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GAME POPULATIONS AND HUNTING PRESSURE ON A RURAL FRONTIER IN SOUTHERN BRASILIAN AMAZONIA

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ABSTRACT

As rural areas expand into the Amazon, hunting pressure increases progressively, leading to drastic reductions in the populations of many large-bodied vertebrates, in particular ungulates. In the present study, the effects of harvesting were evaluated on a recently established rural frontier in southern Brasilian Amazonia, Nova Bandeirantes, Mato Grosso (09º48'S, 57º51'W), through the monitoring of 14 local hunters and surveys of local populations of large-bodied birds and mammals. Standard line transect surveys at three sites (hunted and unhunted) were complemented with qualitative records of species. Most of the species expected for the study area were recorded, including all the largest-bodied forms. A comparison among sites indicated that hunting pressure had yet to affect the abundance of large-bodied vertebrates. Hunters covered an area of approximately 38 km² over a seven-month period, and targeted primarily peccaries (62.0% of animals captured), but also carnivores (12.4%), which were not used for food. No primates or birds were harvested. Mammalian biomass was extracted at an estimated rate of 145.7 kg km^{-2} per annum, and members of the hunters' households consumed approximately 200 g of bushmeat per day, on average. The sustainability of harvesting over the short term (3 years) appears to be due to a source-sink dynamic involving neighboring areas of forest, but it remains to be seen whether this system will sustain game availability as habitat fragmentation progresses and hunting pressure increases in coming years.

Keywords: Mammals, birds, Amazonia, hunting, colonization, conservation, management.

RESUMO

À medida que as áreas rurais da Amazônia se expandem, a pressão de caça aumenta progressivamente, resultando em drásticas reduções nas populações de muitos vertebrados de grande porte, principalmente ungulados. Neste estudo foram avaliados os efeitos da colheita em uma fronteira recém estabelecida na Amazônia meridional, Nova Bandeirantes, Mato Grosso (09º48'S, 57º51'W), através do monitoramento de 14 caçadores locais e levantamentos das populações locais de aves e mamíferos de grande porte. Levantamentos de transecção linear padronizados foram realizados em três locais (com e sem caça), e completados com registros qualitativos da presença de espécies. A maioria das espécies de ocorrência esperada na área de estudo foi registrada, incluindo todas as de maior porte. A comparação entre os locais indicou que a pressão de caça ainda não afetou a abundância de vertebrados de grande porte. Os caçadores atuaram dentro de uma área de pelo menos 38 km² ao longo de um período de sete meses, e alvejaram principalmente porcos-do-mato (62,0% dos animais abatidos), mas também carnívoros (12,4%), que não foram aproveitados para a alimentação. Nenhuma ave ou mamífero foi abatido. A biomassa de mamíferos foi extraída a uma taxa estimada em 145.7 kg km^{-2}por ano, e os membros das famílias dos caçadores consumiram aproximadamente 200 g de carne de caça por dia, em média. Neste curto prazo de 3 anos, a sustentabilidade da caça na área parece ser determinada por uma dinâmica fonte-dreno, que envolve áreas vizinhas de floresta, embora reste saber se este sistema sustentará a disponibilidade da caça na medida em que avance a fragmentação de hábitats e aumente a pressão de caça ao longo dos próximos anos.

Palavras-chave: Mamíferos, aves, Amazônia, caça, colonização, conservação, manejo.

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INTRODUCTION

The subsistence hunting of game, primarily mammals and birds, is a widespread activity in rural Amazonian communities (Bodmer *et al*., 1994; Alvard *et al*., 1997; Robinson & Bennett, 1999; Gavin, 2007), and presents a major selective pressure on the populations of some species (e.g. Peres, 1997). Hunting patterns vary considerably within the Amazon basin, however, according to factors such as the ethnic or regional origin of the population and its density, and the history of colonization and habitat fragmentation (Peres & Michalski, 2006). Patterns may also vary according to the composition of the local fauna, hunting pressure, and species depletion. Ultimately, hunting may lead to the local extinction of species (Bodmer *et al*., 1997; Lopes & Ferrari, 2000; Ferrari *et al*., 2003), which has highly deleterious consequences for the ecosystem as a whole (Redford, 1992).

If subsistence hunting is accepted as an inevitable consequence of the human occupation of the Amazon, there is an obvious need for the development of management strategies to guarantee its sustainability over the long term. This has clear benefits for both colonists and remaining ecosystems. Hunting is not necessarily unsustainable over the long term (e.g. Novaro *et al*., 2000; Hurtado-Gonzalez & Bodmer, 2004), but it may require specific mechanisms such as the establishment of buffer and protected zones and, ultimately, may depend on the maintenance of population density at tolerable levels (Gavin, 2007). It would also seem necessary to introduce such strategies sooner rather than later during the colonization process, when habitat and faunal communities are still relatively intact.

Obviously, any such measures require good knowledge of the characteristics of the local fauna and the hunting practices of residents. In , the study of hunting patterns is complicated by the fact that any such exploitation of native fauna constitutes an indictable offence, subject to severe penalties, although a federal law passed in 1998 exempted subsistence hunting, including the protection of livestock. In practice, few rural inhabitants know or understand such legislation, and are often reluctant to reveal their activities to outsiders. In addition, as it considers subsistence hunting to be a sporadic, rather than a systematic activity, the legislation virtually precludes the implementation of government-sponsored management programs outside protected areas destined for the sustainable exploitation of natural resources. Given this, effective management practices in areas of rural colonization will require significant input and participation from local communities.

In the present study, game populations were surveyed on a rural frontier in southern Brasilian Amazonia, and local hunting patterns were evaluated, with a view to establishing a baseline for the development of management strategies. Despite considerable pressure on large-bodied mammals, in particular ungulates, harvesting appears to be sustainable at present levels, possibly supported by low human population density, and a source-sink dynamic involving neighboring areas of forest. The need for the implementation of long-term management practices is clear, however.

METHODS

Study area: The present study took place in the municipality of Nova Bandeirantes (09Ú00'–10Ú30'S, 57Ú30'–58Ú40'W), in the Brasilian state of Mato Grosso (Figure 1), located between the Juruena and Teles Pires rivers in the southern Amazon basin, a region assigned a high priority status for the conservation of Amazonian mammals (Brasil, 2001). The municipality was founded in 1981, by colonists who migrated from southern Brasil in search of land for agriculture and cattle ranching. The predominant

forest cover in the region is classified as tropical deciduous (Dinerstein *et al*., 1995), with some open forest and areas of forest/cerrado transition.

The study was conducted at a settlement known as Japuranã, which was established in 1996 on part of a large ranch known as *Fazenda do Tenente* by a local political group known as "Movimento Terra é Nossa". The specific study area is located in the second phase of the settlement, which covers 37,000 hectares, and was occupied in 2000. Families live on 100-hectare plots within this area. The control site was the *Fazenda Juventude*, with an area of 6854 ha, all but 84 ha (which are planted with *Tectona grandis*) of which is still primary forest. The owners of this site prohibit hunting or other activities within the forest.

Population surveys: The relative abundance of large-bodied mammals was estimated at three sites using standard line transect surveys (cf. Bodmer *et al*., 1994; Bodmer, 1995; Peres, 1999; Lopes & Ferrari, 2000). Two linear transects were established at Japuranã (Dacasa and Pantera), and one within the continuous forest at Fazenda Juventude, as the unhunted control. At the former site, transects were located in the main block of forest immediately adjacent to settlers' plots. Transects ranged in length from 2.7 to 3.7 km at a given site.

Surveys concentrated on a subset of the local mammalian fauna that encompasses all the species targeted by local hunters by virtue of their relatively large body mass (> 1 kg). This subset included all the

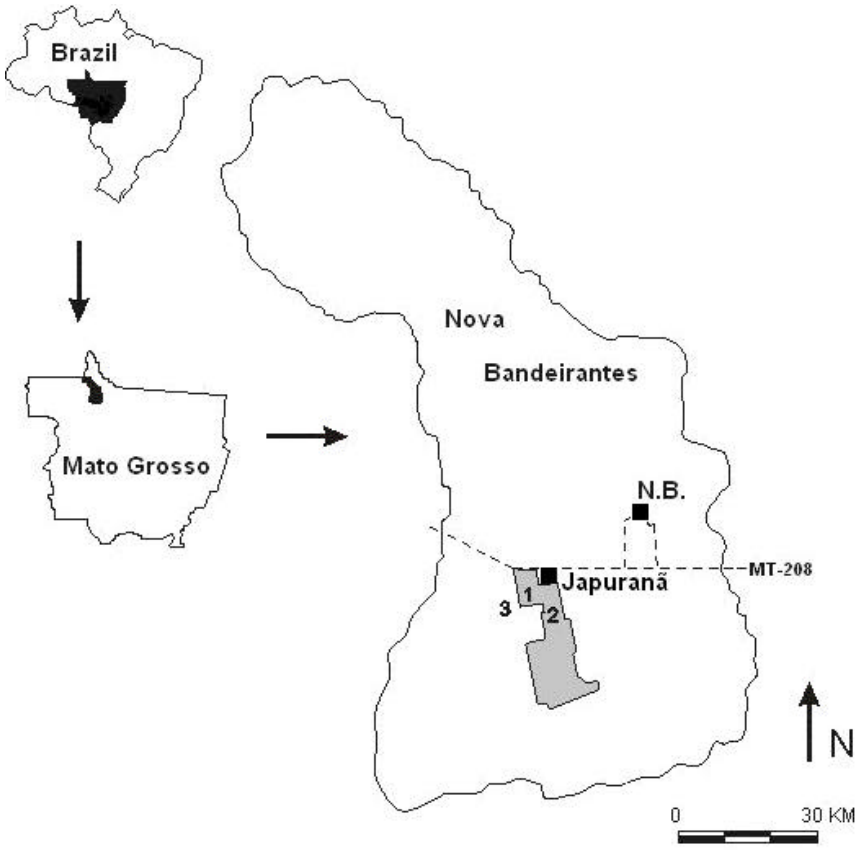

Figure 1. Map of the study area in the municipality of Nova Bandeirantes, Mato Grosso, showing the town of Nova Bandeirantes (N.B.), the Japuranã settlement (shaded), the MT-208 highway, and the three sites mentioned in the text (1 = Pantera; 2 = Dacasa; 3 = Fazenda Juventude).

members of the orders Artiodactyla, Carnivora, and Perissodactyla, most members of the Primates, and Xenarthra, as well as caviomorph rodents (Cavioidea and Erethizontoidea). Two families of large-bodied game birds (Cracidae and Psophidae: see Begazo & Bodmer, 1998) were also included.

Data were collected between May and November, 2003, in standard line transects, during which trails were walked carefully and attentively at a velocity of 1-2 km, with a pause at approximately every 50 m, between 07:00 h and 11:00 h. At each encounter with a target animal, the species and the number of individuals was recorded. In the case of social species, a standard limit of 10 minutes was set for the collection of complementary data on group size. Given the reduced number of sightings, estimates of abundance were based on the number of sightings per 10 km walked.

Hunting pressure: As hunting is a sensitive issue in Brasil, it was important to establish a relationship of trust with the subjects (14 hunters from nine different families, with a total of 40 members) to ensure the reliability of the data collected on their hunting activities (see Trinca & Ferrari, 2006). These hunters were supplied with wire, which was used to tie the skull of each animal harvested to a tree adjacent to the place of its capture, out of reach of potential scavengers. On monthly visits, the hunters were interviewed and the skulls were collected and their locations recorded on a map of the area using a GPS. This provided information on the animal's species and age, and the hunter's area of activity. The area was estimated by the minimum polygon procedure. Complementary information was obtained from the hunters, including the hunting technique used and the motive for killing the animal. When the skull disappeared or had been destroyed by dogs, the species was identified from the description provided by the hunter. Given the similarities of the different species, it was only possible to identify armadillos and deer to genus.

RESULTS

Diversity and abundance of mammals: According to the available literature (Emmons & Feer, 1997; Eisenberg & Redford, 1999), the target subset of the local mammalian fauna includes at least 40 species. Of these, 28 were recorded during the study period, although not all of these species were sighted during surveys (Table 1). Only one of the largest-bodied species (> 20 kg body weight), the giant armadillo, *Priodontes maximus*, was not recorded during the present study, although representatives of the state environment agency (FEMA) reported observing the remains of an animal that had been hunted by local residents two years prior to the study. Other, smaller-bodied mammals sighted during surveys included squirrel monkeys (*Saimiri ustus*) and squirrels (*Sciurus* sp.).

The lack of records of other primates – *Chiropotes albinasus*, and *Mico melanurus* – was unexpected, especially considering the abundance of observed species, in particular *Ateles chamek*, at all three study sites (Tables 2, 3, and 4). The absence of survey records of many of the carnivore species was less surprising, considering their predominantly solitary and nocturnal habits. The sighting of a jaguar during the survey at Pantera was presumably an isolated, fortuitous event, although the name of the site, which means "panther" in English, may have been chosen precisely because of the relative abundance of carnivores in the area. The individual sighted during the survey was a black morph, and was likely the same individual later killed when attacking a domestic pig 50 m from the residence of a hunter.

Logistic and other limitations restricted survey time, and the distance walked at any one site was no more than 46 km, a marginally adequate sampling effort by Amazonian standards (Ferrari *et al*., 2002, 2003). While this provided well over one hundred sightings overall, most species were recorded only once or twice at a given site, and estimates of abundance must be

treated with caution, especially for comparisons among sites. However, a number of apparently meaningful trends were revealed.

Primarily, survey results indicate that large-bodied mammals are still relatively abundant throughout the study area, that is, at both hunted and unhunted sites. In particular, with one exception, all four species of even-toed ungulates (Artiodactyla) were recorded at all three sites, and sighting rates (1.8-2.3 sightings per 10 km walked) were relatively high by regional standards. At 32 sites surveyed in the neighboring state of Rondônia (transects of 50-323 km per site), for example, the maximum sighting rate recorded by Ferrari and colleagues (unpublished data) for the Artiodactyla was 1.6, although this was an exceptional value, the next highest being 0.8, and in fact no ungulates were observed at nine of the sites. Similar values have been recorded at other sites in southern and eastern Amazonia (e.g. Emídio-Silva, 1998; Lopes & Ferrari, 2000). The abundance of ungulates within the study area is further emphasized by the fact that 14.4 white-lipped peccaries were observed, on average, in sightings of *T. pecari*.

The lack of any clear difference in the abundance of ungulates between hunted and unhunted sites is unexpected, especially considering that these species made up a large proportion of the mammals hunted during the study period (see below). A number of factors may be important here. The survey data indicate that ungulates are naturally abundant within the study area, and as habitat fragmentation is still incipient, densities in hunted areas may be upheld by a source-sink dynamic (e.g. Navaro *et al*., 2000). White-lipped peccaries, in particular, are known to roam semi-nomadically over areas of dozens of square kilometers (Kiltie & Terborgh, 1983; Fragoso, 1998). In addition, ongoing deforestation may result in increasing densities over the short term by reducing the habitat available to remnant populations.

The paucity of the primate fauna is less easily accounted for, not least because the three species recorded at all three sites (*Ateles*, *Callicebus*, and *Cebus*) represent widely differing ecological characteristics, and were all relatively abundant. While the absence of one or two species from a given site is not unusual (Ferrari, 2004), the widespread absence of the ecologically flexible *Mico melanurus*, in particular, was unexpected.

Abundance of birds: Whereas four of the five target bird species were observed throughout the study area (Table 1), there were no records or any kind of report of *Crax fasciolata*, which suggests that this species may be absent from the region. As for the mammals, sighting rates were relatively high at all three sites (Tables 2, 3, and 4), and there was no clear difference among sites in either diversity or abundance.

Hunting pressure: The 14 hunters that participated in the study captured a total of 113 wild mammals belonging to 17 species between May and November of 2003 (Table 5). All the animals killed were ungulates, rodents, xenarthrans or carnivores, and no primates or birds were harvested during this period. According to one hunter, while birds such as curassows are appreciated as game (see Begazo & Bodmer, 1998), they are considered unprofitable, given the price of ammunition and the quantity of meat provided, especially as the heavy shot used to hunt ungulates would normally render much of the carcass unusable. The potential return to hunting effort appears to be the only criterion employed by the hunters in their selection of game animals.

Whereas ungulates, rodents, and armadillos were harvested for their meat, the carnivores and anteaters were hunted because of the threat they pose to domestic animals, and their carcasses were abandoned. The anteaters, jaguar, puma and coatimundi were killed when they were cornered during dog hunts. While it is toothless, a giant anteater has massive claws, and can easily maul a dog to death. Other carnivores are considered to be potential

predators of small-bodied livestock, such as chickens and pigs, and are shot on sight, or captured in traps (Trinca & Ferrari, 2006).

With almost two-thirds of the individuals captured, and over half of the biomass harvested, peccaries were by far the most important game species within the study area. This is a clear reflection of the relative abundance of these species at the hunted sites (Tables 2 and 3). According to the locations of kills, the hunters covered an area of at least 38 km² during the study period, or just under one kilometer per household member, although this area is subject to a certain amount of encroachment from other hunters. The owners of some plots prohibit outsiders on their land, although hunts with dogs are especially unpredictable, and may often cross property boundaries in an erratic manner. Salt licks and ambush sites are considered personal property, however, and are normally avoided by unauthorized hunters in order to avoid unnecessary conflict (Trinca, 2004). The estimated 3,230 kg of biomass extracted during the study thus represent a rate of approximately 145.7 kg per square kilometer per annum. Discounting the non-game species and 40% of total mass attributable to bones, skin and offal (cf. Smith, 1976; Ayres & Ayres, 1979), each hunter harvested approximately 17.5 kg of meat per month, which corresponds to the consumption of approximately 200 g of bushmeat per household member per day.

The fact that primates were not hunted may reflect two principal factors. One is the non-Amazonian origin of the colonists. Whereas native or traditional Amazonian hunters have decimated primate populations in many areas (Peres, 1997), recent colonists from other regions often consider these mammals taboo (Iwanaga & Ferrari, 2002). The second factor is the abundance of preferred, larger-bodied game species, which offer a higher cost-benefit ratio to hunting effort/expenditure, within the study area. In general, smaller-bodied species – in particular primates and birds – are only hunted when larger game becomes scarce.

DISCUSSION

Despite certain methodological limitations, as discussed above, the results of the surveys, together with the complementary information on the occurrence of species indicate quite clearly that large-bodied vertebrates are still relatively abundant throughout the study area. This is despite the not inconsiderable hunting pressure recorded during the study period, which targeted peccaries in particular. Overall, however, a relatively small number of species were targeted, especially in comparison with areas with a much longer history of colonization (e.g. Gavin, 2007).

While less striking in terms of the numbers of animals killed (Table 5), the pressure on carnivore populations is more preoccupying. In particular, the loss of at least four big cats over a seven month period from an area of 38 km² is a disturbing trend, although the populations of these (and other) carnivores may suffer more negatively from the synergistic effects of habitat fragmentation (Michalski & Peres, 2005), which is still incipient within the study area. On the other hand, the relative abundance of peccaries in the area may have determined that of the big cats (Mendes-Pontes & Chivers, 2007), indicated by the hunting data, however, rather than survey results.

While white-lipped peccaries appear to be relatively abundant within the study area, they may be less so than in the recent past, given that a herd of at least 60 individuals was observed at site 2 in 2000, and groups of no more than 25 individuals were recorded during the study period. However, peccaries are known to range over wide areas (Kiltie & Terborgh, 1983; Fragoso, 1998), and the potential for a source-sink dynamic within the study area is considerable, given the proximity to the hunted sites of large areas of continuous forest, including site 3. In fact, local residents have reported seeing bands of *T. pecari* crossing open areas between fragments at site 2. Such a system may be essential to guarantee the long-term sustainability of ungulate harvesting (Novaro *et al*.,

2000), but it does demand the preservation of adequate areas of source habitat. This would seem to be one of the primary considerations for the planning of long-term management strategies. Up to now, major local landowners, such as the proprietors of site 3 have been willing to preserve large areas of forest (Trinca, 2004), but this may not always be the case in the future.

The abundance of birds and primates within the study area, and their absence from the list of hunted game (Table 5) is a positive sign, for a number of reasons, although, once again, the moot question is the long-term potential of this situation. Certainly, it seems that guans and curassows, at least, are not hunted at the present time only by virtue of the abundance of other game. So, it remains to be seen what will happen when the populations of more preferred species are depleted.

An intriguing additional question here is the apparent absence of certain species (*Chiropotes albinasus*, *Crax fasciolata*, and *Mico melanurus*) expected to occur within the region (Sick, 1997; Eisenberg & Redford, 1999). *Alouatta seniculus* was also unexpectedly scarce within the area, especially in comparison with *Ateles chamek*. These, and possibly other lacunae in the local distribution of species may be important indicators of certain ecological patterns within the study area, which may also be relevant to long-term shifts in the composition of the fauna.

As of the study period, then, colonization, habitat fragmentation, and the effects of hunting pressure on the local vertebrate fauna were all still at incipient levels. Studies such as those of Novaro*et al*. (2000) and Hurtado-Gonzalez & Bodmer (2004) have shown that the harvesting of Amazonian ungulates may be sustainable, especially where game densities in hunted areas are maintained at tolerable levels through a source-sink dynamic with neighboring areas of continuous forest, such as that found at site 3 in the present study. The critical question is how the characteristics of this dynamic, and ungulate densities, will evolve as colonization progresses and, in particular, habitat fragmentation expands through the study area. Ongoing research within the study area will hopefully provide at least some answers, and provide a database for the development of long-term management strategies.

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Table 1. Records of large-bodied birds and mammals (see text) known to occur in the region of Nova Bandeirantes, Mato Grosso, according to Emmons & Feer (1997), Sick (1997) and Eisenberg & Redford (1999).

Taxon			Common Name	Record (sites)[1]
Galliformes	Cracidae	*Crax fasciolata*	Bare-faced curassow	-
		Mitu tuberose	Razor-billed curassow	Surveys (1, 2, 3)
		Penelope sp.	Guan	Surveys (1, 2, 3)
		Pipile pipile	Trinidad piping guan	Surveys (2), sighting (1)
Gruiformes	Psophidae	*Psophia viridis*	Dark-winged trumpeter	Surveys (1, 2, 3)
Xenartha	Myrmecophagidae	*Myrmecophaga tridactyla*	Giant anteater	Hunted (2), report (3)
		Tamandua tetradactyla	Collared anteater	Sighted (3)
	Bradypodidae	*Bradypus variegates*	Tree-toed sloth	-
	Megalonichidae	*Choloepus didactylus*	Two-toed sloth	Trinca et al. 2006 (2)
	Dasypodidae	*Cabassous unicinctus*	Naked-tailed armadillo	-
		Dasypus kappleri	Great long-nosed armadillo	Hunted (2)
		Dasypus novemcinctus	Nine-banded armadillo	Hunted (2)
		Dasypus septemcinctus	Seven-banded armadillo	Hunted (2)
		Euphractus sexcinctus	Six-banded armadillo	-
		Priodontes maximus	Giant armadillo	-
Primates	Aotidae	*Aotus infulatus*	Night monkey	Animal kept as pet (2)
	Atelidae	*Alouatta seniculus*	Red howler monkey	Surveys (2)
		Ateles chamek	Black spider monkey	Surveys (1, 2, 3)
	Cebidae	*Cebus albifrons*	White-fronted capuchin	-
		Cebus apella	Tufted capuchin	Surveys (1, 2, 3)
	Pitheciidae	*Callicebus moloch*	Titi monkey	Surveys (1, 2, 3)
		Chiropotes albinasus	White-nosed bearded saki	-
Carnivora	Canidae	*Atelocynus microtis*	Short-eared dog	-
		Speothos venaticus	Bush dog	-

Table 1. Continued.

Taxon			Common Name	Record (sites)[1]
Carnivora	Felidae	*Herpailurus yaguarondi*	Jaguarundi	Hunted (2)
		Leopardus pardalis	Ocelot	Hunted (2)
		Leopardus wiedii	Margay	Skin seen in Nova Bandeirantes
		Panthera onca	Jaguar	Surveys (1), hunted (1, 2), tracks (3)
		Puma concolor	Puma	Hunted (2), tracks (1)
	Mustelidae	*Eira barbara*	Tayra	Surveys (1), hunted (2), sighted (2).
		Galictis vtitata	Greater grison	Sighted (1)
		Lontra longicaudis	Long-tailed otter	Surveys (1)
		Pteronura brasiliensis	Giant otter	-
	Procyonidae	*Nasua nasua*	Coati	Hunted (2), Surveys (1, 2)
		Potos flavus	Kinkajou	-
		Procyon cancrivorus	Crab-eating raccoon	-
Artiodactyla	Cervidae	*Mazama americana*	Red brocket deer	Surveys (2, 3), sighted (1)
		Mazama gouazoupira	Grey brocket deer	Surveys (1, 2, 3)
	Tayassuidae	*Pecari tajacu*	Collared peccary	Surveys (1, 2, 3)
		Tayassu pecari	White-lipped peccary	Surveys (1, 2, 3)
Perissodactyla	Tapiridae	*Tapirus terrestris*	Tapir	Hunted (2), sighted (2)
Rodentia	Agoutidae	*Agouti paca*	Paca	Hunted (2)
	Dasyproctidae	*Dasyprocta azarae*	Azara's agouti	Surveys (1, 2, 3)
	Erethizontoidea	*Coendou prehensilis*	Brasilian porcupine	-
	Hydrocheridae	*Hydrochaeris hydrochaeris*	Capybara	Hunted (2), tracks (2)

[1]1, Pantera 2, Dacasa 3, Fazenda Juventude

Table 2. Sightings of large-bodied mammals at Pantera (25.6 km walked).

Taxon		Sightings (per 10 km)	Individuals (per 10 km)
Primates	*Ateles chamek*	6 (2.3)	16 (6.3)
	Callicebus moloch	8 (3.1)	12 (4.7)
	Cebus apella	11 (4.3)	33 (12.9)
Rodentia	*Dasyprocta azarae*	6 (2.3)	8 (3.1)
Artiodactyla	*Tayassu pecari*	1 (0.4)	25 (9.8)
	Pecari tajacu	2 (0.8)	12 (4.7)
	Mazama gouazoupira	2 (0.8)	2 (0.8)
Carnivora	*Panthera onca*	1 (0.4)	1 (0.4)
	Eira barbara	1 (0.4)	2 (0.8)
	Nasua nasua	1 (0.4)	4 (1.6)
Galliformes	*Mitu tuberosa*	4 (1.6)	5 (1.9)
	Penelope sp.	7 (2.7)	15 (5.8)
Gruiformes	*Psophia viridis*	2 (0.8)	5 (1.9)
Total		**52 (20.3)**	**140 (54.5)**

Table 3. Sightings of large-bodied mammals at Dacasa (45.6 km walked).

Taxon		Sightings (per 10 km)	Individuals (per 10 km)
Primates	*Alouatta seniculus*	3 (0.7)	14 (3.1)
	Ateles chamek	13 (2.9)	77 (16.9)
	Callicebus moloch	3 (0.7)	8 (1.8)
	Cebus paella	17 (3.7)	83 (18.2)
Rodentia	*Dasyprocta azarae*	11 (2.4)	13 (2.9)
Artiodactyla	*Tayassu pecari*	6 (1.3)	87 (19.1)
	Pecari tajacu	2 (0.4)	4 (0.9)
	Mazama americana	1 (0.2)	1 (0.2)
	Mazama gouazoupira	2 (0.4)	2 (0.4)
Carnivora	*Lontra longicaudis*	1 (0.2)	1 (0.2)
	Nasua nasua	1 (0.2)	9 (2.0)
Galliformes	*Mitu tuberosa*	6 (1.3)	6 (1.3)
	Pipile pipile	1 (0.2)	1 (0.2)
	Penelope sp.	8 (1.8)	12 (2.6)
Gruiformes	*Psophia viridis*	1 (0.2)	4 (0.9)
Total		**76 (16.7)**	**322 (70.6)**

Table 4. Sightings of large-bodied mammals at Fazenda Juventude (36.5 km walked).

Taxon		Sightings (per 10 km)	Individuals (per 10 km)
Primates	*Ateles chamek*	3 (0.8)	33 (9.0)
	Callicebus moloch	3 (0.8)	6 (1.6)
	Cebus apella	11 (3.0)	44 (12.1)
Rodentia	*Dasyprocta azarae*	6 (1.6)	8 (2.2)
Artiodactyla	*Tayassu pecari*	2 (0.6)	18 (4.9)
	Pecari tajacu	1 (0.3)	10 (2.7)
	Mazama americana	2 (0.6)	2 (0.6)
	Mazama gouazoupira	1 (0.3)	1 (0.3)
Galliformes	*Mitu tuberose*	4 (1.1)	8 (2.2)
	Penelope sp.	5 (1.4)	13 (3.6)
Gruiformes	*Psophia viridis*	2 (0.5)	6 (1.6)
Total		**40 (11.0)**	**149 (40.8)**

Table 5. Mammals hunted and biomass extracted by 14 hunters at Japuranã settlement, Nova Bandeirantes between May and November 2003. Body weights are based on Eisenberg & Redford (1999) and Rios (2001), except for *Panthera onca* (n = 1) and *Agouti paca* (n = 4), which were recorded at the study site.

Species	Mean body weight (kg)	Animals hunted (% do total)	Biomass (% do total)
Tayassu pecari	28.55	47 (41.6)	1341.9 (41.55)
Pecari tajacu	17.52	23 (20.4)	403.0 (12.48)
Mazama spp.	26.00	6 (5.3)	156.0 (4.83)
Tapirus terrestris	148.95	5 (4.4)	744.8 (23.06)
Dasyprocta azarae	2.84	1 (0.9)	2.8 (0.09)
Agouti paca	7.50	7 (6.2)	52.5 (1.63)
Hydrochaeris hydrochaeris	31.50	5 (4.4)	157.5 (4.88)
Nasua nasua	3.88	3 (2.6)	11.6 (0.36)
Panthera onça	75.00	2 (1.8)	150.0 (4.65)
Puma concolor	37.00	2 (1.8)	74.0 (2.29)
Leopardus pardalis	10.46	5 (4.4)	52.3 (1.62)
Herpailurus yaguarondi	2.60	1 (0.9)	2.6 (0.08)
Eira barbara	3.98	1 (0.9)	4.0 (0.12)
Dasypus spp.	3.54	3 (2.6)	10.6 (0.33)
Myrmecophaga tridactyla	32.90	2 (1.8)	65.8 (2.04)
Total		**113 (100.0)**	**3229.3 (100.00)**