ZOOLOGIA 33(3): e20160027
ISSN 1984-4689 (online)

www.scielo.br/zool

SHORT COMMUNICATION

# Observations on the mating behavior of the eastern lowland olingo *Bassaricyon alleni* (Carnivora: Procyonidae) in the Peruvian Amazon

**Sean M. Williams**[1]

[1]*Department of Zoology, Michigan State University. East Lansing, MI 48824, USA. E-mail: seanbirder@gmail.com*

ABSTRACT. The behavior of wild olingos is poorly known. From May-Jul 2015, I surveyed nocturnal mammals in southeast Peru and recorded the behavior of olingos. Multiple olingos were observed in close proximity on four occasions: two occasions in which multiple olingos were feeding on the inflorescences of a *Parkia pendula* tree; an adult and immature olingo traveling together; and a pair of olingos copulating. The copulation lasted at least 142 minutes, and was characterized by the male biting the hind neck and back of the female, constant female vocalizations, and rapid head turning by the female toward the male. Olingos and kinkajous were similarly abundant. These observations offer insight into the behavior of the wild olingo.

KEY WORDS. Natural history, Procyonidae, reproduction, sexual behavior.

The natural histories of the four species of olingo, *Bassaricyon* J.A. Allen, 1876), are poorly known (Kays 2000, Pontes & Chivers 2002, Oliveira 2009). Recent studies on olingos have focused on taxonomy, abundance, and distribution (González-Maya & Belant 2010, Sampaio et al. 2011, Helgen et al. 2013), but few studies have offered insight on their behavior, doubtlessly due to their low abundance, nocturnal habits, and confusion with the physically similar kinkajou *Potos flavus* (Shreber, 1774, Procyonidae).

Olingos occur in lowland rainforest, cloud forest, and forests on nutrient-poor soils (Kays 2000, Sampaio et al. 2010, Helgen et al. 2013), and may be fairly common (Emmons 1997, Pontes & Chivers 2002). Olingos are likely mostly frugivorous, and may occasionally feed on arthropods and nectar (Emmons 1997, Reid 1997, Prange & Prange 2009). Groups of olingos have been encountered as foraging aggregations, indicating that they may be gregarious around food sources (González-Maya & Belant 2010).

The natural history of olingos of any species is poorly known. For example, reproductive behavior is undescribed. In this paper, I report some aspects of the behavior of wild eastern lowland olingos *Bassaricyon alleni* (Thomas, 1880), Procyonidae – including reproductive behavior – and I provide insight on olingo abundance in southern Amazonian Peru.

Observations were made from May-Jul 2015 at Los Amigos Biological Station in the Madre de Dios department, Peru (12.568 S, 70.100 W). The field site is at 300 m above sea level, within 1500 km$^2$ of primary rainforest along two rivers. I regularly conducted nocturnal surveys in which I recorded all non-volant mammals seen and heard, identified as specifically as possible.

I followed and recorded the behavior of all olingos that I encountered. Observations were recorded with a digital voice recorder. Olingos were illuminated with a Fenix PD-35 flashlight. Photo and video were taken using a Canon 7D digital SLR camera with a Canon EF 400 5.6 L USM lens. Distances and measurements from the observer to the olingos were estimated visually after practice and validation.

During 32 nocturnal surveys I walked a total 135.75 km on 40 km of different trails for 80.5 hours. I encountered eastern lowland olingos in pairs and solitary 29 times, a rate of once every 4.7 km (Table 1). By comparison, kinkajous were encountered 32 times, or once every 4.2 km. I detected olingos primarily by first hearing moving vegetation in the canopy over the trail; I detected some by voice. Olingos almost always occurred in the lower canopy at 15-20 m above the ground. The few individuals that were encountered in mid-story at 10-15 m above the ground, quickly moved into the lower canopy after being pursued by the author. Olingos were often vocal; they frequently called after I followed them for a couple minutes, seemingly in response to my pursuit. Less commonly they called from a distance, thus unlikely prompted by me. The two-note call sounded similar to a human clearing their throat. The first note of the call was fast and rising, and the second note snappily cut off the first note, which is likely the "wer-toll" of Kays (2000).

Olingos were encountered slightly less often than kinkajous. Olingos were often more mobile and vocal than kinkajous, suggesting that detectability of olingos may be higher than kinkajous. In other studies in southern Peru, olingos were



ZOOLOGIA An International Journal for Zoology

encountered approximately once per 30 km of walking trails, whereas kinkajous were found about six times per 30 km (Emmons 1984, Janson & Emmons 1990). Other estimates of olingo and kinkajou densities from other regions suggest that they occur at similar densities, which is mirrored by my results (Emmons 1984, 1997, Kays 2000).

Table 1. Olingos were almost always observed solitarily, although olingos were observed in pairs on four occasions, for which I have added details on their behavior.

| Number of olingos | Sample size | Behavior |
|---|---|---|
| 1 | 25 | |
| 2 | 1 | Adult and immature females traveling together |
| 2 | 1 | Male and female copulating |
| 2 | 2 | Feeding on Parkia pendula inflorescences |

Twice a pair of olingos, and twice solitary olingos were observed feeding on the inflorescences *P. pendula*, totaling four occasions in which olingos were seen feeding. These observations occurred in three different trees and were the only occasions I observed olingos feeding, which suggests that *P. pendula* is an important food resource for olingos, as it is for primates (Peres 2000).

On 18 June 2015, at 05:15, I encountered two olingos in the same tree, no more than a meter apart from each other. One olingo was at most 2/3 the size of the other, and the smaller olingo had a disproportionately shorter tail. Both olingos appeared to be females, bearing no scrotal sacs. When I approached the smaller olingo for photographs, the larger olingo began vocalizing, and continued to vocalize for at least ten minutes. The vocalization was the "wer-toll" vocalization described above. The olingos remained 1-10 m from each other for the next 30 minutes, moving through trees for at least 30 m, at which point I departed. The olingos frequently sniffed the bark of large branches, and occasionally stopped and looked around. No direct interactions between the individuals were observed. Given that this adult female and smaller olingo were traveling together, they may compose a mother and offspring pair.

On 21 June 2015, at 03:45, I encountered a pair of olingos on a horizontal vine about 10 cm in diameter. One olingo was on top of the other, with the belly of the top olingo lying directing on the back of the bottom olingo (Fig. 1). The olingos were copulating, i.e. the olingo on top was thrusting the pelvis into the posterior end of the olingo below. The male olingo frequently bit the hind neck and back of the female, and the female often immediately threw her head back toward the male with her mouth open, still vocalizing. The female gave 1-3 calls per second, which sounded like an incessant, high-pitched grunt – "Yik! Yik! Yik!..." – that varied slightly in pitch and amplitude. The male never vocalized, although he frequently bit the female

Figure 1. The first observation of mating wild olingos. The female is positioned on the right with her mouth open and all four feet contacting the branch, and the male is on the left grasping the female with his two front feet.

on the back and neck. Over the course of the two hours, they moved from the horizontal vine to a large tree branch 50 cm in diameter, and at one point they were suspended amongst a tangle of diagonal vines, each about 1 cm in diameter (Supplementary Material S1[1], Appendix 1).

There were five occasions in which the male dismounted, likely in response to a particularly strong head turn and snap of the mouth from the female. The female ran from the male between 1 to 5 m, and when she was separated from the male, she vocalized far less frequently, i.e. once every 1-3 seconds. These five intermissions lasted a few seconds to five minutes. During each intermission, the female did not move as the male approached, but remained motionless and increased her vocalization rate as the male remounted. The onset of one of the intermissions was caused by a pair of black-headed owl monkeys *Aotus nigriceps* (Dollman, 1909, Aotidae). The pair of owl monkeys was moving through the canopy and passed within 5 m of the olingos. When the monkeys were closest, the male olingo ceased his pelvic thrusts, the female ceased vocalizing, and both olingos looked toward the monkeys. The female shortly thereafter ran up the branch 2 m away, and the male approached the female and remounted after three minutes.

Between 04:45 and 05:35, another olingo could be heard nearby, approximately 20 m away. This third olingo was giving the typical "wer-toll!" At 06:08, the olingos separated for a last time and the female slowly departed from the male. One minute after departure, the female excreted approximately 100-200 mL of liquid. The female continued moving through the trees for at least five minutes until out of sight, and the male remained on an exposed branch for at least half an hour until 06:45, at which point I left.

[1]Available as Online Supplementary Material with the HTML version of the article at http://www.scielo.br/zool

This is apparently the first recorded observation of an olingo copulation in situ. I observed the pair of wild olingos engaged in mating behavior for a total of 143 minutes, which is longer than the longest duration of mating behavior (68 minutes) of olingos in captivity (Poglayen-Neuwall 1976). The length of this copulation suggests that olingos are induced ovulators, as are other procyonids and carnivores (Llewellyn & Enders 1954, Milligan 1982, Hass & Roback 2000, Boone et al. 2004). The wild female olingo in this study vocalized incessantly, and a captive eastern lowland olingo female vocalized "always during copulation, and sometimes following it" (Poglayen-Neuwall 1966). The calls of the female olingo appear to be part of the mating ritual, although their exact function remains unclear. The female olingo sharply turned her head toward the male while still underneath him, seemingly as a direct aggressive response to the male biting her hind neck and back. Given her position, it was difficult for her to reach the male for physical contact with her mouth.

The behavior observed in this study is similar to behavior observed in other procyonids. A copulation of kinkajous lasted 150 minutes (Kays & Gittleman 2001). In a fashion similar to the female olingo in this study, female kinkajous aggressively threaten the male, and the male advances and mates with her regardless (Kays & Gittleman 2001). The mating behavior of olingos is most similar to the mating behavior of northern raccoons (*Procyon lotor*). A female and male northern raccoon exhibited mating behavior for at least 56 minutes, which was characterized by the female vocalizing frequently during copulation, turning her head upward toward the male, attempting to bite the male, and the male and female ceasing and resuming copulation multiple times over the course of the 56 minutes (Stains 1956). White-nosed coatis, however, differ from olingo in that copulation lasts only 5-6 s but occurs many times over multiple hours, the female does not display aggression or vocalize, and the male vocalizes and does not bite the female (Hass & Roback 2000).

Only until recently were olingos recognized as several distinct species that diverged approximately 3.5 mya (Helgen et al. 2013). Although these observations pertain to only the eastern lowland olingo, the behavior of other olingo species likely is similar due to the relatively recent divergence.

In sum, these behavioral details offer important insight into the natural history of olingos. Further observations of any behavior on any species of olingo will serve as important contributions to our knowledge about these cryptic, nocturnal carnivores.

## ACKNOWLEDGEMENTS

I thank my advisor, Catherine A. Lindell, for reviewing this manuscript and offering important feedback. Dara Adams and Gordon Ulmer were helpful in discussing olingo and kinkajou identification while in the field. Roland Kays graciously discussed these observations with me and offered insight on the interpretation of the behavior. Varun Swamy helped me identify the fruiting tree in which the olingos were feeding. Chloe Williams revised the manuscript with English grammatical corrections.

## LITERATURE CITED

Boone WR, Keck BB, Catlin JC, Casey KJ, Boone ET, Dye PS, Schuett RJ, Tsubota T, Bahr JC (2004) Evidence that bears are induced ovulators. **Theriogenology 61**: 1163-1169.

Emmons LH (1984) Geographic variation in densities and diversities of non-flying mammals in Amazonia. **Biotropica 16**: 210-222. doi: 10.2307/2388054

Emmons LH (1997) **Neotropical rainforest mammals: A field guide.** Chicago, University of Chicago Press, 2nd ed., XVI+307p.

González-Maya JF, Belant JL (2010) Range extension and sociality of bushy-tailed olingo *Bassaricyon gabbii* in Costa Rica. **Small Carnivore Conservation 43**: 37-39.

Hass CC, Roback JF (2000) Copulatory behavior of white-nosed coatis. **Southwestern Naturalist 45**: 329-331.

Helgen KM, Pinto CM, Kays R, Helgen LE, Tsuchiya MTN, Quinn A, Wilson DE, Maldonado JE (2013) Taxonomic revision of the olingos (*Bassaricyon*), with description of a new species, the olinguito. **ZooKeys 324**(SI): 1-83. doi: 10.3897/zookeys.324.5827

Janson CH, Emmons LH (1990) Ecological structure of the nonflying mammal community at Cocha Cashu Biological Station, Manu National Park, Peru, p. 314-338. In: Gentry AH (Ed.) **Four Neotropical Rainforests.** New Haven, Yale University Press, XVI+627p.

Kays, RW (2000) The behavior and ecology of olingos (*Bassaricyon gabbii*) and their competition with kinkajous (*Potos flavus*) in central Panama. **Mammalia 64**: 1-10. doi: 10.1515/mamm.2000.64.1.1

Kays RW, Gittleman JL (2001) The social organization of the kinkajou *Potos flavus* (Procyonidae). **Journal of Zoology 253**: 491-504. doi: 10.1017/S0952836901000450

Llewellyn LM, Enders RK (1954) Ovulation in the raccoon. **Journal of Mammology 35**: 440.

Milligan SR (1982) Induced ovulation in mammals. **Oxford Reviews of Reproductive Biology 4**: 1-46.

Oliveira, TG (2009) Notes on the distribution, status, and research priorities of little-known small carnivores in Brazil. **Small Carnivore Conservation 41**: 22-24.

Peres, CA (2000) Identifying keystone plant resources in tropical forests: the case of gums from *Parkia* pods. **Journal of Tropical Ecology 16**: 287-317. doi: 10.1017/S0266467400001413

Poglayen-Neuwall I (1966) Notes and care, display, and breeding of olingos, *Bassaricyon*. **International Zoo Yearbook 6**: 169-171. doi: 10.1111/j.1748-1090.1966.tb01739.x

Poglayen-Neuwall I (1976) Fortpflanzung, geburt, und aufzucht, nebst anderen beobachtungen von makibären (*Bassaricyon* Allen, 1876). **Zoologische Beiträge 22**: 179-233.

Pontes ARM, Chivers DJ (2002) Abundance, habitat use, and con-

servation of the olingo *Bassaricyon* sp. in Maracá Ecological Station, Roraima, Brazilian Amazonia. **Studies on Neotropical Fauna and Environment 37**: 105-109.

Prange S, Prange TJ (2009) *Bassaricyon gabbii* (Carnivora: Procyonidae). **Mammalian Species 826**: 1-7. doi: 10.1644/826.1

Reid FA (1997) **A field guide to the mammals of Central America and southeast Mexico.** New York, Oxford University Press, XVII+334p.

Sampaio R, Munari DP, Röhe F, Ravetta AL, Rubim P, Farias IP, da Silva MNF, Cohn-Haft M (2010) New distribution limits of *Bassaricyon alleni* Thomas 1880 and insights on an overlooked species in the Western Brazilian Amazon. **Mammalia 74**: 323-327. doi: 10.1515/mamm.2010.008

Sampaio R, da Silva MNF, Cohn-Haft M (2011) Reassessment of the occurrence of the kinkajou (*Potos flavus* Schreber, 1774) and olingo (*Bassaricyon beddardi* Pocock, 1921) in the northern Brazilian Amazon. **Studies on Neotropical Fauna and Environment 46**: 85-90. doi: 10.1080/01650521.2011.572678

Stains HJ (1956) **The raccoon in Kansas, natural history, management, and economic importance.** Lawrence, State Biological Survey of Kansas, 76p.

Submitted: 12 February 2016
Received in revised form: 30 March 2016
Accepted: 5 May 2016
Editorial responsibility: Darren Norris

**Competing Interests:** The author has declared that no competing interests exist.

Appendix 1. About the Supplementary Material S1 (available with the HTML version of the article at http://www.scielo.br/zool).

The video demonstrates the olingos mating, the male biting the female on the back, leg, and neck, and the female snapping her mouth toward the male and incessantly vocalizing. The video is composed of six segments. For each segment, I give the segment duration, the time of day the segment starts, and I describe noteworthy events. Segment 1 (0:00-1:41, 04:46am): At 0:22, the female snaps her mouth particularly strongly toward the male, and at 0:51-1:09 the male bites the neck of the female. Segment 2 (1:41-4:05, 4:52am): At 01:43 and 01:56, the male bites the female, and the female responds by vigorously snapping her mouth toward the male. Segment 3 (4:06-4:47, 5:01am): At 4:14-4:28, the male olingo bites the neck of the female. At 4:29, the female olingo displaces herself from the male, and at 4:34, the male olingo again bites the neck of the female. Segment 4 (4:47-5:11, 5:04am) The male olingo bites the back of the female many times throughout the segment, to which the female responds by snapping her head toward the male, and even once biting the leg of the male at 4:55. Segment 5 (5:12-5:54, 5:48am) The male olingo again bites the neck of the female at 5:15, and he bites the leg of the female three times at 5:29-5:34. Segment 6 (5:55-6:28, 05:52am) At 6:02, the male sniffs the posterior end of the female. At 6:20, the male olingo dismounts from the female for a final time, but the two olingos remain adjacent to each other for approximately 20 minutes after the end of the video.