Kim Hill and Hillard Kaplan

Population and Dry-season Subsistence Strategies of the Recently Contacted Yora of Peru

The Panoan-speaking Yora (or Yaminahua) live in the headwaters region of the Madre de Dios, Urubamba, and Purus Rivers in Peru. This region is one of the most remote and least explored of the Amazon Basin; the Yora first made peaceful contact with outsiders only in 1984. During June and July 1986 the authors visited a Yora village. They present qualitative and quantitative data on Yora subsistence adaptations, including diet, time allocation to food acquisition, and food sharing. The data show significant riverine resource depletion near the Yora settlement. Results are discussed in light of current debate regarding protein resources, warfare, and disease as determinants of the size and distribution of native Amazonian populations. Health and recent mortality due to contact with Westerners are also discussed.

Manú National Park in southeastern Peru is one of the largest national parks in the world—it encompasses nearly the entire watershed of the Manú River, an upper tributary of the Madre de Dios River. In addition to the park's >1.5 million ha, another nearly 0.5 million ha along the southern boundary of the park are protected as a forest and game reserve. Along its western border, the park reaches elevations of almost 4000 m along the steep eastern slopes of the Andes. It then drops precipitously to ~2000 m in only a few kilometers, and from this point slowly descends from upland humid forest to lowland tropical forest at elevations <500 m near the Manú River. To the north and east, near the headwaters of the Piedras River, lie vast tracts of virtually unexplored lowland tropical forest. Only to the south, along the Madre de Dios River and its tributaries, are there a small but growing number of Peruvian frontiersmen and gold seekers.

Geologically, most of the lowland areas of the park are undulating, washboard formations of old upland alluvial plain. More recent floodplain due to river meander is extensive in the south along the Alto Madre de Dios River, and may reach widths of several kilometers along the lower Manú. Some headwater tributaries also have recent floodplains wider than 1 km. According to informants, these limited floodplain zones are important factors in decisions concerning the location of settlements in the headwaters region.

The climate near the Manú River is similar to that in much of tropical South America. While mean daily temperatures fluctuate little throughout the year, changes in monthly rainfall are dramatic, creating marked wet and dry seasons. Mean monthly temperature ranges from 22 to 25°C. May through September is the driest part of the year with mean

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monthly precipitation < 10 cm. The wet season, October through April, is characterized by mean monthly rainfall of ~26 cm. The annual total rainfall from September 1976 to September 1977 was 208 cm at the Cocha Cashu Biological Research Station (all data from Terborgh 1984).

Although most of Manú Park remains unstudied, the ecology of the area around the Cocha Cashu Biological Research Station has been extensively studied by Peruvian scientists and a variety of international research teams. As a result, the Cocha Cashu area is one of the best-described patches of tropical forest in the world. Terborgh (1984) recognizes seven major plant communities in the 4-km^2 area of intensive study. The forest that covers most of the interior of Manú Park is termed tropical moist forest by the Holdridge classification. Despite its apparent uniformity, it actually contains varied patches of unique forest types. Drainage, soil composition, slope, light exposure, and other factors combine to produce a mosaic of plant communities. More than 20 species of palms also lend diversity to the forest.

The fauna near Cocha Cashu is one of the richest in diversity and density in lowland South America (Terborgh 1984): tapirs, peccaries, jaguars, deer, large rodents, and other typical South American fauna; 13 species of primates; > 1000 species of birds; and some of the rarest animals in the world, e.g., the giant otter. Manú Park is one of the few areas in lowland South America for which animal biomass estimates are based on quantitative data: densities are higher than in Suriname or Guatopo, Venezuela, and almost equivalent to Barro Colorado Island in Panama (Eisenberg 1979, Terborgh 1984). Game densities for frequently hunted animals are several times higher than in random transects of eastern Paraguay (authors' unpublished data).

History of the Area

There is virtually no information about the prehistory of native peoples in the Manú Park region, but since natives are known to have been living on the upper Ucayali drainage at least 3000 years ago (Lathrap 1970), the same is likely to be true for the Manú area. In fact the Machiguenga Indians have found many potsherds and other cultural material in their fields during planting.

The Spanish explorer Juan Alvarez Maldonado (1899) descended the Madre de Dios River from its headwaters near present-day Pilcopata in 1567. Alvarez battled continuously with natives in the area; after losing most of his men, he retreated. Jesuit priests established missions along the upper Ucayali and Urubamba Rivers (just north of the park) in the late 1600s, but were very unsuccessful with the southernmost Arawakan groups, the Piro and Machiguenga (Garcia 1942, Steward 1948).

During the rubber boom in the early 1900s, Lache and later Fitzcarrald transported rubber to Iquitos across the famed Isthmus of Fitzcarrald that separates the Urubamba from the Manú drainage. From 1893 to 1897 hundreds of Mashco, the original inhabitants, were slaughtered, perhaps leaving a vacuum in the drainage for the Yora to fill some 50 years ago. Fitzcarrald brought a group of Piro who settled on the upper Manú. Extremely hostile natives (probably the Yora) were found along the north side of the upper Manú and throughout the area of the isthmus. The Piro and Machiguenga lived by fishing, hunting, and swidden gardening. The principal crops were plantains and manioc (de la Combe 1904, Morrison et al. 1985). Slave raiding on uncontacted tribes in the area was also an important economic activity.

After the collapse of the rubber boom, most of the Peruvian nationals and Europeans left the area. Of the several scientific expeditions through

the area the most important were Cipriani's expedition in 1900 (Cipriani 1902), the de la Combe survey in 1903 (de la Combe 1904), and the Peabody Museum survey under Farabee in 1906 (Farabee 1922). In 1940, Fejos conducted a census of the upper Madre de Dios drainage (Fejos 1941). All of these studies agree that the Machiguenga (also called Campa, Kirineri, and Pacapacuri) lived in the headwaters area of the Manú and many of its tributaries, and that a group of either Mashco or Mashco mixed with Piro (also called Chontaquiro) inhabited many remote interfluvial areas in the park.

In the second half of the 20th century the Manú Park area was temporarily inhabited by a few nonnatives who were primarily involved in wood extraction, hide sales, or missionary work. Shell Oil Company did seismic testing and put in transect trails throughout much of the lower part of the park (from just above the mouth of Panagua tributary southward) in 1973 and 1974. The Summer Institute of Linguistics established a mission at the Machiguenga settlement of Tayakome in 1968, but abandoned it when Manú National Park was created in 1973. Until the park was established in 1973, Machiguenga and Piro Indians (along with some Peruvians) earned cash by extracting lumber, selling animal skins and other animal products from the forest, and working as boatmen, guides, and day laborers. After the establishment of the park, all commercial activities within the park boundaries were prohibited, as were firearms. All nonnative settlers were evicted from the area, and native inhabitants who had previously been involved in the cash economy (mainly at Tayakome) returned to fishing, hunting, and gardening for a living. The other native populations (headwaters Machiguenga, Mashco/Piro, and Yaminahua) were protected and isolated from outside incursions into their traditional home ranges.

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Figure 1. *Yora women care for children while their husbands fish and collect wild plantains.*

The Yora—Recent History

Two groups call themselves the Yora in the northern extreme of Manú Park. Members of one group also say they are Yaminahua (or, more specifically, Yaminahua Shara) to distinguish themselves from other Nahua ethnic groups. (Nahua is the term that refers collectively to the autonomous Panoan-speaking tribes of the upper Yurua and Purus Basins.) The Yaminahua (a term that means iron people) are currently the most numerous and widespread of the Nahua groups. Reports in the 1950s placed Yaminahua peoples as far apart as the Mishagua and Piedras Rivers in the south, and in the north along several rivers in western Brazil (Ribeiro 1957). The various Yaminahua groups are culturally and linguistically similar and can easily be distinguished from other Nahua groups because they alone shave the forehead (Carneiro 1962).

The term Yora apparently applies to all those Yaminahua living in settlements along the tributaries of both the upper Mishagua and upper Manú that recognize each other as related rather than as enemies. The various Yora groups visit each other frequently and appear to intermarry. These groups have been extremely hostile to outsiders, raiding and killing woodcutters, oilmen, and neighboring Machiguenga until 1984, when they were contacted and "pacified." (The last known attack, however, took place on the Machiguenga of Quebrada Fierro as late as January 1985 and included Yora warriors who had already made contact and visited the Sepahua mission.) The Yora are a highly mobile population. Those currently living in the park were born primarily on the Manú, the Condeja, the Cashpajali, and the upper Mishagua Rivers. A few of the oldest men were born near a distant river system that they describe as farther than the Mishagua. Yora informants state that although they have dominated the upper Manú for the past 40 or so years, they originally had to drive Machiguenga from the area with frequent raids. Machiguenga living downstream tell tales of wholesale massacres from which the few remaining survivors fled.

The authors estimate that just prior to 1984, the Yora in and around the park numbered 300 to 400, but contact has halved the population. According to various accounts (Sarzar 1984, Summer Institute of Linguistics 1984a, b), several Yora raided a woodcutters' camp on the upper Mishagua River and stole a canoe in April or May of 1984. The group of woodcutters included Peruvian nationals and Machiguenga, Piro, and Yaminahua Indians from the Sepahua mission. On the morning following the raid, the woodcutters found the Yora on a beach on the Mishagua River. A short battle ensued during which three or four Yora were either captured or were convinced to put down their arms and remain with the woodcutting party. Those Yora were then taken to the Sepahua mission, given gifts, and released. Soon after this initial contact, several small groups of Yora visited the Sepahua mission to receive gifts. Unfortunately, many of these visitors became sick, presumably because they had no immunity to the diseases to which they were exposed in Sepahua. When they returned to their communities, an epidemic of respiratory disease quickly spread to all the Yora groups in the forest.

In August and September 1984, Summer Institute of Linguistics missionaries and medical personnel treated ~200 Yora, who were gravely ill from pneumonia, at a site near the headwaters of the Mishagua. They also vaccinated the Yora for polio, measles, diphtheria, and tetanus. An estimated 50 to 150 died of epidemics at this time. More Yora died of illness throughout 1985, almost all on the Manú, Cashpajali, and Condeja

Rivers. In November 1984, missionaries set up a permanent base of operations at Putaya on the Mishagua River. A year later in December 1985, a medical team sponsored by the administration of Manú National Park and the Dominican Mission at Shintuya visited a Yora settlement for the first time on the Manú side of the watershed at the mouth of the Condeja, and treated severe cases of pneumonia. Nevertheless, many Yora continued to die well after their plight was known, because they did not have access to full-time medical treatment and had no means of communicating with the outside world when another epidemic struck. Yora population in July 1986 was estimated to be 180.

The Study Population

The authors lived with the Yora (Figure **1**) in Manú Park for 29 days between 12 June and 18 July 1986. The community studied was located on a small hill ~30 m above the north bank of the Manú River and ~1.8 km

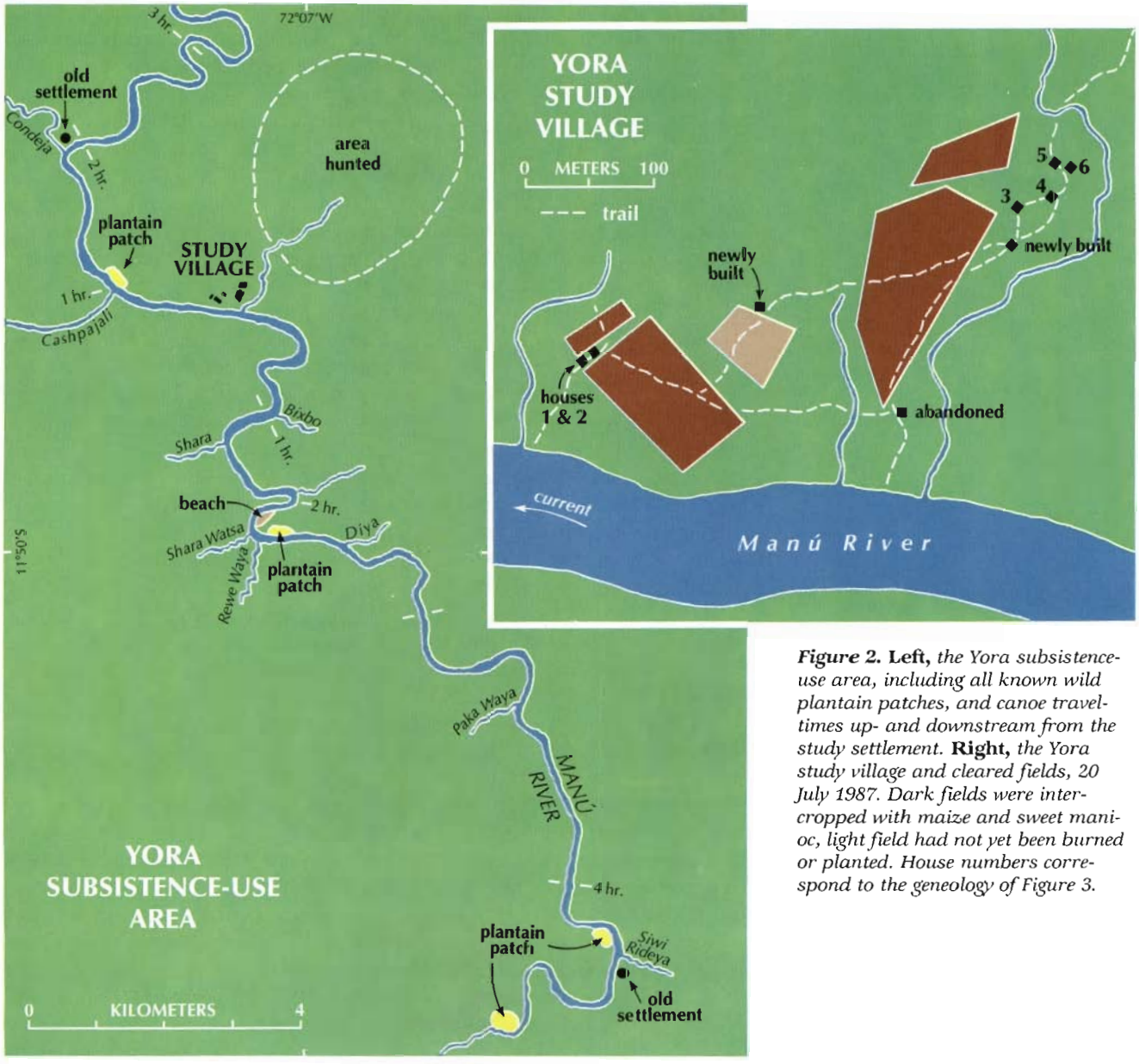

Figure 2. **Left,** *the Yora subsistence-use area, including all known wild plantain patches, and canoe travel-times up- and downstream from the study settlement.* **Right,** *the Yora study village and cleared fields, 20 July 1987. Dark fields were intercropped with maize and sweet manioc, light field had not yet been burned or planted. House numbers correspond to the geneology of Figure 3.*

upstream from the mouth of the Cashpajali tributary (Figure **2**). The Manú River is ~40 m wide at this point, with a rocky bottom, steep banks, no oxbow lakes, and very small beaches. The Yora had apparently lived on, or very near, that spot in times past, but this occupation was relatively recent; when the authors arrived the place had probably been inhabited for only about three months. When the medical team visited in December 1985, the Yora were living at the mouth of the Condeja, 4 km downstream, at a site they visited occasionally during June and July to bring manioc cuttings to plant. Both settlements were cleared in old, alluvial floodplain forest which was quite hilly; farming quickly depleted the clayey soil of nutrients.

The Yora settlement above the Cashpajali consisted of six occupied houses; one house had been abandoned recently and two more were built during the observation period (Figure **2**). Houses were roofed with palm thatch, and none had walls. The population was clearly divided into a downstream cluster and an upstream cluster ~400 m apart. On 14 June both clusters contained 37 Yora residents. In June and July intervillage visiting caused the village population to fluctuate between 33 and 41. The old Condeja settlement consisted of six houses which were also separated into two clusters, suggesting that settlement size and organization had remained similar since the previous year.

The residence pattern among the Yora was primarily based upon kinship and tended to be patrilocal, although it also appeared to be somewhat in flux as a result of the large number of contact-related deaths. The genealogical relationship of community members and their household affiliation are shown in Figure **3**. The names are fictive; the Yora, like many other South American groups, do not wish to reveal their traditional names, possibly because they fear that someone might use them in witchcraft. They did want Spanish names which they felt no compunction about using in public, and the authors gave a Spanish first name to each person who did not already have one.

Cesár was the leader of the downstream section and the second most influential Yora in the community. The upstream section was composed of interlocking familial relationships with Pandiko and Curaca forming the core. Pandiko was the leader of this section, and the most influential person in the Yora community. While these section "headmen" were well respected and played a major role in decision-making, they had no formal authority. Pandiko seemed to gain his influence through his personal magnetism and energetic labor.

The community consisted of 12 adult males, 6 adult females, 15 male children, and 4 female children. Causes of the skewed sex ratio are unclear. The Yora report that more females than males died in the epidemics at first contact. It was also the authors' impression that female children were treated worse and given less to eat than males, which may have resulted in higher mortality of female children. Another possibility is that the Yora practiced female infanticide.

An examination of the recent marriage and reproduction patterns of the community illustrates the devastating effects of first contact. Of the 12 adult men in the community, five had been recently widowed because of the contact epidemic and one had lost his wife to an acculturated Yaminahua. Of the remaining six men, four were currently married and two were bachelors. Of the six adult women, three were married, two were widowed in the contact epidemic (one of these remarried), and one was an orphan (her parents died in the contact epidemic) who remained unmarried. According to informants, potential husbands were available for both unmarried women but neither woman seemed willing to mar-

ry. More impressive still, of the 19 children in the community, only four had both parents still living, and the remaining 15 had recently lost one or both parents from death due to illness.

Intervillage visiting appears to be an important part of Yora social life. On several occasions, small groups of visitors spent a few days at the settlement. They arrived with their bodies covered in red dye made from achiote, and wearing flowers, feathers, and sweet-smelling plants tied to their arms and legs (Figure 4). Proper etiquette seemed to require that the visitors be provided with a comfortable hammock to rest in, plenty of plantains and fish to eat, and a good wad of tobacco to chew. Visitors generally requested, and were given, gifts from their hosts. They departed a few days later. This web of intervisitation maintains ties among communities, but is also the means by which epidemics spread through the population. One group of visitors arrived quite sick, and within a few

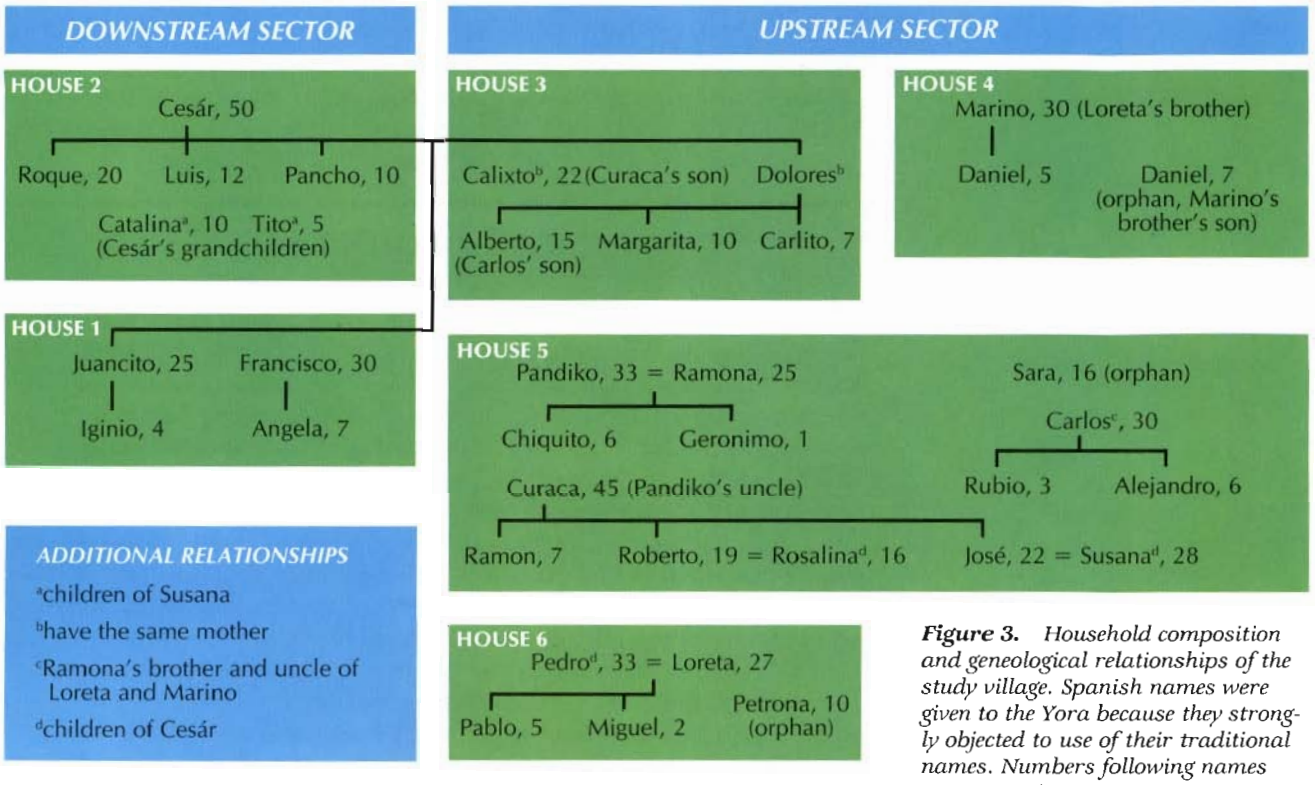

Figure 3. *Household composition and geneological relationships of the study village. Spanish names were given to the Yora because they strongly objected to use of their traditional names. Numbers following names are approximate ages.*

days after their departure, the entire community became very ill with respiratory infections and high fevers. Although antibiotics saved the lives of even the most gravely ill, one and perhaps two of the three visitors died in the forest, after leaving the Cashpajali settlement.

Anthropometry and Health

Weights and heights for most of the population were collected on three occasions and triceps skin-fold thicknesses were recorded once. When the authors first arrived, the Yora were undoubtedly one of the shortest and fattest Amazonian populations reported. For adult men, mean height was 154.1 cm and mean weight, 63.9 kg; for adult women, mean height was 137 cm and mean weight, 49.5 kg. This is 7% shorter but 9% heavier than two Machiguenga populations studied in Manú Park (Hurtado et al. 1986). Triceps skin-fold thickness showed a mean of 7 mm for men and 13.3 mm for women. Between 14 June and 14 July men lost a

mean of 1.6 kg, women lost 1.0 kg, and children lost 0.2 kg. Part of this weight loss was certainly due to the illnesses that swept through the group, but the loss may have been exacerbated by the increasing scarcity of plantains as the dry season progressed.

The Yora gave the impression of being rather unhealthy. Complaints of malaria or trembling due to fever were almost universal, although these reports have yet to be confirmed by clinical analyses of blood. They also seemed somewhat listless and enervated. As mentioned above, a severe epidemic of pneumonia affected almost every member of the population (with the exception of the headman and his family). Aspirin and antibiotics were administered throughout much of the visit.

Two systematic but rudimentary health checks of all children on 23 June and 12 July revealed that 14% of the children seemed severely anemic (as determined by the color of tissue on the inner eyelid), 28% had skin infections (3% very severe), 41% had open sores on the head, 100% had lice (21% severe), 45% had coughs, 45% had fever, and 7% had diarrhea. In addition, during the field session the authors observed at least 20 large ant and wasp stings, 1 poisonous snake bite, 1 burn, and 1 large accidental wound; but no cases of leishmaniasis, even though it is extremely common among the Machiguenga of Manú Park.

Yora Subsistence Ecology

Methods

Time allocation was measured by "instantaneous scan samples." This method involved a visit to each household, beginning at randomly chosen hours so that all daylight hours were represented. An attempt was made to locate each person within the vicinity of the settlement and to determine the activity in which each was engaged. The activities of foragers outside the settlement were determined by questioning those present, questioning the foragers as they left the settlement, and observing what equipment the foragers left with and what they returned with.

In order to calculate Yora efficiency and to observe behavior away from the settlement, the authors collected two additional kinds of data. On 22 days all persons were clocked out of, and back into, the camp anytime they left the residence areas, again asking them what they were going to do, if this could not be inferred from tools taken and resources brought back. When they returned the authors weighed all resources acquired. The caloric equivalents of these resources were determined using published sources (see Hill et al. 1985 for details). This allowed determination of the total food consumed by the sector and the return rates for subsistence effort (i.e., calories acquired per hour of work effort).

These data were complemented by following individuals and observing their behavior away from the settlement. Each day a member of the community was accompanied when he left the settlement. Women rarely left the settlement to forage and when they did they were always accompanied by men, so their behavior could be monitored while following the men. Time allocation was recorded for the focal person and all who accompanied him. All resources acquired were weighed, and all food eaten before returning to the settlement was determined either by estimation or by re-weighing the food upon returning to the settlement. These data allowed calculation of the degree to which measurements of food brought back to the settlement underestimated the total food acquired. On single-day foraging forays, very little food was eaten before returning to the settlement. However, on overnight

trips, a good deal of the food was eaten. The authors accompanied the Yora on three overnight trips to monitor food consumption and food acquisition farther from the settlement. This also allowed determination of the percentage of time away from the settlement that was actually devoted to subsistence effort, and determination of the productivity of foraging as a function of distance from the current village.

Generally, one author remained at the settlement and collected either scan-sample data or in–out productivity data while the other followed a focal individual. The combination of more precise but more time-intensive focal individual data with community-level scans and in–out productivity records was designed to maximize the amount and accuracy of the information acquired during a short field study.

Finally, the authors mapped the Yora settlement in detail and updated the map weekly as men continued to clear more land for gardening.

The principal shortcoming of this study is the brief field period and the size of the sample. Only dry-season subsistence behavior could be observed; information on other times of the year was derived from interviews. These interviews were conducted by the authors in Yaminahua, since the Yora were basically monolingual with a Spanish vocabulary of some 20 to 30 words (mostly the names of food resources, items of clothing, and technology). Although learning Yaminahua was facilitated by a Yaminahua grammar and a dictionary supplied by the Summer Institute of Linguistics and derived from work with other Yaminahua groups, these interviews were limited by the authors' rudimentary linguistic competence. Given the year-to-year variability that probably characterizes Yora subsistence patterns, data on several complete seasonal rounds are necessary to fully describe their economy. This problem is further exacerbated by the fact that some features of Yora subsistence behavior are in the process of change.

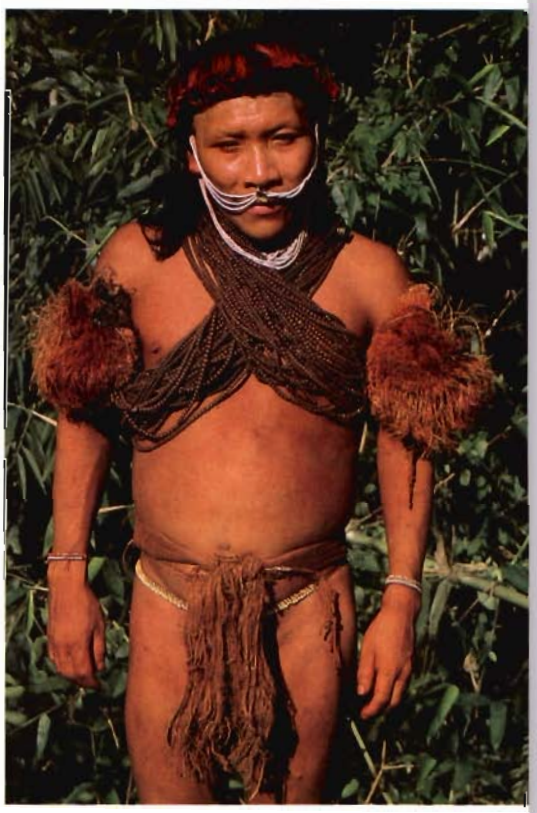

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Figure 4. *Yora visitor arrives at the Cashpajali settlement adorned to impress his hosts.*

Gardening

Although the Yora were in the process of clearing small gardens when the authors arrived, they had not planted gardens for at least a year and had no fresh or stored garden produce to eat. During the period of observation, they met daily food needs by fishing, hunting, and collecting plantains that grew wild along the river.

When the authors left in late July, the Yora had planted ~1.5 ha of manioc and corn (intercropped), with a few plantains, pineapples, and papayas near their houses (Figure **2**). They also had cleared and burned ~0.25 ha which had not yet been planted by late July. The apparent enthusiasm of some of the men for garden work was curious in light of the total abandonment of gardening the previous year at Condeja; they had not even left enough manioc stalks to use for seed cuttings in their own fields. (They traveled to Tayakome to bring back cuttings.) Men did some agricultural labor on 14% of all days monitored, whereas women only worked at horticultural tasks on 2% of these days.

Presumably, this pattern of intermittent gardening with years of total reliance on foraging is traditional, at least in the recent past. The Yora report that before contact, they had only one old machete and one ax in their village. Clearing gardens was difficult, and therefore they had very small gardens. They did not use stone axes, but instead used a sharpened hardwood club to clear the thick bamboo forests.

Thus, even these garden plots may have been large by Yora standards (their old gardens at Condeja totaled < 1 ha). Nevertheless, at their 1986 size the Yora gardens would not produce enough food to support the population year-round. Downstream the Machiguenga at Tayakome

had ~4 ha of producing (new or one-year-old) fields for 54 persons (1 ha/13.5 persons). The Machiguenga at Quebrada Fierro had ~8 ha of producing fields for 94 persons (1 ha/11.8 persons). In contrast, the Yora had only ~1.5 ha that would be in production the next year for ~39 persons (1 ha/26 persons). This contrast is even more striking because the members of the Yora population were considerably older than those of the Machiguenga (there were only two infants in the Yora population), and would need more food per capita.

The primary crop planted in the Yora fields was maize. This contrasts sharply with the sweet-manioc–based economies of their Machiguenga neighbors, or the large plantain gardens that must have existed along the river before the Yora drove out the previous inhabitants. This difference may be due to preference or to a shortage of manioc cuttings. Furthermore, Yora did not appear to be skilled at tropical gardening. The authors measured the time it took them to plant their fields (data on clearing, weeding, harvesting, and food-processing times are lacking). On average, men planted one yucca hole every 2.1 minutes, compared with the Machiguenga at Quebrada Fierro who planted one yucca hole every 0.6 minutes. The Yora planted ~2700 holes/ha and the Machiguenga ~2100 holes/ha. The efficiency differences are more striking considering that the Yora plant only two cuttings per hole whereas the Machiguenga plant three. If both groups planted ~2500 holes/ha, it would take the Machiguenga 24.6 man-hours (about four workdays) to plant a 1-ha manioc field, while the Yora would spend 87.5 man-hours (about 14.5 workdays)—more than three times as long. These data again suggest that gardening may be a relatively new and unimportant activity for the Yora, although part of this difference may be due to the Yora's apparent ill health and general lack of energy.

Foraging

Diet and Time Allocation

Quantitative data on the diet were collected in one or both subsections of the community on 22 days (Table **1**). Calorically, the most important resource was wild plantains which grow in patches along the Manú River. The Yora collected 1320 kg of wild plantains. Almost all of these were sweet, eating plantains (bananas, species unknown) and not green, cooking plantains. The plantains were almost certainly the descendants of cultigens planted earlier in this century or in previous centuries by the Machiguenga (and, possibly by Piro who lived at the mouth of the Cashpajali during the Fitzcarrald era). Apparently, during the yearly floods plantain root stalks are washed downstream and deposited in areas that favor their propagation. Plantains were collected every few days when men went out to fish; they accounted for 79% of the calories in the Yora diet during the dry-season field period.

Fish were the most important protein resource in the diet, and the second most important food category in terms of energy, accounting for 14% of the calories in this sample. Almost half of the 274 kg of fish taken consisted of 16 very large fish (13 *zungaro* and 3 *paco*, species unknown), whereas the remainder was made up of > 60 small fish. At least 60% by weight was caught with hook and line, 32% shot with bow and arrow (Figure **5**), and 8% speared. This means that exactly how much fish the Yora were eating before 1984, when they first acquired hook and line, is difficult to estimate.

A variety of other wild resources made up the remainder of the Yora diet, including 7 caimans, 2 turtles, 3 sting rays, 1 woolly monkey, and 11 kg of turtle eggs. Wild honey was also taken on one occasion. The

Yora exploited no wild fruits or nuts during this time of the year, although they did eat small quantities of insects, palm hearts, and palm starch. They also acquired non-food items such as achiote to make red paint, latex to mix with achiote for hair-paste (see p. 267), tobacco to chew, and some raw materials for bows and arrows.

During the study period, Yora men left camp to fish, hunt, and collect on only 27% of all days. Plantains were almost always collected during fishing trips. Women, on the other hand, devoted much less time to subsistence labor, spending only 7% of all days on hunting–fishing–collecting excursions. Food-processing time for women was also minimal because the plantains were either eaten raw, boiled, or roasted without processing. Consistent with their low time input to subsistence, women acquired only 6% of the total calories consumed by the group. In fact, this figure overestimates their contribution because men spent hours poling the canoes to collection sites, and women only harvested the plantains upon arrival. Yora women's subsistence effort (at least during the period observed) is one of the lowest yet reported for traditional societies. This may be because men can combine plantain collection with fishing and hunting. Women must be transported to the collection site for the few minutes that they will gather. It may be simpler for men to do the whole job. In fact, Pandiko's wife was not observed to engage in direct food acquisition or to travel with foraging parties on the river during the entire field session. However, she had a very young child and the insects on the river are quite numerous and noxious. The other woman with a young child went on only one day-long foraging trip, and her baby returned with his entire body covered in bites.

Boys often accompanied adult men and fished with hook and line, but their total catch was <10 kg. Girls also frequently accompanied Yora men, and gathered a few turtle and bird eggs.

Table 1. Yora Diet, 22-day Sample

Food Type	Kilos Acquired	Calories/ Kilo	Percent Edible	Kilos/ Capita/ Day*	Calories/ Capita/ Day	Percent of Diet
MEAT						
Fish	274	960	75	0.44	320	14
Alligator	47	2320	65	0.08	114	5
Monkey	6	1160	75	0.01	9	<1
Turtle	6	890	50	0.01	4	<1
Total meat	333			0.54	447	19.5
Banana	1319	1320	65	2.11	1814	79
Manioc	5	1320	80	<0.01	2	<1
Turtle eggs	11	2180	90	0.02	31	1
Total					2294 (2995†)	

Based on 624 person-days of food consumption
†*Based on 478 person-days of food consumption (children counted as 0.5 consumers)*

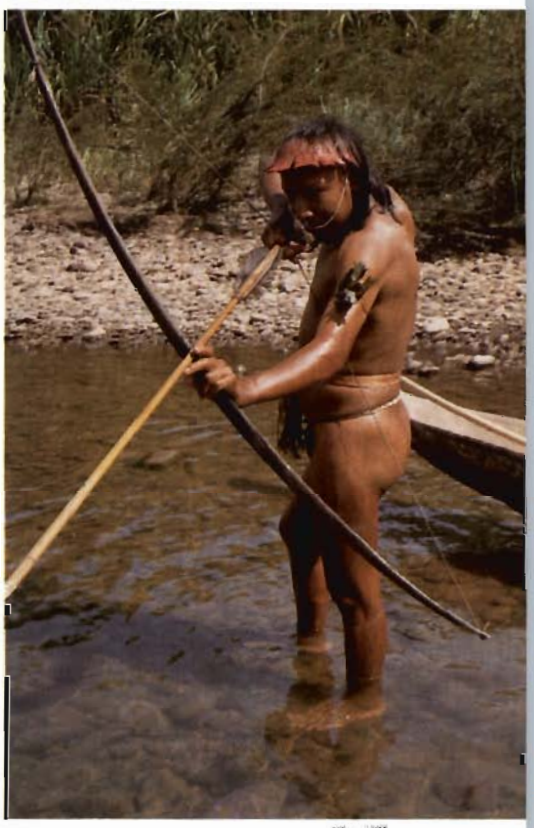

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Figure 5. *Yora man prepares to shoot a fish in the clear headwaters of the Manú River.*

Although the Yora did almost no work during the authors' first week with them (most of this period was not included in the sample)—perhaps due to an observer effect—they seemed to work much more toward the end of the study period. The Yora became extremely ill following the visit of their relatives from the Mishagua drainage, but illness probably had only a small effect on average time devoted to subsistence. Men may have compensated for lost foraging time when they recovered and may have increased foraging effort to provision sick group members. The Yora managed to acquire between 2294 and 3000 cal/person (depend-

ing upon whether children are counted as half or full consumers) and >100 g of protein/person/day (more than twice the Recommended Daily Allowance). Their low subsistence effort may be due primarily to the ease with which they could acquire large quantities of plantains, reasonably high returns for fishing, and a low adult:child ratio (possibly a result of contact-related mortality and subfecundity).

Behavior on Foraging Trips

Data obtained on the 14 days a focal man was followed on his hunting–fishing–collecting trips (six of these days were overnight trips with a group of Yora men, women, and children) allow for a more detailed description of dry-season food acquisition. On these trips the authors mapped major resource patches, and the travel time to each (Figure **2**). Encounters with all potentially edible resources and the Yora reaction to each were also recorded. When Yora attempted to acquire a food item, the time expended and the success rate were measured.

A common pattern throughout the study period was for two or more men—sometimes accompanied by boys, girls, or women—to leave in the morning and travel up- or downstream by canoe. One or more men would propel the canoe with a cane pole while another would shoot fish from the bow, or get out and walk along the bank, hunting fish with bow and arrow. The target early in the day was generally *bocachico.* These fish would either be saved to eat or used for bait in hook-and-line fishing. Data on return rate indicate that the success rate (kg/h) for this type of fishing is much higher farther away from the main settlement (Figure **6A**), which indicates significant resource depletion near the settlement. The overall goal of this first phase of the trip seems primarily to be to travel some distance from the settlement and to acquire bait.

After traveling for one or more hours, the men looked for a large, deep pool in the river to fish with hook and line. Once again, return-rate data indicate that more distant pools were more productive (Figure **6B**). When a large, deep pool was near but no bait had been acquired, the men walked up a small stream with a machete, trying to kill minnows. The time dedicated to bow-and-arrow fishing was about equal to that dedicated to hook-and-line fishing, but the latter was twice as efficient (1.61 kg/h hook and line vs. 0.83 kg/h bow and arrow [return rates are for actual fishing, not including travel time]; Table **2**). This is mainly because it allows the hunter to acquire much larger prey than can be killed with an arrow. No wonder the Yora undertake long journeys to acquire the equipment for hook-and-line fishing; before contact the Yora must either have fished more hours or eaten less fish.

If men encountered large fish (5 to 30 kg) in the river's shallows, they would try to spear the fish with an unstrung bow. Their zeal and ability to chase down and impale large fish in the river's shallows suggests that this may have been a major source of food before the acquisition of hook-and-line gear. This technique is also quite productive when circumstances are favorable (Table **2**).

Before returning to the settlement the men sometimes hunted caiman. Yora men walked up small streams looking for fresh caiman tracks, and then systematically searched along the stream edge in holes, logs, and other debris where caiman may hide. Once the caiman was located, it was speared with an unstrung bow. This form of hunting is extremely productive (13.16 kg/h, not including travel time to the stream).

Table **2** shows return rates for overall meat foraging. On focal follows, the Yora spent 181.4 hours traveling, searching for, and pursuing fish and game. The total amount acquired during these follows was 126.4 kg

(live weight), for a mean return rate of 0.70 kg/h (live weight). Combined data for all activities indicate resource depletion near the village settlement (Figure **6C**). The mean foraging return rate was only 0.06 kg/h within one hour's travel time from the settlement, but it steadily increased to 3.47 kg/h within five hours' travel time from the settlement (the maximum distance the authors traveled).

During the mid to late dry season, the Yora often left their canoes to search the beaches for turtle eggs, and children looked for bird eggs along the banks. However, plantains were, by far, the most important collected resource. When the Yora were ready to return to the settlement, they would collect plantains at one of the large, well-known patches (Figure **2**). Some children and all adults and adolescents would leave the boat to look for large plantain stalks, which they would cut with a machete or poke with a sharp stick until the plant doubled over.

Plantain collecting was extremely efficient; in patches of wild plantains, the Yora could gather plantains at a rate of 44.8 kg/h. Since plantain collecting is much more efficient than plantain or manioc cultivation (e.g., Bergman [1980] calculates that Shipibo Indians obtain 18.7 kg/h from plantain cultivation and 3.9 kg/h from manioc cultivation), it is not surprising that the Yora did not spend much time making gardens. Each person on a foraging trip usually acquired his own share of plantains and brought it to the canoe; this was an individual or family effort. Finally, when the canoe was loaded with plantains (150 to 200 kg), the Yora returned to the settlement. On arrival, fish, plantains, and other resources were shared. Although sharing was extensive, it was by no means equal and was generally biased toward close kin.

Table 2. Yora Hunting and Fishing Productivity

Activity	Travel Time (h)	Catch (kg)	Hours Spent	Return Rate (kg/h)
IN PATCH				
Bow-and-arrow fishing	0–1	3.6	11.7	0.31
	1–2	5.5	3.0	1.83
	2–3	1.6	5.2	0.31
	3–4	0.8	4.2	0.20
	4–5	9.1	5.3	1.72
	>5	7.4	3.2	2.31
Total bow-and-arrow fishing		28.0	32.6	0.86
Hook-and-line fishing	0–1	0.1	9.1	0.01
	1–2	5.3	2.1	2.52
	2–3	7.5	3.3	2.27
	3–4	8.5	1.6	5.31
	4–5	3.0	5.7	0.53
	>5	28.0	5.3	5.28
Total hook-and-line fishing		52.4	27.1*	1.93
Spearfishing		7.0	1.7	4.12
Caiman hunting		32.9	2.5	13.16
INCLUDING SEARCH AND TRAVEL TIME TO PATCH				
Forest monkey hunting		6.3	15.0	0.42
All riverine meat acquisition	0–1	3.7	64.7	0.06
(fish, caiman, birds, turtles)	1–2	14.4	24.6	0.59
	2–3	21.2	29.2	0.73
	3–4	9.3	22.3	0.42
	4–5	42.4	30.4	1.39
	>5	35.4	10.2	3.47
Total riverine meat acquisition		126.4	181.4*	0.70

**Includes time getting bait*

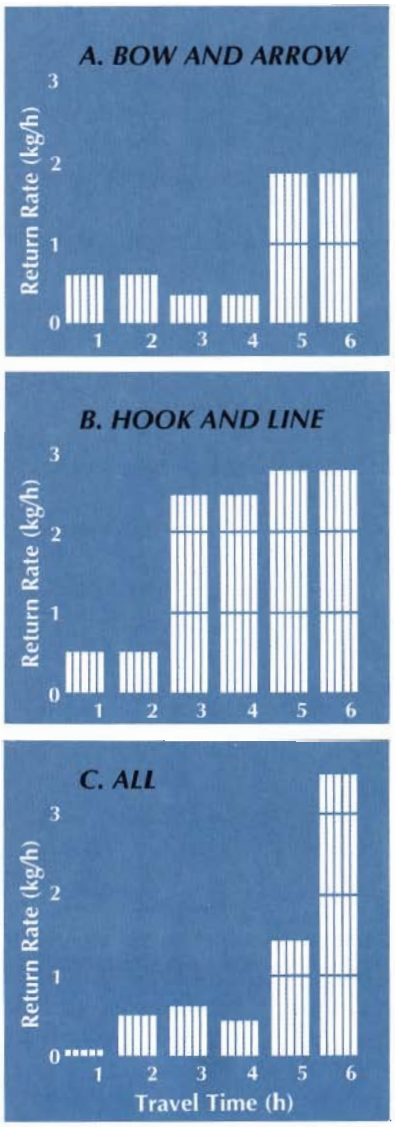

Figure 6. *Return rates from men's foraging as a function of travel time from their village.*

Fishing versus Hunting

Given the very high density of mammalian fauna in Manú Park, why do Yora men not hunt in the forest more often? During the one-and-a-half-month observation period they stayed close to the rivers and virtually ignored signs of forest game. To test the proposition that this was primarily due to the greater ease of obtaining fish during this season, the authors asked two hunters to spend a day hunting in the forest. The two hunters acquired only 0.42 kg of meat per man-hour in the forest, whereas the mean acquisition rate for riverine activities was 0.70 kg of fish and meat per man-hour (Table **2**). This difference between hunting and fishing efficiency is largely due to the productivity of hook-and-line technology. Even if hunting and fishing were equally efficient, the Yora may still prefer fishing because it can easily be combined with plantain collecting and transport. More data are necessary to test these propositions.

Late Dry- and Wet-season Subsistence

In the late dry season, turtle eggs increase in importance. In late July, after the authors left the Yora to work with the Machiguenga in Tayakome, 21 Yora arrived by canoe to visit the Machiguenga. The Yora had ~50 kg of turtle eggs, collected on the beaches along the upper Manú. Undoubtedly many eggs were eaten on the trip, so for about four weeks in July and August, the peak turtle-egg season, the Yora exploit that resource heavily. The Yora also said (and Machiguenga agreed) that in August during the peak dry season, plantains stop fruiting for a few months. This appeared to cause extreme food stress among the Yora who had no garden crops to eat at that time. They complained that lack of food upstream was one reason they traveled so much in the dry season.

Information on the wet-season economic pattern could only be obtained from interviews. The Yora stated (and again, the Machiguenga corroborated this claim) that they do not spend much time along the river during the wet season, but instead move up the small tributaries. Game seems to be important at this time of year, especially woolly and spider monkeys. Fish are difficult to catch because the rivers are high and muddy. Plantains are said to be superabundant, and many forest fruits are ripe during the wet season. How the Yora coordinate plantain collection with hunting in the forest is still unclear.

Food Sharing

On six occasions the authors recorded everything that was shared when foraging parties returned to the settlement. On three other occasions sharing that took place in the canoe before the party arrived was recorded, and on six occasions quantitative food sharing on overnight trips was recorded. In addition, the authors recorded the recipients of already-cooked food for seven meals in order to learn about the "secondary" food-sharing pattern (Figures **7** & **8**). The meat-sharing pattern strongly favored the nuclear family when food was brought back to the settlement but was widespread and equal among all families during overnight trips. Plantains were shared less than meat and were shared both before and after cooking. Plantains were frequently hidden in the forest to ripen; the Yora claimed that other Yora would have stolen them if the plantains had been left in their houses.

The Yora sharing pattern shows that food distribution is not necessarily egalitarian in supposedly egalitarian societies. The Ache of Paraguay have a similar pattern. On overnight foraging trips, the Ache share all meat equally (Kaplan et al. 1984). At their horticultural colony, food sharing is more kin-based and more is kept by the hunter's family.

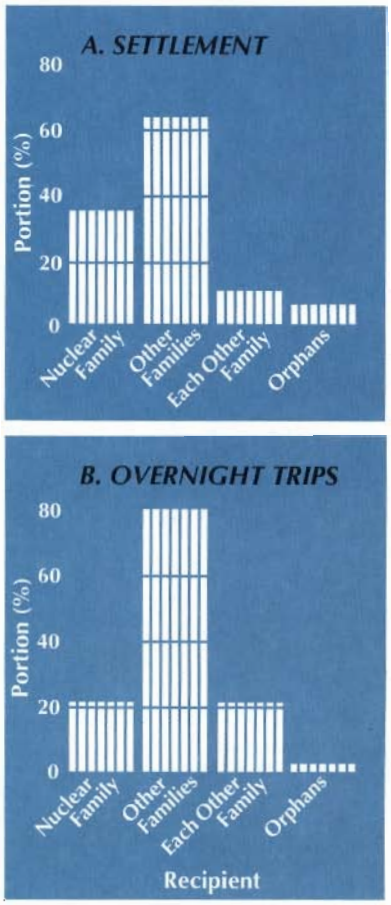

Figure 7. *Meat sharing at primary distributions (i.e., before cooking). The distribution was determined by weighing portions with a hanging spring scale and recording how much was retained by the nuclear family of the acquirer, or given to some other person. Total amount given to others is indicated, as well as the average amount that each other nuclear family received from the distribution.*

Discussion and Conclusions

These data provide some preliminary information about Yora subsistence, demography, and health. Since the data are derived from a brief field visit during the dry season and during a period in which the Yora were clearly suffering from the effects of new contacts with the Western world, they do not represent traditional Yora subsistence ecology as a whole. Nevertheless, even this initial data set has implications for the most important recent debate on the determinants of population density, settlement pattern, and political organization in Amazonia.

The tropical forests of the New World are seemingly among the richest habitats on Earth. Plants and animals are as abundant and diverse as anywhere in the world; temperatures are never extreme; and water is plentiful. Yet traditionally > 95% of the Amazon Basin has been sparsely populated by small groups of people that were politically autonomous. For the most part, explanations of settlement and population patterns have been ecological and based on hypotheses about resource constraints (for reviews see Gross 1975, 1983; Roosevelt 1980). Two major factors have been implicated in the search for ecological determinants of population densities in the Amazon tropical forests. First, the extremely low quality of interfluvial tropical soils limits their agricultural potential (Cochrane & Sanchez 1982; Meggers 1957, 1971, 1973; Roosevelt 1980). Second, a limiting factor may be dietary protein, most of which in the interfluvial areas is provided by hunting, which requires a large infrequently hunted territory. Gross (1975, 1982, 1983) has provided the most elaborate arguments in favor of this hypothesis.

Roosevelt (1980) observes that the "protein limitation hypothesis" is based on taking the interfluvial plantain- and root-crop complex as a given. Studies do indeed show that crops that do well in the interfluvial tropical soils of Amazonia are high producers of calories, but extremely low producers of other nutrients, notably the important macro-nutrients, lipid and protein. Therefore, population density may be limited by the amount of available land for producing calories or, more probably, by the quality of Amazonian soils, which results in the requirement of large hunting territories to obtain desirable protein intake levels.

Another possible explanation of low population densities in lowland Amazonia is the cost of clearing plant communities. This may be especially important for populations that do not use metal tools. Since the number of good locations for gardens may increase dramatically with the acquisition of metal tools, it is especially important to examine gardening constraints on traditional pre-Columbian native peoples (e.g., Carneiro 1974, 1979). In an experimental study of clearance costs using both metal and stone axes in Paraguayan subtropical forests, the authors found that while tree size affects clearance costs for both metal and stone tools, tree hardness has a much more dramatic effect on stone-tool felling times (Kaplan 1985). Although the data have yet to be fully analyzed, apparently for softwoods, felling times for the stone ax can be only three to six times greater than for the metal ax; whereas for hardwoods, the time cost for stone-ax clearance can be 60 times greater that for metal tools. This suggests that modern native populations using metal tools should have considerably higher population densities than pre-Columbian populations if time or energy were a limiting factor.

Some anthropologists (e.g., Beckerman 1979, Lathrap 1970), however, have suggested that current settlement patterns in Amazonia are more a function of recent history than of local ecology. Specifically, de-

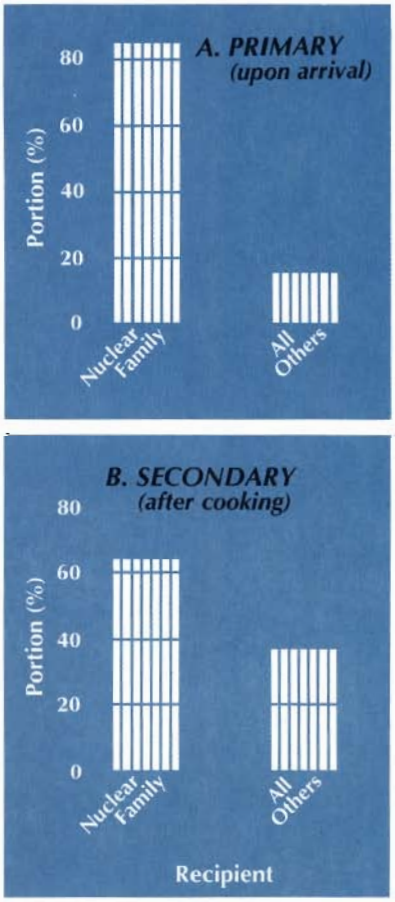

Figure 8. *Plantain distributions at the settlement, upon arrival from a collecting trip or after cooking.*

population has resulted directly from epidemics, slave raiding, and outright massacre consequent to European incursions into the area.

Chagnon (1968, 1974, 1979a) has argued that population densities, group size, and settlement location are all best explained by patterns of warfare, and that warfare is independent of resource constraints, but is instead motivated by competition for mates. Chagnon (1979b) also proposes that coefficients of genetic relatedness are important determinants of group size and warfare. Hames (1980) has used this perspective with some success to predict settlement patterns among the Yanomamö.

The preliminary results obtained in Manú Park suggest that settlement pattern in southeastern Peru cannot be explained by a unifactorial model. Virtually all of these factors appear to have had an effect on settlement patterns in the region. Historic depopulation through massacres and through illness has affected population density along the Manú River and, in fact, is associated with the Yaminahua "invasion" of the region. The Yaminahua engaged in territorial warfare which was responsible for group extinctions and apparently for the concentration of previously dispersed Machiguenga households in the settlement of Quebrada Fierro. Even small groups of people can deplete resources, both on land and in rivers, and in some areas this may pattern settlement size and duration, extensiveness of land use, and warfare.

Among the Machiguenga, who rely heavily on horticulture, the traditional response to game depletion may have been to live in dispersed and less dense settlements. The Yora, who rely less on horticulture, appear to respond to game depletion by adopting a pattern of extensive land use with frequent residential moves and territorial aggression (which, in turn, affected the Machiguenga pattern). The Machiguenga report that prior to the introduction of metal tools, the availability of potential garden plots (softwood forests located almost exclusively along the parts of river courses that flood seasonally) influenced decisions about where they should live. Yora reliance on foraging may be the result of very limited access to metal tools before 1984. The distance between river courses may therefore be an accurate predictor of the pre-Columbian distribution of horticulturalists and foragers in Amazonia.

These results seem to suggest that future research on settlement in Amazonia should move beyond debates regarding which factor determines the pattern, to more detailed studies of when and how each of the important factors comes into play and how those factors vary from region to region as a result of local ecology and history. Future research should concentrate on detailing the links between putative determinants and population results (for example, between game depletion, reproduction rates, and warfare), and on the causes of variability in cultural responses to the same ecological conditions.

The humanitarian implications of this research with the Yora are clear. All newly contacted native groups should be provided with immediate, long-term access to modern medical care. The Yora case is not unique. The authors' experience with the Ache in Paraguay and accounts of other contacts throughout Amazonia (Ciba Foundation 1979) show the same pattern. Once new diseases are introduced, intervisitation among groups leads to massive epidemics. If untreated, a third or more of the population can die within a very few years. Vaccination and then antibiotic administration can reduce mortality from these contact-related diseases to near zero. Too often, however, the initial response is too late. And, even more often, the groups are neglected after the initial excitement associated with contact wanes.

The authors believe that scientific anthropology and humanitarian

support can and should be integrated, and that anthropologists need not choose between pure research and efforts to aid traditional peoples (cf. Kolata 1987). Scientific investigation often generates the necessary funds to support long-term presence in the field during which anthropologists can combine research with assistance in health care, relations with outsiders, and land claims, as well as provide information about the world with which the Indians now have to deal directly.

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