

Yanomamö: Varying Adaptations of Foraging Horticulturalists

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The documentation of behavioral variation in cultural anthropology is key to scientific description and explanation. Early ethnographers were content to describe typical patterns of behavior to give readers an idea of what was expected or customary in a given culture. To understand variation in cultural practices, anthropologists who are engaged in cross-cultural comparison use individual societies as data points or exemplars of particular traits. Although comparative or cross-cultural approaches have been enormously productive, they are not the only useful approach to a scientific understanding of cultural variation. Within each society, individuals or even whole regions may vary enormously in how they conduct their social, economic, and political lives. Accurately documenting this intracultural variation and attempting to associate it with explanatory factors is an important alternative approach. This is not to say that intracultural comparisons are superior to or in competition with cross-cultural approaches. In fact, I would expect them to complement each other. For example, one might demonstrate cross-culturally that warfare is strongly associated with a particular environmental variable. This then might lead us to test that proposition within a particular cultural group if that environmental variable had enough variation.

The goal of this chapter is to describe variation in Yanomamö economic activities at cross-cultural, regional, and individual comparative levels. I will first compare Yanomamö horticultural adaptation to other horticultural groups. The striking finding here is that compared to other horticulturalists the Yanomamö spend an enormous amount of time in the foraging activities of hunting, gathering, and fishing. In many ways, they behave like hunters and gatherers, peoples without agriculture. I will

then turn to a regional comparison of Yanomamö economic adaptations by comparing how highland and lowland Yanomamö adapt to the rain forest. Here we will find that highland Yanomamö are much more dedicated to a sedentary horticultural life than lowland Yanomamö. Finally, I will turn to an analysis of individual Yanomamö to describe how sex and age determine the division of labor and the amount of time that individuals work.

DEMOGRAPHY, GEOGRAPHY, AND ENVIRONMENT

The Yanomamö are a tribal population occupying the Amazonian border between Venezuela and Brazil. In Venezuela, the northern extension of the Yanomamö is delimited to the north by headwaters of the Erebató and Caura rivers, east along the Parima mountains, and west along the Padamo and Mavaca in a direct line to the Brazilian border. In Brazil, they concentrate themselves in the headwaters of the Demini, Catrimani, Araca, Padauari, Urari Coera, Parima, and Mucajai rivers. In both countries, the total area inhabited by the Yanomamö is approximately 192,000 square kilometers. Dense tropical forest covers most of the area. Savannas are interspersed in forests at high elevations. In general, the topography is flat to gently rolling, with elevations ranging from 250 to 1,200 meters.

Area Exploited

The area village members exploit in the course of their economic activities is probably best characterized as a *home range*. Home ranges differ from territories because they are not defended, but like

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territories they tend to be used exclusively by a single group. This exclusiveness is not determined by force but by the following simple economic considerations. Important food resources tend to be evenly distributed in the tropical forest. When Yanomamö establish a new village they intensively exploit and deplete resources near the village. Through time, they must travel greater distances where higher return rates compensate for greater travel costs needed to reach areas of higher resource density. At a certain point, they will begin to reach areas that are exploited by neighboring villages and if they were to travel still further they would begin to enter areas close to neighboring villages that have been depleted. At this point, it is not economic to travel further since the costs of gaining resources increases (more travel time) while resource density decreases. Thus, the borders of home ranges are established with some overlap with the home ranges of adjacent villages. The point to understand here is that a village has near-exclusive use of its home range but that exclusivity is determined by economic factors and not by aggression or threat of aggression.¹

Where warfare is intensive, home ranges may become more like territories if enemy villages are neighbors. In such cases, exclusive use of an area is maintained through aggression or threat of aggression. However, it is difficult to determine what is being defended. It may be that the Yanomamö want to keep enemies out of their foraging areas so that they may hunt and gather without the worry of meeting a raiding party; or it may be that a powerful village decides to press its advantage over a weaker neighbor by expanding its range into a neighbor's area to monopolize all the resources in the area. The way in which Yanomamö verbally rationalize their reasons for warring complicates this matter further. Yanomamö may claim that they go to war in order to avenge an insult, a previous killing, an abduction of a woman, or the illness-causing spells cast by a neighboring shaman. Therefore, Yanomamö explain war in terms of vengeance for harm caused by an enemy. The problem here is that neighboring villages invariably have members who have done one or more of the above to a neighbor or a neighbor's ancestor. Why some past wrongs are ignored or acted upon may be

determined by economic (territorial) and political (opponent's strength or perceived threat) factors. Further complexities of Yanomamö warfare are described in the section on conflict below.

We have little comparative data on sizes of the home ranges of Yanomamö villages. Differences in home range may be the result of ecological differences in resource density or the distribution of neighboring villages. The limited data we have indicate that home ranges vary from three hundred to seven hundred square kilometers, roughly a circular area with a radius of ten to fifteen kilometers. This radius is approximately the distance one can easily walk through the forest in less than a day.

Demography and Settlement Pattern of Yanomamö Villages

Although ethnographers have done extensive and excellent demographic research on some Venezuelan and Brazilian Yanomamö, a complete census for Venezuelan and Brazilian Yanomamö is lacking. Current estimates are 12,500 and 8,500 Yanomamö in Venezuela and Brazil, respectively, for a total of 21,000. However, the figures for Brazil may be significantly less because of epidemics and white-Yanomamö fighting caused by incursions of Brazilian gold miners starting about 1987. I discuss this problem later. In Venezuela and Brazil, there are approximately 363 villages ranging in size from 30 to 90 residents each. But some Venezuelan villages in the Mavaca drainage may reach two hundred or more. Napoleon A. Chagnon² provides evidence that warfare intensity is associated with village size: Where warfare is intense, villages are large. People are forced to associate in large villages both to deter attackers and enable themselves to mount effective counterattacks. Population density ranges from about 6.7 square kilometers per person to 33.5 square kilometers per person.

Anthropologists consider stable settled life one of the important consequences of the agricultural revolution. Although the Yanomamö are agriculturalists, villages are unstable in duration, location, and membership. A typical Yanomamö village (*shabono*) has the shape of a giant circular "lean-to" with a diameter of fifty meters or more

depending on the number of people living in the village. Each house or apartment section of a village has a roof and a back wall but no front or side walls. Individual family lean-tos are joined in a circle. When a Yanomamö sits in his hammock and looks left or right he sees his next-door neighbor; if he looks straight ahead he sees a broad plaza and the dwellings of neighbors on the other side of the village. A village structure rarely lasts more than a few years before the roof thatch begins to rot and the entire village becomes filled with vermin. On such occasions, a new village may be constructed adjacent to the old one.

Aside from the reasons stated above, Yanomamö villages are relocated about every five years because of economic and political considerations.³ The practice of shifting cultivation forces the Yanomamö to use extensive tracts of land. This is because garden land is used for only two to three years, and then, abandoned to the encroaching forest. Through time gardens become increasingly distant from the village. When gardens or easily accessible garden land become too distant, the village may move several kilometers to be in the midst of good garden land. Raiding provides a political cause for village relocation. When a village is repeatedly raided by a more powerful enemy, the entire village may be forced to relocate. Such moves are designed to put as much distance as possible between themselves and an enemy and may cause great privation due to loss of easy access to productive gardens.

Highland and Lowland

There is good reason to suspect that there are fundamental differences in environmental quality for Yanomamö who occupy highland and lowland elevations. Defining a precise boundary between the highlands and lowlands is impossible at this point. However, I tentatively define highland populations as villages found in areas higher than 500 to 750 meters of elevation and occupying areas of highly dissected and hilly terrain with small fast flowing streams and occasional savannas. The lowland environment is flatter with slowly moving, larger streams and rivers. This highland-lowland distinction appears to have important implications for the fundamental

economic activities of gathering, hunting, fishing, and agriculture.

General ecological research provides considerable evidence that plant biomass and diversity decrease with increases in altitude. Detailed ethnographic research on the Yanomamö points to a similar conclusion. For example, ethnobotanical research by Lizot⁴ shows a greater variety of edible plants are available to lowland groups, more plants are restricted to lowland environments, and, on average, more edible plants are available on a monthly basis for lowland groups. In addition, the cultural geographer William Smole⁵ notes a decrease in edible plants with increasing elevation. Although it cannot be positively concluded that gathering is more productive in lowland areas because plants differ enormously in food value, processing costs, density, and seasonal availability, available data show that the rate of return in gathering wild forest resources is much greater in lowland than in highland areas.⁶

It is well established that fish are more abundant and larger in the wider, slower moving rivers in lower elevations.⁷ A comparison of sites reveals that groups living along large streams or rivers consume twice as much fish and other aquatic prey (frogs, caimans, and crabs).⁸ In addition, these lowland groups gain fish at efficiencies two to three times higher than highland groups.⁹

The evidence on game density is less direct. However, it is my impression (based on Yanomamö statements and direct observation) and that of other Yanomamö researchers¹⁰ that game animals are much less abundant in higher elevations. In terms of kilograms of game killed per hour of hunting, Colchester shows that the highland Sanema Yanomamö hunt much less efficiently than lowland Yanomamö.¹¹ Because both highland and lowland groups use the same bow and arrow technology and are equally adept hunters, it can be concluded that the greater hunting success of lowlanders is the result of greater game densities in the lowlands. A review of the ecological and biogeographical literature on altitude and animal biomass gradients suggests that huntable biomass declines with increasing elevation.¹²

We have no convincing comparative data to indicate significant differences between highland and lowland areas for agricultural pursuits. Agricultural productivity is a complex interplay of

many factors, such as soil quality, quantity and distribution of rain, and temperature extremes. It is clear, as I show below, that significant differences in garden size correspond to a highland and lowland divide. What is not clear, however, is whether these differences are the result of environmental, economic, or socio-political factors to be discussed below.

YANOMAMÖ ECONOMICS

Economically, the Yanomamö, along with most other tribal peoples living in the tropics, are classified as shifting cultivators because most of their dietary calories come from horticulture. However, a significant amount of time is allocated to the foraging activities of hunting, gathering, and fishing. In fact, as we shall see later, the Yanomamö allocate more time to foraging activities than they do to agriculture. Their dedication to foraging is greater than any other Amazonia group and any other horticultural group that we know of.¹³ Given this huge investment in foraging activities it might be more accurate to refer to the Yanomamö as "foraging horticulturalists." In this section, I describe the basic productive components of the Yanomamö economy.

Technology

Until the mid-1950s, the Yanomamö relied on a locally produced "stone age" technology, which was dependent on local, non-metal resources. For example, axes were made of stone, knives of bamboo, fish hooks of bone, and pots of clay. Since that time, much of their traditional technology has been replaced by steel cutting tools (machetes and axes), aluminum pots, and other industrial items given or traded to the Yanomamö primarily by missionaries. The main impact of such introductions has been to reduce labor time and increase Yanomamö dependence on non-Yanomamö to satisfy these new needs.¹⁴ In many instances the Yanomamö no longer possess the skills to make or use traditional technology, such as clay pots or fire drills.

Gardening

In shifting cultivation, forest is cleared with machetes, axes, and fires. The newly opened forest is

then planted with plantains, root crops (manioc, sweet potatoes, and taro) and a large variety of plants that serve as relishes, medicines, and technology sources. After about two to three years of cultivation, the garden is abandoned to the encroaching forest. In most years, Yanomamö add to the size of a current garden by clearing adjacent forest. As yields begin to diminish and weeding becomes time consuming, they cease to work old areas of the garden and let them naturally revert to scrub and, later, to forest. Men do nearly all the heavy work involved in clearing, such as slashing the undergrowth and felling large forest trees. Men and women work together to plant the garden and women are responsible for the nearly daily trips to the garden to harvest and weed.

There is considerable variation, as Figure 1 clearly indicates, in the amount of land under cultivation per capita in Yanomamö villages. Per capita land cultivated in highland villages averages five times as much as in lowland villages, a difference that is statistically significant. At least two possible ecological and economic explanations exist for these differences. Garden land may not be as fertile in higher elevations, or basic crops may not be as productive because of the cooler temperatures in highland areas.¹⁵ As a result, highlanders are forced to increase garden size to produce the same quantity of plantains as lowlanders. A second reason to cultivate less land in lowland areas is that foraging success (efficiency) is greater in lowland areas, therefore lowlanders may gain a larger fraction of their diet from foraging, which lessens their dependence on garden food.

There is a basic contrast in subsistence crops relied upon by highland and lowland groups that

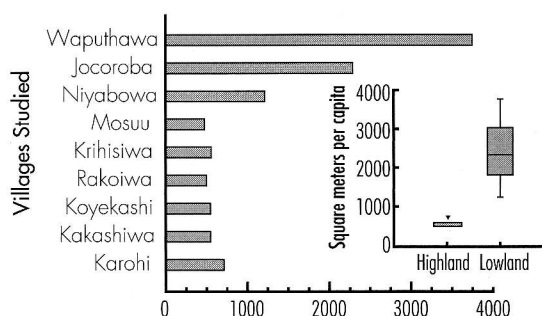


FIGURE 1 Garden Land Per-Capita (m²) in Nine Villages, and Low-land/Highland Contrasts

may have far-reaching consequences in helping us understand their economic differences. Lowland groups rely on plantains and bananas as the basic subsistence crop while some highland groups rely more heavily on manioc, a very productive root crop. Where either crop is a staple, it contributes up to forty percent or more of all dietary calories. This difference leads us to ask why some highland groups depend on manioc and what impact dependence on one or the other has on the overall Yanomamö economy. Colchester suggests that manioc is a recent introduction from neighboring groups such as the Ye'kwana.¹⁶ Where manioc has been introduced, the Yanomamö have taken it up because it appears to be a forty percent more efficient source of calories than plantains. However, this alleged advantage may disappear because the comparative data on efficiency do not consider processing costs. Some varieties of manioc become poisonous ("bitter") soon after harvesting and must be detoxified. In addition, many varieties require a laborious process of peeling, grating, and baking before consumption. Plantains, in contrast, are easily peeled and quickly cooked by roasting or boiling. Chagnon makes an opposite argument by suggesting that manioc was aboriginal with the Yanomamö and it was replaced by plantains (an Old World crop introduced by the Spanish more than four hundred years ago) because plantains were a more efficient producer of calories.¹⁷ Unfortunately, neither Colchester or Chagnon have quantitative data to back up their claims. Clearly, relatively simple research could help settle this issue.

Whether or not manioc or plantains are ancient or recent introductions, dependence on one or the other may have a strong impact on the Yanomamö economy. The key issue here is not one of efficiency but of reliable and predictable yield. Tropical forest peoples tend to rely on crops that can be harvested over a long time. In contrast to temperate horticulturalists, many tropical peoples who grow root crops or plantains do not harvest their entire field during a single harvest period and do not store the crop to tide them through seasons when crop growth is impossible or risky. Instead, tropical cultivators stagger-plant throughout the year so that what is needed can be harvested from the field every few days or weeks. For example, one can harvest manioc six, twelve, or eighteen or more

months after it is planted. This allows the manioc cultivator considerable flexibility in insuring a steady and reliable yield. Plantains, in contrast, have much less flexibility. Although Yanomamö attempt to stagger-plant plantains to gain a reliable weekly or half-weekly yield, a variety of environmental factors thwart this strategy. Dry spells can hasten maturation while prolonged wet spells slow maturation. Also, heavy winds that accompany violent thunderstorms may blow down plantains with heavy maturing racemes (bunches). Yanomamö can salvage blown down bunches of plantains (if they're close to maturation) by hanging them in the village. When the plantains ripen there will be a momentary glut of food, but there will be a lack of plantains in the near future when they would have otherwise matured.

Heavy dependence on plantains by lowland groups may help us to understand their greater reliance on gathering compared to manioc-producing highland groups. Since plantains are far less reliable than manioc, lowland Yanomamö may be forced to gather because of periodic underproduction of plantains. Evidence consistent with this idea is presented in Table 1. The only highland group on which we have time allocation (Sanema, in the table) shows that the average adult spends only twenty-six minutes each day gathering, which is the lowest figure in the table and fully one-half of the average time allocated to this task in lowland villages.

If manioc is more reliable than plantains we must ask why plantain-growing lowlanders do not grow more manioc than they currently do. Because lowland gathering is about twice as efficient as highland gathering, it may mean that unreliable plantain production is buffered by highly productive gathering. Because the overall work effort for the highland Sanema is essentially identical to the average level of work for lowland villages (see the Total column in Table 1), I suggest that this is clear evidence that plantain gardening coupled with a high reliance on gathering causes no discernible hardship in overall work effort.

Foraging

Foraging is the simple extraction of resources from the environment without any attempt to modify the environment (as agriculture does) to

TABLE 1 Time Allocation in Eight Yanomamö Villages (Minutes per Day)²⁵

Village	Hunt	Fish	Garden	Gather	Cook	Manufacture	Misc	Total	Source
Bisaasi	83	86	29	51	42	43	33	367	2
Hasubë	65	19	40	100	ND	ND	ND	^a	4
Koyekashi	42	85	85	66	26	36	17	357	3
Krihi	32	108	32	54	26	58	65	375	2
Mishi	13	109	81	53	37	149	17	459	1
Rakoi	12	109	44	24	27	68	76	360	2
Sanema	70	15	52	26	59	118 ^b	ND	350	5
Toropo	61	56	43	55	41	69	35	359	1
Yanomami	38	40	38	45	54	52	84	357	2
Mean	50	64	45	52	37	62	49	359	

Sources: 1 = Hames, 1989; 2 = Hames, b; 3 = Lhermillier, 1974; 4 = Good, 1989; 5 = Colchester, 1984. ND = no data.

^a total not given because of incomplete data

^b technology and maintenance activities are combined and column mean ignores these figures

increase the yield of that which is harvested. Hunting, gathering, and fishing are the basic foraging activities. Foraging is the most ancient technique humans use to exploit the environment and is an adaptation that humans share with all other animals. What is interesting about Yanomamö foraging is the large amount of time they allocate to it. As time allocation statistics in Table 1 indicate, Yanomamö allocate more than twice as much time to foraging as they do to gardening.

Given the amount of time the Yanomamö spend foraging on a daily basis, the term *foraging horticulturalists* might be an apt designation for their economic adaptation to the tropical forest. The logic of this designation is reinforced further by the Yanomamö practice of *waiyumö*, or trekking. Trekking is camping in the forest and subsisting mostly by foraging. It usually occurs in the dry season when there is an abundance of forest fruit and the dryness makes walking and camping out pleasant. The probable motivation behind most trekking is to save travel time by taking advantage of abundant vegetable resources distant from the village. However, trekking may also be stimulated by a shortage of garden food or the presence of powerful enemies. If the latter is the cause, then trekking is an adaptation designed for concealment against enemies. Treks may last a week to more than a month and normally include all village members. Dependence on wild resources is not total; young men are sent from forest camps to gardens to harvest plantains if the wild resources are scarce.

Hunting

Hunting is the main source of dietary protein for the Yanomamö. As we shall see in the time allocation statistics, hunting is essentially a male activity with important social and ritual functions. Bows and arrows, which measure approximately two meters in length, are the main weapons of the hunt. The long arrow is not accurate beyond about thirty meters. This is of little significance in dense tropical forest where it is rare to have a clear shot at a greater distance.¹⁸ Skills in locating game and stalking it to a short distance are abilities that differentiate good from poor hunters. Game sought ranges from 1-kilogram birds, to 25-kilogram peccaries, and to the occasional 175-kilogram tapir (the largest terrestrial animal in South America). Yanomamö quivers contain large lanceolate (spear shaped) tips for big game, poisoned pencil-shaped tips for monkeys, and harpoon points for birds and small terrestrial game. Because arrows are two meters long, a hunter can carry no more than three arrows on a hunt; however, hunters carry a case that contains a repair kit of thread, resin, and a hand tool to repair damaged arrows.

Although most hunting is done by individuals or pairs, organized group hunts occur under two important circumstances. If a hunter discovers a herd of white-lipped peccaries (a distant relative of the pig weighing twenty to thirty kilograms), he carefully notes the location and immediately returns to the village to alert other hunters who return to cooperatively hunt the herd. To prepare

for a feast (*reahu*), organized hunting parties travel great distances and may continuously hunt for a week in order to amass a large quantity of game to provide high-quality meals for visiting allies on a variety of social occasions (*reahu* and *braiai* rituals). During these excursions hunters especially seek highly esteemed game, such as peccaries, turkey-like birds, and monkeys.

Gathering

The harvesting of wild plant resources is an activity that includes all ages and sexes and is commonly organized by families and groups of families. Important resources include honey, palm fruits, brazil nuts, palm heart, and cashew fruit. Men specialize in the risky task of climbing trees to shake loose fruit or to sever fruit-laden branches. The peach palm is especially important. It is planted in gardens but it only begins to yield several years after a garden has been abandoned and it continues to bear for a decade or more. The Yanomamö assert that peach palms are owned by those who planted them and it is not uncommon for disputes to arise over ownership. With the exception of the peach palm, the Yanomamö make little or no effort to harvest fruit trees or palms so they may be harvested on a sustained basis. The Yanomamö fell small, fruit-laden trees to make harvesting easier, but never such forest giants as Brazil nut or cashew trees because of the enormous labor required.

Fishing

Most Yanomamö villages occupy areas between major rivers that are crossed by small streams. Fish found here are seldom larger than a few kilograms. Nevertheless, fishing is widely and avidly pursued by all ages and sexes, especially in the dry season through hand catching, stream poisoning, and archery. In the dry season, small streams begin to shrink, leaving fish in large ponds or cut-offs. The Yanomamö will use a vegetable poison to stun fish and cause them to rise to the surface where they can be grabbed or shot with a miniature bow and arrow. Women sometimes will jointly push a long, broad palm frond through the water to herd fish towards a bank where they can be trapped.

MARRIAGE AND FAMILY

Yanomamö marriage rules prescribe that marriage partners ought to be cross-cousins. Ideally, mates are double cross-cousins, a result of the practice of sister exchange. Soon after their first menses, women typically marry men in their early twenties. Although women are required to reside in their husband's village after marriage (patrilocal marriage), a husband must initially live with his in-laws for several years and work diligently for them, performing what is known as bride service. This requirement may be relaxed for high-status males. Polygyny (a man having more than one wife) is permitted; ten to twenty percent of all males at any time are polygynists. Ideally, polygynists marry sisters (sororal polygyny) because the Yanomamö believe that sisters get along better. If a woman's husband dies, she may be required to marry his brother (levirate marriage) and if a man's wife dies he may claim her sister as a bride (sororate marriage). Men and women average 2.8 marital partners during their lifetime, with about seventy-five percent of those marriages ending as a result of divorce with the balance as a result of death of one of the partners.¹⁹

Monogamous or polygynous nuclear families are the rule among the Yanomamö. Deviations from this pattern occur when aged parents live closely associated with married children or when newly-weds dwell with one or the other's parents. Each family has a garden or gardens and is responsible for basic subsistence activities.

POLITICAL ORGANIZATION

Each Yanomamö village is an autonomous political entity, free to make war or peace with other villages. Coalitions between villages are important; nevertheless, such coalitions tend to be fragile and ephemeral. Although the Yanomamö are an egalitarian people, age, sex, and personal accomplishments are important in status differentiation. Yanomamö men acquire high status through valor in combat, accomplished oratory, and expertise in shamanism. However, high status cannot be inherited—it must be earned. Mature men dominate positions of political authority and religious practice. Local descent groups play important roles in regulating marriages and settling disputes within the village.

The village headman is the dominant political leader and comes from the largest local patrilineage (a kin group whose members trace descent through male relatives). When a village is large or when two local descent groups are approximately equal in size, a village may have several headmen. The headman must rely on demonstrated skills in settling disputes, representing the interests of his lineage, and successfully dealing with allies and enemies. Styles of leadership vary: some headmen lead through practiced verbal skills while others resort to bullying. Concerted action requires the consensus of adult males. However, an individual is free to desert collective action if it suits him.

Villages range in size from about forty residents to more than two hundred. As a village increases in size it has a tendency to break into two groups of approximately equal size, which form new villages. As villages become large, kinship relationships become weaker and village headmen are less able to amicably settle disputes.²⁰ In addition, local resources tend to be more quickly depleted, which causes an increase in work effort.²¹ However, if warfare is intense village members are more likely to realize the value of large size as a deterrent against enemies and are more likely to tolerate irksome co-villagers and increased work loads.

Social Control

Conflicts typically arise from accusations of adultery, failure to deliver a betrothed woman, personal affronts, stinginess, or thefts of coveted garden crops such as tobacco and peach palm. For men, if such conflicts move past a boisterous shouting match, a variety of graded, formal duels may occur. If a fight becomes serious, respected men may intervene to cool tempers and prevent others from participating. Frequently, duels end in a draw, which allows each contestant to preserve his dignity. For women, dueling is rare. Instead, a direct attack is made by the aggrieved woman using hands and feet or makeshift weapons.

Conflict

Warfare between villages is endemic among the Yanomamö. While the initial cause of a conflict may be frequently traced to a sexual or marital issue, conflicts are self-perpetuating since the

Yanomamö lack any formal mechanisms to prevent aggrieved parties from exacting the amount of vengeance or counter-vengeance they deem sufficient once a conflict has started. The primary vengeance unit is the lineage, but co-resident non-kin have some obligation to assist, because co-residence with a feuding faction is seen as implicit support of the faction by the faction's enemies. Most combat is in the form of stealthy raids. The goal is to quickly kill as many of the enemy as possible (who frequently are found on the outskirts of the other village engaging in mundane activities), abduct nubile women if possible, and return quickly home. Although the primary goal is to kill mature men and their kin believed to be responsible for a previous wrong, unrelated co-villagers may be killed if there is no safe opportunity to kill primary targets. Endemic warfare has a profound effect on politics and settlement size and location. Each village needs at least one allied village it can call upon for assistance if it is over-matched by a more powerful enemy; and village size and distance between villages tend to increase with the intensity of conflict. Peace between villages may develop if conflict has remained dormant for a long period and there is a mutual need for an alliance in the face of a common enemy. It begins with a series of ceremonially festive visits. If old antagonisms do not flare, visits may lead to joint raids and intermarriage between villages that strongly solidify an alliance. Proximity of missions and government agencies has had little impact on warfare.

MAJOR CHANGES

Over the last twenty years, most Yanomamö have become totally dependent on outside sources of axes, machetes, aluminum cooking pots, and fish hooks and line. These metal goods have replaced much of their stone-age technology. Most of these items have come from missionaries as gifts and wages. Through mission-organized cooperatives, the Yanomamö recently have begun to market baskets and arrows and some agricultural products.

Missionary presence also has distorted the traditional Yanomamö settlement pattern. Yanomamö attempt to gain easy access to mission outposts by moving their villages near a mission. As a result, the normal spacing of about a day's walk between

villages has diminished dramatically. For example, around the Salesian mission at Mavaca there are five villages and numerous small settlements with a total population of about nine hundred people within one day's walk. This population density is unprecedented for the Yanomamö and has led to severe depletion of wild resources. In addition, a significant fraction of that population no longer lives in traditional round communal villages but rather in small settlements of two to three houses occupied by a few families. Despite these changes, missionaries have failed to gain significant numbers of Yanomamö converts to Christianity. The Yanomamö have enormous pride in their culture and have strong doubts about the authenticity or superiority of Christian beliefs.

However, the greatest change and threat to the Yanomamö are the thousands of Brazilian gold miners who have infiltrated Yanomamö territory in Brazil and who have again (July 1993) illegally entered into Venezuela and this time killed seventeen men, women, and children. The situation in Brazil is similar to the situation in the United States in the 1800s when whites expanded into the lands of Native Americans. Miners bring epidemics of measles and influenza that lead to high mortality rates among the Yanomamö. Gold processing pollutes streams with mercury, killing fish and ruining a village's water supply. And open warfare between miners and Yanomamö has killed numerous Yanomamö and disrupted village life.²²

TIME ALLOCATION

In the West, we tend to think of work as something done away from the home for forty hours a week. In subsistence-based tribal populations, this sort of definition is as inadequate for them as it is for us. Although it is true that the Yanomamö, for example, leave the village to travel to garden, forest, and stream to acquire resources, much work takes place in the village. But the same thing is true in the West. Driving to work, mowing the lawn, shopping for food, washing clothes, and all those other household chores that must be done are not what we would call leisure time activities. We do these tasks to maintain our material well-being. I believe that most of us would define

leisure time activities as including dining out, going to the movies, visiting friends, and playing sports. Therefore, one can define work as all those other activities we must do to maintain or enhance our material existence. Clearly, adults in the West work more than 40 hours per week if we use this expansive definition of work. Researchers who have investigated time allocated to work in the West show that urban European and North Americans work on average 55 to 65 hours per week, or 7.8 to 9.3 hours per day, seven days a week.²³

Table 1 presents time allocation data for adults in eight Yanomamö villages on a basic set of work activities. The table reveals that the Yanomamö work about 6 hours per day (360 minutes) or 42 hours per week. This is significantly less than the 55 to 66 hours of work in modern societies. Furthermore, if we compare Yanomamö and related simple tropical horticulturalists to other types of economies (hunters and gatherers, pastoralists, agriculturists, etc.), we find that they are among the most leisured people in the world.²⁴

Although Table 1 shows little variation in overall labor time (mean 359, SD 7.88), considerable variation exists among villages in time allocated to various subsistence tasks. Much of the variation can be attributed to local conditions, such as the season in which the researcher collected the data, the degree to which a village is associated with missionaries, or special environmental conditions. Nevertheless, the only highland site, Sanema, shows some interesting patterns. This village allocates the third-most time to gardening, the least time to fishing, the second-least amount of time to gathering, and the second-most amount of time to hunting. Gathering and gardening times are probably related, as I suggested earlier. Because the density of wild sources of plant food is lower in the highlands, foraging is not as productive, which leads highlanders to spend more time gardening. Related to this is the higher reliability of manioc gardening, which makes gathering less of an important alternative source of vegetable foods. Another way of expressing the contrasting dependence on foraging (hunting, gathering, and fishing) and gardening in highland and lowland locales is to note that the highland population spends the least amount of time foraging and has the lowest ratio of foraging time to gardening time

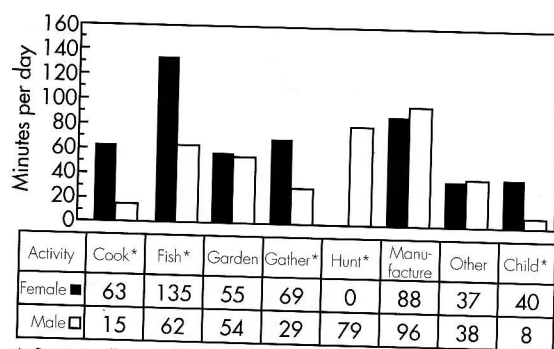
(2.13:1.0 compared to a mean of 4.43:1.0 for the lowlanders).²⁵

The extremely low amount of time highlanders allocate to fishing and the relatively high amount of time they allocate to hunting are also related. Highlanders do little fishing because of difficulties exploiting steep and narrow highland streams. Because fishing and hunting are the only ways of gaining sufficient high-quality protein to the diet and fishing is unprofitable, highlanders are forced to hunt more intensively.

DIVISION OF LABOR

As Figure 2 indicates, women spend significantly more time in cooking, fishing, gathering, and caring for children than men do, whereas men spend more time hunting than women. From what we know about the division of labor cross-culturally, these differences in time allocation are not surprising. In all cultures, hunting is either predominantly or wholly a male activity. Although the data indicate that Yanomamö women do almost no hunting, some qualifications are necessary. Yanomamö women occasionally accompany men on hunting forays to act as spotters and to assist in the retrieval of game. Rarely do they ever make kills while with men. However, they occasionally make fortuitous kills of their own while gathering or fishing. Such kills are made without the use of bows and arrows.

Although the data show no significant difference between men and women in gardening, there are important differences in garden tasks performed. Men almost exclusively do the heavy work



* Statistically significant difference at 0.05 level or better

FIGURE 2 Male and Female Time Allocation to Basic Economic Tasks

of felling large trees, slashing the undergrowth, and burning the resulting debris prior to planting. Both sexes share in planting, whereas the daily tasks of weeding and harvesting fall almost exclusively to women. The pattern of men doing tasks which are dangerous and/or take them far from home is consistent with Judith Brown's model of the division of labor.²⁶ Brown suggests that women tend to dominate tasks that are compatible with simultaneous child care. Such tasks are not dangerous, can be accomplished near to home, and can be interrupted and resumed with no loss of efficiency.

While Brown's model usefully captures much of the variation in the division of labor among the Yanomamö and other groups, it does not explain why women who are post-menopausal or otherwise unencumbered with intensive child care do not, for example, engage in hunting or tree felling. For dangerous and arduous activities, such as tree felling, it is probable that models that focus on physical strength differences may be useful. Or perhaps task linkages are required to complement Brown's model.²⁷ However, lack of female participation in hunting may require yet another explanation. Hunting is a highly skilled activity that is not easily learned and requires frequent practice to maintain proficiency. On average, little Yanomamö boys spend sixty to eighty minutes per day playing with bows and arrows and spotting, tracking, and stalking small birds and other tiny game near the village. It may be the case that women don't hunt because they never acquired the skills necessary to become proficient hunters.

The question of whether men or women work more can be answered only if we have a reasonable definition of work. Generally, economic anthropologists define work as all of those activities required to directly maintain and enhance survival and reproduction. Thus, it includes rather obvious activities such as the provisioning and preparing of food, construction and repair of tools and shelter, and the acquisition and management of fuel (or firewood, in the case of the Yanomamö). If we use this definition of work, Yanomamö women work about twelve minutes per day more than men, but the difference is not statistically significant. This finding is rather interesting because, in the vast majority of horticultural tribal populations on which we have time

allocation data, women work significantly more than men.²⁸ The only societies in which men work significantly more than women are hunters and gatherers. That Yanomamö men and women work approximately equally is therefore consistent with the point made earlier: That they can be best characterized as foraging horticulturalists because their time allocation patterns fall between horticulturalists and hunter-gatherers.

Some may consider this definition unnecessarily restrictive because it ignores a task that is critical for the long-term survival of the Yanomamö: child care. The tropical forest harbors many sources of environmental trauma that are very dangerous to infants and small children. Inside and outside the village there are stinging and biting insects, dangerous plant spines, and poisonous plants, snakes, and insects. Infants and small children are protected from these threats by being carried in slings much of the time and actively watched when they are set down.²⁹ Although caring for infants and small children in this way may be pleasurable, it is also exhausting and difficult. And recall that I defined work as those things we do to enhance or maintain our physical well-being. Just as the Yanomamö labor to provide food for their children, they also physically care for them. To assess the impact of child care on overall labor time differences, I must restrict my analysis to data I collected on four Yanomamö villages (Mishimishimaböwei, Rakoiwä, Krihisiwä, and Bisaasi) because none of the other studies collected child care data. When I include direct child care activities (carrying, feeding, nursing, holding, etc.),³⁰ female work time increases by forty-three minutes per day while male work time increases by only eight minutes per day. If child care activities are added to conventionally defined labor, then Yanomamö women work more than men.

Status and the Allocation of Labor

The Yanomamö, like all people, exhibit strong individual differences in the amount of labor they perform that are independent of sex. Factors such as age, number of dependents, and marital status should logically help us to understand much of the variation. For example, one would expect that a married couple with numerous dependent children to labor more than newlyweds with no

dependents. Such a prediction is based on a number of assumptions, such as each family is wholly responsible for supplying its economic needs and economic resources are freely available. Although this latter assumption is correct for the Yanomamö, the former is suspect, as I will later explain. In this section, I will examine the degree to which age determines individual labor time allocation.

Child Labor Trends

On the basis of our own experiences we expect that the amount of work one does will increase with age and that it eventually begins to diminish when one retires or becomes physically incapacitated. We also tend to believe that childhood should be a carefree time with little in the way of work responsibilities—a time for play, exploration, and learning. An examination of Yanomamö time allocation data will allow us to evaluate all of these ideas; and, because the Yanomamö are relatively typical representatives of the tribal world, we can get a sense of whether our Western experience is in any way typical over the history of humankind.

Figure 3 shows the amount of time children from ages five through eighteen allocate to labor time activities.³¹ As can be easily seen, labor time does generally increase with age of the child. The rate of increase is uneven only because of small sample sizes in some of the age groups. Over the chart, I have superimposed adult male and female labor time. You will note in this graph that the females work significantly more (421 min./day) than males (372 min./day). These figures differ from the ones given earlier in the ten-village comparison because they derive from the

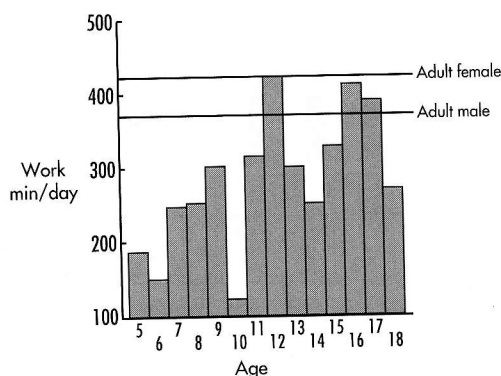


FIGURE 3 Labor Time of Children

four villages I studied. I use this smaller data set here because it is the only one broken down by age. As the figure indicates, boys and girls begin to achieve adult labor time levels by the time they become teenagers.

The data presented seem to indicate that childhood is brief and children are quickly recruited into the family work force. To some extent these figures are an artifact of the method I used to collect time allocation data. If I could not observe someone when I was sampling behavior, I had to rely on reports of what they were doing. For example, someone would tell me that all the members of a particular family were in the forest gathering wild palm nuts or weeding the garden. When I was able to accompany families on their economic activities, I found that children did work but not as hard or as constantly as adults: They worked about forty to eighty percent as much as adults when, for example, a garden was being weeded. Nevertheless, the data tell us something important about work and family life that provides a strong contrast to what occurs in the urban West. Yanomamö children work alongside their parents and are important to the household economy. The family unit does not separate in the morning; children and adults do not go their separate ways to school and work only to rejoin each other in the evening. "School" for a Yanomamö child is in the context of the family economy where they learn how to hunt, gather, garden, fish, and perform all the other activities necessary for them to become competent adults.

Adult Labor Trends

If we extend the analysis of time allocated to work across the entire life span, we expect to see labor time increase to a point and then decrease. This pattern, an inverted U-shaped curve, is evident for both men and women in Figure 4. However, the shapes of the curves are quite different. Male allocation of labor time begins at a lower level but increases rapidly until it peaks around age thirty-five, and then rapidly decreases thereafter. Females, in contrast, begin at initially higher levels, ascend more slowly to a peak at age fifty and then decrease their efforts much more slowly. The last point is rather interesting: the curve shows that women at ages thirty and sixty work about the same amount of time. The factors that

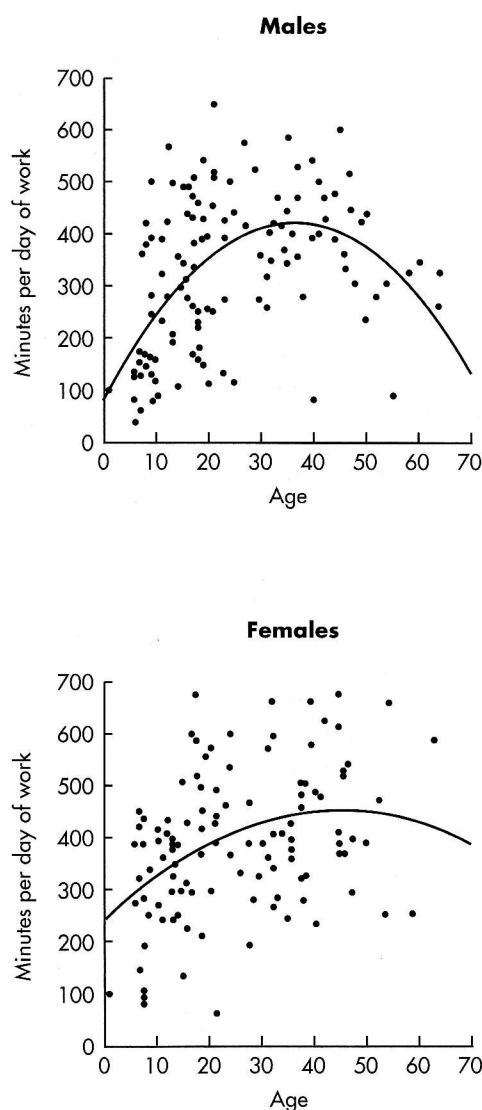


FIGURE 4 Work over the Life Span

account for these patterns are quite complex. Women engaged in active child care (for example, nursing) work less than women who are not.³² This fact probably accounts for female labor time peaking after menopause. Male labor time decreases quite rapidly after age thirty-five, but I am not sure why the rate of decrease is so much greater than for women. There are two inter-related possibilities. Because males have higher rates of mortality than women at all ages, they may also have higher rates of decrepitude than women, that is, their ability to do physically demanding labor may decrease more rapidly. Related to this trend is that as men become older

they work more at relatively sedentary tasks, such as manufacturing and the gardening tasks of weeding and harvesting, and work significantly less in hunting and clearing new gardens.

CONCLUSION

Since 1975, when Allen Johnson reintroduced anthropologists to methods for measuring time allocation,³³ studies of how people use their time have become increasing popular among anthropologists. In this chapter, I have attempted to show some of the uses to which time allocation can be put by showing how it can elucidate fundamental ethnographic problems in intracultural variation. I showed that differences in environment between lowland and highland Yanomamö lead to differences in the allocation of time to basic economic activities. We found that highland groups are much more tied to agricultural pursuits because of a lack of high-quality foraging resources. In the area of the sexual division of labor, we found that men and women work nearly the same amount of time but allocate their efforts much differently. In addition, we found that if child care activities are included in labor time, then women work significantly more than men. Finally, I showed that time allocation patterns show significant patterns associated with age. Both boys and girls are quickly absorbed into the family's labor pool and adult male labor effort peaks earlier and declines more quickly than it does for women.

In closing I should note that time allocation studies are not simply restricted to the documentation of variation in work effort. Researchers now use the method to quantify patterns of social interaction such as how much time husbands and wives spend together, the size and composition of play groups among children, and patterns of cooperation among co-villagers. So long as ethnographers are interested in quantitative measures of variation in social life we can expect that time allocation studies will play a central role.

Notes

1. R. Hames, "The Settlement Pattern of a Yanomamö Population Bloc," in R. Hames and W. Vickers, eds., *Adaptive Responses of Native Amazonians* (New York: Academic Press, 1983), pp. 192–229.
2. N. Chagnon, *Studying the Yanomamö* (New York: Holt, Rinehart & Winston, 1974).
3. N. Chagnon, *Studying the Yanomamö*; R. Hames, "The Settlement Pattern of a Yanomamö Population Bloc."
4. J. Lizot, *Les Yanomami Centraux* (Paris: Editions de L'Ecole des Hautes Etudes en Sciences Sociales, 1984), p. 54, Table 2.
5. W. Smole, *The Yanoama Indians: A Cultural Geography* (Austin: University of Texas Press, 1976).
6. M. Colchester, "Rethinking Stone Age Economics: Some Speculations Concerning the Pre-Columbian Yanoama Economy," *Human Ecology* 12 (1984): 291–314.
7. M. Goulding, *The Fishes and the Forest* (Berkeley: University of California Press, 1980).
8. G. Saffirio and R. Hames, "The Forest and the Highway," in K. Kensinger and J. Clay, eds., *Working Papers on South American Indians #6 and Cultural Survival Occasional Paper #11*, joint publication (Cambridge, MA: Cultural Survival, 1983), pp. 1–52.
9. R. Hames, "Time, Efficiency, and Fitness in the Amazonian Protein Quest," *Research in Economic Anthropology* 11 (1989): 43–85. Anthropologists measure the efficiency of subsistence activities in kilograms of food gained per hour of work, or kilocalories of food gained per kilocalorie of work.
10. W. Smole, pp. 81 and 227.
11. M. Colchester, p. 300, Table 2; Hames, "Time, Efficiency, and Fitness in the Amazonian Protein Quest," p. 64, Table 6.
12. J. Eisenberg, "The Density and Biomass of Tropical Mammals," in M. Soule and B. Wilcox, eds., *Conservation Biology: An Evolutionary-Ecological Perspective* (Sunderland, MA: Sinauer Associates, 1980), pp. 35–55; J. Eisenberg, M. O'Connell, and V. August, "Density, Productivity, and Distribution of Mammals in the Northern Neotropics," in J. Eisenberg, ed., *Vertebrate Ecology in the Northern Neotropics* (Washington, DC: Smithsonian Institution Press, 1979), pp. 187–207.
13. R. Hames, "Time, Efficiency, and Fitness in the Amazonian Protein Quest."
14. R. Hames, "A Comparison of the Efficiencies of the Shotgun and Bow in Neotropical Forest Hunting," *Human Ecology* 7 (1979): 219–252.
15. Data on Yanomamö garden size is from the following sources: E. Fuentes, "Los Yanomami y las plantas silvestres," *Antropologica* 54 (1980): 3–138; Smole, *The Yanoama Indians*, pp. 36–37; J. Lizot, "Economie Primitive et Subsistence: Essai sur Le Travail et L'alimentation Chez les Yanomami," *Libre* 4 (1980): 69–113; and J. Lizot, "La Agricultural Yanomami," *Anthropologica* 53 (1980): 3–93. Information on cultivated bananas and plantains can be found in N. W. Simmonds, *The Evolution of Bananas* (London: Longmans & Green, 1979).
16. M. Colchester, p. 301.
17. N. Chagnon, *Yanomamö: The Fierce People* (New York: Harcourt Brace Jovanovich, 1992).
18. R. Hames, "A Comparison of the Efficiencies of the Shotgun and Bow in Neotropical Forest Hunting."
19. T. Melancon, "Marriage and Reproduction among the Yanomamö of Venezuela" (Ph.D. diss., Pennsylvania State University, 1982). Cross-cousins are offspring of siblings of the opposite sex. For example, your father's sister's children are your cross-cousins and so are your mother's brother's children. Double cross-cousin marriage is set up when two men marry one another's sisters. The Yanomamö prescribe that the offspring of such unions should marry. These people are double cross-cousins because (using the male as an

- example) a male is marrying a woman who is simultaneously his father's sister's daughter and his mother's brother's daughter.
20. N. Chagnon, *Yanomamö: The Fierce People*.
 21. R. Hames, "The Settlement Pattern of a Yanomamö Population Bloc."
 22. N. Chagnon, *Yanomamö: The Last Days of Eden* (New York: Harcourt Brace Jovanovich, 1993); N. Chagnon, "Covering Up the Yanomamö Massacre," *New York Times*, October 23, 1993; see also Saffirio and Hames, on the impact of road construction on Yanomamö economy, and N. Chagnon and T. Melancon, "Reproduction, Epidemics, and the Number of Kin in Tribal Populations: A Case Study," in N. Keyfitz, ed., *Population and Biology: A Bridge between Two Disciplines* (Liege: Ordina Editions, 1984), pp. 147–167, on the effects of epidemics spread by whites.
 23. R. Hames, "Time, Efficiency, and Fitness in the Amazonian Protein Quest." Adult labor time is the average of male and female labor time.
 24. Sources for time allocation data in Table 1 are as follows: Colchester, p. 299; K. Good, "Yanomami Hunting Patterns: Trekking and Garden Relocation as an Adaptation to Game Availability in Amazonia, Venezuela" (Ph.D. diss., University of Florida, 1989); Hames, "Time, Efficiency, and Fitness in the Amazonian Protein Quest"; A. Lhermillier and N. Lhermillier, "Vie Economique et Sociale d'une Unite Familiale Yanomami" (thesis, L'Ecole Pratique des Hautes Etudes, 1974); Lizot, "Economie Primitive et Subsistence."
 25. Ibid.
 26. J. Brown, "A Note on the Division of Labor," *American Anthropologist* 72 (1970): 1073–1078.
 27. G. P. Murdock and C. Provost, "Factors in the Division of Labor by Sex: A Cross-Cultural Analysis," *Ethnology* 12 (1973): 206–212; M. Burton and D. White, "Sexual Division of Labor in Agriculture," *American Anthropologist* 86 (1984): 568–583. In their task linkage model Burton and White show that the sex that begins a task that has a series of steps is more likely to complete the subsequent steps. For example, if women harvest food they are more likely to perform the processing and storage tasks that immediately follow harvesting.
 28. R. Hames, "Time, Efficiency, and Fitness in the Amazonian Protein Quest."
 29. R. Hames, "Variation in Paternal Care among the Yanomamö," in B. Hewlett, ed., *The Father's Role: Cultural and Evolutionary Perspectives* (Chicago: Aldine de Gruyter, 1992), pp. 85–110.
 30. Ibid.
 31. The data reported here on the division of labor, male and female labor time, and child labor time are taken from data I collected in the villages of Mishimishimaböwei-teri, Rakoiwä-teri, Bisaasi-teri, and Krihisiwä-teri in 1986 and 1987. The data set consists of seventy-three adult females and seventy-six adult males. Adults are defined as anyone over the age of fifteen years who is married or has been married.
 32. Ibid.
 33. A. Johnson, "Time Allocation in a Machiguenga Community," *Ethnology* 14 (1975): 301–310. See also the continuing series of studies of time allocation, in various societies, that are published by the Human Relations Area Files.

Suggested Readings

- Biocca, E. *Yanoama: The Narrative of a White Girl Kidnapped by Amazonian Indians*. New York: E. P. Dutton, 1970. Helena Valero was captured by Brazilian Yanomamö when she was twelve years old. This book is the exciting account of her capture, problems in adjusting to Yanomamö social life, marriage to several Yanomamö men, and eventual release to missionaries.
- Chagnon, N. *Yanomamö: The Fierce People*. 4th ed. New York: Holt, Rinehart & Winston, 1992. This is perhaps the most popular ethnography written in the last several decades. It is an introductory yet detailed ethnography of the Yanomamö with a special focus on kinship, social organization, and politics.
- . *Yanomamö: The Last Days of Eden*. New York: Harcourt Brace Jovanovich, 1993. A more personal and accessible account of the Yanomamö than Chagnon's standard ethnography listed above. It presents a lucid picture of what it is like to do fieldwork with the Yanomamö and some contemporary problems faced by the Yanomamö.
- Early, J., and J. Peters. *The Population Dynamics of the Muijacaí Yanomamö*. New York: Academic Press, 1991. This monograph describes Brazilian Yanomamö with a special emphasis on demography in relation to social organization. In addition, it presents a novel explanation of mother-in-law avoidance by the son-in-law, a moderately common cross-cultural phenomenon.
- Lizot, J. *Tales of the Yanomami: Daily Life in the Venezuelan Forest*. Cambridge: Cambridge University Press, 1985. Jacques Lizot is a French social anthropologist who has worked with the Yanomamö for nearly two dozen years. He presents vignettes of Yanomamö life in novelistic fashion with stories of romance, vengeance, politics, shamanism, and women's lives.

CRITICAL THINKING QUESTIONS

1. Who are the Yanomamö and where do they live?
2. Define the differences, in terms of topography, available resources, soil productivity, forest cover, and other factors, between the highland and lowland environments of the Yanomamö.
3. What is trekking, and how does it supplement the Yanomamö horticultural economy?
4. What changes have occurred in Yanomamö culture since their introduction to Western goods and ideas?
5. Discuss the division of labor among the Yanomamö. What tasks are allocated to what group, and who seems to put more effort into the food production economy?

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