones, including and LH in rodents

and primates, as do other non-social- stressor stimuli. For several species, including rodents, ungulates, perissodacyla carnivores, and primates was reported that reproductive functions can be suppressed due to social subordination. Thus, the effect of dominance hierarchy on the physiology of eland antelope requires further investigation (Wirtu et al. 2004).

Treus (1983) stated (under condition of Askania Nova), that in the herd of eland exist linear hierarchy of "*peck-order*" type. Dominant male leads the herd. He manifesting remarkable patience to others member of herd and only seldom attack others animals. The youngest elands give an indication about the male-dominant. They often sniff males lip, prepuce, anal zone and play and butt with him. This they never allow to subdominant males. Sick and injured young look for shield at dominant male.

The leadership in the group is not result of one duel. Sometimes the male must take pains to maintenance of dominant rank. Therefore is suitable to keep only one sexually mature male in the herd. When dominant male is somehow excluded from the group, his rank is automatically supplanted, without fight, by sequent male (according to position). (Treus 1983).

The females have among them another self order of hierarchy. The dominant female not has to be the largest and strongest cow. It must be female well responsive and with a lot of experiences. Dominant position at females is given by fights too. In comparison with males are females fights short (few seconds – 2 minutes) and cruel (Treus 1983). Kingdon (1982) stated, that in open air are fights between females rare but violent and the outcome is settled almost immediately.

It was observed that only adult males and mature females are able to leads the herd peacefully. The leadership of young males and females bring into behaviour of members and existence of herd trouble and increases number of conflicts. The most aggressive individuals serve a function of guards. They first display defensive reaction and take position between herd and danger (Treus 1983).

Young which are born in current year are at lowest hierarchy position (Treus 1983). Cransac and Aulagnier (1996) stated that calves did not enter the hierarchical organisation; however during their ontogeny, the offspring of females from the dominant family maintained a close relationship with their mother, whereas from the other lineages did not. The nature of

these occasional interactions with other adults may be a reflection of their mother's rank, which they inherit as an adult. In determining dominance are very important first experiences. Therefore, the existence of dominance in eland herd may not only be due to genetic inheritance, but may also indicate some maternal influence on dominance.

At sons and daughters of dominant females are manifest vestiges of dominance earlier than at their peers, whose parents are on low hierarchical step. Among all young animals, they lead already from 1.5-2 months of age. But this is relevant only to offspring which was born on the top of reproduction age of dominant female. It is approximately from third to eighth pregnancy (Treus 1983).

In the herd close association between relatives groups, which are keep together, can be formed. They together graze/ browse, rest, and groom together. These are animals of different sexes and ages, which belong to the one family. Usually are distinguish from others by special coloration, characteristic constitution and specialities in behaviour. These are so called clans- the animals are bonded by kinship. There exist also groups of animals that are not bonded by relatedness to each other but they are personally partial - partial groups of animals. These groups are usually little numerous, most often are formed by two individuals (Treus 1983).

3.5.1.1.1 Social foraging and dominance relationships

For any animals, deciding upon the best place, time, and style of foraging is dependent upon a large number of different factors, such as the availability and quality of food, the likelihood of being attacked by predators, the time of day or season and the current energetic requirements of the forager. The situation is complicated further for animals that live and forage in groups, where the social interactions between individuals can have additional effects upon factors such as energetic gain or predation risk (Rands et al. 2006).

In many species of animal that interact socially, dominance hierarchies will also have effects upon the foraging behaviour of an individual, dependent upon its place within the social hierarchy. In socially foraging groups, subordinate individuals may suffer a reduced energetic intake whilst feeding. Dominant individuals may use their social status to occupy good feeding sites or to force the subordinates to position within the group that are more exposed to predators, forcing them to trade off foraging with vigilance behaviour. In some

cases, simply the presence of a dominant individual is enough to cause a reduction in a subordinate's energetic intake (Rands et al. 2006).

Also under conditions of Askania Nova was observed that dominant male doesn't need to chase away the others animals (on low hierarchic positions) from feeder, because subordinates step back him automatically. There was also observed the conflicts when the subordinated animal chase away from feeder older animal. It was observed only among animals of similar age. Young, which are the most subordinate, always came to the feeder last, when all adult animals left. Only mothers permit the place at feeder to their young (Treus 1983).

Wirtu et al. (2004) during their research observed that when dominant females approached or display dominance subordinate females moved away at most of the time. When dominant females were in the vicinity of the chute, they induced fear reaction in the subordinate females and prevented them from entering the chute.

3.5.2 Forming and size of herds

The eland forms larger herd then the most of bovids (Estes 1991). Membership within a herd is variable. Individuals stay in a herd for several hours to several months (Pappas 2002). The absence of close ties allows eland to vary the size and composition of their association (Kingdon 1982). The grouping pattern and herd size vary according to habitat and season (Estes 1991).

Treus (1983) with reference to the other authors stated that the herd of elands compounds of 8-10 animals (to 30 animals). According to others is the group is formed by 25-30 animals but during migration period agglomeration of 100-200 animals commonly occurs.

(Estes 1991) observed that on the Athi Kapiti Plains (Kenya), unisexual adult groups typically numbered 3-5 individuals, bisexual groups 10-12, whereas herds containing juveniles and calves averaged 48 (range 2- 427 individuals). He also counted groups of up to 500 members on the Serengeti Plain and he stated that herds of over 100 individuals are common in many areas.

Under favourable conditions the eland and others species [e.g. buffalo (*Syncerus caffer*) and gemsbok (*Oryx gazella beisa*)] may live in permanent herds numbering many hundreds, even one or two thousand, animals. Seasonal variation in group size may be slightly different, since populations do not usually switch from smaller group to super-herds as can do members of *Alcelaphinae* (hartebeests). Nevertheless eland can show regional and seasonal variation in typical group size, and these variations can be associated with differences in either amount of available food or in dispersion (Jarman 1973).

The largest eland groups were seen usually on the Athi Kapiti plains during and after rainy period when the grassland were green (Hillman 1987). Also Estes (1991) recorded that large herds form during the rainy season and invariably contain numerous calves and juveniles. It was not unusual for young to outnumber adults and one may even see herds composed entirely of calves and juveniles during the rainy season. Kingdon (1982) with reference to others authors noted that small groups were normally scattered but temporarily associated in larger numbers during and after the rains. He recorded that the main attraction for herds on the alluvial plains during the wet season were small herbaceous plants and herbs. He remarked that when some plants such as *Commelina* sp. were abundant they were such an attraction that eland could always be seen feeding exclusively on them.

Hillman (1987) observed that the aggregation of adult females, together in a larger numbers in the presence of juveniles, was linked to their association with their calves, which in turn have aggregating tendencies with their peers. Nursery groups increased in size as environmental condition improved, but all-adult groups did not. He also stated that larger group types were generally smaller in forest than they were in grassland and bush. Also in Loskop Dam nature reserve Underwood (1975) observed that the calving season (August-October) was marked by an increase the group size, due mainly to aggregation of females and young. The females at first formed small nursery herds with only few young of the year, although yearlings and subadults would also join these group. At the same time, bulls would associate together and some mild aggression and sparring were seen.

Groups and single meets, mixed groups and solitary living are possible casually – as are formed by other *tragelaphines*. Herds are entirely open and the only regular association of individuals are between mothers and their calves (Estes 1991). Also Hillman (1987) during his observation found out that within few hours, the original group of elands was changed in composition and size trough individuals leaving and/or joining. Underwood (1975) similarly

found that there was great variability in group size and composition, groups forming and breaking up continually.

3.5.2.1 Social organization compared with other Tragelaphini (According to Hillman 1987)

Other antelopes of the *Tragelaphini* do not form groups as large as those recorded for eland. The bongo (*Tragelaphus eurycerus* Ogilby 1837) forms group of over 40 animals when juveniles are present, and lives in dense forest and wooden savanna habitats. The southern nyala (*Tragelaphus angasi* Gray 1849) forms group up to 27 animals, and lives in relatively open bush habitat. The mountain nyala (*Tragelaphus buxtoni* Lydekker 1910) can form groups of over 90 animals, and groups containing juveniles are consistently larger in size than all-adult groups. Lesser kudu (*Tragelaphus imberbis* Blyth 1869) will very rarely form large groups up to 24 animals. The other *Tragelaphini* typically form groups of fewer than 10 animals, and are often solitary.

3.5.3 Migration

Like highly sociable type of animal, the eland tend to migrate (Treus 1983). The eland is one of the most mobile antelope (Estes 1991). Hillman (1988) highlighted the variance in literary sources. Regular migrations were thought to occur by some authors while others reported irregular nomadism and few observers noted that eland did not move at all, and could always be relied upon to be in the same locality.

Treus (1983) published, that migration of eland begins with drought period, when herds displace to river valley areas. Hillmans (1988) results show that females and juveniles had average home-range sizes five times greater than brown (young) males. The mean female and juvenile home range in his study (222 km^2) was larger than that given for any other African species of a large ungulate, with exception of elephant (*Loxodonta africana*).

The disparity between male and female home-range size is also an unusual feature in the antelopes. Two other *Tragelaphine* species were reported to have different home-range

sizes for males and females, but in these instances the home ranges were far smaller, and the female has a home range approximately half that of the male. Similarities are found in the bushbuck and lesser kudu (Hillman 1988). Kindon (1982) described that females and their young in the Nairobi-Athi area cover a total range of some 1500 km^2 in the course of a year and the males range over only 25-100 km^2 in contrast to Estes (1991) which described that females in Athi-Kapiti plains ecosystem had home ranges of at least 174 up to 422 km^2.

3.5.3.1 Migration in response to food resources

Because eland use a variety of food resources, these nomadic animals move from region to region based on season and food availability. In general, females use more habitats than males and have a larger home range (Pappas 2002). Wherever there are strong seasonal changes (which is the case throughout a large part of the eland's range) in soft browse and ephemerals or scattered patches of bushes, the eland must be therefore nomadic, moving whenever necessary from one distant pasture to another (Kingdon 1982). Also Estes (1991) stated that their broad habitat tolerance is reflected in an extremely varied diet consisting primarily of browse, but also including fruits, pods, seeds, herbs, tubers, and grasses.

According to Jarman (1973) there have been five main feeding styles among antelopes. The eland refers to species which feed unselectively on the wide range of grasses, or grasses and browse, in number of vegetation types and moving seasonally within a large home area. This feeding style includes buffalo too. But according to Kingdon (1982) cattle and buffaloes graze from wider choice of vegetation than eland and so need to move less, have relatively shorter legs that the eland.

When the relationship between body size and feeding style was observed Jarman (1973) found out that those species which feed very selectively on discrete food items tend to be small, while the wide-ranging, relatively unselective feeders tend to be large. A large antelope, having to consume much of the plants, is forced to take a mixture of valuable and valueless parts. The only way for a large antelope to select a high quality diet is for it to seek stands of plants in which most of the constituent parts are at a similar, and valuable, growth stage (Jarman 1973).

Also Littlejohn (1968) described the eland like a highly nomadic animals which is able to cover long distance. He published that eland in the Nyika Plateau migrated into the moist valley of the escarpments after frost or drying of the forage, covering 10-15 miles per day. When not migrating, daily movements were small and 8 miles a week or less was normal. In the Giant's Castle Reserve in Natal, eland move in winter to the sheltered valleys at a much lower altitude. Such migrations are probably associated with a deterioration in the nutritional quality of the herbage in their wet season habitat.

3.5.4 Agonistic behaviour

Between captive males there are fights only during rutting period in open environment (Treus 1983). This is season when is among males the largest interest about females. In semi-domestic conditions were observed fights between males as well as between females to obtaining or maintenance of their dominant position (Treus 1983).

According to Kiley-Worthington (1977) the predominant function of the horns or antlers in ungulates, it has been argued, is for ritualised fighting. The eland are horned in both sexes. The horns are indeed used in rutting fights between males but are used (especially by the females with young) predominantly for defence against predators.

The methods of fighting in horned ungulates are divided into wrestlers, rammers and jumpers. Like the bovids, the eland falls into the first category. They entwine the horns and then by pushing and rotating the head, using the horns as levers, put very considerable pressure on their opponents. In males, a fight may last several minutes as the animals push and twist rather like heavy-weight wrestlers. In females the fights are short and violent, ending after 20 to 30 seconds (Treus 1983). During horn clashing, different levels of intensity are evident, the smaller the angle of the head to the ground–the more intense the fight

Estes (1991) described behaviour and postures connection with meeting individuals of eland:

Dominance/Threat Displays:

- *Glance-threat*

- *Head-toss and horn-wipe*
- *Medial- and low-horn presentation*
- *Feinted attack*
- *Ground-horning and forehead-rubbing*

Defensive/Submissive Displays:

- *Slow head-shaking*
- *Head-low posture*
- *Displacement grazing*

Fighting:

- *Front-pressing*
- *Ramming*

Sparring:

- *Neck-wrestling*
- *Horn-tangling*

According to Estes (1991) most of the aggression between elands is low-key and one-sided, therefore easily over-looked. A bigger animal suppress a smaller one (e.g. from the shade of a bush) simply by moving toward it ant the other moves out of the way. If not, the dominant may resort to a *glance-threat:* raising its head slightly from ground level and looking at the inferior, meanwhile stopping any other activity such as chewing and following

a female. The intimidated animal then moves away, often giving the *slow head-shake*. *Mutual head-shaking* may be seen between elands anxious to share a limited resource without fighting. Grazing attitude is a less obvious expression of inoffensiveness.

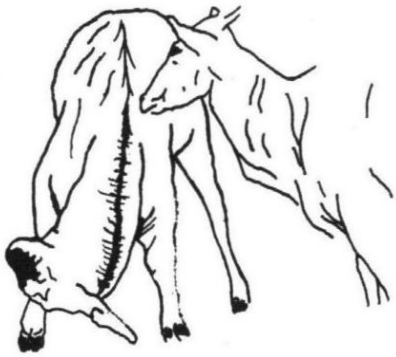
Head-tossing and *wiping the horn tips* across the withers is a stronger threat. Stronger still is *low-horn presentation*, with horns aimed at the adversary. This display can be further intensified by lunging (*feinted attack*). *Ground-horning* is often seen during aggressive interactions (see picture 8). For example, a big bull urinated, stepped back, and rubbed his forehead in his urine while displaying to a younger bull (Estes 1991).

Treus (1983) described the fight about dominant position subsequently: The rivals touch by tips of horns. When bull feels tight muscles at opponent and hard strength of horns, the fight is unavoidable. The males interlace horns, stand firmly and push forward and try to press rival head to the ground. As soon as the dominant male regaining superiority, the inferior male steps aside but horns are still coupling. The dominant push the antagonist back and in the suitable moment the dominant rebuts the head of antagonist. The loser passes of low intensity sound, run away, set free the horns and immediately he begins graze. The fights between approximately same strong males can proceed till 45 minutes. When is one bull considerably stronger the fights last only 1-7 minutes. Duels between females run in the same way like at males, but are much faster. Therefore is difficult to recognize to single phase of fight (Treus 1983).

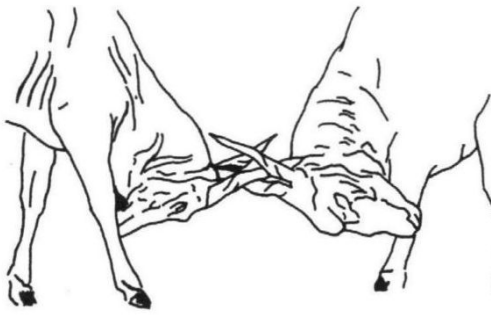
According to Kiley-Worthington (1977) the horn clash may consist of only a pressing of the lowered heads together with forward pointed horns or at higher intensities with the head flattening parallel to the ground and the chin withdrawn (see picture 9). Head rotation may be followed by the rotation of the rump of one or other contestant, presumably to increase or decrease the pressure either on their opponents or their own head and neck.

Neck-wrestling, the supposed holdover from hornless ancestors can be seen during play fights between juvenile. Sparring, including horn contact, is common between subadult and young adult males (Estes 1991). Play-fighting is often assumed to be the prerogative of the young. Males are involved substantially more play-fighting than females or subadult (Kiley-Worthington 1977).

Kerr et al. (1970) studied feeding behaviour of eland. During their observation they noticed that when a branch has been broken down by one member of the herd, eland feeding some distance away will immediately come over and begin stripping the leaves avidly. The resultant competition illustrated hierarchy in the herd. Subordinate animals are threatened by lowering of the head and horns in the attacking position, often combined with short rushes.



Pic. 8 Male horning ground



Pic. 9 Two males fighting with horns entwined

Source: Kiley-Worthington, M.: *The causation, evolution and function of the visual displays of the eland.* University of Sussex, Brighton, England 1977, p. 188.

3.5.5 Social organization and predation

As we can conclusively prove, larger amount of individuals in the group are better protected against of predators. That is mainly why that more eyes more widely see, more ears more hear and more nozzles smell more. The oncoming enemy is recognized much earlier by group of animals that by individual (Veselovský 2005).

All antelope are vulnerable to one or more species of predators. It is clear, that the general size of prey preferred by each predator is strongly correlated with the body size and group size of the predator. There seem to be two aspects to this correlation. Firstly there is an advantage in killing as large an animal is practicable, but secondly the larger animal threaten greater risk of injury to the predator. The injury to lion was recorded by goring of buffalo, sable, roan, and greater kudu, all quite large antelope (Jarman 1973). Kingdon (1982) stated that the main predators of eland are lions and less then leopards, wild dogs, cheetahs and

sometimes hyenas too.

Each antelope species practises forms of behaviour appropriate to the predators to which it is vulnerable. This may mean using different reactions towards each of a range of predators, and may involve some social castes, such as mother with new-born young, behaving differently from others. The major types of behaviour undertaken primarily to avoid being predate are:

a) avoidance of detection by, contact with, or exposure to predators;

b) flight after detection, but before attack;

c) flight under attack;

d) threatening, or even attacking, the predator.

(Jarman 1973)

The single individual is easy prey for predators, but when join nine another individuals, chance be hunted decreases to one tenth. As the hunters count with the only one prey, possibility of successful hunt is being statistically reduced with the group size and its ability to defend itself proportionally increases (Veselovský 2005).

The calf of eland is susceptible to a very wide range of predators due it its small size (weight around 25 kg at birth), while adult male showed little fear of any predators (Hillman 1987). The younger eland, together with the adult females associated with them, aggregated into larger groups (Hillman 1987). Slow and solitary living old males would be vulnerable to large group of lions but, because the larger groups prey mainly on herds of plain ungulates, they seldom hunt in the more thickly wooden country that is preferred by old bulls (Kingdon 1982). Reaction between lone eland and predators were not observed, but the few lone females seen with a calf were always very apprehensive and constantly on the move (Hillman 1987).

The company provides also possibility of active protection of members from predators (Veselovský 2005). Bunching and aggressive defence by the females has been seen against all eland's major predators (Kingdon 1982). Hillman (1987) observed that adult females attacked large predators communally, while juveniles run away in a cluster, leaving the adults between

them and the predator. It is likely that several adult females would be more successful than single ones in repelling a predator. Estes (1991) described this like the most unusual feature of eland social organization. Adult females will jointly defend calves against large predators, including lions. This trait makes elands still more like cattle and less like other antelopes.

On their own calves, mothers may be indifferent to the fate of calves but once alerted and bunched in formation around the young, they may join other adults in a concerned attack, even on large and dangerous predators. The survival of individual calves would be less well served by their looking directly to their mothers for protection than by maintaining cohesion as an age group and relaying upon the larger animals to defend the entire herd (Kingdon 1982). Estes (1991) observed that cows in herds have been seen to advance on lions and to chase cheetahs, but more often ignore predators unless their calves are threatened. Kingdon (1982) saw females come forward to attack a pack of hyenas that chased an isolated calf. Jarman (1973) described similar behaviour at buffalo. The herds would react to the distress calls of a buffalo calf, the whole herd, not just a mother, coming to the sound. Also at muskox (*Ovibos moschatus*) was observed similar behaviour. They aggregate into circle during the wolf's attack and with the aid of horns they protect their calves (Veselovský 2005).

It seems that the larger the antelopes are they are more prepared to defend itself against predators and the more incline it is to combine with others for anonymity or mutual defence (Jarman 1973). They are very often in the company of zebras and joint defence has been seen on more than one occasion. In Uganda, a single zebra stallion was seen to rush at wild dogs circling a mixed bunch of eland. Also was seen female eland that were walking with zebras attack hyenas that attempted to hunt their companions (Kingdon 1982).

During the defence is obvious a hierarchical position. Kingdon (1982) recorded an interesting effect during defence. The lowest ranking cow (one with a broken horn) was forced on to the periphery when the herd bunched against a cheetah.

3.5.6 Communication

Communication may be defined so as to include all possible interactions between two animals, or it may cover only a very limited range of exchanges between individuals (Underwood 1975). Social, sexual and defence behaviour directly depend on mutual

communication. The communication in the broadest conception provides detection and intercommunity of social or sexual partners, but also can be used as warning against enemy (Veselovský 2005). General requirement for mutual communication is ability to put together tidings from movement, mimic, vocal and effluvial signs to intelligible code.

	TYPE OF SIGNAL			
Characteristics	**Chemical**	**acoustic**	**visual**	**Tactile**
Reach	Distant	distant	limitary	Short
Diffusion	Slow	quick	quick	Quick
Restriction	No	no	yes	Yes
Localization	Variable	medium	excellent	Excellent
Energy expenditure	Low	high	high	Low

Tab. 1 Type of signal

Source: Veselovský, Z.: *Etologie; biologie chování,* Akademie věd ČR, 2005, s.189 (in Czech)

3.5.6.1 Visual communication

It has been suggested that large conspicuous animals that live in open habitats use visual signals as the most appropriate and primary means of communication. It is to be expected that visual displays will be well developed in these animals. The eland is a sophisticated visual communicator, but the importance of olfactory, auditory and tactile communication in this species must not be ignored (Kiley-Worthington 1977).

The visual communication includes broad range of a movements an postures. According to Kiley-Worthington 1977 these are:

a) Postural movements

b) Protective movements

c) Orientation movements

d) Movements related to cutaneous irritation

"Broadcast" indicates that the action is apparently performed without reference to a particular individual (Underwood 1975).

"Directed" indicates that the action is directed towards particular animals (Underwood 1975).

He also observed broad range of the movements and actions which serve to communication. Among these movements pertain for example normal walk, slow walk and erect posture, flight jumps, intensive grazing, grooming movements, concentrated attention, ears movements, adult female urination posture, chinning, horn threats, neck stretch, head toss and a lot of other.

Non-directed rotational scanning movements of the ears, eyes and nostrils occur much of time when the animal is not asleep in order to detect environmental changes (Kiley-Worthington 1977). Ear position often serves a communicatory function in mammals (Underwood 1975). The eland, like most of the ungulates, has very mobile pinnae allowing independent and accurate movements in both the lateral and dorso-ventral planes (Kiley-Worthington 1977). According to Underwood 1975 in general, if the ears are pricked upright and point of the front, the animals has its attention fixed on something. In a social situation, this usually means a readiness to interact with the animal being watched, either aggressively (i.e. as a threat or challenge) or more peacefully (as in a calf approaching its dam to suckle). The ears are pricked upright and to the rear under two main sets of circumstances. Firstly, when an animal is very interested in something to the rear, (e.g. the animal avoids threats from another). Secondly, it is seen in threats. I the letter case, it was often seen at the end of a threatening approach – a dominant animal would approach a subordinate with ears pricked forward, then about two to five metres from the subordinate would flick its ears back briefly.

Ear pricking is not confined to stimuli of potential danger to animal. For example, eland may have their ears pricked as they approach to greet a familiar or oestrous animal as well as to a strange or interesting occurrence in the environment. Advancing to attack another animal with ears pricked forward characterises a fully confident individual (Kiley-Worthington 1977).

3.5.6.2 Vocal and auditory communication

The eland does not seem to rely greatly on auditory communication. Were noted three apparently distinct continua of sounds – contact calls; alarm barks; aggressive vocalization (Underwood 1975). Most of the sounds elands make are either inaudible at any distance or infrequent. There is a mother-calf contact call that resembles a creaking door slowly opened, and a faint bleat that is given by calves and mothers (Estes 1991).

Eland have a typical tragelaphine alarm bark (Estes 1991). Both sexes can utter a loud bark when alarmed (Kindgon 1982). These calls are gruff, deep, penetrating sounds. Barking is heard from adult females and subadult of both sexes. The head is thrown up during the bark, in the same way as in dogs: the posture is otherwise concentrated attention (Underwood 1975).

The most unusual sound elands make it the castanet-like clicking produced by mature bull (rarely and irregularly by old cows) (Estes 1991). This clicking noise it may seem that is emanating from the hooves but is in fact made by the sinews of the knees (Kingdon 1982). Probably it is a tendon slipping over the carpal (knee) joint or another food bone. The sound can be heard for hundreds of meters on a still night (Estes 1991). Kingdon (1982) suggested it is possible that the click might communicate information on the status of a bull as the sound could be correlated with the weight-load.

3.5.6.3 Olfactory communication

The presence and distribution of specialised scent glands in eland is uncertain. The false hoof gland, typical of all tragelaphines, gives off a sweetish odour in eland which resembles the smell of the rest of the body, but is much stronger (Underwood 1975). For both sexes the olfactory communication is linked with rubbing the forehead brush and foreheads in odorous substances. Wet earth elicits this behaviour and urine is the wetting agent: their own or another eland's, and even the urine of other mammals (elephant, buffalo, etc.) (Estes 1991). According to Kingdon (1982) the principal stimulus for a bull is his own urine. The wetted forehead tuft in urine and mud often become thickly clotted with powerful scented mud, which on drying may puff out in a little cloud of a dust while the animal shake its head. The

bull will also rub his tuft in the urine of an oestrous female and this distinction is interesting because female elands which have no tufts, frequently soak their foreheads in one another's urine but do not do this to a companion if she is in oestrus. Taste probably supplements olfaction in most circumstances. Young eland investigating strange objects or individuals almost invariably attempt to lick the object after the prolonged period of sniffing. Possible opportunities for gustatory communication include mutual grooming; sexual licking of genitalia; lapping and drinking urine; dams licking their neonates and drinking calves semi-liquid faeces, calves licking the mother's underside while locating the teat (Underwood 1975).

3.5.6.4 Tactile communication

Direct physical contact between individuals was limited to only a few situations. Apart from calf/calf, mother/infant and sexual interaction, any action which involved contact, or which implied that contact would follow, seemed to make the receiving animal uneasy (Underwood 1975). According to Estes (1991) young calves elicit social licking from all other classes. Social licking is limited, as in other *tragelaphine*, to situation in which a lower-ranking individual attempts to appease a higher-ranking one.

3.5.7 Synchronization of behaviour

Behavioural synchronization means that the behaviour of several individuals is related in time (Engel and Lamprecht 1997). It has been suggested that social facilitation influences the patterns of behaviour of grazing herbivores (Rook and Penning 1991). Clayton (1978) defined social facilitation as: "an increase in the frequency or intensity of responses or initiation of particular responses, already in an animal's repertoire, when shown in the presence of others engaged in the same behaviour at the same time".

Being synchronized with other individuals is not automatically advantageous, but it may be in certain context like the regulation of body temperature, reproductive behaviour, flight, and activity rhythm (Engel and Lamprecht 1997). In groups of animals some synchronization of behaviour between the members is essential for group cohesion, and such cohesion may be advantageous for the group members (Engel and Lamprecht 1997). Jarman (1973) stated that the formation of groups, by herbivores, affords protection from predators and, for group cohesion, it is important that members of that group all graze and rest synchronously.

It has been suggested, that sight, and to lesser smell, are probably the major senses involved in group cohesiveness and the synchronization of behaviour by grazing herbivores (Rook and Penning 1991).

Ruckstuhl (1999) stated that degree of synchrony depends on the type of group. She studied bighorn sheep in bachelor, nursery or mixed groups and synchronise of their activities with other group members. She observed that when young rams leave nursery groups they are larger than adult females but smaller than adult males. Young males, which are still growing, may therefore not be able to follow their optimal activity budgets in either adult male or female group. If young rams synchronise their activity with that of adults of either sex they may incur a cost, and face a trade-off between their nutritional needs and the needs to synchronise their behaviour with other group members to stay with the group.

Male and female differ significantly in their activity time budget (Ruckstuhl 1998). They therefore show high synchronization of activities when in same-sex groups, but low or no synchronization when in mixed-sex group. Groups with members of different age and sexes are less synchronized in their activity than the same-age-sex group (Ruckstuhl 1999).

Pic. 10 Synchronized movement of elands on pasture

3.5.8 Sexual behaviour

Sexual segregation is widespread among social mammals. In most ungulate species, males and females live in separate group outside the breeding season (Ruckstuhl 2001).

Sexual maturity in females is approximately 2.5 years of age, whereas that in males is approximately 4 years of age. Although eland can reproduce at any time of the year, they have peak breeding and calving seasons. Estrus occurs at 21 to 26 days intervals and least for 3 days. Gestation is 271 ± 2.9 days (Pappas 2002).

Sexual behaviour of bulls includes rapprochement with cow, tasting and licking of cow, muzzle touches, laying of head to female's nape, pressure to her side and copulation (Treus 1983). Although courtship and mating behaviour does not seem to be as elaborate as in other *tragelaphines*, Underwood (1975) described several behaviour patterns which can be recognised and which are similar to sexual behaviour in other bovids.

Tending-this behaviour basically involved the bull keeping close to the cow. His normal position is to her side and rear and would sometimes "drive" considerable distances at a walk. Driving is widespread in ungulates, sometimes in the form of chases e.g. chamois, mountain sheep and roe deer, but chasing never occurred in eland. When is tending particularly intense, the bull would go through his normal activity cycle of feeding, ruminating etc, always keeping within two or three meters of the cow. This behaviour lasted at least one day in several cases, and probably longer.

Testing-all animals tested other's urine from time to time by sniffing, licking or drinking it, then giving flehmen. While cows were not seen to respond to bulls nudging or licking by urinating, contrary to most horned ungulates, they frequently urinated when driven hard by a bull.

Apart from testing and the tending bond, eland courtship was mainly limited to the bull rubbing his head along his partner's flanks as he walked alongside her, and licking and nuzzling her anal region (Underwood 1975). According to Kingdon (1982) the courtship involves persistent following and circling by the male, which makes conspicuous motions of licking and tries to rest his chin on the estrous cow's rump. The dewlap tends to come into direct contact with the root of the tail or even the vulva, so it is possible that the dewlap has tactile importance.

3.5.7.1 *Ukali* (according to Kingdon 1982)

It has been noticed that captive bull eland, like other *tragelaphines*, has periods of *ukali*, when normally tame males become intemperate aggressive and are very dangerous to other males and also to their human keepers. A keeper in Woburn Abbey was killed by an eland in *ukali* condition. *Ukali* can last for a few days or even months but average about three weeks. It is of irregular appearance in captivity but if it occurs in the wild it might have some synchrony with mating peaks. Horning of the ground and bushes is frequent particularly if another male is in sign, in which case an *ukali* bull may circle around in a very slow walk with the proud stance tilted head and rolling eyeballs, while the hair of the neck and frontal tuft appear to be more erect. Kingdon also described seeing such a bull deliberately using the female as a "stalking horse" to launch a surprise on another male.

Fight start with a short rush and, with chins tucked into chest, the opponents engage the tips of their horns; throwing their weight into the clash they twist stab to try gain advantage. One or both opponents may drop on their knees, which puts their weight more directly behind the lowered head and makes their stance more stable but limits agility. Fighting is generally attributed to direct competition for oestrous females. With rising aggression in any one bull might be reinforced by an increase in the frequency and intensity of aggressive responses in other bulls. From Kingdons observations of a *ukali* in captivity it is clear that any threat by a human, even staring at an animal, elicits a storm of charges and horning, whereas direct evasion, preferably with averted eyes, has an appeasing effect. Females may also exhibit fits of aggressive behaviour, at which time captive have been seen to keep other animals away from troughs for a day or two.

Pic. 11 Horning of the ground during the Ukali

4 CONCLUSION

This bachelor thesis is literature review and therefore isn't established on my ownobservation and results.

Eland (*Taurotragus oryx*) is easily tamed, quite calm animal with mild temperament. That's just this characteristics is possible to say, that eland has potential to be fully domesticated as was recommended by Scherf (2000) for keeping in captivity. Breeding of animals in captivity is necessary to use suitable technology of breeding and create of such conditions, which will fully comply with biology of these animals. It is necessarily to create the basic conditions for well being – it means to ensure enough of water and suitable food, suitable stabling, sufficiency of space and company of other animals (the eland is gregarious animal and hence the company with other elands is essential) and globally ensure them conditions without psychical and physical deprivation.

Therefore, fulfilling of the natural behaviour in captivity is one of the main indicator of suitability of applied technologies and measure of adaptability of species to breeding condition. So if we need to achieve this, we must know not only natural behaviour in the wild, but also we must observe visual and physiological displays of animals kept in captivity. The great advantage to study the eland in captivity is their close phylogenetical relationship and similarities to domestic cattle, therefore, we can use verified techniques of breeding which are physiologically and anatomically resemble. At the captive animals is very important to recognize and eliminate disturbing elements for creating of optimal living condition.

In wild the males and females live separately except for reproduction period. In captivity the segregation of sexes is problematic, that's why the natural needs would be evaluated by the study of activity synchronization. In consequence of different body size of males and females they have different requirements in energetic demands and efficiency of digestion and from these reasons also to differences in behaviour at ingestion of food (Štechmüller 2005). The males of sexually dimorphic ruminants in comparison to females spend less time by grazing and more time by rumination, it is thanks to their body size and proportion of digestive organs. Therefore, in mixed groups may be very problematic to reach exact energetic demand of every animal due to group cohesion and technique of feed provisioning. The individuals of different sex or another size can embody the minimal

synchrony with the rest of herd, because they have another energetic demands and different efficiency of digestion. This can disturb the cohesion and cause some behavioural problems .

Living in group brings a lot of benefits but simultaneously with number of animals increases intraspecific competition in case of limited feeding resources and it may involve also rising of aggressiveness in the group. Dominant animals can inhibit access to food for submissive animals. Therefore is necessary to ensure sufficient space at feeding place for all animals in captivity. In nature the aggressive encounters of dominant animal against subordinate occurs only in case of limited food sources (e.g. salt lick, water, attractive plants etc.), but in captivity due to limited space and higher concentration of animals under non stable social environment, can arise into huge problems.

During period of wintering in the barn the eland males were observed by Treus (1983) being into the same box, that caused frequent injuries or deaths which were irreversible, if they were not immediately separated. They were exposed to stress situation from presence of the other males at small space. This aggressive behaviour was observed though, that several minutes before housing these same males were seen at peace at the paddock. The death injuries are eliminable by the enlarging and dividing the breeding place, also like in the nature. The fights among males occurs in the wild only during oestrous period.

The phenomenon so-called *ukali* which is accompanied by raising of aggressiveness was observed only at captive males. This situation was displayed by aggressiveness against other males and also against humans (Kingdon 1982). Normally tame males become intemperately aggressive and were very dangerous to other males and their human keepers. The horning of the ground and bushes accompanied this behaviour.

In the wild approximately 83% females calved each year. It was reported that captive cows bearing eight calves in six years (Kingdon 1982). In nature the majority of births are between May to November, because in this period are the best environment conditions. In captivity females can give birth during all the year round, because they aren't dependent on seasonal food sources.

The study of social organization in captive eland should be resumed in my diploma thesis on the basis of own observation of social relationships among individuals of eland on the University Farm at Lány.

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6 LIST OF PICTURES