Utilization of game along Brazil's transamazon highway

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Abstract

The hunting methods and game yield from rain forest and second growth along the Transamazon highway are described and the importance of wild meat in the diet of setlers is assessed. The implications of game take with respect to the human carrying capacity of interfluvial forest in Amazonia is also explored.

Introduction

In 1970, Brazil initiated an ambitious scheme to populate the 'demographic void' of the Amazon basin, which includes the world's largest tropical rain forest of 5 million sq. km. The pioneer 3,000 km Transamazon highway, completed in 1974, was conceived as the main axis for settlement of the North (Figure 1). As of December, 1974, a total of 5,717 families had settled along the highway in 27 *agrovilas*, containing 48 to 66 houses, 3 *agropoli* intermediate-sized towns, and 1 *ruropolis*, an administrative center at the apex of the rural-urban hierarchy (Smith, 1976a).

Although tropical rain forests are rich in species of both plants and animals, the population of any one species in a given area is usually low. Furthermore, livestock populations in a pioneer zone require several years to build up for sustained yield slaughter. Thus, the contribution of game to the diet of Transamazon settlers is examined in order to assess its importance in satisfying the protein requirements of settlers. Finally, the implications of game yield with respect to the human carrying capacity of the interfluvial forests of the region are investigated.

Study areas and field methods

In 1973-4, the wildlife take of three well separated agrovilas was examined. The region around the first, Coco Chato, at km 42 along the Marabá-Altamira stretch, had been settled previously by some thirty peasant *(caboclo)* families which had engaged in subsistence slash and burn agriculture for approximately fifteen years. Thus, mature upland forest *(mata pesada)* is interspersed with second growth at various stages of succession. The second agrovila, Leonardo da Vinci, at km 18 Altamira-Marabá, is surrounded by relatively undisturbed liana forest *(mata de cipó*, cf. Pires, 1974; Goodland and Irwin, 1975:103), whereas mature upland forest predominates in the region of the third agrovila, Nova Fronteira, km 80 Altamira-Itaituba. In these study areas, the annual rainfall averages approximately 1,700 mm with a pronounced dry season extending from June through December. According to the Köppen system, the climate is classified as Aw (Smith, 1976b). All of the study sites are on non-flooded *terra firme*.

By accompanying hunters and by interviewing all residents at least every eight weeks within a 5 km radius of the study agrovilas, the harvest of wildlife was estimated. A total of 25 hunts were witnessed, 12 of which registered kills. Colonists were found to estimate the weight of their kills reasonably accurately. However, since settlers are more likely to forget smaller game, the compiled data (Tables 1-3) may be biased in favor of larger species. Only two overnight hunting trips were conducted from the study agrovilas. Most of the settlers hunt within 5 km of their agrovilas. The 100 sq. km cropping area surrounding each agrovila was determined by observing side-roads, built every 5 km along the Transamazon in the study zones, and by demarcation paths at the end of the 100 ha lots.

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Diurnal hunting methods

Within each community, two to four hunters *(caçadores)* normally make at least one trip a week into the forest in pursuit of large game and account for most of the game take by weight. In addition, during the course of agricultural work settlers kill wild animals, especially smaller species such as agoutis *(Dasyprocta* sp.) and nine-banded armadillos *(Dasypus novemcinctus)*. Most hunters work alone, but two or more were present at 24% of the recorded kills. Men may form a small group if there are signs of tapir *(Tapirus terrestris)* or whitelipped peccaries *(Tayassu pecari)* in the area. Some hunters consider dogs a nuisance and do not use them; others always take one to four of them into the forest to help in locating game. Dogs were present at 34% of the kills. Leaves of *Piper lanceolatum* (Piperaceae) are sometimes rubbed into the noses of dogs, apparently to sharpen their sense of smell and thus improve their tracking ability. Dogs usually fan out in front of the hunter and thus cover a comparatively large area of forest. The *caçador* controls his dogs with loud calls, and the dogs indicate the presence and kind of game with yelps and barks.

If the dogs locate a band of white-lipped peccaries, the latter often flee, in which case the hunter may not get close enough for a shot. But sometimes the band, which may contain 100 members, turns to fight the dogs, and thereby allows the hunter to catch up and kill as many as eight peccaries, usually with a 16 or 20 gauge shotgun. In the fight, however, he may lose several dogs to the slashing peccary tusks. Without dogs, the hunter may encounter undisturbed white-lipped peccaries in a mud wallow, or feeding on fallen palm fruits of *açaí (Euterpe oleracea)* or *paxiúba (Iriartea* sp.) by a stream. The clacking of peccary teeth may warn the hunter at a distance of 200 meters, so that he can approach his quarry from downwind. Tracking a band of *porcão,* as *T. pecari* is known in the study areas, is relatively easy since it produces a broad wake of shuffled leaves and tracks.

Collared peccaries *(Tayassu tajacu)*, which usually occur in bands of less than 15 individuals, often flee from dogs by hiding inside a hollow log or an armadillo burrow as small as 25 cms. in diameter. If the peccaries are inside a rotting trunk, the hunter uses a machete to gain access to his prey. If the quarry has entered a hole in the ground the hunter drives stakes across the entrance and pokes a long, thin pole into the tunnel to irritate *caitetu,* as *T. tajacu* is known in the Brazilian Amazon. When a peccary comes to the surface, the hunter easily kills it at the barrier with a shotgun blast. He then removes the carcass, replaces the stakes, and jams the pole in again in an attempt to locate other peccaries. Up to four have been killed from a single burrow in this manner.

Tapirs, weighing up to 200 kg, are the largest mammals of the *terra firme* forests of Amazonia. Hunters find them by following their distinctive footprints and occasional, unmistakably-large feces piles. Sometimes, the shrill whistle of a tapir alerts the hunter, who then approaches with extreme caution from downwind. If dogs pursue a tapir, it usually turns to fight in a stream where it has an advantage, frequently inflicting severe bites on the dogs. While the tapir is thus occupied, the hunter is able to dispatch his prey with several shotgun blasts.

Some hunters train dogs to locate brocket deer *(Mazama americana)* and agoutis and to chase the game to them. Only rarely are the dogs alone able to bring down a full-grown brocket deer of about 50 kg. After shooting a deer, the stomach contents of the kill are rubbed into the hair of the dogs, apparently to make them enemies of deer and eager trackers.

At dawn and dusk, colonists hide in forest or second growth at the edge of maize fields for agoutis to come and feed. Settlers also wait for agoutis near *babaçu* palm *(Orbygnia martiana)* since the pulpy mesocarp of the fist-sized fruit is a favored food of the rodent (Smith, 1974). Agouttis favor areas of slash and burn agriculture where the fire-resistant palm proliferates. Fire liberates the oily nuts in the endocarp and these germinate readily in the nutrient-rich ash. This is an exceptional case, however, since most of the major game animals along the highway, such as tapir and

white-lipped peccary, are eliminated or considerably reduced when their forest habitat is destroyed.

Nocturnal hunting methods

Night hunting is largely confined to the dry season in order to avoid being drenched, and when the rustle of leaves or the snap of a twig betrays game. In the *espera* or waiting method, a man slings a hammock or constructs a narrow platform some two meters above ground within shotgun range of a tree with fallen fruit or flowers and signs of feeding by game. The hunter arrives before sundown and may wait until dawn, shotgun and flashlight ready, ignoring insect bites. Forest trees with falling fruit much sought by brocket deer include *tatajuba (Bagassa guianensis,* Moraceae), *gameleira (Ficus* spp., Leguminosae), *jatobá* (*Hymenaea* spp., Leguminosae), *tamboril (Enterolobium maximum,* Leguminosae) and frutão *(Pouteria pariry,* Sapotaceae). Hunters also wait at night for deer in mature forest by trees with falling flowers such as *sapucaia (Lecythis usitata,* Lecythidaceae), *castanheira (Bertholletia excelsa,* Lecythidaceae) and *jarana (Holopyxidium jarana*, Lecythidaceae).

In one night a hunter may kill one or two pacas *(Agouti paca)* or a tapir as they feed on fallen *gameleira* fruit. Pacas are also shot at night when they come out of burrows or hollow logs to feed on dropped flowers of *sapucaia, mata mata (Eschweilera* spp., Leguminosae) or *piquiá (Caryocar villosum,* Caryocaraceae)

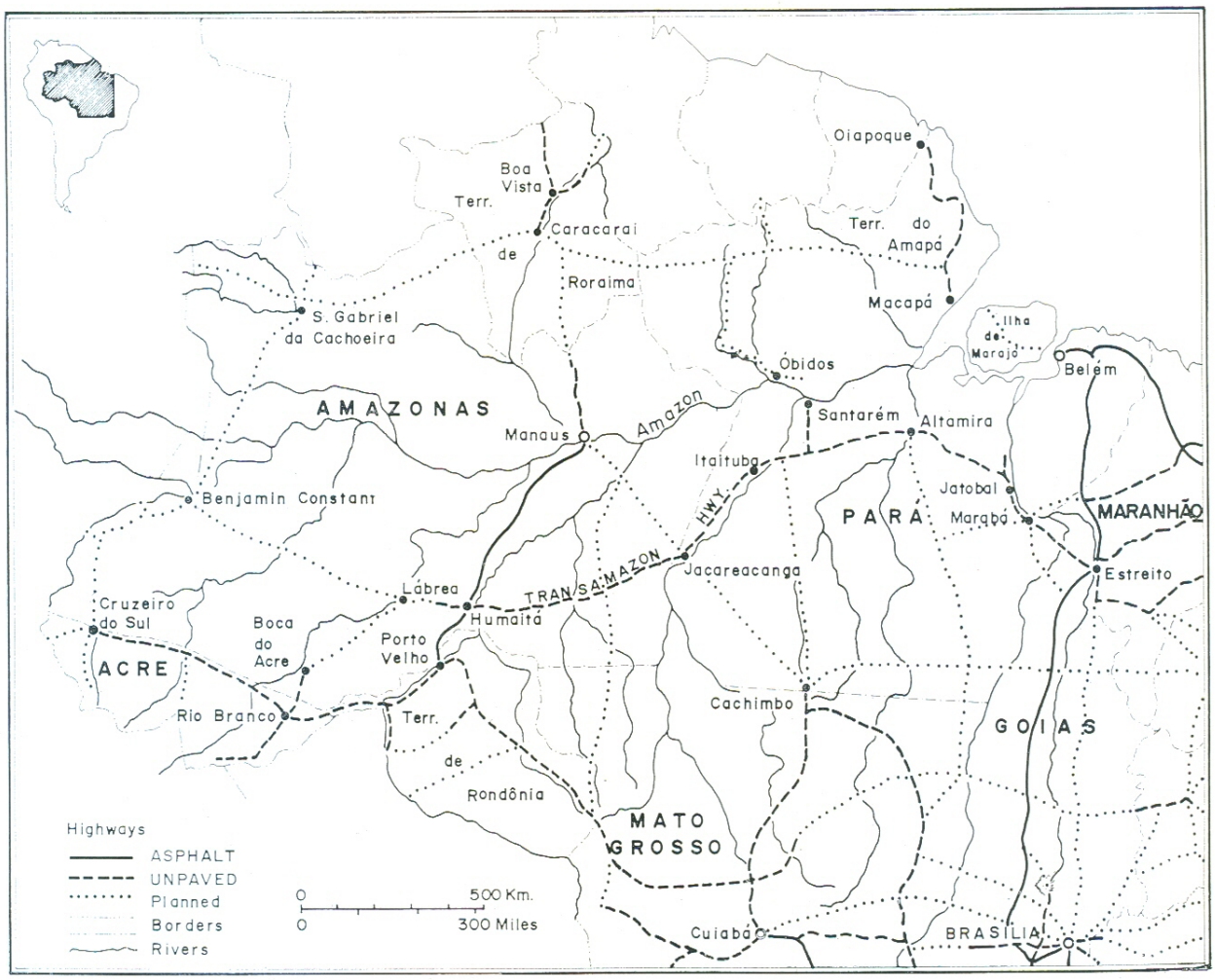

Figure 1. The Brazilian Amazon Highway System, 1975.

in forest, fallen fruits of *babaçu* palm in second growth, or maize in cultivated fields. Nine-banded armadillos are taken at nigth while feeding on fruit under *najá* palms *(Maximilliana regia)*.

The *fachear* or flashlight method is used to capture armadillos or pacas. If the former is the quarry, a hunter, usually a small boy, searches the ground in forest or old second growth with dogs, flashlight, and machete. When an armadillo runs, the dogs often capture and kill the animal before it can escape down a burrow. If one enters a hole, it is dug out, a process that can take an hour or more. To capture pacas by the *fachear* method, a hunter without dogs follows a stream and periodically scans the banks with his flashlight. If the *caçador* spots the red-hued reflection of large paca eyes, he quietly aims his shotgun at the mesmerized rodent.

Traps

The hunting technology employed by Transamazon settlers is not as elaborate as that of some aborigines (Ryden, 1950; Ruddle, 1970). Colonists set gun traps for paca and nine-banded armadillos only on individual lots far from agrovilas. No pitfalls were employed in the study areas. Some settlers built box traps with a collapsable roof or sliding door to capture ocelots *(Felis pardalis)*, since a good pelt from that spotted cat brought the hunter about U.S. $40 in 1974 (Smith, 1976c). Sometimes, hunters with dogs tree a wild cat in daylight and shoot it. In spite of Brazilian law 5.197/67, that prohibits commerce in wild animals or their products, skins from two jaguars *(Felis onca)* and three ocelots were sold by hunters in the vicinity of agrovila Nova Fronteira and Leonardo da Vinci in 1974. Although the coats of black jaguars and pumas *(Felis concolor)* have little market value, their meat is appreciated.

Game yields

A total of 3,214 kg of game was taken within the 100 sq. km hunting area of agrovila Nova Fronteira during the course of twelve months in 1973/4 (Table 1). Allowing for an average weight loss of 40% due to discarded bones, viscera and skin (cf. White, 1953), the actual amount of game meat consumed was about 1,928 kg. Allowing for variation among species, the protein content of the total game take is probably close to 20%. Thus, the hunting yield could supply each of the 204 agrovila members with 5 g protein a day.

The average protein requirement of an agrovila resident is calculated as 0.7 g animal protein/kg body weight/day, based on reference weights employed by W.H.O. (1973: 100), and population surveys of the study communities conducted by the author which reveal that 43%, 49% and 51% of the inhabitants of agrovilas Leonardo da Vinci, Nova Fronteira, and Coco Chato respectively are under 15 years old. Thus, the game take for agrovila Nova Fronteira could supply only 17% of the protein needs of the community.

Settlers in the vicinity of Leonardo da Vinci, the other study agrovila surrounded by relatively undisturbed forest, killed an estimated 3,389 kg of game during 1974 (Table 2). Allowing for 40% wastage, approximately 2,033 kg of game was consumed by the 179 agrovila residents, enough meat to supply about 20% of the protein needs of the community. The much smaller game yield from the vicinity of agrovila Coco Chato (Table 3) is attributed to 15 years of hunting and habitat alteration. Tapirs and white-lipped peccaries, two of the most important species in forested areas in terms of game take by weight, are no longer found within 5 km of the community. The 761 kg of undressed game could supply each of the 351 members of agrovila Coco Chato with only 2% of their protein requirements.

Although game taken in predominately forested areas is sufficient, in theory, to provide approximately 18% of the protein needs of the agrovila populations, whether each individual receives a significant amount of game depends on a number of ecological and cultural variables. Both the temporal and spatial distribution of kills, for example, depend on the season and cultural background of the settler.

The yield of game from forested areas in the vicinity of agrovilas Nova Fronteira and Leonardo da Vinci fluctuates markedly during

the year (Figure 2). The yield is greatest during the latter part of the rainy season, primarily because of the increased kill of white-lipped peccaries. Seasonal differences in the number of hunting trips cannot explain the greatly increased game yield in the wet season, since settlers have ample opportunities to hunt during the relatively slack months towards the end of the dry season after fields have been cleared. One factor is that, according to hunters, *porcão* is more active in the rainy season because more forest trees bear fruit and because the seasonally-dry streams are flowing. Game take is lowest during the early part of the rainy season (December to January) partly because colonists are then occupied in planting crops. The temporal variation in game yield is less marked in the more disturbed environment surrounding agrovila Coco Chato. There the two most important game animals, agoutis and nine-banded armadillos, are captured throughout the year. The increased game take during the dry season (Figure 2) is attributed mainly to nocturnal kills of deer by the *espera* method.

Even during the months of low yield, game contributes significantly to the diet, not only in terms of supplying protein, but also for the psychological benefit. Settlers consider lunch and dinner unsatisfying without some form of meat or fish. It is common practice to salt and sun-dry some game meat, especially large animals such as tapir and brocket deer, for consumption during the months of low hunting yield.

The distribution of game within Transamazon communities is also uneven. Unlike many aborigines, agrovila residents do not share their kills equitably. Along the highway, the distribution of game is confined to hunters and their immediate families, or to those who can afford to purchase game meat at U.S. $0.70/kg. Alternatively, depending on the needs of the hunter, other settlers may barter goods, such as rice, manioc flour, or tobacco, in exchange for meat.

Another obstacle to the widespread distribution of game within agrovilas is the system of food avoidances which reduces the consumption of certain species. Southerners, for example, tend to avoid unfamiliar game. Some

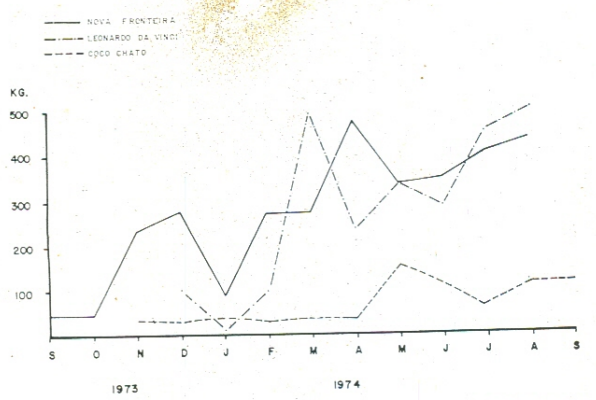

Figure 2. Monthly game capture in kilos for three Transamazon Agrovilas.

gaúchos and Paranaenses consider the meat of most forest animals unclean. More familiar animals, such as agoutis, pacas and rabbits, which occur in southern Brazil, are, however, more acceptable. On the other hand, Nordestinos and Amazonian peasants shun rabbit meat as too slippery *(lisa)*. Settlers who feel ill generally avoid "strong" or *reimosa* game (Table 4), thinking it will provoke latent disease or exacerbate symptoms of a chronic illness. Tapir meat, for example, is deemed especially offensive to the liver, while ingesting succulent paca flesh can apparently transform a cold into a case of pneumonia. The fatty meat of armadillos, tortoises *(Geochelone* sp.) and collared peccary is considered prejudicial to those susceptible to skin disorders.

The origin of the food avoidances of Transamazon settlers is unclear, but many have undoubtedly been absorbed, in modified form, from aboriginal cultures. Among the Witoto of the Brazilian northwest, for example, tapir meat is considered to be very strong, especially for women, and is thus eaten sparingly (Whiffen, 1915:126). Females of Kayapó groups, which inhabit the interfluvial forest between the Tocantins and Xingu, shun tortoise meat since it is thought to inflame the skin (Dreyfus, 1963).

Implications of hunting yields for settlement

The interfluvial forests of Amazonia, occupying approximately 95% of the basin, are generally considered to be inhospitable for

Table 2. GAME TAKEN IN VICINITY OF AGROVILA LEONARDO DA VINCI, KM 18 ALTAMIRA-MARABÁ, DECEMBER 1973 - AUGUST 1974 (9 MONTHS).

ENGLISH/ BRAZILIAN NAME	SCIENTIFIC NAME	No. Killed	Kg Day	% Day	Kg Night	% Night	Kg Total	% Total	Av. kg Each	Ratto ♂ : ♀	Km Walked	Av. km Per kill	Yield kg/km
White-lipped peccary Queixada, porcão	* **Tayassu pecari**	52	1166	100	—	—	1166	46.5	22.4	1.2:1	353.5	6.4	3.4
South American tapir Anta	* **Tapirus terrestris**	6	370	75	120	25	490	19.6	81.7	4:1	65	10.8	7.5
Brocket deer Veado, mateiro, fiboca	* **Mazama americana**	15	265	78	75	22	340	13.6	22.6	0.7:1	82.5	5.5	4.1
Collared peccary Caitetu	* **Tayassu tajacu**	18	173	85	30	15	203	8.1	11.3	0.7:1	87.5	4.9	2.3
Tortoise Jabuti	§ **Geochelone** sp.	36	102	100	—	—	102	4.1	2.8	3:1	78	2.2	1.3
Nine-banded armadillo Tatu verdadeiro	* **Dasypus novemcinctus**	29	34.4	45	41.5	55	75.9	3.0	2.6	1.3:1	35.2	1.2	2.1
Paca Paca	* **Agouti paca**	10	36.7	66	19	34	55.7	2.2	5.6	0.7:1	40.5	4.0	1.4
Agouti Cotia	* **Dasyprocta** sp.	17	46.7	100	—	—	46.7	1.9	2.7	1.3:1	34	2.0	1.4
Eight-banded armadillo Tatu quinze kilos	* **Dasypus kappleri**	1	—	—	12	100	12	0.5	12	0:1	0.5	0.5	24.0
White-crested guan Jacu verdadeiro	+ **Penelope pileata**	5	9.5	100	—	—	9.5	0.4	1.9	—	35.5	7.1	0.3
Razor-billed curassow Mutum fava	+ **Mitu mitu**	1	3.5	100	—	—	3.5	0.1	3.5	—	8	8	0.4
Blue-headed parrot Curica	+ **Pionus menstruus**	1	0.2	100	—	—	0.2	—	0.2	—	1	1	0.2
TOTAL			2207	88	297.5	12	2504.5	100			803.2		3.1

NOTE :
Cropping area 100 sq. km
No. hunts successful = 109
Av. distance covered per hunt = 7.5 km

Contribution of game animals by class :
* Mammals = 95.4% + Birds =;0.5%
§ Reptiles = 4.1%

Estimated game take for 12 month period is 3389 kg (based on extrapolation of Figure 2).

Table 3. GAME TAKEN IN VICINITY OF AGROVILA COCO CHATO, KM 42 MARABÁ-ALTAMIRA, NOVEMBER 1973 - SEPTEMBER 1974 (11 MONTHS).

ENGLISH/ BRAZILIAN NAME	SCIENTIFIC NAME	No. Killed	Kg Day	% Day	Kg Night	% Night	Kg Total	% Total	Av. kg Each	Ratto ♂ : ♀	Km Walked	Av. km Per kill	Yield kg/km
Agouti Cotia	* **Dasyprocta** sp.	68	186.3	100	—	—	186.3	26.7	2.7	0.6:1	70.7	1.0	2.6
Nine-banded armadillo Tatu verdadeiro	* **Dasypus novencinctus**	64	111.5	71	46	29	157.5	22.6	2.5	1.3:1	79.9	1.2	2.0
Brocket deer Veado, mateiro, fiboca	* **Mazama americana**	5	56	45	69	55	125	17.9	25	0.3:1	12.5	2.5	10.0
Paca Paca	* **Agouti paca**	12	52	62	32	38	84	12	7	0.8:1	16.8	1.4	5.0
Collared peccary Caitetu	* **Tayassu tajacu**	4	66	100	—	—	66	9.5	16.5	1:1	8.6	2.1	7.7
Giant armadillo Tatu canastra	* **Priodontes giganteus**	1	—	—	30	100	30	4.3	30	—	3	3	10.0
Tortoise Jabuti	§ **Geochelone** sp.	7	21	100	—	—	21	3	3	3:1	6	0.8	3.5
Gray-necked wood-rail Saracura	+ Aramides cajanea	11	12	100	—	—	12	1.7	1.1	—	4.8	4.0	2.5
Howler monkey Guariba	* **Alouatta belzebul**	1	6	100	—	—	6	0.9	6	1:0	1.2	1.2	5.0
Ruddy ground-dove Juriti	+ **Columbina talpacoti**	44	3.4	100	—	—	3.4	0.5	0.07	—	9.8	0.2	0.3
Gray tinamou Macuco, tona	+ **Tinamus tao**	2	3.1	100	—	—	3.1	0.4	1.5	—	6.5	3.2	0.5
Capuchin monkey Macaco prego	* **Cebus apella**	1	3	100	—	—	3	0.4	3	0:1	1	1	3.0
Blue-headed parrot Curica	+ **Pionus menstruus**	1	0.2	100	—	—	0.2	0.03	0.2	—	0.3	0.3	0.8
TOTAL			520.5	75	177	25	697.5	100			221.1		3.1

NOTE :
Cropping area 100 sq. km
No. hunts successful = 86
Av. distance covered per hunt = 2.6 km

Contribution of game animals by class :
* Mammals = 94.4% + Birds = 2.6%
§ Reptiles = 3.0%

Estimated game take for 12 month period is 761 kg (based on extrapolation of Figure 2).

Table 4. FOLK CLASSIFICATION OF MEAT ACCORDING TO DEGREE TO WHICH IT MAY MODIFY HEALTH

VERY STRONG (MUITO REIMOSA)	STRONG (REIMOSA)	CLEAN/MILD (LIMPA)
Tapir (anta)	White-lipped peccary (porcão)	Brocket deer (veado)
Tapirus terrestris	**Tayassu pecari**	**Mazama americana**
Collared peccary (caitetu)	Paca (paca)	Wild fowl **
Tayassu tajacu	**Agouti paca**	Chicken (galinha) *
Nine-banded armadillo (tatu verdadeiro)	Agouti (cotia)	Beef (gado) *
Dasypus novemcinctus	**Dasyprocta** sp.	
Tortoise (jabuti)	Common opossum (mucura)	
Geochelone sp.	**Didelphis marsupialis**	
	Rabbit (coelho)	
	Sylvilagus brasiliensis	
	Monkey (macaco)	
	Cebidae (several genera)	
	Wild cats (gato, onça)	
	Felis spp.	
	Domestic pig (porco) *	
	Muscovy duck (pato)	
	Cairina moschata ***	

NOTE
(*) indicates domestic animal.
(**) in the following families: Columbidae, Cracidae, Phasianidae, Psophidae, Tinamidae, Psittacidae.
(***) occurs both as a wild and domestic species.
SOURCE: Interviews conducted by the outhor with colonists.

hunters, gatherers, and subsistence farmers because of the limited fish resource, sparse game populations, and generally poor soils (Castro and Reis, 1952; Meggers, 1954; Ferdon, 1959; Denevan, 1968; Lathrap, 1968; Denevan, 1970; Meggers, 1971; Gross, 1975). For example, Galvão (1963) claims that aboriginal groups cannot attain a size larger than 200 individuals employing manioc *(Manihot esculenta)* as a basic staple on the *terra firme*, although Carneiro (1960, 1961) has convincingly argued that a tribe of 2,000 can be supported on a completely sedentary basis in upland forests of Amazonia by cultivating the root crop in a swidden system within 6.4 km of a village.

Although the potential of manioc as an abundant and reliable source of energy is generaly well-recognized, several writers have suggested that a shortage of protein in the *terra firme* forest is a major factor limiting the size and permanence of aboriginal groups (Denevan, 1966 Carneiro, 1970a; Denevan, 1971; Gross, 1975). In spite of the fact that game provides only a fraction of the protein needs of Transamazon colonists in areas previously occupied for as little as fifteen years by subsistence farmers, and that Amazonian tribes do not rear domestic animals for food(1), the low density of mammalian populations in Neotropical rain forests (cf. Eisenberg and Thorington, 1973; Fittkau and Klinge, 1973) does not preclude the possibility of large sedentary settlements in non-riverine environments of Amazonia.

The generally small size and semi-nomadic habits of groups currently occupying the interfluvial forests of Amazonia may be attributed to a number of factors not related to protein shortage or soil exhaustion but to introduced diseases (Neel, 1970; Arnaud and Alves, 1974, Arnaud, 1975) (fission as a result of internal disputes (Lima, 1950; Goldman, 1966; Chagnon, 1976), warfare, and superstition. Apparently, the natural resources of *terra firme* forests are capable of supporting large,

(1) — However, Amazonian Indians keep monkeyis and peccaries as pets and raise parrots, macaws and harpy eagles **(Harpia harpyja)** for their feathers which are employd in ceremonial wear (Gilmore, 1950; Carvalho, 1951). The fact that no Amazonian tribes domesticated animals for meat production may reflect the abundance of wild sources of animal protein.

sedentary native settlements. In 1824, for example, even after a century of intermittent contact with Luso-Brazilians and at least one smallpox epidemic, three villages of the Apinayé, who still inhabit in much reduced numbers the interfluvial region between the Tocantins and Araguaia, contained a 1,000 individuals or more, with the largest sheltering 1,600 inhabitants (Nimuendaju, 1939).

The fact that 23 archaeological sites are situated in the study areas, 4 of them associated with anthropogenic black earth *(terra preta do indio)*, suggest that sedentary aboriginal groups were able to occupy *terra firme* sites along the Transamazon without exhausting soil or protein resources. The four *terra preta* sites range from 0.5 to 5 ha in area, and assuming that the groups lived in communal houses, from 100 to at least 500 inhabitants may have occupied the sites. No stratigraphic studies of any Transamazon archaeological sites has been made so it is not known of they were occupied continuously. However, a preliminary analysis of potsherds collected by the author (DeBoer, et al. 1976) suggests that at least 2 of the black earth sites were occupied by one group (single ware). Further, since 87 cms. depth of *terra preta* measured at one of the sites probably represents close to a century of kitchen middens and ash accumulation (cf. Evans, 1964), it seems plausible that relatively large groups occupied upland sites along the highway transect without destroying soil or protein resources.

A number of cultural traits may partly explain how the native groups were able to crop wild sources of animal protein without exhausting the resource. The concept of game may differ among cultures occupying the same region. Whereas mammals account for 96% of the game take around the highway agrovilas (Tables 1-3), aboriginal groups of Amazonia generally exploit a much wider spectrum of the animal biomass. Insects, an excellent source of high quality protein (Platt, 1962; FAO, 1970), account for most of the animal biomass in the *terra firme* forests of central Amazonia (Fittkau and Klinge, 1973), and are widely consumed by Amerind groups (Carvalho, 1951; Oberg, 1953; Bruzzi, 1962:220; Chagnon, 1968:30; Baldus, 1970:165; Ruddle, 1973; Reichel-Dolmatoff, 1974:62; Taylor, 1974: 23). However, Transamazon colonists were never observed eating arthropods.

Instead of cropping more abundant mammals, such as rodents and marsupials, settlers in forested areas along the Transamazon concentrate on relatively large taxa such as peccary, tapir and brocket deer, the latter three species compose 89% of the game take by weight in the vicinity of agrovilas Nova Fronteira and Leonardo da Vinci (Tables 1,2). Only when the larger species become scarce in heavily hunted and modified habitats, are rodents significantly represented in the annual kill. Thus pacas and agoutis account for 39% of the game take in the 100 sq. km cropping area around agrovila Coco Chato, where the habitat has been degraded, but rodents account for only 3% of the annual game take by weight in predominately forested areas. However, rats and mice, notorious agricultural pests along the highway, and a source of food for some aboriginal groups (Wilbert, 1974), are not eaten by Transamazon colonists.

Wild birds, a minor source of animal protein to colonists in the study areas, account for only 0.6% of the game yield by weight in forested regions, and 2.6% in the vicinity of Coco Chato (Tables 1-3), whereas in some Amerind groups, birds are an important food (Ruddle, 1970). By hunting and gathering a diverse range of animal species, and by taking advantage of abundant taxa such as rodents and arthropods, pressure on game is more evenly distributed and a more reliable protein supply is assured.

Aborigines crop larger areas than agrovila residents and thus conserve local game populations. For example, Gê groups, such as the northern Kayapó of the middle and upper Xingu (Dreyfus, 1963), and the Xikrin of the Itacaiúnas river in southeastern Pará (Caron, 1971: 278) conduct extended hunting trips lasting from several days to a month or more. Non-Gê groups such as the Maracá of eastern Colombia (Ruddle, 1970) may also hunt for several days at a time. Some of the game taken on such trips is preserved by smoking and sun-drying for later consumption in the village.

Another cultural mechanism which may help to explain how relatively large groups were able to remain sedentary on the *terra firme* is the strict system of taboos which check the consumption of certain game animals in many native cultures. Some tribes prohibit the eating of some animals during puberty (Levi-Strauss, 1948; Metraux, 1948), menstruation (Nimuendaju, 1948a), gestation (Nimuendaju, 1948a) and immediately following birth (Metraux, 1948: Nimuendaju, 1948a, b). Such checks may alleviate hunting intensity.

Respect for supernatural animal spirits is wide-spread among native cultures of South America (Zerries, 1954; Murphy, 1958:14; Reichel-Dolmatoff, 1974:85; Wilbert, 1974) and helps to prevent the over-exploitation of game, but no such checks operate among hunters in the study areas. Whereas a few settlers along the highway assert that a supernatural humanoid, known locally as *pai da caça* or *caipora,* lurks in the forest and may punish anyone who kills too many of a single species, none of the *caçadores* in the study areas believe that *caipora* has any power over them. Although peasants fear spirit-protectors of game in other areas of Amazonia (Wagley, 1967:235; Moran, 1974), the traditions of *caboclos* in the study areas have been diluted by contact with colonists from other regions, particularly from the more developed South.

Another trait that reduces the threat of protein malnutrition is the tradition of sharing kills, especially large ones, among tribal members (Nimuendaju, 1952:32; Leacock, 1964; Frikel, 1968; Carneiro, 1970b; Taylor, 1974:32). However, in highly acculturated tribes such traditions may break down thereby restricting the distribution of meat (Maybury. Lewis, 1956), as is the case with *caboclo* culture along the Transamazon.

Conclusion

A combination of cultural attributes, from consumption of unorthodox game and vegetable sources of protein, to the cropping of large areas, food taboos, respect for supernatural protectors of game, and sharing kills among community members, may have enabled groups that formerly occupied the archaeological sites along the Transamazon to remain sedentary without exhausting game populations. A comparison between the cultural traits of aboriginal groups and those of the present settlers along the highway, suggests that the low game intake of the latter is in large measure due to cultural, rather than ecological, factors.

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Resumo

Os métodos de caça e o rendimento na mata e na capoeira, ao longo da Transamazônica, são descritos e a importância de proteína de caça na dieta dos colonos é avaliada. As implicações do rendimento de caça sobre a capacidade da mata de terra firme para suportar populações humanas são também investigadas.

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