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Front cover: A juvenile *Alouatta guariba clamitans* from Rio de Janeiro, Brazil. Photo by Russell A. Mittermeier.

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SHORT ARTICLES

PRIMER CENSO DEL MONO AULLADOR NEGRO (*ALOUATTA PALLIATA AEQUATORIALIS*) EN EL CHOCÓ BIOGEOGRÁFICO COLOMBIANO

Carolina Ramírez-Orjuela
Iván M. Sánchez-Dueñas

Introducción

Para Colombia, Panamá y Ecuador se ha reconocido la subespecie *Alouatta palliata aequatorialis* (Rylands *et al.*, 2000). *Alouatta palliata* es probablemente la especie de primate más estudiada del Nuevo Mundo y las poblaciones mejor investigadas han sido las de la isla Barro Colorado en Panamá y las de la Hacienda La Pacífica en Costa Rica (Fedigan *et al.*, 1998). En Colombia, el conocimiento del estado actual de *A. p. aequatorialis* no ha tenido mayores avances desde que su distribución geográfica y ecología fueron descritas por Hernández-Camacho y Cooper (1976). Entre 1995 y 1996 se realizó el primer estudio sobre la dieta de este primate en la región del Chocó Biogeográfico Colombiano (Ramírez-Orjuela, 1997) con el apoyo de la Fundación Natura, el Proyecto Biopacífico y la Fundación Inguedé.

El Chocó Biogeográfico es una de las zonas con mayor biodiversidad y endemismo del planeta (Mast *et al.*, 1993). Por esta razón y por su alto grado de amenaza, es considerado como una de las 25 Ecorregiones Terrestres Prioritarias (ETP) del mundo (Mittermeier *et al.*, 1999). Esta ETP comprende los bosques húmedos y semihúmedos tropicales de Panamá, Colombia, Ecuador y Perú, cuya extensión original fue estimada en 260 595 km^2 pero actualmente sólo permanece el 24% de la vegetación nativa. Las amenazas actuales que pesan sobre esta región son las mismas que se presentan en casi todas las ETP del mundo; éstas incluyen desde los cambios climáticos, el avance de la colonización y el desarrollo infraestructural, hasta la transformación directa de la tierra en campos agrícolas. Adicionalmente, la cacería sigue siendo un problema sobre todo hacia especies mayores de aves y mamíferos (Mittermeier *et al.*, 1999).

La necesidad de obtener estimaciones precisas de las densidades poblacionales de especies amenazadas, es fundamental para establecer prioridades en la formulación de planes de manejo y conservación (Defler y Pintor, 1985). En primates, el método del transecto lineal ha sido ampliamente usado durante las últimas tres décadas porque permite obtener índices confiables del estado de la población (Peres, 1999; De Thoisy, 2000). Este método ha sido recomendado en estudios cortos con requerimientos limitados y se ha utilizado con diferentes objetivos: 1) para cuantificar la abundancia poblacional de primates en bosques tropicales (De Thoisy, 2000; Wallace *et al.*, 2000); 2) para hacer comparaciones entre áreas (Peres, 1997; Chapman y Balcomb, 1998); 3) para monitorear el estado poblacional a través del tiempo (Clarke y Zucker, 1994); 4) para investigar los efectos de la cacería (Peres, 1990, 1997) y, más recientemente, 5) para evaluar los efectos de la fragmentación del hábitat (Chiarello y Melo, 2001; González-Solís *et al.*, 2001).

Este estudio tuvo como objetivo principal censar por primera vez una población del mono aullador negro (*Alouatta palliata aequatorialis*) en el Chocó Colombiano, así como conocer en forma preliminar su abundancia poblacional en la zona. Este trabajo también aporta consideraciones que deben tomarse en cuenta para reducir las amenazas sobre las poblaciones locales de este primate. Pretendemos que este estudio sirva como base metodológica para estudios posteriores que se deben realizar en otras localidades del Chocó Biogeográfico y con ello conocer el estado de conservación de esta subespecie en todo su rango de distribución.

Métodos y Área de Estudio

Área de estudio
El estudio se realizó en un bosque húmedo tropical de la Estación Biológica El Amargal (05°34'25"N, 77°30'22"W), localizada sobre la región costera en el área de Cabo Corrientes, a cinco km de la población de Arusí, Departamento del Chocó, Colombia (Fig. 1). La topografía de esta área se caracteriza por las montañas con pendientes entre 10–50° que descienden hasta las playas, drenadas

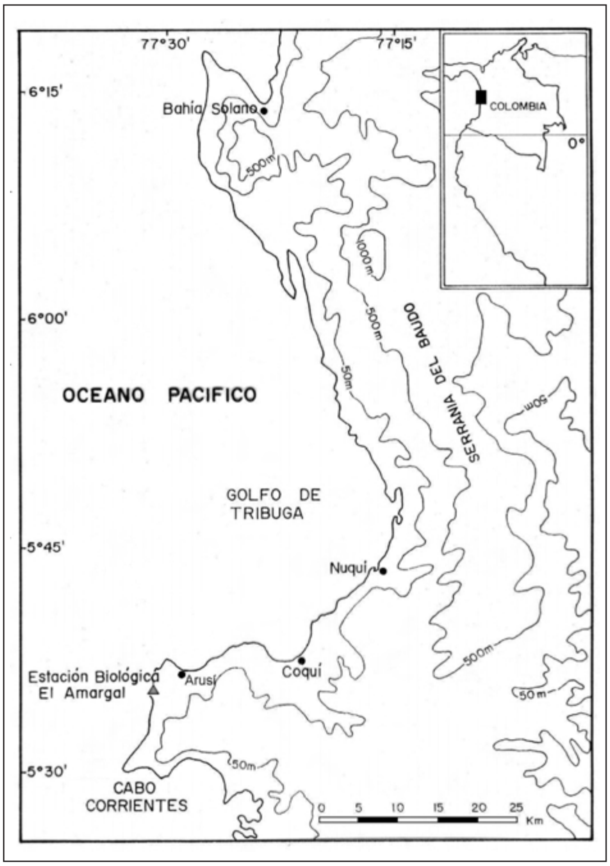

Figura 1. Ubicación de la Estación Biológica El Amargal en la Costa Pacífica, Departamento del Chocó, Colombia.

por quebradas y pequeños ríos (Galeano *et al.*, 1998). Con base en los registros climáticos de nueve años (1993–2001), los promedios anuales de precipitación y temperatura son de 7,735 mm y 24.5°C respectivamente. El censo se realizó en el mes de marzo de 2002, correspondiente a la época de menor precipitación durante el año. De acuerdo con el estudio de vegetación realizado en la Estación Biológica El Amargal por Galeano *et al.* (1998), el bosque corresponde a un bosque maduro caracterizado por poseer un gran número de árboles grandes, un dosel denso con alturas entre 35–45 m y árboles emergentes que alcanzan 59 m de altura.

La mayoría de los habitantes en esta región pertenecen a la población negra (80%), mientras que los indígenas Embera (5%) y los blancos (15%) son minoría. La economía primaria se basa en la pesca, el cultivo (de arroz y plátano) y la explotación de maderas. El turismo constituye una actividad de reciente implementación (Jimeno *et al.*, 1995). Múltiples factores tales como el difícil acceso por la precariedad o inexistencia de las vías de comunicación y la ausencia del Estado, hacen que las condiciones de vida y las capacidades de desarrollo sean muy limitadas para los pobladores locales. Los índices de calidad de vida son los más bajos de Colombia y la desnutrición, el analfabetismo y el desempleo, registran las tasas más elevadas del país (Díaz, 1993).

Censos

Para estimar la densidad poblacional de *Alouatta palliata aequatorialis*, empleamos el método del transecto lineal siguiendo los lineamientos propuestos por Peres (1999). Este método ha sido ampliamente aplicado durante las últimas tres décadas para cuantificar la abundancia poblacional de primates en bosques tropicales (Peres, 1999). Trazamos dos transectos de quatro km cada uno, aprovechando el previo conocimiento de la presencia de algunos grupos de monos aulladores en esta zona. El transecto N°1 (T1) correspondió a un tramo del camino preexistente entre la Estación Biológica El Amargal y el pueblo de Arusí. El transecto N°2 (T2) siguió los cursos de algunas quebradas y caminos preexistentes (Fig. 2). En cada uno de los transectos estimamos la abundancia de algunos recursos alimenticios para los monos aulladores con el objeto de conocer si la presencia o ausencia de recursos condicionaría la probabilidad de tener avistamientos durante los recorridos.

A partir del estudio realizado por Ramírez-Orjuela (1997) e información de nuestro auxiliar de campo, obtuvimos un listado preliminar de las especies vegetales presentes en los transectos, que componen la dieta de los monos aulladores en la zona. En 82 estaciones de muestreo que cubrieron un área total de 10.30 ha contamos el número de árboles (DAP > 20 cm) e identificamos su estado fenológico. Para determinar la abundancia de los recursos alimenticios en cada transecto, agrupamos las especies vegetales de acuerdo al nombre común dado en la región (morfotipo), de manera que la abundancia fue registrada para cada uno de estos grupos y no para cada especie en particular.

Realizamos los censos desde las 6:00–7:00 hasta las 12:00 horas, y desde las 13:00 hasta las 18:00 horas. Recorrimos cada transecto a una velocidad aproximada de 0.5–1.0 km/h, con breves paradas cada 100 m para inspeccionar el área y minimizar el ruido. T1 fue recorrido 24 veces acumulando 96 km, mientras que T2 lo recorrimos 18 veces acumulando 72 km. El ancho del transecto fue estimado con base en tres métodos: Leopold, Green y Kelker (NRC, 1981). Una vez establecido éste, calculamos la densidad grupal (*Dg*) a partir de la siguiente fórmula (NRC, 1981):

$$\text{Densidad } (Dg) = \frac{\text{Sumatoria de todos los avistamientos}}{2\text{ (longitud} \times \text{ancho del transecto)}}$$

Resultados

Reconocimos 15 morfotipos de plantas que según Ramírez-Orjuela (1997) son consumidas por los monos aulladores y corresponden aproximadamente a 35 especies (Tabla 1). El "lechero" (*Brosimum utile*, Moraceae) fue la especie más abundante en ambos transectos y en toda el área evaluada. La mayoría de los árboles se encontraron en estado de fructificación, otros estuvieron florecidos, en estado vegetativo (con hojas maduras y jóvenes), o habían perdido completamente las hojas.

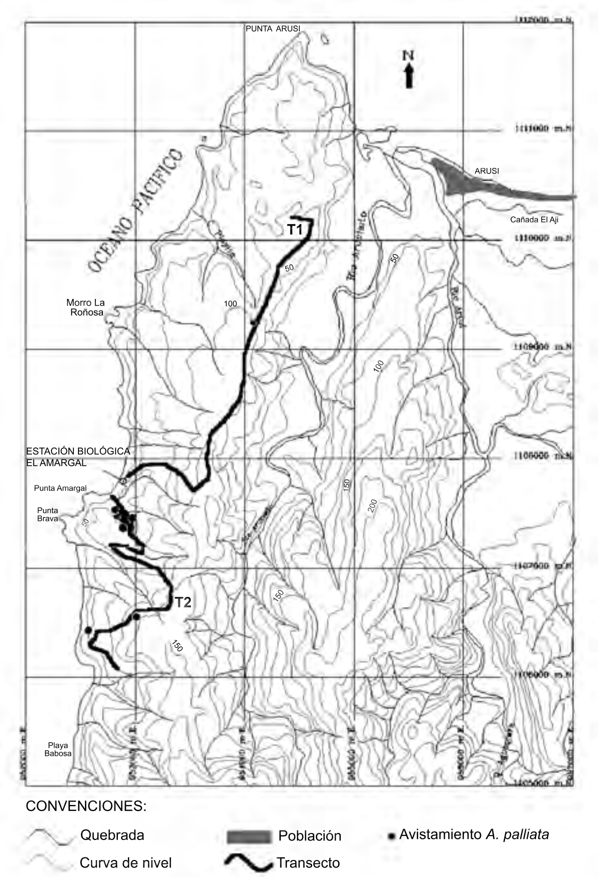

Figura 2. Ubicación de los transectos (T1 y T2) y de los avistamientos de monos aulladores (*A. p. aequatorialis*) cerca a la Estación Biológica El Amargal.

Tabla 1. Abundancia absoluta (árboles/hectárea) de los recursos disponibles para el mono aullador negro (*Alouatta palliata aequatorialis*) en los transectos destinados al censo.

Familia	Especie(s)	Nombre Común	Abundancia		
			Transecto 1	Transecto 2	Promedio
Moraceae	*Brosimum utile*	Lechero	14.56	13.01	13.79
Cecropiaceae	*Cecropia insignis*	Guarumo	4.27	10.10	7.18
	Cecropia obtusifolia				
Sapotaceae	*Chrysophyllum* sp.	Caimito	6.60	6.80	6.70
	Pouteria aff. *cuspidata*				
	Pouteria sp.				
Rubiaceae	*Faramea occidentalis*				
Myristicaceae	*Otoba latialata*	Cuángare	2.52	5.83	4.17
	Virola elongata				
Moraceae	*Castilla tunu*	Cauchillo	2.91	4.08	3.50
	Perebea xanthochyma				
	Pseudolmedia laevigata				
Fabaceae	*Inga acrocephala*	Churimo	1.75	4.47	3.11
	Inga coruscans				
	Inga macradenia				
	Inga mucuna				
	Inga panamensis				
	Inga quaternata				
	Inga sp.				
	Pterocarpus sp.				
Fabaceae	*Pentaclethra macroloba*	Dormilón	0.58	4.66	2.62
	Dipteris panamensis	Choibá	2.33	2.14	2.23
Moraceae	*Ficus* cf. *maxima*	Higueroncillo	1.17	3.30	2.23
	Ficus tonduzii				
Moraceae	*Brosimum lactescens*	Matapalo	0.97	1.75	1.36
	Ficus americana				
	Ficus hartwegii				
	Ficus involuta urbaniana				
	Ficus pallida				
Clusiaceae	*Symphonia globulifera*	Machare	0.00	1.36	0.68
Annonaceae	*Unonopsis* sp.	Ají	0.39	0.19	0.29
Fabaceae	*Dussia macrophyllata*	Bagatá	0.58	0.00	0.29
	Lonchocarpus sp.				
Anacardiaceae	*Anacardium excelsum*	Espavé	0.00	0.58	0.29
Tiliaceae	*Apeiba membranacea*	Peine de mono	0.00	0.39	0.19
Total			**38.64**	**58.64**	**48.64**

Tabla 2. Composición de los grupos de monos aulladores (*Alouatta palliata aequatorialis*) observados en la Estación Biológica El Amargal. Am = Adulto macho, Ah = Adulto hembra, J = Juvenil, I = Infante, NI = No Identificado.

Transecto	Grupo	Composición edad / sexo					
		Am	Ah	J	I	NI	Total
T1	A1	1	1	1	1	6	10
T2	A2	2	11	6	5	9	33
Total	2	3	12	7	6	15	43
Promedio	–	1.5	6	3.5	3	7.5	21.5

Tabla 3. Esfuerzo invertido en el censo y abundancia relativa de monos aulladores (*Alouatta palliata aequatorialis*) en la Estación Biológica El Amargal.

Transecto	Esfuerzo (km)	Avistamientos	Abundancia relativa (grupos/10 km)
T1	96	1	0.10
T2	72	13	1.81
Total	**168**	**14**	**0.83**

Tabla 4. Parámetros empleados para estimar la densidad de monos aulladores (*Alouatta palliata aequatorialis*) mediante tres métodos (ver texto) en la Estación Biológica El Amargal.

Parámetros	Método de Leopold	Método de Green	Método de Kelker
Ancho del transecto (km)	0.03	0.06	0.04
Longitud del transecto (km)	168	168	168
Número de avistamientos	14	14	11
Densidad (grupos/ km^2)	1.5	0.7	0.8

Detectamos la presencia de dos grupos de monos aulladores (A1 y A2). El conteo y la identificación de las diferentes clases de edad y sexo no fueron fáciles. Dadas las condiciones del terreno y la dispersión de los monos, en varias ocasiones empleamos hasta una hora para obtener conteos confiables (Tabla 2). El tamaño promedio del grupo fue de 21.5 individuos.

Recorrimos un total de 168 km y obtuvimos 14 avistamientos lo que corresponde a una abundancia relativa de 0.83 grupos/10 km (Tabla 3). Aunque el esfuerzo invertido en el censo fue levemente mayor para T1, hubo una clara diferencia en la cantidad de avistamientos entre ambos transectos. El alto número de avistamientos obtenido en T2 corresponde a que el grupo A2 fue observado varias veces durante seis días consecutivos en el mismo sector. En la Tabla 4, se presentan los valores del ancho del transecto y la densidad obtenida a partir de los tres métodos empleados.

Discusión

La alta abundancia y los diferentes estados fenológicos (hojas jóvenes y maduras, flores y frutos) que presentaron los recursos evaluados, pueden asegurar una alta disponibilidad de alimento para los monos durante esta época del año. A pesar de ello y del alto esfuerzo invertido en los censos (168 km recorridos), la cantidad de avistamientos en los transectos fue relativamente baja (Tabla 3). Esto puede estar siendo afectado, en parte, por la distribución de los recursos en el bosque. Si están dispuestos en forma agregada, como normalmente sucede con los árboles en fructificación, la localización de los grupos estaría determinada por la ubicación de esos "parches." Esto se observó en T2 donde ocasionalmente observamos a los aulladores alimentándose (Fig. 2), sugiriendo que la concentración de recursos alimenticios provocó la permanencia en ese sitio de uno de los grupos de aulladores durante varios días consecutivos. El bajo número de avistamientos en T1 se puede explicar en parte, por la menor abundancia de recursos y por ende a una menor disponibilidad de alimento con respecto a T2 (Tabla 1). La disponibilidad de recursos alimenticios ha sido una de las variables determinantes en la abundancia de primates, como lo estableció Mendes-Pontes (1999) en la Amazonia brasileña.

En la mayoría de los avistamientos fue difícil realizar conteos exactos del número total de individuos, puesto que la metodología del transecto lineal establece que el observador no debe alejarse del transecto por más de 10 minutos para efectuar el conteo. Aunque algunas veces optamos por alejarnos del transecto hasta por periodos de una hora para obtener conteos confiables, podríamos estar subestimando el tamaño poblacional mediante esta metodología como también lo experimentaron Defler y Pintor (1985) y González-Solís *et al.* (2001) para *A. seniculus* y *A. guariba* respectivamente. El tamaño promedio de grupo (21.5 individuos) es muy alto comparado con los de estudios hechos en México, Costa Rica y Ecuador (Fedigan *et al.*, 1985; Clarke y Zucker, 1994; Estrada y Coates-Estrada, 1996; Charlat *et al.*, 2000; Estrada *et al.*, 2001), donde se registraron tamaños grupales promedio entre siete y 14 individuos. Dado que nuestro conteo de monos pudo estar subestimado, el tamaño promedio grupal en El Amargal puede ser aún mayor.

Considerando que por lo menos 35 especies vegetales proporcionan recursos abundantes para los monos aulladores durante la época de menor precipitación y otras suministran alimento durante gran parte del año en la Estación Biológica El Amargal (Tuberquia *et al.*, 1996), podemos sugerir que la alta disponibilidad de recursos favorece la formación de grupos grandes en ese lugar, así como lo proponen otros autores para distintas localidades (Gaulin y Gaulin, 1982; Chapman y Balcomb, 1998; Mendes-Pontes, 1999). Diferentes características poblacionales de los monos aulladores han sido estudiadas y se han identificado varios factores que determinan en gran parte la estructura poblacional de cada localidad: la disponibilidad (distribución y calidad) del alimento, el parasitismo, la competencia intraespecífica, el infanticidio, la depredación, la aparición eventual de enfermedades y la cacería (Freese *et al.*, 1982; Milton, 1982; Peres, 1997; González-Kirchner, 1998; Chiarello y Melo, 2001). Para conocer la influencia de todos estos factores sobre el tamaño grupal de los monos aulladores en El Amargal, es necesario realizar estudios más detallados y de mayor duración.

González-Solís *et al.* (2001) afirman que las estimaciones de densidad obtenidas a partir de pocos avistamientos deben ser interpretadas con cuidado. De Thoisy (2000) menciona que las densidades obtenidas a partir de transectos lineales realizados en periodos de tiempo relativamente cortos, deben ser considerados como un índice más que como una densidad absoluta. A pesar de estas desventajas, el método del transecto lineal es práctico, eficiente, de bajo costo y por ser ampliamente utilizado permite que los resultados sean comparables entre diferentes estudios (NRC, 1981; Stevenson, 1996; Peres, 1999). Estas ventajas y la carencia de información sobre las características poblacionales de *A. palliata* en Colombia, justificaron el uso del método en la Estación Biológica El Amargal para obtener aportes preliminares al estado actual de la población de *A. palliata*, como lo hicieron González-Solís *et al.* (2001) para *A. guariba clamitans* y *Brachyteles arachnoides arachnoides* en Brasil.

Una característica poblacional de los aulladores en El Amargal es la baja densidad grupal y el gran tamaño grupal promedio, comparados con los resultados de otros estudios. Estrada (1982) y Estrada y Coates-Estrada (1985) registraron densidades (crudas y ecológicas) de aproximadamente 2.43 grupos/km^2 en la región de Los Tuxtlas (México). Esta densidad grupal es mayor que la registrada en El Amargal (0.7–1.5 grupos/km^2). Aparentemente, en Los Tuxtlas existe un alto número de grupos pero de menor tamaño comparados con los de El Amargal, lo que podría explicar en parte la diferencia en las densidades de los dos sitios. En el Parque Yumká (México), Estrada *et al.* (2001) establecieron densidades muy elevadas para *A. palliata* en un fragmento de bosque completamente aislado (11.9 grupos/km^2). Las causas de esta inusual densidad de aulladores la desconocen ellos, pero sugieren que la incapacidad de colonizar hábitats muy distantes hace que los aulladores permanezcan en el fragmento durante varios años. En la Hacienda La Pacífica (Costa Rica), Clarke y Zucker (1994) registraron valores de densidad poblacional altos (8.2 grupos/km^2) comparados con los nuestros. De acuerdo con estos autores, existe evidencia de cambios poblacionales a través de la paulatina formación de grupos transitorios (asociaciones alimenticias), que aunque no llegan a ser grupos semipermanentes, explicaría en parte la gran abundancia de grupos. En la isla Barro Colorado (Panamá), Milton (1982) encontró una densidad ecológica de 92 ind./km^2, y ella propone que al igual que en la Hacienda La Pacífica, los bosques están cerca de su capacidad de carga y pueden estar saturados de aulladores. En este caso, la alta densidad es característica de una población que ha permanecido estable en el tiempo y la mortalidad, como su principal regulador, ocurre por procesos naturales tales como el parasitismo y la escasez periódica y con frecuencia impredecible de alimento de buena calidad.

Al comparar la estructura poblacional encontrada en este estudio con la de otras localidades (México, Costa Rica, Panamá y Ecuador), la mayoría de ellas con gran influencia de factores antrópicos, podemos sugerir que la presencia de grupos grandes y la baja densidad de éstos en El Amargal puede ser el estado "natural" de esta especie bajo condiciones favorables que han perdurado desde hace muchos años; por ejemplo, la continuidad del hábitat con gran representatividad de bosques primarios conservados y poca presión de cacería. Esta situación se asemeja en parte, a la descrita para la isla de Barro Colorado en Panamá (Milton, 1982).

La baja densidad grupal y el gran tamaño grupal promedio de los monos aulladores en El Amargal, determinan que sus áreas de dominio vital sean extensas y nos puede hacer pensar que los transectos de quatro km de longitud empleados no son suficientes para detectar a más de un grupo en cada recorrido. Sin embargo, no creemos que esto sea un factor limitante para obtener estimaciones de densidad con el método del transecto lineal, siempre y cuando se obtenga el número de avistamientos necesario para emplear métodos estadísticos robustos. Aunque Chapman y Balcomb (1998) afirman que es muy difícil estimar las densidades poblacionales de primates en áreas muy grandes (como sucedería en El Amargal), la NRC (1981) y Defler y Pintor (1985) proponen que el método más exacto para hacer estas estimaciones es el estudio detallado de grupos específicos, porque permite obtener cálculos confiables de a) el área utilizada por los primates y b) del tamaño y la composición grupal. Aplicando este método en El Amargal obtendríamos valores de densidad ecológica, parámetro que es muy cercano a la densidad "real" y que resulta ser un mejor estimador de la abundancia poblacional, como lo señala Mendes-Pontes (1999).

Consideraciones para la Conservación de *A. p. aequatorialis*

Por varios años, la UICN ha clasificado a *A. p. aequatorialis* como taxón de "Preocupación Menor" (*Least Concern*) en su libro rojo de especies amenazadas (IUCN, 2001, 2003). En Colombia ha sido colocada como Vulnerable (VU) siguiendo los mismos criterios de la UICN (Defler, 2003). Las poblaciones del mono aullador negro han sido afectadas principalmente por grandes disturbios en su hábitat, tales como la deforestación total, inundaciones por la construcción de represas, y por su cacería indiscriminada (Crockett, 1998). En México, la rápida desaparición de áreas boscosas redujo la distribución original de *A. palliata* (Estrada y Coates-Estrada, 1984).

Algunas zonas de la Ecorregión Prioritaria Terrestre "Chocó–Darién–Ecuador occidental," en particular el Chocó y Ecuador occidental, han figurado entre las máximas prioridades de conservación del mundo desde hace unos 20 años. Esto ha fomentado la realización de varios proyectos de conservación por parte de los gobiernos nacionales, instituciones financieras y organizaciones de conservación internacionales y nacionales (Mittermeier *et al.*, 1999). A pesar de estos esfuerzos institucionales, actualmente en Colombia no existe un programa de conservación del mono aullador negro como sí lo hay en México (Crockett, 1998), lo que merece ser considerado si se tiene en cuenta que las poblaciones colombianas pueden representar cerca del 50% de la población total de esta subespecie (Defler, 1996). A medida que avance la colonización y la destrucción de los bosques primarios del pacífico colombiano con fines de desarrollo, podemos esperar que las poblaciones de monos aulladores residentes en los alrededores de la Estación Biológica El Amargal sufran un proceso similar al descrito para la Hacienda La Pacífica en Costa Rica. En este sitio, Clarke y

Zucker (1994) han reportado que a medida que aumenta la alteración de los bosques en el área, los monos aulladores experimentan una reorganización poblacional mediante la separación de grupos grandes en grupos más pequeños.

Las poblaciones humanas de la costa Pacífica han sido objeto de numerosas acciones de desarrollo que han demostrado ser incapaces de brindar oportunidades de vida mejor y de preservar la integridad biológica y cultural de esos ecosistemas, porque además de los intereses de las comunidades locales convergen otros de orden departamental, nacional y mundial y por lo general, éstos últimos son los que priman (Casas y Bosini, 1998). Bajo este panorama poco alentador, la implementación de grandes programas de conservación parece ser poco factible por el momento, sobre todo si emplean altas sumas de dinero. Dadas las condiciones actuales, las comunidades locales esperan que cualquier apoyo externo les sirva en primera instancia para suplir necesidades básicas de alimentación, salud y educación.

Consideramos que en la región de Cabo Corrientes en particular, se puede implementar un monitoreo a largo plazo de la población de aulladores. Este monitoreo se puede llevar a cabo mediante la formulación y ejecución de proyectos de investigación con enfoques biológicos, ecológicos, veterinarios y culturales, con el fin de identificar la estructura poblacional, su dinámica, los factores (bióticos y abióticos) que la regulan, la magnitud de la relación entre los monos y su hábitat, y el interés socio-económico y cultural que tiene la comunidad hacia estos animales. La continua recopilación de esta información, con la participación activa de los habitantes locales, irá consolidando las bases conceptuales para estructurar programas de conservación de mayor envergadura.

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DIETA, FORRAJEO Y PRESUPUESTO DE TIEMPO EN COTONCILLOS (*CALLICEBUS DISCOLOR*) DEL PARQUE NACIONAL YASUNÍ EN LA AMAZONIA ECUATORIANA

Gabriel Carrillo-Bilbao
Anthony Di Fiore
Eduardo Fernández-Duque

Introducción

La subfamilia Callicebinae se encuentra representada por el género *Callicebus*, conocidos en Ecuador como cotoncillos o songo-songos (Tirira, 1999). La sistemática del género ha recibido importantes revisiones últimamente luego que Hershkovitz (1990) realizara una revisión taxonómica en la que llevó el número de especies de tres a 13 (Kinzey, 1981; de la Torre, 1998; Van Roosmalen *et al.*, 2002). Actualmente, sólo dos especies del género se encuentran en Ecuador (*C. lucifer* y *C. discolor*, Van Roosmalen *et al.*, 2002) y las mismas habitan el bosque lluvioso tropical amazónico.

Todas las especies de *Callicebus* han sido siempre descriptas como socialmente monógamas, diurnas, arborícolas y territoriales (Kinzey, 1981; Wright, 1986; Robinson *et al.*, 1987; García y Tarifa, 1988, 1991; Stallings y Robinson, 1991; Defler, 1994; Brooks, 1996; Müller, 1996a, 1996b; Tirira, 1999; Bossuyt, 2002; Van Roosmalen *et al.*, 2002; Norconk, en prensa). La alimentación

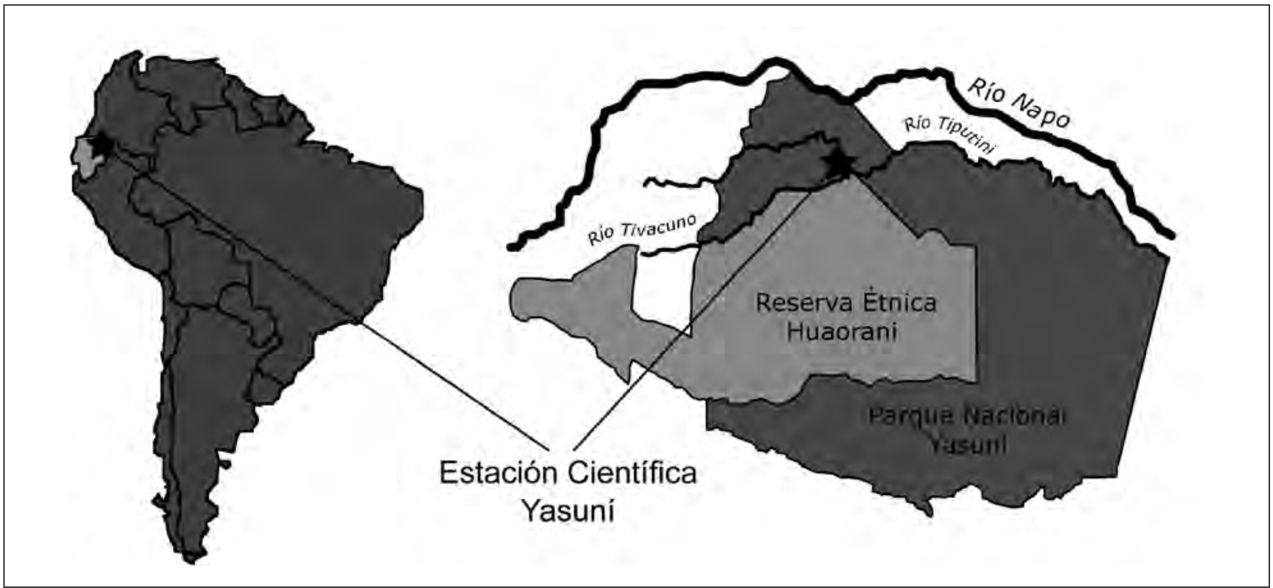

Figura 1. Área de estudio en el Parque Nacional Yasuní, Amazonia, Ecuador.

está basada en el consumo de hojas inmaduras, frutos, flores e insectos, prefiriendo los estratos medios y bajos del bosque denso (Kinzey, 1977, 1981, 1997; Wright, 1985; Campos, 1991; de la Torre, 1998). Los grupos sociales tienen entre dos y cinco individuos que se mantienen juntos la mayor parte del tiempo. La poca información disponible sugeriría que los juveniles dejan el grupo a los dos o tres años de edad (Wright, 1985, 1986; Müller, 1996a; Bossuyt, 2002). La dispersión del sub-adulto aparentemente es estimulada por el nacimiento de la nueva cría. La hembra produce una cría al año (de la Torre, 1998), luego de una gestación de aproximadamente 160 días (Valeggia *et al.*, 1995, 1999) y la cría lacta aproximadamente durante ocho meses. El macho participa activamente en el cuidado de la cría, siendo quien la transporta la mayor parte del tiempo (Wright, 1984; Mendoza y Mason, 1986).

En el presente trabajo resumimos los resultados de un estudio realizado como parte de un proyecto de investigación a largo plazo de las especies de primates monógamas del Parque Nacional Yasuní (Schwindt *et al.*, 2004; Hurst *et al.*, 2005; Di Fiore *et al.*, sometido). El objetivo del estudio fue describir y cuantificar aspectos generales de la ecología y comportamiento de un grupo de *Callicebus discolor*, incluyendo estimaciones de su área de vida, presupuesto de tiempo, dieta y forrajeo.

Métodos

Área y grupo de estudio

El estudio se llevó a cabo en La Reserva de la Biósfera Yasuní (74.5°W, 0.7°S), en la amazonia ecuatoriana (Fig. 1). La reserva se encuentra entre los 5 y 600 msnm en una zona de bosque lluvioso tropical que registra una temperatura anual promedio que varía entre los 23 y 25.5°C (Di Fiore, 2001). La zona se caracteriza por tener una época lluviosa y una seca durante el año, con un promedio de precipitación anual de 2000 a 4000 mm. Las abundantes lluvias favorecen la existencia de varios tipos de formaciones vegetales como los bosques de tierra firme (90%), bosques de varzeas, bosques de igapó y bosques de pantano (Taco, 2001).

En Ecuador se registran un total de 19 especies de primates, de las cuales 15 se encuentran en los bosques tropicales de la amazonia ecuatoriana (de la Torre, 1998). Específicamente en la zona donde se realizó este estudio se registran hasta la fecha 10 especies de primates (Di Fiore, 2001).

El grupo estudiado estaba conformado por una hembra adulta, dos individuos de similar tamaño (“adulto” y “subadulto”) y un individuo de tamaño menor (“juvenil”). Ocho meses antes de comenzar el estudio, se capturó a la hembra adulta para colocarle un collar siguiendo los procedimientos utilizados en monos nocturnos (*Aotus* spp.), una especie de tamaño similar (Fernández-Duque y Rotundo, 2003).

Colección y análisis de datos

La toma de datos se realizó durante ocho meses entre agosto del 2003 y marzo del 2004. Previamente se había implementado un sistema de transectas marcadas y mapeadas que facilitó el seguimiento del grupo. Durante dicho período, se realizaron seguimientos del grupo desde las seis de la mañana hasta aproximadamente las cinco de la tarde, cuando el grupo se aprestaba a dormir. Durante el tiempo que se permanecía en contacto con el grupo se tomaron datos de uso del espacio, uso de los diferentes estratos del bosque, dieta y comportamiento social.

Los datos sobre uso del espacio se tomaron cada 20 minutos. La posición del grupo fue determinada en base a la ubicación del individuo que se observaba durante un determinado período focal. Los datos sobre uso del estrato vertical (suelo, sotobosque, subdosel, dosel bajo, dosel medio y dosel alto) se colectaron de todos los individuos visibles cada cinco

Tabla 1. Especies vegetales ingeridas por *Callicebus discolor* y parte de la planta utilizada.

Familia	Especie	Parte utilizada
Arecaceae	*Iriartea deltoidea*	Hojas nuevas
Bignoniaceae	*Memora cladotricha*	Hojas nuevas
Bignoniaceae	*Siparuna* sp.	Fruto
Bombacaceae	*Matisia malacocalyx*	Fruto
Caesalpiniaceae	*Brownea grandiceps*	Hoja
Cecropiaceae	*Cecropia ficifolia*	Fruto
Cecropiaceae	*Cecropia sciadophylla*	Fruto
Cecropiaceae	*Pourouma bicolor*	Fruto
Cecropiaceae	*Pourouma minor*	Fruto
Euphorbiaceae	*Alchornea triplinervia*	Fruto
Fabaceae	*Bauhinia guianensis*	Fruto
Fabaceae	*Inga acreana*	Fruto
Fabaceae	*Inga auristellae*	Fruto
Fabaceae	*Inga capitata*	Fruto
Fabaceae	*Inga marginata*	Fruto
Fabaceae	*Inga thibaudiana*	Fruto
Fabaceae	*Inga umbratica*	Hoja
Fabaceae	*Zygia heteroneura*	Hoja
Flacourtiaceae	*Tetrathylacium macrophyllum*	ver texto
Lecithydaceae	*Gustavia longifolia*	Fruto
Melastomataceae	*Bellucia pentamera*	Fruto
Melastomataceae	*Blakea* sp.	Fruto
Melastomataceae	*Miconia napoana*	Hojas nuevas y flor
Melastomataceae	*Miconia* sp. 1	Fruto
Melastomataceae	*Miconia* sp. 2	Fruto
Melastomataceae	*Mouriri myrtilloides*	Hoja
Meliaceae	*Trichilia elegans*	Hojas nuevas
Phytolaccaceae	*Trichostigma octandra*	Hojas nuevas
Sapindaceae	*Paullinia simulans*	Tallo joven
Tiliaceae	*Apeiba membranacea*	Fruto y hoja nueva

minutos. Para registrar el estado comportamental se hicieron muestreos focales de 20 minutos de todos los individuos en el grupo. Durante cada período de 20 minutos se realizaron muestreos instantáneos del individuo focal cada minuto y muestros de barrido de todos los miembros observables del grupo cada cinco minutos. Las categorías que se utilizaron para registrar el estado comportamental de los individuos en cada muestreo instantáneo fueron: forrajeo, alimentación, movimiento, descanso y comportamiento social.

El análisis de los datos está basado en información colectada durante 260 horas de observación distribuídas en 168 días durante los ocho meses de estudio. Para el cálculo del área de vida se determinó el polígono máximo utilizando los puntos más lejanos en donde se observó al grupo. Para estimar el número de especies vegetales ingeridas, se colectaron especímenes de todas las especies que fueron consumidas. Los mismos fueron luego examinados y clasificados taxonómicamente con la colaboración del personal del herbario que mantiene la Estación Científica Yasuní.

El análisis de los datos consistió en obtener el porcentaje de muestreos instantáneos y muestreos de barrido en los que se registró cada una de las variables dependientes cuantificadas (por ejemplo, forrajeo, estrato árboreo) en cada hora, obteniendo luego promedios para cada día y finalmente promedios para toda la duración del estudio.

Resultados y Discusión

El grupo utilizó aproximadamente 3.3 hectáreas como área de vida durante el período de estudio. El tamaño del área de vida se encuentra dentro de lo habitualmente descripto para otras especies de *Callicebus* (Mason, 1966; Robinson, 1979, 1981; Easley y Kinzey, 1986; Robinson *et al.*, 1987; Norconk, en prensa). Nunca se observó otro grupo dentro del área utilizada por el grupo bajo estudio, mientras que sí se localizaron grupos en la periferia. Estas observaciones, si bien en cierta manera preliminares, refuerzan la noción que los *Callicebus* son territoriales, entendiéndose por ello que hacen un uso relativamente exclusivo de su área de vida.

Con respecto a la utilización vertical del espacio, los monos utilizaron preferentemente los estratos medios del bosque. Utilizaron mayormente el subdosel (46% de los registros), seguido del sotobosque (34%), dosel bajo (14%), dosel medio (5%) y dosel superior (1%). El grupo utilizó para su dieta un total de 30 especies vegetales, agrupadas en 21 géneros pertenecientes a 14 familias. La familia Fabaceae fue la más utilizada con un total de ocho especies consumidas, seguida por las familias Melastomataceae y Cecropiaceae con seis especies de la primera y cuatro de la segunda (Tabla 1). Dado que los géneros *Miconia* y *Cecropia*, intensamente utilizados por los monos, son géneros asociados a bosques perturbados, se podría suponer que esta especie podría adaptarse a vivir en bosques no primarios.

La dieta vegetal del grupo incluyó frutos, hojas, flores y tallos. La dieta consistió principalmente de frutos (63% de los registros), seguido por hojas (28%), flores (6%) y tallos (3%). Los datos obtenidos indican un importante rol de *Callicebus* como posible dispersor de semillas. Es interesante destacar la utilización de *Tetrathylacium*, ya que las hojas de esta planta fueron masticadas y luego frotadas por el cuerpo de manera similar al comportamiento observado en monos nocturnos en cautiverio (Evans *et al.*, 2004). Esta conducta también ha sido observada en *Callicebus cupreus* en el Parque Nacional Manú en Perú, en donde Bossyut (pers. com.) observó a estos monos masticar hojas nuevas de cinco especies de la familia Annonaceae y de una enredadera (Bignoniaceae) y frotárselas por el abdomen.

Con respecto al uso del tiempo, los individuos pasaron más de la mitad del tiempo forrageando (42% de los registros), mientras que el resto del tiempo fue distribuido de una manera relativamente similar entre socializar (15%), descansar (8%), ingerir alimentos (8%) o moverse (10%). Los animales estuvieron fuera de vista el resto del tiempo (17%) lo que ilustra la naturaleza críptica de la especie.

La información aquí presentada y los análisis correspondientes nos permiten concluir que el grupo de *Callicebus discolor* bajo estudio es socialmente monógamo, diurno, principalmente frugívoro y aparentemente territorial. El alto porcentaje de registros fuera de vista y la preferencia por estratos bajos de poca visibilidad también sugieren una probable estrategia de cripticidad para evitar predadores. Si bien es necesario resaltar el carácter netamente preliminar de este estudio, los patrones observados sugieren que la ecología comportamental de *Callicebus discolor* se ajustaría a los patrones descriptos para otras especies de cotoncillos. Los estudios en progreso de otros grupos sociales de *Callicebus discolor* en la Estación de Biodiversidad Tiputini en la amazonia ecuatoriana permitirán evaluar la generalidad de los resultados obtenidos en este estudio.

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VOCALIZAÇÕES DE LONGO ALCANCE COMO COMUNICAÇÃO INTRA-GRUPAL NOS BUGIOS (*ALOUATTA GUARIBA*)

Sandra Steinmetz

Introdução

Os primatas das florestas neotropicais, onde a visibilidade é pequena, são muito dependentes de comunicação vocal (Marler, 1965; Seyfarth, 1987). Dentre estes primatas, os bugios são bem conhecidos por suas vocalizações (Whitehead, 1987; Neville *et al.*, 1988). O osso hióide alargado dos adultos, uma estrutura única entre os primatas, atua como uma caixa de ressonância, auxiliando a produzir o rugido ou ronco (Altmann, 1959; Schön Ybarra, 1988).

As vocalizações de longo alcance nos bugios são constituídas por rugidos (*howls* ou *roars*) e latidos (*barks*) que têm elevada amplitude e podem ser ouvidas a centenas de metros de distância (Oliveira, 1997). O rugido tem sido bastante estudado e é considerado um meio de comunicação intergrupal (Carpenter, 1934; Altmann, 1959; Chivers, 1969; Baldwin e Baldwin, 1976).

Observações sobre as vocalizações de longo alcance foram coletadas em um estudo sobre o comportamento e ecologia do bugio, *Alouatta guariba*, realizado no Parque Estadual Intervales (Steinmetz, 2000, 2001).

Métodos

O Parque Estadual Intervales (PEI) abrange uma área de 49.888 ha de Mata Atlântica situada no Estado de São Paulo, entre a Serra de Paranapiacaba e o Vale do Ribeira, com sede no Município de Ribeirão Grande (24°12' a 24°25'S e 48°03' a 48°30'W).

O clima da região do Parque Intervales é temperado. A precipitação anual é maior que 1.000 mm e não existe estação seca. A temperatura média do mês mais frio é de 18°C e do mês mais quente 22°C (Petroni, 2000). Durante o ano de estudo (novembro 1998 a outubro 1999) a temperatura média foi de 16,2°C e a precipitação total 1.707,82 mm (dados obtidos na sede do Parque Estadual Intervales).

O padrão de atividades e dieta de um grupo de seis indivíduos—composto inicialmente por dois adultos machos, um sub-adulto macho, um jovem macho, uma fêmea adulta e um infante—foram registrados através de amostragem instantânea, mensalmente de novembro 1998 a outubro 1999. Durante o início do estudo, o sub-adulto saiu do grupo. As observações diretas do grupo totalizaram 92 dias ou 918:30 horas (Steinmetz, 2000).

A quantificação do padrão de atividades sociais foi dividida nas seguintes categorias: Brincadeira, Catação, Vocalização e Outros (compreendendo as interações agonísticas e cópulas). Todas as interações entre o grupo de estudo e outros grupos de bugios, bem como as interações com outras espécies de animais, foram oportunamente registradas.

Durante o trabalho de campo foi observada a freqüência das emissões de rugidos ao longo do dia, sendo para tanto anotado o número de rugidos ouvidos dentro de intervalos de uma hora. As emissões de rugidos dos diferentes grupos avistados também constaram nesta amostra. Quando mais de um grupo de bugios rugiu ao mesmo tempo (encontro entre grupos), isto foi considerado como um único evento de emissão. Como a permanência no campo não foi igual ao longo dos meses, para se verificar variações mensais na emissão de rugidos, o número total de rugidos por mês foi dividido pelo número de horas que permanecemos no campo. Quando o emissor estava sendo observado, foram anotados a identidade deste e o possível motivo do rugido: encontro de grupos, chamado, predação e desconhecido. O chamado ocorreu quando o indivíduo emissor estava perdido do resto do grupo.

Para verificar diferenças mensais e sazonais foi utilizado o teste estatístico de Mann-Whitney. O coeficiente de Spearman foi utilizado para correlacionar os dados de comportamento do grupo com a dieta, temperatura e percursos diários. O teste de Friedman foi utilizado para verificar diferenças entre os indivíduos do grupo quanto às atividades. Todos esses testes possuem significância $p < 0,05$.

Resultados e Discussão

Padrão de atividades sociais
O grupo de bugios passou em média 3% do tempo interagindo socialmente. As atividades sociais mais representativas foram a brincadeira (34,23%), a catação (33,98%) e a vocalização (29,60%). Marques (1996) constatou que os bugios, em sua área de estudo, gastaram 4,24% do tempo em interações sociais, sendo 1,22% em vocalizações, 2,41% em brincadeiras, 0,55% em catação e 0,06% em agressão.

As vocalizações se mantiveram constantes entre as duas estações (Mann-Whitney $U = 23,000$; $p = 0,4318$). Marques (1996) também não encontrou diferenças sazonais quanto às vocalizações.

Interações agonísticas foram observadas nos encontros entre o grupo de estudo e outros grupos de bugios. Nestes encontros, geralmente os machos vocalizavam e se perseguiam sem que ocorresse contato físico entre eles. Outros trabalhos confirmam esse comportamento pacífico dos bugios (Carpenter, 1965; Neville *et al.*, 1988; Oliveira e Ades, 1993). Freeland (1976) discute que confrontos físicos em encontros de grupos são raros na maioria das espécies de primatas, pois os grupos tendem a manter um distanciamento físico para evitar a propagação de doenças.

Todos os indivíduos do grupo vocalizaram. O macho 1 e o infante foram os que mais vocalizaram e a fêmea a que menos apresentou este comportamento (teste de Friedman $Fr = 20.812$; $p = 0,0003$). O infante e o jovem, normalmente, vocalizavam quando não conseguiam achar o grupo ou quando estavam longe da fêmea. Os machos vocalizavam quando encontravam outro grupo de bugios ou, então, quando estavam longe do seu grupo. A fêmea vocalizou apenas quando estava perdida do resto do grupo.

Distanciamento intragrupal
Durante o descanso, geralmente os membros do grupo de estudo ficavam próximos uns dos outros na mesma árvore, e durante o deslocamento e alimentação o grupo se apresentava mais disperso, como o grupo observado por Perez (1997).

Porém, em Intervales, aconteceu um fato peculiar, isto é, os indivíduos do grupo se perderam uns dos outros em várias ocasiões quando estavam forrageando. Quando isso acontecia, os indivíduos “perdidos” ficavam se deslocando a procura dos outros e em alguns casos vocalizavam. Esse fato poderia ser particular do grupo de estudo, mas também foi presenciado em dois outros grupos de bugios acompanhados em Intervales.

Observamos os indivíduos do grupo de estudo se perderem em 22 ocasiões. Em dez destes episódios os bugios não conseguiram se encontrar até o final do dia e dormiram separados, sendo que por três vezes dormiram mais de duas noites separados. Os indivíduos envolvidos em cada divisão do grupo, o número de observações e as durações de cada separação estão na Tabela 1.

Geralmente o que acontecia era que um ou mais indivíduos saíam forrageando na frente e os outros ficavam para trás ou seguiam outro caminho e o grupo acabava se separando. Ficavam então dando voltas, procurando os outros bugios e quase sempre vocalizavam, mas os outros nunca respondiam. As vocalizações eram de “chamado” e, em alguns casos, roncos. O jovem não ficou muito tempo sozinho, separado do grupo, indicando que os bugios dão mais atenção aos imaturos. Os machos, quando perdidos, eram os que mais se deslocavam atrás do resto do grupo. Em certas ocasiões, os bugios “perdidos” chegavam a passar ao lado dos outros membros do grupo, porém sem enxergá-los. Neville (1972) observou que em certas ocasiões parte do

Tabela 1. Indivíduos agrupados em cada divisão do grupo de estudo, número de ocorrências e tempos de duração destas divisões, no Parque Estadual Intervales, São Paulo. M1 = Macho 1; M2 = Macho 2; F = Fêmea; J = Jovem; I = Infante.

Divisões	Ocorrências	Tempos de duração (horas) para cada ocorrência
(F + I) (M1 + M2 + J)	6	(3:50)(17:50)(> 4 dias)(7:00)(2:00)(29:00)
(J) (M1 + M2 + F + I)	3	(2:00)(2:20)(0:20)
(M1 + M2) (F + J + I)	3	(1:20)(16:50)(> 24:00)
(M2) (M1 + F + J + I)	3	(> 4 dias)(19:10)(3:00)
(M1 + J) (M2 + F + I)	2	(15:00)(13:40)
(M1) (M2 + F + J + I)	2	(1:10)(47:30)
(J + I) (M1 + M2 + F)	1	(1:40)
(F + J) (M1 + M2 + I)	1	(2:00)
(F) (M1 + M2 + J + I)	1	(16:30)

grupo ficou separada por grandes distâncias, provavelmente porque alguns indivíduos não perceberam que os outros já tinham saído.

O grau de fragmentação presente em um grupo parece ser determinado por uma combinação de fatores ecológicos, sociais, demográficos e filogenéticos (Kinzey e Cunningham, 1994). Um fator que deve ter ajudado nesta maior dispersão do grupo em Intervales é a extensão da sua área de vida (33 ha), considerada grande para um grupo de apenas cinco a seis bugios (Steinmetz, 2001).

Vocalizações de longa distância

A Tabela 2 mostra a variação mensal e diária dos rugidos emitidos pelos diferentes grupos presentes no Parque Estadual Intervales.

A média de rugidos escutada em Intervales durante o ano de estudo foi de 0,14 por hora. A média do total de rugidos por hora de campo não variou entre as estações chuvosa e menos chuvosa (Mann-Whitney U = 23,000; p = 0,4318). Não houve correlações entre a variação mensal da temperatura e pluviosidade e a emissão de rugidos. A emissão de rugidos foi comparada ao padrão de atividades, dieta e tamanho dos percursos diários do grupo de estudo. Apenas houve uma correlação entre o tamanho médio mensal dos percursos diários e a emissão de rugidos (Spearman r = 0,5874; p = 0,0446), indicando que nos meses em que os animais percorreram maiores distâncias, os rugidos foram mais frequentes. A Fig. 1 ilustra a emissão de rugidos ao longo do dia.

A emissão de rugidos ao longo do dia foi comparada ao padrão de atividades por horário do grupo de estudo. Houve uma correlação negativa entre emissão de rugidos e descanso (Spearman r = -0,5675; p = 0,0431), mas os rugidos não estiveram correlacionados com o deslocamento e a alimentação (Spearman r = 0,4353; p = 0,1371 e r = 0,5344; p = 0,0599, respectivamente). As vocalizações foram mais freqüentes durante o período de atividade dos bugios, das 07:00 às 17:00 horas, e apresentaram três picos: um maior entre 07:30 e 09:30, outro entre 11:30 e 12:30 e o último às 15:30 (Fig. 1).

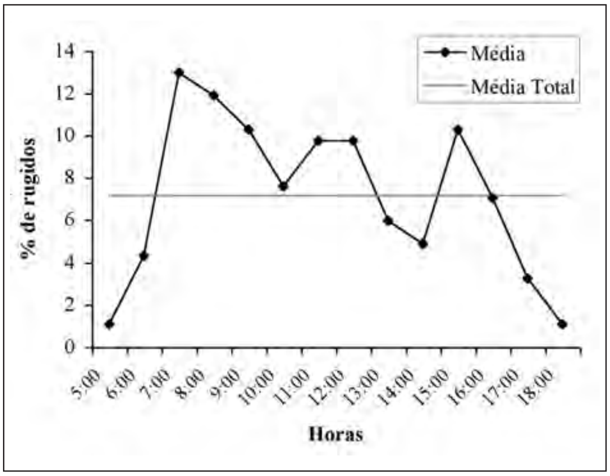

Figura 1. Frequência de rugidos emitidos pelos bugios por hora do dia no Parque Estadual Intervales.

Durante o acompanhamento do grupo de estudo, foi possível observar a identidade do emissor e avaliar o possível motivo do rugido; os dados estão na Tabela 3.

Os indivíduos que mais emitiram rugidos foram os machos adultos. Foram encontrados três motivos para a emissão de rugidos pelos indivíduos do grupo de estudo. O mais frequente foi o chamado, com 17 observações. Como discutido no item anterior, os indivíduos do grupo de estudo se perderam em várias ocasiões e, em alguns destes episódios, os indivíduos emitiram rugidos. Nunca houve resposta vocal por uma das partes do grupo quando a outra parte emitiu rugidos. O indivíduo que vocaliza, neste caso, parece estar querendo avisar ao resto do grupo a sua localização. O segundo motivo mais importante para a emissão de rugidos foi o encontro com outros grupos. Em uma ocasião, o macho 1 vocalizou após o grupo ter sofrido uma tentativa de predação por gavião. Em oito ocasiões não foi possível avaliar o motivo do rugido, mas os indivíduos podem ter percebido a presença de outro grupo ou predador.

Com o aumento dos percursos diários, as chances de encontros com outros grupos são maiores, bem como as chances dos indivíduos do grupo se perderem, e talvez isso explique

Tabela 2. Número de rugidos por horário e por mês emitidos por vários grupos de bugios no Parque Estadual Intervales.

Hora	Nov	Dez	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Total	% do Total
05:00	2												2	1,08
06:00	1				2	1					1	3	8	4,32
07:00	1	1	4	2	6		1			2	1	6	24	12,97
08:00	1	2	2	2	3	1	1			5	1	4	22	11,89
09:00	2		2	2	3	1	1	2	2	1		3	19	10,27
10:00	3			3	1	1	1	1	1	1		2	14	7,57
11:00	2		2	2	3	2	1		1	2	1	2	18	9,73
12:00	1		3		2	2			1	2	1	6	18	9,73
13:00	1		2	1	1		1		1	1	1	2	11	5,95
14:00	1	1		1	1	2					1	2	9	4,86
15:00	1		3	2	2	2	3	1		1	1	3	19	10,27
16:00	2	2	2	2	1						1	3	13	7,03
17:00			1	1	1	1						2	6	3,24
18:00											1	1	2	1,08
Total	**18**	**6**	**21**	**18**	**26**	**13**	**9**	**4**	**6**	**15**	**10**	**39**	**185**	**100**
Horas	173	98	133	113	102	113	79	97	87	94	103	117	1309	
Total/ Horas	**0,10**	**0,06**	**0,16**	**0,16**	**0,25**	**0,11**	**0,11**	**0,04**	**0,07**	**0,16**	**0,10**	**0,33**	**0,14**	

Tabela 3. Número de observações dos motivos e identidade do emissor dos rugidos dos bugios do grupo de estudo no Parque Estadual Intervales. Favor notar que a fêmea e o jovem vocalizaram junto com os machos no encontro de grupos; nessa situação, todos do grupo vocalizam. No total foram 14 situações de encontro de grupos.

Emissor	Encontro de grupos	Chamado	Predação	Desconhecido	Total
Machos adultos	14	14	1	8	37
Fêmea	1	3			4
Jovem	2				2
Total	**14**	**17**	**1**	**8**	**40**

a correlação do tamanho dos percursos com a emissão de rugidos.

Em *A. palliata* e *A. seniculus*, o rugido tem sido apontado como um mecanismo importante na manutenção do distanciamento entre os grupos (Carpenter, 1934; Chivers, 1969; Sekulic, 1982) e na regulação dos territórios (Carpenter, 1934; Altmann, 1959). Em *A. palliata*, *A. seniculus* e *A. belzebul*, foi constatada a ocorrência de uma alta freqüência de rugidos ao alvorecer. Este coro matinal antecede as outras atividades diárias desses animais e foi considerado uma forma de cada grupo anunciar sua posição aos grupos vizinhos (Carpenter, 1934; Altmann, 1959; Chivers, 1969; Baldwin e Baldwin, 1976; Bonvicino, 1989). Neste trabalho e em outros estudos realizados com *A. guariba* não foi constatada a presença de um coro matinal (Mendes, 1989; Chiarello, 1995; Marques, 1996; Oliveira, 1997). Foi observado que os rugidos em *A. guariba* eram emitidos, principalmente, em encontros de grupos. Devido à ausência de coro matinal e aos rugidos serem quase restritos a encontros entre grupos, Mendes (1989) sugere que, em *A. guariba*, a principal função desta vocalização seja a defesa do espaço. Já Chiarello (1995) sugere que a batalha vocal nos encontros entre grupos seria uma forma de avaliação dos oponentes, enquanto Oliveira (1997, 2002) conclui que as vocalizações de longo alcance são usadas para a defesa de recursos.

Foram observados 12 encontros do grupo de estudo com outros grupos; dez aconteceram entre setembro e março e dois em agosto. A maioria dos encontros se deu em fontes alimentares ou nas proximidades, indicando que os bugios poderiam estar defendendo recursos específicos.

Alguns autores relatam a emissão de rugidos em interações agonísticas dentro do grupo (Sekulic, 1982; Drubbel e Gautier, 1993; Chiarello, 1995), porém são as interações intergrupais que têm sido apontadas como o principal motivo para a emissão de rugidos. Algo semelhante ao observado em Intervales foi relatado por Sekulic (1982): em algumas ocasiões um macho sub-adulto de um dos grupos ficou longe por horas ou dias, normalmente acompanhando uma fêmea solitária, e quando reencontrou o grupo, o macho adulto começou a rugir antes de ser acompanhado pelo macho sub-adulto. Oliveira (2002) também observou uma fêmea vocalizar durante a separação entre membros de um mesmo grupo, provavelmente para indicar sua localização aos demais membros distantes. Parece que em Intervales, onde os grupos se mantêm mais dispersos e a pressão demográfica é menor, os rugidos desempenham um importante papel na comunicação intragrupal. Seriam necessários estudos em outros locais com mata contínua, onde as áreas de uso ocupadas pelos grupos de bugios fossem maiores, para se averiguar a importância dos rugidos na comunicação entre os membros do mesmo grupo.

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CYTOCHROME *B* SEQUENCES SHOW SUBDIVISION BETWEEN POPULATIONS OF THE BROWN HOWLER MONKEY (*ALOUATTA GUARIBA*) FROM RIO DE JANEIRO AND SANTA CATARINA, BRAZIL

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Zelinda Hirano Braga, Célia P. Koiffmann

Introduction

The brown howler monkey (*Alouatta guariba*) is a medium-sized and fully arboreal monkey that inhabits the Atlantic Forest of South America. Its geographic distribution extends from southern Bahia through the coastal Brazilian states south to the province of Misiones in northernmost Argentina (Kinzey, 1982; Di Bitetti *et al*., 1994; Rylands *et al*., 1988, 1996). Traditionally, two subspecies have been recognized, *A. guariba guariba* in the north and *A. guariba clamitans* in the south, although their exact distributions remain unclear. Kinzey (1982) reported that the transition from one subspecies to the other occurs in Espírito Santo and Minas Gerais, in regions flanking the Rio Doce, while Rylands *et al.* (1988) found evidence suggesting that *A. guariba clamitans* extends as far north as the Rio Jequitinhonha in northern Minas Gerais, and that *A. guariba guariba* may be restricted to southern Bahia (see Rylands *et al*., 1996).

In general, *A. guariba* has been little studied, although several studies have described variation in pelage coloration (Kinzey, 1982) and in cranial and hyoid dimensions (Gregorin, 1996) that for the most part appear to be clinal in nature. The southern populations tend to be larger in body size, with larger cranial and hyoid dimensions, and display greater sexual dichromatism (see Kinzey, 1982; Gregorin, 1996). Chromosomal variation is extensive in *A. guariba*: Koiffmann (1977), Oliveira *et al.* (1995, 1996, 1998, 2000, 2001, 2002), and Gifalli (2003) have reported large differences among populations, including chromosomal rearrangements and differences in diploid number (ranging from 2N = 45 to 52). To date very little information exists about genetic variation within *A. guariba*.

Here we present a preliminary assessment of levels of genetic variation and inferred population structure in *A. guariba*, based on mtDNA encoded cytochrome *b* (cyt-*b*) sequences collected from populations in the Brazilian states of Rio de Janeiro, São Paulo and Santa Catarina.

Materials and Methods

We analyzed a total of 19 DNA sequences from *A. guariba*; details are provided in Appendix I. We collected cyt-*b* sequences from a total of 15 samples, including eight individuals from Santa Catarina, five from São Paulo, and two from Rio de Janeiro (Fig. 1). All samples from Santa Catarina were collected from frozen specimens preserved by Projeto Bugio at the Universidade Federal e Regional do Blumenau (FURB). Projeto Bugio collected some of these monkeys after they died in accidents (e.g., crossing the road); the project also rescues monkeys that have been captured by local residents. To sample these animals, a small (1 cm^2) section of frozen muscle was collected under the direction of one of the authors (ZHB). The samples from São Paulo were collected by another author (CG-I) and derive from animals held in captivity at DEPAVE (Departamento de Parques e Áreas Verdes do Estado de São Paulo, Divisão Técnica de Medicina Veterinária e Manejo da Fauna Silvestre – São Paulo, SP, Brazil) or at CEMAS (Centro de Estudo e Manejo de Animais Silvestres, Instituto Florestal, Fundação Florestal, São Paulo). Of the five sequences derived from samples from Rio de Janeiro, three were downloaded from GenBank and have been previously published (see Appendix I). Of these samples, one was derived from a specimen at the Centro de Primatologia do Rio de Janeiro (CPRJ), and two others from the Universidade Federal do Pará, Belém (UFPA). Another sample from Rio de Janeiro was collected under the auspices of CEMAS from an individual from Seropedica, RJ. The final sample from Rio de Janeiro was from an individual rescued from a fire by IBAMA in Poço das Antas, RJ; although the individual subsequently died, its body has been frozen and is stored by Projeto Bugio at FURB.

Our analysis also included an additional four sequences of cyt-*b* from *A. guariba* that were downloaded from GenBank at the National Center for Biotechnology Information. One sequence comes from the São Paulo Zoo (GenBank Accession No. AF289987; see Bonvicino *et al*., 2001) and three sequences came from the Centro de Primatologia do Rio de Janeiro (AY065898 and AY065899 from Cortés-Ortiz *et*

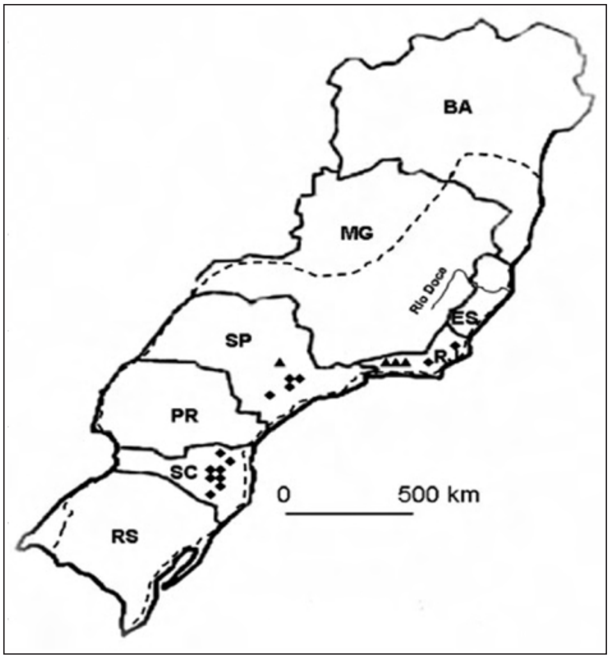

Figure 1. Map of southeastern Brazil showing the distribution of *A. guariba*. ◆ = Localities of samples of *A. guariba* collected and sequenced in this study: Rio de Janeiro (RJ), São Paulo (SP), Paraná (PR), Santa Catarina (SP). ▲ = Additional sequences from Rio de Janeiro and São Paulo downloaded from GenBank, National Center for Biotechnology Information. In Appendix I we list all individuals analyzed in this study.

al., 2003, and AF289986 from Bonvicino *et al.*, 2001). Fig. 1 provides more detailed information on the geographical origin of individual monkeys.

DNA was extracted either from frozen blood using a GFX Mini Blood Kit (Amersham) or from frozen muscle samples using a standard phenol-chloroform protocol (Maniatis *et al.*, 1982). An mtDNA region of nearly 1.2 kb, including the cyt-*b* gene, was amplified by PCR and sequenced using the oligonucleotide primers citb1, citb2, cit-alo (for primer sequences see Bonvicino *et al.*, 2001; Nascimento *et al.*, 2005) and CB1-5', CB2-3', CB-435L (see Cortés-Ortiz *et al.*, 2003). The sequences from our samples of *Alouatta guariba* are available in GenBank under the accession numbers reported in Appendix 1.

We used BioEdit v.7.0.1.4 (Hall, 1999) to align the sequences. Phylogenetic analyses were performed in MEGA v.3.1 (Kumar *et al.*, 2004) and PAUP* (beta version 10) (Swofford, 2000), while population genetic parameters were estimated in SITES (Hey and Wakeley, 1997) and ARLEQUIN v.2.0 (Schneider *et al.*, 1997). Translations of cyt-*b* nucleotides to amino acids were done using the EMBOSS Transeq application (Rice *et al.*, 2000). We used ModelTest 3.06 (Posada and Crandall, 1998) to estimate the best model of sequence evolution for our distance-based estimates of divergence dates.

Results

The cyt-*b* DNA sequences show 28 polymorphic sites and 8 unique mtDNA sequences (haplotypes). Transitions outnumber transversions by a ratio of 2.5 to 1.0. There are no indels in the sequences and the amino acid sequences (determined in the EMBOSS Transeq application) are not interrupted by premature stop codons, indicating they are functional cyt-*b* sequences and confirming they are not Numts (i.e., mitochondrial sequences inserted into the nuclear genome; see Mundy *et al.*, 2000).

Genealogical analysis and population genetics

Identical genealogical trees were generated using the Neighbor-Joining algorithm based on either p-distances or NrT + G (gamma = 0.2441) distances, selected by ModelTest 3.06 and rooted with published sequences from *A. belzebul* and *A. caraya* (Bonvicino *et al.*, 2001; Nascimento *et al.*, 2005). The deepest branch of the tree (Fig. 2) leads to two distinct haplogroups, labeled Haplogroups 1 and 2. All individuals from Rio de Janeiro fall into Haplogroup 1, whereas all individuals from Santa Catarina fall into Haplogroup 2. Individuals from São Paulo have cyt-*b* haplotypes that fall into either haplogroup. These same two haplogroups were found in the strict consensus Maximum Parsimony Tree and in the Maximum Likelihood Tree (-ln likelihood = 1955.66419) using the TrN + G model of sequence evolution (Posada and Crandall, 1998). These trees include sequences from *A. belzebul* (Ab-1001 and Ab-1088) and *A. caraya* (Ac-592 and Ac-XO51). Each pair represents the two most divergent haplotypes within each of these two species (see Bonvicino *et al.,* 2001; Nascimento *et al.*, 2005). As can be seen, the deepest branch in the *A. guariba* tree (occurring between Haplogroup 1 and 2) is slightly older than the divergence between the two *A. belzebul* haplotypes, and is nearly the same age as the deepest branch between the two *A. caraya* haplotypes. This presumably indicates that the divergence between Haplogroups 1 and 2 in *A. guariba* took place earlier than the split between the two most divergent haplotypes of *A. belzebul,* and appears to be as old as the split between the two most divergent *A. caraya* haplotypes.

Since individuals from Rio de Janeiro and Santa Catarina are found exclusively in either Haplogroups 1 or 2, respectively, we describe parameters estimating their degree of population differentiation as compared with estimates of differentiation between other pairs of populations. First, we note that there are nine fixed differences between individuals from Rio de Janeiro and Santa Catarina. Fixed nucleotide differences are sites at which all samples from one population show a different nucleotide compared to the nucleotide at that site in all samples from another population. Such differences are not expected if two populations are panmictic (i.e. freely interbreeding). In contrast, there is only one fixed difference between São Paulo and Santa Catarina, and none between Rio de Janeiro and São Paulo. Second, we found that F_{st} values, which measure population differentiation, are notably high when comparing samples from Santa Catarina and Rio de Janeiro (0.933, $p < 0.05$). This is almost double the value found when comparing samples

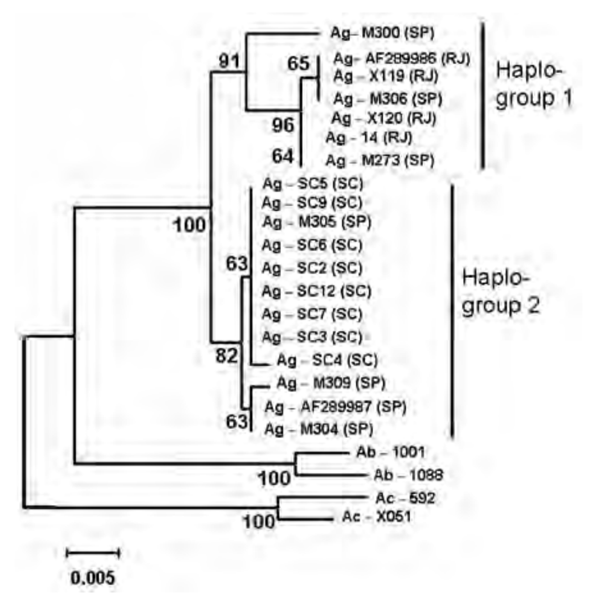

Figure 2. Neighbor-Joining Tree based on p-distances with bootstrap values from 1000 replications printed at nodes. RJ = Rio de Janeiro, SP = São Paulo, and SC = Santa Catarina. All samples of *A. guariba* in the gene tree are labeled beginning with the prefix "Ag." More information on the specimens of *Alouatta belzebul* and *A. caraya* is available via their sample numbers: Ab-1001 and Ab-1088 (*A. belzebul,* Tucuruí, Pará, Brazil; see Nascimento *et al.*, 2005), Ac-592 (*A. caraya,* Rio Casca, Manso Dam Reservoir, Chapada dos Guimarães, Mato Grosso, Brazil; see Bonvicino *et al.*, 2001) and Ac-X051 (*A. caraya,* Bolivia; see Nascimento *et al.*, 2005). Scale units are percent nucleotide divergence.

from Rio de Janeiro and São Paulo (0.532) and four times greater than the value when comparing São Paulo and Santa Catarina (0.221).

Tajima's (1993) relative rate test (as employed in MEGA), using *Brachyteles* as an outgroup, indicated no significant departures from equal rates of evolution along ingroup lineages. Since the Santa Catarina and Rio de Janeiro populations are exclusive to different haplogroups, we estimated the divergence time between them using two different calibration points: 12.9 Myrs (Goodman, 1996) and 16 Myrs (Cortés-Ortiz *et al.*, 2003) for divergence between *Brachyteles* and *Alouatta*. Distances were estimated using a TrN + G (gamma = 0.2411) model of sequence evolution (Posada and Crandall, 1998). We used these distances instead of p-distances, since they correct for multiple hits and among-site rate variation that, if left unconsidered, could produce large overestimates of the actual dates of divergence between haplotypes (Arbogast *et al.*, 2002). We used net distances in order to subtract the time it takes for the coalescence of sequences within ancestral species. We solved Formula 5.13 in Li and Graur (1991) using the distance between *Brachyteles* and *A. guariba* from Rio de Janeiro (0.36212), the distance between *Brachyteles* and *A. guariba* from Santa Catarina (0.37158), and the distance between *A. guariba* from Rio de Janeiro and *A. guariba* from Santa Catarina (0.01254). This yielded divergence dates of ~441 Kyrs and ~532 Kyrs for the respective calibration points. These dates were as old as the estimated dates between the most divergent sequences within *A. belzebul* (~326 Kyrs) and within *A. caraya* (~511 Kyrs).

Measures of genetic diversity

We compared the levels of variation in *A. guariba* in two ways: by comparing *A. guariba* with the closely related species *A. belzebul* and *A. caraya*, for which comparable numbers of sequences are available (23 and 27 samples, respectively; see Nascimento *et al.*, 2005), and by comparing levels of variation within the three geographic samples of *A. guariba* (Fig. 2). While mean p-distances are very similar in these three species, average pairwise diversity (π/bp) in *A. guariba* (0.00778) is over twice the value in *A. caraya* (0.0038) and about one-third greater than in *A. belzebul* (0.00579). The maximum p-distance in *A. guariba* (1.7%) was considerably greater than the maximum p-distances in both *A. caraya* and *A. belzebul*. Furthermore, p-distances compared across Haplogroups 1 and 2 (ranging from 1.2% to 1.7%) mostly exceed the largest within-species distances in *A. belzebul* or *A. caraya* (1.0% and 1.3%, respectively). In fact, the maximum p-distances within *A. guariba* (1.7%) are nearly twice the genetic distances between *A. caraya* individuals from the geographically disparate localities of Santa Cruz, Bolivia and Serra da Mesa in the state of Goiás, Brazil (~0.9%) (see Nascimento *et al.*, 2005).

Within *A. guariba*, the Santa Catarina population is notably depauperate in mtDNA diversity. It is between 4 to 15 times less diverse in its π/bp and mean p-distance measures compared with populations from Rio de Janeiro and São Paulo. Conversely, the São Paulo population shows very high levels of diversity in all measures, due to the fact that it alone possesses haplotypes found in both Haplogroups 1 and 2.

Discussion

Our samples of cyt-*b* diversity in *Alouatta guariba*, drawn from populations in Rio de Janeiro, São Paulo, and Santa Catarina, are only representative of the southern portion of the full distribution of *A. guariba*, which extends from southern Bahia to northern Argentina (Rylands *et al.*, 1994). The region we sampled is usually ascribed to the southern subspecies *A. guariba clamitans,* reported by Kinzey (1982) to range as far north as the south bank of the Rio Doce in Espírito Santo, or, as more recent observations by Rylands *et al.* (1988) indicate, as far north as the Rio Jequitinhonha in Minas Gerais. The primary distinguishing feature of *A. guariba clamitans* is its sexual dichromatism, in which the male pelage is a dark rufous-red and the female is generally dark to light brown, although considerable variation is recognized (Kinzey, 1982). Gregorin (1996), however, reported a north-to-south cline in sexual dichromatism, as well as in measurements of the cranium and hyoid, which are generally larger in southern populations. Gregorin (1996) found that these clines weakened the value of these characters for distinguishing the two subspecies.

Table 1. Population genetic parameters. V = number of variable sites; Hapl. = number of haplotypes; π = nucleotide diversity (average proportion of nucleotide differences between all possible pairs of DNA sequences).

	N	Mean P-Distance	Range P-Distance	V	Hapl.	π/bp
A. guariba	19	0.70%	0.0–1.7%	28	8	0.00778
Rio de Janeiro	5	0.02%	0.0–0.4%	5	5	0.00196
São Paulo	6	0.92%	0.0–1.7%	20	3	0.00876
Santa Catarina	8	0.05%	0.0–0.2%	2	2	0.00047
Between Haplogroups 1 & 2	—	1.40%	1.2–1.7%	—	—	—
A. caraya	27	0.50%	0.0–1.3%	22	13	0.00338
A. belzebul	23	0.60%	0.0–1.1%	37	17	0.00579

Although we studied samples only from the range of the southern subspecies, *A. g. clamitans*, we found evidence in the cyt-*b* sequences suggesting a strong population subdivision between *A. g. clamitans* from Rio de Janeiro and those from Santa Catarina. This subdivision is evident in several aspects of the data: (1) samples from the two states fall exclusively into different haplogroups; (2) the samples show a considerable number of fixed nucleotide differences between them, which would not be expected if the populations were panmictic; and (3) the samples show statistically significant F_{st} values, indicating differentiation.

Howler monkeys show the greatest degree of karyological variation, both between and within species, of any platyrrhine genus (Koiffmann, 1977; Gifalli, 2003). Within *Alouatta*, *A. guariba* shows a notable degree of geographic chromosomal variation (Koiffmann, 1977; Oliveira *et al.*, 1995, 1998, 2000, 2002) that appears to be consistent with our findings of geographic differentiation. Individuals of *A. guariba clamitans* from the southern states of Santa Catarina and Paraná contrast with *A. guariba clamitans* from Rio de Janeiro in their diploid number (2N = 45 [♂♂] or 46 [♀♀] versus 2N = 49 [♂♂] or 50 [♀♀]), as well as in several Robertsonian rearrangements, pericentric inversions, and chromosomal translocations (Oliveira *et al.*, 1995, 2000, 2002). Our ongoing efforts to karyotype all individuals in the preliminary cyt-*b* genealogy presented here should help to clarify the association between chromosomal and cyt-*b* results.

The population differentiation we observe within *A. guariba clamitans,* along with the chromosomal differences previously described by Koiffmann (1977), Oliveira *et al.* (1995, 1996, 1998, 2000, 2001, 2002), and Gifalli (2003), may indicate that *A. g. clamitans* is actually representative of two distinct subspecies, or possibly even two separate species. Oliveira (2000) suggested that the large chromosomal differences characterizing these populations may indicate they are reproductively isolated from each other.

This pattern of population subdivision may have arisen during the late middle Pleistocene (over 400,000 years ago, based on our estimate) following forest fragmentation, and/or the formation of distinct ecoregions that became centers of endemism. One such region might have formed in the southern Atlantic Forest, including Santa Catarina, and another in the middle northern Atlantic Forest, including Rio de Janeiro. Müller (1973) and Kinzey (1982) speculated on refuges in the Atlantic Forest, but neither recognized a distinct refuge in the southern Atlantic Forest that would account for the differentiation of the Santa Catarina population. A more recent study of possible centers of endemism in the Atlantic Forest (Costa and Leite, 2000) likewise did not identify a center of endemism as far south as Santa Catarina. Nevertheless, the polymorphic São Paulo population— which shares haplotypes with both the Rio de Janeiro and Santa Catarina populations—may have formed as the forests themselves expanded (in the case of refuges), or as populations expanded from centers of endemism, and animals carrying divergent haplotypes came into renewed contact with each other.

Interestingly, we found that the maximum genetic distances between individuals of *A. guariba* were considerably greater than those found in either *A. caraya* or *A. belzebul*. For example, even the distances between geographically widespread individuals of *A. caraya*, from Bolivia and from Goiás in Brazil (see Nascimento *et al.*, 2005), are only half the maximum distances we found between *A. guariba* in Rio de Janeiro and Santa Catarina. The reasons for this are not clear, but may be related to the topographic differences in habitat occupied by these three species. *A. guariba* inhabits mountainous forests of the Serra do Mar and Serra da Mantiquiera of the Atlantic Forest, while the respective habitats of *A. caraya* (ranging across southern Brazil, Paraguay and northern Argentina) and *A. belzebul* (in the south-eastern Amazon and far northeastern Atlantic Forest) are generally devoid of mountainous terrain. Altitudinal variation has likewise been suggested to have played a role in the population differentiation of the genus *Brachyteles*, also endemic to the Atlantic Forest (see Rylands *et al.*, 1996).

Populations of *A. guariba* show remarkable variation in mtDNA. Although these differences need to be confirmed with other genetic markers, the Santa Catarina population demonstrates 4 to 15 times less variation in cyt-*b* than the populations in Rio de Janeiro or São Paulo, respectively, while the São Paulo population shows extreme variability. Apart from the insights it may allow into the evolution of these populations, this information is also relevant for conservation efforts, as *A. guariba* has been listed as Vulnerable (*A. guariba clamitans*) or Critically Endangered (*A. guariba guariba*) (Rylands *et al.*, 1994; Hilton-Taylor *et al.*, 2004).

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Appendix I. List of all *Alouatta guariba* samples analyzed in this study.

Sample ID[a]	Geographic Origin[b]	GenBank Accession Number[c]	Organization[d]	Reference[e]
SC2	Blumenau, SC	DQ679777	Projeto Bugio, FURB	This study
SC3	Brusque, SC	DQ679778	Projeto Bugio, FURB	This study
SC4	Jaraguá do Sul, SC	DQ679779	Projeto Bugio, FURB	This study
SC5	Indial, SC	DQ679780	Projeto Bugio, FURB	This study
SC6	São Bento de Sul, SC	DQ679781	Projeto Bugio, FURB	This study
SC7	Blumenau, SC	DQ679782	Projeto Bugio, FURB	This study
SC9	Indial, SC	DQ679783	Projeto Bugio, FURB	This study
SC12	Lages, SC	DQ679784	Projeto Bugio, FURB	This study
M273	Mairiporã, SP	DQ679776	DEPAVE	This study
M300	Serra de Cantereira, SP	DQ679773	CEMAS	This study
M304	Serra de Cantereira, SP	DQ679774	CEMAS	This study
M305	Reserva Florestal in Campinas, SP	DQ679772	CEMAS	This study
M309	Serra de Cantereira, SP	DQ679775	CEMAS	This study
AF289987	SP	AF289987	ZSP	Bonvicino *et al.* (2001)
AF289986	RJ	AF289986	CPRJ	Bonvicino *et al.* (2001)
M306	Seropedica, RJ	DQ679771	CEMAS	This study
X119	RJ	AY065898	UFPA	Cortés-Ortiz *et al.* (2003)
X120	RJ	AY065899	UFPA	Cortés-Ortiz *et al.* (2003)
14	Poço das Antas, RJ	DQ679770	Projeto Bugio, FURB	This study

[a] The sample ID is the code assigned to a specific animal and that is used to label the cyt-*b* gene tree in Figure 2. Exceptions are AF289987 and AF 289986, which are also GenBank accession numbers.
[b] SC = Santa Catarina; SP = São Paulo; RJ = Rio de Janeiro.
[c] The GenBank database may be accessed at <http://www.ncbi.gov>.
[d] Name of organization where the individual is kept, either as a living specimen or preserved. See Materials and Methods for more information.
[e] References to consult for more detailed information about sample and sequence.

FORMAS NÃO USUAIS PARA A OBTENÇÃO DE ÁGUA POR *ALOUATTA GUARIBA CLAMITANS* EM AMBIENTE DE FLORESTA COM ARAUCÁRIA NO SUL DO BRASIL

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Introdução

O bugio-ruivo (*Alouatta guariba clamitans*) é endêmico da Floresta Atlântica *sensu lato*, e encontra-se distribuído desde o sul do Rio Doce no Espírito Santo até o Rio Grande do Sul e norte da Argentina, ocupando várias fisionomias florestais como a Floresta Atlântica *sensu strictu*, a Floresta com Araucária e a Floresta Estacional Semidecidual (von Ihering, 1914; Cabrera, 1957; Hirsch *et al.*, 1991; Gregorin, no prelo). Observações do comportamento de beber água por parte dos bugios (gênero *Alouatta*) são incomuns em animais de vida livre (Carpenter, 1934; Glander, 1978; Terborgh, 1983; Neville *et al.*, 1988; Bonvicino, 1989; Bicca-Marques, 1992; Serio-Silva e Ricco-Gray, 2000; Almeida-Silva, 2004). Acredita-se que estes animais obtenham recursos hídricos diretamente de seu alimento, principalmente frutos e folhas novas (Glander, 1978; Milton, 1980; Bicca-Marques, 1992, 2003; Steinmetz, 2001). O objetivo deste trabalho foi registrar e descrever as diferentes formas observadas do comportamento de beber água em *A. g. clamitans*, fornecendo então informações sobre particularidades do comportamento do bugio-ruivo.

Área de Estudo e Métodos

O estudo foi conduzido na Chácara Payquerê: Centro de Educação Ambiental e Apoio a Pesquisa (propriedade particular, Cerâmica Brasília, Ltda.) (25°29'52"S, 49°39'24"W), situada no Distrito do Bugre, Município de Balsa Nova, Paraná. O remanescente florestal do Bugre apresenta aproximadamente 700 ha de Floresta com Araucária e está inserido na Área de Proteção Ambiental Estadual da Escarpa Devoniana. O clima na região é "Cfb" segundo a classificação de Köppen (IAPAR, 1978), apresentando uma média anual de temperatura de 18°C e uma precipitação anual de 1600 mm (Miranda e Passos, 2004).

Durante o período de um ano (setembro de 2003 a agosto de 2004), no decorrer de estudos sobre a ecologia e conservação da subespécie (Miranda, 2004; Miranda e Passos, 2004, 2005; Miranda *et al.*, 2004, no prelo), foram acompanhados dois grupos de *A. g. clamitans*. O grupo Patropí era composto por quatro membros: um macho adulto, uma fêmea adulta, um macho subadulto e um juvenil II. O grupo Forninho possuía 10 indivíduos: um macho adulto, três fêmeas adultas, um macho sub-adulto, dois juvenis II, dois juvenis I e um infante. Esses dois grupos foram acompanhados por 393 horas nas quais foram observadas cinco ocorrências do comportamento de beber água. A metodologia utilizada na coleta dos dados que constam no presente trabalho foi *ad libitum* (Altmann, 1974).

Resultados e Discussão

Em uma primeira ocasião, uma fêmea adulta (grupo Patropí) se utilizou da água contida entre as folhas de uma bromélia, removendo-as afim de conseguir espaço suficiente para conduzir a água com as mãos até a boca. Numa segunda oportunidade uma outra fêmea adulta (grupo Forninho) tentou beber a água que se encontrava em um oco natural sobre um galho. O indivíduo procurou alcançar a seu objetivo com as mãos e posteriormente diretamente com a boca. Pelo pequeno diâmetro da abertura do reservatório em questão, esta não obteve sucesso e foi seguida por dois juvenis II que lograram êxito bebendo diretamente com a boca. Por duas vezes foi observada a descida de uma outra fêmea adulta do grupo Forninho, com um infante agarrado em seu dorso, ao solo se utilizando da água tanto de uma poça a beira de um riacho quanto do seu próprio leito. Tanto a fêmea quanto o infante beberam água nestas ocasiões, alcançando a água diretamente com a boca. Esta fêmea sempre teve a cauda presa a uma árvore, aparentemente como uma forma de acelerar sua subida em algum caso de emergência. As descidas desta fêmea e seu filhote ao solo para beber água tiveram duração de aproximadamente um minuto da primeira vez e um minuto e meio da segunda.

Houve apenas um registro do comportamento de beber para machos adultos quando, após uma noite bastante úmida, um deles parece ter tido conseguido se aproveitar, diretamente com a boca, da água acumulada em um "tapete" de briófitas epífitas. Nesse estudo, aparentemente os bugios beberam pouca água, o que também é observado por outros autores (Bicca-Marques, 1992; Steinmetz, 2001). As descidas ao chão podem ser inibidas pela presença do observador, o que provavelmente não ocorre com relação às outras formas de obtenção de água.

Todas as formas de beber água descritas pela literatura para *Alouatta* foram observadas no decorrer desse estudo, além de uma forma alternativa: "água acumulada em briófitas epífitas" (Bonvicino, 1989; Bicca-Marques, 1992; Serio-Silva e Ricco-Gray, 2000; Steinmetz, 2001). Na Floresta Atlântica *sensu strictu* os bugios beberam somente em bromélias, devido a alta densidade em que essas se encontram nessa fisionomia florestal (Steinmetz, 2001). Já outros autores ressaltam que a descida ao solo é muito rara, podendo ocorrer em situações de seca prolongada e outras ocasiões especiais (Gilbert e Stouffer, 1989; Serio-Silva e Ricco-Gray, 2000). É válido ressaltar que todas observações deste comportamento ocorreram durante o outono ou inverno, estações do ano nas quais os alimentos disponíveis são principalmente folhas maduras, as quais são pobres em água e tem altas concentrações de compostos secundários de difícil digestão (Milton, 1980; Chiarello, 1994). Tanto frutos quanto folhas jovens — alimentos que figurariam entre as principais fontes de hidratação do organismo dos animais — são escassos durante este período (Miranda e Passos, 2004). Outros estudos também mostram um maior consumo de água durante as épocas mais secas do ano (Glander, 1978; Bonvicino, 1989; Steinmetz, 2001). Isso é relacionado diretamente com o consumo de folhas maduras e inversamente com o consumo de frutos (Steinmetz, 2001).

No remanescente florestal do presente estudo os bugios podem ter dificuldade para encontrar água em reservatórios arbóreos, pois a Floresta com Araucária não possui uma grande riqueza e densidade de bromélias, principalmente se comparada à Floresta Atlântica *sensu strictu*, além de que parte da área de estudo é formada por floresta secundária, o que diminui a quantidade de epífitas e de cavidades naturais, geralmente ligadas a grandes árvores. A pouca disponibilidade de recursos hídricos arbóreos pode ter impelido os bugios a descerem ao solo e mesmo a utilizar formas alternativas de obtenção de água, como por exemplo a água acumulada nas briófitas epífitas.

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An Update on the Distribution of Primates of the Tapajós-Xingu Interfluvium, Central Amazonia

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Introduction

The first records of the primate fauna in the Tapajós-Xingu interfluvium date from the beginning of the 20th century. Snethlage (1912) listed *Chiropotes albinasus* and *Ateles marginatus* as the most conspicuous species of the region, and also cited the presence of *Saimiri sciureus, Cebus* sp., *Callicebus* sp. and *Alouatta* sp. Almost a century later, this region remains poorly studied, and our knowledge of the local primate species and their distribution is still incomplete. This paper updates the list of primate species in the Tapajós-Xingu interfluvium, and adds new records for the southern part of this region. We emphasize the need to conserve the primate fauna of this region, as this portion of Amazonia is a target for development projects and is subject to strong pressures from logging and ranching activities.

Methods

We compiled data on the occurrence of primates in the Tapajós-Xingu interfluvium by literature review (Appendix 1), as well as from field observations and by the examination of specimens deposited at the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ), the Museu Paraense Emílio Goeldi (MPEG) and the Museu de Zoologia da Universidade de São Paulo (MZUSP). We calculated geographic coordinates based on information in catalogues, systematic revisions, faunistic surveys, maps (IBGE, 1972) and gazetteers available on the Internet such as Species Link – Geoloc (CRIA, 2005) and Global Gazetteer 2.1 (FRG, 2004). We plotted the points corresponding to these coordinates (Fig. 1) using the program ArcView 3.3 (ESRI, 2002). The species nomenclature follows Rylands *et al.* (2000).

Our fieldwork was carried out during two excursions to the region of Serra do Cachimbo, southern Pará State,

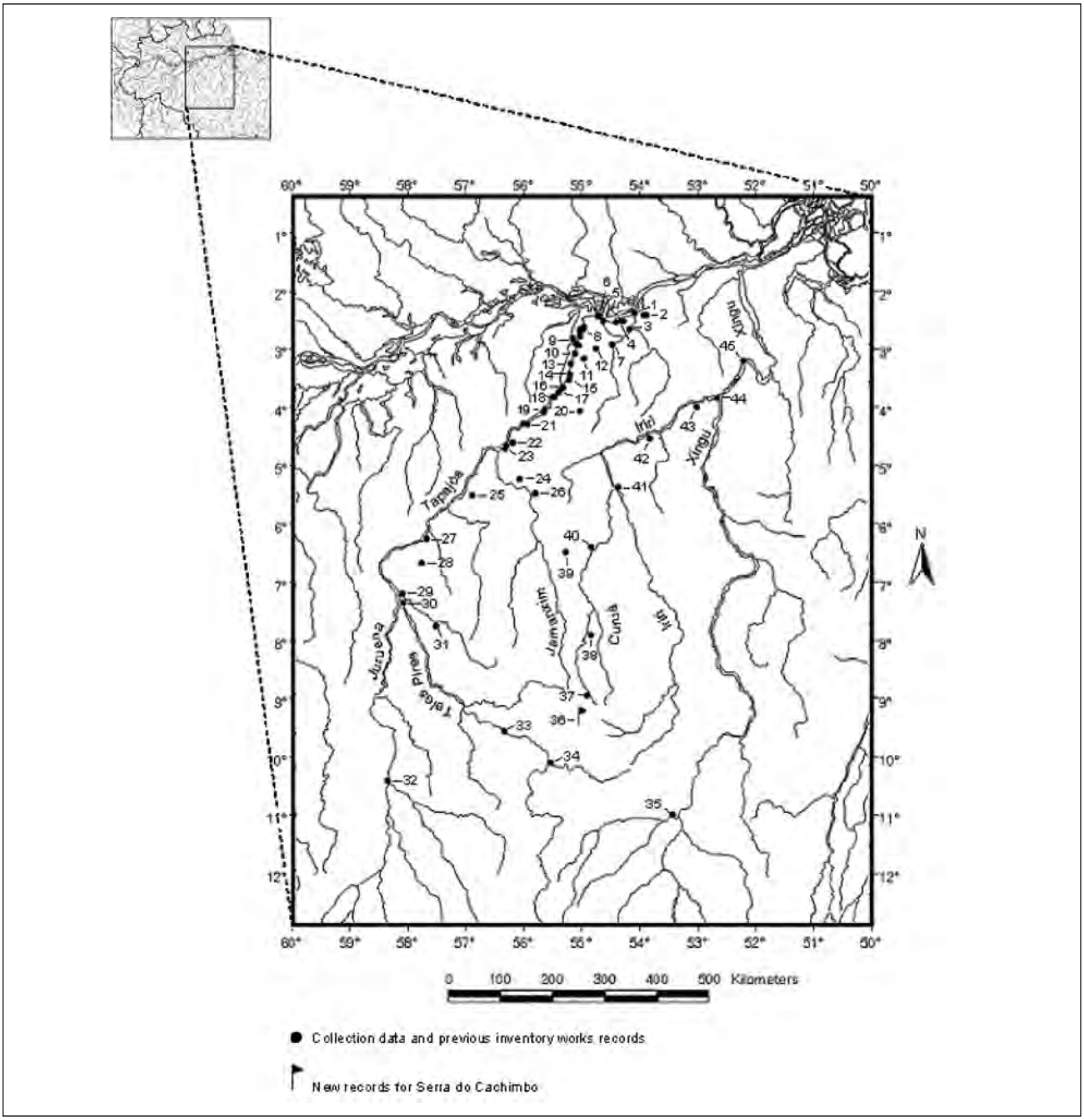

Figure 1. Map of the Tapajós-Xingu interfluvium, showing the localities of primate records. 1. Mouth of the Rio Curuá-Una (02°23'S, 54°05'W); 2. Cuçari, between the lower reaches of the Rios Xingu and Tapajós (02°25'S, 53°55'W), Tamaruri (02°25'S, 53°52'W); 3. Mouth of the Rio Curuá do Sul (02°40'S, 54°10'W); 4. Os Patos (02°31'S, 54°18'W), Taperinha (02°32'S, 54°17'W), Maicá (02°33'S, 54°24'W); 5. Mararu (02°32'S, 54°38'W); 6. Santarém (02°26'S, 54°43'W), Mojuí dos Campos (02°26'S, 54°42'W); 7. Curuá-Una, 54 km S and 40 km E of Santarém (02°55'S, 54°28'W); 8. Belterra (02°38'S, 54°57'W), Cajutuba (02°40'S, 55°00'W), Aramanaí (02°43'S, 55°00'W), Maguari (02°47'S, 55°01'W), Piquiatuba (02°40'S, 54°58'W); 9. Caxiricatuba (02°50'S, 55°08'W), Tapaiúna (02°54'S, 55°05'W), Itapoama (02°57'S, 55°02'W); 10. Tauari (03°05'S, 55°06'W); 11. Santarém-Cuiabá highway km 84 (03°10'S, 54°58'W); 12. Rio Curuá-Tinga, tributary of the Rio Curuá-Una (03°00'S, 54°45'W); 13. Aveiros (03°15'S, 55°10'W); 14. Tavio, Rio Tapajós (03°27'S, 55°11'W); 15. Igarapé-Açú (03°32'S, 55°12'W); 16. Fordlândia (03°40'S, 55°18'W); 17. Rio Cupari, tributary of the Rio Tapajós (03°45'S, 55°23'W); 18. FLONA Tapajós (03°50'S, 55°27'W), Rio Tapurucurazinho (3°50'S, 55°29'W), Araipá (03°50'S, 55°28'W); 19. Monte Cristo (04°06'S, 55°38'W), Pedreira, Rio Tapajós (04°03'S, 55°37'W); 20. Santarém-Cuiabá km 212 (04°04'S, 55°00'W); 21. Santarém-Cuiabá-Itaituba (04°18'S, 55°55'W); 22. Pimental (04°37'S, 56°11'W); 23. Rio Jamanxim (04°43'S, 56°18'W), Estrada do Palhau km 5 (04°40'S, 56°17'W); 24. Santarém-Cuiabá highway km 446 (05°15'S, 56°03'W); 25. Bom Jardim (05°31'S, 56°52'W); 26. Cachoeira da Estiva (05°29'S, 55°47'W); 27. Missão Cururú (06°16'S, 57°39'W); 28. Prainha (06°40'S, 57°45'W); 29. Upper Cururu (07°12'S, 58°04'W); 30. São Manoel, Rio Teles Pires (07°21'S, 58°03'W); 31. Rio Cururu (07°45'S, 57°30'W); 32. Rio Arinos (10°25'S, 58°20'W); 33. Left margin of the Rio Santa Helena, tributary of the Rio Teles Pires (09°34'S, 56°19'W); 34. Fazenda São José, Peixoto de Azevedo (10°06'S, 55°31'W); 35. Rio Arraios, upper Rio Xingu (11°00'S, 53°25'W); 36. Serra do Cachimbo (09°22'S, 55°00'W); 37. Cachimbo (08°57'S, 54°54'W); 38. Maloca, Rio Curuá (07°55'S, 54°50'W); 39. Jamanxim-Curuá (06°30'S, 55°15'W); 40. Upper Rio Curuá (06°25'S, 54°50'W); 41. Mouth of the Rio Curuá (05°23'S, 54°22'W); 42. Mundo Novo, right margin of the Rio Irirí (04°33'S, 53°49'W); 43. Largo do Souza, Rio Irirí (04°00'S, 53°00'W); 44. Irirí-Xingu (03°51'S, 52°40'W), Cocal, Rio Irirí (03°51'S, 52°40'W); 45. Altamira (03°12'S, 52°12'W).

Brazil. The first excursion was during the rainy season (1–28 March 2004) and the second in the dry season (29 August – 17 September 2004). Serra do Cachimbo is located in a transitional zone between the biomes of Amazonia and the Cerrado; from this complex arise several tributaries of the Rios Xingu and Tapajós. The landscape is dominated by a mosaic of vegetation types, including cerrado formations, white sand vegetation, and typical Amazonian forest formations such as *terra firme* forests and *igapó* (Lleras and Kirkbride Jr., 1978).

FEP made direct observations of six primate species at Serra do Cachimbo, following existing trails through all the vegetation types in the study area. Those species directly observed included *Mico emiliae*, *Callicebus moloch*, *Cebus apella*, *Chiropotes albinasus*, *Alouatta belzebul discolor* and *Ateles marginatus*. FEP also collected specimens which were later deposited in the MPEG mammal collection (MPEG 37806–37811). We identified the species we collected and observed using illustrations and diagnostic characters described in the literature (Kellogg and Goldman, 1944; Hershkovitz, 1977, 1985, 1990; Jones and Anderson, 1978; Vivo, 1991; Auricchio, 1995; Gregorin, 1996; Emmons and Feer, 1997; Van Roosmalen *et al.*, 1998, 2002; Silva Júnior, 2001), as well as by direct comparison with museum specimens.

Results and Discussion

The majority of the records for primates in the Tapajós-Xingu interfluvium are restricted to the regions close to the lower Rio Tapajós and to the Rio Amazonas. By contrast, there is virtually no information available on the primate fauna in the central regions of the interfluvium.

We compiled a total of 45 localities in the Tapajós-Xingu interfluvium where primates have been recorded, confirming the presence of 13 taxa in this region (Table 1). Five of these taxa (*Cebus apella*, *Callicebus moloch*, *Chiropotes albinasus*, *Ateles marginatus* and *Alouatta belzebul discolor*) have wide distributions in this region. Of the others, *Cebus albifrons* and *Mico leucippe* have been recorded only from the east bank of the Rio Tapajós; *Aotus azarae infulatus* and *Mico argentatus* from the north of the interfluvium, *Saimiri ustus* from the north-central portion, *Saimiri sciureus* from the central region, *Mico emiliae* only from the southern portion and *Alouatta seniculus* from the south-central area.

Species distribution in the Tapajós-Xingu interfluvium

The distribution of *A. marginatus*, as defined by Kellogg and Goldman (1944), includes the forests of the south bank of the Amazon River between the Rios Tapajós and Tocantins, in the Brazilian state of Pará. However, although Kellogg and Goldman (1944) designated its type locality as Cametá — on the west bank of the lower Rio Tocantins — no specimen has been observed in the Tocantins-Xingu interfluvium since then, despite many surveys of the mammals of the region. Its historical occurrence in this region is doubtful at best, and the given type locality is almost certainly incorrect (Martins *et al.*, 1988). Thus, this species is effectively known only from the Tapajós-Xingu interfluvium. The southernmost records are restricted to Snethlage's observations from 1912. Our observations in Serra do Cachimbo agree with the hypothesis of Martins *et al.* (1988), who gave the Rio Teles Pires as the southern limit of *A. marginatus*.

The distribution of *Chiropotes albinasus* is restricted to the south of the Amazon River, from the west bank of the Rio Xingu-Irirí to the Rio Madeira (Hershkovitz, 1985). In the Tapajós-Xingu interfluvium, the most southerly records for this species are given by Hershkovitz (1985) and in this paper.

According to Gregorin (1996), *A. belzebul discolor* (*sensu* Rylands *et al.*, 2000) is distributed to the south of the Amazon

Table 1. Species recorded from the Tapajós-Xingu interfluvium with their known localities of occurrence. The numbers follow the localities in Fig. 1.

Species	Locality
Mico argentatus (Linnaeus, 1766)	2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 20, 23, 42, 45
Mico emiliae (Thomas, 1920)	34, 36, 38, 40
Mico leucippe (Thomas, 1922)	5, 14, 16, 18, 19, 22
Saimiri sciureus (Linnaeus, 1758)	4, 6, 8, 9, 10, 13, 14, 16, 18, 19, 25, 39
Saimiri ustus I. Geoffroy, 1843	4, 5, 6, 8, 9, 12, 13, 15, 25, 29, 42
Cebus albifrons (Humboldt, 1812)	4
Cebus apella (Linnaeus, 1758)	4, 5, 6, 8, 9, 13, 16, 18, 19, 24, 25, 27, 29, 36, 39, 41, 42, 43
Callicebus moloch (Hoffmannsegg, 1807)	2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 16, 18, 19, 20, 21, 25, 29, 30, 31, 32, 34, 35, 36, 37, 39, 41, 42
Chiropotes albinasus (I. Geoffroy & Deville, 1848)	6, 8, 9, 16, 18, 19, 23, 24, 26, 29, 30, 31, 34, 36, 37, 39, 42, 44, 45
Ateles marginatus (É. Geoffroy, 1809)	1, 3, 4, 5, 6, 8, 9, 10, 13, 16, 17, 18, 27, 29, 36, 37, 39, 41, 42, 45
Alouatta belzebul discolor (Spix, 1823)	4, 6, 8, 9, 11, 13, 16, 18, 19, 25, 28, 29, 33, 36, 37, 39, 42, 43
Aotus azarae infulatus (Kuhl, 1820)	4, 8, 9, 13, 18, 19, 42, 43
Alouatta seniculus (Linnaeus, 1766)	33

River, from the east bank of the Rio Tapajós to the lower Rio Tocantins and the island of Mexiana. The southernmost records of this species' distribution include our observations (Fig. 1, loc. 36) and those given by Pinto and Setz (2000) for the west bank of the Rio Santa Helena, a tributary of the Rio Teles Pires (Fig. 1, loc. 33). Pinto and Setz (2000) also recorded *A. seniculus* in the same locality — the only record for this species in the Tapajós-Xingu interfluvium.

Callicebus moloch is distributed between the Rios Araguaia-Tocantins and Tapajós (Hershkovitz, 1990; Van Roosmalen *et al.*, 2002), limited in the south to the region between the headwaters of the Rios Xingu and Juruena (Fig. 1, loc. 32 and loc. 35).

The three species of *Mico* found in the interfluvium have distributions which are restricted or poorly understood. *Mico leucippe* seems to be endemic, with records only in the Tapajós-Cupari interfluvium (Ávila-Pires, 1969, 1986; Napier, 1976; Hershkovitz, 1977; Branch, 1983; Vivo, 1985; George *et al.*, 1988; Alperin, 1993). *Mico argentatus* is recorded from the north (Fig. 1, Table 1), restricted to the lower courses of the Rios Tapajós and Tocantins (Ferrari and Lopes, 1990). Hershkovitz (1977) extended its distribution to include the Curuá-Irirí interfluvium, as he considered *Mico emiliae* to be a synonym of *M. argentatus*. *M. emiliae* has a relatively wide distribution, apparently including the Brazilian states of Amazonas, Mato Grosso, Pará and Rondônia (Vivo, 1985, 1991; Ávila-Pires, 1986; Ferrari and Lopes, 1992; Alperin, 1993; Roosmalen *et al.*, 2000). However, the details of this distribution are still not well understood, because of its apparent discontinuity. Rylands *et al.* (1993) suggest that the form of *M. emiliae* recorded in Rondônia (Vivo, 1985, 1991) is distinct from that described by Thomas (1904) in the Tapajós-Xingu interfluvium. This was corroborated by Sena (1998) and Ferrari *et al.* (1999), who demonstrated that the form of *emiliae* found in the Tapajós-Xingu interfluvium is more similar in every way to *M. argentatus* than to the form of "*emiliae*" found in Rondônia. Until now, *M. emiliae* had not been proven to occur in the region of Serra do Cachimbo. Our observation provides a significant range extension of *M. emiliae* to the southwest, to at least the right bank of the Rio Teles Pires.

The possible presence of *Cebus albifrons* in the Tapajós-Xingu interfluvium is controversial. There is only one record from the region, on the lower Tapajós (Napier, 1976), which we believe to be valid; but more observations will be required to determine whether *C. albifrons* is widespread in the interfluvium.

The records of *Saimiri sciureus* in this area are restricted to the middle and lower Tapajós (Ayres and Milton, 1981; Thorington, 1985; George *et al.*, 1988; Silva Júnior, 1992; Vaz, 2001). The only record of this species beyond the right bank of the Rio Tapajós is that of Snethlage (1912) from the Jamanxim-Curuá interfluvium. In the area of the Rio Xingu, this species has only been recorded from the east bank (Voss and Emmons, 1996). Almost all the records of *Saimiri ustus* are from the middle and lower Rio Tapajós, but one record (Martins *et al.*, 1988) is from outside of this region (Fig. 1, loc. 42).

Recorded localities for *Aotus azarae infulatus* extend from the Rios Tapajós and Juruena (Pieczarka *et al.*, 1993) to the Rio Paraguai in the south of Mato Grosso (Ford, 1994), and throughout the reach of the Rio Tocantins (Schneider *et al.*, 1989). This taxon is known only from the northern portion of the Tapajós-Xingu interfluvium (Vieira, 1955; Branch, 1983; Martins *et al.*, 1988; Vaz, 2001).

Threats to the primates of the Tapajós-Xingu interfluvium

Ateles marginatus is listed as Endangered by the IUCN Red List (IUCN, 2003) due to hunting pressure and environmental degradation in the Tapajós-Xingu interfluvium. This is due mainly to the exploitation of the region along the Transamazônica (BR-230) and Cuiabá-Santarém (BR-163) highways, primarily from logging and ranching. Furthermore, its restricted distribution — as well as those of *M. emiliae* and *M. leucippe* — is a contributing factor to threats to these species.

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Appendix I. Gazetteer of catalogs, systematic reviews and inventories from the Tapajós-Xingu interfluvium, and localities obtained from analysis of specimens deposited in scientific collections. The numbers follow those in Figure 1.

Source	Locality
Alperin (1993)	2, 4, 6, 8, 9, 10, 11, 13, 14, 16, 18, 19, 20, 22, 23, 34, 38, 45
Ávila-Pires (1969)	4, 5, 6, 8, 9, 10, 16, 22, 34, 38, 45
Ávila-Pires (1986)	22, 34, 38
Branch (1983)	18
George *et al.* (1988)	18
Gregorin (1996)	4, 6, 8, 9, 16, 19, 25, 28, 29, 37
Hershkovitz (1977)	2, 4, 5, 8, 9, 10, 13, 16, 18, 19, 22, 38, 45
Hershkovitz (1985)	8, 9, 16, 18, 19, 23, 26, 30, 31, 34, 37, 44, 45
Hershkovitz (1990)	2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 16, 19, 20, 21, 25, 30, 31, 32, 34, 35, 37, 41
Kellogg & Goldman (1944)	6, 8, 9, 10, 45
Martins *et al.* (1988)	42
Napier (1976)	2, 4, 5, 6, 17, 22, 38, 44
Pimenta & Silva Júnior (this paper)	36
Pinto & Setz (2000)	33
Snethlage (1912)	39
Thorington (1985)	4, 5, 6, 8, 9, 10, 13, 14, 16, 19, 25
Vaz (2001)	8, 9
Vieira (1955)	4, 5, 6, 8, 9, 13, 25, 28, 30, 40, 41, 45
Vivo (1985)	2, 4, 5, 6, 8, 9, 10, 14, 16, 19, 22, 38, 45
Collection data (this paper)	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 18, 19, 24, 27, 29, 37, 41, 43, 44

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Novos Registros de Primatas no Parque Nacional do Itatiaia, com Ênfase em *Brachyteles arachnoides* (Primates, Atelidae)

Diogo Loretto
Henrique Rajão

Introdução

O status atual do muriqui, *Brachyteles arachnoides* (E. Geoffroy, 1806), de espécie criticamente ameaçada de extinção no estado do Rio de Janeiro (MMA/SBF, 2002) é atribuído principalmente à caça e aos intensos desmatamentos sofridos pela Mata Atlântica (Strier e Fonseca, 1996/1997). Há mais de 30 anos, no primeiro levantamento conhecido das populações de *B. arachnoides*, já era evidente que restavam poucos indivíduos nas serras do estado (Limeira, 1999). A ocorrência de muriquis no Parque Nacional do Itatiaia (PNI) foi registrada pela primeira vez em 1950 por J. Lima (Marroig e Sant'Anna, 2001). Poucos anos depois, Vieira (1955) já cita o PNI como área de distribuição geográfica do muriqui, informações que foram confirmadas pelos subseqüentes estudos de Aguirre (1971) e Ávila-Pires e Gouvêa (1977), com exemplares coletados a 1300 m de altitude na trilha Maromba-Lamego, e registros visuais entre as cotas de 1000 e 1800 m de altitude.

Somente mais recentemente, outros dois registros desta espécie foram feitos no Parque, em 1992 por Câmara (1995) e em 1993 por Marroig e Sant'Anna (2001). No primeiro deles, um espécime foi encontrado eletrocutado próximo à área da sede do PNI. O segundo registro foi feito na trilha dos Três Picos, entre 1100 e 1400 m de altitude. Nesta última ocasião, apenas um indivíduo foi avistado, cruzando a trilha. Reportamos aqui novos registros do muriqui no PNI, assim como os registros e considerações sobre outras quatro espécies de primatas da região.

Métodos

Durante o período de novembro de 2003 a março de 2005, fizemos sete excursões ao PNI. Foram 48 dias de trabalho de campo (cerca de 580 horas de censo). Em todas as excursões foram percorridas duas trilhas, geralmente em dias alternados: a Trilha dos Três Picos (22°25'S a 22°26'S e 44°35'S a 44°36'S), com aproximadamente 6 km de extensão, e a Trilha Maromba-Lamego (22°25'S a 22°26'S e 44°33'W a 44°37'W), com aproximadamente 10 km. As trilhas foram percorridas a uma velocidade aproximada de 1 km/h e as observações iniciavam-se às 0600 h estendendo-se até o anoitecer. Essas trilhas, localizadas em duas vertentes distintas do maciço do Itatiaia, são pouco usadas por turistas e apresentam variações altitudinais muito semelhantes, indo de 1080 a 1662 m na Trilha dos Três Picos e de 1100 a 1700 m na Trilha Maromba-Lamego. As altitudes foram medidas em campo com o uso de altímetro analógico Thommen, com escala de 10 m, e as coordenadas geográficas obtidas com aparelho de navegação portátil GPS II Garmin. As gravações foram feitas com gravador Sony TCM 5000 EV e microfone direcional Senheiser ME66 e depositadas no Arquivo Sonoro Elias Coelho (ASEC), do Laboratório de Ornitologia e Bioacústica, da Universidade Federal do Rio de Janeiro.

Resultados e Discussão

Em duas ocasiões registramos *B. arachnoides* na trilha dos Três Picos. Na primeira, em 10 de novembro de 2003, observamos durante 35 minutos (1555–1630 h), a cerca de 50 m da trilha, um grupo com pelo menos seis indivíduos, incluindo uma fêmea com um filhote, a 1580 m de altitude (22°25'24"S, 44°35'42"W). Os indivíduos foram fotografados e suas vocalizações gravadas durante cinco minutos.

O segundo registro ocorreu em 16 de junho de 2004, quando observamos um grupo com pelo menos 10 indivíduos forrageando na copa de árvores situadas a menos de 10 m da trilha, a 1620 m de altitude (22°25'38"S, 44°34'59"W). As observações se estenderam por 45 minutos (1500–1545 h). Os animais foram fotografados e suas vocalizações gravadas durante 20 minutos, a uma distância de cerca de 30 m.

Em todas as situações observamos os muriquis forrageando em árvores de grande porte (*ca.* 20 m de altura e mais de 30 cm de DAP [diâmetro a altura do peito]). A preferência por árvores de grande porte e com galhos espessos está de acordo com o observado para *B. hypoxanthus* por Lemos de Sá e Strier (1992) na Estação Biológica de Caratinga, Minas Gerais, e com o padrão geral para primatas neotropicais, no qual a altura do estrato e o diâmetro dos suportes utilizados parece estar diretamente relacionada com o tamanho de corpo das espécies (Cunha, 2005).

Nossos registros de *B. arachnoides* são semelhantes, no que diz respeito ao tamanho de grupos e altitude, aos feitos por Garcia e Andrade Filho (2002) e Cunha (2003, 2004) no Parque Nacional da Serra dos Órgãos, em Teresópolis, Estado do Rio de Janeiro. Assim como citado acima, nossos dois registros de *B. arachnoides* ocorreram em regiões altas e pouco visitadas do PNI, o que pode ser um reflexo da pressão antrópica excercida nos últimos séculos, levando a espécie a se refugiar nas encostas mais remotas e pouco acessíveis das serras.

Outras quatro espécies de primatas foram registradas dentro dos limites do PNI, nas mesmas trilhas usadas para o censo de *B. arachnoides. Callicebus nigrifrons* (Thomas, 1913), a espécie mais abundante em todas as seções de amostragem (25 grupos), esteve presente em praticamente todo o gradiente altitudinal das duas trilhas. O registro mais cedo foi feito às 0540 h e o mais tarde às 1605 h, entre 1100 e 1600 m. Existem registros de pequenos grupos desta espécie desde 700 até 1720 m nesta região (Ávila-Pires e Gouvêa, 1977). Em todas as observações *C. nigrifrons* formou pequenos grupos, de até quatro indivíduos, que se locomoviam pelo estrato intermediário da floresta, entre 10 e 15 m de altura.

Cebus nigritus (Goldfuss, 1809) foi a segunda espécie mais abundante registrada (n = 12; grupos de até oito indivíduos). Esteve presente somente nas áreas mais baixas das duas trilhas, entre 1080 e 1300 m, quando estiveram ativos entre 0655 e 1730 h.

Alouatta guariba Humboldt, 1812 foi a espécie menos abundante neste período, registrada somente a partir de vocalizações e excrementos. (As fezes das espécies de *Alouatta* possuem cheiro e forma bem característicos; o odor das fezes é difícil de confundir com odores de outros animais.) As vocalizações foram escutadas na trilha Maromba-Lamego no dia 11 de novembro de 2003, às 0650 h a 1250 m e no dia 17 de dezembro de 2004, às 1500 h a 1150 m de altitude. Nas duas ocasiões os grupos estavam distantes da trilha, o que não permitiu o avistamento. Encontramos fezes e urina de *A. guariba* na trilha dos Três Picos a 1120 m, uma única vez, no dia 19 de junho de 2004.

Alouatta guariba é uma espécie pouco estudada nesta região e em geral se distribui em populações pequenas e isoladas (MMA/SBF, 2002). A maior parte dos registros desta espécie no PNI foi feita a mais de 20 anos (Ávila-Pires e Gouvêa, 1977). De acordo com esses autores a população de *A. guariba* no PNI teria diminuído muito a partir de 1939, em decorrência de uma epizootia.

Apenas *Callithrix aurita* Geoffroy, 1812, encontrada anteriormente na região (Ávila-Pires e Gouvêa, 1977; Olmos, 1995), não foi registrada por nós no PNI. Coimbra-Filho (1991) sugere que esta sempre foi uma espécie rara em toda a sua distribuição. Outros estudos apoiam este status de espécie rara de *C. aurita*, como a recente revisão do gênero *Callithrix* (Rylands *et al.*, 1993), e em estudos feitos na Serra dos Órgãos (Schirch, 1932; Cunha, 2004).

No entanto, dois guias turísticos do Parque nos informaram sobre a presença recente de "uma rara espécie de sagüi-preto-de-cara-branca" nas trilhas situadas próximo a entrada na parte baixa do PNI (entre 600 e 800 m). Este registro se assemelha em altitude ao espécime de *C. aurita* coletado a 750 m de altitude reportado por Ávila-Pires e Gouvêa (1977). Outro registro, feito por um funcionário do PNI em outubro de 2004, ocorreu na trilha da Cachoeira Poranga, *ca.* 900 m de altitude, onde um grupo — provavelmente de *C. aurita* — foi avistado. A identificação do "sagüi-preto-de-cara-branca" foi confirmada quando o funcionário identificou rapidamente a espécie no momento em que apresentamos a Prancha II do guia de *Primatas do Brasil* (Auricchio, 1995).

A confirmação da presença no PNI das cinco espécies de primatas nativos registrados para a região (veja Geise *et al.*, 2004), reforça a importância dessa unidade de conservação para a preservação das espécies de primatas da Mata Atlântica.

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CONSERVATION IMPLICATIONS OF PRIMATE HUNTING PRACTICES AMONG THE MATSIGENKA OF MANU NATIONAL PARK

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Introduction

Much ink has been spilled recently in the debate over whether indigenous people are "ecologically noble savages"—natural-born conservationists—or whether they pose a threat to biodiversity in the Amazon and other ecosystems (Redford, 1991; Alcorn, 1993; Alvard, 1993; Redford and Stearman, 1993; Robinson, 1993; Terborgh, 1999; Schwartzman *et al.*, 2000). Tropical biologists and ecological anthropologists alike have brought important empirical data and theoretical perspectives to the debate, including estimates of game animal densities, rates of harvest and consumption by indigenous and other hunting communities, alteration in species composition and depletion or extinction of vulnerable species under different intensities of hunting, and models to estimate sustainability of hunting practices and catchment area sizes (Hames, 1980; Hames and Vickers, 1982; Bodmer *et al.*, 1988; Peres, 1990; Mitchell and Ráez-Luna, 1991; Vickers, 1991; Bodmer *et al.*, 1994; Robinson and Redford, 1994; Ráez-Luna, 1995; Alvard *et al.*, 1997).

Though often overlooked, the sociocultural, economic and political dimensions of hunting and resource use are also critical for assessing sustainability and establishing management and conservation strategies (Campos *et al.*, 2001; Ráez-Luna, 2001; Shepard, 2002). In this paper, we present data on the species preferences and sex ratios of primates taken by a sample of Matsigenka hunters during a one-year period. We also note sociocultural beliefs and practices relevant to primate hunting among the Matsigenka (see Shepard, 2002), and provide suggestions for long-term monitoring and community-based management of game animals in these and other native communities.

Research for this paper was carried out in the Matsigenka native community of Yomybato, approximately 450 m above sea level on a small tributary that joins the Río Manu some 30 km upriver from the Cocha Cashu Biological Station (EBCC), located in Manu National Park, Department of Madre de Dios, southeastern Peru (Terborgh, 1990). The vegetation around Yomybato is mostly *terra firme* forest, dissected by streams (Shepard *et al.*, 2001).

The Matsigenka are an indigenous people numbering more than 11,000, distributed among some three dozen small communities settled throughout tributaries of the Ríos Urubamba, Madre de Dios and Manu. During the 1960s, an American Protestant missionary organization contacted isolated populations throughout Madre de Dios and settled them in the community of Tayakome on the upper Río Manu (d'Ans, 1981). After the creation of the Manu National Park in 1973, the missionaries were expelled by the Peruvian government, as their commercial activities (sale of animal pelts to support operations) and provisioning (with shotguns, ammunition, Western clothes and medicines) among the Matsigenka were seen as contrary to the park's goals of natural and cultural preservation. The small airstrip and bilingual school at Tayakome were abandoned, while shotguns, commercial extraction, and other market economic activities were prohibited. About half of the approximately 200 Matsigenka in Tayakome at that time accompanied the missionaries on their exodus from Manu to the adjacent Río Camisea. Driven by internal social conflict, as well as fear of attacks by the hostile Nahua (Yora) people of the Manu headwaters, another segment of the population left Tayakome around 1978 to establish the community of Yomybato, some 30 km inland from Tayakome up the tributary stream Quebrada Fierro or *Yomuivaato* (see Shepard *et al.*, in press, for a detailed history). The community of Yomybato has grown from 92 inhabitants in 1986 to 218 in 2005, owing both to population increase and migration

Table 1. Non-human primate species of Manu; for more information see Pacheco *et al.* (1993).

English Common Name	Matsigenka Name	Latin Name	Hunting Preference	Weight (kg)
Spider monkey	*Osheto*	*Ateles paniscus*	High	7.5 – 13.5
Woolly monkey	*Komaginaro*	*Lagothrix lagotricha*	High	3.6 – 10.0
Red howler monkey	*Yaniri*	*Alouatta seniculus*	Medium	3.6 – 11.1
Brown capuchin	*Koshiri*	*Cebus apella*	Medium	1.7 – 4.5
White-fronted capuchin	*Koakoaniro, Makere*	*Cebus albifrons*	Medium	1.2 – 3.6
Squirrel monkey	*Tsigeri*	*Saimiri boliviensis*	Medium	0.6 – 1.4
Owl monkey	*Pitoni*	*Aotus nigriceps*	Medium	0.8 – 1.2
Monk saki	*Maramponi*	*Pithecia irrorata*	Low	2.2 – 2.5
Dusky titi	*Togari*	*Callicebus brunneus*	Low	0.9 – 1.4
Saddleback tamarin	*Potsitari tsigeri*	*Saguinus fuscicollis*	Low	0.3 – 0.4
Emperor tamarin	*Tsintsipoti, Chovishishini*	*Saguinus imperator*	Low	0.4
Goeldi's monkey	*(Marapito?)*	*Callimico goeldii*	Low	0.5
Pygmy marmoset	*Tsigeriniro, Tampianiro, Tampiashitsa*	*Cebuella pygmaea*	Low	0.1 – 0.2

from isolated Matsigenka settlements in the Manu headwaters (Ohl, 2004).

Manu National Park hosts thirteen non-human primate species (Terborgh, 1983; Emmons and Feer, 1990; Pacheco *et al.*, 1993; Shepard, 2002; see Table 1). Of these, spider monkeys and woolly monkeys are preferred by Matsigenka hunters. Howler monkeys and two species of capuchins are also hunted, but less frequently, while the owl monkey is considered a delicacy by some hunters. Other small primate species such as squirrel monkeys, emperor and saddle-back tamarins, dusky titis and monk sakis may be taken on occasion, either as substitute prey on unsuccessful forays or by younger or less skilled hunters. An unidentified primate species known as *marapito* (possibly the rare Goeldi's monkey) is also taken occasionally. The tiny pygmy marmoset has never been observed to be hunted, and is attributed magical powers by some hunters.

Due to the firearms prohibition, the Matsigenka hunt mostly with palm-wood bows and bamboo-tipped arrows, using visual and auditory cues to locate monkey troops. Hunters also exchange information about recent sightings. Hunters imitate woolly and spider monkey calls well enough to elicit responses or even attract naïve troops. Upon encountering a monkey troop, hunters try to position themselves for a nearly vertical shot as high as 30 m. Hunters try to pick out the large adult males or *kurakas* (a Quechua loan word meaning "leader") as targets for their first arrows. If the first arrow does not hit the animal in the chest, or if the troop is scared off, the hunter must pursue the fleeing animals, often targeting the slower-moving females burdened by young. Even fatally wounded monkeys are often able to climb into a tall tree and get a firm grip on a branch, and hence do not fall when they die. Hunters frequently recover their prey by climbing high into the canopy, and falls causing severe injuries or death are known to happen. Other noted hunting accidents include being struck by a stray arrow and snakebite (Shepard, 1999a; Izquierdo and Shepard, 2004).

Methods

This study uses a participatory methodology of hunting returns that has been used with success elsewhere (Bodmer, 1994; Townsend, 1997). In December 1998, we asked three Matsigenka bow hunters, living in two different settlements in Yomybato (one near the central village area, one at a distance of some 6 km), to store the skulls of all mammals hunted and killed for the ensuing year. We returned to the community in December 1999 to collect the data and evaluate the success of the exercise. We did not pay the informants on a per-skull basis or offer other incentives that might distort hunter effort. However, upon our return, we did give a nominal, unsolicited reward, a kitchen knife or machete, in appreciation of the informants' efforts. Da Silva examined and photographed each set of skulls and carried out an interview with the hunters (translated from the Matsigenka by Shepard) concerning the species, sex, age class, and approximate kill date for each skull. The hunters were frequently able to remember, in the case of female animals, whether they were pregnant or burdened by young when hunted.

We present here only the data on primate species preference. We had initially planned, following Bodmer (1994), to study species preferences for all large animals based on skull collection data. However, this proved difficult because of sociocultural beliefs and practices specific to the Matsigenka. Matsigenka men do not eat meat from the heads of animals they themselves have killed, believing that they will "lose their aim" if they do so (see Shepard, 2002). For this reason the heads of large ungulate prey are frequently gifted to close kin to "suck/finish off the meat of the head" (*tsogitotagantsi*). This practice resulted in all three hunters' ungulate skull collections being incomplete. Because primate heads are relatively small, a hunter's wife and children can easily "suck off the meat," and the skull thus remained in the hunter's skull collection. Such sociocultural considerations are of fundamental importance in designing appropriate monitoring strategies in different local communities (see Shepard *et al.*, in press).

Results

Prey profiles

From the 1998–99 collection, we identified 17 woolly monkeys, 14 spider monkeys, three capuchins and one howler monkey, a clear reflection of Matsigenka dietary preferences (for an explanation of the low preference for howler monkeys, see the Discussion). One of the hunters continued collecting skulls from 1999 to 2000, and his profile remained similar, though there was a slight shift toward smaller species: 11 woolly monkeys, six spider monkeys, and one each of owl, dusky titi, and squirrel monkeys. Approximately ten years earlier, Alvard and Kaplan (1991) found a similar prey profile in a study by direct observation of a broader sample of hunters throughout a full year (1988–89): 24 woolly monkeys, 17 spider monkeys, three capuchins and two howlers. Following Rowcliffe *et al.* (2003), a simple way to detect game depletion—and thus unsustainable hunting at the local scale—is to assume that hunters are optimal foragers who hunt additional species as their preferred prey becomes scarce. Comparison of the two datasets reveals no significant change in prey frequencies more than a decade later (Monte Carlo RxC contingency table [Engels, 1988]: 1988–1999 data only, $p = 0.975 \pm 0.001$ s.e.; 1988–2000 data pooled, $p = 0.993 \pm 0.001$ s.e.). This is despite the fact that the population of Yomybato had grown by approximately 78% during that time, due partly to immigration from isolated Matsigenka settlements in the Manu headwaters (Ohl, 2004).

Sex ratios

In addition to their detailed memory about hunting expeditions, even months later, Matsigenka hunters also appear able to differentiate between male and female skulls of primates and other species of game animals, using cranial features such as canine size, robustness of the sagittal crest and supraorbital margins, and overall skull size (cf. Ramirez, 1988; Corner and Richtsmeier, 1993). According to the interviews with the hunters, conducted during da Silva's examination of the skulls (1998–99 data only), 13 of 14 spider monkeys killed (93%) were female. Alvard and Kaplan (1991) noted a similar pattern: females represented 15 of 17 (88%) spider monkeys taken during their observations. The pooled dataset (n = 31) finds a significant female bias (two-tailed binomial test, p = 0.026) when compared to the spider monkeys' naturally female-biased sex ratio of 73%, as registered nearby at Cocha Cashu Station on the Río Manu (McFarland Symington, 1987). For woolly monkeys, the sex ratio in our dataset was close to parity: 8 of 17 (47%), contrasting with Alvard and Kaplan's (1991) data showing 18 of 24 kills (75%) to be female. Woolly monkeys have not been well studied in Manu, but populations in Venezuela show roughly equal sex ratios varying from 80 to 120 males per 100 females (Nishimura and Izawa, 1975; Izawa, 1976; both cited in Alvard and Kaplan, 1991). Assuming an equal sex ratio, there is a weak indication that woolly monkey kills by Matsigenka hunters are female-biased (two-tailed binomial: pooled, n = 41, p = 0.088; Alvard and Kaplan [1991] data only: p = 0.015). Any female kill bias probably represents a balance between expressed hunter preference for the larger adult males and easier access to females burdened by young. We should note, however, that these sex ratios represent only successfully retrieved kills; about half of the large monkeys shot with arrows escape capture, although many of them probably die afterwards (Ohl *et al.*, in preparation). If we assume that males (larger and unburdened by young) are more likely both to be shot and to escape, then the female bias in the skull data could at least partially represent a post-shot retrieval bias, and the sex ratio of all killed animals could be closer to parity.

Discussion

Prey profile data taken more than ten years apart suggest that hunters experienced no primate prey depletion between 1988 and 2000. Following Rowcliffe *et al.* (2003), we infer that primate hunting around Yomybato village was sustainable during this time, and continues to be sustainable in 2005 (Ohl *et al.*, in prep.), despite a doubling of the Matsigenka population. In fact, large primates are still commonly hunted within five km of the central village area. During our 1999 stay, we encountered apparently naïve and unafraid spider monkeys at a distance of only eight km from the central village area, and less than two km from the nearest household-garden compound. These observations support the suggestion that primate populations are sustained by immigration from troops living in adjacent, non-hunted areas (Alvard *et al.*, 1997; Novaro *et al.*, 2000; Peres, 2001; Peres and Nascimento, in press; Shepard *et al.*, in press). It is well-established in ecological theory that predator-prey dynamics are stabilized by prey refuges (May, 1978; Joshi and Gadgil, 1991; Lewis and Murray, 1993), and much of the rest of Manu Park appears to be such a refuge.

This conclusion contrasts with the results of calculating sustainability via the standard method of estimating minimum catchment areas (Robinson and Redford, 1991). We calculate a catchment area estimate using Alvard and Kaplan's (1991) data for a historical Matsigenka population of approximately 105 people for Yomybato only, and then extrapolate to the current total Matsigenka population of 420 in the two settled communities of Manu Park, Tayakome (not studied by Alvard and Kaplan) and Yomybato. The catchment area is defined as the area needed to sustain the *per capita* consumption rate reported in Alvard and Kaplan (1991), assuming the maximum sustainable harvest rates from Robinson and Redford (1991). The measured *per capita* consumption rate is doubled in order to count wounded but escaped animals that eventually die (see Ohl *et al.*, in prep.).

According to these calculations, a Matsigenka population of 105 people (Yomybato only) would have needed 7.0% and 4.3% of Manu Park to support their offtake of woolly and spider monkeys, respectively. (Note that the park covers an area of 17,165 km^2, larger than the U.S. state of Connecticut.) By linear extrapolation, the current population of 420 (Tayakome and Yomybato) should be using 28.0% and 17.2% of Manu Park, respectively. These are large numbers, and they project that at least all of Manu Park would be needed to sustain spider monkey offtake for a population of merely 1500 human consumers. Given that several isolated indigenous groups currently reside within park boundaries, and that nine Westernized native communities are situated around the park's borders (see Shepard *et al.*, in press), the number of human consumers currently exploiting the park's game animal resources certainly approaches if not exceeds 1500. Thus, we might expect that spider monkeys, at least, should already show signs of large-scale depletion. However, the results presented here, as well as ongoing participatory research with Matsigenka hunters (Shepard *et al.*, in press; Ohl *et al.*, in prep.), provide no such evidence.

Clearly, a linear extrapolation does not take into account the fact that human hunters are central-place foragers, typically traveling less than six km from their homes on hunting forays (Ohl *et al.*, in prep.). An important implication is that for each game species, the rate of mortality due to hunting should scale up more slowly than does human population growth, eventually stabilizing at a level equal to the rate of immigration of animals from the "source" populations (non-hunted areas of the park) into the "sink" of the hunting zone (see also Sirén *et al.*, 2004). Such source-sink dynamics are credited with maintaining viable game animal populations within the larger indigenous reserves across the Amazon, despite local hunting pressure (Novaro *et al.*, 2000; Peres, 2001; Peres and Nascimento, in press). Manu and other large parks in the Amazon almost certainly act as game refuges, contributing to the food security of any native inhabitants or neighboring human populations, though this important benefit is rarely acknowledged by local peoples (who tend to see parks as hindering their economic interests) or conservation scientists and policy-makers (who would rather not think about charismatic megafauna going to the soup pot; see Shepard, 2002).

Certain native beliefs and practices reflect traditional socio-environmental concepts that have conservation implications (Posey, 1999). This is especially the case for primates, many species of which have mythological or symbolic importance and are subject to taboos, restrictions or dietary avoidance among diverse Amazonian peoples (Shepard, 2002; Cormier, in press). Matsigenka hunters mostly avoid taking woolly and spider monkeys from the peak dry season (July–August) through the early rainy season (November–December) when fruits are scarce and monkey meat is lean and tough, and thus likely to provoke disparaging comments by their wives. Instead, monkey-hunting is concentrated in the late rainy season and beginning of the dry season (March–June) when monkeys are fat. The Matsigenka believe that certain monkeys (especially large adult males) and other game animals have vengeful spirits that can "take revenge" on the hunter's family, causing illness to young children. Matsigenka women use special fragrant herbs to protect newborn babies from the musk-smelling, vengeful spirits of monkeys and other game animals (Shepard, 2004). Hunters may also practice sexual abstinence, behavioral taboos, and ritual purification by purgative and hallucinogenic plants in order to ensure "good aim" (*kovintsari*) and to maintain good relations with the invisible spirits who guard and multiply game animals (Shepard, 1998, 1999b).

Such beliefs imply a system of checks and balances between humans and the natural world, implicit in many Amazonian cosmologies (Reichel-Dolmatoff, 1976). A good example of how culture impinges on hunter behavior is found in the case of the howler monkey (see also Shepard, 2002). Based on a specific mythical narrative, Matsigenka hunters often refer to howler monkeys as shaman/sorcerers (*seripigari*). This represents a somewhat humorous reference to the howler's loud "singing," but also implies a potential threat on the spiritual level. Howler monkeys are also considered to be lazy; this undesirable character trait could be passed on to children who consume their meat. In more practical terms, howler monkeys are also known to be infested with botfly larvae, rendering their meat less attractive. Together, these beliefs and attitudes result in a greatly reduced hunter preference for howler monkeys, despite body weights comparable to spider and woolly monkeys and high local abundance. (Authors' personal observations: howler monkey troops can be heard vocalizing near many Matsigenka settlements in Manu.)

In short, culturally mediated beliefs and practices affect hunter behavior, sometimes in ways that run contrary to "optimal foraging" analyses based solely on protein or caloric profitability (e.g., Alvard and Kaplan, 1991; Alvard, 1993). Thus, traditional socio-environmental concepts could provide the ideological framework for future conservation measures (Shepard, 2002). Still, long-term sustainable management of game animals will require policy intervention by the Manu Park administration as well as commitment and participation by the Matsigenka themselves (Shepard *et al.*, in press). An understanding of hunting practices, hunter preferences, and their sociocultural underpinnings will be crucial in developing and maintaining a productive dialogue on game management and primate conservation.

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NEWS

RECORDS OF PRIMATES AT ITATIAIA NATIONAL PARK, BRAZIL

Itatiaia National Park (Parque Nacional do Itatiaia) is located in the Serra da Mantiqueira, in the southwest of the state of Rio de Janeiro and south of the state of Minas Gerais in Brazil. Incorporating land from both states, the park comprises an area of 30,000 ha; it is covered primarily by Montane Atlantic Rainforest and Seasonal Semideciduous Forest, at elevations ranging from 400 to 2790 m. Four main plant communities are found along an altitudinal gradient: Sub-Montane Forest (from 400 to 499 m), Montane Forest (from 500 to 1499 m), High Montane Forest (from 1500 to 1999 m) and High-Altitude Grasslands (above 2000 m) (Ururahy *et al.*, 1983; Geise *et al.*, 2004).

Six primates have been recorded from the Itatiaia National Park: *Callithrix aurita*, *Callithrix penicillata*, *Cebus nigritus nigritus*, *Callicebus nigrifrons*, *Alouatta guariba clamitans* and *Brachyteles arachnoides*. Most of these are older records, however, published mainly in the 1970s (i.e., Aguirre, 1971; Ávila-Pires and Gouvêa, 1977; see also Câmara, 1995; Marroig and Sant'Anna, 2001), and new surveys will be necessary to update our knowledge of primate distributions in this area.

During field surveys which I carried out in July 2004, I made new records for three primate species belonging to three genera and two families. All my observations were made on a hiking trail known as Trilha dos Três Picos (Three Peaks Trail), which runs for six kilometers and culminates at an elevation of 1662 m at the Serra do Palmital. The trail passes through Montane and High Montane Forest communities. In general, human traffic is infrequent on this trail; hunters and poachers are not known from this area of the park, and the only visitors are a very few tourists and researchers.

Alouatta guariba clamitans Cabrera, 1940
On 15 July 2004, at 0930 hours, I observed an adult male and an adult female carrying an infant on its back at an elevation of 1060 m, at 22°26'07"S, 44°36'30"W. They did not respond to my presence and remained resting for a long period, typical for *Alouatta.*

Cebus nigritus nigritus (Goldfuss, 1809)
Later on 15 July, at 1400 hours, I observed a group of 10 to 15 individuals at an elevation of 1600 m, at 22°25'23"S, 44°35'19"W. The individuals demonstrated aggressive behaviors when I approached them, such as breaking of branches, vocalizations, and threat displays (piloerection and baring of teeth).

Callicebus nigrifrons (Spix, 1823)
On 20 July 2004, at 1500 hours, I recorded typical vocalizations of this species at an elevation of 1620 m, at 22°25'25"S and 44°35'07"W. I heard the calls in a steep, remote area of the park, and estimated the individuals were approximately 500 m away.

The elevations at which *Alouatta guariba clamitans* and *Callicebus nigrifrons* were recorded coincide with the relative frequency distribution of captures of primate species presented by Geise *et al.* (2004) for elevational gradients at Itatiaia National Park. These authors reported *Cebus nigritus nigritus* from altitudes between 500 and 1500 m. My observations of these taxa, however, were made outside this range, at 1600 m.

These observations indicate that Itatiaia National Park still supports a variety of primate taxa and is important for the maintenance of primate diversity in the region. Most species and subspecies present in this Park are on the *Lista da Fauna Ameaçada de Extinção do Estado do Rio de Janeiro* (Bergallo *et al.*, 2000): *Callithrix aurita* (Vulnerable), *Callicebus nigrifrons* (Vulnerable), *Alouatta guariba clamitans* (Possibly Threatened), and *Brachyteles arachnoides* (Critically Threatened). Additional field surveys will be necessary to obtain new records, especially for the genus *Callithrix*.

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BLACK HOWLER MONKEYS IN EL SALVADOR: A RESULT OF THE PET TRADE

The geographical distribution of the black howler monkey, *Alouatta pigra*, is restricted to the south of Mexico (in the state of Tabasco, the north of Chiapas, and the Yucatán peninsula), Guatemala (Petén), and Belize (Horwich and Johnson, 1986; Horwich and Lyon, 1990; Rowe, 1996; Estrada and Mandujano, 2003). The only monkey reported as native to El Salvador is the black-handed spider monkey, *Ateles geoffroyi*, which is found mainly in the forests of the Jiquilisco Bay in the Department of Usulután, in the southeast of the country (Morales Hernández, 2002).

The park guards of the San Diego Forest have been reporting the presence of two monkeys there since 2004.

Figure 1. Female black howler monkey in San Diego Forest, El Salvador, February 2005.

Figure 2. The two female black howler monkeys in San Diego Forest, El Salvador, February 2005. (Photos courtesy of CEPRODE.)

The San Diego Forest (SDF) is a dry tropical forest in the department of Santa Ana (northern El Salvador) on the border with Guatemala. It covers 1,842 ha, with altitudes ranging from 440 to 780 m above sea level (CEPRODE-FIAES, 2000). SDF is outside the known range of spider monkeys in the country (Morales Hernández, 2002), and it was first thought that they were spider monkeys that had been released there. I visited this area three times to verify their presence.

The guards described these monkeys as "all black." Drawings and pictures of different Mesoamerican monkeys were shown to them in order to correctly identify the animals, but they never recognised them as "spider monkeys" (*Ateles geoffroyi*). The monkeys were eventually found during my third visit to SDF, on 16 February 2005, and I was able to verify that they were in fact two female howler monkeys, *Alouatta pigra*.

According to the information I have to date, their presence is a result of the pet trade, but their origin remains unknown. The authorities received recommendations from expert primatologists who have studied howler monkeys in the wild that they would best be left in the San Diego Forest and monitored. Their relocation would be expensive, traumatic for the animals, and pointless. They are both females and so will not reproduce. They are surviving well there, eating leaves and fruits of vegetation such as *Brosimum alicastrum*, *B. terrabanum* and *Ficus* spp. (CEPRODE-FIAES, 2000). Howler monkeys are adaptable (Eisenberg, 1979), although both *A. palliata* and *A. pigra* are seriously threatened, because of forest destruction within their small geographic distributions (Crockett and Eisenberg, 1987). It is important for us to know how these animals got there, and why their presence has been ignored for so long. It is urgent that national and international authorities along the borders and within the countries reinforce their efforts to protect endangered primates such as *Alouatta pigra*, as well as other wildlife, from the pet trade.

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GROUP DYNAMICS AND FEMALE REPRODUCTIVE MONOPOLIZATION IN THE MOUSTACHED TAMARIN (*SAGUINUS MYSTAX*)

On 14 July 2005, Petra Löttker defended her doctoral thesis on aspects of group dynamics and reproductive monopolization by female moustached tamarins (*Saguinus mystax*) at the University of Münster, Germany. Her supervisors were Prof. Dr. Norbert Sachser, Department of Behavioural Biology, Institute of Neuro- and Behavioural Biology, University of Münster, and Dr. Eckhard W. Heymann, Department of Behavioural Ecology and Sociobiology, German Primate Centre, Göttingen. The study was supported by DFG (HE 1870/10-1,2). The following is a summary of the thesis.

Callitrichids are the only family of primates in which group members are characterized by a cooperative breeding system with only one, rarely two breeding female(s) per group, often polyandrous matings, dizygotic twin offspring with high neonatal body mass, delayed offspring dispersal, and intensive helping behaviour shown by all group members. To date, the factors shaping the evolution of cooperative breeding in general, and the proximate mechanisms and ultimate causes of female reproductive monopolization in particular, remain largely unknown. A number of models have been put forward to explain single-female breeding. They incorporate various factors influencing the degree of monopolization, including relatedness between dominant and subordinate females, dispersal costs, the risk of inbreeding depression, infanticide by dominant females, and availability of helpers. In general, two (non-exclusive) scenarios are possible: dominant females can suppress reproduction in subordinate females, or subordinate females can restrain themselves from reproduction. Both dominant suppression and subordinate self-restraint can be manifested behaviourally and/or physiologically by preconception and/or postconception mechanisms. Which mechanisms are actually involved seems to depend on a variety of factors such as species, demographic and social context, reproductive/physical status of the dominant female, age of subordinates, and environment (captive versus wild).

Against this background, the aim of this study was to investigate different aspects of the cooperative breeding system, focusing on female reproductive monopolization in a wild tamarin species by investigating the demographic background as well as underlying physiological and behavioural mechanisms. We studied eight wild groups of moustached tamarins (*Saguinus mystax*) at the Estación Biológica Quebrada Blanco (EBQB) in north-eastern Peruvian Amazonia over four years, using a combined approach of detailed, long-term behavioural observations and modern non-invasive techniques of genetic and endocrine analyses from faecal samples.

The demographic and genetic data revealed that wild moustached tamarins exhibit a clear monopolization of reproduction by one female per group (Löttker *et al.*, 2004a). Despite the presence of up to three adult females per group, in none of the groups did more than one female breed successfully at any time. Relatedness within groups was generally high, and most non-breeding individuals were either natal or closely related to the respective same-sex breeder. Apart from members of breeding pairs that were never closely related, only three groups in three group years out of eight groups in 17 group years contained individuals unrelated to any of the group members. Hence, in the majority of groups, non-breeding females were able to gain indirect fitness benefits from helping to rear offspring of a closely related female (mother or sister). Along with assumed low chances for independent breeding in the study population, this situation might induce subordinate females to restrain themselves from reproduction.

Endocrine analyses on two breeding and two non-breeding females from two study groups revealed that the monopolization of reproduction was apparently not caused or maintained through ovarian inactivity in non-breeding females (Löttker *et al.*, 2004b). Non-breeding females demonstrated temporal fluctuations in hormone concentrations and absolute hormone levels that were similar to ones in the breeding females during their phases of ovarian activity. Along with the absence of overt female-female aggression, this questions the action of dominant suppression. Instead, both non-breeding females were daughters of the actual breeding pair and sexual interactions with their group males were never observed. Hence, reproductive inactivity in them is likely to be shaped by inbreeding avoidance. Along with the general constraints of helpers on the successful rearing of the young, this would suggest that females avoid reproducing until prevailing conditions improve. Thus, overall, subordinate self-restraint offers a more useful framework than dominant suppression for understanding single-female breeding in wild moustached tamarins.

Behavioural analyses of grooming relationships in two study groups revealed that breeding females groomed most intensely, and with the most reciprocity, with breeding males and non-breeding offspring compared to potentially breeding males (i.e., males that copulated with the female but did not sire young; Löttker *et al.*, in prep.). Breeding females groomed and were groomed by breeding males more during the phases of ovarian activity, when conceptions were possible, and with potentially breeding males (= individuals that invested highly in helping behaviour) during pregnancies. These results suggest that breeding females might use grooming as an (additional) means of establishing and maintaining the cooperative breeding system by inducing mate association with the breeding male and encouraging helping behaviour in other group members.

By combining demographic, endocrinological and behavioural data, this study has contributed to a better understanding of the proximate mechanisms causing and maintaining female reproductive monopolization and cooperative breeding in wild moustached tamarins. However, further studies — and most importantly, more long-term studies on different callitrichid species, using a combination of methods as applied here — are needed to generalize our understanding of the factors shaping the evolution of the cooperative breeding system and female reproductive monopolization in callitrichid primates.

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ESTACIÓN BIOLÓGICA EL REFUGIO HUANCHACA, BOLIVIA

El Refugio is a 50,000 ha private reserve and research station operated by the Weeden Foundation, a philanthropic organization based in the United States. El Refugio is located in northeastern Bolivia (14°45'S, 61°00'W) adjacent to and partially overlapping the Noel Kempff Mercado National Park, a rarely studied area of South America. The station is in a broad transition zone between moist Amazonian forest and the dry forest and grasslands characteristic of the Cerrado and Gran Pantanal.

Diverse habitats surround the biological station, including forests, riparian vegetation associated with the Río Paraguá, seasonally-flooded grasslands, and forest islands. The forests at El Refugio include a mixture of Amazonian and non-Amazonian elements, with patches of semi-deciduous terra firme forest, seasonally-flooded vine forest, riparian forest, and dry forest on an isolated outcrop of the Brazilian Shield. The grassland floods from 10 cm to two meters during the rainy season, while fire is a regular phenomenon during the dry season. Forest islands in the grassland range in size from a few square meters to approximately 10 ha, and include a mixture of woody, fire-tolerant shrubs and trees as well as grasses. The Río Paraguá is a small river, 10–30 m wide, much of which is covered by floating mats of aquatic vegetation.

To date, relatively little research has taken place at El Refugio. Species lists of prominent biotic groups (birds, mammals, amphibians and reptiles, and butterflies) form a baseline for further research, but are far from complete. In addition to species-specific studies, or investigations of species diversity across diverse habitat types, other research possibilities at the site include fire ecology, climate change—because it is located in a climate and habitat transition zone, the effects of climate change may be seen at sites like El Refugio before they become manifest in other areas—and wetland ecology, among many others. Additionally, El Refugio has populations of many threatened vertebrate species, including the black caiman (*Melanosuchus niger*), maned wolf (*Chrysocyon brachyurus*), giant river otter (*Pteronura brasiliensis*), and marsh deer (*Blastocerus dichotomus*). Primate species observed at El Refugio include *Mico melanurus*, *Alouatta caraya*, *Ateles chamek*, *Cebus apella*, and *Aotus* sp.

Facilities at El Refugio are basic but comfortable. Accommodations include cabins with single beds, hot showers, kitchen, and common room with a lab and small library. The station staff offers limited but very useful research assistance that may include manual labor (i.e., trail clearing, equipment construction and transport), the use of horses and canoes, and light data collection/monitoring during researcher absence. In addition, the station maintains a complete record of rainfall, river level, and temperature flux.

For more information please visit <http://www.weedenfdn.org> and click on El Refugio Huanchaca. For specific questions or reservations, please contact the El Refugio administrators at <dosmilanos@cotas.com.bo>.

A Website for the Primate Specialist Group

A new website is being developed for the Primate Specialist Group to provide information for PSG members and all others interested in primate conservation. In addition to membership and background information on the PSG, the website will present a running summary of currently recognized primate diversity and the conservation status of each species, plus a special section on primates listed as Critically Endangered. The website will also contain guidelines for authors submitting to the PSG's regional publications—*African Primates*, *Asian Primates*, *Lemur News* and *Neotropical Primates*—and to its overarching journal, *Primate Conservation*. Current issues of all these publications, as well as Action Plans and the Top 25 Most Endangered Primates report, will be available for free download in PDF format. Also planned is an area devoted to the new Section on Great Apes, with information on great ape taxonomy, workshops and publications, and the Great Ape Emergency Conservation Fund.

The PSG website will be developed and maintained by John Aguiar, PSG General Coordinator, with oversight by PSG Deputy Chair Anthony Rylands. Information on great apes will be provided by Liz Williamson, Coordinator for the Section on Great Apes. The new website will be available at <http://www.primate-sg.org>, and the PSG gratefully acknowledges the support of Space2Burn.com for their website hosting services. Questions and suggestions about the PSG website may be sent to John Aguiar at <j.aguiar@conservation.org>.

Recent Publications

Books

Mammal Species of the World, Third Edition, by D. E. Wilson and D. M. Reeder. 2005. The Johns Hopkins University Press, Baltimore. 2000pp. ISBN 0801882214 (hardback, two volumes, $125.00). Wilson and Reeder's *Mammal Species of the World* is the classic reference book on the taxonomic classification and distribution of the more than 5400 species of mammals that are known to exist today. The third edition includes detailed information on nomenclature and, for the first time, common names. Each concise entry covers type locality, distribution, synonyms, and major reference sources. The systematic arrangement of information indicates evolutionary relationships at both the ordinal and the family level. This indispensable reference work belongs in public and academic libraries throughout the world, and will be a valuable resource for every biologist who works with mammals. *Available from*: The Johns Hopkins University Press, 2715 North Charles Street, Baltimore, Maryland 21218-4363, USA, Phone: (410) 516-6900, Fax: (410) 516-6968. Orders: 1-800-537-5487, Fax: (410) 516-6998. More information online at <http://www.press.jhu.edu>.

Manual de Huellas de Algunos Mamíferos Terrestres de Colombia, por José Fernando Navarro y Javier Muñoz. 2000. Edición de Campo, Medellín. 136pp. Este libro está hecho para brindar información básica sobre mamíferos neotropicales. Describe e ilustra 33 especies de mamíferos de las que se pueden encontrar con mayor probabilidad sus rastros en el campo. Para cada una de ellas se incluyen ilustraciones de sus huellas con medidas aproximadas y dimensión de la pisada, una descripción de la especie, su taxonomía y nombres vernáculos con los cuales se la conoce en Colombia, datos ecológicos y de distribución, entre otros. Este libro está hecho para ser llevado al campo; puede ser utilizado por profesionales, naturalistas aficionados, estudiantes y el público en general. Con esta publicación se pretende generar el interés por el conocimiento y la conservación de nuestros mamíferos amenazados. Mas información: <http://www.humboldt.org.co>.

Noninvasive Study of Mammalian Populations, by W. E. Evans and A. V. Yablokov. 2004. Pensoft Publishers, Sofia, Bulgaria. 142pp. ISBN 9546422045 (hardback, €37.80). Although it is a tenet of particle physics that nothing can be observed without its being altered by the observer, biologists have long sought to do precisely that. Apart from their theoretical interest, noninvasive techniques have particular value for the conservation of threatened and endangered species. Written by two specialists in marine mammal research, this book is an expanded English-language version of an earlier monograph published in Russian. As such it is written from a distinctly Russian perspective, in particular with its emphasis on phenetics — a Russian school of evolutionary thought based on the "phene," which the authors define as "any discreet [sic] phenotypic character" which may be used to explore the frequencies of genotypes in a population. Although their expertise in cetacean biology inevitably inclines this book towards the ocean realm, much of what they detail may be applied to terrestrial mammals as well. *Available from*: Pensoft Publishers, Geo Milev Str., No 13a, 1113 Sofia, Bulgaria, Tel: +359-2-9674070, Fax: +359-2-9674071, e-mail: <pensoft@mbox.infotel.bg>. More information available at <http://www.pensoft.net>.

Patterns of Behavior: Konrad Lorenz, Niko Tinbergen, and the Founding of Ethology, by Richard W. Burkhardt Jr. 2005. The University of Chicago Press, Chicago. 648pp. ISBN 0226080900 (paperback, $29.00). This book traces the scientific theories, practices, subjects, and settings integral to the construction of a discipline pivotal to our understanding of the diversity of life. Central to this tale are Konrad Lorenz and Niko Tinbergen, 1973 Nobel laureates whose research helped legitimize the field of ethology and bring international attention to the culture of behavioral research. Demonstrating how matters of practice, politics, and place all shaped "ethology's ecologies," Burkhardt's book offers a sensitive reading of the complex interplay of the field's celebrated pioneers and a richly textured reconstruction of ethology's transformation from a quiet backwater of natural history to the forefront of the biological sciences. *Contents*: Acknowledgments; Introduction; Theory, practice, and place in the study of animal behavior; 1. Charles Otis Whitman, Wallace Craig, and the biological study of animal behavior in America; 2. British field studies of behavior: Selous, Howard, Kirkman, and Huxley; 3. Konrad Lorenz and the conceptual foundations of ethology; 4. Niko Tinbergen and the Lorenzian program; 5. Lorenz and National Socialism; 6. The Postwar reconstruction of ethology; 7. Ethology's new settings; 8. Attracting attention; 9. Tinbergen's vision for ethology; 10. Conclusion: Ethology's ecologies. *Available from*: The University of Chicago Press, 1427 E. 60th Street, Chicago, Illinois 60637, USA, Tel.: 773.702.7700, Fax: 773.702.9756, and online at <http://www.press.uchicago.edu>.

The Rise of Placental Mammals: Origins and Relationships of the Major Extant Clades, edited by Kenneth D. Rose and J. David Archibald. 2005. The Johns Hopkins University Press, Baltimore. 280pp. ISBN 080188022X (hardback, $95.00). From shrews to blue whales, placental mammals are among the most diverse and successful vertebrates on Earth. Arising sometime near the Late Cretaceous, this broad clade of mammals contains more than 1,000 genera and approximately 4,400 extant species. Although much studied, the origin and diversification of the placentals continue to be a source of debate. Here paleontologists Kenneth D. Rose and J. David Archibald have assembled some of the world's leading authorities to provide a comprehensive and up-to-date evolutionary history of placental mammals. Focusing on anatomical evidence, the contributors present an unbiased scientific account of the initial radiation and ordinal relationships of placental mammals, representing both the consensus and significant minority viewpoints. This book will be valuable to students and researchers in mammalogy, paleontology and evolutionary biology. *Available from*: The Johns Hopkins University Press, 2715 North Charles Street, Baltimore, Maryland 21218-4363, USA, Phone: (410) 516-6900, Fax: (410) 516-6968. Orders: 1-800-537-5487, Fax: (410) 516-6998. More information online at <http://www.press.jhu.edu>.

Shaping Primate Evolution: Form, Function and Behavior, edited by Fred Anapol, Rebecca Z. German and Nina G. Jablonski. 2004. Cambridge University Press, New York. 442pp. ISBN 0521811074 (hardback, $130.00). This book on how form is described in primate biology, and its consequences for function and behavior, includes contributions by internationally respected researchers of quantitative primate evolutionary morphology. Each chapter elaborates upon the analysis of the form-function-behavior triad. The book is unique, therefore, not only in the diversity of the topics discussed, but in the range of levels of biological organization addressed — from cellular morphometrics to the evolution of primate ecology. *Contents*: Preface: Shaping primate evolution — F. Anapol, R. Z. German and N. G. Jablonski; 1. Introduction — Charles Oxnard: An appreciation — M. Cartmill. Part I. Craniofacial Form and Variation. 2. The ontogeny of sexual dimorphism — R. Z. German; 3. Advances in the analysis of form and pattern — P. O'Higgins and R. L. Pan; 4. Cranial variation among the Asian Colobines — R. L. Pan and C. P. Groves; 5. Craniometric variation in early *Homo* compared to modern gorillas — J. M. A. Miller, G. H. Albrecht and B. Gelvin. Part II. Organ Structure, Function and Behavior. 6. Fiber architecture, muscle function and behavior — F. Anapol, N. Shahnoor and J. Patrick Gray; 7. Comparative fiber type composition and size in the antigravity muscles of primate limbs — F. K. Jouffroy and M. F. Medina; 8. On the nature of morphology — R. S.

Kidd; 9. Plant mechanics and primate dental adaptations—P. W. Lucas; 10. Convergent evolution in brain 'shape' and locomotion in primates—W. de Winter. Part III. *In Vivo* Organismal Verification of Functional Models. 11. Jaw adductor force and symphyseal fusion—W. L. Hylander, C. J. Vinyard, M. J. Ravosa, C. F. Ross, C. E. Wall and K. R. Johnson; 12. Hind limb drive, hind limb steering? Functional differences between fore and hind limbs in chimpanzee (*Pan troglodytes*) quadrupedalism—Y. Li, R. H. Crompton, W. Wang, R. Savage and M. M. Günther. Part IV. Theoretical Models in Evolutionary Ecology. 13. Becoming bipedal—N. G. Jablonski and G. Chaplin; 14. Modelling human walking as an inverted pendulum of varying length—J. T. Stern Jr., B. Demes and D. Casey Kerrigan; 15. Estimating the line-of-action of posteriorly inclined resultant jaw muscle forces in mammals using a model that minimizes functionally important distances in the skull—W. S. Greaves. Part V. Primate Diversity and Evolution. 16. The evolution of primate ecology—J. G. Fleagle and K. E. Reed; 17. Charles Oxnard and the aye-aye: Morphometrics, cladistics and two very special primates—C. P. Groves; 18. From 'Mathematical Dissection of Anatomies' to morphometrics—F. L. Bookstein and F. James Rohlf; 19. Design, level, interface and complexity: Morphometric interpretation revisited—C. E. Oxnard; 20. Postscript and acknowledgements—C. E. Oxnard. *Available from*: Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211, USA, Fax: 1-212-691-3239. General Address (Orders & Customer Service): Cambridge University Press, 100 Brook Hill Drive, West Nyack, NY 10994-2133, USA, Tel: 1-845-353-7500, Fax: 1-845-353-4141. Website: <http://www.cup.org>.

What Makes Biology Unique? Considerations on the Autonomy of A Scientific Discipline, by Ernst Mayr. 2004. Cambridge University Press, New York. 246pp. ISBN 0521841143 (hardback, $30.00). This collection of new and revised essays argues that biology is an autonomous science rather than a branch of the physical sciences. Ernst Mayr, widely considered the most eminent evolutionary biologist of the 20th century, offers insights on the history of evolutionary thought, critiques the conditions of philosophy to the science of biology, and comments on several of the major developments in evolutionary theory. Notably, Mayr explains that Darwin's theory of evolution is actually five separate theories, each with its own history, trajectory and impact. Ernst Mayr, commonly referred to as the "Darwin of the 20th century" and listed as one of the top 100 scientists of all time, was at the time of publication Professor Emeritus at Harvard University. *What Makes Biology Unique?* is the 25th book he wrote during his long and prolific career. *Contents*: Preface: What is there at issue?; Introduction; 1. Science and sciences; 2. The autonomy of biology; 3. Teleology; 4. Analysis or reductionism; 5. Darwin's influence on modern thought; 6. Darwin's five theories of evolution; 7. Maturation of Darwinism; 8. Selection; 9. Kuhn's scientific revolutions; 10. Another look at the species problem; 11. The origin of man; 12. Are we alone in this vast universe?; Glossary. *Available from*: Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211, USA, Fax: 1-212-691-3239. General Address (Orders & Customer Service): Cambridge University Press, 100 Brook Hill Drive, West Nyack, NY 10994-2133, USA, Tel: 1-845-353-7500, Fax: 1-845-353-4141. Website: <http://www.cup.org>.

ARTICLES

Alouatta

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Yamamoto, M. E., Domeniconi, C. & Box, H. O. Sex differences in common marmosets (*Callithrix jacchus*) in response to an unfamiliar food task, p.54.

Ziegler, T. E. & Snowdon, C. T. Sex differences in reproductive and parental hormones in cotton top tamarins, p.54.

MEETINGS

2005

1st Congress of the European Federation of Primatology, 9–12 August 2005, Göttingen, Germany. The Congress will be hosted by the German Society for Primatology (GfP) at the German Primate Centre (DPZ), University of Göttingen. It will coincide with the 9th Congress of the German Society. European students and researchers working on all aspects of primatology are invited to attend. Registration is from 1 November 2004 to 30 March 2005. For more information contact Peter M. Kappeler, President EFP, German Primate Center (DPZ), Abteiling Verhaltensforschung & Ökologie, Kellnerweg 4, D-37077 Göttingen, Germany, e-mail: <pkappel@gwdg.de>, website: <http://www.gf-primatologie.de/EFP2005/index.htm>.

28th Annual Meeting of the American Society of Primatologists, 17–20 August 2005, Portland, Oregon. The meeting will be held at the Benson Hotel and hosted by the Oregon National Primate Research Center. A call for abstracts and the meeting announcement will be sent electronically to all ASP members in mid-December 2004. Deadline for proposals for symposia, roundtables, or workshops is 17 January 2005. Deadline for abstracts for contributed papers, symposia speakers, workshops, and roundtable discussions is 14 February 2005. If a paper version of the meeting announcement is preferred, please contact Larry Williams, Program Co-Chair, Tel: +1 251-460-6293, Fax: +1 251-460-6286, e-mail: <lwilliams@usouthal.edu>. For more information, please contact Dr. Kristine Coleman, chair of the local organizing committee of the ONPRC at <colemank@ohsu.edu>.

29th International Ethological Conference, 20–27 August 2005, Budapest, Hungary. For more information, write to IEC2005, Department of Ethology, Eötvös University, 1117 Budapest, Hungary, or subscribe to the e-mail newsletter at <IEC2005-subscribe@yahoogroups.com>.

COHAB 2005: First International Conference on Health and Biodiversity, 23–25 August 2005, Galway, Ireland. This important global event will provide an international forum for scientists, professionals, policymakers, and stakeholders to address the issues linking environmental health, human health, biological diversity, and international development. Full details of the conference may be found at <http://www.cohab2005.com>. Enquiries should be directed to Conor Kretsch, COHAB Director, e-mail: <info@cohab2005.com>.

Measuring Behavior 2005—5th International Conference on Methods and Techniques in Behavioral Research, 30 August – 2 September 2005, Wageningen, The Netherlands. Measuring Behavior will offer an attractive mix of presentations, demonstrations, discussions, meetings, and much more (see <http://www.noldus.com/mb2005/program/index.html> for details). Proceedings of the 2002 meeting are available at <http://www.noldus.com/events/mb2002/index.html>. Deadline for proposals of symposia and SIGs is 1 December 2004. For more information, contact Prof. Dr. Louise E. M. Vet, Program Chair, Measuring Behavior 2005, Conference Secretariat, P.O. Box 268, 6700 AG Wageningen, The Netherlands, Tel: +31-317-497677, Fax: +31-317-424496, e-mail: <mb2005@noldus.nl>, website: <http://www.noldus.com/mb2005>.

Sixth Meeting of the Asociación Primatológica Española, 27–30 September 2005, Facultad de Psicología, Universidad Complutense de Madrid, Madrid, Spain. Sponsored by the Asociación Primatológica Española (A.P.E.), this Meeting will focus on the themes of Child Ethology, Conservation, Great Apes, and Humans: Similarities and Differences, and Tool Use. For more information please see the website at <http://www.ucm.es/info/ape05> or contact Dr. Fernando Colmenares (<colmenares@psi.ucm.es>) or Dra. María Victoria Hernández-Lloreda (<ape@psi.ucm.es>).

2005 Annual Meeting of the Conservation Breeding Specialist Group, 29 September – 1 October 2005, Syracuse, New York, USA. Regional network meetings will take place on Tuesday, 27 September, and a Steering Committee meeting will take place on Wednesday, 28 September. Accommodations are at the Genesee Grande Hotel (<http://www.geneseegrande.com>), which offers a variety of rooms and rates. The deadline for registration is 1 August 2005; for more information, email a request to <2005cbsg@cbsg.org> or visit their website at <http://www.cbsg.org>.

New World Primate Workshop (A Focus on Cebids), 30 September – 1 October, 2005, Cleveland, Ohio, USA. The Cleveland Metroparks Zoo announces a workshop on New World Primates that will focus on the captive care of Cebids in U.S. institutions. Informal roundtable discussions will include the following topics: diet and health, social groups and mixed species, enrichment and training behaviors, and population management. The workshop will begin at 10 a.m. on Friday, 30 September, and end at 4 p.m. on Saturday, 1 October. Attendance is limited to 50 people and registrants will be asked to complete a pre-meeting survey regarding their experiences with Cebids. The workshop will be held on the zoo grounds. Some meals will be provided and local lodging suggestions are available. Registration fee is $25. For more information and a registration form, contact Tad Schoffner at 216-635-3332 or <tad@clevelandmetroparks.com>.

8th World Wilderness Congress, 30 September – 6 October, 2005, Anchorage, Alaska, USA. Over a thousand delegates from dozens of nations will attend the Eighth WWC, with additional events in Kamchatka and the Russian Far East. The WWC convenes every three to four years, with the theme of this year's Congress being "Wilderness, Wildlands and People—A Partnership for the Planet." This Congress will generate accurate, up-to-date information on the benefits of wilderness and wildlands to both contemporary and traditional societies and will examine the best models for balancing wilderness and wildlands conservation with human needs. For more information, see the Congress website at <http://www.8wwc.org>.

60th World Association of Zoos and Aquariums Annual Conference, 2–6 October 2005, New York, New York, USA. The 60th WAZA Annual Conference will be hosted by the Wildlife Conservation Society and held at the Marriott Marquis hotel. The theme of the meeting will be "Wildlife Conservation: A Global Imperative for Zoos and Aquariums." Additional information will be made available on the conference website at <http://waza2005.org>.

III Congresso Brasileiro de Mastozoologia, 12 a 16 de outubro de 2005, realizado pela Sociedade Brasileira de Mastozoologia (SBMz) e a Universidade Federal do Espírito Santo (UFES), no SESC Praia Formosa em Aracruz, Espírito Santo. O evento reunirá pesquisadores, profissionais e estudantes com o objetivo de apresentar, analisar e discutir trabalhos científicos, descobertas e tendências no estudo dos mamíferos. O tema dessa edição é "Diversidade e Conservação de Mamíferos," que será abordado sob diversos aspectos durante o evento, que contará com a participação de especialistas ligados a instituições de ensino e pesquisa nacionais e estrangeiras, bem como outros profissionais que atuam em órgãos governamentais, na iniciativa privada e em organizações não-governamentais. Somente serão aceitas inscrições pela internet. Poderá ser realizada a inscrição online do congresso até o dia 31 de maio, e o envio dos resumos podem ser feitos até o dia 30 de junho de 2005. Mais informações: <http://www.cbmz.com.br>.

Counting Critters: Estimating Animal Abundance and Distance Sampling, 17–21 October 2005, Disney's Animal Kingdom, Orlando, Florida, USA. This five-day workshop will introduce participants to the most important methods of estimating animal abundance in a rigorous but accessible way. For more details, please see <http://www.ruwpa.st-and.ac.uk/counting.critters/> or contact Rhona Rodger, Workshop Organizer, CREEM, University of St Andrews, The Observatory, St Andrews, Scotland KY16 9LZ, tel: +44 1334 461842, fax: +44 1334 461800, e-mail:<rhona@mcs.st-and.ac.uk>.

Primer Congreso Colombiano de Primatología, Asociación Colombiana de Primatología, del 2 al 4 noviembre de 2005, Bogotá, Colombia. El Primer Congreso Colombiano de Primatología tendrá tres Áreas Temáticas para la presentación de los trabajos: *Biología y Ecología* — estudios en ciencias básicas que incluyen morfología, taxonomía, sistemática, genética, biología molecular, evolución, biodiversidad, comportamiento y ecología; *Medicina* — estudios en anatomía, fisiología, medicina, clínica, patología, epidemiología, nutrición, y restricción de primates; y *Conservación y Manejo* (*in situ* / *ex situ*) — investigación aplicada y gestión multidisciplinaria, herramientas conceptuales y técnicas dirigidas a la conservación, uso y aprovechamiento, trabajo comunitario, comercio, mantenimiento en cautiverio, reproducción, técnicas de captura, manipulación, registro y marcaje, enriquecimiento ambiental, rehabilitación, disposición de primates decomisados, normatividad y legislación. La ponencia debe incluir información nueva, se pueden enviar resúmenes de temas presentados en reuniones anteriores pero su aporte al Congreso debe ser clave, generar discusión constructiva o representar temas emergentes. Para mayor información del Congreso, puede visitar la siguiente página web: <http://www.geocities.com/primatescolombia>, o en el correo electrónico <ACP_investigacion@yahoo.com>.

Primate Society of Great Britain (PSGB) Winter Meeting 2005, 9 December 2005. Flett Theatre, The Natural History Museum, London. The theme is "Primate Evolution and the Environment." Guest speakers include R. D. Martin (The Field Museum, Chicago), Erik Seiffert (Oxford University), Peter Andrews (The Natural History Museum), Jussi Eronen and Mikael Fortelius (University of Helsinki), Susan Antón (New York University), Sarah Elton (University of Hull), Christophe Soligo (The Natural History Museum), Jonathan Kingdon (Oxford University), Urs Thalmann (University of Zürich) and Laurie Godfrey (University of Massachusetts). Organised by: Christophe Soligo, The Natural History Museum, e-mail: <C.Soligo@nhm.ac.uk>. See website: <http://www.psgb.org/Meetings/Winter2005.html>.

V Göttinger Freilandtage "Primate Diversity—Past, Present and Future," 13–16 December 2005. University of Göttingen and German Primate Center, Göttingen, Germany. Organized by Peter M. Kappeler. Confirmed invited speakers: *Diversity in the past*: Extinct primate communities – John Fleagle (State University of New York, Stony Brook). *Diversity today*: Diversity of Malagasy primates – Anne Yoder (Yale University); Diversity of American primates – Anthony B. Rylands (Conservation International); Diversity of Asian primates – Jatna Supriatna (Conservation International Indonesia); Diversity of African primates – John F. Oates (Hunter College New York); Primate biogeography – Shawn Lehman (University of Toronto); Speciation and taxonomy – Colin P. Groves (Australian National University); Human diversity – Mark Stoneking (Max Planck Institute, Leipzig). *Preserving Diversity for Tomorrow*: Diversity and conservation hotspots – Russell A. Mittermeier (Conservation International); Extinction biology – Carlos Peres (University of East Anglia); Conservation genetics – George Amato (Wildlife Conservation Society); Conservation genetics – Michael Bruford (Cardiff University); Reintroductions – Carel P. van Schaik (University of Zürich). *Comparative Perspectives*: Speciation in birds – Trevor Price (University of Chicago); Bird taxonomy and conservation – Robert Zink (University of Minnesota). Contact: Prof. Dr. Peter M. Kappeler, Deutsches Primatenzentrum (DPZ), Kellnerweg 4, D-37077 Göttingen, Tel/Fax: +49-551-3851-284/291, e-mail: <pkappel@gwdg.de>, website: <http://www.dpz.gwdg.de/sociobiology/GFT2005/index.htm>.

2006

Ecology in an Era of Globalization: Challenges and Opportunities for Environmental Scientists in the Americas, 8–12 January 2006, Merida, Mexico. This conference will be held at the Fiesta Americana Hotel in Merida and is co-hosted by the Universidad Autónoma de Yucatán and the Centro de Investigaciones Científicas de Yucatán. Abstracts should address one of the meeting's three subthemes: invasive species, human migration, and production. The invasive species subtheme includes such topics as dispersal of invasive plant and animal species, emerging diseases, and resistance of local ecosystems to invasive species and disease. The human migration subtheme includes the environmental effects of international and local emigration and immigration on recipient and source areas. Potential topics include infrastructure development needs and impacts, effects on land cover, and land-use impacts. The production subtheme focuses on ecosystem transformations, including land-use change required to produce goods and services for human use. Potential topics include the effects of changes in forest and agricultural policy on economies, biodiversity, and ecosystems throughout the Americas, in terrestrial, marine, and freshwater systems. We particularly welcome reports of projects that are interdisciplinary and that consider the need to communicate with broad audiences. For more information or to submit an abstract, visit <http://www.esa.org/mexico>. Deadline for abstract submissions: 16 September 2005.

75th Annual Meeting of the American Association for Physical Anthropology, 5–12 March 2006, Anchorage, Alaska, USA. For program information, please contact the Program Chair, Lyle W. Konigsberg, Department of Anthropology, University of Tennessee, Knoxville, TN 37996-0720, USA, Tel: (865) 974-4408, fax: (865) 974-2686, e-mail <aapavp@utk.edu>. Local Arrangements Committee Chair: Christine Hanson, Department of Anthropology, University of Alaska Anchorage, Anchorage, AK 99508, USA, tel: 907-786-6839, fax: 907-786-6850, e-mail <afclh@uaa.alaska.edu>. Website at <http://www.physanth.org/annmeet>.

Primate Society of Great Britain (PSGB) Spring Meeting 2006, 27–28 March 2006, University of Stirling, Stirling, Scotland. The theme is "Primate Mentality and Wellbeing." On the afternoon of 27 March invited speakers will address the relationship between cognition and welfare in primates. Other topics are welcomed for posters and oral sessions. There will be a prize for the best postgraduate presentation and poster. A provisional programme and instructions for presenters can be found on the meeting web site at: <http://www.psychology.stir.ac.uk/staff/svick/PSGB2006.php>. For more information please contact: Dr. Sarah Vick (PSGB), Psychology Department, University of Stirling, FK9 4LA, Scotland. E-mail address for enquiries: <psgbspring@stir.ac.uk>.

21st Congress of the International Primatological Society, 25–30 June 2006, Imperial Resort Beach Hotel, Entebbe, Uganda. Theme: "Primate Conservation in Action." Preliminary contact details: Dr. William Olupot, Chair, Organizing Committee, IPS 2006 Congress, P. O. Box 21669, Kampala, Uganda, Tel: 077598134, 077947397, 041501020, e-mail <wolupot@yahoo.com>.

29th Annual Meeting of the American Society of Primatologists (ASP), 16–19 August 2006, San Antonio, Texas. Sponsored by Southwest National Primate Research Center. Tentative deadline dates are 5 December 2005 to notify program chair of intent to offer a symposium or workshop; 9 January 2006 to send symposia and workshop abstracts with confirmed list of participants to program chair; and 6 February 2006 for all final abstracts for symposia, oral, and poster presenters. See the ASP website for updates and further information: <http://www.asp.org/meetings/index.html>.

1st European Congress of Conservation Biology, 22–26 August 2006, Eger, Hungary. The European Section of the Society for Conservation Biology is determined to promote the development and use of science for the conservation of

European species and ecosystems, and to make sure that conservation policy is firmly underpinned by the best available scientific evidence. This keystone congress will bring together a wide array of academics, policymakers, students, NGO representatives, and biodiversity managers from throughout Europe and beyond. For more information, see the Congress website at <http://www.eccb2006.org> or contact András Báldi, Chair of the Local Organising Committee, at <baldi@nhmus.hu>.

VII Congreso Internacional sobre Manejo de Fauna Silvestre en la Amazonía y América Latina, del 3 al 7 de septiembre de 2006, Ilhéus, Bahia, Brasil. El VII Congreso Internacional sobre Manejo de Fauna Silvestre en la Amazonía y América Latina enfocará su atención en los estudios y programas de manejo que actualmente están siendo ejecutados en la Amazonía y en Latinoamérica, con el propósito de evaluar los resultados alcanzados y las limitaciones encontradas en la conducción de los mismos. Una de sus principales metas será expandir el enfoque del evento a los más amplios aspectos del manejo de fauna en toda Latinoamérica. El VII Congreso Internacional sobre Manejo de Fauna Silvestre en la Amazonía y América Latina incluirá conferencias magistrales, mesas redondas, secciones temáticas con presentaciones orales libres, exposiciones en posters, simposios, workshops, cursos durante y posteriores al congreso, y excursiones pos-congreso. Las áreas temáticas que se abordarán en este evento serán: conservación *in situ* y áreas naturales protegidas, conservación *ex situ* de fauna silvestre, preservación y recuperación de hábitats, metodologías aplicadas para el manejo de fauna silvestre con comunidades, criterios para el uso sustentable de fauna silvestre, indicadores de sustentabilidad, etología aplicada al manejo, medicina veterinaria de la conservación, fisiología y ecología, producción en criaderos, comercio, política y legislación de fauna silvestre. Estamos recibiendo propuestas para mini-cursos, workshops y simposios hasta el 31/12/05. Apreciaremos el apoyo de diversas instituciones. Existen posibilidades de instalación de stands institucionales para difusión y ventas. El plazo para el envío de resúmenes es hasta el 30/04/06. Para mayor información: <http://www.viicongresso.com.br>.

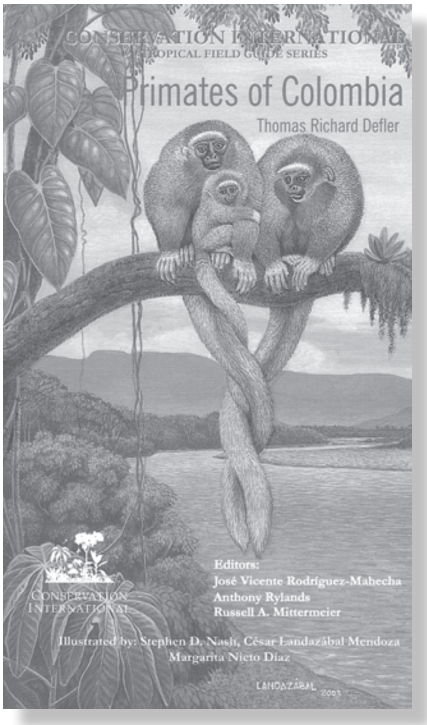
2007

6th Zoos & Aquariums Committing to Conservation Conference, 26–31 January 2007, Houston, Texas. ZACC is a bi-annual event that promotes the role of zoos and aquariums in supporting conservation activities worldwide, both at their institutions and in the field. Conference participants include representatives from zoological institutions, international conservation organizations, local non-governmental organizations, government agencies, funding agencies and, most importantly, field biologists and conservationists. Presentations at the 2007 ZACC will highlight both ongoing projects and new initiatives that offer opportunities for institutional support. There will be a major focus on field-based initiatives that have already established links to zoos and aquariums, as well as promising candidates for such partnerships. In addition, the program will feature presentations related to the organization, management, and support of zoo-based and aquarium-based conservation programs. The full conference registration fee ($195) will include icebreaker event, all sessions, breaks, lunches, conference proceedings, zoo day transport, zoo day lunch and dinner. All funds raised above conference costs will be allocated to the conservation fund for this conference. The deadline for submitting paper and poster abstracts is 1 September 2006. Abstracts submitted electronically should be addressed to <bkonstant@houstonzoo.org> and to <priger@houstonzoo.org>. Abstracts submitted as hard copy should be addressed to: 2007 ZACC Conference, Attn: Bill Konstant, Director of Conservation and Science, Houston Zoo, 1513 North MacGregor, Houston, Texas 77030, USA. For more information, see the conference website at <http://www.houstonzoo.org/ZACC>.

XII Congresso Brasileiro de Primatologia, 22 a 27 de julho de 2007, Belo Horizonte, Minas Gerais, Brasil. O local escolhido é a PUC-BH, de excelente infra-estrutura e localizada no bairro Coração Eucarístico, em Belo Horizonte (MG), o que facilitará o acesso de quem vem de fora. O tema escolhido pela diretoria foi "Prioridades de pesquisa para o estudo de primatas neotropicais" e, portanto, solicitamos a colaboração e participação de todos os interessados na construção da programação deste evento tão importante para todos nós. Estaremos recebendo propostas de mesas-redondas, palestras, mini-cursos e eventos paralelos, tudo voltado ao tema citado acima, até dia 30 de abril próximo, onde colocaremos à disposição no site da SBPr ou na lista de discussões dos primatólogos (<http://br.groups.yahoo.com/group/primatologia>) para votações finais e conclusão de nossos trabalhos ainda neste semestre. Informações adicionais: <http://www.carangola.br/primatologia/> ou entrar em contato com Prof. Dr. Fabiano R. de Melo, Presidente da Sociedade Brasileira de Primatologia, Coordenador do curso de Ciências Biológicas, UEMG/FAFILE, campus de Carangola, Praça dos Estudantes, 23, Santa Emília, Carangola 36800-000, Minas Gerais, Brasil, (32) 3741-1969 / (32) 8845-2904.

Primates of Colombia

Conservation International
Tropical Field Guide Series #5



Colombia is one of the most biologically diverse countries in the world due to its rich and varied flora and fauna and is superseded only by Brazil and Peru in terms of primate diversity. This field guide illustrates and describes 28 primate species comprising 43 different taxa, 15 of which are endemic to Colombia. It is a compilation of all primate field work done on Colombian primates both in and out of country and has quickly become an important tool for young primatologists to establish research priorities for study. The field guide also includes chapters on primate classification, fossil history, zoogeography, conservation and phylogeny, and is a first step towards the necessary conservation of this beautiful group of animals.

Colombia es uno de los países con mayor diversidad biológica del mundo debido a su rica y variada flora y fauna; sólo Brasil y Perú la superan en términos de diversidad de primates. Esta guía de campo ilustra y describe 28 especies de primates conteniendo 43 distintos taxones, 15 de los cuales son endémicos de Colombia. Es una recopilación de todo el trabajo de campo que fue realizado sobre primates colombianos dentro y fuera del país, y se ha convertido rápidamente en una importante herramienta para jóvenes primatólogos que desean establecer prioridades de investigación para sus estudios. La guía de campo también incluye capítulos sobre clasificación de primates, historia fósil, zoogeografía, conservación y filogenia, y es un primer paso hacia la conservación necesaria de este hermoso grupo de animales.

About the author, Thomas Richard Defler:

Tom Defler is a primatologist who has spent the last 28 years in the Orinoco and Amazonian regions of Colombia, focusing his studies on the ecology and conservation of primate species in these two regions of the country. His research began in 1976 with INDERENA of the Ministry of Agriculture (now superceded by the Ministry of the Environment) studying Colombian flora and fauna. He established two research stations, Caparú Biological Station and Ecological Station Omé. Defler has written more than 60 publications on diverse aspects of ecology, primate taxonomy and natural history. He is currently Professor at the Instituto Amazónico de Investigaciones, at the National University of Colombia in Leticia.

Thomas Richard Defler, biografía del autor:

Tom Defler es un primatólogo que ha pasado los últimos 28 años en las regiones del Orinoco y Amazonía de Colombia, enfocando sus estudios en la ecología y conservación de especies de primates en estas dos regiones del país. Inició sus investigaciones en 1976 con el INDERENA del Ministerio de Agricultura (ahora Ministerio del Ambiente), estudiando la flora y fauna colombiana. Estableció dos estaciones de investigación, la Estación Biológica Caparú y la Estación Ecológica Omé. Defler ha escrito más de 60 publicaciones sobre distintos aspectos de la ecología, taxonomía e historia natural de primates. En la actualidad, es profesor del Instituto Amazónico de Investigaciones, en la Universidad Nacional de Colombia en Leticia.

Primates of Colombia
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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 Portuguese contributions to: John M. Aguiar, Conservation International, Center for Applied Biodiversity Science, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, Tel: 703 341-2400, Fax: 703 979-0953, e-mail: <j.aguiar@conservation.org>, and all Spanish contributions to: Ernesto Rodríguez-Luna, Instituto de Neuroetología, Universidad Veracruzana, Apartado Postal 566, Xalapa 91000, Veracruz, México, Tel: 281 8-77-30, Fax: 281 8-77-30, 8-63-52, e-mail: <saraguat@speedy.coacade.uv.mx>.

Contributions

Manuscripts may be in English, Spanish or Portuguese, and should be double-spaced and accompanied by the text on diskette for PC compatible text-editors (MS-Word, WordPerfect, Excel, and Access), and/or e-mailed to <j.aguiar@conservation.org> (English, Portuguese) or <saraguat@speedy.coacade.uv.mx> (Spanish). 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 texts 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), Biogeography, Ecology and Conservation. Texts for full articles should not exceed about 20 pages in length (1.5 spaced, and including the references). Please include an abstract in English, and (optional) one in Portuguese or Spanish. Tables and illustrations should be limited to six, excepting only the cases where they are fundamental for the text (as in species descriptions, for example). Full articles will be sent out for peer-review.

Short articles. These 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 which 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 which occur in them. Texts should not exceed 10 pages in length (1.5 spaced, including the references).

Figures and maps. Articles may include small black-and-white photographs, high-quality figures, and high-quality maps and tables. Please keep these to a minimum. We stress the importance of providing maps which are **publishable.**

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

References. Examples of house style may be found throughout this journal. 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.

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Contents

Short Articles