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GEOGRAPHIC DISTRIBUTION OF NIGHT MONKEYS, *AOTUS*, IN NORTHERN BRAZIL: NEW DATA AND A CORRECTION

The geographic distribution of *Aotus trivirgatus* Humboldt, 1812 was recently extended eastwards as far as the state of Amapá on the basis of four specimens collected at Carmo do Macacoari, Itaubal, eastern Amapá, and on the island of Caviana in the Marajó archipelago, Pará (Fernandes, 1993). In 1994, fieldwork at these two sites resulted in the collection of a further two specimens of *Aotus* from the former (Museu Paraense Emílio Goeldi MPEG 24035 and Instituto de Pesquisas do Estado do Amapá IEPA 041) and three from the latter (MPEG 24130, 24131 and 24132).

All ten specimens now collected at these two sites were analyzed using the diagnostic characteristics used by Hershkovitz (1983). According to Hershkovitz, *Aotus trivirgatus* and *Aotus infulatus* Olfers 1818 belong to the gray-necked and red-necked groups, respectively. His phenetic key to the *Aotus* species and subspecies (1983, p.213), showed that *A. trivirgatus* and *A. infulatus* may be distinguished by just two characteristics: the coloration of the side of the neck, and the presence (or absence) of a whitish band at the lateral corner of the eye. The remaining characters cannot be considered diagnostic. The entire side of the neck behind and below the ear is grayish agouti or brownish agouti in *A. trivirgatus*, as are the flank or the outer side of the arm, and whitish bands are found at the lateral corners of the eyes. In *A. infulatus*, the neck is partially or entirely orange or buff, and two small whitish patches are found above the eyes.

All ten specimens exhibit the diagnostic characters of *A. infulatus*. The animals from Carmo do Macacoari were indistinguishable from those of Caviana Island, and the Goeldi Museum specimens of *A. infulatus* from Marajó Island and the Rio Tocantins. All these thus represent a single species, *A. infulatus*, the geographic distribution of which is extended to the left (north) bank of the lower Amazon, in Amapá (Fig. 1). Consequently, the known eastern limit of the geographic distribution of *A. trivirgatus* is still the Rio Trombetas, as described by Hershkovitz (1983). Contrary to Fernandes (1993), then, the occurrence of night monkeys in the remainder of Amapá, west of the Rio Trombetas in Pará remains to be confirmed, especially as the genus was not reported from previous primate surveys in Amapá (Carvalho, 1962), Suriname (Mittermeier and van Roosmalen, 1981), and French Guiana (Roussilhon, 1988).

The presence of *A. infulatus* north of the Amazon is consistent with the occurrence of other closely related taxa on both sides of the lower reaches of the river: *Cebus apella apella, Cebus nigrivittatus/kaapori, Chiropotes satanas* ssp., *Saguinus midas* ssp. and

Saimiri sciureus sciureus (see Torres de Assumpção, 1988; Hershkovitz, 1977, 1985; Queiroz, 1992; Silva Jr., 1992; Harada, 1994). Of the primate genera that occur on both banks, only *Alouatta* is clearly represented by distinct species; *A. belzebul* to the south and *A. seniculus* to the north. The apparently limited distribution of *Aotus infulatus* in Amapá clearly indicates the need for further investigation, especially given the recent
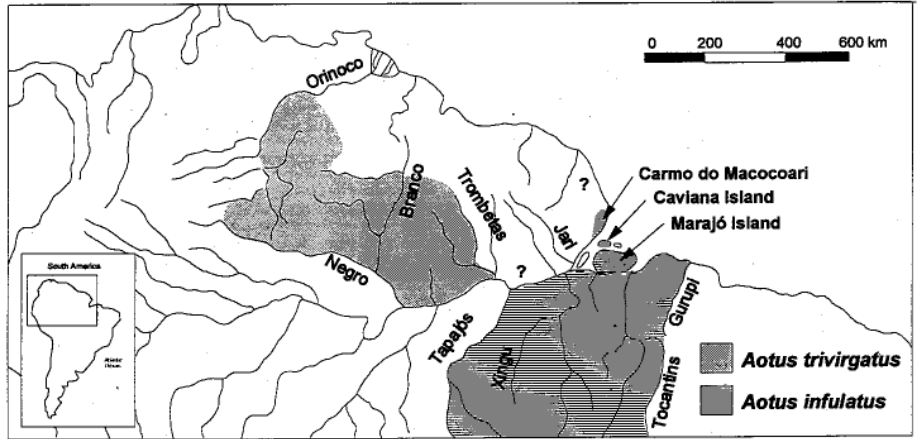

Figure 1. Geographic distribution of *Aotus infulatus* in Pará (part) and Amapá, and of *Aotus trivirgatus*. Map by José de Sousa e Silva Jr.

observation of enclave populations of *A. belzebul* north of the Amazon (Fernandes, 1993; A. Nunes, pers. obs.). Like *Alouatta belzebul*, the presence of an enclave of *Aotus infulatus* north of the Rio Amazonas may be related to shifts in the course of the river, resulting in the passive transfer of populations between banks, as probably occurred with *Aotus nancymai* and *A. vociferans* further west (Hershkovitz, 1983). Alternatively, if *Aotus infulatus* is found to be more widespread in Amapá, it would seem reasonable to conclude that species occurred throughout the area prior to the formation of the Amazon delta (Frailey *et al.*, 1988), as seems to have been the case for *Cebus*, *Chiropotes*, *Saguinus* and *Saimiri*. The collection of additional data from Amapá, northern Pará, and the Guianas will thus not only help define the distribution of *Aotus* in northeastern Amazonia, but also provide new insights into the role of river barriers in the recent biogeography of Amazonian primates.

Specimens examined: *Aotus infulatus*: Pará: Vila Brabo, right bank of Rio Tocantins (MPEG 12177, 12178); Sítio Calandrinho, left bank of Rio Tocantins (MPEG 8869, 8870); Timbozal, left bank of Rio Tocantins (MPEG 1185, 11853); Saúde, left bank of Rio Tocantins (MPEG 12179); Cocal, right bank of Rio Tocantins (MPEG 11851); Conceição do Araguaia (MPEG 1321); Lago Arari, Marajó Island (MPEG 99, 100); Ponta de Pedras, Marajó Island (MPEG 8875, 8876, 8877); Fazenda Santana, Caviana Island (MPEG 23058, 23059, 24130, 24131, 24132). Amapá: Carmo do Macacoari, Itaubal (MPEG 225223, 22523, 24035, IEPA 0040, 0041, and specimen with field number 837).

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POLE BRIDGES TO AVOID PRIMATE KILLS: A SEQUEL TO VALLADARES-PADUA *ET AL.*

Roads can interrupt habitat continuity and reduce the chances of survival of some species by fragmenting their populations (Beier, 1995; Oxley *et al.*, 1974; Wilkins, 1982). Additionally, roads may have a negative impact on wildlife populations by increasing mortality through road deaths (Beier, 1995; Comita, 1984; O'Gara and Harris, 1988; Polaco and Guzmán, 1993; Wilkins and Schmidly, 1980). Road accidents with wildlife also have an important economic and social cost (Hansen, 1983). These are likely to be important and increasing problems as roads are constructed in wilderness areas and where they cross regions inhabited by threatened species and populations. Several solutions have been proposed and implemented, including the use of warning signs, road fencing, illumination, reflectors, and road underpasses and overpasses for wildlife (Feldhamer *et al.*, 1986; Gibson, 1980; Reed, 1981; Reed and Woodward, 1981; Schafer and Penland, 1985). These solutions - which have met with mixed success - may be useful for terrestrial fauna, but their utility for arboreal animals is uncertain.

Valladares-Padua *et al.* (1995) demonstrated a simple and imaginative way of avoiding primate road kills and connecting isolated areas of their habitat by placing a pole bridge above a road. They have observed black lion tamarins (*Leontopithecus chrysopygus*) and capuchin monkeys (*Cebus apella*) using the bridge. Valladares-Padua *et al.* (1995) mentioned the successful implementation of the bridge (although not systematically assessed), and made no reference to any negative effects.

The use of pole bridges in open areas (such as in many roads) may, however, have a potentially serious side-effect: primates, particularly callitrichids, may be more exposed to predators, mainly raptors. To make the design of the pole bridge constructed by Valladares-Padua *et al.* more effective in open areas, it would be necessary to provide some sort of shelter while they cross the bridge. This could be achieved in a number of ways, and using local materials, by simply building a roof or providing some other protection such as a web of ropes. By promoting the growth of creeping vines and other plants, bridges and their 'roofs' could be camouflaged to disguise them or make them more appealing aesthetically. However, care has to be taken to avoid creating in this way places for other predators to hide (for example, snakes). Another issue to consider is that raptors may use poles and other artificial platforms to nest (Steenhof *et al.*, 1993). In fact, it is a common management practice to increase raptor populations by providing them with artificial nesting structures (Lefranc and Millsap, 1984). Thus, in regions where this may be a concern, it may be necessary to build the bridges in such a way as to minimize this problem, and to monitor them to remove undesired raptor nests. Finally, having a single pole bridge may create a bottleneck and make the monkeys (and their travel routes) predictable, hence increasing their risk of predation or of being captured by humans. Having several bridges would help solve these problems. The implementation of these proposals would increase the cost of bridges, but it would be minimal compared to the costs of losing individuals of seriously depleted populations. Of course, as in most management programs, decision of what is appropriate for one site will need to be determined case-by-case.

It is of great importance to make an objective assessment of the effectiveness and cost of different bridge designs under various road conditions (for example, road type - paved or dirt - and width, intensity and speed of traffic flow, noise levels, distance to primate habitats). These evaluations are fundamental in order to convince governments and road constructors and operators of their value. If effective, as current evidence and common sense suggest, the establishment of wildlife tunnels and bridges, as well as other means to mitigate population fragmentation and wildlife mortality, should become a standard practice.