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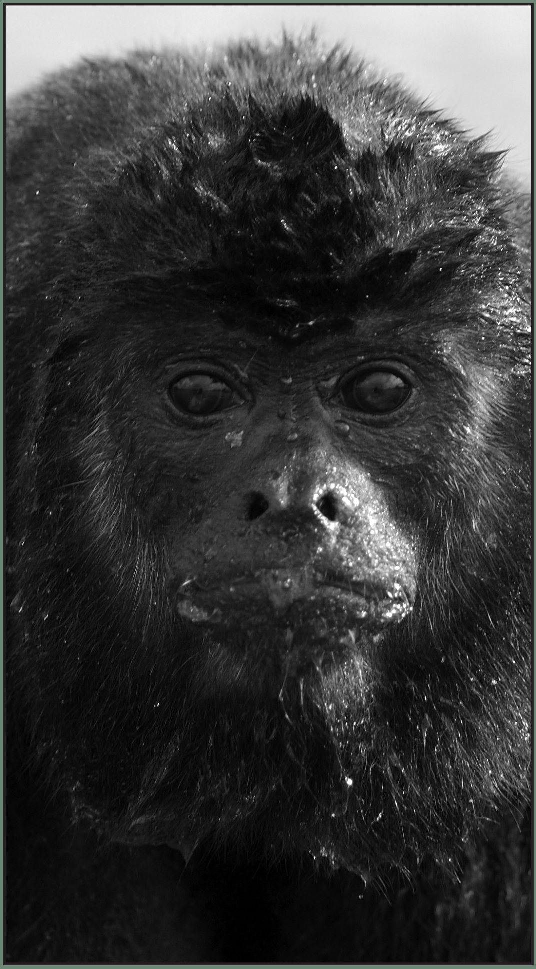
NEOTROPICAL PRIMATES



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Front cover: Adult male mantled howler (*Alouatta palliata*) at the Rio Salado, Cuero y Salado Wildlife Refuge, Honduras. Photo by Daniel Gonzalez-Socoloske.

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ARTICLES

CAMBIOS DEMOGRAFICOS EN POBLACIONES DE PRIMATES DE LA REGION SUR DE LOS TUXTLAS, MEXICO: ANALISIS LONGITUDINAL 1985–2008

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Resumen

Este análisis se basa en el censo de las poblaciones de primates realizado en la porción sureste de la Reserva de Biosfera Los Tuxtlas, México. Los datos demográficos obtenidos en 2008 son comparados con los reportados en 1985, con la finalidad de identificar las tendencias poblacionales de los primates en esta región. Se encontraron 12 fragmentos ocupados con un total de 37 individuos de *Alouatta palliata mexicana* y 68 individuos de *Ateles geoffroyi vellerosus.* El tamaño de la población total de primates en esta zona es muy similar al reportado para finales de la década de los 80s. Sin embargo, se encontró un aumento en la densidad ecológica y una disminución en la proporción de hembras y de inmaduros en los grupos de ambas especies de primates. Lo anterior puede considerarse como el inicio de procesos de declive demográfico en las poblaciones de primates en esta región, lo que puede ser consecuencia de una reducción en la calidad y cantidad de hábitat. Como medida conservacionista se sugiere aumentar la conectividad entre fragmentos de vegetación conservada, dentro de una estrategia que comprenda la compleja dinámica territorial de esta región.

Palabras Clave: parámetros demográficos, tendencias poblacionales, primates mexicanos, conservación

Abstract

This analysis is based on a census of the primate populations of the southeastern part of the Los Tuxtlas Biosphere Reserve. The demographic data obtained in 2008 were compared to those formerly reported in 1985, to identify the primate population trends in this region. A total of 37 individuals of *Alouatta palliata mexicana* and 68 individuals of *Ateles geoffroyi vellerosus* were found in 12 fragments. The size of the total primate population in this site is similar to that reported at the end of the 80's. Nonetheless, the ecological density was higher and a wane in the adult females and immature proportions within primate groups was observed. This could be considered as the beginning of demographic decline processes inside primate population in this region, which could be a consequence of a decrease in habitat quality and quantity. Improving the connectivity between forest fragments was suggested as a conservation measure within a strategy that takes into account the complexity of land dynamics in the region.

Key Words: demographic parameters, population trends, Mexican primates, conservation

Introducción

La región de Los Tuxtlas representa el límite norte de la selva húmeda tropical en el continente americano (Dirzo *et al.,* 1997); fue declarada Reserva de Biosfera en 1998, siendo uno de los últimos relictos de selva alta perennifolia en el país (Arriaga *et al.,* 2000). Aquí habitan dos de las tres especies de primates presentes en México, el mono aullador de manto (*Alouatta palliata mexicana*) y el mono araña (*Ateles geoffroyi vellerosus*), ambas consideradas en peligro de extinción por las autoridades nacionales e internacionales (SEMARNAT, 2002, UICN, 2008a y 2008b).

En 1985, Rodríguez-Luna *et al.* (1987) realizaron un censo de las poblaciones de primates en la Sierra de Santa Marta, al sureste de Los Tuxtlas. Los autores reportaron que más del 86% del bosque natural había sido destruido y reconocieron que los regímenes de tenencia de tierra, los cambios en el uso de suelo y la baja rentabilidad de los sistemas productivos se relacionaban directamente con la amenaza o conservación de estos mamíferos. A partir de esa fecha, varios estudios enfocados a los primates y su hábitat se han realizado en esta región (Silva-López *et al.,* 1988; García-Orduña, 1996; Rodríguez-Toledo, 2002; González y Mandujano, 2003; Mandujano *et al.,* 2005; Arroyo Rodríguez y Mandujano, 2006; Mandujano y Escobedo, 2008). El objetivo del presente estudio es determinar los cambios demográficos de 1985 a 2008 para ambas especies de primates, e identificar las tendencias poblacionales y sus implicaciones en la conservación de estos organismos para esta porción de la Reserva de Biosfera Los Tuxtlas (RBLT).

Métodos

Zona de estudio
La RBLT se encuentra ubicada al sur del estado de Veracruz; tiene una superficie de 155,122 ha y tres zonas núcleo: el volcán San Martín Tuxtla, el volcán Santa Marta y el volcán San Martín Pajapan. La zona de estudio se ubica en la Sierra de Santa Marta al sureste de la RBLT, presenta un paisaje altamente fragmentado y predominancia de las actividades ganaderas. El polígono de muestreo es el mismo que emplearon Rodríguez-Luna, *et al.* (1987), con la finalidad de que los datos fueran comparables; abarcando los ejidos de Mirador Pilapa, Magallanes, Fernando López Arias y Guadalupe Victoria (Fig. 1).

Los tres primeros ejidos se encuentran dentro de la zona de amortiguamiento de la RBLT, designada para al aprovechamiento sustentable de recursos naturales; mientras que el ejido de Guadalupe Victoria se encuentra dentro de la zona núcleo, en la que sólo se permiten actividades de preservación de ecosistemas y biodiversidad e investigación (CONANP, 2006).

Censo de poblaciones de primates
El trabajo de campo se realizó durante los meses de marzo a junio de 2008. Previamente, con ayuda de imágenes satelitales, se identificaron los fragmentos de vegetación conservada o semiconservada dentro de la zona. Se consideró como fragmento a los remanentes de vegetación con superficie mínima de 0.5 ha y estrato arbóreo $\geq$10 m (Estrada y Coates-Estrada, 1996, Rodríguez-Toledo et al., 2003). Para determinar el número de individuos de *Alouatta* y *Ateles* se hicieron recorridos dentro y alrededor de los fragmentos; cada recorrido comenzó a las 6:00 y terminó a las 16:00 h. El tiempo de búsqueda en cada fragmento dependió del tamaño del mismo, invirtiendo hasta 4 recorridos en los fragmentos más grandes. Durante los recorridos se registró: posición geográfica de los grupos de primates encontrados, especie, número de individuos por grupo, sexo y edad (Izawa *et al.,* 1979). Los parámetros demográficos que se analizaron fueron: población total, tamaño promedio grupal, densidad ecológica y proporciones macho adulto-hembra adulta y hembra adulta-inmaduro.

Resultados

Se visitó un total de 25 fragmentos (335.47 ha), de los cuales 12 estuvieron ocupados por primates, equivalente al 7% del total del área de estudio (3,370.71 ha) (Fig. 2). *Alouatta* estuvo presente en 8 fragmentos (49% de la superficie con cobertura forestal $\geq$ 10 m de altura) con un total de 37 individuos (15 machos, 15 hembras,

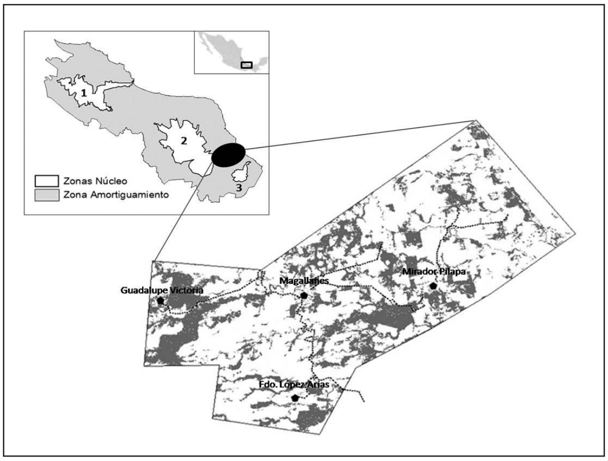

Figura 1. Zona de estudio dentro de la Reserva de Biosfera Los Tuxtlas. Puntos = localidades, Gris = manchones de vegetación., 1 = Volcán San Martín Tuxtla, 2 = Volcán Santa Marta, 3 = Volcán San Martín Pajapan.

Tabla 1. Composición y densidad de los grupos de *Alouatta* en la zona de estudio (n: total de individuos, N: número de grupos, Sol: individuos solitarios, MA:HA = proporción macho adulto-hembra adulta, HA:INM = proporción hembra adulta-inmaduro, T.P.G: tamaño promedio de grupo)

Fragmento	n	N	Sol	MA:HA	HA:INM	T.P.G	Densidad ind/ha
Uno	3	1	0	1: 1	1: 1	3	0.63
Nueve	6	1	0	1: 0.7	1: 0.5	6	0.18
Once	1	0	1	---	---	---	0.02
Doce	1	0	1	---	---	---	0.03
Catorce	2	1	0	1: 1	0	2	0.09
Diecisiete	13	1	1	1: 1.3	1: 0.6	13	1.11
Veintidós	5	1	0	1: 3	1: 0.3	5	3.36
Veinticinco	6	1	0	1: 1.5	1: 0.3	6	0.82
TOTAL	37	6	3	1: 1.4	1: 0.5		0.22[a]
PROMEDIO				1: 1	1: 0.5	5.7	0.78

[a] Considerando la superficie total de los fragmentos ocupados

4 juveniles y 3 infantes). El tamaño promedio de grupo fue de 5.8 individuos (rango de 2–12), con una composición promedio de 2 machos adultos (rango de 1–4), 2.5 hembras adultas (rango de 1–5), 0.7 juveniles (rango de 0–2) y 0.5 infantes (rango de 0–1) (Tabla 1). El 19% de la población total censada correspondió a individuos inmaduros (juveniles + infantes). La densidad ecológica de *Alouatta*, considerando la superficie de hábitat disponible, fue de 0.11 ind/ha.

Por otra parte, 68 individuos (29 machos, 25 hembras, 4 infantes, 10 no identificados) de *Ateles* fueron encontrados en 7 fragmentos (56% de la superficie con cobertura forestal ≥ 10 m de altura). El tamaño de los grupos varió de 2 a 7 individuos, conformados en promedio por 2 machos adultos (rango de 0–6), 1.9 hembras adultas (rango de 0–5) y 0.3 infantes (rango de 0–1) (Tabla 2). Solamente en 4 de los 14 grupos se encontraron infantes, con un equivalente al 3% de la población total censada. La densidad ecológica de *Ateles* fue de 0.20 ind/ha.

Los parámetros poblacionales registrados en este trabajo, para ambas especies de primates, son similares a los reportados en censos anteriores para esta porción de la Sierra de Santa Marta, registrándose los mayores cambios en la densidad ecológica y la composición grupal (Tabla 3). La densidad ecológica es relativamente mayor a la reportada por Rodríguez-Luna y colaboradores (1987); mientras que ha existido una clara disminución en la proporción de hembras y de inmaduros al interior de los grupos de 1985 a la fecha. En términos de la población total de primates en la zona de estudio, observamos un aumento en la densidad ecológica, pasando de 0.24 ind/ha en 1985 (Rodríguez-Luna *et al.,* 1987) a 0.31 ind/ha en 2008.

Discusión

El tamaño total de las poblaciones de ambas especies de primates se ha mantenido relativamente estable durante los últimos 25 años en esta porción de la Sierra de Santa Marta. El elevado número de individuos de *Alouatta* registrado en 2000–2003 (Rodríguez-Toledo, 2002; Mandujano *et al.* 2005) puede ser resultado ya sea de fluctuaciones poblacionales naturales o de diferencias metodológicas en el censo. Manchones que Rodríguez-Toledo (2002) y Mandujano *et al.* (2005) reportan como ocupados por grupos de *Alouatta*, se encuentran ahora deshabitados y no se pudo determinar qué ocurrió con esos individuos.

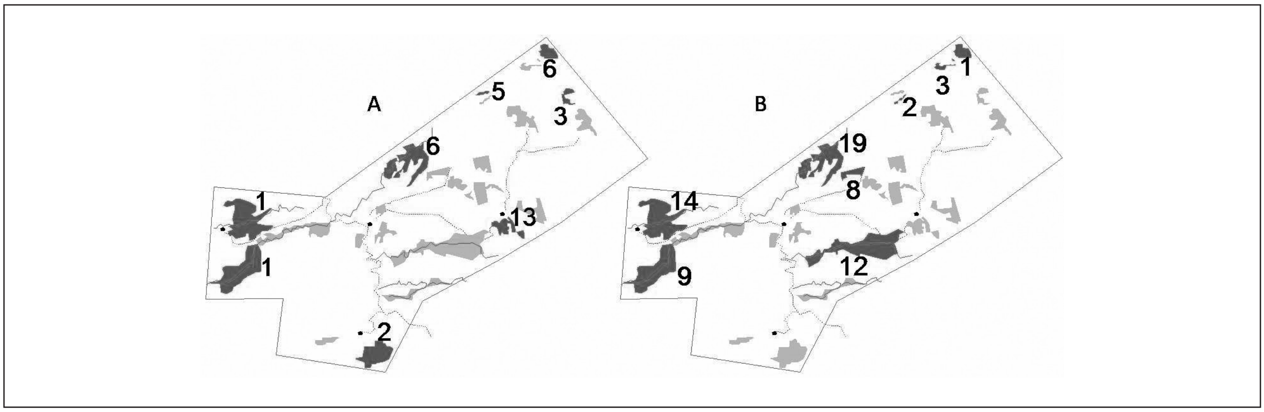

Figura 2. Fragmentos ocupados por primates. El número corresponde a los individuos registrados en el fragmento. A) *Alouatta palliata.* B) *Ateles geoffroyi*.

Tabla 2. Composición y densidad de los grupos de *Ateles* en la zona de estudio (n: total de individuos, N: número de grupos, Sol: individuos solitarios, MA:HA = proporción macho adulto-hembra adulta, HA:INM= proporción hembra adulta-inmaduro, T.P.G: tamaño promedio de grupo)

Fragmento	n	N	Sol	MA:HA	HA:INM	T.P.G	Densidad ind/ha
Ocho	8	1	0	---	---	8	1.36
Nueve	19	3	1	1: 0.9	1: 0.3	6	0.56
Once	9	3	0	1: 0.6	1: 0.3	3	0.19
Doce	14	3	1	1: 3	1: 0.1	4.3	0.39
Dieciséis	12	2	0	1: 0.3	0	6	0.20
Veintiuno	2	1	0	---	---	2	1.93
Veintitrés	4	1	1	1: 2	0	3	1.11
TOTAL	68	14	3	1: 1.4	1: 0.1		0.37[a]
PROMEDIO				1: 0.9	1: 0.2	4.6	0.82

[a] Considerando la superficie total de los fragmentos ocupados

Debido a que estos fragmentos son pequeños, angostos, están rodeados de pastizales y el ganado entra constantemente, se cree que estos grupos pudieron haber migrado; sin embargo, dadas las características del paisaje, los primates habrían tenido que atravesar grandes distancias a campo abierto para encontrar un fragmento en mejores condiciones.

A. geoffroyi y *A. palliata* se caracterizan por tener grupos conformados por un número mayor de hembras que machos (Freese, 1976; Chapman y Balcomb, 1998). La paulatina reducción en la proporción de hembras en los grupos de primates censados puede explicarse por una mayor mortandad de hembras que de machos, como consecuencia de los procesos de migración o eventos de agresión (Campbell, 2003). Del mismo modo, la proporción de inmaduros en los grupos de ambas especies ha sufrido una disminución en estos 25 años. Para el caso de *Alouatta,* a pesar de la disminución, los datos obtenidos coinciden con la proporción de inmaduros por hembras adultas (HA:INM) reportados para poblaciones estables (Zucker y Clarke, 2003). Sin embargo, el porcentaje de infantes en la población de *Ateles* del sitio de estudio (3%) es mucho menor que el 11% y 25% reportado para esta especie por Freese (1976) y Milton y Hopkins (2005) respectivamente. La reducción en la proporción de inmaduros en grupos de ambas especies de primates puede ser causada por la baja proporción de hembras, por estrés reproductivo o por una alta mortalidad infantil, y se ha relacionado con la cantidad y calidad de hábitat disponible (Cristóbal-Azkarate *et al.,* 2005). Una baja tasa de reemplazamiento poblacional, dada por la reducida proporción de hembras y la poca cantidad de inmaduros, puede considerarse como indicador de que procesos de declive demográfico están comenzando a suceder en las poblaciones de primates en esta zona (Clarke *et al.,* 2002; Zucker y Clarke, 2003).

Tabla 3. Parámetros demográficos de las poblaciones de primates en la zona de estudio y comparación con lo reportado anteriormente (MA:HA= proporción macho adulto-hembra adulta, HA:INM= proporción hembra adulta-inmaduro)

Parámetros demográficos	*Alouatta*	*Ateles*
Población total		
Rodríguez-Luna *et al.* 1987	40	
Rodríguez-Toledo, 2002	50	67
Mandujano *et al.* 2005	71	68
Presente estudio	37	
Tamaño promedio grupal		
Rodríguez-Luna *et al.* 1987	5.7 ± 2.1	
Rodríguez-Toledo, 2002	4.5 ± 2.4	6.7 ± 4.4
Mandujano *et al.* 2005	5.7 ± 3.1	4.6 ± 2.1
Presente estudio	5.7 ± 3.5	
Densidad ecológica (ind/ha)		
Rodríguez-Luna *et al.* 1987	0.09	0.15
Presente estudio	0.11	0.20
MA:HA		
Rodríguez-Luna *et al.* 1987	1.8	
Mandujano *et al.* 2005	1.3	2.1
Presente estudio	1	0.9
HA:INM		
Rodríguez-Luna *et al.* 1987	0.7	
Mandujano *et al.* 2005	0.6	1
Presente estudio	0.5	0.2

El aumento en la densidad ecológica para el total de primates en la zona de estudio es resultado de la reducción del hábitat disponible y puede estar ocasionando una mayor competencia interespecífica por recursos alimenticios, ya que *Ateles* y *Alouatta* tienen una dieta muy similar, compartiendo el 45% de las especies consumidas (Silva-López *et al.* 1988). Esta competencia puede estar limitando el acceso al alimento y por ende restringiendo el tamaño promedio de grupo, y posiblemente influenciando la presencia o ausencia de alguna de las especies en los fragmentos de hábitat remanentes.

El hábitat potencial de los primates en la zona de estudio ha estado sujeto a constantes presiones y deterioro, desde el establecimiento de las primeras comunidades humanas en la región alrededor de 1950 a la fecha. Los procesos de deforestación asociados a la apropiación territorial, han ocasionado una importante disminución en la conectividad del paisaje y en el tamaño de los manchones de hábitat remanentes (Solórzano-García, 2010). No obstante, la relativa estabilidad en el tamaño de la población total de primates en la zona de estudio de 1985 a la fecha, a pesar de la reducción progresiva del hábitat disponible, puede ser explicada por la capacidad que ambas especies tienen para adaptarse a vivir en ambientes perturbados (Silva-López *et al.,* 1988; Jones, 1995; DeGama y Fedigan, 2006). Aún cuando los individuos de estas especies presentan una gran plasticidad ecológica, la fragmentación de su hábitat los hace vulnerables al parasitismo y enfermedades, depredación y depresión genética (Bicca-Marques, 2003). Por esta razón, se ha sugerido que las estrategias de conservación de los primates en esta región de la RBLT, deberán estar encaminadas a aumentar la conectividad en el paisaje (Rodríguez-Toledo *et al.,* 2003); probablemente mediante cercas vivas y cultivos agroforestales, puesto que ambos han sido reportados como utilizados por estas especies (Estrada y Coates-Estrada, 1996; Shedden, 2007). Asimismo, este análisis revela las variaciones poblacionales de los primates en correspondencia al proceso de fragmentación del hábitat, resultante de las actividades antrópicas sobre el territorio. Dada la compleja dinámica en la apropiación territorial y uso de suelo de los asentamientos humanos en la zona, se sugiere analizar la problemática desde un enfoque multidisciplinario para proponer soluciones integrales, con mayores probabilidades de éxito (Rodríguez-Luna *et al.,* 2009).

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Referencias

Arriaga, L., Espinoza, J. M., Aguilar, C., Martínez, E., Gómez L. y Loa, E. 2000. *Regiones terrestres prioritarias de México*. Comisión Nacional para el Conocimiento y uso de la Biodiversidad, México.

Arroyo Rodríguez, V. y Mandujano S. 2006. Forest fragmentation modifies habitat quality for *Alouatta palliata. Int. J. Primatol.* 27(4): 1080–1096.

Bicca-Marques, J. C. 2003. How do howler monkeys cope with habitat fragmentation? En: *Primates in fragments, ecology and conservation.* L. K. Marsh (ed.), pp.283–303. Kluwer Academy/Plenum Publishers.

Campbell, C. J. 2003. Female-directed aggression in free-ranging *Ateles geoffroyi. Int. J. Primatol.* 24(2): 164–291.

Chapman, C. A. y Balcomb, S. R. 1998. Population characteristics of howlers: ecological conditions or group history. *Int. J. Primatol.* 19(3): 385–403.

Clarke, M. R., Crockett, C. M., Zucker, E. L. y Zaldivar, M. 2002. Mantled howler population of Hacienda La Pacifica, Costa Rica, between 1991 and 1998: Effects of deforestation. *Am. J. Primatol.* 56(3): 155–163.

CONANP. 2006. *Programa de Conservación y Manejo, Reserva de la Biosfera Los Tuxtlas*. Secretaría del Medio Ambiente y Recursos Naturales. México.

Cristóbal-Azkarate, J., Vea, J. J., Asensio, N. y Rodríguez-Luna, E. 2005. Biogeographical and floristic predictors of the absence and abundance of mantled howlers (*Alouatta palliata mexicana)* in rainforest fragments at Los Tuxtlas, Mexico. *Am. J. Primatol.* 67: 209–222.

DeGama-Blanchet, H. N. y Fedigan, L. M. 2006. The effects of forest fragment age, isolation, size, habitat type and water availability on monkey density in tropical dry forest. En: *New perspectives in the study of Mesoamerican primates: Distribution, ecology, behavior and conservation*, A. Estrada, P. A. Garber, M. S. Pavelka y L. Luecke (eds.), pp.165–188. Springer, New York. USA.

Dirzo, R., Gonzales-Soriano, E. y Vogt, R. C. 1997. Introdución General. En: *Historia Natural de los Tuxtlas*, E. Gonzales-Soriano, R. Dirzo, y R. C. Vogt (eds.), pp.1–3. Universidad Nacional Autónoma de México.

Estrada, A. y Coates-Estrada, R. 1996. Tropical rain forest fragmentation and wild populations of primates at Los Tuxtlas, Mexico. *Int. J. Primatol.* 17(5): 759–782.

Freese, C. 1976. Censusing *Alouatta palliata, Ateles geoffroyi* and *Cebus capucinus* in the Costa Rican dry forest. En: *Neotropical primates, field studies and conservation. Proceedings of a symposium on the distribution and abundance of neotropical primates,* R. W. Thorington Jr. y P. G. Heltne (eds.), pp.6–9. National Academy of Science. Washington D.C.

García-Orduña F. 1996. Distribución y abundancia del mono aullador (*Alouatta palliata*) y el mono araña (*Ateles geoffroyi*) en fragmentos de selva del municipio de San Pedro Soteapan, Veracruz. Tesis de licenciatura, Universidad Veracruzana, Jalapa, Ver., México.

González, Z. A. y Mandujano, S. 2003. Uso de fragmentos por *Ateles geoffroyi* en el sureste de México. *Neotrop. Primates* 11(3): 172–175.

Izawa, K., Kimura, K. y Samper-Nieto, A. 1979. Grouping of the wild spider monkeys. *Primates* 27: 53–62.

Jones, C. B. 1995. Howler monkeys appear to be pre-adapted to cope with habitat fragmentation. *Endangered species* 12: 9–10.

Mandujano, S., Escobedo-Morales, L. A., Palacios-Silva, R., Arroyo-Rodrígez, V. y Rodríguez-Toledo, E. M. 2005. A metapopulation approach to conserving the howler monkey in highly fragmented landscape in Los Tuxtlas, México. En: *New perspectives in the study of Mesoamerican primates: Distribution, ecology, behavior and conservation,* A. Estrada, P. A. Garber, M. S. Pavelka y L. Luecke (eds.), pp.513–538. Springer, New York. USA.

Mandujano, S. y Escobedo, M. L. A. 2008. Population viability analysis of howler monkeys (*Alouatta palliata mexicana)* in a highly fragmented landscape in Los Tuxtlas, México. *Tropical Conservation Science* 1: 43–62

Milton, K. y Hopkins, M. E. 2005. Growth of a reintroduced spider monkey (*Ateles geoffroyi)* population on Barro Colorado island, Panama. En: *New perspectives in the study of Mesoamerican primates: Distribution, ecology, behavior and conservation,* A. Estrada, P. A. Garber, M. S. Pavelka y L. Luecke (eds.), pp.417–435. Springer, New York. USA.

Rodríguez-Luna, E., Fa J. F., García-Orduña, F., Silva-López, G. y Canales-Espinoza, D. 1987. Primate Conservation in Mexico. *Primate Conservation* 8: 114–118.

Rodríguez-Luna, E., Solórzano-García, B., Shedden, A., Rangel-Negrín, A., Dias, P.A.D., Cristóbal-Azkárate, J., Cortés-Ortiz, L., Dunn, J. C., Domingo-Balcells, C., Sánchez, S., Vea-Baró, J., Carrillo, L., Cornejo, J. 2009. *Taller de Conservación, Análisis y Manejo planificado para los primates mexicanos, 2006.* Universidad Veracruzana, México. IUCN/CBSG.

Rodríguez-Toledo, E. M. 2002. Propuesta sobre la conexión de fragmentos como alternativa para la conservación del mono aullador (*Alouatta palliata mexicana)* en un paisaje alterado en "Los Tuxtlas" Veracruz. Tesis de Maestría. Instituto de Ecología A.C. México.

Rodríguez-Toledo, E. M., Mandujano, S. y García-Orduña, F. 2003. Relationships between forest fragments and howler monkeys (*Alouatta palliata mexicana)* in southern Veracruz, Mexico. En: *Primates in fragments, ecology and conservation.* L. K. Marsh (ed.), pp.79–97. Kluwer Academy/Plenum Publishers.

SEMARNAT. 2002. NOM-059-SEMARNAT-2001. *Protección ambiental, especies nativas de México de flora y fauna silvestres. Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio. Lista de especies en riesgo*. SEMARNAT. Diario Oficial 6 de Marzo de 2002. México.

Shedden, G. A. C. 2007. Estrategias de adaptación ecológica que despliega un grupo de monos aulladores (*Alouatta palliata*) translocado a un fragmento de hábitat de uso intensivo para cultivos. Tesis de Maestría. Instituto de Neuroetología. Universidad Veracruzana, México.

Silva-López, G., García-Orduña, F. y Rodríguez-Luna, E. 1988. The status of *Ateles geoffroyi* and *Alouatta palliata* in a disturbed forest areas of Sierra de Santa Marta, Mexico. *Primate Conservation* 9: 53–61.

Solórzano-García, B. 2010. Influencia de los factores socioeconómicos y políticos en el estado de conservación de las poblaciones de primates y su hábitat (Sierra de Santa Marta, Reserva de Biosfera Los Tuxtlas). Tesis de Maestría. Centro de Investigaciones Tropicales. Universidad Veracruzana, México.

UICN. 2008a. IUCN Red list of threatened species. Cuarón, A. D., Morales, A., Shedden, A., Rodriguez-Luna, E. y de Grammont, P. C. 2008. *Ateles geoffroyi ssp. vellerosus*. Website: www.iucnredlist.org. Consultado el 12 de diciembre de 2008.

UICN. 2008b. IUCN Red list of threatened species. Cuarón, A.D., Morales, A., Shedden, A., Rodriguez-Luna, E. y de Grammont, P. C. 2008. *Alouatta palliata ssp. mexicana*. Website: www.iucnredlist.org. Consultado el 12 de diciembre de 2008.

Zucker, E. L. y Clarke, M. R. 2003. Longitudinal assessment of immature to adult ratios in two groups of Costa Rican *Alouatta palliata. Int. J. Primatol.* 24(1): 87–101.

GASTROINTESTINAL PARASITES OF OWL MONKEYS (*AOTUS AZARAI AZARAI*) IN THE ARGENTINEAN CHACO

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Abstract

In fragmented habitats, an increase in the proportion of available forest edge has been positively correlated to parasite richness. We evaluated how the presence of forest edge may affect parasite-host dynamics in a population of wild owl monkeys (*Aotus azarai azarai*) in an unlogged gallery forest in Formosa, Argentina. We collected 53 fecal samples from groups inhabiting edge territories (n = 7 groups, 33 samples) and groups inhabiting the interior of the forest (n = 3 groups, 15 samples). We compared the number of parasite species (richness) found between the two types of groups, as well as the frequency of samples with multiple infections (more than one parasite species in the sample) and the distribution of helminths on the forest floor between habitat types. The number of parasite species, the proportion of samples with multiple infections and the helminth distribution were not significantly different across the two habitat types.

Key words: Forest fragmentation; parasite richness; owl monkeys; gastrointestinal parasites; helminths; gallery forest.

Resumen

En hábitats fragmentados, un incremento en la proporción de borde de bosque ha sido correlacionado con la riqueza de parásitos. Evaluamos cómo la presencia de borde de bosque puede afectar la dinámica de parasite-hospedero en una población silvestre de monos de noche (*Aotus azarai azarai*) en un bosque de galería no perturbado en Formosa, Argentina. Colectamos 53 muestras de heces fecales de grupos que habitaban territorios en el borde del bosque (n = 7 grupos, 33 muestras) y grupos habitando al interior del bosque (n = 3 grupos, 15 muestras). Comparamos el número de especies de parásitos (riqueza) encontrado entre los dos tipos de grupos, así como la frecuencia de muestras con múltiples infecciones (más de una especie de parásito en la muestra) y la distribución de helmintos en le suelo del bosque entre tipos de hábitat. El número de especies de parásitos, la proporción de muestras con múltiples infecciones y la distribución de helmintos no fue significativamente diferente entre los dos tipos de hábitat.

Palabras clave: Fragmentación del bosque; riqueza de parásitos; monos de noche; parásitos gastrointestinales; helmintos; bosque de galería.

Introduction

The effects of logging or other anthropogenic alterations to the landscape that result in forest fragmentation have been linked to changes in host-parasite dynamics in primates (Chapman *et al.*, 2005; Gillespie & Chapman, 2005; Gillespie & Chapman, 2008). Studies of the effect of logging on African primates have shown changes in parasite richness (e.g. total number of parasite species), as well as parasite prevalence and host density (Chapman *et al.*, 2000, Gillespie *et al.*, 2005, Chapman *et al.*, 2006a). The process of forest fragmentation affects animal communities by reducing food availability, increasing host densities and increasing risk of pathogen transmission (Milton, 1996; Püttker *et al.*, 2006). To better understand the natural dynamics of parasite-host interactions in primates inhabiting fragmented forests it is useful to examine primate communities living in fragmented landscapes that are the result of natural processes. These studies can provide insights into the ability of animals to cope with their naturally changing environment and therefore their potential future reactions to human-induced fragmentation. The eastern Argentinean Chaco is a fragmented landscape consisting of a matrix of palm savannahs and wetlands dotted by forest islands and transected by gallery forests growing along rivers. Howler monkeys and owl monkeys live sympatrically throughout this fragmented landscape (Zunino *et al.*, 1985; Brown & Zunino, 1994; Zunino *et al.*, 2001).

Owl monkeys are medium-sized monogamous primates that live in small social groups (2–6 individuals) composed of a reproductive pair and their offspring (Fernandez-Duque, 2001). They are omnivores and forage for a variety of fruit, leaves, invertebrates and, occasionally, vertebrates (Fernandez-Duque, 2007). Taxonomists currently recognize at least eight owl monkey species, in a genus that is widely distributed from Panamá to northern Argentina (Hershkovitz, 1983; Ford, 1994). The southernmost species *Aotus azarai* is found near the Paraguayan and Argentinean borders and it is unique within the genus because of its cathemeral habits. *Aotus azarai* displays a lapse of activity during the day that varies in length and time depending on moon phase and temperature (Fernandez-Duque, 2003; Fernandez-Duque & Erkert, 2006). In the Eastern Chaco, the species is regularly found in gallery forests adjacent to rivers, as well as forest islands that are surrounded by grasslands. The territories of owl monkey groups have either an edge with the grassland and/or river, or have no edge because they are adjacent to other owl monkey territories. All territories overlap with neighboring territories.

The owl monkey population of the Guaycolec Ranch in the eastern Argentinean Chaco has been studied since 1997. The existing information from groups holding territories with and without edge does not suggest any profound differences in demography or behavior (Fernandez-Duque *et al.*, 2001). Although there have been some reports of gastrointestinal parasites infecting owl monkeys (Diaz-Ungria, 1965; Thatcher & Porter, 1968; Wolff, 1990; Michaud *et al.*, 2003; Phillips *et al.*, 2004), we currently have no information on the gastrointestinal parasites found in *A. azarai* from northern Argentina. We also do not know whether the edge and non-edge groups differ in the nature of their interactions with parasites.

The main goal of our study was to describe the gastrointestinal parasites found in the Guaycolec owl monkey population, and to determine if there is a difference in the host-parasite interactions between edge and non-edge territories. Given that owl monkeys live in a naturally fragmented forest where the increase or appearance of edges in the forest has been the result of a slow natural process, we hypothesize that the monkey population may have adapted accordingly. Therefore, we predict no differences in the parasitology of edge and non-edge territories. To test our prediction, we compared the total number of parasite species in each habitat, and the proportion of individuals with multiple infections (i. e. more than one parasite species per sample) between the two habitat types; parameters that have been related to mortality and morbidity of primate populations and linked to compromised nutritional status (Chapman *et al.*, 2006b). We also compared the overall distribution of helminth parasites on the forest floor using soil samples in order to test for any differences between habitat types (Gillespie *et al.*, 2005).

Methods

Area of study and subjects

The area of study is part of an undisturbed section of the ranch Estancia Guaycolec (58°11' W, 25°58' S). The Estancia Guaycolec is a 25,000-hectare cattle ranch located in the Argentinean Gran Chaco. The forest is highly seasonal with fluctuating rainfall, temperature, photoperiod, and food availability (Fernandez-Duque *et al.*, 2002). Mean temperatures range from 16°C in the winter months (May-August) to 27°C during the summer months (December-March) (Fernandez-Duque *et al.*, 2002). This forest is characterized by starkly contrasting edge habitats formed at the boundaries of forest with grasslands and the surrounding river (Fig. 1). Owl monkeys residing within this forest have been studied extensively since 1996, which facilitated the identification and location of the different owl monkey groups.

Fecal sample collection

We collected fecal samples both from individuals in social groups and from solitary individuals. During July-August 2007, we collected weekly samples from individuals within social groups and from solitary individuals opportunistically as we encountered them in the forest. These solitary individuals may travel across various territories containing or lacking edges, therefore their samples could not be used for comparisons between habitats. If the identity of the individual providing the sample was unknown, only the group identity was recorded. Otherwise, the sex, age and group composition were noted. In a few cases the identity of the individual defecating was not determined which might have led to a sampling bias of some individuals and potential pseudoreplication. Comparisons were done with and without considering the samples from unknown individuals.

Figure 1. Area of study and sampled territories. White and black circles delineate edge and non-edge territories respectively.

To evaluate the potential relationship between parasite richness and forest structure we collected samples from individuals living in edge (n = 7 groups) and non-edge groups (n = 3), as well as soil samples from the corresponding territories (n = 5 edge, n = 2 non-edge). We defined an edge territory as a territory immediately or partially adjacent to the grasslands and/or the river boundaries. A non-edge territory on the other hand, is only adjacent to other owl monkey territories.

We collected fecal samples immediately after defecation and preserved them in 10% formalin. We gathered qualitative information about the fecal sample (e.g. color, consistency) at the time of collection. The fecal samples were processed using flotation and sedimentation techniques (Sloss *et al.*, 2004) at the Parasitology Laboratory in the National University of the Northeast (UNNE) in Corrientes, Argentina. Each sample was evaluated for presence or absence of parasites based on morphological characteristics. Color, size and shape of ova, cysts, larvae or adult parasites were some of the parameters used to identify each parasite species. In cases where multiple samples from the same individual were collected, parasitic diversity was compared among samples to determine any possible intra-specific variation. Soil samples were collected using V-shaped transects and analyzed immediately for helminth larvae and ova using both sedimentation and flotation techniques (Sievers *et al.*, 2007).

Data analyses

We used the following three parameters to evaluate potential differences between edge and non-edge territories; 1) mean number of parasite species (i.e. parasite diversity, Mann-Whitney U test), 2) number of samples with multiple parasitic infections (i.e. more than one gastro-intestinal parasite found, Chi-square test) and 3) number of soil samples containing helminths (Chi-square test).

Results

We collected and processed 32 fecal samples from 23 individuals and 16 samples from several unidentifiable individuals from 10 social groups. We also collected five fecal samples from five solitary individuals. The majority of the samples (92%, n = 49) contained parasites and more than half of them (60%, n = 32) had multiple infections. When the samples from unknown individuals were excluded from the analyses the percentages did not change markedly: 94% of samples contained parasites and 58% of them had multiple infections. Five of the 7 individuals sampled more than once showed intra-specific variation in parasitic diversity with a tendency to higher parasitic diversity in early winter. The parasite diversity consisted of four helminth and six protozoan species (Table 1). Diversity was different between social groups and solitary individuals. Fecal samples collected from social groups presented all four helminths and protozoa species, whereas samples from solitary individuals did not contain any *Uncinaria* sp, *Blastocystis sp* and *Taenia* sp. This apparent difference may be a result of the uneven sampling of social and solitary individuals.

There were some qualitative differences in the parasite species found in 15 samples from individuals living in edge territories (n = 9 individuals from n = 7 territories) and in 33 samples from non-edge ones (n = 14 individuals from n = 3 territories). *Entamoeba* sp was only associated with edge territories, whereas *Taenia* sp and the unidentified amoeba were found only in samples from individuals living in non-edge territories. The mean number of parasite species in edge and non-edge groups did not differ significantly ($U = 215$, $n_1 = 7$, $n_2 = 3$, $z = -0.75$, $p = 0.45$) and the lack of statistical difference persisted when we excluded samples from unknown individuals ($U = 124$, $p = 0.94$). Qualitative differences of parasite diversity also remained unchanged after excluding samples from unknown individuals.

Table 1. Parasite count and percentage of samples containing each parasite species.

Parasite	Social/edge	Social/non-edge	Solitary	Total samples (percent)
Strongyloides sp.	6	9	1	16 (30%)
Uncinaria sp.	8	1	0	9 (17%)
Taenia sp.	1	0	0	1 (2%)
Trypanoxyrious sp.	5	6	1	12 (23%)
Entamoeba sp.	0	11	1	12 (23%)
Blastocystis sp.	2	12	0	14 (26%)
Isospora sp.	7	14	3	24 (45%)
Giarda sp.	1	2	1	4 (8%)
Endolimax nana	3	7	2	12 (23%)
Unspecified amoeba	1	0	1	2 (4%)
Total (number of samples)	34	62	10	106

Edge and non-edge territories did not differ significantly in the presence of parasite species per sample nor in the number of samples with multiple infections. More than half of the samples collected from edge and non-edge territories had multiple infections (60% and 58% respectively; $\chi 2 = 0.25$, df = 1, $P = 0.565$). These comparisons remained unchanged when "Unknown" samples were excluded (62% and 50% respectively; $\chi 2 = 0.43$, df = 1, $P = 0.512$). The percentage of soil samples with helminths was not different in edge (36%, n = 15) and non-edge territories (27%, n = 8) ($\chi 2 = 0.039$, df = 1, $P > 0.843$).

Discussion

This is the first report on the gastrointestinal parasites of free-ranging *Aotus azarai* from Formosa, Argentina. The study includes data on parasites already described for *Aotus* such as *Strongyloides* sp, *Giardia* sp, *Trypanoxyrious* sp., *Entamoeba* sp, *Endolimax nana*, *Isospora* sp (Tantalean & Gozalo, 1994), and the first report for *Blastocystis* sp. As predicted our data did not show any marked quantitative differences between edge and non-edge territories in the number of parasite species found. This result could be due to a relatively small sample size, but it is also possible that the dramatic variation in rainfall characteristic of the region that regularly leads to the flooding of sections of the forest far from the river may reduce differences between the two habitats we compared.

The parasite richness in the population was relatively high when compared with other primates of similar size. A survey of the gastrointestinal parasites of six primate species of Tambopata National Park in Perú showed that medium to small-sized primates (*Callicebus brunneus, Cebus albifrons, Cebus apella, Saguinus fuscicollis*, *Saimiri sciureus*, and *Aotus vociferans*) had a maximum of 5 parasite species (Phillips *et al*., 2004). A similar study of the sympatric howler monkeys (*Alouatta caraya*) found that this gregarious species living in a series of highly fragmented and continuous gallery forests had lower parasite richness (Santa Cruz *et al*., 2000) than the one we report here for owl monkeys. Howler monkeys are larger than owl monkeys and live in large multi-male multi-female groups. It is possible that howlers experience a higher parasitic diversity because they provide a larger variety of niches for parasites and they have a higher risk of transmission and infection due to their sociality (Kuris *et al*., 1980; Moller *et al*., 1993; Altizer *et al*., 2003). It has been proposed that leaf-eating primates, such as howler monkeys, may experience a higher parasitic diversity because the large volumes of plant matter ingested contain infective-stage pathogens (Vitone *et al*., 2004).

To date, most studies that have examined the relationships between host body mass, host sociality and parasite diversity have yielded conflicting results because of the complex effects of phylogeny in these interactions (Arneberg *et al*., 1998; Morand & Poulin, 1998; Nunn *et al*., 2003; Cote & Poulin, 1995). In the future, further sampling of additional groups in the population, of other populations in the region and of other sympatric mammals in the area will contribute to better understand the possible sources of relatively high parasite diversity in owl monkeys.

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References

Altizer, S., Nunn, C. L., Thrall, P. H., Gittleman, J. L., Antonovics, J., Cunningham, A. A., Dobson, A. P., Ezenwa, V., Jones, K. E., Pedersen, A. B., Poss, M., and Pulliam, J. R. C. 2003. Social organization and parasite risk in mammals: Integrating theory and empirical studies. *Annu. Rev. Ecol. Evol. S.* 34: 517–547.

Arneberg, P., Skorping, A., Grenfell, B., and Read, A. F. 1998. Host densities as determinants of abundance in parasite communities. *P. R. Soc. Lon. B. Bio.* 265: 1283–1289.

Brown, A. D., and Zunino, G. E. 1994. Hábitat, distribución y problemas de conservación de los primates de la Argentina. *Vida Silvestre Neotropical* 3:30–40.

Chapman, C. A., Gillespie, T. R., and Goldberg, T. L. 2005. Primates and the ecology of their infectious diseases: How will anthropogenic change affect host-parasite interactions? *Evol. Anthrop.* 14: 134–144.

Chapman, C. A., Balcomb, S. R., Gillespie, T. R., Skorupa, J. P., and Struhsaker, T. T. 2000. Long-term effects of logging on African primate communities: a 28-year comparison from Kibale National Park, Uganda. *Conserv. Biol.*14: 207–217.

Chapman, C. A., Speirs, M. L., Gillespie, T. R., Holland, T., and Austad, K. M. 2006a. Life on the edge: Gastrointestinal parasites from the forest edge and interior primate groups. *Am. J. Primatol.* 68: 397–409.

Chapman, C. A., Wasserman, M. D., Gillespie, T. R., Speirs, M. L., Lawes, M. J., Saj, T. L., and Zeigler, T. E. 2006b. Do food availability, parasitism, and stress have synergistic effects on red colobus populations living in forest fragments? *Am.J. Phys.Anthropol.* 131: 525–534.

Cote, I. M., and Poulin, R. 1995. Parasitism and group size in social animals: A meta-analysis. *Behav. Ecol.* 6: 159–162.

Diaz-Ungria, C. 1965. Nematodes de primates Venezolanos. *Boletín de la Sociedad Venezolana de Ciencias Naturales* 25: 393–398.

Fernandez-Duque, E. 2003. Influences of moonlight, ambient temperature and food availability on the diurnal and nocturnal activity of owl monkeys (*Aotus azarai*). *Behav.Ecol. Sociobiol.*54: 431–440.

Fernandez-Duque, E. 2007. *Aotinae*: Social monogamy in the only nocturnal haplorhines. In: *Primates in Perspective,* C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger, and S. K. Bearder (eds.), pp 139–154. New York, Oxford Univ Press.

Fernandez-Duque, E., and Erkert, H. 2006. Cathemerality and lunar periodicity of activity rhythms in owl monkeys of the Argentinian Chaco. *Folia Primatol.* 77: 123–138.

Fernandez-Duque, E., Rotundo, M., and Sloan, C. 2001. Density and population structure of owl monkeys (*Aotus azarai*) in the Argentinean Chaco. *Am. J. Primatol.* 53: 99–108.

Fernandez-Duque, E., Rotundo, M., and Ramirez-Llorenz, P. 2002. Environmental determinants of birth seasonality in night monkeys (*Aotus azarai*) of the Argentinean Chaco. *Int. J. Primatol.* 23: 639–656.

Ford, S. M. 1994. Taxonomy and distribution of the owl monkey. In *Aotus: The Owl Monkey,* J. F. Baer, R. E. Weller, and I. Kakoma (eds.), pp 1–57. San Diego, Academic Press.

Gillespie, T. R., and Chapman, C. A. 2005. Prediction of parasite infection dynamics in primate metapopulations based on attributes of forest fragmentation. *Cons. Biol.* 20: 441–448.

Gillespie, T. R., and Chapman, C. A. 2008. Forest fragmentation, the decline of an endangered primate, and changes in host-parasite interaction relative to an unfragmented forest. *Am.J. Primatol.* 70: 22–230.

Gillespie, T. R., Chapman, C. A., and Greiner, E. C. 2005. Effects of logging in gastrointestinal parasite infection and infection risk in African primates. *J. Appl. Ecol.* 42: 699–707.

Hershkovitz, P. 1983. Two new species of night monkeys, genus *Aotus* (Cebidae, Primates): A preliminary report on *Aotus* taxonomy. *Am. J. Primatol.* 4: 209–243.

Kuris, A. M., Blaustein, A. R., and Alio, J. J. 1980. Hosts as islands. *Am. Nat.* 116: 570–586.

Michaud, C., Tantalean, M., Ique, C., Montoya, E., and Gozalo, A. 2003. A survey for helminth parasites in feral New World non-human primate populations and its comparison with parasitological data from man in the region. *J. Med. Primatol.* 32: 341–345.

Milton, K. 1996. Effects of bot fly (*Alouattamyia baeri*) parasitism on a free-ranging howler (*Alouatta palliata*) population in Panama. *J. of Zool.* 239: 39–63.

Moller, A. P., Dufva, R. and, Allender, K. 1993. Parasites and the evolution of host social behavior. *Adv. Stud. Behav.* 22:65–102.

Morand, S., and Poulin, R. 1998. Density, body mass and parasite species richness of terrestrial mammals. *Evol. Ecol.*12: 717–727.

Nunn, C. L., Altizer, S., Jones, K. E., and Sechrest, W. 2003. Comparative tests of parasite richness in primates. *Am. Nat.* 162: 597–614.

Phillips, K. A., Haas, M. E., Grafton, B. W., and Yrivarren, M. 2004. Survey of the gastrointestinal parasites of the primate community at Tambopata National Reserve, Perú. *J. of Zool.*264: 149–151.

Püttker, T., Meyer-Lucht, Y., and Sommer, S. 2006. Effects of fragmentation on parasite burden (nematodes) of generalist and specialist small mammal species in secondary forest fragments of the coastal Atlantic forest, Brazil. *Ecol Res* 23: 207–215.

Santa-Cruz, A. C. M., Toribio-Borda, J., Patiño, E. M., Gomez, L., and Zunino, G. E. 2000. Habitat fragmentation and parasitism in howler monkeys (*Alouatta caraya*). *Neotrop. Primates* 8:146–148.

Sievers, G., Amenabar, A., and Gadicke, P. 2007. Comparación de cuatro sistemas de muestreo de tierra para determinar contaminación de áreas con huevos de *Toxocara canis. Parasitología Latinoamericana* 62: 67–71.

Sloss, M. W., Kemp, R. L., and Zajac, A. M. 1994. *Veterinary clinical parasitology*. Ames, Iowa State University Press.

Tantalean, M., Gozalo, A. 1994. Parasites of the *Aotus* monkey. In *Aotus: The Owl Monkey,* J. F. Baer, R. E. Weller, and I. Kakoma (eds.), pp 354–373. San Diego, Academic Press.

Thatcher, V. E., and Porter, J. A. 1968. Some helminth parasites of Panamanian primates. *T. Am. Microsc. Soc.* 87: 186–196.

Vitone, N.D., Altizer, S., and Nunn, C. L. 2004. Body size, diet and sociality influence the species richness of parasitic worms in anthropoid primates. *Evol. Ecol.. Res.* 6: 183–199.

Wolff, P. L. 1990. Parasites of new world Primates: A review. *P. Am.Assoc. Zoo Vet.*: 87–94.

Zunino, G. E., Galliari, C. A., and Colillas, O. J. 1985. Distribución y conservación del mirikina (*Aotus azarae*), en Argentina: resultados preliminares. *A Primatologia no Brasil* 2: 305–316.

Zunino, G. E., Gonzalez, V., Kowalewski, M., and Bravo, S. P. 2001. *Alouatta caraya*: Relations among habitat, density and social organization. *Primate Report* 61: 37–46.

DEMOGRAPHY AND CONSERVATION STATUS FOR THE CRITICALLY ENDANGERED MEXICAN HOWLER MONKEY (*ALOUATTA PALLIATA MEXICANA*) IN THE SOUTHERN PART OF LOS TUXTLAS BIOSPHERE RESERVE, VERACRUZ, MEXICO

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Abstract

The conservation status of the Mexican howler monkey in core zone III of Los Tuxtlas Biosphere Reserve, Veracruz, Mexico, is uncertain. Here, we provide the first set of demographic data of *Alouatta palliata mexicana* in the southern sector of the core zone III by using two different methods: line transect and sweep census. A total of twenty-six individuals divided in 6 groups were registered inhabiting the continuous forest, with a mean group size of 4 (± 0.5) individuals and a range of 3 to 6 individuals. The density of the animals for the study site was 0.04 howler monkeys/ha. Conversely, no individuals were found in any of the fragments surveyed within the buffer zone. Overall, field research showed a much lower density than was expected, suggesting historical and/or contemporary factors may be directly and/or indirectly affecting the persistence of the howlers in the area. New studies focused on the environmental changes caused by natural or anthropogenic factors will be of great aid in future management interventions and viability assessments of the population.

Key words: *Alouatta palliata mexicana*, Tropical rain forest, Demography, Veracruz, Mexico.

Resumen

El estatus de conservación del mono aullador Mexicano en la zona núcleo III de la Reserva de Biosfera Los Tuxtlas es incierto. En apariencia, el área presenta condiciones suficientes para albergar una población robusta de monos aulladores dado su estatus de protección, no obstante no existe investigación de campo para validar esta suposición. Aquí, nosotros proporcionamos el primer compendio de datos demográficos para *Alouatta palliata mexicana* en el sector sur de la zona núcleo III utilizando dos métodos: transecto lineal y censo de barrido. Así, un total de 26 individuos divididos en 6 grupos fueron registrados en el continuo de selva con una media de tamaño grupal de 4 (± 0.5) individuos y un rango de 3 a 6. La densidad de animales para el área de estudio fue de 0.04 aulladores/ha. Al contrario de lo observado en el continuo, ninguno de los fragmentos de la zona buffer fue encontrado habitado por aulladores. En general, la investigación de campo demostró una densidad mucho menor a la esperada lo cual sugiere que factores históricos y/o contemporáneos pueden estar afectando directa o indirectamente la persistencia de los aulladores en el área. Estudios centrados en cambios ambientales causados por factores naturales o antropogénicos serán de gran ayuda en futuras acciones de manejo y análisis de viabilidad de la población.

Palabras Clave: *Alouatta palliata mexicana*, Bosque tropical lluvioso, Demografía, Veracruz, México.

Introduction

The Mexican howler monkey (*Alouatta palliata mexicana*) is a Neotropical primate that occurs from southern Mexico to Guatemala. In Mexico, Los Tuxtlas Biosphere Reserve is one of the largest areas where populations of this subspecies occur. In this protected area, several studies have been carried out concerning the distribution and conservation status of primate populations (Estrada 1982; Rodríguez-Luna 1992; García-Orduña 1996; Canales-Espinosa and García-Orduña 2001; Silva-López and Portilla-Ochoa 2002; Cristóbal-Azkárate et al 2005; Mandujano and Escobedo-Morales 2008). However, there are still areas within the reserve without information on demographic structure, habitat quality and areas of occupancy of these species. In order to contribute to filling in these gaps concerning *A. p. mexicana* status in the tropical region of Los Tuxtlas, here we provide the first set of demographic data for howlers inhabiting the southernmost sector of core zone III within Los Tuxtlas Biosphere Reserve in Veracruz, Mexico, and a discussion of the likely reasons of the current population features in the area.

Methods

Study area

This study was conducted in the southernmost point of the core zone III of the reserve, circumscribed within the municipality of Pajapan, Veracruz, Mexico (Fig. 1). A 1:50,000 topographic map (INEGI 1999) and a LANDSAT-TM image (NASA 2003) were used to define the polygon of the site. The sector corresponding to core zone III within Pajapan's territory that consists of tropical rain forest was digitized using the ArcMap application from ArcGIS program version 9.2. Finally, during the census period, each tropical rainforest fragment visited (each with different degrees of degradation/disturbance), was mapped and georeferenced. Spatial information was downloaded into MapSource program version 6.11.6 and then imported to ArcMap for further analysis.

Field protocol

Censuses were conducted in continuous forest and forest fragments during the months of May and June 2009. Initially, in order to determine howler monkey abundance and absolute density, we used the line transect census method which has been widely applied in surveys of primates and other mammal species (NRC 1981; Chapman et al 1988; Buckland and Turnock 1992; Peres 1999). This method assumes that all individuals on a transect are detected at their initial location. Moreover, distance measurements of each individual from the observer must be accurately recorded and sighting events must be large enough to estimate the absolute density (Buckland et al 2001; Thomas et al 2002). Second, a sweep census was carried out using pre-existing trails and traversing the entire forest in a more systematic survey, attempting to determine the howler monkeys' true abundance in the study site. Although the "sweep" serves to determine abundance, it does not consider any distance measurement and therefore does not provide data to estimate absolute density as with the line transect method (Thomas et al 2002). Alternatively, density can be calculated by taking the total number of individuals censused and dividing it by the total area surveyed, an approach that has shown to be effective in similar studies (Estrada 1982 and references therein). For the fragments in the sector within the buffer zone, the sweep census method was applied as well.

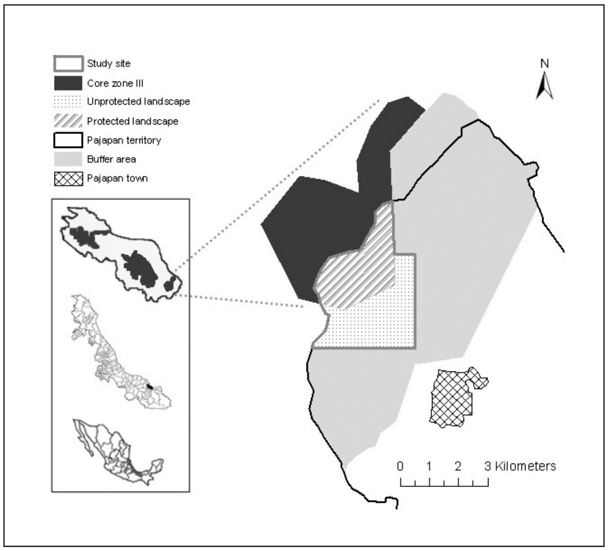

Figure 1. Study site within the municipality of Pajapan, which includes part of the protected (core zone III) and unprotected (buffer area) landscapes in the southern part of "Los Tuxtlas" Biosphere Reserve (illustrated at the top of the inner map) located in the state of Veracruz, Mexico.

Line transect census

Eight linear transects (±1 km long) were randomly selected within the study site (ranging from 300 to 500 m between them and from ± 500 m to ± 1,000 m above sea level). Although a minimum of ten is recommended (Buckland et al 2001), more survey lines within the study site could cause an overlapping of home ranges, compromising the accuracy of both the abundance calculation and the estimate of absolute density. During the first half of May researchers walked slowly along the transects twice a day from 0500 h to 1800 h, and stopped occasionally in order to detect any sign of howlers' activities (Peres 1999). When a group was detected, individuals were counted and classified as adults (large body size and fully developed genitalia), juveniles (individuals half the size of the adults independent of the mother) or infants (individuals carried by the mother) for further demographic analysis (NRC 1981). Number of males and females were registered for each class except infants. The, radial distance from the observer to each howler and the sighting angle of the observation from the transect line were also recorded (Buckland et al 2001). No more than 20–30 minutes were spent in counting the groups and acquiring demographic data. It was assumed that sighting events per transect were independent provided that vocalizations of the group previously detected were heard occasionally during the survey in the same or following transects. Additionally, particular body features were used to differentiate individuals of a particular group to help prevent counting the same individual twice.

Sweep census

In order to refine the findings of the line transect method and detect all the individuals within the study site, two entire weeks were spent in a sweep census with researchers walking along existing trails which overlapped at several points throughout the forest. In order to avoid traversing the same path twice and minimize bias in sighting events, the routes were delineated by marking stems and branches. When a group was detected, the same demographic data was registered as in the line transect method.

Census and mapping of forest cover in fragments

Within the study area, 24 fragments of tropical rain forest with different levels of degradation/disturbance/fragmentation were systematically surveyed. The surveys lasted from 0600 h to 1800 h every day for 2 weeks, with researchers walking through the interior of the fragments until the entire area was completely surveyed. In order to identify those fragments with potential to promote the flow of howlers in the landscape, positional data for each fragment was recorded to calculate fragment size, edge perimeter, shortest distance to the nearest fragment and shortest distance to the protected forest using the ArcMap application of ArcGIS version 9.2.

Results

Forest cover status

The study site has 1,192 ha and 16.3 km of perimeter (Fig. 2). A total of 25 fragments were mapped and surveyed covering 106.12 ha of tropical rain forest in various degrees of transformation. The largest fragment was considered to be a part of the core zone III with 620.2 ha and 25.4 km of perimeter. The remaining fragments varied in size from 8.8 ha to 0.1 ha with a mean of 1.77 ha. The shortest distance between fragments was 24 m and the largest 115 m. General characteristics of fragments are available by request to the authors.

Howlers' abundance

A total of 20 individuals from 5 groups were censused during the survey in the area corresponding to the core zone III by using the line transect census method. The 20 individuals included; 7 adult males, 9 adult females, 1 juvenile male, 2 juvenile females and 1 infant not sexed. The mean group size was 4 individuals with a range of 3–6 animals. Table I shows the age and sex composition for each of the groups censused.

The adult female-to-male ratio was 1.28:1 ($N_{\text{adult-females}} = 9$, $N_{\text{adult-males}} = 7$) and the juvenile female-to-male ratio was 2:1 ($N_{\text{juv-females}_s} = 2$, $N_{\text{juv-males}} = 1$). Overall sex-ratio female-to-male was 1.37:1 ($N_{\text{females}} = 11$, $N_{\text{males}} = 8$). Given the small number of individuals in the area, the estimate of absolute density as described by Buckland (2001) was not performed.

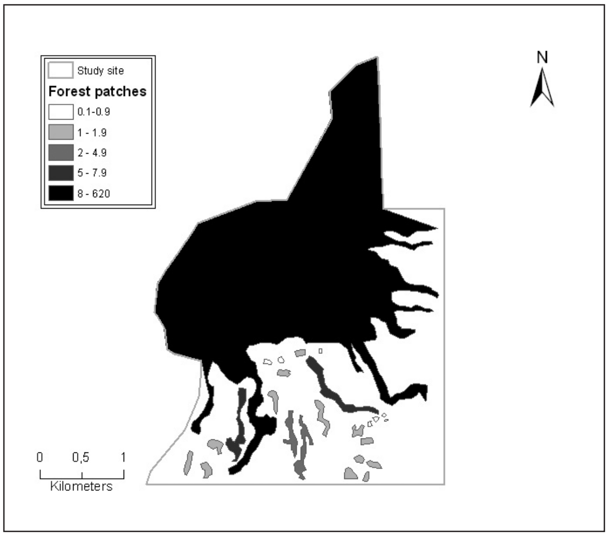

Figure 2. Forest distribution within the study area showing the range of vegetation cover in hectares.

Howlers' abundance using sweep census

The sweep census, which required two weeks of intensive field work, detected a total of 24 individuals divided in 6 groups, 5 of them previously detected by the line transect method provided that detections were near to the areas where previous groups were located, and their sex-stage classes were equal except for groups 2 and 5 (Table II) where a juvenile male and an adult female were missing but they were not found either migrating to another area, or dead. Based on the total area surveyed, the density of the animals for the study site was 0.04 howler monkeys/ha. Adult female-to-male ratio was 1.33:1 ($N_{\text{adult-females}} = 12$, $N_{\text{adult-males}} = 9$), however, due to absence of male juveniles, no juvenile female-to-male ratio is reported. The sex of the infant was not distinguished. Overall sex-ratio female-to-male was 1.33:1 ($N_{\text{females}} = 12$, $N_{\text{males}} = 9$).

Analysis in fragments

No howlers were detected during the sweep census in the fragments. However, historical incidence was obtained by interviewing local villagers owning the lands where the

Table I. Results of the line transect census in the portion of core zone III within the municipality of Pajapan, Veracruz, Mexico. Abbreviations of age-sex as follows: AM = Adult males; AF = Adult females; JM = Juvenile males; JF = Juvenile females; I = Infants; Sex ratio = Female to Male adults.

Group	AM	AF	JM	JF	I
1	1	1	0	1	0
2	2	3	1	0	0
3	1	2	0	1	0
4	2	1	0	0	1
5	1	2	0	0	0
Totals	7	9	1	2	1
Mean	1.4	1.8	0.2	0.4	0.2
±SD	0.54	0.83	0.44	0.54	0.44

Table II. Results of sweep census at the portion of core zone III within the municipality of Pajapan, Veracruz, Mexico. Abbreviations of age-sex as in Table 1; Statistics of the new group detected are highlighted in bold Individuals observed in the line transect but absent in the sweep census are highlighted within brackets.

Group	AM	AF	JM	JF	I
1	1	1	0	1	0
2	2	3	0 [1]	0	0
3	1	2	0	1	0
4	2	1	0	0	1
5	1	1 [1]	0	0	0
6	2	4	0	0	0
Totals	9	12	0	2	1
Mean	1.5	2.0	0.0	0.4	0.2

fragments are located (supplemental material available in request). Four fragments were reported to previously have been inhabited by howlers (Table III).

In the past, the main cause of forest clearance was to establish grazing lands. This activity often extended fires beyond small forest-cleared spots and resulted in the loss of habitat for many species (Durand and Lazos 2004). Nowadays, fieldworkers know that clearance of forested areas near the reserve can lead to criminal prosecution and therefore they minimize the effect of slash and burn practices within agricultural lands. This supports the claims that recent disappearance of howlers from fragments may be due at least to some extent, to natural fires or other stochastic phenomena that take place periodically in the region (Rodríguez-Luna et al 1996).

Discussion

Howlers' status in continuous forest

Results from the field research within the core zone III, circumscribed to Pajapan, revealed small groups of *A. p. mexicana* ranging from six to only three individuals with a mean group size and sex ratio less than the average reported in other sites of the reserve either with similar (Estrada 1982; Estrada and Coates-Estrada 1996) or different degree of habitat quality (Cristóbal-Azkárate et al 2005) (Table IV). In order to determine abundance in the study two different techniques were carried out: linear transect and sweep census. Although the former was used to estimate abundance by linear sampling only, the latter attempted to count all the individuals present within the study area. The combination of both techniques should provide a robust overview of the demographic numbers and it is unlikely that the small number of individuals reported may be attributed to sampling error. However, the sweep census for the entire core zone III was expected to generate a larger number of howlers: given the protected and well conserved habitat within the reserve, there does not appear to be any impediment to host a larger population. As with other primate populations, the small numbers may be due to historical and contemporary factors working synergistically (Rodríguez-Luna et al 1987; Anderson et al 2007; Struhsaker 2008). Some potential factors are suggested below.

According to field workers of Pajapan, there are individuals from other towns that sporadically visit the reserve in search of white-tailed deer (*Odocoileus virginianus*), armadillo (*Dasypus novemcinctus*) and paca (*Agouti paca*); howler and spider monkeys may be hunted opportunistically in these cases. In addition field workers argued that they have never seen a forest guard patrolling the area while working in their parcels near the forest. During our own study, we never observed any guard patrols, which, together with the empty shotgun cartridges that were found discarded far into the forest, suggests a potential hunting threat in the area.

A less likely cause for the low abundance may be food scarcity. Although howlers show preference for some tree species (Estrada 1984; Silva-López 1987; Jímenez-Huerta 1992), they can feed from a wide variety of fruits, leaves and flowers from alternative species due to their flexible diet (Rodríguez-Luna et al 1995; Gómez-Marín et al

Table III. Forest fragments reported as occupied by howler monkeys in the last 20 years.

Fragment ID	Area (Ha)	No. of howlers	Last date seen alive	Cause of disappearance	Current threats
15	2.4	4	8 years	Natural forest fire causing the death of the howlers	Firewood collection
24	8.8	5	5 years	Natural forest fire causing howlers' migration to the continuous	Firewood collection and selective logging
5	1.2	1	20 years	Provoked forest fire by uncontrolled slash and burn agriculture practices	Firewood collection
13	1.8	1	20 years	Provoked forest fire by uncontrolled slash and burn agriculture practices	Firewood collection

Table IV. Demographic data of populations of *A. p. mexicana* censused at different sites within the core zones of Los Tuxtlas Biosphere Reserve.

	Estrada 1982	Estrada and Coates- Estrada 1996	Cristóbal - Azkárate et al 2005	This study 2009
	Core zone I	Core zone I-II	Core zone I	Core zone III
Mean group size	9.12	14.62	7.09	4.00
Population density (ha)	0.23	0.52	1.33	0.043
Sex ratio	1.37	2.34	1.47	1.33

2001; Cristóbal-Azkárate and Arroyo-Rodríguez 2007). In consequence, variety, density, quality and availability of either kind of resources may influence howlers' population growth. Although the analysis of food availability was beyond the scope of this study, it is very unlikely that a large and presumably undisturbed habitat was unable to provide an adequate source of food. However, assuming scarcity of resources, in theory there should be individuals or groups migrating in search of food from the study site to the north part of the reserve. Further research on the distribution, abundance and availability of food resources within the core zone III may clarify this.

A third explanation may come from the history of the area. Los Tuxtlas was declared as a natural protected area in 1998, while the first records of intensive human colonization in the region originate in the late 1960's and early 1970's (Durand and Lazos 2004). Moreover, Lazos and Paré (2006) as part of compilation of historical transformation processes within Pajapan and the adjacent municipality Tatahuicapan, reported encounters of villagers with primates as early as 1930 and a reduction of primate abundance due to primates being utilized as food resource. Unfortunately this study did not provide rates at which the animals were persecuted for this use.

Fragments' status
Although previous surveys have found individuals in forest fragments in the buffer zone in the northern part of the San Martín Pajapan Volcano (Solórzano 2010), no howlers were detected in any fragment within the buffer zone around Pajapan, the southernmost point of the reserve: this was true regardless of fragment size, fragment shape or current conservation status. Nevertheless, a dataset with the profiles of forest fragments was built to facilitate further investigation and management actions.

Summary and conclusions
Results of the census indicated a very low abundance of howler monkeys in the area despite its apparently well-conserved status; in fact, no howlers inhabit the various fragments within the buffer zone. Before any attempt is made to promote fragment occupancy by howlers, it is imperative to take actions towards determining those landscape attributes that act as constraints on the howlers' persistence. Probably, the current groups are a remnant of a once robust population. Although findings reported here are insufficient to prove this, further research on natural and anthropogenic changes in the area as well as historical howlers' occupancy will help to reveal both patterns of habitat transformation and howlers' population trends. This would be of great importance in developing viability assessments and in turn, management plans to guarantee the persistence of howlers for the future. Otherwise, fragments will continue to be reduced and the fate of the howlers will remain uncertain.

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References

Anderson, J., Cowlishaw, G. and Rowcliffe, J.M. 2007. Effects of forest fragmentation on the abundance of *Colobus angolensis palliatus in Kenya's coastal forests. Int. J. Primatol.* 28(3): 637–655.

Buckland, S.T. and Turnock, B.J. 1992. A robust line transect method. *Biometrics.* 48:901–909.

Buckland, S.T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borhchers, D. L. and Thomas, L. 2001. *Introduction to distance sampling. Estimating abundance of biological populations.* Oxford University Press. New York.

Canales-Espinosa, D. and García-Orduña, F. 2001. Some parameters indicative of health in populations of *Alouatta palliata mexicana* (mantled howler monkey), living in segments of original vegetation in Los Tuxtlas, Veracruz. I Congreso Mexicano de Primatología. Merida Yucatán.

Chapman, C. A., Fedigan, L. M. and Fedigan, L. 1988. A comparison of transect methods of estimating population densities of Costa Rican primates. *Brenesia.* 30: 67–80.

Cristóbal-Azkárate, J., Vea, J. J., Asensio, N. and Rodríguez-Luna, E. 2005. Biogeographical and floristic predictors of the presence and abundance of mantled howlers (*Alouatta palliata mexicana*) in rain forest fragments at Los Tuxtlas, Mexico. *Am. J. Primatol.* 67: 209–222.

Cristóbal-Azkárate, J. and Arroyo-Rodríguez, V. 2007. Diet and activity pattern of howler monkeys (*Alouatta palliata*) in Los Tuxtlas, Mexico: effects of habitat fragmentation and implications for conservation. *Am. J. Primatol.* 69(9): 1013–1029.

Durand, L. and Lazos, E. 2004. Colonization and tropical deforestation in the Sierra Santa Martha, Southern Mexico. *Environ. Conserv.* 31(1): 11–21.

Estrada, A. 1982. Survey and census of howler monkeys (*Alouatta palliata*) in the rain forest of Los Tuxtlas, Veracruz, Mexico. *Am. J. Primatol.* 2: 363–372.

Estrada A. 1984. Resource use by howler monkeys (*Alouatta palliata*) in the rain forest of Los Tuxtlas, Veracruz, Mexico. *Int. J. Primatol.* 5(2): 105–131.

Estrada A. and Coates-Estrada, R. 1996. Tropical rain forest fragmentation and wild populations of Primates at Los Tuxtlas, Mexico. *Int. J. Primatol.* 17(5): 759–783.

Gómez-Marín, F., Vea, J.J., Rodríguez-Luna, E., García-Orduña, F., Canales-Espinosa, D., Escobar, M. and Asensio, N. 2001. Food resources and the survival of a group of howler monkeys (*Alouatta palliata mexicana*) in disturbed and restricted habitat at Los Tuxtlas, Veracruz, Mexico. *Neotrop. Primates*. 9(2): 60–67.

Instituto Nacional de Estadística, Geografía e Informática (INEGI). 1999. Carta topográfica San Juan Volador. E15 A74. Veracruz, México.

Jímenez-Huerta, J. 1992. Distribución y abundancia de los recursos alimenticios en un fragmento de selva alta perennifolia y su uso por *Ateles* y *Alouatta* en el ejido Magallanes (Municipio de Soteapan, Veracruz). Tesis de licenciatura. Universidad Veracruzana. México.

Lazos, E. and Paré, L. 2006. *Miradas indígenas sobre una naturaleza entristecida. Percepciones del deterioro ambiental entre nahuas del sur de Veracruz*. Universidad Nacional Autónoma de México. (UNAM). México.

Mandujano, S. and Escobedo-Morales, L. A. 2008. Population viability analysis of howler monkeys (*Alouatta palliata mexicana*) in a highly fragmented landscape in Los Tuxtlas, Mexico. *Trop. Conserv. Sci*. 1: 43–62.

NASA Landsat Program. 2003. Landsat ETM+ scene L71008058_05820031026, SLC-Off, USGS, Sioux Falls, 10/26/2003.

National Research Council 1981. *Techniques for the study of primate population ecology*. National Academy Press: Washington.

García-Orduña, F. 1996. Distribución y abundancia del mono aullador (*Alouatta palliata*) de el mono araña (*Ateles geoffroyi*) en fragmentos de selva del municipio de San Pedro Soteapan, Veracruz. Tesis de Licenciatura, Universidad Veracruzana, Xalapa, Veracruz, México.

Peres, C. A. 1999. General guidelines for standardizing line-transect surveys of tropical forest primates. *Neotrop. Primates*. 7(1): 11–16.

Rodríguez-Luna, E., García-Orduña, F. and Canales-Espinoza, D. 1987. Primate Conservation in Mexico. *Primate Conserv.* (8): 114–118.

Rodríguez-Luna, E. 1992. Regional plan for the conservation of primates in Mexico. In: XIV Congress of the International Primatological Society. Strasbourg.

Rodríguez-Luna, E., Cortés-Ortiz, L. and Miller, P. 1995. Population and habitat viability assessment (PHVA) for *Alouatta palliata mexicana*. IUCN/SSC. Conservation Breeding Specialist Group, Apple Valley, MN.

Rodríguez-Luna, E., Cortés-Ortiz, L., Ellis, S. and McCance, E. 1996. Conservation workshop, analysis and management planning for Mexican Primates. *Neotrop. Primates*. 4: 113–118.

Solórzano, B. 2010. Influencia de los factores socioeconómicos y políticos en el estado de conservación de las poblaciones de primates y su hábitat en la Sierra de Santa Marta, Reserva de Biosfera Los Tuxtlas. Tesis de licenciatura. Universidad Veracruzana. México.

Silva-López, G., Benítez-Rodríguez, J. and Jímenez-Huerta, J. 1987. Habitat use in *Ateles* and *Alouatta*: A study in disturbed areas. International Ethological Conference.

Silva-López, G. and Portilla-Ochoa, E. 2002. Primates, lots and forest fragments: Ecological planning and conservation in the Sierra de Santa Marta, Mexico. *Neotrop. Primates.* 10(1): 9–11.

Struhsaker, T. T. 2008. Demographic variability in monkeys: implications for theory and conservation. *Int. J. Primatol.* 29(1): 19–34.

Thomas, L., Buckland, S. T., Burnham, K. P., Anderson, D. R., Laake, J. L. and Borchers, D. L. 2002. Distance Sampling. In: *Encyclopedia of environmetrics*, A. H. ElS-haarawi, and W. W. Piegorsh (eds.), (vol I, pp. 544–552). Chichester: John Wiley and Sons.

Thomas, L., Laake, J.L., Strindberg, S., Marques, F.F.C., Buckland, S.T., Borchers, D.L., Anderson, D.R., Burnham, K.P., Hedley, S.L., Pollard, J.H., Bishop, J.R.B. and Marques, T.A. 2006. Distance 5.0. Release "x"[1]. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK. http://www.ruwpa.st-and.ac.uk/distance/

SHORT ARTICLES

PLANT FEEDING PATCHES: PATTERNS OF USE BY ASSOCIATING *CALLIMICO GOELDII*, *SAGUINUS LABIATUS*, AND *S. FUSCICOLLIS*

Jennifer Alexis Rehg

Introduction

Structural properties of feeding sites affect resource use in socially mediated ways in primates. Feeding patch characteristics (size, density, dispersion) relate to foraging efficiency and the ability to monopolize foods; for example, small or clustered patches may be more defendable than large, dispersed patches (e.g., Janson, 1988). Aspects of habitat use, such as vertical ranging, may also affect encounter rates of resources with varying structural properties. Thus, characteristics such as patch size are linked to interspecific dietary differences, and influence interactions at resources, including those of mixed species groups (Peres, 1996). Mixed species groups, or polyspecific associations (PSA), form when two or more species maintain proximity or coordinate activities, and often occur among closely-related taxa. Associating species may overlap substantially in their diets and share feeding sites, providing opportunities to more efficiently find and monitor resources, but also potentially increasing competition (Heymann and Buchanan-Smith, 2000; Peres, 1996).

The callitrichids *Callimico goeldii* (callimico), *Saguinus labiatus* (red-bellied tamarin), and *Saguinus fuscicollis* (saddle-back tamarin) form PSA in regions of sympatry in Amazonian Brazil and Bolivia (Pook and Pook, 1982; Porter, 2001b; Rehg, 2006b). All are small-bodied frugivore-insectivores, but differ in aspects of habitat use (Porter, 2001a; Rehg, 2006a). They tend to be vertically stratified, with *S. labiatus* more often in the mid to upper forest canopy, *S. fuscicollis* in lower to mid levels, and *C. goeldii* in forest understory (Porter, 2001b; Rehg, 2006a). However, there is notable overlap in their fruit diets. Data from the Fazenda Experimental Catuaba (FEC) in Brazil indicated 66% of plant food species were used by at least 2 of the primates, and 35% were used by all 3 (Rehg, 2006b). In Bolivia, of 95 fruit species consumed, 44 were eaten by *C. goeldii* and at least one of the tamarins (Porter, 2001a). Despite this diet overlap, aggression is infrequent in callitrichid PSA (Heymann, 1990). Porter and Garber (2007) reported only 16 instances of interspecific aggression in over 1300 observation hours of *C. goeldii*, *S. labiatus*, and *S. fuscicollis*.

Given differences in vertical ranging and infrequent aggression among *C. goeldii, S. labiatus,* and *S. fuscicollis*, but substantial overlap in fruit diets, I report on aspects of resource sharing related to a measure of patch size. Specifically, I provide data on the relationship of patch size to use of feeding sites by each species, sharing of feeding sites during PSA, and frequency of interspecific aggression in relationship to food resources.

Methods

Data on *C. goeldii*, *S. labiatus*, and *S. fuscicollis* were collected at the FEC (S10°04, W067°36), an 820 ha reserve managed by the Universidade Federal do Acre (UFAC), Brazil. The site is composed of *terra firme* forest of various successional stages in a region averaging ~2000 mm of rain annually, with a marked dry season June-August (IMAC, 1991; Rehg, 2006a). The research was approved by the Institutional Animal Care and Use Committee of the University of Illinois Urbana-Champaign, and permits granted by UFAC and the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) of Brazil.

Data were collected primarily on a single group of each species (Stream Group) from Sept 1999 to Mar 2000, Dec 2000, June to Aug 2002, and June to Aug 2003. Other groups were observed opportunistically. Group sizes ranged from 7–12 individuals for *C. goeldii*, 6–10 individuals for *S. fuscicollis*, and 4–11 individuals for *S. labiatus*. In Stream Group, the same groups of each species associated — as defined by a distance of 25 m or less between group peripheries--throughout the study, and were not observed with other groups (Rehg, 2006a). The 3 species were in PSA 61% of observation time, and shared an identical home range of 48 ha through Mar 2000, which increased in 2003 to 56 ha for *Saguinus* and 59 ha for *C. goeldii* (Rehg, 2007). Thus, feeding sites available to one species would presumably be available to the others.

Data were collected using a modified instantaneous scan sampling method at 5 min intervals (Rehg, 2006b). Specific data collected varied among study periods due to changes in the research objectives; however, data were always collected on PSA status. There was an unequal number of scans of each species, with more recorded for *C. goeldii* (N = 2741), but nearly comparable samples for the tamarins (N = 1740 *S. fuscicollis*, N = 1670 *S. labiatus*). I recorded all events of feeding (N = 232 wet season, N = 470 dry seasons), which was defined as manipulating or ingesting food. Sampled individuals were those readily visible, likely resulting in a bias for individuals that were close to one another, close to me, and active. Thus, observations of multiple individuals and species at feeding sites at the same time may be overrepresented. All occurrences of aggression (e.g., chasing, biting) were recorded, and when it involved feeding individuals it was considered food-related.

I collected data on structural features, such as DBH, of plant feeding sites, defined as individual trees and lianas with fruits, flowers, or exudates that were eaten. I used three grades of patch size (adapted from Peres, 1996): "Small" patches were trees with DBH ≤ 10 cm, and lianas with crowns of ≤5 m in diameter. "Medium" patches were trees with DBH >10 cm and ≤ 30 cm, and lianas with a crown diameter > 5 m and ≤ 10 m. "Large" patches were trees with DBH ≥ 30 cm, and lianas with a crown diameter ≥ 10 m. Exudate patches on tree trunks are considered comparable to small patches in terms of access, and grouped with them. Structural properties such as DBH are not directly representative of food quality (Chapman et al., 2003), but patch size can represent space available to forage or feed, and is a way of evaluating ability to access or monopolize a resource. I calculated the number of plant feeding sites used by 1, 2, or 3 species at the same visit ("synchronous" use). Individuals were not marked, so determination of the specific individuals using feeding sites was not possible. A visit occurred when one or more individuals fed at a site, and lasted until all individuals left the site. As there was no attempt to quantify consumption rates, I cannot estimate food availability based on time at a site. I examined the relationship of patch size to the number of species that fed synchronously in the patch. Only samples in which 2 or more species were associated were included, as this assumes that multiple species could potentially "share" a site during a visit. I also tested the relationship of visit duration to patch sizes, and visit duration to the number of species using sites. Visit duration was approximated by number of sequential scans at a feeding site; visits recorded outside a scan and not lasting long enough to be included in a scan, were rounded to the nearest scan (counted as a 'single scan' visit).

Data were analyzed using SAS (Statistical Analysis System, Carey version 9.2, North Carolina). Given possible violations of random sampling, I used a resampling method, randomization, to analyze the data. Resampling methods allow the probability of results from a sample to be evaluated without assumptions about the population distribution (Crowley, 1992). Pearson chi-square goodness of fit tests were first conducted on the original data sets. For each randomization analysis, 1000 randomized data sets were constructed, and chi-square tests applied to each of these 1000 data sets. To determine if associations among variables in the original data set are significant, the distributions of chi-square values for the randomized data sets are compared to the value of that same statistical test on the original data set. If the value from the original data set is greater than 95% of the chi-square values from randomized data sets, the association among variables is significant (equivalent to $\propto = 0.05$). Here results are reported on the original chi-square tests as well as the proportion of chi-square values from randomized data sets that are below this value (see Rehg, 2006 for a similar application).

Results

All 3 primates made use of a similar size range of feeding trees, from small (<8 cm DBH) to large trees (>150 cm DBH): for *C. goeldii* ē = 94.2 ± 85.0 cm (mean ± standard deviation), N=38; for *S. fuscicollis* ē = 105.0 ± 78.8 cm, N=43; and for *S. labiatus* ē = 103.0 ± 74.5 cm, N=69. However, there were interspecific differences in the sizes of sites shared during visits versus those that were not shared. For *C. goeldii* and *S. fuscicollis*, sites visited alone included more small/trunk sites, while sites shared with heterospecifics (more than one species feeding at the same visit) included more medium and large sites ($N = 49$, $x^2 = 7.41$, $p = 0.025$ for *C. goeldii*; $N = 78$, $x^2 = 15.84$, $p = 0.0004$ for *S. fuscicollis*). In contrast, *S. labiatus* demonstrated no differences in patches visited alone or with heterospecifics ($N = 92$, $x^2 = 0.21$, $p = 0.903$). Analyses on randomized data sets supported these results (96.2% for *C. goeldii*; 100% for *S. fuscicollis*; 0% for *S. labiatus*).

There were a total of 145 visits to 107 feeding sites when 2 or more species were in PSA. In 39% of these visits (57/145), more than 1 species fed during the visit, and in nearly all these instances (52/57) individuals of more than 1 species were in the site synchronously. In 22% of visits in which all 3 species were present, they all fed. On occasions when just one species used a site, it was primarily *S. labiatus* (50%). Visits made to sites by all 3 species were mainly to large patches (59%), with small/trunk patches accounting for 7% of visits (Fig. 1). Visits by any 2 species were mainly to large (58%) and medium patches (30%). Visits by just 1 species were predominately to large patches (45%), but included more medium (23%), and small/trunk (33%) patches. All sites that were jointly used by multiple species were also visited on multiple occasions. Visits to feeding sites by a single species or by multiple species were not independent of patch size ($N = 145$, $x^2 = 6.15$, $p = 0.046$; greater than 95.5% of results on resampled data sets). Number of species visiting a site was not independent of visit duration by scans ($N = 134$, $x^2 = 31.43$, $p = 0.0001$; 0% of randomized data sets were greater than original chi-square value). Visits in which two or more species used a feeding site were more likely to be recorded over multiple scans than visits by a single species. However, most visits to feeding sites were recorded only for a single scan, regardless of the patch size and there was no relationship between patch size and visit duration ($N = 134$, $x^2 = 3.55$, $p = 0.470$).

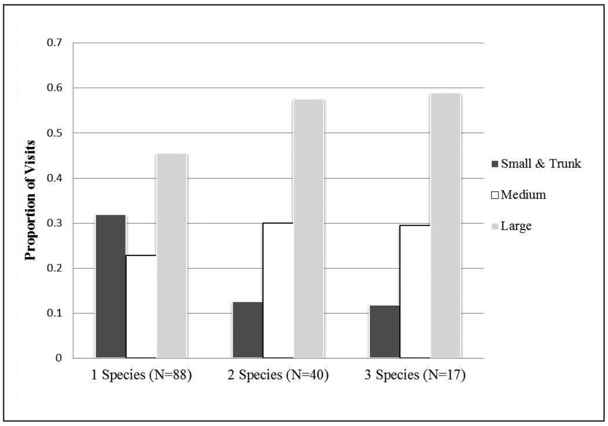

Figure 1. Proportion of visits to feeding sites of different patch sizes by 1, 2, or 3 species.

I observed food-related aggression a total of 33 times (1/13 hrs); 14 of these events were interspecific. All involved adult *S. labiatus* displacing or chasing adult *C. goeldii* or *S. fuscicollis* from a plant feeding "perch", except once when *C. goeldii* displaced *S. fuscicollis*. Ten interactions occurred in the dry season and 4 in the wet season (1/31 hrs vs. 1/39 hrs); nine interactions occurred at small patches.

Discussion

At the FEC *C. goeldii*, *S. fuscicollis*, and *S. labiatus* most often visited larger feeding sites while in PSA. However, *S. fuscicollis* and *C. goeldii* made proportionally more visits to small and medium patches than *S. labiatus*. Given vertical stratification among the species (Porter 2001a; Rehg 2006a), it is not surprising that *S. fuscicollis* and *C. goeldii* would more often encounter smaller sites in the low canopy or understory. However, closely-related *S. labiatus* and *S. fuscicollis* demonstrated greater plant diet overlap (Rehg 2006b), and jointly fed at more sites. Overall, the high frequency of shared visits to sites (over a third of all visits) and especially joint use of larger patches may support the suggestion by Porter and Garber (2007) that *S. fuscicollis* and *C. goeldii* take advantage of associations with *S. labiatus* to feed on fruit in the upper canopy. These observations also correspond with research on groups of *S. mystax* and *S. fuscicollis* in which Peres (1996) found greater interspecific dietary overlap on fruits found in large trees. Shared sites were more often medium or large patches, suggesting patch size was related to detectability of, or access to the resources. Although patch size is not a direct measure of resource abundance at any point in time, it may be correlated with potential productivity, and fallen fruit from larger sites would cover larger areas of the ground (making them more detectable from the understory). Patch size is also related to monopolizability. Bicca-Marques and Garber (2003) reported that at experimental feeding platforms *S. fuscicollis* acquired fewer food rewards visiting with *S. imperator* than alone, perhaps from deferring to (or being displaced by) the larger tamarin.

Duration of feeding visit was related to the number of species visiting a site, irrespective of patch size. This may be related to resource abundance, such that sites with more resources were fed at longer and by more species — irrespective of patch size. However, the precise data on resource abundance at the feeding sites needed to test this hypothesis were not collected at the time of the visits. In addition, a relationship between patch size and visit duration may be obscured by the crude duration measure of number of scans; most feeding visits on any size patch were recorded during a single scan only. It is of interest that callitrichid feeding bouts, even at large fruit resources, are typically short. Peres (1996) reported average feeding bout length of 2.3 mins at small patches, and an average length of 6.4 mins at large patches. This may indicate that even some large patches can be depleted of easily accessed and ripe resources quickly, or it may be that other factors (exposure to predators, satiation) may cause the tamarins to limit feeding bouts.

Interspecific aggression was uncommon, and when it did occur *S. labiatus* was typically dominant, which is in agreement with previous studies (reviewed by Heymann and Buchanan-Smith, 2000) on dominance patterns in mixed tamarin groups. Although even infrequent aggression could be seen as a cost of PSA, direct interference competition would appear to be of minor consequence. The mixed groups at the FEC were often dispersed during foraging, and could encounter small, isolated food patches that could be quickly depleted. First access to these resources may affect food acquisition, although such scramble competition is difficult to evaluate as a PSA cost. Use of different vertical regions of the forest canopy by associating species may facilitate niche expansion (Porter and Garber, 2007). Such stratification, along with interspecific differences in diet and reduced association frequency in the dry season (Porter, 2001b; Rehg, 2006b), might also limit contest and scramble competition among *C. goeldii*, *S. labiatus*, and *S. fuscicollis*.

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References

Bicca-Marques, J. C., Garber, P. A. 2003. Experimental field study of the relative costs and benefits to wild tamarins (*Saguinus imperator* and *S. fuscicollis*) of exploiting contestable food patches as single- and mixed-species troops. *Am. J. Primatol.* 60: 139–153

Chapman, C. A., Chapman, L. J., Rode, K. D., Hauck, E.M., McDowell, L.R. 2003. Variation in the nutritional value of primate foods: among trees, time periods, and areas. *Int. J. Primatol.* 24(2): 317–333

Heymann, E. W. 1990. Interspecific relations in a mixed-species troop of moustached tamarins, *Saguinus mystax*, and saddle-back tamarins, *Saguinus fuscicollis* (Platyrrhini: Callitrichidae), at the Rio Blanco, Peruvian Amazonia. *Am. J. Primatol.* 21: 115–127.

Heyman, E. W., Buchanan-Smith, H. M. 2000. The behavioural ecology of mixed-species troops of callitrichine primates. *Biol. Rev.* 75: 169–190.

IMAC – Núcleo de Cartografia. 1991. *Atlas Geográfico Ambiental do Acre*, Rio Branco.

Janson, C. H. 1988. Intra-specific food competition and primate social structure: a synthesis. *Behaviour* 105: 1–17.

Peres, C. A. 1996. Food patch structure and plant resource partitioning in interspecific associations of Amazonian tamarins. *Int. J. Primatol.* 17(5): 695–723

Pook, A. G., Pook, G. 1982. Polyspecific association between *Saguinus fuscicollis*, *Saguinus labiatus*, *Callimico goeldii* and other primates in North-western Bolivia. *Folia Primatol.* 38: 196–216

Porter, L. M. 2001a. Dietary differences among sympatric callitrichines in northern Bolivia: *Callimico goeldii*, *Saguinus fuscicollis* and *Saguinus labiatus*. *Int. J. Primatol.* 22(6): 961–992

Porter, L. M. 2001b. Benefits of polyspecific associations for the Goeldi's monkey, *Callimico goeldii*. *Am. J. Primatol.* 54: 143–158

Porter, L. M., Garber, P. A. 2007. Niche expansion of a cryptic primate, *Callimico goeldii*, while in mixed species troops. *Am. J. Primatol.* 69: 1340–1353

Rehg, J. A. 2007. Population density of *Callimico goeldii* (Goeldi's monkey) in relationship to home range and habitat in a forest fragment in Acre, Brazil. In: *A Primatologia no Brasil* 10 J. C. Bicca-Marques (ed.), pp 269–298. Sociedade Brasileira de Primatologia, Porto Alegre,

Rehg, J. A. 2006a. Hábitats utilizados por três espécies de primatas, *Callimico goeldii*, *Saguinus labiatus* e *Saguinus fuscicollis*, na Fazenda Experimental Catuaba, Acre, Brasil. In: *Fauna do Acre,* Série Estudos e Pesquisas 2, P. Drummond (ed.), pp 147–172. EDUFAC, Rio Branco.

Rehg, J. A. 2006b. Seasonal variation in polyspecific associations among *Callimico goeldii*, *Saguinus labiatus*, and *S. fuscicollis* in Acre, Brazil. *Int J Primatol* 27(5): 1399–1428

Terborgh, J. 1983. *Five New World Primates*. Princeton University Press, Princeton.

WAS THERE EVER A MURIQUI (*BRACHYTELES*) POPULATION IN THE ILHA DO CARDOSO STATE PARK IN SOUTHEASTERN BRAZIL?

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Introduction

The muriqui, or woolly-spider monkey, (*Brachyteles*) is the largest of the New World primates (Nishimura *et al.*, 1988), and a flagship for the conservation of the Atlantic Forest in Brazil. They are endemic to the Brazilian Atlantic Forest (Aguirre, 1971; Nishimura *et al.*, 1988), which itself is threatened due to deforestation, with now only 8% remaining, scattered among innumerable fragments of different sizes. Of the 91,930 km² left, only 36% (33,084 km²) is protected under federal law, despite the fact that it is a conservation hotspot due to its species richness and many endemic species (MMA and SBF, 2000; Myers *et al.*, 2000). Two species of muriqui are recognized: the southern (*Brachyteles arachnoides*) and the northern (*B. hypoxanthus*). Both are threatened from habitat loss and hunting — the southern muriqui is classified as Endangered and the northern muriqui as Critically Endangered (Nishimura *et al.*, 1988; Mendes *et al.*, 2008; Talebi, 2008). Research on primates in the Atlantic Forest has been ongoing since the late 1970s, and was stimulated mainly by Aguirre's (1971) pioneering monograph that generated interest in and concern for muriquis (Strier *et al.*, 2005). By 1971, the muriqui (only one species was recognized at the time) was believed to have occurred in forests extending south from the Rio Paraguaçú in Bahia to the Rio Ribeira valley in northern Paraná (Aguirre, 1971). Melo and Dias (2005) reviewed the numerous surveys and discoveries of further populations since the report by Aguirre (1971). This included the first report of a population in the Ilha do Cardoso State Park by Martuscelli *et al.* (1994). Martuscelli *et al.* (1994) reported that muriquis were seen twice in the northern part of the island (four adults in April 1989, two individuals in January 1991) during a four year study (1989–1992), but that they had since been extirpated (at least two monkeys were known to have been killed by local people). The occurrence of the muriqui on the island has never been independently confirmed. Here we report our findings concerning the presence of the muriqui in the Ilha do Cardoso State Park and discuss whether there ever was in fact a muriqui population there.

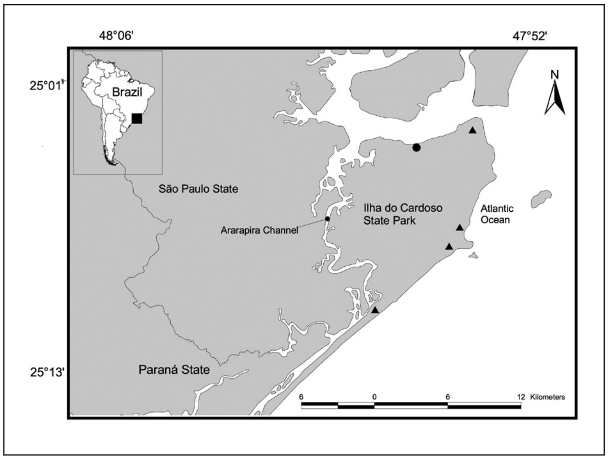

Figure 1. Study area and location of the four villages (black triangles) and an isolated family (black circle) interviewed in the Ilha do Cardoso State Park, in São Paulo, southeastern Brazil.

Methods

Study Area

The Ilha do Cardoso State Park (151 km²) is on the southern coast of the state of São Paulo, in southeastern Brazil (25°10'015"S, 48°00'05"W; Sampaio *et al.*, 2005; Fig. 1). The island is part of the Iguape-Cananéia-Paranaguá estuarine-lagoon complex, a group of coastal-marine preserves and one of the largest preserved areas of the Atlantic Forest of the states of São Paulo and Paraná (Tabarelli *et al.*, 2005). The Ilha do Cardoso is separated from the mainland by the Ararapira Channel which, in some places, is only 30 m wide (Fig. 1). The altitude ranges from sea level to 800 m (Pfeifer, 1981–1982), with the highest elevations in the center of the island (Barros *et al.*, 1991). There is no dry season, but rainfall is highest from December to March, with maxima of 1673–3014 mm yr^{-1} (Funari *et al.*, 1987). Most of the island (74%) is tropical lowland rainforest, including the slopes and coastal plains, along with sandy soil shrub (*restinga*), sand dunes and mangroves in the remaining areas (Melo and Montovani, 1994). People of European descent occupied the island prior to it being declared a protected area in 1962, and fishing and small-scale agriculture were the most important local activities (Almeida, 1946). Today, there are still some people there, but they occupy only the margins of the southern, eastern, and northern coastal plains, with fishing and tourism being their chief livelihoods. In 1992, Amerindians of the Guarani Mbya ethnic group settled in the northwestern part of the island.

Data collection

During 2002–2007, we made an extensive study of the occurrence of medium to large mammals on the island. We used a combination of census techniques, including direct sighting, camera trapping and transect surveys (Wilson *et al.*, 1996; Thompson *et al.*, 1998; Pardini *et al.*, 2004; Tomas and Miranda, 2004). Besides primates, we found evidence of 18 medium to large mammal species. For primates, we used direct sightings during walks along transects (NRC, 1981; Chiarello and Melo, 2001). We also interviewed local people about their hunting practices and their knowledge of the fauna of the island. This part of the study was carried out under the auspices of the Cananéia Institute for Research (Instituto de Pesquisas Cananéia) that has been involved in ethnoecological studies there for more than 10 years (Oliveira, 2006; Oliveira *et al.*, 2008; Hanazaki *et al.*, 2009; Bahia and Bondioli, 2010). We conducted interviews, following Viertler (2002) in 2007, asking people about their hunting traditions, their knowledge of the local flora and fauna on the island as well as the Ilha Comprida and Ilha de Cananéia and the nearby mainland. Questions concentrated on the last five years, but also included memories of older experiences when they were offered. This was part of a study to establish the historical presence of mammals on the islands (Cheida *et al.*, unpubl. data) through information gathered from active and retired hunters who were well acquainted with the islands and nearby mainland. We interviewed 39 people between the ages of 17 and 81, most of whom had lived for more than 30 years on the island or nearby**.** Photographs were shown during the interviews to help identify species, including the muriqui and three other primates known to occur in the region (Lorini and Persson, 1994; Passos *et al.*, 2007): the southern muriqui (*Brachyteles arachnoides*), the black capuchin (*Cebus nigritus*), the brown howler monkey (*Alouatta clamitans*), and the black-faced lion tamarin (*Leontopithecus caissara*).

Results

A total of 224 km were walked along trails in all vegetation formations on the island during 2002–2005 (Barros *et al.*, 1991; Nakano-Oliveira, 2006). In 2005 and 2006, we intensified census efforts and included an additional 175 km of rainforest (92 km in the lowlands, 83 km in the uplands). Walking speed was consistently 0.5–1.0 km h^{-1} (Buckland *et al.*, 1993). There were five trails totaling 8,050 m (Ingberman *et al.*, 2009). Previous studies were concentrated on the northern part of the island where muriquis were originally reported (Martuscelli *et al.*, 1994), where we sighted just one primate, the brown howler monkey (*Alouatta clamitans* Cabrera, 1940).

Of the 39 interviewees, 28 hunt or hunted on the island; 19 of them lived in one the four villages on the island (Pereirinha, Marujá, Cambriú, Foles) or elsewhere on the island (Fig. 1), and another nine lived on nearby islands. It was clear that these 28 hunters were very familiar with the local fauna and they easily and correctly identified mammals from the photos. Of the primates, only the brown howler monkey was identified as occurring on Ilha do Cardoso. The black capuchin and the black-faced lion tamarin were both recognized as occurring on the nearby islands and mainland. Not one interviewee recognized the muriqui or suggested that it was found anywhere in the region.

Discussion

Earlier studies also failed to find the muriqui on the island, and stated that the only primate there was the brown howler (Almeida, 1946; São Bernardo, 2004). In addition to the howler, all other mammals weighing more than 3 kg (as in Almeida, 1946) are still found on the island (this study), the only exception being the jaguar (*Panthera onca*) (Cheida *et al.*, unpubl. data; Fusco-Costa *et al.*, unpubl. data; Nakano-Oliveira, 2006; Ingberman *et al.*, 2009; Fusco-Costa *et al.*, 2010). Besides the jaguar, therefore, the assemblage of medium to large mammals is as it has been for over 60 years.

Since the channel that separates the Ilha do Cardoso from the mainland is often very narrow, it is possible that muriquis could cross it and remain on the island temporarily, such as from 1989 to 1991, as reported by Martuscelli *et al.* (1994), but without being seen by the local people. However, aside from Martuscelli *et al.* (1994), there is no evidence of the muriqui in additional studies along the northern coast of state of Paraná (Andriguetto-Filho *et al.*, 1998) nor in other coastal regions near the Ilha do Cardoso State Park (this study). The nearest documented record of the muriqui is about 35 km away in a more mountainous area (farther inland near the headwaters of the rios Serra Negra, Pardo and Jacupiranga [Aguirre, 1971]) that is more typical of where they are found elsewhere in their range today. Also, emigration in this genus does not occur in groups but rather by females who leave their natal group when they mature (Strier, 1991), so it is very unlikely that a whole group would go to the island.

Evidence for the occurrence of muriqui on the Ilha do Cardoso is tenuous at best; Martuscelli *et al.* (1994) providing the only record, with no additional support for a population or its extinction, in over 60 years of historical records. Because that report did not provide additional information, such as methods, exact dates and locations, we suggest that the muriqui was never resident on Ilha do Cardoso and, therefore, this single and unsupported record should not be used in determining its distribution. Conservation efforts for the endangered *Brachyteles arachnoides* will be better directed by understanding its true habitat requirements and geographic distribution.

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References

Aguirre, A. C. 1971. *O mono* Brachyteles arachnoides *(É. Geoffroy). Situação atual da espécie no Brasil.* Academia Brasileira de Ciências, Rio de Janeiro.

Almeida, A. P. 1946. Memória histórica da Ilha do Cardoso. *Revista do Arquivo Municipal* 111: 19–52.

Andriguetto-Filho, J. M., Krüger, A. C. and Lange, M. B. R. 1998. Caça, biodiversidade e gestão ambiental na Área de Proteção Ambiental de Guaraqueçaba, Paraná, Brasil. *Biotemas* 11(2): 133–156.

Bahia, N. C. F. and Bondioli, A. C. V. 2010. Interação das tartarugas marinhas com a pesca artesanal em cerco-fixo em Cananéia, litoral sul de São Paulo. *Biotemas* 23(3): 203–213.

Barros, F., Melo, M. M. R. F., Chiea, S. A. C., Kirizawa, M., Wanderley, M .G .L. and Jung-Mendacolli, S. L. 1991. *Flora Fanerogâmica da Ilha do Cardoso: Caracterização Geral da Vegetação e Listagem das Espécies Ocorrentes*. Hucitec, São Paulo.

Buckland, S. T., Anderson, D. R., Burnham, K. P. and Laake, J. L. 1993. *Distance Sampling. Estimating Abundance of Biological Populations.* Chapman and Hall, London.

Chiarello, A. G. and Melo, F. R. 2001. Primate population densities and sizes in Atlantic forest remnants of northern Espirito Santo, Brazil. *Int. J. Primatol.* 22(3): 379–396.

Funari, F. L., Struffaldi-De Vuono, Y. and Salum, S. T. 1987. Balanço hídrico de duas áreas de Mata Atlântica: Reserva Biológica de Paranapiacaba e Parque Estadual da Ilha do Cardoso (Estado de São Paulo). *Anais do VI Congresso da Sociedade Botânica de São Paulo*: 95–101.

Fusco-Costa, R., Ingberman, B., Zarate do Couto, H. T., Nakano-Oliveira, E. C. and Monteiro Filho, E. L. A. 2010. Population Density of a Coastal Island Population of the Ocelot in the Atlantic Forest of Southeastern Brazil. *Mamm. Biol.* 75: 358–362.

Hanazaki, N., Oliveira, F. C., Miranda, T. M. and Peroni, N. 2009. Ethnobotany of artisanal fishers. In: *Current Trends in Human Ecology*, Vol. 1, A. Begossi and P. Lopes (eds.), pp 101–124. Cambridge Scholars Publishing, Newcastle.

Ingberman, I., Fusco-Costa, R. and Monteiro-Filho, E. L. A. 2009. Population survey and demographic features of a coastal island population of *Alouatta clamitans* in Atlantic Forest, southeastern Brazil. *Int. J. Primatol.* 30: 1–14.

Lorini, M. L. and Persson, V. G. 1994. Status and field research on *Leontopithecus caissara*: the black-faced lion tamarin Project. *Neotrop. Primates* 2 (suppl.): 52–55.

Martuscelli, P., Petroni, L. M., Olmos, F. 1994. Fourteen new localities for the muriqui *Brachyteles arachnoides*. *Neotrop. Primates* 2(2): 12–15.

Melo, F. R. and Dias, L. G. 2005. Muriqui population reported in the literature over the last 40 years. *Neotrop. Primates* 13 (suppl.): 19–24.

Melo, M. M. R. F. and Montovani, W. 1994. Composição florística e estrutura de trecho de mata atlântica de encosta, na ilha do Cardoso (Cananéia, SP, Brasil). *Boletim do Instituto de Botânica* 9: 107–158.

Ministério do Meio Ambiente (MMA); Secretaria de Biodiversidade e Florestas (SBF). 2000. *Avaliação e Ações Prioritárias para a Conservação da Biodiversidade da Mata Atlântica e Campos Sulinos.* CI do Brasil, Fundação SOS Mata Atlântica, Fundação Biodiversitas, IPÊ, Secretaria do Meio Ambiente do Estado de São Paulo, Instituto de

Florestas-MG. DelRey Gráfica e Editora, Belo Horizonte, Brazil.

Mendes, S. L., de Oliveira, M. M., Mittermeier, R. A. and Rylands, A. B. 2008. *Brachyteles arachnoides*. In: IUCN 2008. *2008 IUCN Red List of Threatened Species*. International Union for Conservation of Nature (IUCN), Species Survival Commission (SSC), Gland, Switzerland, and Cambridge, UK. Website: <http://www.iucnredlist.org>.

Myers, N. , Mittermeier, R. A., Mittermeier, C. G. , Fonseca, G. A. B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature*, *Lond.* 403: 853–858.

Nakano-Oliveira, E. 2006. Ecologia e Conservação de Mamíferos Carnívoros de Mata Atlântica na Região do Complexo Estuarino Lagunar de Cananéia, Estado de São Paulo. PhD dissertation, Universidade Estadual de Campinas, Campinas, Brazil.

National Research council (NRC), Subcommittee on Conservation of Natural Populations and Committee on Nonhuman Primates.1981. *Techniques for the Study of Primate Population Ecology.* National Academy Press, Washington, DC.

Nishimura, A., Fonseca, G. A. B. da, Mittermeier, R. A., Young, A. L., Strier, K. B. and Valle, C. M. C. 1988. The muriqui, genus *Brachyteles*. In: *Ecology and Behavior of Neotropical Primates,* Vol. 2, R. A. Mittermeier, A. B. Rylands, A. F. Coimbra-Filho and G. A. B da Fonseca (eds.), pp.577–610. World Wildlife Fund, Washington, DC.

Oliveira, F. C. 2006. Etnobotânica da exploração de espécies vegetais para confecção do cerco-fixo na região do Parque Estadual Ilha do Cardoso, SP. MSc thesis, Universidade Federal de Santa Catarina, Florianópolis, Brazil.

Oliveira, F., Beccato, M. A. B., Nordi, N. and Monteiro-Filho, E. L. A. 2008. Etnobiologia: interfaces entre o conhecimento tradicional e científico. In: *Biologia, Ecologia e Conservação do Boto-Cinza,* E. L. A Monteiro-Filho and K. D. K. A. Monteiro (eds.), pp. 233–261. Páginas and Letras Editora e Gráfica, São Paulo, Brazil.

Pardini, R., Ditt, E. H., Cullen Jr., L., Bassi, C. and Rudran, R. 2004. Levantamento rápido de mamíferos terrestres de médio e grande porte. In: *Métodos de Estudo em Biologia da Conservação e Manejo da Vida Silvestre,* L. Cullen Jr., R. Rudran and C. Valladares-Padua (eds.), pp.181–202. Editora da Universidade Federal do Paraná, Curitiba, Brazil.

Passos, F. C., Miranda, J. M. D., Aguiar, L. M., Ludwig, G., Bernardi, I. P. and Moro-Rios, R. F. 2007. Distribuição e ocorrência de primatas no Estado do Paraná, Brasil. In: *A Primatologia no Brasil 10*, J. C. Bicca-Marques (ed.), pp.119–150. EDIPUCRS, Porto Alegre, Brazil.

Pfeifer, R. M. 1981–82. Levantamento semidetalhado dos solos do Parque Estadual da Ilha do Cardoso - SP. *Silvicultura em São Paulo* 15/16: 91–115.

Sampaio, D., Souza,V. C., Oliveira, A. A., Paula-Souza, J. and Rodrigues, R. R. 2005. *Árvores da Restinga: Guia de Identificação*. Editora Neotropica, São Paulo, Brazil.

São Bernardo, C. S. 2004. Abundância, densidade e tamanho populacional de aves e mamíferos cinegéticos no Parque Estadual Ilha do Cardoso, SP, Brasil. MSc thesis, Universidade de São Paulo, Piracicaba, Brazil.

Strier, K. B. 1991. Demography and conservation in an endangered primate, *Brachyteles arachnoides*. *Conserv. Biol.* 5: 214–218.

Strier, K. B., Pinto, L. P. S., Paglia, A., Boubli, J. P., Mendes, S. L., Marini-Filho, O. J. and Rylands, A. B. 2005. The ecology and conservation of the muriqui *(Brachyteles*): reports from 2002–2005. Introduction. *Neotrop Primates* 13(suppl.): 3–5.

Tabarelli, M., Pinto, L. P., Silva, J. M. C., Hirota, M. and Bedê, L. 2005. Challenges and opportunities for biodiversity conservation in the Brazilian Atlantic Forest. *Conserv. Biol.* 19: 695–700.

Talebi, M. 2008. *Brachyteles arachnoides* Geoffroy 1806. In: *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção,* Machado A. B. M., Drummond G. M. and Paglia A. P. (eds)., Vol. 2, pp.730–732. Ministério do Meio Ambiente (MMA), Brasília, and Fundação Biodiversitas, Belo Horizonte, Brazil.

Thompson, W. L., White, G. C. and Gowan, C. 1998. *Monitoring Vertebrate Populations.* Academic Press, San Diego.

Tomas, W. M. and Miranda, G. H. B. 2004. Uso de armadilhas fotográficas em levantamento populacionais. In: *Métodos de Estudo em Biologia da Conservação e Manejo da Vida Silvestre*, L. Cullen Jr., R. Rudran and C. Valladares-Padua, C. (eds.), pp.243–268. Editora da Universidade Federal do Paraná, Curitiba, Brazil.

Viertler, R. B. 2002. Métodos antropológicos como ferramentas para estudos em Etnobilogia e Etnoecologia. In: *Métodos de Coleta e Análise de Dados em Etnobiologia, Etnoecologia e Disciplinas Correlatas. I Seminário de Etnobiologia e Etnoecologia do Sudeste,* M. C. M. Amorozo, L. C. Ming and S. M. P. Silva (eds.), pp.11–29. Rio Claro, Brazil.

Wilson, D. E., Cole F. R., Nichols, J. D., Rudran, R. and Foster, M. S. 1996. *Measuring and Monitoring Biological Diversity: Standard Methods for Mammals.* Smithsonian Institution Press, Washington, DC.

EXTENSIÓN DE RANGO DE DISTRIBUCIÓN DEL MONO LUCACHI *CALLICEBUS AUREIPALATII* (PITHECIIDAE) PARA EL DEPARTAMENTO DE LA PAZ, BOLIVIA

Omar Martínez

Introducción

Los monos tití (*Callicebus* spp.) pertenecen al grupo de primates de tamaño pequeño, cuyo rango de masa corporal varía desde 0.8 a 1.4 kg (Smith y Jungers, 1997), poseen cola no prensil y son primariamente frugívoros (Hershkovitz, 1990). La familia Pitheciidae agrupa alrededor de

40 especies (Martínez y Wallace, 2010), con cuatro géneros conocidos (*Phitecia, Cacajao, Chiropotes* y *Callicebus*) (Rylands *et al*., 2000). Los componentes del género *Callicebus*, agrupan a más de 29 especies típicas del Neotrópico (Van Roosmalen *et al*., 2002; Wallace *et al*., 2006; Martínez y Wallace, 2007). Por ejemplo, *Callicebus moloch,* de amplia distribución, dividido en 10 especies (actualmente, ha sido dividido dentro de muchas especies diferentes), es común en bosques húmedos maduros o perturbados de tierras bajas, bosques secos y bosques de galería con vegetación densa y con enmarañado de bejucos y lianas como las orillas de ríos, caños y quebradas (Emmons y Feer, 1999). Son de hábito diurno, arborícola, ocurriendo en grupos de dos a cinco individuos y se alimentan de hojas y frutos, pero mayormente son folívoros (Emmons y Feer, 1999); son incapaces de nadar y aparentemente visitan bosques inundados solo durante la época de las aguas altas (Van Roosmalen *et al*., 2002). En Bolivia se reconocen seis especies de *Callicebus* (*C. donacophillus, C. pallescens, C. brunneus, C. olallae, C. modestus* y *C. aureipalatii*) (Martínez y Wallace, 2010), siendo *C. aurepalatii*, especie recientemente descubierta en el Parque Nacional y Área Natural de Manejo Integrado Madidi (Wallace *et al*., 2006; Martínez y Wallace, 2010). Los monos tití se encuentran habitando en los departamentos de Pando, Beni y Santa Cruz; norte de La Paz y este de Cochabamba (Hershkovitz, 1988; Anderson, 1997).

Los patrones de distribución, preferencias de hábitat, hábitos alimenticios y comportamiento de muchas de estas especies de *Callicebus* son aún desconocidos (Martínez y Wallace, 2007). Hasta hace unos años atrás, el norte del departamento de La Paz, Bolivia fue aparentemente poco explorado y por ende con muy poca información biológica disponible para la región (Wallace *et al*., 2006). Sin embargo, información actual indicaría que el Parque Nacional Madidi es una de las áreas protegidas de mayor diversidad biológica en el mundo (Remsen y Parker, 1995). El registro de 917 especies de aves confirmadas y 1138 esperadas (Remsen y Parker, 1995), así lo indican; no obstante, gran parte del área nunca fue visitado por biólogos (CARE/WCS/IE/SERNAP, 2003). Por otra parte, el oeste de Bolivia en estos últimos años ha proveído una serie de extensiones de rango para especies de vertebrados amenazados o raros (Tarifa *et al*., 2001; Hennessey, 2002a; Gottdenker *et al*., 2003; Martínez, 2008; Martínez *et al*., 2010), nuevos registros bolivianos (Hennessey & Gómez, 2003; Ríos *et al*., 2004; Maillard *et al*., 2007; Martínez, 2008; Martínez *et al*., 2010); así como especies de vertebrados potencialmente nuevas para la ciencia (Wallace & Painter, 1999; Hennessey 2002b, Herzog *et al*., 2008). En este reporte damos cuenta de dos nuevos registros de extensión de rango de distribución del mono "lucachi" (*Callicebus aureipalatii*), considerados los más extremos en bosques de tierras bajas al noroeste de Bolivia.

La distribución de *C. aureipalatti* en Bolivia incluye el norte del Departamento de La Paz, al sur del Río Madre de Dios y aparentemente el Río Beni ubicado al este, representa una barrera natural para su distribución (Mercado y Wallace, 2010; Martínez y Wallace, 2010). La distribución del lucachi se conoce a partir de observaciones registradas durante expediciones conducidas en el norte de La Paz desde 1999 a 2004 y se menciona a cuatro sitios (Ríos Hondo, Tuichi, Undumo y la región del Alto Madidi) (Wallace *et al*., 2006). De ellos, Alto Madidi fue considerado parte de su distribución más norteña (coordenadas 13° 37'18"S, 68° 44' 33"O). Actualmente se conocen 57 registros confiables de *C. aureipalatii* en Bolivia al sur de su distribución potencial (Martínez y Wallace, 2010), aunque solo se indican de 13 registros utilizados para la evaluación de su distribución potencial (Mercado y Wallace, 2010; Martínez y Wallace, 2010). Sin embargo, en este estudio se reporta dos nuevos registros del lucachi, al límite norte del Parque Nacional Madidi hacia las Pampas del Heath.

Materiales y métodos

Entre julio y agosto de 2007, mediante caminatas y observaciones en transectos a lo largo de una senda de 2.5 km, empleando binoculares Nikon 10×36 y cámara Sony digital DSC-H9, se realizaron muestreos por 24 días en las localidades de Arroyo Negro y Tacuaral, comprensión de las Pampas del Heath, sin resultados positivos sobre la presencia de *C. aureipalatii.* Ese mismo año, entre septiembre y octubre con un esfuerzo de muestreo similar al anterior, registramos en dos oportunidades a este primate a lo largo de una senda de 5.3 km, con rumbo oeste-este, entre la localidad de Green Bolivia (a orillas del Río Heath) y las Pampas del Heath, al norte de las localidades antes mencionadas (Fig. 1). La vegetación de la región corresponde al Distrito Biogeográfico de las Pampas del Heath con bosque ribereño y plantas típicas como "ambaíbo" (*Cecropia menbranacea*), "asaí" (*Euterpe precatoria*), "mapajo" (*Ceiba pentandra*), "palo María" (*Calophyllum brasiliensis*), "lúcuma" (*Pouteria caimito*), "almendrillo" (*Dypteryx micrantha*) y el "patujú" (*Heliconia marginata*), entre otros. En las Pampas del Heath son típicas: *Bellucia grossularioides, Cardiopetalum calophyllum, Cussarea hydrangeifolia, Miconia albicans, M. rufescens, M. tiliifolia, Ocotea gracilis, Tabebuia ochracea* y "la palma real" (*Mauritia flexuosa*) en áreas inundadas de bajíos (Navarro, 2002).

Resultados y discusión

El primer registro ocurrió el 2 de octubre del 2007 a las 06:50 h (hora local), el grupo integrado por una pareja se encontraba aproximadamente a 20 m de altura del bosque, cuyo hábitat corresponde a selva baja tropical perennifolia (*sensu* Stotz *et al*., 1996), a medio camino (2.6 km) del trayecto del albergue Green Bolivia a las Pampas del Heath (12°40'30.03"S, 68°52'3.89"O, 210 msnm), Provincia Iturralde, Departamento de La Paz. El albergue Green Bolivia se encuentra a orillas del Río Heath (12°40'48.46"S, 68°42'45.41"O, 180 msnm) y existe un sendero de 5.3 km con dirección oeste-este que conduce a las Pampas del Heath. Esta pareja de lucachis al momento de su detección se encontraba en un fragmento de bosque semiabierto por la tala y extracción de especies forestales de valor comercial. Existen evidencias fotográficas de mala calidad, dada la hora y distancia a la cual fueron tomadas, que no se incluyen en este reporte, que muestran el cuello de color naranja muy brillante, la punta de la cola de color blanco y presencia de una corona dorada, aspecto que distingue a *C. aureipalatii* y lo diferencia de *C. brunneus* o *C. cupreus* (ver Wallace *et al*., 2006).

El segundo registro ocurrió el 6 de octubre de 2007 y fue al final del mismo sendero (12°39'48.88"S, 68°40'39.79"O; 150 msnm). Esta vez se trató de un grupo familiar de cuatro individuos. Al momento del contacto (18:20 h) el grupo se encontraba presto para dormir al filo de un bosque transicional bajo y las Pampas del Heath, a una altura aproximada de 6 m. Al día siguiente por la mañana (06:30 h) el grupo familiar aún permanecía en el lugar y con los primeros rayos del sol, empezaron a movilizarse lentamente en los alrededores (Fig. 2). Ante nuestra presencia, estos primates se mostraron confiados y poco activos, ejecutando leves vocalizaciones a manera de silbidos suaves; a menudo permanecían sentados por periodos prolongados entre las ramas densamente cubiertas por hojas.

Es preciso enfatizar la falta de información existente acerca de esta especie, puesto que poco se conoce de su distribución a nivel de Bolivia. Existen registros de poca confiabilidad taxonómica (Martínez y Wallace, 2010), al norte de su distribución potencial que coincide con nuestros puntos de muestreo, la mayoría de ellos proporcionados por ACA-Bolivia. Este estudio se constituye en el primer registro fotográfico y fílmico del lucachi al norte de su distribución potencial. Estos dos registros de *C. aureipalatti* en el norte de La Paz confirman su presencia al norte de su rango de distribución potencial, siendo los mismos extralimítales de distribución más norteña conocidos para Bolivia.

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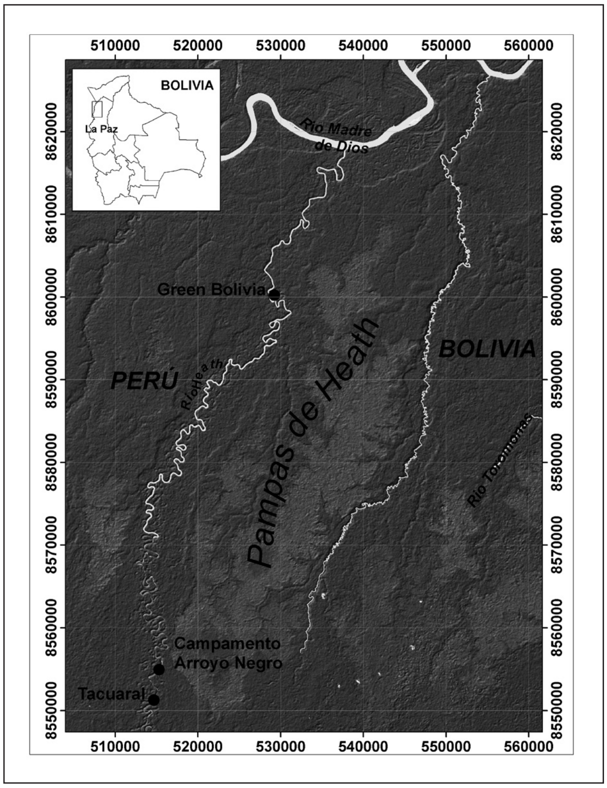

Figura 2. Mapa de ubicación del área de estudio, mostrando la localidad de Green Bolivia cerca a las Pampas del Heath, provincia Iturralde, departamento La Paz, Bolivia.

Figura 2. Dos aspectos de un grupo de "lucachis" (*Callicebus aureipalatii*) observados a 6 m de altura, al filo de bosque bajo transicional amazónico y Pampas del Heath en el albergue Green Bolivia, Provincia Iturralde, La Paz (Bolivia). Fotos por O. Martínez.

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Referencias

Anderson, S. 1997. Mammals of Bolivia. Taxonomy and distribution. *Bull. Ame. Mus. Nat. His.* 231: 1–652.

CARE/WCS/IE/SERNAP. 2003. *Madidi de Bolivia, Mágico, único y nuestro*. CD-ROM. Digifilms. La Paz, Bolivia.

Emmons, L. H. y Feer, F. 1999. *Mamíferos de los bosques húmedos de América tropical*. Editorial FAN. Santa Cruz de la Sierra, Bolivia.

Gottdenker, N., Wallace, R. B. y Gómez, H. 2001. La importancia de los atropellos para la ecología y conservación. *Ecología en Bolivia* 35: 61–67.

Hennessey, B. A. 2002a. Red Data Bird – *Wattled Curassow World Bird Watch* 24(2): 30–31.

Hennessey, B. A. 2002b. First Bolivian observation of swallow-tailed cotinga, *Phibalura flavirostris* in 98 years. *Cotinga* 17: 54–55.

Hennessey, B. A. y Gómez, M. I. 2003. Four species new to Bolivia: An ornithological survey of the Yungas site Tokoaque, Madidi National Park. *Cotinga* 19: 25–33.

Hershkovitz, P. 1988. Origin, speciation and dispersal of South American titi monkeys, genus *Callicebus* (family Cebidae, Platyrrhini). *P. Acad. Nat. Sci. Phila.* 140(1): 240–272.

Hershkovitz, P. 1990. Titis, New World monkeys of the genus *Callicebus* (Cebidae, Platyrrhini): A preliminary taxonomic review. *Fieldiana Zool. New Series* 55: 1–109.

Herzog, S. K., Kessler, M. y Balderrama, J. A. 2008. A new species of Tyrannulet (Tyrannidae: *Phyllomyias*) from Andean foothills in norwest Bolivia and adjacent Perú. *Auk* 125(2): 265–276.

Maillard, O., Bates, J. M., Tello, J. G. y Aponte, M. A. 2007. Avifauna del RíoManupare y Cráter Iturralde, un bosque amazónico en el departamento de La Paz, Bolivia. *Ornitol. Neotrop.* 18: 1–16.

Martínez, J. 2007. Further Notes on the distribution of endemic Bolivian titi monkeys, *Callicebus modestus* and *Callicebus ollallae*. *Neotrop. Primates* 14 (2): 47–54.

Martínez, J. y R. B. Wallace. 2010. Pitheciidae. En: *Distribución, Ecología y Conservación de los Mamíferos Medianos y Grandes de Bolivia*, R. B. Wallace, H. Gómez, Z.R. Porcel y D.I. Rumiz (eds.), pp.305–330.Centro de Ecología Simón I. Patiño-Departamento de difusión. Santa Cruz de la Sierra, Bolivia.

Martínez, O. 2008. *Biodiversidad de las Pampas del Heath*. Informe Final. Parte: Aves. Reporte no publicado. Asociación para la Conservación de la Amazonía (ACA) – Bolivia. La Paz, Bolivia.

Martínez, O., Terán M. y Ayala, J. 2010. Primer registro del bobo coronado, *Notharcus tectus* (Aves: Bucconidae) para el departamento de La Paz y Parque Nacional Madidi, Bolivia. *Kempffiana* 6 (1): 43–48.

Mercado, N. I. y Wallace, R. B. 2010. Distribución de primates en Bolivia y áreas prioritarias para su conservación. *Trop. Conserv. Science* 3: 200–217.

Navarro G. 2002. Provincia Biogeográfica Boliviano-Tucumana. En: *Geografía ecológica de Bolivia. Vegetación y ambientes acuáticos*, G.Navarro y M. Maldonado(eds.), pp.349–451. Centro de Ecología Simón I. Patiño-Departamento de difusión. Cochabamba, Bolivia.

Remsen, J. V. y Parker III, T. A. 1995. Bolivia has opportunity to created planet richest park for terrestrial biota. *Bird Cons. Int.* 5: 181–189.

Ríos Uzeda, B., Vargas, J.y Wallace, R. B.2004. Un nuevo registro de mamífero para Bolivia: la jayupa de la altura (*Cuniculus taczanowski*, Rodentia, Cuniculidae). *Mastozool. Neotropical* 11: 5–10.

Rylands, A. B., Schneider, H., Langguth, A., Mittermeier, R. A., Groves, C. P. y Rodriguez-Luna, E. 2000. An assessment of the diversity of new world primates. *Neotrop. Primates* 8: 61–93.

Smith, R. L. y Jungers, W. L. 1997. Body mass in comparative primatology. *J. Hum. Evol.* 32: 523–559.

Stotz, D. F., Fitzpatrick, J. W., Parker III, T. A., y Moskovits, D. K. 1996. *Neotropical birds: ecology and conservation.* Univ. Chicago Press., Chicago, Illinois.

Tarifa, T., Rechberger, J., Wallace, R. B. y Núñez, A. 2001. Confirmación de la presencia de *Odoicoleus virginianus* (Artyodactyla, Cervidae) de Bolivia, y datos preliminares sobre su ecología y simpatría con *Hippocamelus antisiensis*. *Ecología en Bolivia* 35: 41–49.

Van Roosmalen, M. G. M., Van Roosmalen, T., y Mittermeier, R. 2002. A taxonomic review of titi monkeys, genus *Callicebus* Thomas, 1903, with the description of two new species, *Callicebus bernhardi* y *Callicebus sthephennashi*, from Brazilian Amazonian. *Neotrop. Primates* 10: 1–52.

Wallace, R. B. y Painter, L. E. 1999. A new primate record for Bolivia: An apparently isolated population of common woolly monkeys representing a southern range extension for the genus *Lagothrix*. *Neotrop. Primates* 7(4): 111–113.

Wallace, R. B., Painter, L. E., Taber, A. B. y Ayres, J. M. 1996. Notes on a distributional river boundary and southern range extension for two species of Amazonian primates. *Neotrop. Primates* 4(4): 149–151.

Wallace, R. B., Gómez, H.,Felton, A., y Felton, A. M.2006. On a new species of titi monkey, genus *Callicebus* Thomas (Primates, Pitheciidae), from Western Bolivia with preliminary notes on distribution and abundance. *Primate Conserv*. 20: 29–39.

AN INCIDENT OF SWIMMING IN A LARGE RIVER BY A MANTLED HOWLING MONKEY (*ALOUATTA PALLIATA*) ON THE NORTH COAST OF HONDURAS

Daniel Gonzalez-Socoloske
Kymberley Anne Snarr

Introduction

With the exception of hominids, most primates rarely travel or forage in water (but see Williamson *et al.*, 1988; Parnell and Buchanan-Smith, 2001). There are no reported cases of swimming by prosimians; however a number of cercopithecoids (Old World monkeys) are capable of swimming (bonnet macaques *Macaca radiata:* Agoramoorthy *et al.*, 2000, proboscis monkeys *Nasalis larvatus*: Bennett, 1988; Bennett and Sebastian, 1988; Yeager, 1991, olive baboons *Papio anubis*: Forthman, 1999–2000, Japanese macaques *Macaca fuscata fuscata*: Wata, 1981). Among the platyrrines (New World monkeys), several species may inhabit or utilize swamp forests and seasonally flooding forests (*Cebus* spp.: Fernandes, 1991; Snarr, 2009, *Alouatta* spp.: Kinzey, 1997; Bravo and Sallenave, 2003; Snarr, 2009, *Cacajao* spp., *Aotus* spp., and *Saimiri* spp.: Bezerra *et al.*, 2010), but accounts of swimming or crossing bodies of water are rare and have only been reported for howling monkeys, *Alouatta* spp., and golden-backed uakaris *Cacajao melanocephalus*. *Cacajao melanocephalus* were only observed swimming when they accidentally fell into the water and returned immediately to a nearby tree (Bezerra *et al.*, 2010). Several authors have inferred that *Alouatta* can swim based on anecdotal reports (Collins and Southwick, 1952; Milton, 1982; Izawa and Lozano, 1990) or from identifiable animals on islands moving to adjacent areas (Froehlich and Thorington, 1982; Feeley and Terborgh, 2005). Glander (Neville *et al.*, 1988; K. E. Glander, pers. comm.) placed a captured male mantled howling (*Alouatta palliata*) on a natural stone in the middle of a relatively fast moving river in Costa Rica and it swam 15 m to shore without hesitation. Kinzey (1997) stated that both mantled and red howlers are excellent swimmers, however there is only one published first-hand observation of a wild howler swimming without human manipulation (*A. seniculus*: Izawa and Lozano, 1990). We report the use of a major river by an adult male mantled howling monkey in the attempt to swim from one patch of forest to another on the north coast of Honduras.

Study Site

The study site, Cuero y Salado Wildlife Refuge (CSWR; 15°46'30"N, 87°3'25"W; sea level, 13,255 ha; PROBAP, 2002; WCS, 2002) situated 18 km west of La Ceiba, the largest urban area in the Atlantida region of Honduras, is one of the 26 wildlife refuges in Honduras (PROBAP, 2002). Both mantled howling monkeys and white-faced capuchin monkeys (*Cebus capucinus*) are found in the refuge (Snarr, 2005, 2006). Central American spider monkeys (*Ateles geoffroyi*) are not present but appear to have been historically present in the refuge (Trapido and Galindo, 1955; Snarr, 2009). The natural areas of the refuge are made up of regenerating patches of red mangrove (*Rhizophora mangle*), and lowland wet tropical forest, containing a complex series of salt and freshwater wetlands (Snarr, 2009). In addition, there are areas rich in thick mats of vines and lianas. Beyond the natural areas, the refuge is a mosaic of regenerating agricultural lands, private agricultural holdings with small plantations of African palm and other subsistence crops, and cattle pasture land. Surrounding CSWR, there are large African palm (*Elais* sp.) plantations and citrus groves eliminating virtually all connectivity between the refuge and other natural areas (Snarr, 2009).

Observations

On July 21st 2005, Daniel Gonzalez-Socoloske and assistant Jose Paz were conducting an Antillean manatee (*Trichechus manatus manatus*) survey in the eastern portion of CSWR on an overcast day (Gonzalez-Socoloske *et al.*, 2009). While traveling southeast up the Salado river from survey point 14 at the mouth of the Salado river to survey point 16 located at the junction of the Marinero and Salado rivers, Gonzalez-Socoloske saw what initially appeared to be a small child jumping repeatedly in a spread eagle manner from a small dugout canoe piloted by two local fishermen. However, upon approaching the swimmer, Gonzalez-Socoloske confirmed that it was a mantled howler (*Alouatta palliata*), swimming in the water in a dog-paddling manner with only the head above the water. The local fishermen in the canoe reported that minutes earlier, they saw the howler swimming west across the river and when they approached it climbed onto their canoe. As the fishermen paddled slowly across the river, the howler would jump off of the canoe but then return to it. When Gonzalez-Socoloske approached within 1 m of the mantled howler, the howler climbed onto the front end of the small (1x3 m) flat-bottom research boat. The encounter occurred where the river is at least 150 m wide, beginning at 7:34 am and lasting 20 minutes (see Figure 1). Based upon Carpenter's (1934) criteria, the mantled howler was identified as an adult male based upon his large white testicles, large body size, and pronounced mantle (Figure 2).

While traveling on the research boat with Gonzalez-Socoloske, the howler avoided direct eye contact with the researchers but moved his gaze from the shore and the water. The howler jumped in and out of the boat several times when the boat slowed down or when the researchers turned the 25HP outboard motor off. The howler would begin swimming towards the western shore of the river, but as the researchers followed it to one side it would turn towards the boat and climb on again. Soft 'uh, uh, uh, uh' vocalizations were given at irregular intervals. The howler remained passive and in a seated position in the boat as it moved. The researchers traveled upriver with the howler in the boat for ~1.25km and when they approached the western side of the river, the howler climbed from the boat onto red mangrove stilt roots, resting 3 m up in the canopy along the water's edge (Fig. 1). The howler rested there until the boat left the river's edge. Prior to the event of swimming, Gonzalez-Socoloske and residents in the Salado village reported that the adult male howler was solitary for approximately three days and fed from a large mango tree that was fruiting during that time.

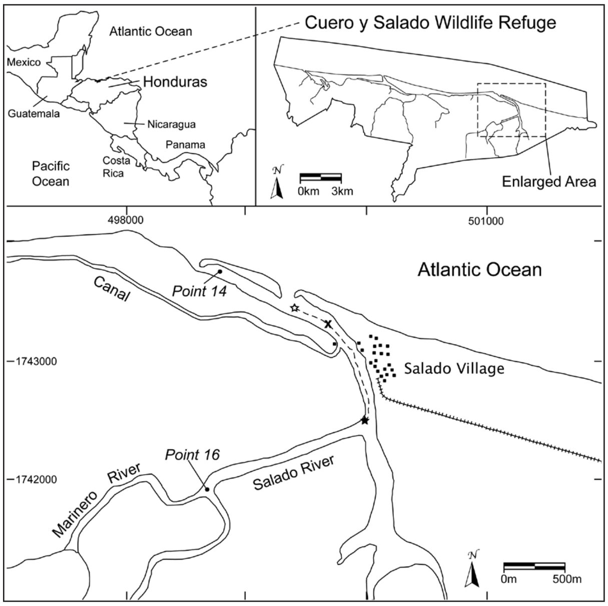

Figure 1. Study site and observation location of the swimming mantled howler (*Alouatta palliata*) in Cuero y Salado Wildlife Refuge, Honduras. Boat travel path with the howler (dashed line) after it climbed on the boat at 7:34 am (hollow star) and jump off the boat at 7:55am (solid star). The approximate location where Figure 2 was taken (x).

Figure 2. Photograph of the adult male mantled howler (*Alouatta palliata*) in Cuero y Salado Wildlife Refuge, Honduras, shortly after it climbed onto the front end of research boat (7:38 am, 7/21/2005). The dugout canoe that first encountered it swimming can be seen on the top right and several buildings from the Salado village on the eastern shore on the left. The boat is traveling upriver heading southeast. Photo Credit: Daniel Gonzalez-Socoloske

Discussion

During Snarr's (2006) study period in 2001, there was no evidence of howlers using water for travel. In the ethnographic inquiry, locals reported that howlers rarely used the ground for travel with no mention of howlers using water for travel (Snarr, 2009). Gonzalez-Socoloske (2007) reports no other observations of howlers using water for travel in CSWR; however, assistant Jose Paz reported that while this was a rare event, he had seen it before, including one occasion in which an adult male and female were seen crossing together.

Caiman and crocodiles are listed as potential predators of New World monkeys (Miller, 2002), but have not been observed predating on any. Both crocodiles (*Crocodylus acutus*) and caiman (*Caiman crocodilus chiapasius*) were commonly seen in the refuge on a near daily basis (DG-S pers. obs.; KAS pers. obs.). Thus, it is a surprise that a howler would be crossing the river. It may be that the crocodiles and caiman are not considered a threat by the howlers. However considering the rarity of ground use and especially water use for travel by howlers, it is more likely that they don't know them as potential predators. Howlers have shown considerable flexibility in their diet and social systems, and have been able to live in fragments under great ecological stresses (McCann *et al.*, 2003; Rodriguez-Toledo *et al.*, 2003; Burton and Carroll, 2005). Although they are normally highly arboreal, studies have shown that they can exhibit behavioral plasticity in disturbed and isolated habitats and under extreme environmental conditions (i.e. high temperatures), at times exhibiting otherwise uncommon behavior such as frequent ground use (Glander, 1992; Pozo-Montuy and Serio-Silva, 2007) and feeding and drinking from ground sources (Gilbert and Stouffer, 1989; Bicca-Marques, 1992; Serio-Silva and Rico-Gray, 2000; Clark *et al.*, 2002; Almeida-Silva *et al.*, 2005; Pozo-Montuy and Serio-Silva, 2007). This swimming incident may demonstrate further this flexibility in fragmented forests and to what extent a howling monkey will go to disperse or to obtain a desired food source.

The swimming behavior (paddling with all four legs with only the head out of the water) observed for *A. palliata* is consistent with other anecdotal accounts for the species (Collins and Southwick, 1952) and that of *A. seniculus* reported by Izawa and Lozano (1990). The adult male had no injuries and appeared to be in good health. In addition, after interviewing residents of the Salado Village there was no evidence found that the howler was driven into the water by any human or animal predator (howlers are well tolerated in CSWR; see Snarr, 2009). Thus, it appears that it entered the water on its own accord. We speculate it would have crossed the river without any assistance had it not been disturbed because it did not appear out of breath or in a state of panic when it climbed on the research boat, even though it was in close proximity with the researchers. Interestingly, the red howler encountered by Izawa and Lozano (1990) swimming across a 200 m river also climbed onto their canoe when they approached it and it was also an adult male. They suggested that it might have been a solitary male dispersing to a new habitat.

Rivers have been examined as important barriers and determinants of ecological and genetic distribution and variation in species and communities (Haffer, 1982; Gascon *et al.*, 1996; Peres *et al.*, 1996; Gascon *et al.*, 1998; Gascon *et al.*, 2000). In New World primates, the effects of river as barriers have been examined by Ayres and Clutton-Brock (1992), da Silva and Oren (1996), Peres *et al.* (1996), and Collins and Dubach (2000). This documented event of a mantled howler attempting to swim across a 150 m slow moving river indicates that while rare, howlers do cross rivers, and that this type of water system may not be an effective barrier to them. Like other uncommon behaviors (i.e. ground use), it may become more common as forests are increasingly fragmented and howlers are forced to use waterways for reaching suitable habitats.

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References

Agoramoorthy, G., Smallegange, I., Spruit, I. and Hsu, M. J. 2000. Swimming behaviour among bonnet macaques in Tamil Nadu: A preliminary description of a new phenomenon in India. *Folia Primatol.* 71:152–153.

Almeida-Silva B., Guedes, P. G., Boubli, J. P. and Strier, K. B. 2005. Deslocamento terrestre e o comportamento de beber em um grupo de barbados (*Alouatta guariba clamitans*, Cabrera, 1940) em Minas Gerais, Brasil. *Neotrop. Primates* 13(1):1–3.

Ayers, J. M. and Clutton-Brock, T. H. 1992. River boundaries and species range size in Amazonian primates. *Am. Nat.* 10:537–551.

Bennett, E. 1988. Proboscis monkeys and their swamp forests in Sarawak. *Oryx* 22(2):69–74.

Bennett, E. and Sebastian, A. C. 1988. Social organization and ecology of Proboscis monkeys (*Nasalis larvatus*) in mixed coastal forest in Sarawak. *Int. J. Primatol.* 9(3):233–255.

Bezerra, B. M., Barnett, A. A., Souto, A. and Jones, G. In press. Ethogram and natural history of golden-backed uakaries (*Cacajao melanocephalus*). *Int. J. Primatol.*

Bicca-Marques, J. C. 1992. Drinking behavior in the black howler monkey (*Alouatta caraya*). *Folia Primatol.* 5: 107–111.

Burton, F. D. and Carroll, A. 2005. By-product mutualism: conservation implications amongst monkeys, figs, humans and their domesticants in Honduras. In: *Commensalism and Conflict: The Human-Primate Interface. Volume 4, Special Topics in Primatology*, J. D. Paterson and J. Wallis (eds.), pp. 24–39. Norman, Oklahoma.

Carpenter, C. R. 1934. A field study of the behavior and social relations of howling monkeys (*Alouatta palliata*). *Comp. Psych. Monographs* 10(2), serial no. 48, John Hopkins Press, Baltimore

Clarke M. R., Collins, D. A. and Zucker, E. L. 2002. Responses to deforestation in a group of mantled howlers (*Alouatta palliata*) in Costa Rica. *Int. J. Primatol.* 23:365–381.

Collins, A. C., and Dubach, J. M. 2000. Biogeographic and ecological forces responsible for speciation in *Ateles*. *Int. J. Primatol.* 21(3):421–444.

Colllins, N. and Southwick, C. 1952. A field study of population density and social organization in howling monkeys. *Proc. Am. Phil. Soc.* 96(2):143–156.

da Silva, J. M. C. and Oren, D. C. 1996. Application of parsimony analysis of endemicity in Amazonian biogeography: An example of primates. *Biol. J. Linn. Soc.* 59:427–437.

Feeley, K. J. and Terborgh, J. W. 2005. The effects of herbivore density on soil nutrients and tree growth in tropical forest fragments. *Ecology* 86(1):116–124.

Fernandes, M. E. B. 1991. Tool use and predation of oysters (*Crassostrea rhizophorae*) by tufted capuchins, *Cebus apella apella*, in brackish water mangrove swamp. *Primates* 32(4):529–531.

Forthman, D. 1999–2000. Note on water 'play' by an olive baboon *Papio anubis* in Gilgil, Kenya. *Afr. Primates* 4(1&2):74.

Froehlich, J. W. and Thorington, R. W. 1982. Food limitation on a small island and the regulation of population size in mantled howling monkeys (*Alouatta palliata*). *Am. J. Phys. Anthropol.* 57:190.

Gascon, C., Malcolm, J. R., Patton, J. L., da Silva, M. N. F., Bogart, J. P., Lougheed, S. C., Peres, C. A., Neckel, S. and Boag, P. T. 2000. Riverine barriers and the geographic distribution of Amazonian species. *P. Natl. Acad. Sci. (USA)* (25):13672–13677.

Gascon, C., Lougheed, S. C. and Bogart, J. P. 1996. Genetic and morphological variation in *Vanzolinus discondactylus*. *Biotropica* 28(3):376–387.

Gascon, C., Lougheed, S. C. and Bogart, J. P. 1998. Patterns of genetic population differentiation in four species of Amazonian frogs: A test of the riverine barrier hypothesis. *Biotropica* 30:104–119.

Gilbert, K., and Stouffer, P. C. 1989. Use of a ground water source by mantled howlers (*Alouatta palliata*). *Biotropica* 21:380.

Glander K. E. 1992. Dispersal patterns in Costa Rica mantled howling monkeys. *Am. J. Primatol.* 13:415–436.

Gonzalez-Socoloske, D. 2007. Status and distribution of manatees in Honduras and the use of side-scan sonar. Masters thesis, University of Loma Linda, Loma Linda, California.

Gonzalez-Socoloske, D., Olivera-Gomez, L. D., and Ford, R. E. 2009 Detection of free-ranging West Indian manatees *Trichechus manatus* using side-scan sonar. *Endang. Species Res.* 8:249–257.

Haffer, J. 1982. General aspects of the refuge theory. In: *Biological Diversification in the Tropics,* G. T. Prance (ed.), pp.5–22. University Press, New York.

Izawa, K. and Lozano, M. H. 1990. River crossing by a wild howler monkey (*Alouatta seniculus*). *Field studies of New World monkeys, La Macarena, Colombia* 3:29–33.

Kinzey, W. G. 1997. Synopsis of New World Primates (16 genera): *Alouatta*. In: *New World Primates: Ecology, Evolution, and Behavior,* W. G. Kinzey (ed.), pp. 174–185. Aldine de Gruyter, New York.

McCann, C., Williams-Guillen, K., Koontz, F., Espinoza, A. A. R., Sanchez, J. C. M. and Koontz, C. 2003. Shade coffee plantations as wildlife refuge for mantled howler monkeys (*Alouatta palliata*) in Nicaragua. In: *Primates in Fragments: Ecology in Conservation,* L. K. Marsh (ed.), pp. 321–342. Kluwer Academic/Plenum Publishers, New York.

Miller, L. E. 2002. The role of group size in predator sensitive foraging decisions for wedge-capped capuchin monkeys (*Cebus olivaceus*). In: *Eat or Be Eaten: Predator Sensitive Foraging Among Primates,* L. E. Miller (ed.), pp. 95–106. Cambridge University Press, United Kingdom.

Milton, K. 1982. Dietary quality and demographic regulation in a howler monkey population. In: *The Ecology of the Tropical Forest, Seasonal Rhythms and Long-Term Change*, A. S. Rand and D. M. Windsor (eds.), pp. 273–289. Smithsonian Institution Press, Washington, D. C.

Neville, M. K., Glander, K. E., Braza, F. and Rylands, A. B. 1988. The Howling Monkeys, Genus *Alouatta*. In: *Ecology and Behavior of Neotropical Primates, Volume 2*, R. A. Mittermeier, A. B. Rylands, A. F. Coimbra-Filho and G. A. B. da Fonseca (eds.), pp. 349–453. World Wildlife Fund, Washington.

Parnell, J. P. and Buchanan-Smith, H. M. 2001. An unusual social display by gorillas. *Nature* 142:294.

Peres, C. A., Patton, J. L. and da Silva, M. F. 1996. Riverine barriers and gene flow in Amazonian saddle-back tamarins. *Folia Primatol.* 67:113–124.

Pozo-Montuy, G. and Serio-Silva, J. C. 2007. Movement and resource use by a group of *Alouatta pigra* in a forest fragment in Bálancan, Mexico. *Primates* 48:102–107.

PROBAP 2002. Proyecto de Biodiversidad en Áreas Prioritarias de AFE-CODEFOR (Administración Forestal de Estrado, Corporación de Desarrollo Forestal). CODEFOR, Honduras.

Rodriguez-Toledo, E. M., Mandujano, S. and Garcia-Orduna, F. 2003. Relationships between forest fragments and howler monkeys (*Alouatta palliata mexicana*) in Southern Veracruz, Mexico. In: *Primates in Fragments: Ecology and Conservation,* L. K. Marsh (ed.), pp. 79–98. Kluwer Academic/Plenum Publishers, New York.

Serio-Silva, J. C., and Rico-Gray, V. 2000. Use of a stream by Mexican howler monkeys. *Southwestern Nat.* 45(3):332–333.

Snarr, K. A. 2005. Seismic activity response as observed in mantled howlers (*Alouatta palliata*), Cuero y Salado Wildlife Refuge, Honduras. *Primates* 46(4):281–285.

Snarr, K. A. 2006. Life in a lowland wet forest fragment on the north coast of Honduras: The mantled howlers (*Alouatta palliata*) of Cuero y Salado Wildlife Refuge. Doctoral thesis, University of Toronto, Toronto, Canada

Snarr, K. 2009. Sustainability in a forest fragment on the north coast of Honduras. VDM Publishing House Ltd., Germany.

Trapido, H., and Galindo, P. 1955. The investigation of a sylvan yellow fever epizootic on the north coast of Honduras, 1954. *Am. J. Trop. Med. Hyg.* 4(4):665–674.

Wata, K. 1981. Habitat utilization by wintering Japanese macaques (*Macaca fuscata fuscata*) in the Shiga Heights. *Primates* 22(3):330–348.

Williamson, E. A., Tutin, C. E. G. and Fernandez, M. 1990. Western lowland Gorillas feeding in streams and on savannas. *Primate Report* 19:29–34.

World Conservation Society (WCS) 2002. Plan de manejo para la Fundación Cuero y Salado (FUCSA). WCS, La Ceiba, Honduras.

Yeager, C. P. 1991. Possible antipredator behavior associated with river crossings by proboscis monkeys (*Nasalis larvatus*). *Am. J. Primatol.* 24(1):61–66.

CONTRIBUIÇÃO À DISTRIBUIÇÃO DO GÊNERO *MICO*, (CALLITRICHIDAE, PRIMATES) NO MÉDIO TELES PIRES, JACAREACANGA, PARÁ

Marcos de Souza Fialho

Metade das espécies de primatas categorizadas como Deficiente em Dados (DD) pelo Ministério do Meio Ambiente da República Federativa do Brasil (Chiarello *et al.*, 2008) pertencem ao gênero *Mico* da família Callitrichidae. Tal realidade se deve, em parte, à existência de lacunas no conhecimento da distribuição geográfica dos táxons. Esta é a situação do *Mico leucippe* (Thomas, 1922), cuja distribuição geográfica conhecida se restringe ao interflúvio Tapajós-Cupari no baixo rio Tapajós (van Roosmalen *et al.*, 2000; Pimenta e Silva Júnior, 2005) (Figura 1). A observação de dois indivíduos de *M. leucippe* na margem direita do rio São Benedito (9°02'51"S, 56°32'09"O), afluente do rio Teles Pires (antigo São Manuel), no município de Jacareacanga, Pará (Figura 1), durante inventário de primatas realizado entre 19 e 22 de março de 2010 (Tabela 1) sugere uma ampliação de mais de 400 km da área de ocorrência para o sul. Relatos de moradores também indicam a ocorrência da espécie às margens do rio Cururu, ao norte. Estas observações sugerem que a distribuição de *M. leucippe* pode contornar as cabeceiras do rio Jamanxim para oeste, tendo o rio São Benedito como limite sul.

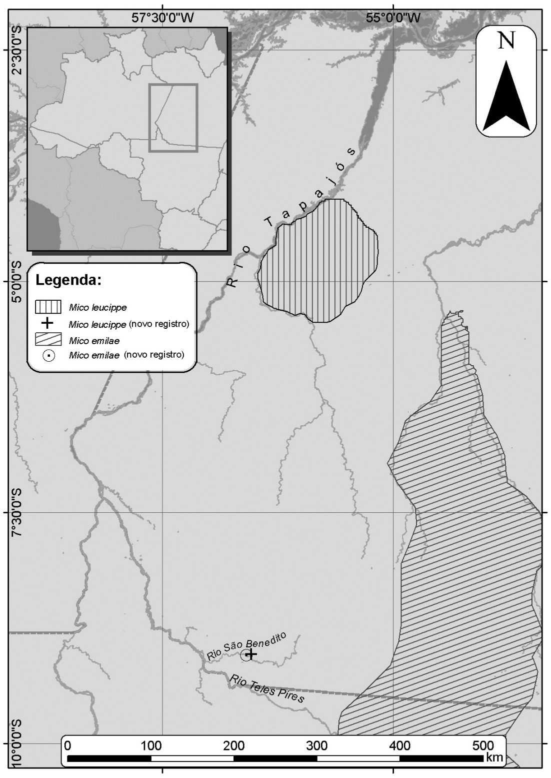

Figura 1. Sítios de observação de *M. leucippe* na margem direita do rio São Benedito, e *M. emiliae* na margem esquerda do rio Teles Pires.

Tabela 1. Registros de primatas ao longo das margens do rio São Benedito, município de Jacareacanga/PA. o = observação, v = vocalização, r = relato.

Táxon	Margem	
	Esquerda	Direita
Alouatta discolor	r	o
Aotus sp.	r	r
Ateles marginatus	o	o
Callicebus sp.	r	v
Cebus apella	r	o
Chiropotes albinasus	o	r
Mico emiliae	o	
Mico leucippe		o
Saimiri sp.	r	r

Um grupo de *Mico emiliae* (Thomas, 1920) (9°03'05"S, 56°35'12'O) composto por, pelo menos, quatro indivíduos foi observado forrageando em uma pequena capoeira na margem esquerda do rio Teles Pires durante a mesma expedição (Fig. 1). Esta observação sugere uma extensão de cerca de 170 km de sua distribuição para oeste, visto que os registros mais ocidentais haviam sido obtidos na Serra do Cachimbo, Pará, e em Peixoto de Azevedo, Mato Grosso (Pimenta e Silva Júnior, 2005).

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Referências

Chiarello A. G., Aguiar L. M. S., Cerqueira R., Melo F. R., Rodrigues F. H. G. e Silva V. M. 2008. Mamíferos ameaçados de extinção no Brasil. Em: *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*, A. B. M. Machado, G. M. Drummont e A. P. Paglia (eds.), pp. 681–702. Ministério do Meio Ambiente; Secretaria de Biodiversidade e Florestas; Departamento de Conservação da Biodiversidade, Brasília.

Pimenta, F. E. e Silva Júnior, J. S. 2005. An update on the distribution of Primates of the Tapajós-Xingu interfluvium, Central Amazonia. *Neotrop. Primates* 13(2): 25–30.

van Roosmalen, M. G. M., van Roosmalen, T., Mittermeier, R. A e Rylands, A. B. 2000. Two new species of marmoset, genus *Callithrix* Erxleben, 1777 (Callithrichidae, Primates) from the Tapajós/Madeira interfluvium, South Central Amazonia, Brazil. *Neotrop. Primates* 8(1): 2–18.

NEWS

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The Instituto Uiraçu is seeking scientific partners to study primates in the Serra Bonita Reserve Complex and to reintroduce primates that formerly inhabited this region. The Serra Bonita Reserve Complex is located in the cocoa region of Southern Bahia, in the Brazilian Atlantic Forest. The complex includes four RPPNs (private reserves), totaling circa 2,000 ha (5,000 acres). Individuals or research teams who would be interested in pursuing research and conservation activities with primates at Serra Bonita are encouraged to submit by email a letter and any supporting materials describing their interests, experience, and qualifications. We encourage potential participants to visit the reserve as part of their deliberations. Please contact Dr. Vitor O. Becker, Scientific Director of Instituto Uiraçu, Email: Becker.vitor@gmail.com

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RECENT PUBLICATIONS

BOOKS

Primate Neuroethology, edited by M. Platt and A. Ghazanfar. 2010. Oxford University Press. 688pp. ISBN: 978–0195326598. This book collects information on primate behavior and cognition, neurobiology, and the emerging discipline of neuroethology. Here leading scientists review work ranging from primate foraging behavior to the neurophysiology of motor control, from vocal communication to the functions of the auditory cortex. The resulting synthesis yields a richer understanding of primates that also sheds light on the evolutionary development of human behavior and cognition. *Contents:* 1. Introduction – M. Platt and A. Ghazanfar; 2. Primate classification and diversity – M. Cartmill; 3. Primate locomotor evolution – D. Schmitt; 4. Foraging cognition in nonhuman primates – K. Zuberbühler & K. Janmaat; 5. Primate vocal communication – R. Seyfarth & D. Cheney; 6. Rational decision making in primates – J. Stevens; 7. Primate social cognition – A. Rosati, L. Santos & B. Hare; 8. Behavioral signatures of numerical condition – E. Brannon, K. Jordan & S. Jones; 9. The foundations of transdisciplinary behavioral science – H. Gintis; 10. Sensory and motor systems in primates – J. Kaas; 11. Vision – B. Hayden; 12. Circuits of visual attention – T. Moore, R. Schafer & B. Noudoost; 13. Vocalizations as auditory objects – C. Miller & Y. Cohen; 14. Encoding and beyond in the motor cortex – N. Hatsopoulos, M. Saleh & J. Mattiello; 15. Looking at sounds – J. Groh & D. Pai; 16. Circuits of emotion in the primate brain – K. Gothard & K. Hoffman; 17. Neurophysiological correlates of reward learning – W. Schultz; 18. Associate memory in the medial temporal lobe – Y. Naya & W. Suzuki; 19. Neurobiology of social behavior – D. Maestripieri; 20. Neural bases of numerical cognition – A. Nieder; 21. Executive control circuits – J. Wallis; 22. Reinventing primate neuroscience for the twenty-first century – T. Preuss; 23. Ethologically relevant movements mapped on the motor cortex – M. Graziano; 24. Object recognition – D. Tsao, C. Cadieu & M. Livingstone; 25. The primate frontal and temporal lobes and their role in multisensory vocal communication – L. Romanski & A. Ghazanfar; 26. Neuroethology of attention in primates – S. Shepherd & M. Platt; 27. Neuroethology of decision making – D. Lee; 28. Out of our minds – L. Barret & D. Rendall; 29. The comparative neuropsychology of tool use in primates with specific reference to chimpanzees and capuchin monkeys – W. Hopkins; 30. Evolution of an intellectual mond in the primate brain – A. Iriki, Y. Yamazaki & O. Sakura.

ARTICLES

Agostini I, Holzmann I, Di Bitetti MS. 2010. Are howler monkey species ecologically equivalent? Trophic niche overlap in syntopic *Alouatta guariba clamitans* and *Alouatta caraya. Am. J. Primatol.* 72(2): 173–186.

Arnedo LF, Mendes FDC, Strier KB. 2010. Sex differences in vocal patterns in the northern muriqui (*Brachyteles hypoxanthus*). *Am. J. Primatol.* 72(2): 122–128.

Arroyo-Rodriguez V, Dias PA. 2010. Effects of habitat fragmentation and disturbance on howler monkeys: a review. *Am. J. Primatol.* 72(1): 1–16.

Baldi M, Morales JA, Hernández G, Jiménez M, Alfaro A, Barquero-Calvo E. 2010. *Chromobacterium violaceum* infection in a free-ranging howler monkey in Costa Rica. *J. Wildlife diseases* 46(1): 306–310.

Behie AM, Pavelka MS, Chapman CA. 2010. Sources of variation in fecal cortisol levels in howler monkeys in Belize. *Am. J. Primatol.* (Advance online publication):1–7.

Boyle SA, Smith AT. 2010. Behavioral modifications in northern bearded saki monkeys (*Chiropotes satanas chiropotes*) in forest fragments of central Amazonia. *Primates* 51(1): 43–51.

Casado F, Bonvicino CR, Nagle C, Comas B, Manzur TD, Lahoz MM, Seuanez HN. 2010. Mitochondrial

divergence between 2 populations of the hooded capuchin, *Cebus* (*Sapajus) cay* (Platyrrhini, Primates). *J. Heredity* 101(3): 261–269.

Dias PAD, Rangel-Negrin A, Vea JJ, Canales-Espinosa D. 2010. Coalitions and male-male behavior in *Alouatta palliata*. *Primates* 51(1): 91–94.

Felton AM, Felton A, Foley WJ, Lindenmayer DB. 2010. The role of timber tree species in the nutritional ecology of spider monkeys in a certified logging concession, Bolivia. *Forest Ecol. & Management* 259(8): 1642–1649.

Fragaszy D, Pickering T, Liu Q, Izar P, Ottoni E, Visalberghi E. 2010. Bearded capuchin monkeys' and a human's efficiency at cracking palm nuts with stone tools: field experiments. *Anim. Behav.* 79(2): 321–332.

Gutierrez-Granados G, Dirzo R. 2010. Indirect effects of timber extraction on plant recruitment and diversity via reductions in abundance of frugivorous spider monkeys. *J. Trop. Ecol.* 26: 45–52.

Hilario RR, Ferrari SF. 2010. Feeding ecology of a group of buffy-headed marmosets (*Callithrix flaviceps*): fungi as a preferred resource. *Am. J. Prim.* 72(6): 515–521.

Hilario RR, Ferrari SF. 2010. Double infanticide in a free-ranging group of buffy-headed marmosets, *Callithrix flaviceps*. *J. Ethology* 28(1): 195–199.

Hiwatashi T, Okabe Y, Tsutsui T, Hiramatsu C, Melin AD, Oota H, Schaffner CM, Aureli F, Fedigan LM, Innan H, Kawamura S. 2010. An explicit signature of balancing selection for color vision variation in New World monkeys. *Mol. Biol. & Evol.* 27(2): 453–464.

Lima MA, Romano-Lieber NS, Duarte AMRC. 2010. Circulation of antibodies against yellow fever virus in a simian population in the area of Porto Primavera Hydroelectric Plant, Sao Paulo, Brazil. *Rev. Inst. Med. Trop. Sao Paulo* 52(1): 11–15.

Maldonado AM, Nijman V, Bearder SK. 2010. Trade in night monkeys *Aotus spp*. in the Brazil-Colombia-Peru tri-border area: international wildlife trade regulations are ineffectively enforced. *Endangered Sp. Research* 9(2): 143–149.

Melo FPL, Martinez-Salas E, Benitez-Malvido J, Ceballos G. 2010. Forest fragmentation reduces recruitment of large-seeded tree species in a semi-deciduous tropical forest of southern Mexico. *J. Trop. Ecol.* 26(1): 35–43.

Nyakatura JA, Heymann EW. 2010. Effects of support size and orientation on symmetric gaits in free-ranging tamarins of Amazonian Peru: implications for the functional significance of primate gait sequence patterns. *J. Human Evol.* 58(3): 242–251.

Oliveira LC, Hankerson SJ, Dietz JM, Raboy BE. 2010. Key tree species for the golden-headed lion tamarin and implications for shade-cocoa management in southern Bahia, Brazil. *Anim. Conserv.* 13(1): 60–70.

Palminteri S, Powell G, Endo W, Kirkby C, Yu D, Peres CA. 2010. Usefulness of species range polygons for predicting local primate occurrences in southeastern Peru. *Am. J. Prim.* (Advance online publication):1–9.

Parathian HE, Maldonado AM. 2010. Human-nonhuman primate interactions amongst Tikuna people: perceptions and local initiatives for resource management in Amacayacu in the Colombian Amazon. *Am. J. Primatol.* (Advance online publication):1–11.

Pave R, Kowalewski MM, Peker SM, Zunino GE. 2010. Preliminary study of mother-offspring conflict in black and gold howler monkeys (*Alouatta caraya*). *Primates* (Advance online publication):1–6.

Pedersen AB, Davies TJ. 2010. Cross-species pathogen transmission and disease emergence in primates. *Ecohealth* (Advance online publication):1–14.

Silva Junior WM, de Melo FR, Moreira LS, Barbosa EF, Meira-Neto JAA. 2010. Structure of Brazilian Atlantic forests with occurrence of the woolly spider monkey (*Brachyteles hypoxanthus*). *Ecol. Research* 25(1): 25–32.

Spehar SN, Link A, Di Fiore A. 2010. Male and female range use in a group of white-bellied spider monkeys (*Ateles belzebuth*) in Yasuni National Park, Ecuador. *Am. J. Primatol.* 72(2): 129–141.

Stojan-Dolar M, Heymann EW. 2010. Vigilance of mustached tamarins in single-species and mixed-species group - the influence of group composition. *Behav. Ecol. & Sociobiol.* 64(3): 325–335.

Svensson MS, Samudio R, Bearder SK, Nekaris KAI. 2010. Density estimates of Panamanian owl monkeys (*Aotus zonalis*) in three habitat types. *Am. J. Primatol.* 72(2): 187–192.

Valenta K, Fedigan LM. 2010. Spatial patterns of seed dispersal by white-faced capuchins in Costa Rica: evaluating distant-dependent seed mortality. *Biotropica* 42(2): 223–228.

Wenz A, Heymann EW, Petney TN, Taraschewski HF. 2010. The influence of human settlements on the parasite community in two species of Peruvian tamarin. *Parasitol.* 137(4): 675–684.

MEETINGS

2010

"Gombe 50": The Primate Society of Great Britain Winter Meeting

The Winter Meeting will take place in London, UK, from December 8 to 9, 2010. For more information visit the web site: http://www.psgb.org/Meetings/Winter2010.htm

2011

XX Congreso Nazionale Dell´Associazione Primatologica Italiana

The XX Congress of the Italian Primatological Society will take place in the Parco Natura Viva, Verona, Italy, from April 10 to 13, 2011. For more information visit the web site: http://www.parconaturaviva.it//Il-Parco/Dipartimentu/Ricerca/convegnoAPI2011

80th Annual Meeting of the American Association of Physical Anthropologists

The annual meeting of the American Association of Physical Anthropologists will take place in Minneapolis, Minnesota, USA, from April 12 to 16, 2011. For more information visit the web site: http://physanth.org/annual-meeting/2011

20th Annual meeting of the International Behavioral Neuroscience Society

The annual meeting of the International Behavioral Neuroscience Society will be held in Steamboat Springs, Colorado, USA, from May 24–29, 2011. The major goal of the meeting is to bring together scientists whose interests are in the broad area of understanding the neural control of behavior. Abstract submission deadline: February 8, 2011. For more information go to http://www.ibnshomepage.org/annualmtg11.htm

Joint Meeting of the International Ethological Conference and the Animal Behavior Society

The International Ethological Conference and the Animal Behavior Society will have a joint meeting this year at the Indiana University, Bloomington, Indiana, USA, from July 25–30, 2011. For more information and registration go to: http://www.indiana.edu/~behav11

45th Congress of the International Society for Applied Ethology

The 45th congresso of the International Society for Applied Ethology will take place in Indianapolis, USA, from July 31 to August 4, 2011. The general theme will be Scientific evaluation of behavior, welfare and enrichment; and some of the specific topics: Zoo animal behavior, Laboratory animal behavior, Engineering environments & measurement technologies for science and welfare Pain, distress & humane end-points. Abstract submission closes February 14th. For more information visit http://www.applied-ethology.org/isaemeetings.htm

34th Meeting of the American Society of Primatologist

The meeting of the American Society of Primatologist will be held in Austin, Texas, USA, fro, August 13–17, 2011. Preliminary abstracts for symposia and workshops should be submitted by January 15, 2011. General abstracts deadline March 12, 2011. **For more information go to** http://www.asp.org/asp2011/index.htm

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Notes to Contributors

Scope

The journal/newsletter aims to provide a basis for conservation information relating to the primates of the Neotropics. We welcome texts on any aspect of primate conservation, including articles, thesis abstracts, news items, recent events, recent publications, primatological society information and suchlike.

Submissions

Please send all English and Spanish contributions to: Erwin Palacios, Conservación Internacional – Colombia, Carrera 13 # 71-41 Bogotá D.C., Colombia, Tel: (571) 345-2852/54, Fax: (571) 345-2852/54, e-mail: <epalacios@conservation.org>, and all Portuguese contributions to: Júlio César Bicca-Marques, Departamento de Biodiversidade e Ecologia, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga, 6681 Prédio 12A, Porto Alegre, RS 90619-900, Brasil, Tel: (55) (51) 3320-3545 ext. 4742, Fax: (55) (51) 3320-3612, e-mail: <jcbicca@pucrs.br>.

Contributions

Manuscripts may be in English, Spanish or Portuguese, and should be double-spaced and accompanied by the text on CD for PC compatible text-editors (MS-Word, WordPerfect, Excel, and Access), and/or e-mailed to <epalacios@conservation.org> (English, Spanish) or <jcbicca@pucrs.br> (Portuguese). Hard copies should be supplied for all figures (illustrations and maps) and tables. The full name and address for each author should be included. Please avoid abbreviations and acronyms without the name in full. Authors whose first language is not English should please have their English manuscripts carefully reviewed by a native English speaker.

Articles. Each issue of *Neotropical Primates* will include up to three full articles, limited to the following topics: Taxonomy, Systematics, Genetics (when relevant for systematics and conservation), Biogeography, Ecology and Conservation. Text for full articles should be typewritten, double-spaced with no less than 12 cpi font (preferably Times New Roman) and 3-cm margins throughout, and should not exceed 25 pages in length (including references). Please include an abstract in the same language as the rest of the text (English, Spanish or Portuguese) and (optional) one in Portuguese or Spanish (if the text is written in English) or English (if the text is written in Spanish or Portuguese). Tables and illustrations should be limited to six, except in cases where they are fundamental for the text (as in species descriptions, for example). Full articles will be sent out for peer-review. For articles that include protein or nucleic acid sequences, authors must deposit data in a publicly available database such as GenBank/EMBL/DNA Data Bank of Japan, Brookhaven, or Swiss-Prot, and provide an accession number for inclusion in the published paper.

Short articles. These manuscripts are usually reviewed only by the editors. A broader range of topics is encouraged, including such as behavioral research, in the interests of informing on general research activities that contribute to our understanding of platyrrhines. We encourage reports on projects and conservation and research programs (who, what, where, when, why, etc.) and most particularly information on geographical distributions, locality records, and protected areas and the primates that occur in them. Text should be typewritten, double-spaced with no less than 12 cpi (preferably Times New Roman) font and 3-cm margins throughout, and should not exceed 12 pages in length (including references).

Figures and maps. Articles may include small black-and-white photographs, high-quality figures, and high-quality maps. (Resolution: 300 dpi. Column widths: one-column = 8-cm wide; two-columns = 17-cm wide). Please keep these to a minimum. We stress the importance of providing maps that are publishable.

Tables. Tables should be double-spaced, using font size 10, and prepared with MS Word. Each table should have a brief title.

News items. Please send us information on projects, field sites, courses, Thesis or Dissertations recently defended, recent publications, awards, events, activities of Primate Societies, etc.

References. Examples of house style may be found throughout this journal. In-text citations should be first ordered chronologically and then in alphabetical order. For example, "…(Fritz, 1970; Albert, 1980, 2004; Oates, 1981; Roberts, 2000; Smith, 2000; Albert *et al.*, 2001)…"

In the list of references, the title of the article, name of the journal, and editorial should be written in the same language as they were published. All conjunctions and prepositions (i.e., "and", "In") should be written in the same language as rest of the manuscript (i.e., "y" or "e", "En" or "Em"). This also applies for other text in references (such as "PhD thesis", "accessed" – see below). Please refer to these examples when listing references:

Journal article

Stallings, J. D. and Mittermeier, R. A. 1983. The black-tailed marmoset (*Callithrix argentata melanura*) recorded from Paraguay. *Am. J. Primatol.* 4: 159–163.

Chapter in book

Brockelman, W. Y. and Ali, R. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Rain Forest,* C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.

Book

Napier, P. H. 1976. *Catalogue of Primates in the British Museum (Natural History). Part 1: Families Callitrichidae and Cebidae.* British Museum (Natural History), London.

Thesis/Dissertation

Wallace, R. B. 1998. The behavioural ecology of black spider monkeys in north-eastern Bolivia. Doctoral thesis, University of Liverpool, Liverpool, UK.

Report

Muckenhirn, N. A., Mortensen, B. K., Vessey, S., Fraser, C. E. O. and Singh, B. 1975. Report on a primate survey in Guyana. Unpublished report, Pan American Health Organization, Washington, DC.

Website

UNESCO. 2005. UNESCO Man and the Biosphere Programme. United Nations Educational, Scientific, and Cultural Organisation (UNESCO), Paris. Website: http://www.unesco.org/mab/index.htm. Accessed 25 April 2005. ("Acessada em 25 de abril de 2005" and "Consultado el 25 de abril de 2005" for articles in Portuguese and Spanish respectively).

For references in Portuguese and Spanish:

"and" changes to "e" and "y" for articles in Portuguese and Spanish respectively.

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"Doctoral thesis" changes to "Tese de Doutoramento" and "Tesis de Doctorado" for articles in Portuguese and Spanish respectively.

"MSc Thesis" changes to "Dissertação de Mestrado" and "Tesis de Maestría" for articles in Portuguese and Spanish respectively.

"Unpublished report" changes to "Relatório Técnico" and "Reporte no publicado" for articles in Portuguese and Spanish respectively.

Neotropical Primates
A Journal and Newsletter of the IUCN/SSC Primate Specialist Group
Vol. 17(1), June 2010

Contents

Articles

Cambios Demográficos en Poblaciones de Primates de la Región Sur de Los Tuxtlas, Mexico: Análisis Longitudinal 1985–2008
Brenda Solórzano García y Ernesto Rodríguez Luna 1
Gastrointestinal Parasites of Owl Monkeys (*Aotus azarai azarai*) in the Argentinean Chaco
J. P. Perea-Rodriguez, A. M. Milano, B. E. Osherov and E. Fernandez-Duque 7
Demography and Conservation Status for the Critically Endangered Mexican Howler Monkey (*Alouatta palliata mexicana*) in the southern part of Los Tuxtlas Biosphere Reserve, Veracruz, Mexico
Eric Isaí Ameca - y Juarez, Ernesto Rodríguez - Luna and Georgina M. Mace 12

Short Articles

Plant Feeding Patches: Patterns of use by Associating *Callimico goeldii*, *Saguinus labiatus*, and *S. fuscicollis*
Jennifer Alexis Rehg 18
Was There Ever a Muriqui (*Brachyteles*) Population in the Ilha do Cardoso State Park in Southeastern Brazil?
Bianca Ingberman, Roberto Fusco-Costa, Carolina Carvalho Cheida, Eduardo Cardim Nakano-Oliveira,
Renato Garcia Rodrigues y Emygdio Leite Araujo Monteiro-Filho 21
Extensión de Rango de Distribución del Mono Lucachi *Callicebus aureipalatii* (Pitheciidae) para el Departamento de La Paz, Bolivia
Omar Martínez 24
An Incident of Swimming in a Large River by a Mantled Howling Monkey (*Alouatta palliata*) on the North Coast of Honduras)
Daniel Gonzalez-Socoloske and Kymberley Anne Snarr 28
Contribuição À Distribuição do Gênero *Mico*, (Callitrichidae, Primates) No Médio Teles Pires, Jacareacanga, Pará
Marcos de Souza Fialho 31

News 32

Recent Publications 33

Meetings 34

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