aproximación al conocimiento de la historia evolutiva de los platirrinos.

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Subspecific Differences in Vulva Size between *Alouatta palliata palliata* and *A. p. mexicana*: Implications for Assessment of Female Receptivity

During a six-month study of sexual behavior in the mantled howler monkey (*A. p. mexicana*) at Catemaco, Veracruz, Mexico, investigators attempted to employ the system of Jones (1985; see also Glander, 1980) for the identification of stages of female receptivity - possibly correlating with stages of estrus - devised for *A. p. palliata* in Costa Rica. This system uses visual inspection of the vulva, in particular vulval color and morphology (swelling), to classify a female's reproductive state for three stages of "estrus" and one stage of "post-estrus", where stage E3 is presumed to be "peak estrus" and the period of heightened fertility. Jones (1985) found that most copulations by high-ranking males occurred during stage E3.

The classification system proved unreliable at Catemaco (L. Cortés-Ortiz, pers. comm.; G. M. Palacios, pers. comm.). In an attempt to evaluate the problem, I traveled to Catemaco in January, 1997 to observe females of the population on Agaltepec Island in Catemaco Lake (see Cortes-Ortiz *et al.* 1994). Observations determined that vulvas of female *A. p. mexicana* are more similar to the relatively inconspicuous vulvas of *A. caraya* than to those of *A. p. palliata* in which vulvas may exhibit genital hypertrophy (Jones, 1995). Whereas *A. caraya* were observed under captive conditions where slight changes in color and morphology were detected (Jones, 1983), the field conditions of *A. p. mexicana* on Agaltepec Island are challenging, making confident external identification of "estrus" stages, *if they exist*, difficult. While vulvas in *A. p. mexicana* and *A. p. palliata* were variable, the largest *A. p. mexicana* vulva did not appear to be as large as the smallest *A. p. palliata* vulva. Discrete measurements of immobilized females are necessary to test this impression.

What factors may explain these subspecific differences in vulval size? First, if a prominent vulva in *A. p. palliata* is a derived trait, what characteristics of the selective regime throughout the range of *A. p. palliata* differ from those of *A. p. mexicana*? Because of the historical significance of topological features (for example, volcanoes), river patterns, and the tropical dry deciduous forest throughout Central America, the environment of *A. p. palliata* may

be more heterogeneous in time and space than that of *A. p. mexicana*, with subsequently stronger sexual selection in the former subspecies. Support for this view is found in the observation that sexual dimorphism appears to be greater in *A. p. palliata* than in *A. p. mexicana* (E. Rodríguez-Luna, pers. comm.; J. C. Serio-Silva, pers. comm.; pers. obs.). Again, verification of these speculations await systematic study.

If the habitats of *A. p. palliata* are significantly more heterogeneous than those of *A. p. mexicana* and if the former subspecies exhibits a greater degree of sexual dimorphism, then it is possible that stronger reproductive competition among females has resulted in female choice by epigamic selection to attract males (for resources and/or "good genes") (see Crockett, 1984) by elaborate sexual signals in the form of prominent labia and the advertisement of estrus. This hypothesis assumes that female signals are "honest". Alternative hypotheses are that *A. p. palliata* females "cheat" males by advertising dishonestly (an expensive strategy), possibly to avoid infanticide (see Crockett, 1987) or the costs of female-female competition (for example, by attracting males to feeding sites away from the group). These alternatives might occur with intense sexual selection such as that proposed for *A. p. palliata* under conditions in which costs to fitness are associated with "honest" signals from females to males including those incurred under conditions of male "coercion".

A. p. mexicana, on the other hand, is either advertising discretely or concealing estrus (at least by visual cues). Other possibilities are that females are polymorphic for labial size and estrus signals, that the display of these traits is incomplete, possibly due to the loss of the derived condition, that the trait is "incipient" in *A. p. mexicana*, or that the latter species never exhibited the trait. Physiological studies are underway to determine the hormonal profile of estrus in *A. p. mexicana* (D. Canales-Espinosa, pers. comm.) after which research will be conducted to determine the correlation, or lack thereof, of visual cues with physiological estrus and the variability in vulval size.

Similar studies are required for *A. p. palliata*. In a preliminary report by Zucker *et al.* (1994), it was concluded that visual cues are not true indicators of physiological estrus, but the reliability of their methods to discriminate visual cues in vulval swelling and color change are in question (Jones, 1995). It might be expected that both subspecies of *A. palliata* would exhibit "honest" signals about reproductive condition from females to males since, although aggression is comparatively rare in both, the costs of a cheater being detected may be high. Environmental heterogeneity, however, may increase the benefits to females of cheating males, leading to the trait in both subspecies, but more accentuated in *A. p. palliata*. Males have been observed to copulate with pregnant females and to reject receptive females in *A. p. palliata* (pers. obs.; K. E. Glander, pers. comm) as well as *A. p. mexicana* (L. Cortes-Ortiz and G. M. Palacios, pers comm.), suggesting that cheating may indeed occur. Alternative hypotheses must be considered, however, since vulval swelling may "reinforce" the advertisement of estrus by olfaction, for example , or vulval swelling may have arisen in response to sperm competition (Nakamura, 1990 in Hrdy, 1997).

This note reports apparent differences in the sizes of vulvas between *A. p. mexicana* and *A. p. palliata* and proposes alternative hypotheses to account for them. These observations are related to conservation because *A. p. mexicana*, the more endangered subspecies, may have lost important behavioral safeguards against environmental heterogeneity if it is adapted to a less seasonal regime than *A. p. palliata*, making it more vulnerable to increased heterogeneity accompanying habitat destruction.

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Population Genetics and Conservation of Owl Monkeys (*Aotus azarai*) in Argentina: A Promising Field Site

The evolution of monogamy and nocturnality in owl monkeys (*Aotus* spp.) remains largely unexplained. This can be blamed, at least partially, on the lack of long-term data on the ecology and behavior of this unique New World primate species. We report here on a field site that offers an unique opportunity to conduct long-term research in *Aotus azarai*. First, we report preliminary data on the ecology and behavior of the owl monkey population. We conclude with a brief description of three research projects that we will conduct in the area in the near future.

Study Area

The field site is located on the borders of the Pilagá River which runs across Estancia Guaycoléc (58°13' W, 26° 54'S) in Eastern Formosa. The area is comprised of a mosaic of grasslands, savannas, xeric thorn forests and semideciduous forests. The semideciduous forests occur along river banks, where they form gallery forests. The 13-18 meter-high gallery forest, contains, on average, 39 tree species per hectare (Placci *et al.*, 1992, cited in Brown *et al.*, 1993). The understorey is clear and easy to walk through because of cattle grazing. The climate is subtropical with mean temperatures of 27.4 °C during the summer and 16.9 °C during the winter. There are usually some nights with below freezing temperatures each year. Although there is no marked rainy season (1400 mm per year), average monthly precipitation tends to be lower between June and August (45 mm/month) than during the rest of the year (160 mm/month). The weather in the region is generally highly unpredictable.

Primate Species

Two primate species inhabit the area: owl monkeys (*Aotus azarai*) and black howler monkeys (*Alouatta caraya*). *Aotus azarai,* is one of the five species south of the Amazon classified in the red-necked group (Ford, 1994). Densities in the area vary from 12.7 ind/km² to 25.4 ind/km² (Rathbun and Gache, 1980; Arditi and Placci, 1990; Arditi, 1992; Brown and Zunino, 1994).

The density of *Alouatta caraya* reported in the area before 1982 was one of the highest for the species in Argentina (63.2 ind/km²), only superseded by the density reported in the flooded forests of the Río Paraná islands (Brown and Zunino, 1994). A significant decrease in population numbers occurred in 1982, apparently as a result of a botfly infestation (*Dermatobia* sp.). The most recent estimate indicated a density in the area of 9 ind/km² (Arditi and Placci, 1990).

Table 1. *Aotus azarai* group composition in Guaycoléc, Formosa, Argentina. N = number of encounters.

Group	Adults	Juveniles	Infants	N
1	2	1	1	5
2	2	1	1	4
3	2	1		5
4	2	1		2

Preliminary Study

Between May and July 1996, we conducted a preliminary study of owl monkeys in the area which allowed us to (1) identify this as a convenient field site for long-term studies, (2) obtain preliminary data on the behavior and demography of the species.

1) Estancia Guaycoléc is a 75,000 ha cattle-raising and rice-growing ranch owned by Pilagá S.A., a multinational company based in Buenos Aires, Argentina. The company has supported scientific research and promoted conservation efforts in the past (Rathbun and Gache, 1980; Zunino *et al.*, 1985; Arditi and Placci, 1990; Arditi, 1992). The commitment of the company to conservation, the convenient location of the ranch (on a paved national highway 25 km from the capital of the province and 100 km from Asunción, Paraguay), and the existence of a wildlife reserve with housing facilities and a small zoo, make this site an excellent one to conduct long-term projects in conservation, wildlife management and environmental education.

2) We have conducted 46 surveys of the area. On 17 occasions we encountered, observed and followed owl monkeys. Based on repeated encounters of one of the groups, we estimated that at least four different groups were regularly ranging within a 1 km-radius of the camp (Table 1).

As has been reported previously for owl monkeys in Argentina, our preliminary observations suggest that they are active both during the day and night. Although most of the activity was recorded during the early and late hours of the day, three of the four groups were observed moving and feeding during the early afternoon (approximately 1500 h, Table 2).

Population Genetics of Owl Monkeys

In the future we will examine how different aspects of the monogamous social organization of owl monkeys interact to determine the degree of genetic differentiation between and within populations. To understand better the evolution of monogamy in these monkeys, we will use molecular genetic data to explore the influences that monogamous patterns of dispersal and mating have on the genetic structure of owl monkey populations. These data should allow us, among other things, to assess the extent to which a *socially* monogamous relationship, as has been described for *Aotus* (Wright, 1994), implies *genetic* monogamy in the sense of an exclusive mating relationship between the adult male and the adult female in a group.

The long-term goals of the study are: 1) to locate and iden-