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Hunting practices among the Awá-Guajá: towards a long-term analysis of sustainability in an Amazonian indigenous community

As práticas de caça entre os Awá-Guajá: contribuições para uma análise de sustentabilidade de longo prazo em um contexto indígena amazônico

Helbert Medeiros Prado[I], Louis Carlos Forline[II], Renato Kipnis[I]

[I]Universidade de São Paulo. São Paulo, São Paulo, Brasil

[II]University of Nevada. Reno, Nevada, USA

Abstract: Indigenous Reserves have played an indispensable role in maintaining forest areas in the Neotropics. In the Amazon there is a clear correlation between these reserves and the presence of forest cover; however, the simple presence of uninterrupted vegetation is no guarantee for the conservation of biodiversity, especially where hunting is practiced. This study describes hunting practices among the Awá-Guajá people from 1993 through 1994, also identifying socio-cultural, technological, and demographic changes that have influenced their resource acquisition strategies over the last two decades. The data was obtained through ethnographic fieldwork, recording 78 days of foraging returns, with follow-up visits through 2010. This work provides useful information for an effective diachronic analysis of hunting in this community, by revealing foraging patterns of the early to mid-1990s, and describing community transformations over the last two decades in this locale.

Keywords: Awá-Guajá Indians. Hunting. Amazonia. Sustainability. Mammals.

Resumo: Reservas indígenas têm tido um papel imprescindível na manutenção de áreas florestais na região neotropical. Existe, na Amazônia, uma clara associação entre estas reservas e a presença de cobertura florestal; entretanto, a simples presença de uma vegetação contínua não é garantia de conservação da biodiversidade, sobretudo em contextos onde a caça está presente. Este estudo caracteriza as práticas de caça entre os índios Awá-Guajá (Maranhão, Brasil), vigentes entre 1993 e 1994, e identifica mudanças socioculturais, tecnológicas e demográficas em curso no local nas últimas duas décadas. Os dados foram obtidos pelo método etnográfico, com o registro de 78 dias de atividades de caça entre 1993 e 1994, e em visitas subsequentes até o ano de 2010. Ao retratar o padrão de caça no início dos anos 1990 e descrever as transformações pelas quais a comunidade tem passado desde então, este artigo disponibiliza informações úteis para que uma análise diacrônica da sustentabilidade de caça no local possa ser efetivada.

Palavras-chave: Índios Awá-Guajá. Caça. Amazônia. Sustentabilidade. Mamíferos.

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Autor para correspondência: Helbert Medeiros Prado. Universidade de São Paulo. Instituto de Biociências. Departamento de Ecologia. Rua do Matão, 321. São Paulo, SP, Brasil. CEP 05508-900 (helbertmedeiros@yahoo.com.br).

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INTRODUCTION

Indian Reserves play an indispensable role in maintaining Neotropical forest areas intact (Nepstad *et al*., 2006). The extension of the Indian Reserves in the Brazilian Legal Amazon covers 104,335,891 ha (20.84% of this Region), areas which are home to about 200,000 indigenous peoples (ISA, 2004). Some areas of the Amazon show a clear correlation between Indian Reserves and uninterrupted forest cover. In some of these areas forest islands are ringed by encroaching frontier expansion and have only managed to survive this onslaught by virtue of being protected Indian Reserves (ISA, 2004).

Until 2001, only 1.14% of the land contained within indigenous reserves was deforested; conversely, outside of these and other protected areas deforested land rose to 18.96% (ISA, 2004). Nowadays mounting evidence shows that Indian Reserves stall deforestation not to mention that environmental reserves also play an important role in habitat protection in Amazonia (Nepstad *et al*., 2006). Nevertheless, the presence of forest cover, *per se*, is no guarantee for the conservation of biodiversity, especially where intensified hunting is practiced (Redford, 1992).

In addition to habitat loss, degradation, fragmentation and the introduction of exotic species, the overexploitation of plant and animal resources is one of the main anthropic threats to the planet's biodiversity (Van Dyke, 2008). In the specific case of hunting, the specialized literature provides various examples of population decline in game species due to predation by local indigenous peoples (Bodmer *et al*., 1997; Peres, 2000; Bodmer and Robinson, 2004).

In the Amazon region, hunting is one of the core activities of indigenous groups, *caboclos*[1] and recently settled communities (Redford and Robinson, 1987; Murrieta *et al*., 2004), offering a significant amount of calories and essential nutrients, particularly protein and fat (Dufour, 1983; Flowers, 1983; Yost and Kelley, 1983; Stearman, 1994; Townsend, 2000; Murrieta *et al*., 2004).

In the majority of tropical forests, most game meat comes from a relatively small number of large animal species (Redford and Robinson, 1987; Redford, 1992), normally ungulates and primates (Robinson and Bennett, 2000). However, primates present particularly low rates of intrinsic population growth (r_{max}), making them more vulnerable to hunting pressure (Bodmer *et al*., 1997).

Besides direct impacts of species-specific hunting, the population decline in fauna can also have a negative effect on the structure and composition of forest vegetation, especially when hunted animals provide key ecological services such as predation, browsing and seed dispersal, as witnessed in most medium to large-sized mammal and bird species in the Neotropics (Redford, 1992; Stoner *et al*., 2007). Even if the species survives at a specific location, over-hunting generally decimates populations to contingents so low in numbers that they become 'ecologically extinct', for all practical purposes, and are rendered incapable of interacting significantly within a given ecosystem (Redford, 1992). Sustainable hunting, on the other hand, in addition to bringing long-term benefits for the local communities that rely on game, also promotes the conservation of related species, directly and indirectly (Swanson and Barbier, 1992; Freese, 1997).

In recent decades, various studies have assessed the sustainability of wild animal hunting in the Neotropics (Fitzgerald *et al*., 1991; Ojasti, 1991; Vickers, 1991; Bodmer, 1994; Alvard, 1998; Hill and Padwe, 2000; Leeuwenberg and Robinson, 2000; Mena *et al*., 2000; Peres, 2000; Townsend, 2000). Many of these studies have shown that the hunting of certain species has overreached sustainable limits. However, in areas where there is stewardship and restrictions on hunting, these species can be hunted without any significant impact on the local faunal population (Ojasti, 1991; Alvard, 1998; Bodmer and Puertas, 2000).

In addition to these approaches established in the literature, in the last decade various studies have demonstrated

[1] This term refers to the mixed blood peasant communities of the Amazon, descended from Indian, Portuguese and, to a lesser extent, African peoples (Galvão, 1955; Parker, 1985; Ross, 1978a; Adams *et al*., 2009).

the importance of buttressing sustainability analyses with data on landscape scale (Novaro *et al*., 2000; Ohl-Schacherer *et al*., 2008), the spatial distribution of hunting activity (Sirén *et al*., 2004; Smith, 2008), and socio-cultural aspects directly related to hunting patterns and intensity (Da Silva *et al*., 2005; Van Vliet and Nasi, 2008b), as well as the use of data sets with temporal depth, in order to make the monitoring of hunting viable (Alvard *et al*., 1997; Novaro *et al*., 2000; Da Silva *et al*., 2005; Van Vliet and Nasi 2008a).

By embracing these new approaches, this research examines the hunting practices of the Awá-Guajá Indians from 1993 through 1994, and looks at socio-cultural, technological and demographic changes occurring in their community over the last two decades. In examining hunting patterns and community transformations, we strive to make data available that will serve as a reference for subsequent studies involving diachronic analyses of hunting in the greater Awá-Guajá catchment area – contrasting recent data with data presented in this work. Although it gives important empirical benefits, the temporal monitoring of hunting practices is difficult to implement, therefore the examples of this approach in the literature are rare (Alvard *et al*., 1997; Novaro *et al*., 2000; Da Silva *et al*., 2005; Van Vliet and Nasi, 2008a).

THE AWÁ-GUAJÁ PEOPLE

The Awá-Guajá are perhaps one of the last peoples in the Amazon for whom foraging, fishing and the hunting of game animals comprise the most important part of their subsistence strategy (Queiroz and Kipnis, 1990; Forline, 1997).

The Awá-Guajá refer to themselves as Awá, and originally came from the Lower Tocantins River valley in Pará state, along with other indigenous groups, such as the Parakanã, Assurini, Urubu-Ka'apor, Amanajó, Anambé and Tenetehara, as well as other now-extinct tribes, comprising the region's largest contingent of the Tupi-Guarani linguistic family (Balée, 1994; Gomes, 1988).

Colonial expansion caused these groups to fragment and scatter, and it is very likely that the Awá-Guajá began their migration eastward toward the state of Maranhão during the Cabanagem revolt of 1835-1840 (Forline, 1997).

The Awá-Guajá came into permanent contact with Brazilian mainstream society in 1973 and have since been settled by Brazil's Indian Service (FUNAI) into four semi-nucleated communities located on three different Indian Reserves (IR – TI in Portuguese) in Maranhão state: Alto Turiaçu (530,525 ha); Caru (172,667 ha); and Awá (118,000 ha). FUNAI estimates that approximately 60 uncontacted Awá-Guajá reside on yet another reserve, Arariboia IR, (413,288 ha). All told, about 315 Awá-Guajá live in these settled communities: 80 at Indian Post Guajá (TI Alto Turiaçu); 150 near Post Awá (TI Caru); 45 in the vicinity of Post Tiracambu (TI Caru); and 40 near Post Juriti (TI Awá). This study primarily analyzes the hunting patterns and yields among the Awá-Guajá located at the Post Awá community, located in the Caru IR (Figure 1).

Some observers speculate that the Awá-Guajá were originally farmers until they were forced into nomadism by pressure from other indigenous groups and the moving Amazonian frontier (Balée, 1994; Gomes, 1988). Yet in recent times, prior to establishing permanent contact with mainstream society, the Awá-Guajá were nomads who lived by hunting and gathering. Today, the Awá-Guajá practice swidden agriculture, which accounts for about 60% of their diet. Notwithstanding this rapid transition in diet, their time spent hunting still exceeds that devoted to other subsistence activities (Forline, 1997).

The Awá-Guajá cultivate a range of crops in their swiddens and orchards, with manioc representing the main crop in terms of effort invested and dietary importance (Forline, 1997). In addition to cassava, other cultivars grown on Awá-Guajá plots include corn, rice, bananas, melons, papayas, beans, yams and sweet potatoes.

Though fishing is certainly nothing new to the Awá-Guajá, since contact its importance has grown in terms of productivity. Before contact with Brazilian national society, the Awá-Guajá lived along small watercourses, in interfluvial zones and headwater areas. Today they

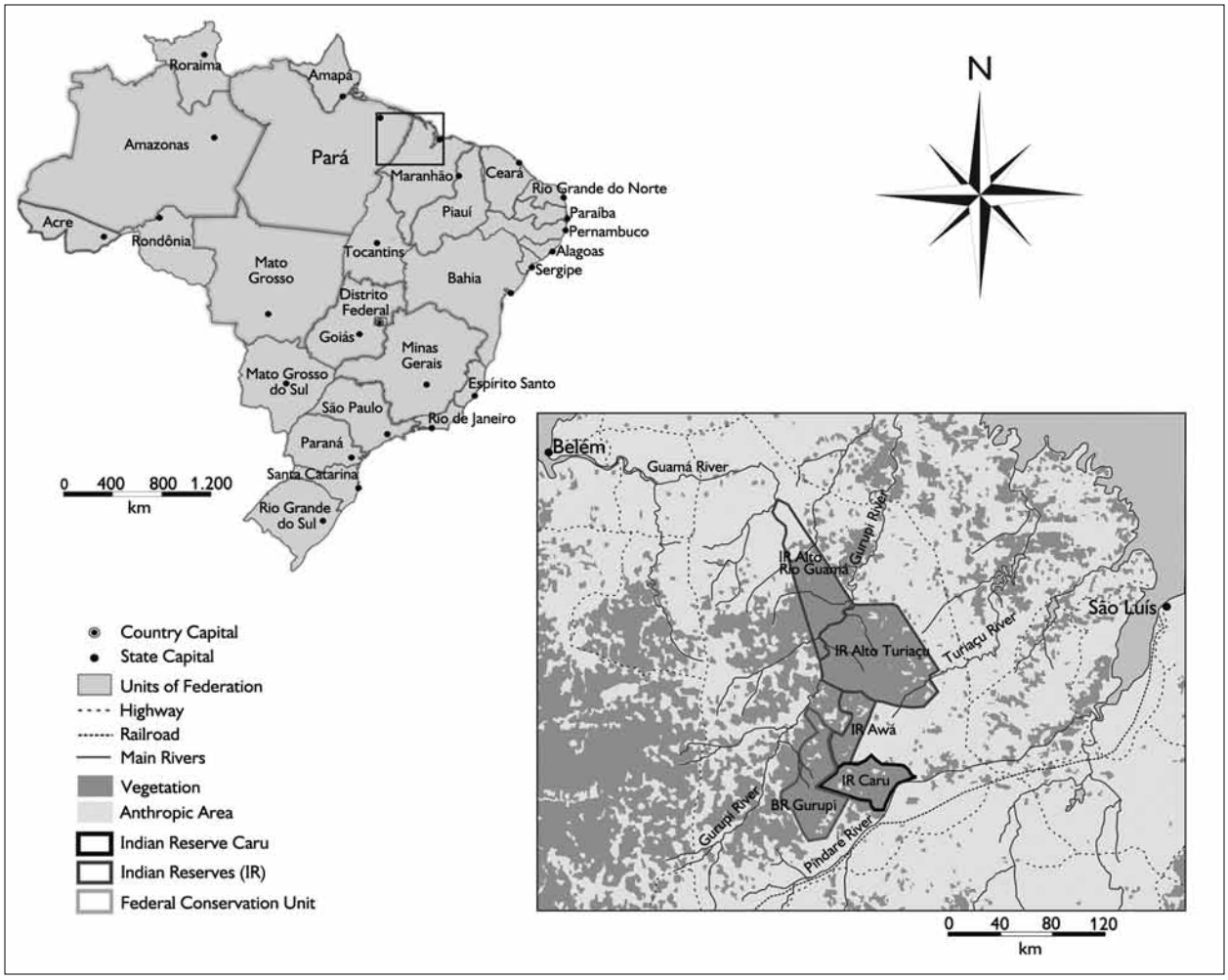

Figure 1. Map of Awá-Guajá lands and adjacent areas in Maranhão State, Brazil.

are situated on the banks of the main rivers of Maranhão state (Pindaré, Caru and Turiaçu), where they make more intensive use of riverine and lacustrine resources.

MATERIAL AND METHODS

STUDY AREA

The Caru IR is located in the eastern fringes of Brazil's Amazon region in the northwestern part of Maranhão state. It is adjacent to IR Awá and the Gurupi Biological Reserve and, together with IRs Alto Turiaçu and Alto Rio Guamá, these areas form a contiguous set of protected areas totaling approximately 1,400,000 ha (Figure 1). The latter indigenous reserve is located in the neighboring state of Pará and is home to the Tembé Indians. The precise coordinates for the area being analyzed in this study, Indian Post Awá, are 3° 46' 38.72" S, 46° 8' 48.17" W.

Four large rivers drain the region: the Turiaçu, Caru, Pindaré and Gurupi. The Caru and Pindaré Rivers flow along the northern and southern limits of the Caru Indian Reserve. The Caru IR is delimited by the Pindaré River on its south-southeastern margins, the Biological Reserve to the southwest, the Carajás railroad to the southeast, and the Awá IR to the northeast. Much of its northernmost territory, part of the

southern stretch and the whole eastern rim of the Caru IR consist of, and border on, anthropogenic landscapes (palm forests, farmland, ranches and urban settlements), not to mention that the Greater Carajás Program (Projeto Grande Carajás – PGC) has stimulated much growth in the region and land invasions in indigenous areas (ISA, 2004) (Figure 1).

Most of the land area of this mosaic is covered by *terra firme*, or upland forests not prone to seasonal flooding, consisting mostly of primary forest. Rivers, lakes, secondary vegetation and other landscapes also add to the area's environmental complexity. Seasonally dry tropical forest cover predominates throughout the region. The climate is divided into two clearly defined seasons, the rainy season (December to May) and the dry season (June to November). Average annual rainfall in the region ranges from 1,500 to 2,500 millimeters (Forline, 1997).

The region is also home to a high concentration of babaçu stands (*Attalea speciosa*), a species that tends to flourish under ecological succession in areas previously cleared for farming and cattle ranching. The high density of babaçu in the area is probably due to the long history of human disturbance in the region's landscapes (Balée, 1994). As they attract a range of mammals and provide a multitude of resources for the Awá-Guajá, babaçu stands are considered choice hunting grounds (Forline, 1997, 2000). And prior to permanent contact with Brazilian mainstream society, the Awá-Guajá frequently resided in or near babaçu stands.

DATA COLLECTION AND ANALYSES

The hunting data presented here was collected as part of a larger anthropological study, which encompassed observing and keeping notes of hunting activities for 229 days in three Awá-Guajá communities, covering 18 months of data collection (Forline, 1997). In the Awá community, 78 days were devoted to recording information about slain animals, of which 42 days were during the dry season (from June to September 1993) and 36 days in the rainy season (from March to May).

Data collection was conducted daily, mostly in the late afternoons, when hunters returned from their foraging tours. All community households were visited by one of the authors (LCF) to keep track of the slain game animals harvested on a given day. Animals were identified, accounted for in field record sheets and weighed with the help of the Awá-Guajá. Some informants anticipated these visits, bringing game to the researcher to be weighed, identified and recorded. Researcher oversight was rare, given the relative ease of conducting this task in a small community such as the Awá-Guajá's. The Awá-Guajá were glad to comply and also cooperated by informing about other hunters who had arrived from hunting expeditions that had gone unnoticed by researchers.

In order to estimate the proportion of slain game actually consumed by community members, the portions not consumed – skin, bones, internal organs and other discarded parts were weighed and subtracted from the total weight of the animal. The data presented here thus consists of the number of individuals slain in each animal class, the total weight of these animals and their net (dressed) weight (see Tables 2 and 3).

Another six days were dedicated to accompanying the Awá-Guajá in their hunting expeditions beyond the main settlement (the aforementioned data was obtained in the main settlement). Of these six days, three were in the dry season and three were in the rainy season. Three night hunts and seven fishing expeditions were also monitored. Follow-up interviews were also conducted to inquire about the nature of Awá-Guajá hunting practices.

The updated information about the human demography in the area, the use of fire arms, and the frequency of long-duration hunting expeditions were obtained from visits to the community by one of the authors (LCF)[2].

[2] Forline has made yearly visits to the Awá-Guajá after a 10-year hiatus, since 2004, to stay abreast of community developments and is in the process of developing a multi-disciplinary collaborative project in their community.

RESULTS

AWÁ-GUAJÁ HUNTING ACTIVITIES

The Awá-Guajá employ diverse hunting methods, including *watá*, or day hunts, walking tours averaging six to seven hours in the forest. This type of hunting can be done individually, but is also conducted by groups of two or more people. The hunting parties normally leave to hunt at daybreak and return to the village in the late afternoon or at dusk.

Another method, known across the Amazon as *mutá* or *caça de espera*, is a nocturnal activity in which the hunter waits for his prey in a hammock, near a fruit tree, armed with a shotgun and flashlight. The range for this type of hunting is anywhere from 1 km to 3 km from the village. The Awá-Guajá also use a trap called a *badogue*, which consists of a small sawed-off shotgun, placed at knee-height in an animal's foraging patch, and is activated by a trip-wire. In both the *mutá* and *badogue* methods, the animals slain are mostly rodents, such as pacas (*Cuniculus paca*) and red-rumped agoutis (*Dasyprocta leporina*), but occasionally red brocket deer (*Mazama americana*), gray brocket deer (*Mazama gouazoubira*) and lowland tapirs (*Tapirus terrestris*) are also killed.

Takaya (hunting blind) hunting involves a camouflage of babaçu palm fronds (*Attalea speciosa* Mart. *ex* Spreng.) and usually takes place in the morning, though parties may set out before dawn. The hunting blind is also set up near fruiting trees and the hunter stays in waiting inside this camouflage, armed with a bow and arrow or shotgun. The range for this type of hunting is from 1 km to 5 km from the village.

Thus the Awá-Guajá use a wide variety of techniques in their hunting activities, whether singularly or in combinations. In terms of return rates (kg hunted/time spent), however, the use of firearms accompanied with hunting dogs yields the best results (Forline, 1997).

The animals consumed by the local population in the beginning of the 1990s included mammals, birds, reptiles, and crustaceans, other than the fish which became an increasingly important element in the Awá community's diet[3]. In taxonomic terms, 35 species of mammals were identified, along with three genera of reptiles (Table 1). In general, there was a higher harvesting of the different animal classes during the dry season, with the exception of birds, which are consumed more during the rainy season (Tables 2 and 3).

There were notable differences between the dry and rainy seasons in terms of the number of animals hunted for consumption. During the dry period, a greater number of fish were consumed, followed by primates, birds, turtles, and pacas (Table 2). In the rainy season, there was a significant increase in the number of felled birds. These were followed by fish, tortoises, primates, and agoutis (Table 3). Nonetheless, the group of animals containing fish, primates, birds and turtles, comprises the highest number of individuals captured for consumption in both seasons.

In regard to the importance of game in the local diet, it was observed that, in the dry season, fish, pacas, primates, caimans and deer present the highest amount of dressed weight consumed (Table 2). On the other hand, in the rainy season, there was a higher consumption of peccaries, birds, primates, agoutis, and turtles (Table 3). In this sense, it was verified that the base of the diet's game portion in the community was considerably altered, with the exception of primates, which remained one of the main sources of animal protein in the two seasons studied.

At the Awá community, primates rank second in terms of frequency of catch and third in gross and dressed weights, during the dry season (Table 2). During the rainy season, primates fall to fourth place in the frequency ranking, but remain the third most important catch in terms of biomass intake (Table 3). Primates are generally stalked by two or more hunters using bows

[3] As many indigenous communities come into contact they are frequently settled in the vicinity of FUNAI outposts, located near rivers, thus increasing the amount of fish in their diets.

Table 1. List of game animals captured by the Awá-Guajá between 1992 and 1994. (Continued)

Class/Family	English name	Portuguese name	Scientific name
MAMMALS			
Erethizontidae	Brazilian porcupine	Quandu	*Coendou prehensilis*
Cuniculidae	Paca	Paca	*Cuniculus paca*
Dasyproctidae	Black-rumped agouti	Cutia	*Dasyprocta prymnolopha*
	Red-rumped agouti	Cutia	*Dasyprocta leporina*
Dasypodidae	Giant armadillo	Tatu-canastra	*Priodontes maximus*
	9-banded long-nosed	Tatu	*Dasypus novemcinctus*
	Southern naked-tailed armadillo	Tatu-rabo-de-couro	*Cabassous unicinctus*
	7-banded long nosed armadillo	Tatu	*Dasypus septemcinctus*
	Great long-nosed armadillo	Tatu	*Dasypus kappleri*
Cebidae	Night monkey	Macaco-da-noite	*Aotus* sp.
	Squirrel monkey	Macaco-mão-dourada	*Saimiri sciureus*
	Capuchin monkey	Macaco-prego	*Sapajus apella*
	White fronted capuchin	Cairara	*Cebus kaapori*
	Black saki	Cuxiu	*Chiropotes satanas*
	Saki	Cuxiu	*Chiropotes* sp.
	Howler monkey	Guariba/Capelão	*Alouatta belzebul*
	Tamarin	Tamarim	*Saguinus midas*
Bradypodidae	Brown-throated 3 toe sloth	Preguiça	*Bradypus variegatus*
Megalonychidae	Southern 2-toes sloth	Preguiça	*Choloepus didactylus*
Myrmecophagidae	Giant anteater	Tamanduá-bandeira	*Myrmecophaga tridactyla*
	Collared anteater	Tamanduá-mambira	*Tamandua tetradactyla*
Procyonidae	South american coati	Quati	*Nasua nasua*
	Kinkajou	Jupará	*Potos flavus*
Mustelidae	Southern river otter	Ariranha	*Lutra longicaudis*
	Tayra	Papa-mel	*Eira barbara*
	Huron	Papa-mel	*Galictis vittata*
Felidae	Margay	Maracajá	*Leopardus wiedii*
	Ocelot	Jaguatirica	*Leopardus pardalis*
	Puma	Onça-vermelha	*Puma concolor*
Cervidae	Gray brocket deer	Foboca	*Mazama gouazoubira*
	Red brocket deer	Veado	*Mazama americana*
Hydrochaeridae	Capybara	Capivara	*Hydrochaeris hydrochaeris*
Tayassuidae	White-lipped peccary	Queixada	*Tayassu pecari*
	Collared peccary	Cateto	*Pecari tajacu*
Tapiridae	Tapir	Anta	*Tapirus terrestris*

Table 1. (Conclusion)

Class/Family	English name	Portuguese name	Scientific name
REPTILES			
Testudinidae	Tortoise	Jaboti-amarelo	*Chelonoidis* sp.
	Tortoise	Jaboti-vermelho	*Chelonoidis* sp.
Alligatoridae	Caiman	Jacaré	*Caiman* sp.
CRUSTACEANS			
	Crab	Caranguejo	?

and arrows, or shotguns and rifles. The primates hunted by the Awá-Guajá are the red-handed howler monkey (*Alouatta belzebul*), brown capuchin monkeys (*Sapajus apella*), Ka'apor capuchins (*Cebus kaapori*), black bearded sakis (*Chiropotes satanas*), owl monkeys (*Aotus infulatus*), squirrel monkeys (*Saimiri sciureus*) and golden-handed tamarins (*Saguinus midas niger*).

Among primates a prevailing number of howlers stood out in the sample. Moreover, in a separate ethno-archaeological study conducted in 1990 in the Post Awá community (Queiroz and Kipnis, 1990), examining game skeletons, 198 howler monkey skulls, 74 capuchin monkeys, ten black bearded sakis, and four squirrel monkeys were uncovered (Prado, 2007). Primates in general are highly sensitive to hunting pressure, due to their low reproductive rate (Bodmer *et al*., 1997), such that they are a priority for future investigations involving the hunting activities in this area.

Primates, and howlers in particular, have a special significance for the Awá-Guajá, not only in terms of their availability but also for cosmological reasons. As Cormier (2003) noted in her work among the Awá-Guajá, the offspring of slain adult primates are raised as pets and obtain a near-human quality in the domestic domain. While this may contribute to a slight increase in primate populations in the village compound, they can also be used as decoys to lure in forest primates. As we discuss below, a number of beliefs that may contribute to sustainable hunting are threatened as contact with the Awá-Guajá intensifies.

HISTORICAL FACTORS RELATED TO HUNTING

Among the Awá-Guajá communities, the vicinity of Post Awá is the one most susceptible to invasion by land-grabbers and poachers, largely due to the proximity of hamlets and settlements that have sprouted along the Carajás railway (part of the Grande Carajás Program) on the southeastern rim of the Caru IR (for more information, Forline, 1997). Additionally, there is a general consensus that the closer the contact indigenous communities have with urban centers, the greater their access will be to modern technologies that render their hunting more efficient and, therefore, less sustainable (Leeuwenberg and Robinson, 2000).

This proximity also tends to give rise to, or intensify, commercial hunting. In the case of the Awá-Guajá at Post Awá, contact with urban communities is increasing, which exposes them to new hunting technologies. On the other hand, there is little evidence of commercial hunting practiced by members of this community. Hunters will, however, hunt animals for FUNAI personnel as they have been engaged in clientilistic relations with the Indian Service in the wake of contact. In this case, cash is rarely involved yet FUNAI invariably leverages its services in exchange for Awá-Guajá labor, including hunting. In Forline's observation this additional amount of hunted animals did not exceed 5% of their yields yet over the long haul this may also impact hunting sustainability. Moreover, in this transition period in Awá-Guajá history men's working loads have increased to both provide for their families and render services for FUNAI outposts (Hernando *et al*., 2011).

Table 2. Animals captured at Awá Community during dry season of 1993, listed here in a decreasing order of importance (42-day observation period). Dressed weight: refer to the proportion of total weight which is ingested (whole weight of the animal minus the weight of discarded parts such as skin, bones among others); n.a.: information not available.

Animal	Dressed weight (kg)	Gross weight (kg)	Individuals
Fish	136.9	182.6	158
Pacas	128.1	197	32
Monkeys	92.1	141.7	62
Caimans	40.2	61.9	7
Deer	33.9	52.5	2
Agoutis	29.7	46.7	20
Peccaries	24.2	37.3	2
Armadillos	17.3	26.7	6
Sloths	14.8	22.8	5
Fowl	10.6	n.a.	61
Tortoises	n.a.	68.1	38
Rats	n.a.	n.a.	13
Coatis	n.a.	n.a.	5

Table 3. Animals captured at Awá Community during wet season of 1994, listed here in a decreasing order of importance (36-day observation period). Dressed weight: refers to the proportion of total weight which is ingested (whole weight of the animal minus the weight of discarded parts such as skin, bones among others); n.a.: information not available.

Animal	Dressed weight (kg)	Gross weight (kg)	Individuals
Peccaries	193.3	297.4	8
Fowl	103.1	153.9	486
Monkeys	64.5	99.2	38
Agoutis	45.2	69.4	32
Tortoises	36.3	104	48
Pacas	32.3	49.7	7
Fish	31.6	42.1	73
Deer	23.5	36.2	2
Armadillos	19.4	29.9	10
Sloths	19.1	29.4	6
Snakes	n.a.	n.a.	6

One factor that could mitigate the effects of wild species hunting is the roaming lifestyle of foragers. The relocation of villages can often occur before the effects of over-hunting become irreversible. Though Post Awá largely comprises a settled community, the local Awá-Guajá also retreat to long-duration hunting camps (some of which can last for months), and this distributes the hunting burden throughout the landscape, boosting sustainability. Another factor possibly diminishing overpredation would be hunting taboos (McDonald, 1977; Ross, 1978b; Balée, 1985; Colding and Folke, 2001; Cormier, 2003); however, contact and increased sedentarism are often associated with a loss of local sustainability, the erosion of beliefs, and seminal introduction into local markets (Bennett and Robinson, 2000). Hunting taboos may also vary between communities and not all individuals in a given community will strictly adhere to food proscriptions. Similarly, while food proscriptions can be enforced tabooed animals can be slain for other purposes, such as bait.

Present-day observations indicate an increasing need among the Awá-Guajá to cover ever-longer distances from their village in search of game (personal observations by authors). The local Awá-Guajá all agree that populations of the medium to large-sized mammals in the vicinity of their village have dwindled. Similarly, with contact and the introduction of firearms and flashlights, night hunting has increased among the Awá-Guajá, demystifying previous avoidance of engaging in nocturnal activities in the forest.

Apparently, the decline in game around the village spurred an increase in lengthier hunting treks in relation to same-day hunting excursions (personal observation). Today, these longer hunting expeditions would seem to represent a return to the higher mobility that existed among the Awá-Guajá prior to permanent contact and settlement. This dynamic demonstrates the importance of establishing indigenous reserves of suitable size, capable of offering conditions for settled communities to adjust to the flow of local displacements before irreversible local damage is done to game species populations. Additionally, it is urgent that land

security for the Awá-Guajá is enforced by Brazil's Indian Service and other agencies tasked to accomplish such measures. As it happens, loggers have co-opted a small number of Awá-Guajá and their presence also compromises games populations as they engage in hunting activities and diminish forested areas (González-Ruibal and Hernando, 2010).

One factor frequently associated with unsustainable hunting is human population growth, something that has been observed among the Awá-Guajá located at Post Awá. In 1993, the Awá community was home to 94 individuals (Forline, 1997). Today, the same community has grown to over 150 people. Thus, in comparison to the other Awá-Guajá villages, this community experiences the greatest hunting pressure by virtue of having the largest population and greater proximity to regional hamlets and the Carajás railway. In fact, the diminishing hunting returns for this area is one of the reasons why some members of this village relocated to form their current community at Post Tiracambu, in the mid 1990s.

The introduction of firearms has also been a negative contributing factor insofar as guns make the hunter more efficient (Hames, 1979; Hames and Vickers, 1982; Hill and Hawkes, 1983; Yost and Kelley, 1983; Alvard, 1995; Mena *et al*., 2000; Stearman, 2000; Levi *et al*., 2009). The introduction of firearms is especially relevant in terms of killing tree-dwelling species, such as the monkeys, that are also more susceptible to hunting due to their low reproductive rate. In the early 1990s, almost all Awá-Guajá hunters in this community used .20 and .28 gauge shotguns, as well as acquiring other implements used in hunting and fishing, such as fish hooks, flashlights, knives and machetes.

In contrast, during the 1980s there were only two such firearms in use within the community, and with very limited ammunition. This situation has changed swiftly, increasing hunting efficiency and altering the pattern of local subsistence. Today, almost all of the community's 70 hunters (this includes males under the age of 15, and women, who indirectly assist in some hunts) use shotguns of various calibers or breech loading rifles.

It is interesting to note that in another Awá-Guajá community, Post Juriti, firearms were not used until recently. The difference between traditional weaponry and introduced technologies is significant, where newer technologies surpass traditional technologies in hunting efficiency by over 300 percent (Forline, 1997). With new technologies hunters access niches that were less exploited in the past, such as canopy areas, and intensify night hunts.

CONCLUSION

There are a number of factors that bear positively and negatively on sustainable hunting yields in the Post Awá community. The absence of commercial hunting, coupled with retreats to hunting camps that distribute hunting pressure across a wider land area, both contribute positively toward the sustainability of hunting at this study site. However, the increase of access to firearms and the growth in indigenous populations at the locale in the last two decades are negative factors for sustainable hunting.

Additionally, the animals are pressured by encroaching development and regional settlers located outside the Indian Reserves. While these elements may cause animals to migrate towards the regional Indian Reserves, often leading to an apparent short-term rise in game populations, border zones and buffer areas often lack the resources of a source-sink area to provide the necessary species exchange and, eventually, game populations will dwindle. Reiterating the need to keep indigenous reserves intact we also stress the importance of keeping outside pressure at bay and urge to optimize introduced technologies, such as firearms, to keep game populations viable.

Considering that the last in-depth hunting survey of this site was in 1993-1994, an up-to-date survey would provide a longer-term perspective on the hunting dynamic. Access to current data on hunting, both qualitative (inclusion or exclusion of species to or from the community's diet) and quantitative (changes in the proportional importance of each animal class), could provide useful information in terms of monitoring the practice and analyzing its effects on fauna. Finally, this study

reinforces the importance of conducting longitudinal studies that keep apace with changes in biological and non-biological factors that play a role in local sustainability.

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