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Short Communication

Chemical communication in free-ranging gray brocket deer (*Mazama gouazoubira*)

Juliano A. Bogoni [1]*

Rafael B. Sühs [1]

Maurício E. Graipel [2]

Nivaldo Peroni [1]

[1] Programa de Pós-Graduação em Ecologia, Departamento de Ecologia e Zoologia
Universidade Federal de Santa Catarina, CEP 88010-970, Florianópolis – SC, Brasil
[2] Departamento de Ecologia e Zoologia
Universidade Federal de Santa Catarina Florianópolis – SC, Brasil
* Autor para correspondência
bogoni.ja@gmail.com

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Resumo

Comunicação química em veados-catingueiros (*Mazama gouazoubira*) na natureza. A comunicação química, em especial a marcação odorífera, é intensa em veados, com a marcação de território feita principalmente pelos machos. Apresentamos gravações em vídeo de pelo menos dois veados-catingueiros (macho e fêmea) que estão desenvolvendo comunicação química através de marcas de cheiro. Os vídeos demonstram a deposição de fezes e urina várias vezes pelos animais, provavelmente para o desenvolvimento de interação intrassexual e secundariamente para demarcações territoriais. A comunicação química observada é possivelmente relacionada à reprodução. Essas marcas territoriais são particularmente importantes para evitar a competição intraespecífica por recursos e parceiros sexuais.

Palavras-chave: Armadilhas fotográficas; Comportamento; Comunicação intraespecífica; Mata Atlântica

Abstract

Chemical communication is intensely used by deer, especially scent-marking behaviors, with territory marking mainly made by males. This work presents several video recordings of at least two gray brockets (male and female) chemically communicating via scent marks. Video recordings demonstrate multiple depositions of feces and urine by the animals, probably for the development of intrasexual interaction and, secondarily, territorial marks. The chemical communication observed is possibly related to reproduction or intraspecific competition for resources. These territorial marks are particularly important for avoiding intraspecific competition for resources and sexual partners.

Key words: Atlantic Forest; Behavior; Camera trap; Intraspecific communication

In mammals, chemical communication and scent marking are used to advertise territory occupancy and ownership (GOSLING, 1982; SILLERO-ZUBIRI; MACDONALD, 1998), and for avoiding intrasexual competition (CLUTTON-BROCK, 2007; 2009; ROSELL et al., 2011; CLUTTON-BROCK; HUCHARD, 2013). Territory marking and chemical communication can provide information about the quality of potential sexual mates based on odors, allowing the hierarchy, health and genotype fitness of partners to be discriminated (BROWN; MACDONALD, 1985; RICH; HURST, 1998). A variety of biological characteristics, based on genetic polymorphism, enables mammals to use chemical communication in different behavioral contexts (BROWN; MACDONALD, 1985). The reactions of animals based on sniffing, Flehmen responses and countermarking latrines of male and female ungulates have been studied in only a few species (BLACK-DECIMA; SANTANA, 2011).

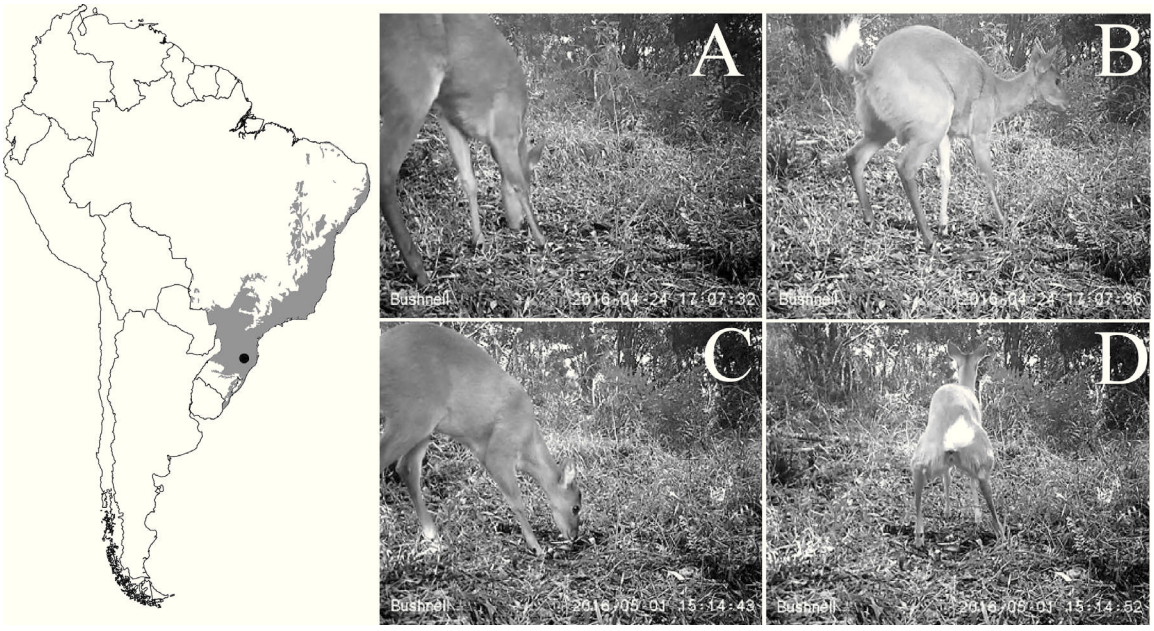
These communication behaviors, especially in territorial animals, consist of the use of feces and urine (BROWN; MACDONALD, 1985; ROLA et al., 2012). For *Mazama gouazoubira* G. Fischer [von Waldheim], 1814 (gray brocket), some of these behaviors have been observed under captive conditions (BLACK-DECIMA; SANTANA, 2011; ROLA et al., 2012), with a single record from the wild (PINDER, 1992). Countermarking and latrine formation and use in ungulates have been studied in relatively few species (BLACK-DECIMA; SANTANA, 2011), for example, in asses (MOEHLMAN, 1985), zebras (KIMURA, 2000), southern pudus (MACNAMARA; ELDRIDGE, 1987) and red brockets (RIVERO et al., 2004). Usually, latrines are used for intrasexual communication, where females defecate and males answer by defecating in the same place (WRONSKI et al., 2006). In gray brocket deer, territorial marking is realized mainly by males using odorous and visual signals (DELLAFIORE; MACEIRA, 2001). Scent marking by defecation and urination in numerous small latrines are related to resource defense, when both males and females seem to be territorial and both contribute to latrines where their ranges overlap (BLACK-DECIMA; SANTANA, 2011).

This work presents data from several observations of sniffing and countermarking the urine and dung in a latrine used by an undetermined number of male and female free-ranging gray brocket deer. We obtained video recordings using camera traps (*Bushnell®:* Bushnell Trophy Cam HD, Model: 119537c. Bushnell Outdoor Products Canada. Ontario, Canada) while conducting research about resource and habitat use by medium- to large-bodied mammals in a subtropical Atlantic Forest site in São Joaquim National Park (SJNP; 28°09'20"S, 49°38'11"W; 1,612 m.a.s.l.) in southern Brazil. Eight camera traps were set along a forest-grassland ecotone zone and remained active for 30 days. The study region falls within the humid subtropics or "Cfa" according to the Köppen-Geiger climate classification system (PEEL et al., 2007). Rainfall is evenly distributed throughout the year, with an annual average of 1,700 mm, and temperatures vary greatly during the year, ranging from -10°C to 35°C with an annual average between 11 and 19°C (MONTEIRO, 2001; PEEL et al., 2007). The vegetation type is mixed ombrophilous forest (*Araucaria* forest) with some patches of cloud forest and transitions to high-altitude grasslands. From April 11, 2016, to May 9, 2016, 12 behavior videos were recorded. These recordings were edited and compiled into a single file (Supplementary Material 1 – <https://www.youtube.com/watch?v=Tq0-_tZcIYY&feature=youtu.be>). Thus, considering that the latrine was used before, over 28 days (starting on April 11, 2016, 06:03 P.M.) a partial sequence of countermarking can be observed, which shows chemical communication by feces, urine and sniffing initiated by a male that was sometimes followed by a female (Figure 1; Supplementary Material 1). Detailed *ad libitum* observation reveals a sum of five active and ten passive (i.e., countermarking by feces/urine and only sniffing, respectively) communication events related to the behavior of gray brockets. The male(s) made three distinct countermarks, while the female(s) made two, always in sequence and in the exact place of the male(s) deposition, at an interval of hours to three days (Supplementary Material 2). Sniffing events by both male(s) and female(s) in the latrine were generally diurnal, seemed to be done with caution and lasted longer, while urine and feces deposition were shorter events. Through urine, a male made the first signal, followed by another male signaling through feces after circa 24 h. Female signaling, possibly also

via urine, occurred only three days after the male(s) signaling. The male response happened after three days, an event in which there was a large feces deposition. After all these events, the animals left the sites by two well-marked trails.

This behavior in ungulates has been commonly observed in nature, through the formation of latrines and piles of dung generally deposited on the borders of forests (PINDER, 1992). However, the social behavior of the gray brocket is poorly understood and existing observations have primarily focused on territorial behavior (PINDER, 1992; PINDER; LEEUWENBERG, 1997; BLACK-DECIMA; SANTANA, 2011). Captive observations showed that the resident male made the most intensive countermarking on dung deposited by "intruder" males (BLACK-DECIMA; SANTANA, 2011). This pattern may be related to intrasexual competition and resource defense, including females, although females did not show a tendency to countermark like the intruder males (BLACK-DECIMA; SANTANA, 2011). In the wild, the marks are commonly distributed along boundaries of forest patches and on trails within dense vegetation, which is done to increase the chance that they will be detected when intruders enter the territory (GOSLING, 1982). Some observational studies support the function of this behavior. For example, Thomson's gazelles (*Eudorcas thomsonii*) reinforce their line of marks along boundaries where intrusions are most common (WALTHER, 1978). This pattern of reinforcing territory marks is found in several other animals, for example, *Litocranius walleri* (gerenuk), *Antilocapra americana* (pronghorn antelope), *Aepyceros melampus* (impala), and by territorial carnivores, such as *Crocuta crocuta* (spotted hyena) (KRUUK, 1972; KITCHEN, 1974; JARMAN, 1979; GOSLING, 1982) Yet, in closed habitats, boundary marks are less important because intruders are more restricted to trails where the marks occur at high density (GOSLING, 1982). Based on our results, we are unable to distinguish how many individuals of the same sex are recorded in the videos. Thus, we do not have evidence of territoriality regarding the observed behaviors. Still, the patterns show that the latrines and dung piles serve at least as a center of chemical communication related to reproduction. However, other explanations should not be ignored because the animals may be defending their territories or the latrine use for several other reasons (e.g., quality of potential sexual partner, discrimination of hierarchy patterns and health (BROWN; MACDONALD, 1985; RICH; HURST, 1998).

FIGURE 1: Gray brocket (*Mazama gouazoubira*) chemically communicating in a subtropical Atlantic Forest site located in São Joaquim National Park, Brazil. (A) Male sniffing; (B) Male signaling with feces/urine; (C) Female sniffing; and (D) Female signaling with feces/urine. Images taken from video (Supplementary Material 1).



The absence of Flehmen responses in male(s), after the signaling of the female, suggests that the latter was not in the estrous cycle during the period of observations, as observed by Rola et al. (2012) when males sniffed the urine of females in estrous. Beyond territoriality, females sniffing urine, latrines, and piles of dung from males may also induce their estrous cycle, as observed for sheep and goats (WALKDEN-BROWN et al., 1999). Recent developments in the field of sexual selection can be attributed in part to detailed studies of female influences beyond mate choice (CLUTTON-BROCK, 2009; STOCKLEY; BRO-JØRGENSEN, 2011). Female reproductive competition has received less attention, but there is evidence that female mammals also compete for both resources and mates in order to secure reproductive benefits (STOCKLEY; BRO-JØRGENSEN, 2011). Yet, recording these behaviors in free-ranging individuals of gray brocket is important to evaluate biological, physiological and ecological aspects of the life of this species, which will allow conservation strategies to be developed. This is especially important considering that the number of gray brocket subspecies may be underestimated due to the lack of systematic and genetic studies (PINDER; LEEUWENBERG, 1997). It is possible that some endemic subspecies are already endangered or extinct because of excessive hunting, destruction of habitat and competition with livestock (PINDER; LEEUWENBERG, 1997). Our recordings of gray brocket deer chemically communicating provide one of the few records of this behavior under natural conditions, showing an intrasexual interaction between male(s) and female(s), and the camera traps used have resulted in rare observations of this mammal in the wild. Moreover, the association of camera traps to latrines allows for rare events concerning interactions of deer species to be observed and enables the development of further studies about their life history.

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Supplementary Material 2

Details of *ad libitum* behavior observations of intraspecific interactions (chemical communication and scent marking) between male and female gray brocket deer (*Mazama gouazoubira*) in a subtropical Atlantic Forest site, Brazil.

Date	Time	Days after	Male	Female	Details of *ad libitum* behaviour observations
April 11, 2016	06:03:31 P.M.	-	**Sniffing**	Not available	Start footage
April 17, 2016	00:40:25 P.M.	6	Not available	**Sniffing**	Sniffing in the same place of previous male sniffing
April 20, 2016	03:17:09 P.M.	3	**Sniffing**	Not available	Sniffing in the same place of previous female sniffing
April 23, 2016	04:51:08 P.M.	3	**Sniffing**	Not available	Sniffing in the same place of previous female sniffing
April 23, 2016	04:51:10 P.M.	3	**Signaling**	Not available	Signaling in the same place of the previous female sniffing
April 24, 2016	05:17:31 P.M.	1	**Sniffing**	Not available	Sniffing in the same place of the previous signaling
April 24, 2016	05:17:34 P.M.	1	**Signaling**	Not available	Signaling in the same place of the previous signaling
April 27, 2016	04:33:36 P.M.	3	Not available	**Sniffing**	Sniffing in the same place of previous male signaling
April 27, 2016	04:33:48 P.M.	3	Not available	**Signaling**	Signaling in the same place of previous male signaling
April 28, 2016	01:35:37 P.M.	1	Not available	**Sniffing**	Sniffing in the same place of the previous signaling, the sequence of movement suggests new signaling
April 28, 2016	01:36:57 P.M.	0	Not available	Not available	Behaviors not identified
April 30, 2016	09:04:10 P.M.	2	**Sniffing**	Not available	Sniffing in the same place of previous female signaling. It is frightened by the camera trap LEDs
May 1, 2016	10:09:37 A.M.	1	**Sniffing**	Not available	Sniffing in the same place of previous female signaling
May 1, 2016	10:09:45 A.M.	1	**Signaling**	Not available	Signaling (with feces) in the same place of previous female signaling
May 1, 2016	03:14:36 P.M.	0	Not available	**Sniffing**	Sniffing in the same place of previous male signaling
May 1, 2016	03:14:50 P.M.	0	Not available	**Signaling**	Signaling in the same place of previous male signaling
May 9, 2016	03:34:00 A.M.	8	Not available	Not available	Behaviors not identified