

Research Reports

The Game of Choice: Patterns of Indian and Colonist Hunting in the Neotropics

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Anthropologists have collected data on hunting by humans to test a number of different hypotheses, including that of protein limitation (Gross 1975), the ideas on taboos advanced by Ross (1978), the efficiency of different weapons (e.g., Hames 1979), and optimal foraging by humans (e.g., Hawkes et al. 1982). These data reveal the astonishing range of game species taken by Neotropical human hunters.

This paper does not address the hypotheses listed above, but instead examines the difference between hunting by Indians and hunting by colonists. In particular, we test the null hypothesis that there were no differences between Indian and colonist hunting in terms of nature and intensity. Any differences found were examined in light of various biological and cultural factors.

We have restricted our analysis to human communities living in tropical forests in South America, though the specific type of forest ranges from subtropical forest in Paraguay to the riverine forests in Peru. We classified each of the communities in our study as either "Indian" or "colonist," although we recognize that this greatly oversimplifies the different levels of acculturation found among communities. We included only communities in which game was never or infrequently sold outside the community.

Methods

To devise a standard index of human impact on animal populations, we tabulated the numbers of individuals of each game species taken by different human communities as recorded in published studies and standardized the raw numbers by converting them to harvest rates. This enabled us to quantify which game species people hunted and how many individuals of each game species were taken.

We could use only those studies that specified: 1) the type and number of prey taken, 2) the length of time during which the data were collected, and 3) the number of people consuming the game. Using these data the following index was calculated for each game species:

$$\text{Harvest Rate (HR)} = \frac{\text{no. of animals killed}}{\text{no. of consumers} \times \text{duration of study}}$$

in which number of consumers includes both hunters and non-hunters, and duration of the study is measured in years. This index measures the number of individual game animals hunted for consumption by the average person in a community in one year.

If reported, we also recorded: 1) the age of the settlement, 2) the general type of habitat in which hunting took place, 3) the weapons used to hunt, and 4) the relative importance of game in the diet.

There were a number of methodological problems. First, because data were collected for so many different reasons, many studies did not record information essential for our purposes, such as the number of consumers or the duration over which the hunting sample was taken. Such studies were included in our discussion but excluded from the quantitative analysis. Second, reporting of scientific names was often so uneven that it was impossible to analyze the full complement of species comprising the diet of a given hu-

man community. We were frequently forced to lump game species into higher taxonomic categories. Third, in some studies, game was sold outside the community. If it was clear that only a particular game species was being hunted for external sale (e.g., tortoises: Ojasti et al. 1987), then we deleted that species from our analysis. Otherwise we excluded the whole study from our quantitative analysis.

Our data analysis differs from others (e.g., Vickers 1984) in the use of the index of number of animals taken per consumer year to compare the harvest of different game species. We were concerned with the nature and intensity of human hunting of animal species, and not with the nutritional importance to humans of different species. We discuss the number of individuals of each species harvested, not the weight of the animals. Use of the term "importance" when referring to certain prey species implies only importance in terms of number of individual game animals taken, and not importance in terms of the amount of meat provided.

The Hunters

Table 1 presents information on the 19 studies of 15 different communities used in our analysis. Of the 22 individual samples, 16 were Indian and 6 were colonist communities. Game was an important source of protein for all of the groups considered, although the extent of its importance varied (Table 1). The variation in the use of terrestrial versus aquatic animal resources was probably primarily related to access to a large, productive river.

The Prey

We calculated the numerical importance of mammals, birds, and reptiles in the diets of the groups studied (Table 2). For Indian communities, mammals constituted the most important type of game, with birds second, and reptiles third. For colonists mammals were first, reptiles second, and birds third.

In most cases we analyzed the data at the species level to determine which kinds

of game were taken. Exceptions to this occurred when 1) several similar species within a single genus were involved, in which case species were combined, and 2) we judged the specific (and sometimes generic) names assigned to prey species to be incorrect based on the location of the study or the size of the animal. In such cases we carried out the analysis at the generic (e.g., *Dasypus*) or "type" level (e.g., "deer"). The latter problem was especially common with birds. In several studies many of the species of birds were never identified, so our analysis of the hunting of birds was based on only 16 of the studies (12 Indian and 4 colonist). In Table 3 we present common and scientific names for the mammals and birds most often mentioned in this paper.

Mammals

Table 4 presents the data on the mammals killed for food, expressed as the average number of individual animals killed per consumer-year. Thirty-two species or species groups were recorded, twenty of them in five or more studies. Combining both Indian and colonist samples, *Dasyprocta* and *Myoprocta* (agoutis and acouchis) were the most frequently taken groups, followed by *Tayassu tajacu* (colored peccaries), *Agouti paca* (pacas), *Tayassu pecari* (white-lipped peccaries), and *Dasypus novemcinctus* (common long-nosed armadillo).

Table 5 presents the totals for mammal hunting by Indians and colonists, with animals divided into five taxonomic groups (with Artiodactyla and Perissodactyla lumped into "ungulates"). Analysis using simple means shows that *within* both the Indian and the colonist categories, hunting preferences were similar (for Indians: Kendall coefficient of concordance $W = 0.47$, $p < 0.001$, $n = 16$; for colonists: $W = 0.48$, $p < 0.05$, $n = 6$). For all five game categories, Indians took a higher average number of animals per consumer year than colonists.

Hunting preferences for animals of a game taxa differed *between* Indians and colonists. For Indians, primates were clearly the most frequently taken mammalian order, followed by rodents, ungu-

Table 1
Details of Indian and colonist hunting studies used in analysis.

| Author | Group | Location and age of settlement (years) | Duration of data collection (days) | No. consumer years | Habitat hunted (f. = forest) | Weapon | | | | | Importance of game ¹ |
|--|--------------------|--|------------------------------------|--|------------------------------|--------|------|-----------|------|-------|--------------------------------------|
| | | | | | | Guns | Bows | Blow-guns | Dogs | Hands | |
| <i>Indians</i> | | | | | | | | | | | |
| Arhem 1976 | Makuna | N.E. Colombia | 65 | 2.72 | Riverine | * | | | | | 39.5% Ga/60.5% F |
| Balee 1984 | Ka'apor | Maranhao, Brazil (5 & 11) | 99 | 13.23 | Upland rainforest | * | * | | | * | |
| Beckerman 1980 | Bari | Northwestern Venezuela | 345 | a | Rainforest | * | * | | | | Ga < 25% of animal P |
| Bennett 1962 | Cuna | Panama | 14 | 3.38 | Semi-deciduous tropical f. | * | | | | | Ga = 52.8% g; F = 47.2% |
| Dufour 1981, 1983 | Tatuyo | S.E. Colombia (ca. 14) | 170 | 51 | Blackwater rainforest | * | | | | | Ga = 8.0% P; F = 57.7% P |
| Hames 1979 | Yanomamo, Ye'kwana | S. Venezuela (5) | 216 | 76.2 | Riverine and wet f. | * | * | | | | |
| Hawkes et al. 1982; Hill 1984, p.c. ¹ | Ache | Northeastern Paraguay | | b | Subtropical forest | * | * | | | * | Ga = 96% calories; F = 3% |
| Lenselink in press | Trio | S. W. Surinam | 30 | 37.5 ^c | Rainforest | | | | | | |
| Ojasti et al. 1987 | Pemon | Bolivar State, Venezuela | 1,080 | 1,050 | Riverine forest | * | | | | | Ga = 25 g/person/day |
| Romanoff 1984 | Matses | Northeastern Peru | 240 | 20.67 ^d | Upland rainforest | * | * | | | * | |
| Saffirio and Hames 1983 | Yanomamo highway | Northern Brazil (3) | 596 | 53,184 ^e | Rainforest | * | * | | | | Ga = 92.8% total kilos; F = 7.2% |
| | Yanomamo forest | Northern Brazil | 554 | 112.58 ^f | Rainforest | * | * | | | | Ga = 86.5% total kilos; F = 13.5% |
| Silverwood-Cope 1972 | Maku | Colombia | 270 | 48.75 ^g | Rainforest | | * | * | * | | Ga; F |
| Sponsel 1981 | Sanema | Southeastern Venezuela | Mammals = 120 Birds = 16 | Mammals = 3.56 Birds = 28.67 ^h | Rainforest | * | * | | | * | F < 4% total animal P; Ga > 95% |
| Vickers 1980 | Siona-Secoya | Northeastern Ecuador (2) | 283 | i | Rainforest | * | | * | * | * | Ga = 32 g/day P; F = 9 g/day |
| Yost and Kelly 1983, p.c. ¹ | Waorani | Eastern Ecuador | 275 | 175.89 ^j | Upland rainforest | * | | * | * | | Almost no F |

Colonists

| | | | | | | | | |
|-----------------------------|----------|--------------------------|-----|------------------------|-------------------------|---|---|--|
| Ayres and Ayres 1979 | Caboclo | Mato Grosso, Brazil (8+) | 120 | 212.67 | Rainforest | * | | 19.3% meals with Ga; 12.7% with F |
| Pierret and Dourjeanni 1966 | Mestizos | Pachitea R., Peru | 360 | 183.51 ^k | Riverine forest | * | | Ga = 52.5% weekly consumption; F = 47.5% |
| Pierret and Dourjeanni 1967 | Mestizos | Ucayali River, Peru | 360 | 2,959,542 ^k | Riverine forest | * | | Ga = 23.7% total animal P; F = 61.7% |
| Smith 1976 | Mestizos | Amazonas, Brazil (15) | 360 | 204 | Upland forest | * | * | Ga = 17% P needs |
| | | | 270 | 134.25 | Liana f. | * | * | Ga = 20% P needs |
| | | | 330 | 321.75 | Mature and secondary f. | * | * | Ga = 2% P needs |

^aThe values for individual game species are already presented in per consumer per year form.

^b130 people in mission: men hunt on 25% of days; sample based on 67% of these days; final figure is mean of per capita-per annum for 1980 and 1981–82.

^cThe village size comes from Husson 1978.

^dConsumer days = 31 people (average longhouse size) × 270 days (eight months). We assumed that data were collected in only one longhouse at a time.

^eHighway village size = 596 days × (34 people [average village size] × 2 villages)

^fForest village size = 554 day × (32 people [average village size] × 3 villages)

^gUsing the ratio provided by Gross (1975:541) we calculated number of hunters to nonhunters as 1:4.

^hThe data for birds were taken from a hunting-camp sample. The larger sample for mammals did not record birds.

ⁱEstimating annual kill from Table 1.

^jThe total populations of the four villages in which most data were collected was $(230 \times 275)/360$ days = 175.69 consumer years. We assumed that data were collected in all villages simultaneously.

^kSurvey figures extrapolated to one year.

^lGa = game; F = fish, P = protein; p.c. = personal communication.

Table 2
Numerical importance of mammals, birds, and reptiles.

| | Mammals | | Birds | | Reptiles | | Total individuals |
|-----------------------|---------|------|-------|------|----------|------|-------------------|
| | No. | % | No. | % | No. | % | |
| Indians | | | | | | | |
| Cuna | 15 | 15.8 | 78 | 82.1 | 2 | 2.1 | 95 |
| Yanomamo (highway) | 50 | 23.7 | 100 | 47.4 | 61 | 28.9 | 211 |
| Yanomamo (forest) | 33 | 36.3 | 47 | 51.6 | 11 | 12.1 | 91 |
| Yanomamo and Yek'wana | 326 | 36.6 | 449 | 50.4 | 116 | 13 | 891 |
| Sanema ^a | 16 | 39 | 18 | 43.9 | 7 | 17.1 | 41 |
| Makuna | 19 | 43.2 | 22 | 50 | 3 | 6.8 | 44 |
| Ka'apor | 138 | 51.3 | 19 | 7.1 | 112 | 41.6 | 269 |
| Trio | 203 | 52.1 | 152 | 39 | 35 | 9 | 390 |
| Waorani ^b | 1,801 | 56.7 | 1,375 | 43.3 | 1 | 0 | 3,177 |
| Maku | 120 | 59.1 | 72 | 35.5 | 11 | 5.4 | 203 |
| Siona-Secoya | 343 | 68.1 | 137 | 27.2 | 24 | 4.8 | 504 |
| Pemon ^c | 579 | 72.5 | 188 | 23.5 | 32 | 4 | 799 |
| Bari | 96 | 73.3 | 35 | 26.7 | 0 | 0 | 131 |
| Matses | 218 | 82.9 | 43 | 16.3 | 2 | 0.8 | 263 |
| Tatuyo | 62 | 83.8 | 8 | 10.8 | 4 | 5.4 | 74 |
| Ache | 1,105 | 89.6 | 76 | 6.2 | 52 | 4.2 | 1,233 |
| Average percentage | | 55.3 | | 35.1 | | 9.7 | |
| Total number | 5,124 | | 2,819 | | 473 | | 8,416 |
| Colonists | | | | | | | |
| Pachitea River, Peru | 3,399 | 44.1 | 964 | 12.5 | 3,348 | 43.4 | 7,711 |
| Ucayali River, Peru | 13,625 | 64.4 | 2,896 | 13.7 | 4,633 | 21.9 | 21,154 |
| Amazonas, Brazil | 147 | 70 | 42 | 20 | 21 | 10 | 210 |
| Amazonas, Brazil | 156 | 70.6 | 58 | 26.2 | 7 | 3.2 | 221 |
| Amazonas, Brazil | 148 | 77.5 | 7 | 3.7 | 36 | 18.8 | 191 |
| Mato Grosso, Brazil | 550 | 82.8 | 111 | 16.7 | 3 | 0.5 | 664 |
| Average percentage | | 68.2 | | 15.5 | | 16.3 | |
| Total number | 18,025 | | 4,078 | | 8,048 | | 30,151 |

^aHunting camp sample.

^b"Small mammal and bird" sample split equally between mammals and birds.

^cGeochelone excluded because sold in market.

lates, edentates, and carnivores. For colonists, on the other hand, primates were third, with rodents first and ungulates second. Edentates and carnivores remained fourth and fifth.

Hunting rates of the different mammalian species also differed between Indians and colonists (Table 6). To compensate for skewness by single high values, we considered only those mammalian species or species groups that occurred in a minimum of five Indian studies and three colonist studies. Our

analysis indicated that Indians took more game than colonists. The average harvest rates of the four mammalian species most preferred by Indians were higher than the average rates for the species most preferred by colonists. The patterns of ordinal preference were repeated. Colonists took four ungulates, two rodents, and one edentate. Indians took the same four ungulates and the same two rodents, with the addition of squirrels, three edentates, and four species of primates.

Table 3
Scientific and common names of game species.

| Scientific Name | Common Name | Scientific Name | Common Name |
|-----------------|-----------------------|-------------------|-------------------------------------|
| Marsupialia | Marsupials | Carnivora | Carnivores |
| Didelphis | Opossum | Nasua | Coati |
| Edentata | Edentates | Potos | Kinkajou |
| Dasybus | Long-nosed armadillos | Panthera | Jaguar |
| Prionodontes | Giant armadillo | Tinamidae | Tinamous |
| Tamandua | Tamandua anteater | Tinamus | Tinamou |
| Myrmecophaga | Giant anteater | Crypturellus | Tinamou |
| Bradypus | Three-toed sloth | Phalacrocoracidae | Cormorant |
| Choloepus | Two-toed sloth | Phalacrocorax | Cormorant |
| | | Ardeidae | Hérons, egrets |
| | | Anatidae | Ducks, geese, swans |
| Primates | Primates | Cracidae | Chachalacas, guans, currasows |
| Callicebus | Titi monkey | Ortalis | Chachalaca |
| Aotus | Night monkey | Penelope | Guan |
| Cebus | Capuchin monkey | Pipile | Piping-guan |
| Alouatta | Howler monkey | Nothocrax | Nocturnal currasow |
| Ateles | Spider monkey | Mitu | Currasow |
| Lagothrix | Woolly monkey | Pauxi | Helmeted currasow |
| Lagomorpha | Hares and rabbits | Crax | Currasow |
| Sylvilagus | Cottontail rabbit | Phasianidae | Partridges, quail |
| Rodentia | Rodents | Odontophorus | Wood quail |
| Agouti | Paca | Psophiidae | Trumpeters |
| Dasyprocta | Agouti | Psophia | Trumpeter |
| Myoprocta | Acouchi | Columbidae | Pigeons, doves |
| Hydrochaeris | Capybara | Psittacidae | Macaws, parrots, parakeets |
| Perissodactyla | Odd-toed ungulates | Ara | Macaw |
| Tapirus | Tapir | Amazona | Parrot |
| Artiodactyla | Even-toed ungulates | Ramphastidae | Toucans, aracarís |
| Tayassu pecari | White-lipped peccary | Pteroglossus | Aracari |
| Tayassu tajacu | Collared peccary | Ramphastos | Toucan |
| Mazama | Brocket deer | Selenidera | Toucanet |

Birds

There was homogeneity in the harvest of certain species of game among colonists. Of the seven species that were found in at least half of the colonist studies, six were found in all of the studies and the seventh in five of the six. This contrasts with the Indian data in which no species is found in all of the studies. Only one species was found in 15 of the 16 studies, and only five of the species were found in over ten of the studies.

Table 7 presents the average number of individual birds killed per consumer-year and the number of studies in which that species or group was taken. Ten families of birds and one category of "other birds" were recorded as harvested. Ten of the listed species of birds were taken in five or more of the studies, and eight species in less than five.

An analysis at the family level showed that within Indian studies, harvest of

Table 4
Harvest rates of mammals (no. of animals taken per consumer-year).

| Prey | Average | Range | Total no. of samples | No. Indian | No. colonist |
|--|---------|------------|----------------------|------------|--------------|
| Marsupialia | | | | | |
| <i>Didelphis marsupialis</i> | 0.248 | | 1 | 1 | 0 |
| Edentata | | | 19 | 13 | 6 |
| <i>Dasypus novemcinctus</i> | 0.589 | .030-4.117 | 14 | 8 | 6 |
| <i>Dasypus</i> spp. | 0.447 | .008-2.377 | 6 | 4 | 2 |
| <i>Priondotes maximus</i> | 0.026 | .003-.040 | 3 | 2 | 1 |
| <i>Tamandua tetradactyla</i> | 0.183 | .014-.740 | 6 | 6 | 0 |
| <i>Myrmecophaga tridactyla</i> | 0.045 | .005-.093 | 4 | 3 | 1 |
| <i>Bradypus tridactylus</i> | 0.077 | .009-.243 | 5 | 5 | 0 |
| <i>Choloepus hoffmanni</i> | 1.402 | .009-2.796 | 2 | 2 | 0 |
| Other edentates | 0.013 | | 1 | 1 | 0 |
| Primates | | | 21 | 16 | 5 |
| <i>Callicebus</i> spp. | 0.471 | .005-1.490 | 4 | 3 | 1 |
| <i>Aotus</i> spp. | 0.792 | .144-1.440 | 2 | 2 | 0 |
| <i>Cebus apella</i> | 2.092 | .003-8.673 | 6 | 5 | 1 |
| <i>Cebus</i> spp. (non-tufted) | 0.292 | .001-1.300 | 8 | 7 | 1 |
| <i>Alouatta</i> spp. | 0.421 | .003-1.514 | 12 | 10 | 2 |
| <i>Ateles</i> spp. | 0.492 | .035-1.766 | 8 | 8 | 0 |
| <i>Lagothrix lagothricha</i> | 1.404 | .125-3.243 | 5 | 4 | 1 |
| Other primates | 0.325 | .021-.932 | 8 | 7 | 1 |
| Lagomorpha | | | | | |
| <i>Sylvilagus brasiliensis</i> | 0.091 | .028-0.154 | 2 | 1 | 1 |
| Rodentia | | | 21 | 15 | 6 |
| Squirrels | 2.057 | .007-6.00 | 5 | 5 | 0 |
| <i>Agouti paca</i> | 0.906 | .009-4.392 | 16 | 10 | 6 |
| <i>Dasyprocta</i> spp. and <i>Myoprocta</i> spp. | 0.701 | .007-4.006 | 21 | 15 | 6 |
| <i>Hydrochaeris hydrochaeris</i> | 0.154 | .013-.580 | 5 | 4 | 1 |
| Other rodents | 0.080 | | 1 | 1 | 0 |
| Perissodactyla | | | | | |
| <i>Tapirus terrestris</i> | 0.055 | .009-.122 | 14 | 9 | 5 |
| Artiodactyla | | | 20 | 14 | 6 |
| <i>Tayassu pecari</i> | 0.831 | .166-4.070 | 16 | 11 | 5 |
| <i>T. tajacu</i> | 0.624 | .013-3.765 | 19 | 13 | 6 |
| <i>Mazama</i> spp. | 0.263 | .016-1.486 | 12 | 7 | 5 |
| Other deer | 0.190 | .020-.920 | 6 | 5 | 1 |
| Carnivora | | | 6 | 4 | 2 |
| <i>Nasua</i> spp. | 0.592 | .005-2.749 | 5 | 4 | 1 |
| <i>Potos flavus</i> | 0.583 | .027-1.140 | 2 | 2 | 0 |
| <i>Panthera onca</i> | 0.026 | .010-.035 | 3 | 2 | 1 |
| Other carnivores | 0.026 | .005-.041 | 6 | 4 | 2 |

avian families was similar ($W = 0.46$; $p < .001$; $n = 12$). Guans and curassows had the highest average harvest, with toucans second, parrots third, tinamous

fourth, "other birds" fifth, trumpeters sixth, and pigeons last.

The four colonist studies showed a different ranking for avian families ($W =$

Table 5
Harvest rates for mammalian orders (no. animals taken per consumer year).

| | Combined | | Indians | | | Colonists | | |
|----------------|----------|----|---------|------------|----|-----------|------------|---|
| | Average | N | Average | Range | N | Average | Range | N |
| All edentates | 0.815 | 19 | 1.04 | .020-4.131 | 13 | 0.326 | .035-.878 | 6 |
| All primates | 2.06 | 21 | 2.304 | .001-8.701 | 16 | 1.279 | .005-4.674 | 5 |
| All rodents | 1.922 | 21 | 1.953 | .009-9.290 | 15 | 1.844 | .042-9.038 | 6 |
| All ungulates | 1.511 | 20 | 1.531 | .140-7.992 | 14 | 1.466 | .029-4.118 | 6 |
| All carnivores | 0.657 | 6 | 0.979 | .105-2.79 | 4 | 0.013 | .010-.015 | 2 |

Table 6
Harvest rates of most commonly taken mammalian species (no. animals taken per consumer-year).

| | Average | No. samples |
|-----------------------------|---------|-------------|
| Indians (n = 16) | | (n ≥ 5) |
| Cebus apella | 2.51 | 5 |
| Sciurids | 2.057 | 5 |
| Tayassu pecari | 0.923 | 11 |
| Agouti paca | 0.915 | 10 |
| Dasybus novemcinctus | 0.793 | 8 |
| Tayassu tajacu | 0.652 | 13 |
| Dasyprocta and Myoprocta | 0.639 | 15 |
| Alouatta spp. | 0.505 | 10 |
| Ateles spp. | 0.492 | 8 |
| Cebus spp. | 0.334 | 7 |
| Tamandua tetradactyla | 0.183 | 6 |
| Mazama spp. | 0.175 | 7 |
| Bradypus tridactylus | 0.077 | 5 |
| Tapirus terrestris | 0.049 | 9 |
| Colonists (n = 6) | | (n ≥ 3) |
| Agouti paca | 0.892 | 6 |
| Dasyprocta and Myoprocta | 0.856 | 6 |
| Tayassu pecari | 0.63 | 5 |
| Tayassu tajacu | 0.564 | 6 |
| Mazama spp. | 0.385 | 6 |
| Dasybus novemcinctus | 0.318 | 6 |
| Tapirus terrestris | 0.056 | 6 |

0.28; $p > .05$; $n = 4$). Although guans and currasows were most frequently harvested on average, toucans were rarely

taken. "Other birds" ranked second, and pigeons third.

We then analyzed the harvest of different species comprising the bird families, considering only those species that occurred in at least five of the Indian studies and at least two of the colonist studies (Table 8). Birds were harvested more by Indians than by colonists, with hunting rates for all species by Indians greater than the highest of the colonists. Colonists took large, chicken-like birds: a guan, a currasow, and a trumpeter. The Indians took a broad range of birds, from parakeets to toucans. There is little concordance between studies, with only one species, the guan *Penelope*, taken in most of the studies.

Reptiles

The data on reptile hunting are very meager and do not allow examination of differences between Indian and colonist hunting. Out of the nine Indian studies in which reptiles were recorded as game, the tortoise *Geochelone* spp. ranked first three times, and caiman (probably several genera) ranked first four times. Caiman appeared in seven studies, and was the most frequent reptile game. Other reptiles taken included the turtles *Platemys* and *Podecnemis*, the boa constrictor. *Geochelone* was the reptile most harvested by the colonists. It ranked first in three studies and can be a very important source of food.

In conclusion, the null hypothesis was rejected, as we have shown that there were differences in the nature and intensity of Indian and colonist hunting:

1. Indians and colonists took a different set of game. Colonists were more homo-

Table 7
Harvest rates of birds (no. of animals taken per consumer-year).

| | Average | Range | Total no. samples (n=16) | No. Indian (n=12) | No. colonist (n=4) |
|--------------------------------|---------|------------|--------------------------------|-------------------------|--------------------------|
| Tinamidae | 0.357 | .004-1.471 | 11 | 9 | 2 |
| Tinamus spp. | 0.189 | .004-.472 | 4 | 3 | 1 |
| Crypterellus spp. | 0.284 | .010-1.471 | 6 | 5 | 1 |
| Phalacrocoracidae | | | | | |
| Phalacrocorax sp. | 0.019 | | 1 | 0 | 1 |
| Ardeidae | 0.187 | .005-.368 | 2 | 1 | 1 |
| Anatidae | 0.039 | .038-.04 | 2 | 1 | 1 |
| Cracidae | 1.883 | .044-4.27 | 15 | 12 | 3 |
| Ortalis sp. | 0.047 | .003-.091 | 2 | 2 | 0 |
| Penelope spp. | 0.706 | .034-2.206 | 13 | 10 | 3 |
| Pipile pipile | 0.654 | .003-1.49 | 5 | 4 | 1 |
| Nothocrax urutum | 0.054 | .041-.068 | 3 | 3 | 0 |
| Mitu spp. | 0.64 | .007-2.26 | 6 | 3 | 3 |
| Pauxi pauxi | 1.43 | | 1 | 1 | 0 |
| Crax spp. | 0.506 | .046-1.69 | 5 | 5 | 0 |
| Phasianidae | | | | | |
| Odontophorus gujanensis | 0.058 | .005-.24 | 5 | 4 | 1 |
| Psophiidae | | | | | |
| Psophia spp. | 0.36 | .005-.24 | 9 | 7 | 2 |
| Columbidae | 0.717 | .008-2.14 | 6 | 4 | 2 |
| Psittacidae | 0.652 | .003-3.46 | 12 | 9 | 3 |
| Ara spp. | 0.09 | .012-.187 | 7 | 6 | 1 |
| Amazona spp. | 0.125 | .004-.368 | 6 | 5 | 1 |
| Ramphastidae | 1.138 | .041-3.676 | 11 | 11 | 0 |
| Pteroglossus flavirostris | 0.729 | | 1 | 1 | 0 |
| Ramphastos spp. | 0.869 | .036-3.676 | 8 | 8 | 0 |
| Selenidera reinwardtii | 0.239 | | 1 | 1 | 0 |
| Ramphastos and Pteroglossus | 1.094 | | 1 | 1 | 0 |
| Other birds | 0.192 | .010-.643 | 11 | 8 | 3 |

geneous in their tastes for game species, while Indians took a much greater variety of species.

2. Both mammals and birds were harvested at a higher rate by Indians than by colonists.

3. There is, however, overlap in species hunted: three of the five species of mammals taken most commonly by Indians were also taken commonly by colonists, as were three of the bird species.

Comparison with Other Studies

In addition to those included in our analysis, other studies provided data suit-

able for qualitative comparison of Indian and colonist hunting. The importance to Indians of small game animals was shown in the data gathered by Ross (1976, 1978) and supports the pattern shown in this paper: primates and rodents were numerically the two most important groups for Indians. Reliance primarily on small game by Indians has also been noted by Berlin and Berlin (1983), Denevan (1971), Lapointe (1970), Gavia (1980), Ruddle (1970), and Paolisso and Sackett (1986).

Our analysis can be compared with that of Vickers (1984), who also com-

Table 8
Harvest rates of most commonly taken bird species (no. of animals taken per consumer-year).

| | Average | No. samples |
|------------------------------|---------|-----------------|
| Indians (<i>n</i> = 12) | | (<i>n</i> ≥ 5) |
| Penelope | 0.895 | 10 |
| Ramphastos spp. | 0.869 | 8 |
| Crax spp. | 0.506 | 5 |
| Psophia spp. | 0.459 | 7 |
| Crypterellus spp. | 0.339 | 5 |
| Amazona spp. | 0.149 | 5 |
| Ara spp. | 0.094 | 6 |
| Colonists (<i>n</i> = 4) | | (<i>n</i> ≥ 2) |
| Penelope spp. | 0.075 | 3 |
| Mitu spp. | 0.072 | 3 |
| Psophia spp. | 0.034 | 2 |

pared Indian and colonist hunting. Our study excludes one community considered by Vickers, and includes an additional seven communities. Our results on the numerical importance of major types of game differ from those of Vickers (1984) only in the ranking of reptiles in the colonist group. This results from the inclusion of Pierret and Dourojeanni's (1966, 1967) studies from Amazonian Peru in which reptiles, particularly tortoises, were important. The percent contribution of reptiles was also greater in the Indian sample due largely to our inclusion of studies by Balee (1984, 1985) on the Ka'apor, and Saffirio and Hames (1983) on the Yanomamo.

To evaluate the relative numerical importance of different groups of mammals, Vickers (1984; Table IV:371) ranked the average ranks of peccaries, primates, rodents and lagomorphs, edentates, carnivores, tapir, deer, and marsupials. By ranking our harvest rates within each study and then averaging these ranks across studies, our data can be compared with those of Vickers. For the Indian communities, our method placed peccaries in third place, behind primates and rodents. Edentates were fourth, followed by

deer, tapir, and carnivores. Vickers placed peccaries first and carnivores fifth.

A similar comparison can be made with the two data sets for colonists. In this case the only difference was the drop in the ranking of edentates (from second in Vickers's study to fifth in ours). The differences in methods between the two studies demonstrate the sensitivity of the results to changing methods of analysis and changing composition of the data set. Our conclusions differ mainly in the numerical importance of smaller-bodied mammals.

Sources of Variation

We have shown that there are significant differences in Indian and colonist hunting. The factors potentially responsible for the patterns of hunting and for the differences in results fall in two groups: biological and cultural. These factors are closely, perhaps inextricably, interrelated.

Variation Due to Biological Factors

Differences in Game Availability. The most obvious factor potentially accounting for variation between Indians and colonists in the types and quantity of animals killed is differing source faunas. Geographic, ecological, and historical factors affect the composition of the fauna potentially available for human hunting. The most striking example of this, albeit outside the scope of this paper, was the amount of fish in the diet of a given community. The presence of a perennial body of water with a reliable source of fish is almost inevitably associated with a diet in which fish is the major source of protein (e.g., the Kalapalo, Basso 1973). Ross (1978:15) states that ". . . the productivity of fishing must be viewed as probably the major determinant of the scope of hunting."

To control for gross habitat differences, we used data only from groups, both Indian and colonist, hunting primarily in tropical forest. We recognized the ecological differences among tropical forests. However, because many of the principal game species have large geographical

ranges and broad ecological tolerances, these differences are less significant. Seventeen of the species of mammals and seven of the genera listed in Table 4 are distributed over most of South America. Even when a species has a localized distribution, the genus is frequently widespread (e.g., the agoutis, *Dasyprocta*).

Important game species such as both species of peccaries, *Dasybus* armadillos, and tapirs are found in a wide range of habitats from moist tropical evergreen forest to dry thornscrub. They are habitat generalists and were thus available to all of the groups considered in our analysis. Other species, in particular the monkeys, are more limited in their distribution and ecological requirements. Except for the sloths, woolly monkeys (*Lagothrix*), and spider monkeys (*Ateles*), however, most of the mammals listed in Table 4 were potentially available to the groups we consider. Colonists have never been recorded as taking sloths, and took monkeys less frequently than Indians did. Global differences in source faunas do not explain differences in hunting by these two groups.

Differences in Prey Density. Even though a game species might be potentially available to a hunter, it might naturally be so rare as to never be killed. Therefore, differences in prey density (number of animals/square kilometer) might affect differences in hunting returns. On average, smaller species of mammals are more common (Robinson and Redford 1986) and more reliable (Robinson and Redford 1988) than larger species. This supports the observation of this paper that taxa with small-bodied species were more commonly taken by Indians.

As Emmons (1984) has pointed out, within Neotropical forests the abundance of certain mammalian species varies considerably at different locations. Within the Amazon basin, densities of selected species are generally highest on the rich alluvial soils of western Amazonia, poorer on *terra firme* soils of central Amazonia, and poorest on the white sand soils of the Guiana Shield. This may explain the very high returns reported for the Ecuadorian

Waorani (2.43 kg/hr: Yost and Kelley 1983 in Hames 1986) and the substantially lower returns for Yanomamo living on the edge of the Guiana Shield (0.56 kg/hr: Saffirio and Hames 1983 in Hames 1986). Vickers (1984) used similar reasoning to explain the differences in hunting yields between Peruvian "montana" sites and those in lowland Amazonia. There are numerous exceptions to such large scale geographic patterns, for even at a single site densities can fluctuate enormously through time (Glanz 1982). Such geographic and temporal variations in the density of game species undoubtedly affect hunting returns for both colonists and Indian hunters.

Game densities are also affected by overhunting and consequent local depletion of prey. Local depletion of certain species of game was apparently a common phenomenon even pre-contact (Ross 1978). Large species of game tended to become increasingly rare near villages through time (Table 9). The species that remained tended to be smaller (Vickers 1980; Table 9), some of which may have remained because of the presence of gardens. Therefore, the age of the village is one of the factors determining what type of game was taken (Vickers 1980).

Local rarification has now frequently turned into local extinction as Indian villages become permanent (Gross et al. 1979). Beckerman (1978) says that the low yield of tapir obtained by the Bari was caused by heavy colonist hunting. Stocks (1983) states that manatee, now locally extinct, used to be a major source of food for the Cocamilla. Large birds, particularly currasows, are no longer found around established settlements.

Smith (1976) reported a similar finding for three Brazilian colonist settlements. In older settlements rodents comprised 39% by weight of all game taken, while in younger settlements they comprised 3%. This is a result of selective hunting for larger game with consequent local depletion and reliance on smaller animals. This pattern has been documented near other colonist villages (Ayres and Ayres 1979; Moran 1977). The fact that colonist settlements tend to remain in one place

Table 9
Cultural factors affecting game harvesting.

| Phenomenon | Species affected | Mediated by | Reference |
|----------------------|---|--|--|
| Hunting near village | Species depleted: Curasow, guans, trumpeters, woolly monkeys, spider monkeys, peccary, tapir | Large-size animals | Hames and Vickers 1982; Patton et al. 1982; Romanoff 1984 |
| | Species remaining: Agoutis, pacas, armadillos, sloths, macaws, toucans | Small size; possible preference for disturbed habitats | |
| Shotgun hunting | Volant and arboreal species | Shotguns more efficient than bows | Hames 1979 |
| | Cracids and two peccary species Larger game species | When chances of a kill are good | Yost and Kelley 1983 Hill and Hawkes 1983 Romanoff 1984; Saffirio and Hames 1983; Yost and Kelley 1983 |
| Hunting with dogs | Collared peccary, tapir, deer | Before dogs were used, these game could not be hunted | Yost and Kelley 1983 |
| | Collared peccary, tapir, paca | Game that runs and then stops | Hill and Hawkes 1983; Paolisso and Sackett 1985; Silverwood-Cope 1972; Vickers 1976 |
| Taboos | Capybara | Tabooed | Balee 1984; Linares 1976; Ross 1978 |
| | Sloth | Eaten Tabooed Eaten | Arcand 1976; Weiss 1969 Ross 1978; Vickers 1976 Romanoff 1984 |
| Garden hunting | Collared peccary, agoutis, deer, armadillos, tapir, paca, white-lipped peccary | Attracted to plants in garden | Balee 1984; Beckerman 1980; Dufour 1983; Gordon 1957; Hames 1980; Nations and Nigh 1980; Nietschmann 1973; Ruddle 1970 |

longer than Indian settlements, combined with the different preferences for game, result in different hunting yields both in nature and intensity.

Variation Due to Cultural Factors

Hunting Technique. Specific hunting techniques of both Indian and caboclo hunters often determined the amount and identity of game taken (Gross 1975; Nietschmann 1972; Hames 1979). However, most hunters are opportunistic and will take whatever game they encounter (Balee 1984; Vickers 1976; Sponsel 1981). Some authors (e.g., Patton et al. 1982) have stated that relative ease of hunting and high consistent returns were responsible for the preference for some prey species. Yet several groups seemed to orient their hunts toward species that were rarely taken (e.g., Hill and Hawkes 1983). Indians took a broader range of species and are therefore more likely to take whatever game is available, whereas colonists, with a narrower range of acceptable species, were more likely not to encounter an acceptable game animal.

Indigenous methods of hunting are still used by many Indian groups considered in our study. For example, of 3,165 animals killed by the Waorani, 64% were killed with blowguns (Yost and Kelley 1983). The Matses are proficient hunters who use machetes, clubs, digging sticks, and other hand-held weapons (Romanoff 1984). The Ache, hunting by hand, can catch up to 50% of the total game taken when bow hunting (Hill and Hawkes 1983). Most of this game is small or medium-sized, such as armadillos, coatis, and pacas. Dogs, which have been in the Neotropics for a long time, are also used by indigenous groups and can increase takes of certain types of game (Table 9). However, some communities (e.g., the Matses, Romanoff 1984) have dogs but rarely use them in hunting.

However, modern technology is often superior to indigenous technology in procuring game (Beckerman and Sussenbach 1983; Table 9). Use of such technology has allowed Indian hunters to increase the scope of their hunting. For example, headlamps and outboard motors

have allowed the Ye'kwana to harvest nocturnal riverine species, such as caiman and paca, which previously they had exploited only rarely. Shotguns have also increased the take of some species (Table 9, Hames 1979). An even more dramatic consequence of the use of shotguns by Indians is the increase in the intensity of hunting, particularly of larger species (Table 9).

Part of the differences in hunting patterns between colonists and indigenous peoples derives from hunting technologies (Tables 6 and 8). Colonists have had greater access to firearms, ordinarily the only weapons they use. They can also obtain ammunition, flashlights, and batteries more easily. Consequently, unlike Indian hunters (Yost and Kelley 1983), they are less concerned about the cost of a shotgun cartridge and more likely to shoot. However, while use of shotguns increases yields, and colonists have greater access to guns, Indians typically had higher harvest rates (Tables 8 and 6). This is undoubtedly partly a consequence of the greater access by colonists to alternative sources of meat (e.g., domestic animals and canned meat).

Taboos. Not all edible animals are taken for food (Arcand 1976; Arhem 1976). One of the reasons for this is the existence of taboos. Whatever the causal or functional reasons for taboos (McDonald 1977; Ross 1978; Eichinger Ferro-Luzzi 1978), taboos affect the types and quantities of game hunted and eaten by both Indians and colonists. Many primary game species have been tabooed by some Indian communities (Ross 1978), although these taboos were not consistent across different communities (Table 9). Tapirs and peccaries were tabooed (Carneiro 1983; Nietschmann 1973; Ross 1978), though in some communities the prohibition is breaking down (Nietschmann 1972; Yost and Kelley 1983). One of the most widespread Indian taboos applies to the meat of both brocket (*Mazama*) and white-tail deer (*Odocoileus*), and this is reflected in the low harvest rates of deer (Table 4). However, with a single exception (Ross 1978), this taboo is also breaking down or

has disappeared (Bennett 1962; Berlin and Berlin 1983; Saffirio and Hames 1983; Yost and Kelley 1983).

Colonists hold a different set of hunting and consuming prohibitions (Moran 1977). While Indians and colonists consume many of the same species, colonists have a much narrower range of acceptable game (Tables 6 and 8). With the exception of the *Dasyfus* armadillos, all of the commonly taken mammals resemble domestic species (Vickers 1984). Other edentates, such as the sloths and anteaters, have been completely avoided by colonists (Table 6). Some primate species are avoided because colonists believed that consumption of their flesh causes sickness (Ayres and Ayres 1979). Most of the birds preferred by colonists also resemble domestic species.

There appears to be as much variation in caboclo prohibitions as in indigenous taboos. Brazilian colonists from the southern part of the country have different preferences from those of Amazonian Brazilians (Smith 1976). Some colonists did not eat primates, while in other areas primates were commonly taken (Ayres and Ayres 1979.)

Clearly, taboos affect the nature of both Indian and colonist hunting, though in different ways. Many Indian taboos are breaking down, which may eventually cause Indian hunting patterns to more closely resemble those of colonists.

Gardens and Habitat Modification. Humans can alter the environment in which they hunt in several ways. Linares (1976) suggested that indigenous peoples procure much of their game by hunting in their gardens. Several studies have provided evidence in support of the idea of "garden hunting" (Table 9) and many of these species are among those most commonly taken by Indians (Table 6).

This association between game and gardens is explicitly understood by many Indian groups: Romanoff (1984:188) stated that the Matses cut fields in primary forest "to ensure a supply of game animals." Understanding that allowing game animals to enter a garden will decrease its harvest, Indians may nonethe-

less leave some gardens unfenced (Balee 1984), compensating for the expected loss of garden produce by deliberate overplanting (Balee 1984; Carneiro 1983; Johnson and Behrens 1980; Nations and Nigh 1980). The Machiguenga grow more than twice as much manioc as they eat and refer to abandoned gardens as "belongs to peccary" (Johnson and Behrens 1982:183). One of the few groups to taboo peccary meat, the Kuikuru, not only fence but also moat their gardens (Carneiro 1983).

Indian gardens continue to yield valuable products long after they have apparently ceased to be cultivated (Denevan et al. 1984; Vickers 1983). Trees in these "abandoned" gardens will continue to bear fruit for many years. Such fruiting trees may attract commonly hunted game (Balee 1984; Chagnon and Hames 1979; Denevan et al. 1984; Gordon 1957; Nations and Nigh 1980; Posey 1982). Many of the species of birds most often hunted (Table 8) are frugivorous and commonly found at fruiting trees. Both new and old gardens can, in this respect, be considered areas modified by humans to attract game. Posey (1982) has argued that certain game species would not occur in forest unmodified by humans, and certainly several of the important game species of mammals such as deer, tapir, and collared peccary reach higher densities in modified areas.

Although colonists are known to hunt in their gardens (Pierret and Dourojeanni 1966; Smith 1976), hunting in both recent and abandoned gardens appears to affect Indian hunting patterns more than those of the colonists. Few data are available to evaluate the importance of colonist gardens as a place to hunt. Since colonists usually plant fewer crops and maintain less densely planted gardens, however, it might be expected that less game would be attracted to their gardens.

Hunting Regulation. The cultural regulation of hunting may also affect hunting yields. Such regulation by indigenous groups can be categorized into hunting zone rotation, outlier camps, and trekking. Balee (1985) described the use of

hunting zones whereby potential hunting areas were divided into zones and a single zone hunted until game was depleted.

The use of "outlier settlements" was described by Romanoff (1984) and Sponsel (1981). The members of a village had alternative housing, the use of which appeared to be related to the lack of game near the main village. Romanoff quoted the Matses as saying that they went to their outlier dwellings "to eat meat" (1984:271). Beckerman (1980) described a version of this pattern, though in the case of the Bari, the outlier houses were in a different ecological zone and were associated with the exploitation of fish.

Trekking has been described by Werner (1983), Posey (1982), and Maybury-Lewis (1965). Trekking consists of extended trips away from the village and, like the previous pattern, was associated with the desire to consume more meat (Werner 1983). These three techniques are not jointly exclusive, and there are variations and combinations of the three types. All three types of cultural regulation serve to decrease the effects of local over-hunting.

Cultural regulation of hunting has been described for colonists only in the form of "game days": on certain days hunting was prohibited so as to prevent the overexploitation of game (Moran 1977). However, such practices are apparently not common amongst colonists and probably have little effect on hunting yields.

Conclusion

There are many differences between Indians and colonists in the nature and intensity of their hunting. Colonists, fully involved in a market economy, have greater access to technologies that make hunting easier. However, due to over-hunting associated with larger, more permanent settlements, habitat degradation, and access to alternative sources of protein, their harvest rates are lower. Cultural factors that restrict the range of acceptable game species combined with habitat degradation and its effects on game populations cause colonists to take

many fewer game species than do Indians.

Indian hunters take a wider variety of game, probably reflecting local variations in presence and abundance of certain game species. Indians also take more game than do colonists, reflecting the greater nutritional importance of game and the existence of a stronger hunting tradition. Indians have developed ways of managing the delicate relationship between hunters and hunted. However, these are breaking down rapidly, producing profound changes in the social structure of Neotropical Indians (Gross et al. 1979) and decreasing the differences between Indians and colonists (Saffirio and Hames 1983).

Notes

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Age, Abstract Thinking, and the American Concept of Person

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This study concerns the way Americans think, as revealed by the descriptive phrases people use to characterize others, especially the personalities of others. Our findings, if substantiated by other studies, have important implications for culture theory as it relates to intracultural and cross-cultural studies of cognition. Our original aim was the replication of the American part of a cross-cultural study by Richard A. Shweder and Edmund J. Bourne (1982) which reports significant differences in the way Chicago-area Americans and Oriyas of Bhubaneswar (Orissa, India) conceptualize and think about the personhood of close acquaintances. In large part we succeed in this replication. (See also the findings on American abstract thinking by Hamilton and Sanders 1983 and Miller 1984).¹ Unexpectedly, however, we also find significant cognitive differences between American adults in different age groups, differences suggesting that older Americans are as much like Oriyas as they are like younger Americans. For comparison with Chicago Americans and Oriya Indians we use the methods of the original study, with certain strategic changes, to examine long-term residents of Chico, a city with a metropolitan population of approximately 88,000 situated within a largely rural region of northern California.

The original Shweder and Bourne study, winner of the 1982 AAAS Socio-Psychological Prize, has now been reprinted with a set of new contributions to