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## ORIGINAL ARTICLE

### Reassessment of the occurrence of the kinkajou (*Potos flavus* Schreber, 1774) and olingo (*Bassaricyon beddardi* Pocock, 1921) in the northern Brazilian Amazon

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Brazil's only records of Pocock's olingo (*Bassaricyon beddardi*) are based on sightings from the northernmost state of Roraima, where the similar kinkajou (*Potos flavus*) was reported as absent. Our recent field work in the region led to the collection of two specimens and several more observations of kinkajous and a complete lack of evidence of the presence of olingos. Furthermore, the name used locally to describe the nocturnal procyonids previously treated as olingos, *gogó de sola*, refers to the leathery bare throat patch that we believe to be a characteristic unique to kinkajous. Thus, we conclude that previous records of olingos in Roraima represent misidentifications of kinkajous and recommend that, until supported by a specimen, *B. beddardi* be treated as absent from Brazil.

**Keywords:** bare throat patch; diagnostic characters; geographic distribution; Maracá Island; Neotropical mammals; specimen collection

#### Introduction

The two procyonids, kinkajous (*Potos flavus*) and olingos (*Bassaricyon* spp.), are poorly known Neotropical mammals that are difficult to distinguish from one another in the field. In addition to their overall morphological similarity, their nocturnal and arboreal habits make them hard to observe well. Thus, for example, Emmons (1984) left numerous individuals unidentified to genus in nocturnal surveys. One result of this difficulty is that knowledge of their distributions is vague and subject to substantial revision (e.g., Sampaio et al. 2010), relying on very few collected specimens and including sight records, which can be problematic.

The first Brazilian records of olingos, identified variously as *Bassaricyon* sp. or *Bassaricyon beddardi* (Pocock's olingo), are sight records with identifications confirmed by local informants (Mendes Pontes & Chivers 2002; Mendes Pontes et al. 2002; Mendes Pontes 2004). These records were identified as olingos based on coat color patterns, absence of a prehensile tail, and presence of a circular reddish furless spot on the ventral side of the neck; their informants called the animal *gogó de sola* (literally "leather throat"), referring to the bare throat patch, sometimes visible in the field (Mendes Pontes & Chivers 2002). Our recent examinations of kinkajou and olingo specimens and literature, to clarify species distributions in Brazil (Sampaio et al. 2010), have led us to suspect, however,

that only kinkajous have this trait (Reid 1997) and that the purported first Brazilian records might refer to kinkajous. Herein we present results of our recent surveys within the main locality in Brazil from which Pocock's olingo was reported.

#### Materials and methods

##### Study area

Maracá Island Ecological Station (03°21'N, 61°26'W), Roraima State, Brazil, was the main field site from which Brazil's only *B. beddardi* records originated (Mendes Pontes & Chivers 2002; Mendes Pontes et al. 2002; Mendes Pontes 2004). It is a very large fluvial island (>1000 km<sup>2</sup>) formed by the bifurcation and rejoining of the Uraricoera river and comprised of seasonally dry forests and tropical dry forests (Mendes Pontes 2004).

##### Field surveys

Between 27 February and 3 March 2009, one of us (R.S.) conducted field work at this site, involving interviews, night surveys, and specimen collection. Interviews using color plates of Emmons & Feer (1999) and Eisenberg & Redford (1999) were carried out on seven subjects independently: four local residents and three officials of the Brazilian environmental agency responsible for the reserve (Instituto

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Chico Mendes de Conservação da Biodiversidade – ICMBio). Adapting some aspects of standard line transect methods (Peres 1999), night surveys were conducted along trails of the project grid of Programa de Pesquisa em Biodiversidade (PPBio) (see PPBio site <http://ppbio.inpa.gov.br/>), all within 8 km of the reserve headquarters. Specimens were collected (by shotgun, ICMBio permit number 15922-1) of the first easily accessible individuals; other individuals detected did not present evidence of being different species and so were not collected.

### Diagnostic characters

The most objective means of separating kinkajous from olingos is by dental formula and total number and shape of teeth; other traits proposed by previous authors include overall size, fur length and color, tail prehensile or not, presence of bare patches, and vocalizations (see Results; Table 1). Considering the difficulty in separating the two genera in the field and our doubts about the validity of some of the characters proposed heretofore, our positive identifications were based on the dental characters of collected specimens. We then looked for other distinguishing features associated with identified specimens that might be visible in the field. We attempted to associate the use of popular names by local residents with correct identifications. The identification of *Bassaricyon beddardi* versus other olingo species, if olingos were encountered, would be based on cranial characters: bullae in *B. beddardi* are supposed to be more inflated anteriorly than in other *Bassaricyon*, and the lowest points on bullae are almost immediately below the auditory meatus when viewed in profile (Pocock 1921; Prange & Prange 2009).

### Results

All seven interviewees responded that the only medium-sized, arboreal, nocturnal mammals occurring in the area were *macaco da noite* (night monkey), pointing to pictures of *Aotus* spp., and *gogó de sola*, pointing to *Bassaricyon* spp. in the color plates.

A total of 26 km were walked during six night transect censuses, resulting in seven detections of solitary procyonids. Based on the considerable distance between records (>1 km), they likely represented seven different animals. Of these, two were silent, poorly seen, and remained unidentified to genus. The first individual seen clearly enough to shoot was collected and identified as a male kinkajou (INPA 5915, field number RS 12; Table 1; Figure 1). The remaining four detections were identified as kinkajous based on vocalizations (Table 1), which were similar to each other in all cases, and on one of these the prehensile tail and a

bare throat patch (Figure 2) were seen clearly. Another of the vocalizing individuals was collected and was a female kinkajou (INPA 5916, field number RS 13; Table 1; Figure 1).

Both specimens were believed to be adults: they had complete dentition (Table 1), the male had a developed scrotum, and the female had developed mammary glands, but was not lactating. The male's head was dark brown and the dorsum was dark yellowish brown, with no sharp contrast in color between the rump and the tail, which had a 5 cm cream tip (Figure 1). The male's ventral coloration from the neck to the lower abdomen was pale yellow, darker on the flanks, legs and tail, on which the cream tip was also visible ventrally, as has been observed in other kinkajous (Emmons & Feer 1999).

The female was darker above and lighter below than the male (Figure 1). The dorsal coloration, from head to rump, was dark grayish brown, with somewhat paler legs. Individual overhairs (twice as long as the male's; Table 1) had a yellowish gray base, light brownish central band and very dark brown tip, giving a brindled dorsal pattern to the animal. The tail was light yellowish brown, similar to the adult male, but with a much shorter cream tip (ca. 1 cm). The ventral coloration from neck to lower abdomen, including the legs, was pale yellow; the tail was yellowish brown ventrally, with very subtle, indistinct partial rings all along and with whitish tip (ca. 1 cm).

The dorsal color pattern of this female was similar to that described for juveniles by Heller (1932) as “darker than the uniform golden-yellow pelage of their captive parents from Belize” and by Emmons & Feer (1999) as “juveniles have pelage gray with dark stripes behind the shoulders.” Furthermore, the female's premolars and molars were less worn than the male's, and her skull had less-developed supra-orbital processes and sutures than the male. For these reasons, we interpreted the female as being younger than the male, perhaps best called “subadult.”

### Discussion

In addition to the diagnostic dental formula present in the two collected specimens, both showed distinctive bare patches on the throat and corners of the mouth. Similar bare patches were also present on all 11 specimens of kinkajous and absent from the three olingo specimens belonging to the mammal collections of the Instituto Nacional de Pesquisas da Amazonia (INPA). Furthermore, other mammalogists consulted (F Reid, personal communication; RW Kays, personal communication; J de Souza and S Junior, personal communication) corroborated our impression that the patches are present in all kinkajous and absent entirely from

Table 1. Genus-level characters of kinkajous and olingos and those of the two specimens collected on Maracá Island, Roraima, northern Brazil.

| Character                                | <i>Potos flavus</i>  | <i>Bassaricyon</i> spp.                             | INPA 5915 (male)                           | INPA 5916 (female)   |
|--|--|---|--|--|
| Size (mass in kg) <sup>1,2</sup>         | 1.4–4.6  | 1.0–1.4   | 1.95                                       | 1.1  |
| Dorsal coloration <sup>1,2,3,4</sup>     | Reddish, brownish, olive or yellowish with distinct dark midline                       | Brown to grayish brown grading darker along midline | Dark yellowish brown with distinct midline | Dark grayish brown, subtly brindled, with distinct midline |
| Ventral coloration <sup>1,2,3</sup>      | Creamy yellow, deep fulvous yellow, or orange-buff                                     | Whitish, light cream to yellow                      | Pale yellow                                | Pale yellow  |
| Fur length (cm)/density <sup>1,2,3</sup> | 1.0/dense and woolly   | 1.5/not as dense                                    | 1.0/dense and woolly                       | 2.0/dense and woolly                                       |
| Tail                                     |  |   |  |  |
| Prehensile/muscular <sup>1,2</sup>       | Yes  | No  | Yes  | Yes  |
| Shape <sup>1,2,8,9</sup>                 | Short fur; tail tapered to pointed tip   | Long fur; tufted tail tip                           | As in <i>Potos</i>                         | As in <i>Potos</i>   |
| Coloration <sup>2,3</sup>                | Plain or with pale tip   | Faintly ringed, darkest at tip                      | Plain with pale tip                        | Faintly banded below with pale tip                         |
| Ear color <sup>8</sup>                   | Uniform  | Narrow white edges                                  | As in <i>Potos</i>                         | As in <i>Potos</i>   |
| Dental formula <sup>1,2</sup>            | i: 3/3; c: 1/1; p: 3/3; m: 2/2; total = 36   | i: 3/3; c: 1/1; p: 4/4; m: 2/2; total = 40          | As in <i>Potos</i>                         | As in <i>Potos</i>   |
| Pre-molar and molar teeth <sup>1,2</sup> | Flatter  | Crowned and tuberculated                            | Flatter                                    | Flatter  |
| Bare patches <sup>5,9</sup>              | Throat and lower corners of jaw  | None  | As in <i>Potos</i>                         | As in <i>Potos</i>   |
| Movement <sup>6,8,9</sup>                | Deliberate, slower than <i>Bassaricyon</i> ; tail usually curled around support branch | Fast and agile; tail stretched out behind body      | As in <i>Potos</i>                         | As in <i>Potos</i>   |
| Vocalizations <sup>7</sup>               | Short whistles, nasal grunts   | Two-note call (sneeze-like)                         | Silent                                     | As in <i>Potos</i>   |

Note: <sup>1</sup>Ford & Hoffmann (1998); <sup>2</sup>Prange & Prange (2009); <sup>3</sup>Emmons & Feer (1999); <sup>4</sup>Kortlukke (1973); <sup>5</sup>Reid (1997); <sup>6</sup>Kays (2000); <sup>7</sup>Emmons et al. (1998); <sup>8</sup>LH Emmons (personal communication); <sup>9</sup>this study.



Figure 1. Dorsal views of three procyonid specimens: (A) male olingo (*Bassaricyon alleni*; INPA 5910) from Igapó-Açu, Amazonas, Brazil (see Sampaio et al. 2010); (B) female kinkajou (*Potos flavus*; INPA 5916); (C) male kinkajou (*Potos flavus*; INPA 5915); both kinkajous are from Maracá Island, Roraima, northern Brazil, as described in this study. All specimens are presented at the same scale, indicated by the black bar. Photos: R. Sampaio.

olingos. Our female specimen had smaller and less conspicuous bare patches, which may exemplify sexual dimorphism (Reid 1997). These bare patches were described as scent glands by Poglayen-Neuwall (1966) and Kays & Gittleman (2001). Thus, the “leather throat” described by the popular name *gogó-de-sola* refers to what appears to be a diagnostic trait of kinkajous. We suggest, then, that reports by local people of *gogó-de-sola* be interpreted as kinkajous, especially if informants confirm having observed the bare patches directly.

Overall coloration, on the other hand, appears not to be very helpful in distinguishing kinkajous from olingos. There was considerable difference in color between the two collected individuals, as has been reported among kinkajous in general (Ford & Hoffmann 1988). The young female specimen, in particular, has similar coloration to an olingo specimen at our disposal (Figure 1). The red or orange color often illustrated for kinkajous may in fact not occur in olingos; however, many kinkajous show grayer tones more typical of those in olingos. Age and sex may have consistent relations to color pattern in these animals, but we were unable to detect any such pattern and, thus, recommend that color alone not be used to distinguish genera.

Similarly, overall body size may not be a trustworthy diagnostic character. Although olingos have never been recorded as attaining the largest sizes found among kinkajous, young kinkajous may fall within the size range typical of olingos. Furthermore, both of our collected specimens appeared to be smaller than usual. The female may not yet have attained full size (as suggested by juvenile-like coloration); however, even the somewhat larger adult male was at the small end of the spectrum described for the species. Interviewees consistently pointed to the illustration of olingos in the field guides (two of them even after seeing the collected specimens), explaining that the local procyonid with which they were familiar was smaller and darker than the kinkajous illustrated. These observations and our two specimens are consistent with the possibility that the Roraima population contains smaller kinkajous than those described elsewhere, perhaps even a distinct taxon; however, further sampling is necessary to confirm this.

Our two specimens represent the first documented evidence of kinkajous for the Maracá Island Ecological Station. Three of our remaining five sight records involved observation of at least some of the characters that we believe to be diagnostic and that were associated with the collected individuals, such as



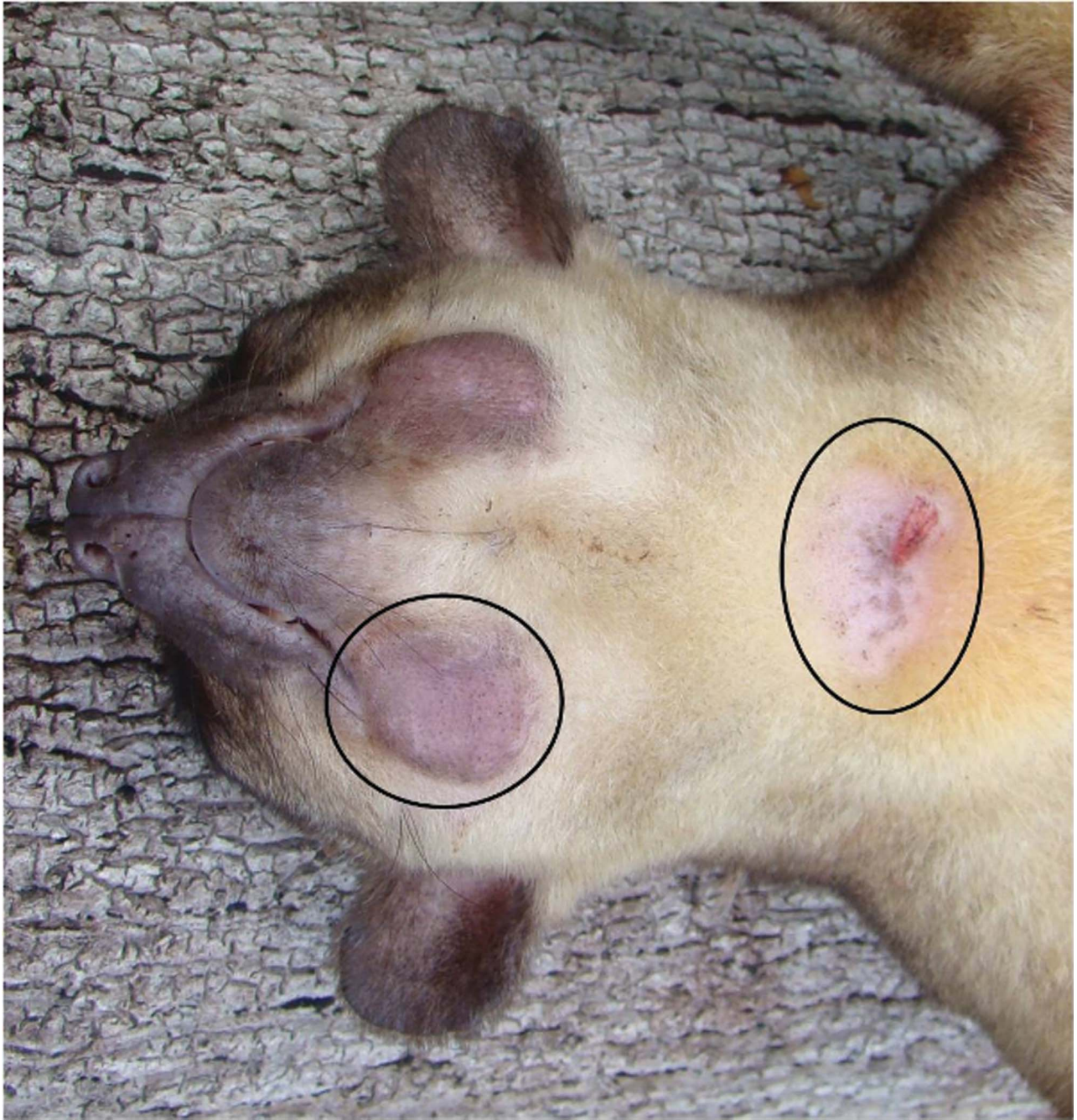


Figure 2. Ventral side of the neck and lower jaw of a freshly collected kinkajou (INPA 5917). Circles indicate one of the bare patches at the corners of the mouth and on the throat. The asymmetrical red mark within the throat patch is a gunshot wound (Color online). The bare patches are less conspicuous on dried specimens. Photo: R. Sampaio.

similar vocalizations, prehensile tail, and the presence of bare patches on the neck. Thus, we conclude that we encountered five kinkajous and two unidentified procyonids. We found no direct evidence of the presence of olingos in the area.

We believe the simplest interpretation of the current evidence is that kinkajous are common on Maracá (and by extension elsewhere in Roraima)

and that olingos do not occur there. Earlier studies (Mendes Pontes & Chivers 2002; Mendes Pontes et al. 2002), in direct contrast, described a complete absence of kinkajous and reported olingos as being remarkably abundant. Throughout the earlier studies and our own, locals were consistent in their use of the name *gogó-de-sola* to describe the one procyonid they believe to occur in the region. Because this name refers to the

bare throat patches that we believe to be diagnostic of kinkajous, and because the only procyonid specimens from Roraima are kinkajous, we treat the inclusion of olingos in the Roraima fauna as a misidentification of unusually small, dark kinkajous. We suggest that Pocock's olingo (*Bassaricyon beddardii*) be removed from the Brazilian fauna until supported by specimen evidence and that Allen's olingo (*B. alleni*), documented recently in southwestern Amazonia (Sampaio et al. 2010), for the time being is the only member of the genus found in Brazil. The case presented here strongly reinforces the need for nocturnal surveys supported by voucher specimens to document our understanding of these elusive animals and of the Amazonian fauna as a whole.

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