Brief Report

Folia Primatol 2003;74:159–161
DOI:10.1159/000070649

Received: September 20, 2002
Accepted after revision: October 30, 2002

Owl Monkeys (*Aotus* spp.) Self-Anoint with Plants and Millipedes

Michael Zito[a] Sian Evans[b] Paul J. Weldon[c]

[a] The Primate Conservancy, Land O'Lakes, Fla., [b] DuMond Conservancy, Miami, Fla., and [c] Conservation and Research Center, Smithsonian Institution, Front Royal, Va., USA

Key Words
Owl monkeys · *Aotus* · Self-anointing · Millipedes

Introduction

Many mammals wipe their pelage with or rub against fruits, arthopods or other scent-bearing materials. Chemicals appropriated as a result of self-anointing are hypothesized to deter ectoparasites and/or microbial pathogens [Baker, 1996; Valderrama et al., 2000].

Self-anointing among primates is best known in the Neotropical genus *Cebus*. Linnaeus [1754] provided an early account of this behaviour in a tufted capuchin monkey *(C. apella)* that scattered tobacco powder on its back. Other reports confirm self-anointing by *C. apella* [Nolte, 1958; Hill, 1960; Gilbert et al., 1998] and document it in white-faced capuchin *(C. capucinus)* [Baker, 1996; Oppenheimer, 1968; Longino, 1984] and wedge-capped capuchin monkeys *(C. olivaceus)* [Valderrama et al., 2000]. Among the anointing materials used are some fruits and leaves, onion, garlic, ants and millipedes. Two compounds from the segmental gland secretions of benzoquinone-producing millipedes, 2-methyl-1,4-benzoquinone (toluquinone) and 2-methoxy-3-methyl-1,4-benzoquinone, elicit self-anointing in *C. apella* and *C. capucinus* [Weldon et al., in press]. These compounds also deter biting mosquitoes.

We report here that owl monkeys (*Aotus* spp.), the only nocturnal Neotropical primates, self-anoint with plants, millipedes and millipede-derived benzoquinones. *Aotus* contains at least 10 species that range in forests from Panama to northeastern Argentina. They are chiefly frugivorous, but also consume leaves, arthropods, small vertebrates and bird eggs [Wright, 1981].

KARGER
Fax +41 61 306 12 34
E-Mail karger@karger.ch
www.karger.com

0015–5713/03/0743–0159$19.50/0

Accessible online at:
www.karger.com/fpr

Michael Zito Jr.
The Primate Conservancy
P.O. Box 1551, Land O'Lakes, FL 34639 (USA)
Tel./Fax +1 813 995 9395
E-Mail Lemur101@tampabay.rr.com

Methods

We tested 4 *A. azarae boliviensis*, 2 *A. lemurinus griseimembra* and 35 *A. nancymaae* for self-anointing behaviours. Subjects ranged from 20 months to about 20 years in age. They were maintained singly or in groups of up to 4 in wiremesh enclosures ranging from 0.6 × 1.2 × 1.2 to 2.4 × 3.7 × 2.4 m. They were fed apples, pears, grapes, cucumbers, bananas, mangos, peanuts, prickly pear cactus, broccoli, mulberry, ficus, bamboo and hibiscus leaves, and commercial diets.

Subjects were presented with: pieces of lime, onion, garlic and chives; the millipede *Anadenobolus monilicornis* (Spirobolida), an introduced species in Florida, USA; millipede-produced quinones, and an acetone extract of cakebush *(Piper marginatum)* leaves, which are used for anointing by *C. capucinus* in Costa Rica [Baker, 1996]. To assess possible individual variation in the tendency to self-anoint, 3 *A. azarae boliviensis*, 2 *A. lemurinus griseimembra* and 32 *A. nancymaae* were presented in their home cages (in the presence of cagemates) with either onion or approximately 8 live millipedes in 10 × 8.9 × 8.9 cm plastic dishes.

To test responses to several millipede-derived chemicals, 1 *A. azarae boliviensis* and 4 *A. nancymaae* were isolated in their home cages and presented with benzoquinone, toluquinone, 2-methoxy-3-methyl-1,4-benzoquinone and hydroquinone. Filter papers (diameter = 4.5 cm) treated with 50 µl of 0.1 *M* solutions of these compounds in acetone, or with acetone alone, were folded in half and placed on the wire of their cage. Compounds were presented in a counterbalanced order. Subjects were observed for 1 min after they had placed their nose within several centimetres of each filter paper. Trials were terminated when subjects moved away from or dropped filter papers. All observations were begun at dusk (19.30–20.15 h).

Results

We observed self-anointing by *Aotus* with onion, garlic, chives, live millipedes, millipede-produced benzoquinones and an extract of *P. marginatum* leaves.

During typical anointing, monkeys manually grasped and wiped scent materials against their dorsolateral trunk, tail, head and extremities, and rubbed and scratched their fur with their hands and/or hindfeet. In addition to manually applying these materials, subjects occasionally rubbed their shoulder or dorsolateral trunk against them.

Twelve of 30 subjects presented with onions, and 26 of 29 subjects presented with live millipedes, exhibited self-anointing during bouts that lasted up to 20 min. Each of the millipede-produced compounds, except hydroquinone, elicited self-anointing and/or rubbing in 1–3 subjects; 2 subjects failed to respond to any condition. 2-Methoxy-3-methyl-1,4-benzoquinone elicited anointing in all 3 responding individuals; the other benzoquinones elicited rubbing in 1 or 2 of them. Self-anointing was not observed with control papers.

Discussion

Moynihan [1964] observed free-ranging *A. trivirgatus* in Panama engage in 'rubbing', a scent-marking behaviour in which the perineal region is scraped from side to side on a branch during encounters between males and females. Urine washing, where urine droplets are collected on the hand and rubbed between the palmar

and plantar surfaces, has also been observed in this species [Hunter, 1981]. Perineal rubbing and urine washing are topographically distinct from self-anointing.

The materials we observed to elicit self-anointing in *Aotus* spp. include those that do so in *Cebus* spp. Benzoquinones and compounds known to occur in the plant materials we presented possess insecticidal or other arthropod-deterrent properties [Baker, 1996; Weldon et al., in press], thus lending support to the hypothesis that self-anointing functions to deter these consumers. Studies are needed to corroborate self-anointing by free-ranging *Aotus* spp. and identify the scent-bearing materials used.

Acknowledgments

J. Gioannetti, C. Moody and E. Vicaria assisted with behavioural observations. J. Oliver provided chemicals. R. Hoffman identified the millipede used in self-anointing.

References

Baker M (1996). Fur rubbing: Use of medicinal plants by capuchin monkeys *(Cebus capucinus). American Journal of Primatology* 38: 264–270.

Gilbert TM, Brown DA, Boysen ST (1998). Social effects on anointing behavior in capuchins *(Cebus apella). American Journal of Primatology* 45: 182.

Hill WCO (1960). *Primates: Comparative Anatomy and Taxonomy,* vol. IV, part A: Cebidae. Edinburgh, Edinburgh University Press.

Hunter AJ (1981). *Chemical Communication, Aggression and Sexual Behaviour in the Owl Monkey* (Aotus trivirgatus griseimembra). PhD dissertation, University of London.

Linnaeus C (1754). *Museum S:ae R:ae M:tis Adophi Friderici,* Holmiae: Laur. Salvii.

Longino JT (1984). True anting by the capuchin, *Cebus capucinus. Primates* 25: 243–245.

Moynihan MA (1964). Some behavior patterns of platyrrhine monkeys. I. The night monkey *(Aotus trivirgatus). Smithsonian Miscellaneous Collection* 146: 109–119.

Nolte A (1958). Beobachtungen über das Instinktverhalten von Kapuzineraffen (*Cebus apella* L.) in der Gefangenschaft. *Behaviour* 13: 189–207.

Oppenheimer JR (1968). *Behavior and Ecology of the White-Faced Monkey*, Cebus capucinus, *on Barro Colorado Island, Canal Zone.* PhD dissertation, University of Illinois, Urbana.

Valderrama X, Robinson JG, Attygale AB, Eisner T (2000). Seasonal anointment with millipedes in a wild primate: A chemical defense against insects? *Journal of Chemical Ecology* 26: 2781–2790.

Weldon PJ, Aldrich JR, Klun JA, Oliver JE, Debboun M (in press). Benzoquinones from millipedes deter mosquitoes and elicit self-anointing in capuchin monkeys (*Cebus* spp.). *Naturwissenschaften.*

Wright PC (1981). The night monkeys, genus *Aotus*. In *Ecology and Behavior of Neotropical Primates* (Coimbra-Filho AF, Mittermeier RA, eds.), pp 211–240. Rio de Janeiro, Academia Brasileira de Ciencias.