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Cutaneous scent glands in pampas deer Blastoceros bezoarticus (L., 1758)

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Abstract

The present paper describes the form and function of the cutaneous scent glands in pampas deer *Blastoceros bezoarticus,* or *Ozotoceros bezoarticus,* from Uruguay, South America, and discusses their behavioural role on the basis of field observations both there and in Argentina. Paired sebaceous vestibular nasal glands are recorded for the first time in this species; other scent glands present include the preorbital, tarsal, and rear interdigital or pedal. Metatarsal and fore interdigital glands, common in other Cervidae, were not found in the seven specimens examined. It is suggested that the forehead may also have an olfactory role.

Introduction

In Cervidae, a wide variety of cutaneous scent glands exists although their precise behavioural role is often still obscure. The present paper describes such glands in the pampas deer, *Ozotoceros bezoarticus* (= *Blastoceros bezoarticus* or *Odocoileus* (*Blastoceros) bezoarticus*), discusses their behavioural function and documents for the first time the presence of a sebaceous vestibular nasal gland in this species.

Pampas deer once lived throughout the vast natural grasslands of eastern South America situated between latitudes 5° and 40° S. Due to Man's direct and indirect activities, this cervid has suffered a substantial reduction in both its numbers and distribution pattern across much of its former range (Jungius 1976). Of the three subspecies, this process is particularly marked in the southernmost or Argentinian form, *O. b. celer* Cabrera 1943, which is recognised as the subcontinent's rarest deer and is in grave danger of extinction (Holloway 1975). Reliable data on this species biology are scarce and incomplete; any novel information is therefore important, however meagre.

Interspecific differences and significant taxonomic characteristics may be discerned by comparative studies of a species glandular spectrum (Pocock 1910, 1923; Cowan 1936). Investigations on the scent glands of pampas deer may therefore prove useful in resolving its controversial systematic status (Pocock 1923; Kraglievich 1932; Cabrera 1941; Haltenorth 1963).

Material and methods

The scarcity of pampas deer in both Argentina and Uruguay rules out the collection of healthy live individuals for scientific purposes. However, on a visit to the county of Salto in northwestern Uruguay in May 1978, the complete carcasses of a pair of recently-dead senile animals were found, examined and dissected by us in the field. The excised interdigital sacs were fixed on site in 10% formaldehyde solution. A week later, the nasal glands were removed from the tanned but not dried skin, and kept in 10% formalin. Subsequently, the material was mounted in parafin wax, sectioned, stained using the standard haematoxylin and eosin procedure, and studied microscopically.

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Six skins from Uruguay, including those of these two specimens, were studied from collections in the University's Vertebrate Zoology Department (ZVC) and the National Museum of Natural History (MNHN), both in Montevideo (Salto, El Tapado ZVC 1309, 1310, 1324, 1325, MNHN 693; Rocha, Sierra de Los Ajos MNHN 2243). One near full-term female foetus from El Tapado belonging to female ZVC 1310 was also available.

Field observations on behaviour were carried out both in Uruguay and more especially in Argentina in connection with IUCN/WWF project 1303.

Results and discussion

Vestibular nasal gland[1]

We can find no previous reference that this paired sebaceous gland exists in pampas deer. Vestibular nasal glands were first recorded in Cervidae by Jacob and von Lehmann (1976a) in another South American species, the marsh deer *Blastocerus dichotomus* or *Odocoileus dichotomus*. The site and gross characteristics of the gland in this species and those of pampas deer are very similar.

In both sexes of the pampas deer, one sac lies on either side of the nose, underneath the skin of the border between the white part of the muzzle and the darker adjoining hair, and lateral to the nasal cavity (Fig. 1). In the skins examined, the site is marked by a smudge of darker hair, further emphasising the contrasting colour pattern and focusing visual attention on that zone. The two white muzzle areas between the black nose and the brown facial hair, are clearly visible in the field (Fig. 2).

The gland is shaped like a flattened oval sac, with its longest axis anterio-posteriorly. It was measured fresh in ♀ ZVC 1324, and registered 24 × 15 mm and approximately 5 mm deep. The creamy-white saccule is encapsulated in connective tissue through which small bumps or lobules, corresponding to root hairs, are visible. A white waxy odourless substance, intermixed with minute hairs, fills the sac lumen, which opens via a 4 mm diameter neck onto the rim of the nostril, some 5 mm in front of the extreme posterior point of its lateral border (Fig. 1).

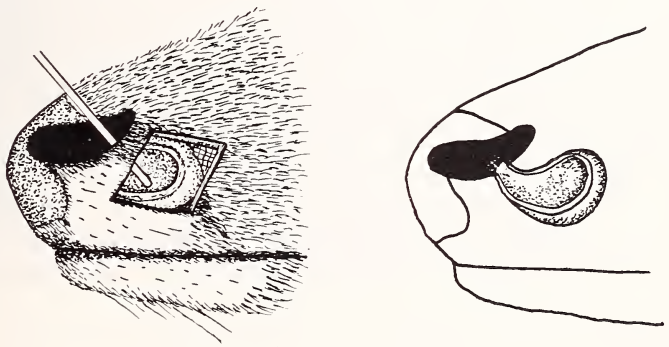

Fig. 1. Pampas deer snout viewed laterally. In A, overlying skin is removed and a probe enters the nasal gland opening, passing through the duct to appear in it's sac lumen. Note the white contrasting nasal spot. In B, the complete gland is shown, with the sac's side wall and overlying skin cut away

[1] To avoid confusion, the term vestibular nasal gland is prefered to that of nasal gland, used by Jacob and von Lehmann (1975b) with marsh deer. In both these cervids, these glands are derived from a group of highly specialised sebaceous glands found in the nasal vestibule. They are therefore distinct from what are normally called nasal glands (glandulae nasales), derived from the nasal mucosa, which are neither holocrine nor sebaceous.

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Fig. 2. Two adult female pampas deer at "El Tapado", Uruguay. Note the conspicuous white markings (arrowed), corresponding to the antler stump sites, around the eyes and on the muzzle

Fig. 3. Histological section of the pampas deer's nasal gland wall, showing well-developed sebaceous glands (A) associated with hair follicles (B)

Owing to tissue deterioration before fixing, only the gross glandular structure was visible histologically and consisted of three layers. The outer one, comprised of connective tissue and abundant muscular material with fibers orientated in differing directions, overlays a layer of sebaceous glands with several acini grouped around each hair, which is bounded internally by a stratified epithelium (Fig. 3).

Jacob and von Lehmann (1976a) also found that the internal sac wall was covered by epidermal epithelium into which emptied numerous large, branched holocrine sebaceous

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glands with exit ducts modified to form an ampule. Small sudoriferous apocrine glands were associated with the sac neck. Analysis of the chemical structure of the secretion revealed a composition of three main lipid fractions; cholesterol esters, and mono and diesters waxes, a mixture of lipids whose constitution differs from that of other holocrine sebaceous glands (Jacob and von Lehmann 1976a, b).

The vestibular nasal gland produces low volatile lipids which casts doubt on the secretion functioning pheromonally. These authors suggested it serves to fix the secretion of another sudoriferous apocrine type gland to assist it to adhere better to a certain object or substrate, enhancing its value in for example marking territory. However it is not clear how the nasal secretion becomes mixed with that of the other gland.

In pampas deer, the vestibular nasal glands appear to have a role in individual recognition. A behavioral sequence occurs (own data) where an arriving deer approaches frontally another already feeding or resting at a given site, and they raise heads to touch noses or nasal areas for several seconds. Mutual grooming may then follow and the newcomer remains with the other animal or animals. This activity has been observed between females and fawns, between does, between adults of different sexes and social ranking, and between bucks and fawns.

Similar behaviour was seen by Geist (1963) in moose *Alces alces andersoni,* who called it naso-nasal testing, and in white-tailed deer *Odocoileus virginianus* by Hirth (1977), although nasal glands are not known from these much studied species.

In recent years, ethological work has attributed a functional role to many of the spots, marks or differentially coloured areas of mammalian pelage. We suggest that the well-defined white area on either side of the pampas deer nose serves to focus visual attention to the nasal gland site, acting as a sign stimulus in the behavioural sequence of naso-nasal testing, apparently concerned with individual recognition between specimens of all ages.

Preorbital gland

This integumentary pocket or sac, situated in a depression of the external face of the lacrimal bone, extends forward from the anterior corner of the eye. It opens to the exterior via a slit bordered by a fringe of short white hairs which merge with those forming the white orbital circumferences (Fig. 2), contrasting sharply with the surrounding facial areas.

The luminal material consists of mass of yellow waxy substance, intermixed with short hairs, similar to that of the nasal glands. There was no noticeable odour in the specimens from this season (winter).

The preorbital gland is comparative large and conspicuous in pampas deer. In other ungulates this sac often has a scent marking role but we have never yet seen this species employing the gland in either this or any other manner.

Metatarsal gland

Macroscopic examination revealed no sign of this gland in either fresh or cured skins. Possibly small dessicated glandular areas were overlooked in prepared material but this is thought unlikely. Neither Miller (1930) nor Mac Donagh (1940) observed them and Hershkovitz (1958) found this glandular area was "sometimes defined" but that tufts were not developed in 19 specimens he examined.

In for example the genus *Odocoileus,* there are quantitative racial differences in the size and position of the metatarsal glands (Cowan 1936; Hershkovitz 1958; Quay 1959). Since the pampas deer has an ample geographical range, in which Cabrera (1943) recognised three subspecies, Brazilian specimens, such as Hershkovitz's, may demonstrate glandular tissue, absent in forms from Uruguay and Argentina.

No behaviour was ever seen to suggest this species has functional metatarsal glands.

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Interdigital gland

Macroscopically, there was no sign of interdigital or pedal glands in the forefeet, but a well-developed saccule exists between the first phalanges of the two principal toes in the hindfoot (Fig. 4). It is shaped like a laterally compressed sac or campule, opening anteriorly and inferiorly into the interdigital cleft above the cutaneous fold at the level of the joint between the first and second phalanges. Bones adjacent to the gland have a depression in their respective medial and lateral faces so forming an interdigital space in which the saccule lies.

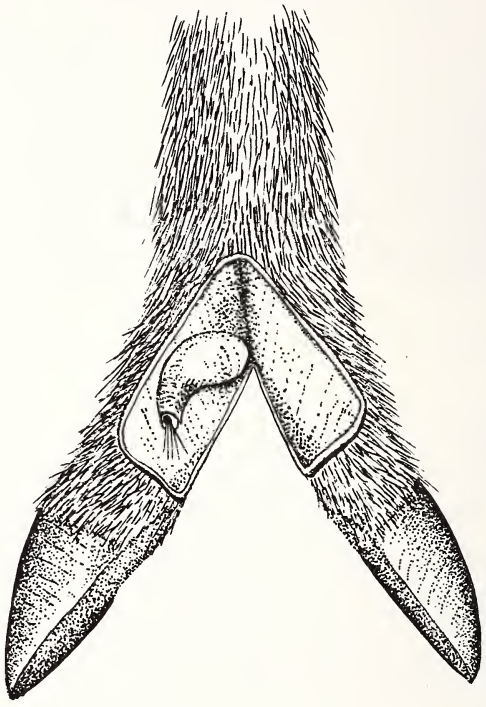

Fig. 4. Diagram of pampas deer hind foot, dissected to show the interdigital gland

In ♂ ZVC 1325, the fresh sac measured 19 mm long, 12 mm deep and 6 mm wide. The wall consisted of two distinct layers; an internal white one, 2 mm thick, and an external yellow zone of about 1 mm depth. Long coarse hairs grow from the sac's internal wall, orientated towards the neck, so filling both the cavity and the duct lumen there, and protruding from the orifice. As Cowan (1936) states, these hairs serve to conduct the glandular secretion between the cleaves of the hooves. More hairs are present loose within the sac than inserted in its wall, indicating that shed hairs remain accumulating for some time in the lumen.

The difference between these internal hairs, and those of the preorbital and nasal glands, that are short and incorporated into the waxy secretion, is notable.

Details of the gland's structure were clearly seen in the histological preparations, although it was not fixed until several days after the deer's death (Fig. 5). Principal features identifiable are: 1) a deep layer of connective tissue, containing muscle fibers, envelopes the sac and has septae that penetrate the underlying material towards the lumen; 2) slightly contorted sudoriparous glands, having a simple cuboid epithelium with large, rounded nuclei. In many tubules the cells nearest the duct appear destroyed and ill-defined; 3) a layer of sebaceous

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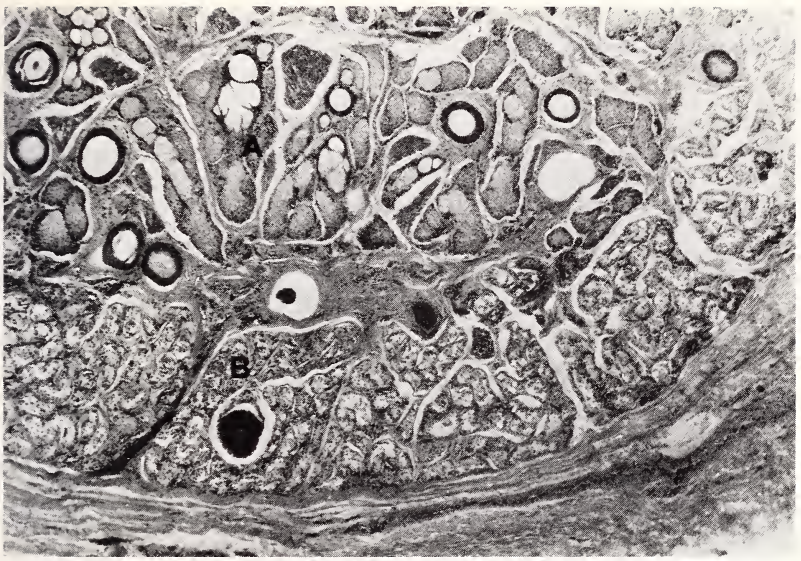

Fig. 5. Histological section of pampas deer interdigital gland wall, indicating the two main glandular areas, sebaceous (A) and sudoriparous (B)

glands with various acini clustered around each hair follicle; 4) the innermost layer, forming the lumen wall, is absent in our oblique sections.

Although the gland wall's microscopic structure is very similar to that of *Odocoileus hemionus,* the form of the saccule in pampas deer is far more modified than the simple sac or pocket-like invaginations described in black and white-tailed deer by COWAN (1936), QUAY (1959) and QUAY and MÜLLER-SCHWARZE (1970).

The hind interdigital glands produce the strong pungent smell, characteristic of the species, that resembles concentrated human sweat. The odour is strongest in adult males, especially during the rut, but is easily noted at some distance all year (pers. observ.). DARWIN remarked on the pampas deer's "overpowering strong and offensive odour" which could be detected half a mile downwind of a herd. Various authors confirm this observation and also note the persistence of the scent on both prepared skins and any material that comes into contact with this cervid (DARWIN 1839, MAC DONAGH 1940; ROOSEVELT 1914). The name "stinking deer" is sometimes applied to this species (WHITEHEAD 1972).

MAC DONAGH (1940) believed the typical odour originated in the tarsal glands but we agree with CAHALANE (1939) that it results from the secretion of the hind interdigital gland.

The scent may have several pheromonal functions. It is particularly strong at bedding sites and along regularly used paths, and may be important in leaving a scent trail as QUAY (1959) suggested was a role of interdigital glands in white-tailed deer. During moments of danger, the exact flight sequence displayed depends on the source and proximity of the stimulus but the smell is commonly liberated and could have an alarm role. When an alien object is close, but not an immediate threat, pampas deer stamp the fore and, to a lesser extent, the hindfoot which could aid in releasing the secretion. When fleeing the cleaves are spread to gain leverage, bringing the gland close to the terrain. Histological work demonstrated the sac has a musculature that may assist in expelling secretion.

Social behaviour of this cervid is poorly known and this secretion may have other functions, particularly during the rut.

Interdigital glands were not detected on macroscopic examination of the forefeet. This

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observation agrees with those of Miller (1930), Hershkovitz (1958) and Cabrera and Yepes (1960) that the saccule is only present in the hindfoot of pampas deer.

Tarsal gland

A tuft of longer coarser hairs on the inner side of the tarsal joint marks the gland's site. White or cream hairs form a smudge or crescent over the upper portion, grading into yellow and chestnut hairs distally. The gland was present in all prepared specimens examined and in the foetus (Fig. 6), and is clearly visible in animals in the field as the lighter coloured tuft contrasts with the surrounding hair. Individual colour variation occurs, some deer having white and others cream hair in tuft, but this could be due to staining by gland secretion.

Fig. 6. Hind foot of pampas deer foetus in medial view; note the white area marking the tarsal gland site

In fresh specimens from winter, the area had a smell different from the adjoining skin and was distinct from, and less pungent than, that of the hind interdigital sac.

On the basis of an adult pair shot during the rut and later used by Cabrera (1943) as type specimens for *O. b. celer,* Mac Donagh attributed the characteristic pampas deer smell to the tarsal glands, failing to detect the pedal ones. The author also says the tarsal gland has an opening into which a finger can be put yet there are no orifices whatsoever in the Uruguayan pelts.

In other cervids, the tarsal gland is widely used in situations of sexual excitement, irritation, warning and fright. Being commonly marked by longer and different coloured hair, as in pampas deer, which is usually erectile too, implies this gland can have an important visual behavioural role besides acting through its secretion.

Before fleeing, both sexes of pampas deer often squat to urinate and at such time tarsal secretion could also be released to act as an alarm pheromone. The habit of "rub-urinating", known from white-tailed deer (Hirth 1977), mule deer, caribou and moose (Geist 1966; Müller-Schwarze 1971), functions as an olfactory signal combining the scents of urine and tarsal gland secretion, although its exact role is uncertain because of the wide range of social contexts it is employed in. However, rub-urinating has never been unquestionably observed by us in pampas deer nor recorded by other authors.

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Other glandular areas

Our observations do not preclude the existence of other modified integumentary regions that play a role in scent communication in pampas deer.

As in various cervids, pampas deer bucks rub both the forehead and bases of the antler sockets on branches and prominent vegetation during the rut. On one occasion an adult male approached a resting doe and sniffed her forehead intensely for five seconds before moving off (own data). The hair in this region is stiffer than those adjoining, and furthermore the sites corresponding to the bucks' antler stumps or bases are marked in females by two white dots (Fig. 2) which serve to draw attention to the forehead region. This suggests that as in roe *Capreolus capreolus* (Schumacher 1936; Kurt 1968) and mule deer (Müller-Schwarze 1971; Quay and Müller-Schwarze 1970), and possibly white-tailed deer (Hirth 1977), the forehead region of pampas deer might be glandular and have a scent role.

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Zusammenfassung

Hautdrüsenorgane des Pampashirsches (Blastoceros bezoarticus L., 1758)

Bau und Funktion von Hautdrüsenorganen des Pampashirsches (*Blastoceros bezoarticus*) aus Uruguay werden beschrieben. Auf Grund von Feldbeobachtungen in Uruguay und Argentinien wird die Bedeutung der Hautdrüsenorgane für das Sozialverhalten diskutiert. Paarige holocrine Drüsenorgane im Vestibulum nasi werden erstmals für den Pampashirsch beschrieben. Außer diesen kommen präorbitale, sowie tarsale und interdigitale Drüsenorgane an der Hinterextremität vor. Bei sieben daraufhin untersuchten Exemplaren fehlen die sonst bei Cervidae häufig vorkommenden metatarsalen und die interdigitalen Drüsenorgane an der Vorderextremität. Möglicherweise besitzt auch die Stirnhaut für die soziale Orientierung wichtige Hautdrüsen.

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The social organisation and aspects of behaviour of the nyala Tragelaphus angasi Gray, 1849

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Abstract

Investigated the social organisation and behaviour of the nyala *Tragelaphus angasi* to provide information which would assist in the management of the species in the game reserves of Zululand, South Africa. Distinct social groupings were recognised and their formation and composition discussed. Visual and vocal communication are noted and discussed. The most important aspects of social behaviour and behaviour related to the environment are described, and conclusions as to the form of social organisation found in nyala are made.

1 Introduction

The group size frequency of nyala has been described by Dorst and Dandelot (1970) and Tello and van Gelder (1975). Groups range in size from one to about 30, but two or three are the most common. Tello and van Gelder (1975) give a detailed breakdown of the various groups they recorded and described their transient nature. They concluded that although nyala are gregarious, long-lasting relationships are not formed.

Walther (1964, 1974) described behaviour patterns of Tragelaphines primarily from observations on captive animals. The patterns he recorded for the nyala are from the unpublished observations of Backhaus but some of these were seen in the wild population studied

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