



Revista Chilena de Historia Natural

ISSN: 0716-078X

editorial@revchilhistnat.com

Sociedad de Biología de Chile

Chile

SARNO, RONALD J.; GRIGIONE, MELISSA M.; ARVIDSON, LANCE D.
Lack of response of an open-habitat ungulate to the presence of predator urine
Revista Chilena de Historia Natural, vol. 81, núm. 2, 2008, pp. 179-183
Sociedad de Biología de Chile
Santiago, Chile

Available in: <http://www.redalyc.org/articulo.oa?id=369944286003>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative

Lack of response of an open-habitat ungulate to the presence of predator urine

La falta de la respuesta de un ungulado de habitat abierto a la presencia de orina de depredadores

RONALD J. SARNO^{1*}, MELISSA M. GRIGIONE² & LANCE D. ARVIDSON³

¹ Hofstra University, Department of Biology, 130 Gittleson Hall, Hempstead, New York 11549-1000, USA

² Pace University, Department of Biology, Marks Hall 26, Pleasantville, New York 10570, USA

³ University of South Florida, Department of Biology, 4202 East Fowler Avenue, SCA 110, Tampa, Florida 33620, USA.

*e-mail for correspondence: ronald.sarno@hofstra.edu

ABSTRACT

The behavioral response of ungulates to the presence of odors associated with dangerous predators has received some attention, yet little is known about how predominantly open-habitat ungulates react to the presence of predator scents. We investigated the behavioral responses of a predominantly open-habitat ungulate, the guanaco, *Lama guanicoe*, when exposed to the urine of various predators. Guanacos only reacted to the urine of mountain lions (native predator), *Puma concolor*, in one trial. The lack of a response to predator urine may indicate that guanacos generally rely on vision more than olfaction for predator detection.

Key words: olfaction, predator scent, predator detection.

RESUMEN

La respuesta conductual de ungulados a la presencia de olores asociados a depredadores ha recibido algo de atención, pero aún se sabe poco sobre cuán predominantemente los ungulados de hábitat abiertos reaccionan a la presencia de olores de depredadores. Examinamos las respuestas conductuales del guanaco, *Lama guanicoe*, cuando estos animales estaban expuestos a orina de varios depredadores. Los guanacos solo reaccionaron a la presencia de la orina del puma en uno de los ensayos. La ausencia de respuesta registrada podría indicar que los guanacos utilizan más la visión que el olfato para detectar a sus depredadores.

Palabras clave: olfato, olor de depredador, detección de depredador.

INTRODUCTION

The influence of mammalian predator scent on the behavior of their ungulate prey has received considerable attention (Müller-Schwarze 1972, Novallie et al. 1982, Melchiors & Leslie 1984, Sullivan et al. 1985, Abbott et al. 1990, Swihart et al. 1991, Chabot et al. 1996, Berger 1998, Berger et al. 2001). The majority of these investigations have quantified changes in feeding behavior, either by measuring the amount of food that was consumed after being treated with a scent (Melchiors & Leslie 1984, Sullivan et al. 1985, Abbott et al. 1990, Swihart et al. 1991) or by measuring feeding time after a scent was presented nearby (Berger 1998). Although this feeding paradigm approach has

been utilized extensively, it does not ultimately test whether observed responses are due to predator recognition (Chabot et al. 1996). Changes in feeding time could be related to diminished palatability of food as a result of the scent being located nearby (Abbott et al. 1990, Swihart & Conover 1990), or as a result of the direct application of predator scent to food (Müller-Schwarze 1972, Novallie et al. 1982, Melchiors & Leslie 1984, Sullivan et al. 1985, Abbott et al. 1990, Swihart et al. 1991, Chabot et al. 1996).

Dial (1990) suggested measuring predator-specific behavioral responses of prey in order to demonstrate that predator detection and recognition have occurred. This would seemingly reduce any confounding issues

regarding decreased palatability of food associated with the treatment of, or close proximity to, predator scents. To date, only Chabot et al. (1996), and Berger et al. (2001), have measured predator-specific behavioral responses of ungulates when exposed to predator scents. Chabot et al. (1996) quantified physiological responses of elk, *Cervus elaphus canadensis*, when they were exposed to predator feces, and Berger et al. (2001), measured vigilance, predator-directed aggression, and abandonment of feeding sites by moose, *Alces alces*, when exposed to predator urine and feces, as well as playback calls of predators. In contrast, Novallie et al. (1982) observed no change in predator-specific behaviors (i.e., alert postures) by cape grysbok, *Raphicerus melanotis*, and gray duiker, *Sylvicapra grimmia*, when presented with urine of the leopard, *Panthera pardus*, and caracal, *Felis caracal*. There was an increase in time spent examining the predator urine over the control urine by both species of antelope, but there was no difference in the frequency of alert postures.

We have found no data describing predator-specific behavioral responses of open-habitat ungulates to the presence of predator scents. Koford (1957) reported that vicuñas, *Vicugna vicugna*, relied on sight as their primary means of predator recognition, and furthermore noted that when vicuñas used olfaction to examine the feces of conspecifics, they did so only from a distance of a few centimeters. The necessity of vicuñas to be in such close proximity to scent cues, along with the lack of reaction to humans hidden nearby and upwind, may indicate that camelid olfaction is not always used for predator recognition.

Because predator detection and recognition via olfaction appears to be a principal sensory modality for many mammals (Eisenberg 1981, Apfelbach et al. 2005), we were interested in testing whether exposure to predator urine would elicit a non-feeding, predator-specific behavioral response in guanacos, *Lama guanicoe*—another open-habitat species of camelid. Because of the prolonged evolutionary association between guanacos and mountain lions, we hypothesized that guanacos would exhibit predator-specific recognition and avoidance behavior when exposed to the urine of mountain lions, but not to the urine of other

predators. An alternative hypothesis, however, is that guanacos might exhibit a general avoidance of all carnivore urines.

Guanacos are highly social and monomorphic, and exhibit a resource-defense-polygyny mating system (Franklin 1983). As migrating animals arrive on the summer range in early spring (September), adult females and their young from the previous birth season join territorial males in the formation of family groups (a generic term in the sense that not all members are necessarily related). Family groups remain together from September to March (Franklin 1983, Ortega & Franklin 1995), and chulengos (individuals between birth and <1 year old) are born in November and December, after a gestation of 11.5 months.

MATERIAL AND METHODS

The study was conducted from 10 to 17 December 2004 in Torres del Paine National Park (51°3' S, 72°55' W), located in the eastern foothills of the Andean mountain range of southern Chile. The site was the most eastern 20 km² section of a 40 km² "peninsula" study site. Elevation varied from 200 to 400 m and this section of the study area was bordered by large lakes to the south and north and a sheep ranch to the east. The landscape was open with rolling hills, vegetation was generally < 1 m high, and animals were easily observed. Grasses, *Festuca gracillana*, *Anarthrophyllum patagonium*, and shrubs, *Mulinum spinosum*, *Senecio patagonicus*, and *Berberis buxifolia*, dominated this pre-Andean steppe community (Pisano 1974). Guanacos did not respond to approaching humans on foot to within 5 to 10 m. This is likely a result of living inside a protected area (Donadio & Buskirk 2006). Although guanacos occupy the entire study area they are patchily distributed throughout the study area owing to their resource-defense polygyny mating system (Franklin 1983). Based upon average group size and the number of encountered groups, there were approximately 750–1,000 guanacos on the study area during our study.

We utilized the urine of a contemporary (and only) predator (mountain lion; *Puma concolor*), novel predator (black bear, *Ursus*

arctos), contemporary, non-guanaco predator (grey fox; *Pseudalopex griseus*), and ungulate (control) (white-tailed deer; *Odocoileus virginianus*). We utilized 100 % real FOX URINE and 100 % real MOUNTAIN LION URINE (Leg Up Enterprises, Inc.), 100 % PURE BEAR URINE (Harmon Deer Scents™), and 100 % BUCK URINE (Whitcomb's WhiteTail's Uncommon Scents, Inc.™). We tested only territorial groups. Prior to the first presentation, we soaked paper towels in the appropriate urine. While walking tangentially past chosen focal groups, we placed each urine-soaked bundle on the ground within 10-20 m of animals. Trials were conducted on days when there was a steady wind from any given direction, when wind speed did not exceed 24 km h⁻¹, and ambient temperature varied between 16 and 21 °C. All urine-soaked bundles were placed upwind of animals. Upon trial termination the urine-soaked bundle of paper towels was placed in a plastic bag that contained more of the urine in order to maintain saturation.

Because guanacos exhibit discernible alarm calls and immediately flee when mountain lions are detected (R. Sarno, personal observation.), our variable of interest was the elapsed time from placement of urine to the emission of alarm calls by any individual in a group. Therefore, our sampling unit of interest was each focal territorial group. All trials were conducted for 15 min. After each trial was terminated, another focal group was located at least 300 m from the previously tested group. Urine from each of the four species was presented at random to each focal territorial group at least 10 times for a total of 48 trials (bear n = 13, puma n = 13, fox n = 12, deer n = 10). We utilized a one-way analysis of variance (Zar 1999) to test for differences in the mean reaction time of guanacos to the urine of each species and the data are based upon 42 trials (six trials were terminated because animals departed the area before 15 min). Based on past censuses and monitoring of marked animals conducted between November and January 1990-1997, there is little gross movement of guanacos on the study area (Sarno & Franklin 1999). Although some animals may have traversed among focal groups, entire groups (based upon location) were not tested repeatedly with different odors.

RESULTS

Mean group size of guanacos (\pm SE) during trials was 5.5 adults (\pm 1.02) and 2.4 juveniles (\pm 0.47). Mean trial time (\pm S.E.) was 14.8 \pm (0.23) min. In none of the trials that were terminated early did animals demonstrate either predator recognition or avoidance behavior; rather these early terminations took the form of slow meandering while feeding, which is indicative of normal grazing behavior of guanacos. There was no difference in the mean reaction time of guanacos to the urine of any species ($F_{3,39} = 1.51$, $P > 0.05$). In fact, there was only 1 instance in which guanacos reacted to the presence of urine and this was a result of exposure to mountain lion urine. The animal closest to the urine ran approximately 2 m, stopped, looked back in the direction of the urine, walked another 2 m, and began feeding. No alarm call was emitted and no other animals reacted. On three other occasions animals walked to within 3 m of mountain lion and black bear urine and did not elicit any measurable reactions.

DISCUSSION

Behavioral responses of numerous species of mammals to the scents of contemporary and novel predators suggest an innate reaction to the presence of predator scent (Apfelbach et al. 2005). Other studies, however, reveal no response by mammalian prey when exposed to the scents of their sympatric predators (Apfelbach et al. 2005). In some cases this has been explained by the lack of a co-evolutionary relationship between predator and prey (Stoddart 1980a, 1980b, Zimmerling & Sullivan 1994). Other explanations involve scent presentation in an incorrect context (Dickman 1992) and low odor concentration (Takahashi et al. 2005).

We can only speculate as to why guanacos in our study generally did not react to mountain lion urine. It is possible that the urine of the mountain lion is not the olfactory stimulus that elicits predator avoidance behavior in guanacos. Olfactory cues present in the skin and fur of predators have been shown to elicit stronger responses by prey than urine (Apfelbach et al. 2005). Perhaps other scents such as those

generated from the whole animal (Jêdrzejewski & Jêdrzejewska 1990, Ylonen & Ronkainen 1994, Parsons & Bondrup-Nielsen 1996, Borowski 1998) and/or feces (Caine & Weldon 1989, Chabot et al. 1996, Berton et al. 1998, Berger et al. 2001) are more important stimuli than urine in eliciting stereotypical predator recognition and avoidance behavior via olfaction. Therefore, our next step is to expose guanacos to whole-body scents and those from feces in order to document their responses and to investigate the conditions (e.g., odor source, habitat type) under which olfaction elicits stereotypical predator recognition and avoidance behavior in guanacos. Low urine concentration was a potential problem; however, we do not believe that it was a factor, because when standing downwind from the urine source we could detect an odor up to 2 to 3 m away. Therefore, we presume that guanacos would easily have detected this. However, if guanacos can detect the age of the deposited scent, which could indicate imminent danger, they may not react to the presence of predator urine owing to the possibility of diminished volatile compounds over time (Pusenius & Ostfeld 2002).

On 16 occasions we have observed guanacos alarm calling and fleeing from an area when sighting a mountain lion (R. Sarno personal observation). Guanacos and other ungulates rely extensively upon vision to detect predators, and this would be especially favored in open habitats with low vegetation (Mitchell & Skinner 2003), which is characteristic of our study area. An intriguing situation presents itself in which to test if reliance upon olfaction by guanacos for predator detection and recognition is modified by habitat. Guanacos inhabiting Isla Grande, Tierra del Fuego spend nearly equal amounts of time in open grasslands and dense forest and retreat to the forest when threatened (Franklin 1983, personal communication). Future work will involve exposing guanacos in both habitats on Tierra del Fuego to the same suite of odors as guanacos on the mainland and observing their responses.

ACKNOWLEDGMENTS

We thank the Chilean National Forestry and Park Service and administration at Torres del

Paine National Park for their assistance. We also thank Isaac Ortega for help with logistics. Dan Blumstein provided valuable comments on an earlier draft of this manuscript as well as two anonymous reviewers.

LITERATURE CITED

- ABBOTT DH, DA BAINES, CG FAULKES, DC JENNENS, PCYK NING & AJ TOMLINSON (1990) A natural deer repellent: chemistry and behaviour. In: MacDonald DW, D Müller-Schwarze & SE Natynczuk (eds) Chemical signals in vertebrates: 599-609. Oxford University Press, Oxford, United Kingdom.
- APFELBACH R, CD BLANCHARD, RJ BLANCHARD, RA HAYES & IS MCGREGOR (2005) The effects of predator odors in mammalian prey species: A review of field and laboratory studies. *Neuroscience & Biobehavioral Review* 29: 1123-1144.
- BERGER J (1998) Future prey: some consequences of the loss and restoration of large carnivores. In: Caro T (ed) Behavioral ecology and conservation biology: 80-100. Oxford University Press, New York, USA.
- BERGER J, JE SWENSON & IL PERSSON (2001) Recolonizing carnivores and naïve prey: conservation lessons from Pleistocene extinctions. *Science* 291: 1036-1039.
- BERTON F, E VOGEL & C BELZUNG (1998) Modulation of mice anxiety in response to cat odor as a consequence of predator's diet. *Physiological Behavior* 65: 247-254.
- BOROWSKI Z (1998) Influence of predator odour on the feeding behaviour of the root vole (*Microtus oeconomus* Pallas, 1776). *Canadian Journal of Zoology* 76: 1791-1794.
- CAINE N & P WELDON (1989) Responses of red-bellied tamarins (*Saguinis labiatus*) to fecal scent of predatory and non-predatory neotropical mammals. *Biotropica* 21: 186-189.
- CHABOT D, P GAGNON AND EA DIXON (1996) Effect of predator odors on heart rate and metabolic rate of wapiti (*Cervus elaphus canadensis*). *Journal of Chemical Ecology* 22: 839-868.
- DIAL BE (1990) Predator-prey signals: chemosensory identification of snake predators by eublepharid lizards and its ecological consequences. In: MacDonald DW, D Müller-Schwarze & SE Natynczuk (eds) Chemical signal in vertebrates: 599-609. Oxford University Press, Oxford, United Kingdom.
- DICKMAN C (1992) Predation and habitat shift in the house mouse, *Mus domesticus*. *Ecology* 73: 313-322.
- DONADIO E & SW BUSKIRK (2006) Flight Behavior in guanacos and vicunas in areas with and without poaching in western Argentina. *Biological Conservation* 127: 139-145.
- EISENBERG JF (1981) The mammalian radiations: an analysis of trends in evolution, adaptation, and behavior. University of Chicago Press, Chicago, Illinois, USA. 610 pp.
- FRANKLIN WF (1983) Contrasting socioecologies of South America's wild camelids. The vicuña and the guanaco. In: Eisenberg JK & DG Kleiman (eds): 573-629. American Society of Mammalogists, Provo, Utah, USA.

- JÊDRZEJEWSKI W & B JÊDRZEJEWSKA (1990) Effect of a predator's visit on the spatial distribution of bank voles: experiments with weasels. *Canadian Journal of Zoology* 68: 660-666.
- KOFORD CB (1957) The vicuña and the puma. *Ecological Monographs* 27: 153-219.
- MELCHIORIS MA & CA LESLIE (1984) Effectiveness of predator fecal odors as black-tailed deer repellents. *Journal of Wildlife Management* 49: 358-362.
- MITCHELL G & JD SKINNER (2003) On the origin, evolution and phylogeny of giraffes *Giraffa camelopardalis*. *Transactions of the Royal Society of South Africa* 58: 51-73.
- MÜLLER-SCHWARZE D (1972) The responses of young black-tailed deer to predator odors. *Journal of Mammalogy* 53: 393-394.
- NOVALLIE P, RC BIGALKE & D PEPLER (1982) Can predator urine be used as a buck or rodent repellent? *South African Forestry Journal* 123: 51-55.
- PARSONS G & S BONDRUP-NIELSEN (1996) Experimental analysis of behaviour of meadow voles (*Microtus pennsylvanicus*) to odours of the short-tailed weasel (*Mustela erminea*). *EcoScience* 3: 63-69.
- PISANO E (1974) Estudio ecológico de la región continental sur del area andino-patagónica, II. Contribucion a la fitogeografía de la zona del parque Nacional "Torres del Paine". *Anales del Instituto de la Patagonia (Chile)* 5: 59-104.
- PUSENIUS J & RS OSTFELD (2002) Mammalian predator scent, vegetation cover and tree seedling predation by meadow voles. *Ecography* 25: 481-487.
- STODDART D (1980a) Some responses of a free-living community of rodents to the odors of predators. In: Müller-Schwarze D & R Silverstein (eds) *Chemical signals: vertebrates and aquatic invertebrates* 1-10. Plenum Publishing, New York, USA.
- STODDART D (1980b) The ecology of vertebrate olfaction. Chapman & Hall Ltd., London, United Kingdom. 234 pp.
- SULLIVAN TP, LO NORDSTROM & DS SULLIVAN (1985) Use of predator odors as repellents to reduce feeding damage by herbivores. II. Black-tailed deer (*Odocoileus hemionus columbianus*). *Journal of Chemical Ecology* 11: 921-935.
- SWIHART RK, JJ PIGNATELLO & MJI MATTINA (1991) Aversive responses of white-tailed deer, *Odocoileus virginianus*, to predator urines. *Journal of Chemical Ecology* 17: 767-777.
- SWIHART RK & MR CONOVER (1990) Reducing deer damage to yews and apple trees: using big game repellents®, Ro-Pel®, and soap as repellents. *Wildlife Society Bulletin* 18: 156-162.
- TAKAHASHI LK, BR NAKASHIMA, H HONG & K WATANABE (2005) The smell of danger: a behavioral and neural analysis of predator odor-induced fear. *Neuroscience & Biobehavioral Review* 29: 1157-1167.
- YLONEN H & H RONKAINEN (1994) Breeding suppression in the bank vole as an antipredator adaptation in a predictable environment. *Evolutionary Ecology* 8: 658-666.
- ZAR JH (1999) *Biostatistical analysis*. Fourth edition. Prentice Hall, Upper Saddle River, New Jersey, USA. 663 pp.
- ZIMMERLING LM & TP SULLIVAN (1994) Influence of mustelid semiochemicals on population dynamics of the deer mouse (*Peromyscus maniculatus*). *Journal of Chemical Ecology* 20: 667-689.

Associate Editor: Loren Hayes

Received July 12, 2007; accepted November 1, 2007

