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A Study of the Comparative Ecology of African Gatherer-Hunters with Special Reference to San (Bushman-speaking People) and Pygmies

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Much importance has recently been assigned to hunting in hominid evolution. A considerable amount of ethnographic data have been accumulated on African hunter-gatherers in the past ten years.

In this paper, the G//ana of the arid Kalahari Desert with the Mbuti of the wet Ituri Forest are compared. Firstly, the vegetation of the African continent, taking the distribution of Anthropeida into account, is reexamined, and the vegetation of the habitats of the G//ana and Mbuti classified. Secondly, the similarities of material culture between two peoples with the same mode of subsistence and the differences caused by the extremely different environmental conditions of their habitats is discussed. Thirdly, the techniques of individual hunting in arid open lands and collective hunting in forests, because of the differences in environmental conditions, is described, as is the effect of different hunting methods on the organization of social groups. Finally, the social group unit in relation to hunting behavior is discussed, using data concerning the predatory behavior of primates and that of social carnivores which have been collected during recent field studies.

INTRODUCTION

Recent research on hunting-gathering peoples has revealed that about half of the human population of so-called hunters, living in various environments, base their livelihood on gathering plants. Furthermore, those peoples whose basic mode of subsistence is hunting or fishing—of which the Eskimos, Indians of the Arctic, the east Asian Yukaghir, Gilyak, South American Ona, and the Yahgan are prime examples—are limited in distribution to regions of higher latitude [LEE 1968; TANAKA 1971]. With increasing distance from the temperate or tropical zones, with their abundance of vegetation, towards the frigid polar regions, where the kinds and amounts of plant life decrease, hunting and fishing as the modes of subsistence are increasingly stressed. Archaeological and anthropological research on the distributions of living primates, fossil primates, and early hominids, leads to the unavoidable conclusion that man's earliest ancestors originated in the tropical regions of Africa or Asia, but, as the distribution of the human species spread into latitudes above 40 degrees, where poor

vegetation exists as an absolute environmental condition, the importance of gathering as a subsistence basis declined.

Of necessity, fishing or hunting replaced gathering and increased proportionately. In particular, those people—the Copper Eskimos, the Ingalik, the Nunamiut and the Yukaghir, for example—who live at latitudes higher than 50°N cannot live on vegetable food, for, at best, it makes up only ten percent or less of the gross weight of their diet.

In this way, groups which base their livelihood on hunting and fishing represent a kind of specialization appearing at a relatively later stage in human evolution in cold regions, where the environment allows for only meager amounts of plant life. When the subsistence mode of human hunter-gatherers is discussed from an evolutionary point of view, what must not be forgotten is that roughly half of the world's hunting-gathering societies live in low latitude regions. Seen from the perspective of those peoples whose livelihood is based on gathering vegetable food, one might say that it is more appropriate to call them "gatherer-hunters" than "hunter-gatherers".

In this paper, I focus on Africa, a continent where hominization is thought likely to have taken place, and where even today are found peoples who continue to preserve traditional gathering-hunting lifestyles. Over the past ten years, a large amount of ecologically based data has been accumulated on "gathering-hunting" peoples. As Lee, Woodburn and Tanaka have pointed out, among the present gatherer-hunters of Africa gathering activities may comprise up to 60–80 percent of their total subsistence activity [LEE 1968; WOODBURN 1968; TANAKA 1971]. Such peoples include the Hadza and the Ndorobo in East Africa, the Pygmies of the Congo Forest, and the northern, central and southern San of South Africa. Judging from the fact that the subsistence of the Hadza in the East African savanna, where game is more abundant than in the Kalahari, is based on gathering of approximately the same percentage (80 percent) as that of the G//ana, the Central Kalahari San, it can hardly be imagined that the ancient inhabitants of Africa once derived their diet primarily from hunting, even if the environmental differences between the Pleistocene and the present are taken into account [TANAKA 1976: 116]. It is clear that these gathering-hunting peoples who live at low latitudes fundamentally base their existence on vegetable food and are in fact "gatherers". Lee says that apart from the exception of the Paraujano of South America, all the remaining gathering-hunting peoples obtain at least twenty percent of their total food supply by hunting mammals, which points up the importance of hunting within a gathering-hunting economy [LEE 1968]. Since man habitually hunts and eats meat, it has been said that hunting has played an important part in the process of hominization. Meat was probably important in the sense that its attractiveness led to habitual hunting and caused qualitative changes in the mode of subsistence, rather than as a quantitatively dominant food input.

Looking into the meaning of hunting in the progress of hominid evolution, we find that the habitat of the African gathering-hunting peoples closely resembles that in which the higher primates live—such as the chimpanzee and the baboon, which, according to the findings of recent field studies on primates, have a high frequency of

predation (hunting). Studies based on this discovery offer many profitable ideas.

Recent research by Schaller and Lowther on carnivores stresses the points of similarity in the hunting behavior and group structure among social carnivores and human hunting-gathering societies [SCHALLER and LOWTHER 1969], and based on these similarities the problems of hunting as a mode of subsistence and the plan of the society in which it is contained must be given consideration.

In the following sections, based on investigations covering the ten years from 1966 to 1976 with the G//ana people who belong to the Central San, I undertake a comparative study of the G//ana San and the Mbuti Pygmies, focusing on each mode of subsistence in relation to the respective natural environments: the G//ana living in the arid area and the Mbuti in the wet Congo Forest. I describe the structure of the life of African gatherer-hunters and, in light of this, outline the hunting behavior of non-human primates and carnivores with an aim toward thus explaining the meaning of hunting as a mode of subsistence in hominid evolution.

1. ENVIRONMENT OF THE HABITAT

A generalized vegetation map of Africa (Figure 1) shows that around the equator, tropical rain forest extends from the west coast to the center of the continent. The tributaries of the Congo River come together to form the Congo Basin. To the north and south, dryer areas extend from the west coast eastwards: the Sahara Desert in the Tropic of Cancer and the Kalahari and Namib Deserts in the Tropic of Capricorn. A broad area of dry savanna occurs between the tropical rain forest and the deserts.

For the African continent as a whole three classes of vegetation types may be discerned: tropical rain forest, dry savanna, and desert. The most humid area is the Congo Basin, which has a great abundance of flora. Toward the east, north or south, aridity increases and a transition occurs from woodland through savanna and semi-desert to desert. On close examination, due to such topographic conditions as high altitude, water systems, and coastline, the vegetation is partially composed of montane forests or other type of evergreen forests. Furthermore, looking at the mosaic distribution of vegetation we see that the Mediterranean shrub zone occupies an area north and south of a latitude of about 35 degrees. Within this vegetation map, lie the habitats of the G//ana San and the Mbuti Pygmies. Their respective locales will be discussed in more detail below.

The areas in which the G//ana live have been described in detail in an earlier paper [TANAKA 1971]. In brief, they live in the area of transition between the savanna and the desert, on the Tropic of Capricorn. It is an inland area with an average altitude of 1,100 m and exhibits the following three vegetation types:

- 1) Graminaceae, chiefly herbs, including such shrubs as *Grewia*, *Terminalia*, *Lonchocarpus*, *Boscia*, and *Commiphora*, which mingle in an open scrub plain.
- 2) *Acacia* woodland, mainly composed of the genera *Acacia* and *Albizia* of the family Mimosaceae, consisting of sparsely scattered tall trees.

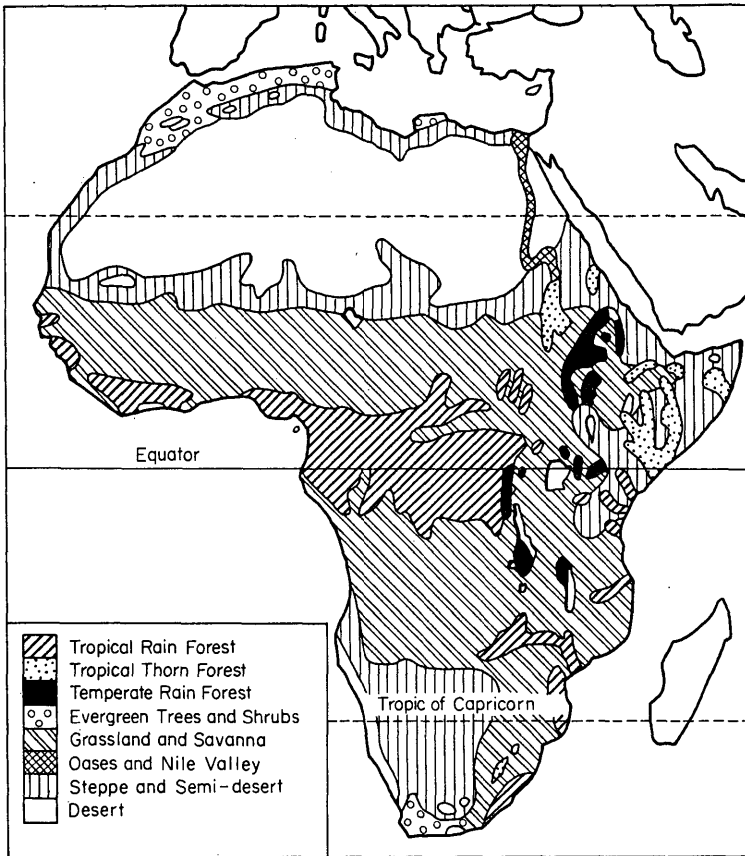


Figure 1. Vegetation map of Africa.

3) Two species of the genus *Bauhinia*, respectively, make up two communities both of which are called the *Bauhinia* plain. They are *B. macrantha* (a shrub) and *B. esculenta* (a creeper); they are arid zone plants in the family Caesalpinaceae.

These three vegetation zones comprise the Kalahari Desert environment. In terms of area, the largest is the open scrub plain, where the amount of rainfall is extremely small, the average annual being about 400 mm. In terms of the three major zones of African vegetation (Figure 1), this area is located in the transitional region between the dry savanna and the desert.

The Mbuti Pygmies inhabit the "Ituri" area, along the course of the Ituri River, just north of the equator, in the eastern fringe of the Congo Basin. It lies at an altitude of 600–1,000 m and covers an area of approximately 100,000 km². According to Itani and others, three types of evergreen trees belonging to the family Caesalpinaceae are the dominant species and form the three types of climax forest. The north-eastern part (the upper reaches of the river) consists of a forest of *Cynometra alexandri*, the southwestern part (the lower reaches of the river) of a forest of *Gilbertiodendron*

dewevreii, and in the middle section there is a forest of *Brachystegia laurentii* [ITANI 1974a; HARAKO 1976; TANNO 1976; ICHIKAWA 1976].

According to Itani, within the Congo Forest, a tropical rain forest, each Caesalpiniaceae climax forest is relatively dry, and because the undergrowth is sparse on the forest floor, walking is easy. Of the African pongids, (apart from the gorilla, which follows a path of specialization and which limits its habitat to montane and moist forests), the chimpanzee is widely distributed in the Caesalpiniaceae zone. All the plants belonging to this family are an important food source for chimpanzees and other primates as well as for human gatherer-hunters, and rodent and ungulate species which have a heavy dependency on nuts as a high calorie source abundant in protein and fat. Noting the rich mammalian fauna in this vegetation zone, Itani doubted the validity of the conventional division of African vegetation zones—such as between the tropical rain forest, the woodland, the savanna and desert—to describe the habitat of Anthropeida. He pointed out [ITANI 1974a] that the division between Caesalpiniaceae and non-Caesalpiniaceae has validity when considering human evolution (Table 1).

Keeping this consideration in mind, we see that the Ituri Forest is on the eastern border of the tropical rain forest of the Congo Basin, and further east is the deciduous woodland which gradually changes into a savanna [ICHIKAWA 1976]. The flora of the G/ana habitat consists of communities of two species of *Bauhinia* belonging to an especially arid type within the deciduous Caesalpiniaceae, but mixed with an *Acacia* savanna.

The Mbuti have a habitat in an extremely humid region of the Caesalpiniaceae zone, whereas the G/ana are located in an extremely dry area of the Caesalpiniaceae zone.

Table 1. Comparison of the habitat of apes and human gatherer-hunters in Africa.

		Caesalpiniaceae zone		non-Caesalpiniaceae zone		
		evergreen	deciduous	montane forest	swamp forest	Mimosaceae savanna
Apes	mountain gorilla			+		
	lowland gorilla				+	
	chimpanzee	+	+			
	pygmy chimpanzee	+				
Human gatherer-hunters	San (G/ana, !Kung)		+			+
	Mbuti	+				
	Twa			+		
	Hadza					+
	Ndorobo					+
	Ik					+

by Itani, J. [1974b]

2. MATERIAL CULTURE

Gathering-hunting societies are generally small in scale, lack tribal integration and frequently have a nomadic residential group as the unit of organization. This kind of residential group has a flexible structure within a prescribed range and it is customary for the membership to change at frequent intervals. Therefore there are many instances in which the social system related to the internal structure of these small-scale societies is as yet undeveloped, as is also generally true of various aspects of their culture. Of course, each society differs in its levels of development in such cultural elements as ideology, religion, and the arts; and comparing those which developed separately in each society with each other presents serious difficulties, but on the other hand, it has been clearly demonstrated that from a technological point of view these elements are both crude and limited.

Gathering-hunting societies are in direct confrontation with the natural environment of their habitat. In other words, while they are controlled completely by nature, they are, at the same time totally dependent on it. Their fundamental attitude concerning their own survival demonstrates an absolute reliance on natural resources. The influence of man on nature does not exceed the lowest levels. One may regard it as a society which lives economically at a hand-to-mouth level of existence, which explains why their material culture is, overall, so meager. The main constraint on the development of the material culture of gathering-hunting societies is the frequent shift in residence locale [TANAKA 1971]. Societies such as the Eskimo, who have developed boats and large sleighs and other such elaborate means of conveyance, present an exceptional lifestyle. Ordinarily nomadic gatherer-hunters rely solely on manpower as the means of transportation, with the result that their household goods are limited to the amount which can be carried on the back and can be conveyed in one trip [SERVICE 1966].

Table 2 shows the material culture of the G//ana San. The total number of items is only 79. Moreover there are many things that are used commonly by the residential group as a whole, while things which do not directly relate to the maintenance of life, (such as decorative objects, musical instruments and objects used for recreation), are fashioned and possessed by only a small number of people. Even those implements necessary for hunting or gathering are owned by only a few people, with even the most basic tools such as knives and spears, for example, frequently borrowed or loaned. The materials for hut construction, logs and plant stalks which need little processing, are taken as needed from the site. Because the mortars made from the hollowed trunks of large trees are very heavy, no more than one or two families within a residential group will possess one. In particular, those implements used in cooking, such as mortars and pestles, sticks for pounding meat, fire rakes, and mixing sticks, are freely shared on a cooperative bases. In the material culture of the G//ana the number of its implements is kept as small as possible; for, a gathering-hunting mode of subsistence develops within the framework of nature, and its characteristics is that not many processes are performed on the naturally available

Table 2. Material culture of the G//ana San.

Item	Material	Category				Remarks
		Animal	Plant	Stone	Metal	
1. Implements for Subsistence Activities						
a) hunting						
bow	trunk of <i>Grewia flava</i> + sinew of large antelope	+	+			
arrow	grass + iron		+		+	
spear	trunk of <i>Grewia flava</i> etc. + iron		+		+	
poison	larvae of <i>Diamphidia Simplex</i>	+				
trap (rope snare)	fiber from <i>Sansevieria scabrifolia</i>		+			
trap (iron trap)	iron				+	
springhare hook	trunk of <i>Grewia flava</i> + steenbok horn		+			
club	trunk of shrub		+			
dog		+				the only domesticated animal
b) gathering						
digging stick	trunk of <i>Rhigozum brevispinosum</i>		+			
straw (for drinking water)	stalk of graminaceous plant		+			
c) carrying						
quiver	root of <i>Acacia luederitzi</i>		+			
tube (for storing small articles)	same as above		+			
hunting bag	steenbok skin	+				
skin wrapper	gemsbok skin	+				
carrying net	sinew of large antelope	+				
skin bag (for small articles)	steenbok skin	+				
skin bag (for storing nuts)	same as above	+				
skin bag (for gathering)	same as above	+				
water container	ostrich egg shell	+				
d) cooking						
fire stick	trunk of <i>Catophractes alexandri</i>		+			
flint	stone + iron			+	+	
tinder	mushroom		+			
pot	iron				+	
bowl	iron				+	
cup	iron				+	
spoon I	stainless steel				+	
spoon II	wood		+			
spoon III	tortoise shell	+				
fire rake	trunk of <i>Boscia albitrunca</i>		+			
feather fan	feather of kori bustard	+				

Item	Material	Category				Remarks
		Animal	Plant	Stone	Metal	
grass sieve	stalk of graminaceous plant		+			
mortar	trunk of <i>Ochna pulchra</i>		+			
pestle	trunk of tree		+			
melon crushing stick I	gemsbok horn	+				
melon crushing stick II	shin bone of ostrich	+				
stick for pounding meat	gemsbok horn + iron	+			+	
mixing stick	branch of shrub		+			
nut cracking wood	branch of shrub		+			
nut cracking stone	stone			+		
tobacco pipe	empty tin				+	
e) tools for manufacturing						
knife	iron					+
axe	iron					+
knife case	skin	+				
rope I	fiber of <i>Sansevieria scabrifolia</i>		+			
rope II	eland skin	+				
peg to pitch raw hide on the ground	branch		+			
scraper I	skull of duiker or steenbok	+				
scraper II	thigh bone of ostrich	+				
scraper III	iron					+
mold for making tobacco pipe	gemsbok horn	+				
plate for preparation of poison	scapula of giraffe	+				
whetstone	stone			+		
II. dwellings						
hut	tree + graminaceous plant		+			
III. clothes and ornaments						
loincloth	steenbok skin	+				
shawl	same as above	+				
apron	same as above	+				
skirt	same as above	+				
cap	skin of fox, jackal, wild cat etc.	+				
sandal	eland skin	+				
head band	ostrich egg shell	+				beads are also used
waist band	same as above	+				same as above
necklace	same as above	+				same as above
	same as above	+				same as above
container (for cosmetics)	shell of <i>Strychnos cocculoides</i> fruit			+		
contanier (for medicine)	same as above			+		

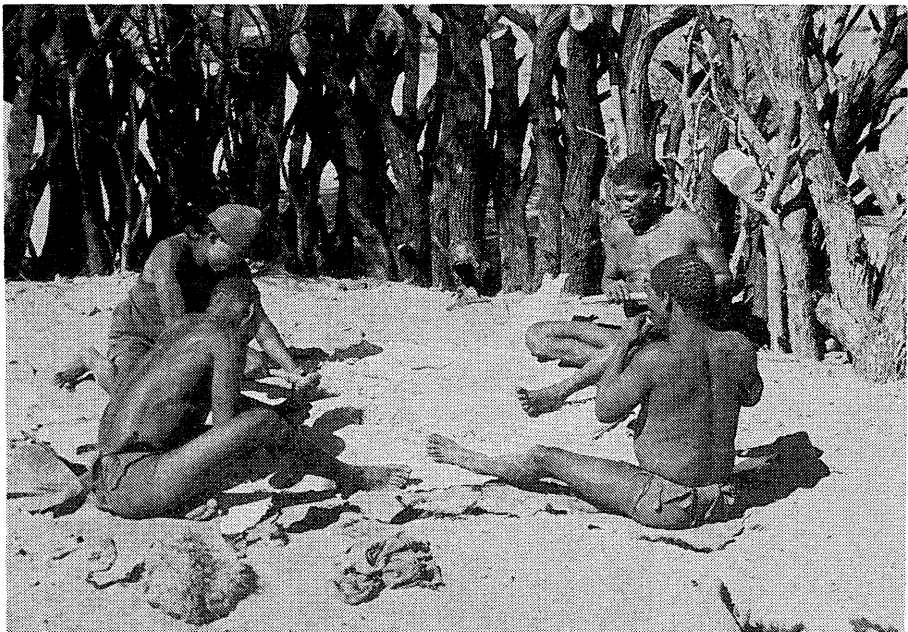
Item	Material	Category				Remarks
		Animal	Plant	Stone	Metal	
bracelet (for wrist)	ostrich egg shell	+				beads are also used
bracelet (for leg)	giraffe tail					
earring	iron				+	
IV. musical instruments and toys						
bow I	trunk of <i>Grewia flava</i> + wire		+			
bow II	trunk of <i>Grewia flava</i> + sinew	+	+			
finger piano	plank + wire		+		+	
violin	trunk of tree + wire + giraffe tail	+	+			
guitar	empty tin + wood + wire		+		+	
toy feather I	branch of shrub + feather of guinea fowl	+	+			make sound by swinging
toy feather II	same as above	+	+			played like batteldore
throwing stick	trunk of <i>Grewia flava</i>		+			
dancing rattle	Cocoon of moth + piece of ostrich egg shell	+				
toy bow	trunk of <i>Grewia flava</i> + sinew	+	+			

materials. For example, there is no demand for the development of such technical skills as those required by pastoralism or agriculture, nor was there any need in the first place for a complicated material culture. Furthermore, there are the limitations imposed by the conditions of migration, to which the natural restrictions on gross weight are added, which affect the development of material culture. These important factors add up to a large set of proscriptions for the material culture. This, of course, is not limited to the G//ana but is a special common characteristic of most gathering-hunting societies.

The G//ana mode of subsistence has continued in its activities of gathering wild plants and hunting animals virtually without change since Paleolithic times (Table 2). Nevertheless they only employ three stone tools: the whetstone, the flint and the nutcracking stone. This is because their present locale is not rocky; and it is only because these three kinds of stone implements have been used over such a long period that they are imported from such a great distance. Previously, techniques of rock painting and engraving in the hills around the Kalahari Desert were also handed down, but those who settle in the areas of the Kalahari, where there are no rocky areas, have lost this tradition. The G//ana culture of the present day uses a dwindling number of stone tools. Arrowheads, hooks and scrapers are now made of bone, horn, animal teeth, or iron; and although there are the above-mentioned stone tools, fires can now be started without trouble with fire sticks, beans can be cracked with sticks that are readily at hand, and even knives, lances and spearheads can be sharpen-



Photograph 1. In the shelter of a rough windbreak, a G//ana woman is pounding melon seeds.



Photograph 2. Men are engaged in tanning gemsbok hides at their worksite.

ed by covering sticks with sand and rubbing across the top of them. Formerly they probably used stone knives, lances, and spearheads as well as axes, which they transported from afar, but since they now use metal implements brought in from far away the use of stone for such purposes has virtually disappeared.

Comparing the G//ana's material culture with that of the forest-dwelling Mbuti, the most pronounced difference is that the Mbuti use almost exclusively plant materials in the things they make, but the G//ana use about fifty percent animal products. The G//ana tan steenbok hides to make clothing and bags, and the hides of larger antelopes such as the gemsbok are made into bedding and transportation gear for which tanned leather is mainly used. Bone, tooth and horn tools are widely used and this is related to the fact that stone cannot be used. Ostrich eggs and the shells of land tortoises, in particular, are convenient as containers.

Of the animal products used as raw materials, hides are an especially valuable material in dry regions, whereas in the humid forests, where preservation becomes difficult, they are not useful. The Mbuti use hides just for drum skins, quivers and bow decorations (Harako, personal communication). To spread tree bark into a thin fabric they use an ivory beater, and although ivory is also used for flutes, it is not something essential to their survival (Harako, personal communication).

The Mbuti use plants to such a great degree that it may even be said that the tools used in their daily lives are basically made of plant material. Like the G//ana, they went through changes from stone to metal tools. The Mbuti and the G//ana use many similar wooden tools such as digging sticks, lance handles, and arrows. In particular, a special characteristic of the Mbuti which reflects their forest environment is the use of the large leaves of herbs and creepers. Among other uses these large leaves provide material for roofing, wrapping materials for carrying food, and materials for transporting goods. Shrubs and creepers are woven into baskets, receptacles and containers for use in transportation. The fiber obtained from several species of tree is fashioned into clothing, rope and hunting nets.

As seen in the comparison between the material culture of the Mbuti and of the G//ana, resemblances such as shapes of dwellings and of bows and arrows, and similarities of spears and digging sticks are based on the common modes of existence; gathering-hunting accompanied by frequent migration. At the same time, there is a great disparity based on the extreme environmental difference between the two habitats: one being arid and the other humid. This is the primary cause of the great differences among the animals and plants which are the objects of hunting and gathering as sources of food. In gathering plants it is sufficient to simply pick them or dig them up, and there is little variation in technique among species or among places. Hunting techniques and skills vary, however, according to the differences in the vegetation of a region, and the size and habits of the animals. Depending on the locale and the animals hunted, different hunting techniques are required, giving rise to limitations in the content of the material culture. At the same time, it is obvious that the resources available to a material culture will influence its composition. The quality of any material differs according to its durability over long periods of use.



Photograph 3. A G/ana hunter is applying poison to arrowheads.



Photograph 4. A Mbuti camp in the forest.

As a result, animal products are used in the arid Kalahari whereas the choice is overwhelmingly in favor of vegetable products in the wet Ituri Forest.

3. MODE OF SUBSISTENCE

The dissimilarity in modes of subsistence of the G/ana and Mbuti is not only due to the material culture but also to the social organization and other cultural aspects in social life which have an important influence. In this section, using hunting as the main example, these societies are compared, with special reference to the environmental factors which create differences in the mode of subsistence.

The common features of the G/ana and the Mbuti societies are that social differentiation is immature and that generally speaking any individual alone can carry out all activities necessary for daily life. The only division of labor observed is one of sexual differentiation in hunting and gathering activities. The G/ana men have a monopoly on hunting activities whereas gathering is chiefly the work of the women; while out hunting, however, the men will occasionally gather fruits or roots and other plants which they ordinarily consume, and when the beans of the *Bauhinia* (which they especially enjoy) are in season, the men eagerly gather them [TANAKA 1971: 73-79].

Among the Mbuti, gathering as a mode of subsistence occupies a place of relatively little importance. But net hunting, in groups, takes up the greater portion of daily activity time. The Mbuti do not engage in much gathering of wild plants probably as a result of 400-500 years of contact with the agricultural Bantu. The Mbuti of today have little need to gather wild plants because they exchange game caught during their hunts for metal implements and agricultural produce (banana, cassava, sweet potato, rice etc.). Meat has a high value in exchange, and accordingly they give hunting special emphasis.

According to Ichikawa, the Mbuti consume approximately fifty percent of the catch of net hunters, and the remainder is traded to the Bantu. During the approximately four months lull in hunting, in the rainy season, the Mbuti stay in the Bantu villages and eat mainly agricultural products. Hence the amount of meat consumed per person per day averages roughly 340 grams [ICHIKAWA, 1976: 32-33]. It is thought that the G/ana consume about 300 grams [TANAKA 1974: 81], and so the difference is small. Although agricultural products make up the bulk of vegetable food in the Mbuti diet, the daily amount ingested averages 700-800 grams, which is also approximately the same as the G/ana.

Although the Mbuti do not now rely to any major extent on wild plants, they utilize up to 60 species [ICHIKAWA 1976: 33], and it is thought that prior to contact with the Bantu wild plants were consumed to a much greater extent. Before agricultural products were introduced it is assumed that the percentage of vegetable food in the total diet was not less than at the present time.

The Mbuti divide into two groups; one is a group which uses bows and arrows and spears as its basic method of hunting, and the second which uses nets. Compared

with bow-and-arrow or spear hunting, which have a comparatively strong individual character, net hunting requires a large group, among whom close cooperation is indispensable.

Representative hunting methods of the G/ana include big game hunting with bow-and-arrow, trapping small antelope with rope snares, and springhare hunting with a long hook. Only rarely do hunting groups comprise more than two men. Usually each person goes off on his own, in a different direction, in search of game. Hunters always carry leather bags containing bows and arrows and spears, so that whenever they spot game they are prepared to hunt. After inspecting the snares and most often while attempting to hunt springhare, the search for larger game is made. Because the bows and arrows are small and crude, their range is short and accuracy is low. Most places in the Kalahari are flat and, being covered with sparse shrubs and grass no more than one meter high, afford an unobstructed field of vision. Tall trees are rare. This makes it extremely difficult to sneak up on the animals, and the work of hunting is difficult, requiring a high level of skill. Where the view is good, hunters can sneak up to within 20 m of their quarry and shoot arrows accurately, such that the number of hunters is kept low and the percentage of game taken rises. Because the animal population density is low, rather than many people using this hunting method to try and kill all of the animals in a given place, individuals disperse and try to cover as wide a range as possible. This increases the probability of the individual hunter encountering animals, and it is said that in this kind of open space, it is more advantageous for individuals to hunt alone.

Tanno [1976] has reported in detail on Mbuti net hunting. Its underlying principle is summarized by Ichikawa:

As the basic material of the hunting net, the endodermis of the creeper *kusa* (*Manniophyton fulvum*) belonging to the family Euphorbiaceae is used. The nets have a height of 1.2 to 1.5 meters and a length of forty to a hundred meters. Each net belongs to the persons who wove it but when one net is short or the number of people handling it are few, the nets of two or three people are connected into one unit and employed. Usually six to twelve units are connected and a circle is cordoned off. From one end, animals are chased into the center so that they get twisted in the nets. Women are employed as beaters and to carry the captured animals. Men are employed to operate the nets and to kill the animals captured in them, and they chase stray animals wandering in the vicinity into their own nets. The length of one net-hunt varies with the length and number of the nets but is about one hour in duration, after which the next hunt begins, when they have gone five to ten minutes away; and there are perhaps ten or so hunting attempts in a single day. [ICHIKAWA 1976: 28]

This kind of net hunting can be undertaken where the forest conditions and the size and habits of the animals, which are the object of the hunt, are suitable. Unlike an open area, trees seriously obstruct the field of vision in a forest, such that bow-and-arrow or spear hunting is generally unsuitable. Since spoors are very difficult to see,

Table 3. Comparison of hunting objects and methods between the G//ana and the Mbuti.

scientific name	common name	distribution pattern	hunted by		hunting method	
			G//ana	Mbuti	G//ana	Mbuti
<i>Pan troglodytes</i>	chimpanzee	C		+		S, (B)
<i>Colobus abyssinicus</i>	Abyssinian colobus	B		+		B
<i>C. angolensis</i>	Angolan colobus	B		+		B
<i>C. badius</i>	red colobus	C		++		B
<i>Papio anubis</i>	doguera baboon	D		+		N, S, (B)
<i>P. ursinus</i>	chacma baboon	F	—			
<i>Cercocebus albigena</i>	grey-cheeked mangabey	C		+		B
<i>C. gareritus</i>	crested mangabey	B		+		B
<i>Cercopithecus hamlyni</i>	Hamlyn's monkey	C		+		B, N
<i>C. ascanius</i>	red-tailed monkey	B		+		B
<i>C. mitis</i>	blue monkey	E		+		B
<i>C. mona denti</i>	Dent's monkey	C		+		B
<i>Galago demidovi</i>	Demidov's galago	C		—		
<i>G. inustus</i>	needle-clawed galago	C		—		
<i>G. senegalensis</i>	lesser galago	D	—			
<i>Perodicticus potto</i>	potto	C		+		(B)
<i>Atherurus</i> sp.	brush-tailed porcupine	C		+		B, (N)
<i>Hystrix africae-australis</i>	crested porcupine	A	+	+	S	B, (N)
<i>Redetes capensis</i>	springhare	G	+++		H	
<i>Lepus capensis</i>	Cape hare	D	+		b', S	
<i>Manis tricuspis</i>	tree pangolin	C		+		b', S
<i>M. gigantea</i>	giant pangolin	C		+		b', S
<i>M. temminckii</i>	Cape pangolin	D	+		(b', S)	
<i>Orycteropus afer</i>	aardvark	A	+	+	(b', S)	b', S
<i>Dendrohyrax arboreus</i>	tree hyrax	B		+		(B)
<i>Loxodonta africana cyclotis</i>	African forest elephant	C		+		S
<i>Canis mesomelas</i>	black-backed jackal	G	+		S, L	
<i>Vulpes chama</i>	Cape fox	F	+		(S)	
<i>Ofocyon megalotis</i>	bat-eared fox	G	+		S, L	
<i>Lycaon pictus</i>	wild dog	D	—			
<i>Mellivora capensis</i>	ratel	A	+		(S)	
<i>Genetta genetta</i>	common genet	D	+		T	
<i>G. spp.</i>				+		(B)
<i>Atilax paludinosus</i>	marsh mongoose	A		+		B, N
<i>Crossarchus obscurus</i>	dark mongoose	B		+		B, N
<i>Mungos mungo</i>	banded mongoose	D	+		L	
<i>Hyaena brunnea</i>	brown hyena	F	+		(S)	
<i>Crocuta crocuta</i>	spotted hyena	D	—			
<i>Proteles cristatus</i>	aardwolf	G	+		(S)	
<i>Felis libyca</i>	African wild cat	D	+		(T)	
<i>F. serval</i>	serval	D	+		(T)	
<i>F. caracal</i>	caracal	D	+		T	
<i>Panthera leo</i>	lion	D	—			
<i>P. pardus</i>	leopard	A	+	—	L, T	
<i>Acinonyx jubatus</i>	cheetah	D	+		b', L, T	
<i>Hippopotamus amphibius</i>	hippopotamus	A		+		S
<i>Phaco choerus aethiopicus</i>	warthog	D	+		S	
<i>Hylochoerus meinertzhageni</i>	giant forest hog	B		+		S
<i>Potamochoerus porcus</i>	bush pig	A	+	+	(S)	S, (B)
<i>Haemoschus aquaticus</i>	chevrotain	C		++		N, (B)
<i>Giraffa camelopardalis</i>	giraffe	D	+		B, (S)	
<i>Okapia johnstoni</i>	okapi	C		+		S
<i>Taurotragus oryx</i>	Cape eland	G	++		B, (S)	
<i>Tragelaphus strepsiceros</i>	greater kudu	D	++		B, (S)	
<i>Boocercus euryceros</i>	bongo	B		+		S, (B, N)
<i>Oryx gazella</i>	gemsbok	F	++		B, (S)	
<i>Alcelaphus caama</i>	red hartebeest	F	++		B, (S)	
<i>Connochaetes taurinus</i>	wildebeest	G	++		B, (S)	
<i>Antidorcas marsupialis</i>	springbuck	F	++		B, L, T	
<i>Neotragus batesi</i>	Bate's pygmy antelope	C		++		N, B
<i>Cephalophus nigrifrons</i>	black-fronted duiker	C		++		N, B
<i>C. dorsalis</i>	Bay duiker	C		++		N, B
<i>C. leucogaster</i>	Gabon duiker	C		++		N, B
<i>C. callipygus</i>	Peter's duiker	C		++		N, B
<i>C. sylvicultor</i>	yellow-backed duiker	C		++		N, B
<i>C. monticola</i>	blue duiker	B		++		N, B
<i>Sylvicapra grimmia</i>	bush duiker	D	++		L, (B)	
<i>Raphicerus campestris</i>	steenbok	G	++		L, (B)	
<i>Syncerus caffer nanus</i>	dwarf forest buffalo	C		+		S

a) distribution pattern; see table 4

b) hunting object

+ species hunted

++ species hunted frequently

+++ species hunted especially intensively

no mark: not distributed in the habitat

— species not hunted

c) hunting method

S : spearing B : bow and arrow

N : netting

b' : stick-beat

R : rope snare

T : iron trap, recently introduced

H : hook

() : rare case



Photograph 5. Mbuti hunting net hanging in the forest.

Table 4. Distribution pattern of mammals in Africa.

Distribution Pattern	Examples
A. Pan Africa excluding Sahara	aardvark, bush pig, leopard
B. Across equatorial Africa	blue duiker, giant forest hog, Abyssinian colobus
C. Tropical rain forest	Demidov's galago, tree pangolin, black-fronted duiker
D. Throughout openland	lesser galago, giraffe, bush duiker
E. East Africa	blue monkey
F. South Africa	chacma baboon, Cape fox, gemsbok
G. East and South Africa	springhare, wildebeest, steenbok

both finding and tracking animals are also extremely hard. The animals mainly sought during net hunts are middle- and small-sized forest antelopes, of which most are duiker, genus *Cephalophus* (Table 3 & 4). Most forest-living antelopes are nocturnal, hiding in the bush by day. Whenever they sense the presence of human beings, they flee into the undergrowth. If the hunt takes place where the animal cannot easily distinguish the nets and the people lying in wait, then the beaters can vigorously drive them in the direction of the nets and they are easily captured. The mesh size of the nets used just permits the head of a small duiker to enter, but animals of that size cannot rip through the nets.

Net hunting requires close cooperation among the participants, and usually all of the members of the camp are involved. It occupies an important position among their subsistence activities. Much energy is spent on it, and the women who serve as beaters and who transport the animals cannot direct their attention elsewhere. This is the general situation of hunting-gathering peoples. The pattern of a division of labor between the men who hunt and the women who gather, which is most general in gathering-hunting societies, would be quite incompatible with the Mbuti net hunter's society. Harako [1976] studied the archers among the Mbuti and pointed out that in their representative method of bow-and-arrow hunting (*Mota*), cooperative activity is very important:

Motá is collective hunting usually done by more than ten archers. The archers take their positions encircling a section of the forest. A dog with a wooden bell tied round its neck sometimes aided by its owner and several boys, runs about in the encircled area and drives the game out of the bush. Archers shoot the game as it rushes out. In a comparison with net hunting, we could say that the archers and bows and arrows correspond to the catchers and nets, while dogs correspond to beaters. ...

Motá varies depending upon the number of attendants. There is a large-scale method called *begbe*, where women and children attend as beaters, taking the same formation as in net hunting. The only difference is that instead of a net, bows and arrows wait for the game. *Begbe* is seldom used, and then only in the early dry season of the year. At those times, co-operation between bands is observed, and the affair takes on sort of a festive mood. [HARAKO 1976: 54]

But the fundamental difference between the two hunting methods, bow-and-arrow hunting, which is central in G//ana hunting life, and net hunting, which fulfills the same role for the Mbuti, is that the grassland-living mammals, which live in an open dry area, and the forest-living mammals, which live in a dense and wet forest, are the most important factor in limiting the gathering-hunting peoples who inhabit these respective regions.

Among the differences in patterns of subsistence activity, the organization of the parties and the activities of the women and men respectively are especially influenced by the hunting method adopted, which in turn affects the principle underlying the organization of their societies.

4. HUNTING AND SOCIAL GROUP UNITS

The social unit of hunting and gathering people is generally a mobile residential group made up of from about ten to twenty families. In the life modes of the gatherer-hunters mobility is an indispensable factor although the demographic characteristics vary among different ethnic groups according to such conditions as the variety of food, the water supply, and so forth. As previously mentioned, a migratory way of life restricts the development of material culture. Frequent migrations go hand in hand with a mode of subsistence which depends overall on limited natural resources; this is a primary factor in determining the limits on the scale of the society. It is for this reason that such societies are small in scale and have a low population density. This means, moreover, that such societies are simple and lack those sorts of integration mechanisms found in societies engaged in agriculture or pastoralism.

In these societies, the smallest social unit is the family. A man and a woman divide the work as a married couple: a man being a hunter and a woman a gatherer. If seen from the point of view of age, a division of labor into food providers and dependents is discernible. A family is established on these bases and it is both the smallest possible unit and an absolutely essential unit. Within certain limits, a single family can exist as a self-sufficient unit, but it is more customary for the unit of daily life to consist of several families gathered together in one place to live cooperatively as a residential group.

The forms and structures of residential groups show considerable variation among peoples, but usually the composition of a residential group is not fixed, and in many cases is quite fluid. In the course of frequent migrations, dissolution and reorganization take place, the membership is not firmly fixed, and in many cases, the word "band" alludes to the residential group of a gathering-hunting people with its outline being not clearly defined. The form and structure of the bands of various peoples differ widely and the various bands have been classified into patrilocal, matrilineal, territorial and composite bands [STEWART 1955; SERVICE 1962, 1966].

The societies of both the G/ana San and the Mbuti Pygmies are structured on the basic premises of migration, small scale and simplicity. The G/ana have a large nomadic range extending to about 4,000 km², and the fission and fusion of residential groups is so frequent that their structure is hardly recognizable as that of a band. The Mbuti on the other hand, tied by patrilineal bonds, have nearly settled bands of several score members and it has been reported that their hunting activities are conducted in a territory with fixed boundaries of 150 to 300 km² [ICHIKAWA 1976]. The Mbuti residential groups can be understood as well-organized patrilocal territorial bands.

The existence of territoriality and the size of a nomadic range probably depends on such major differences as the kinds, numbers and distributions of animals hunted and the hunting methods used. It is necessary for the G/ana, in their discovery and pursuit of large game, to cover a wide area. They cannot delimit fixed boundaries. Mbuti net hunting takes place within the fixed boundaries of a lush forest, with its



Photograph 6. A G/ana hunting team pursuing game.

relatively uniform distribution of animals and plants, over which they have exclusive possession because the yield is fairly stable within this range.

The G/ana residential groups are very open and loose, fission and fusion of the group occur frequently, and the groups have only a very rough outline. The Mbuti residential groups, in contrast, are relatively solid patrilineal groups with a relatively fixed membership. On this point it is thought that the method used in hunting, and in particular whether that method requires close group cooperative effort or whether it can be undertaken by single individuals, is an important related factor.

Bow-and-arrow hunting is, in any event, carried out by single individuals, and it is only when large animals are being butchered and transported that cooperative interaction is essential. In contrast, the practice of net hunting requires a closely cohesive performance by all of the band members throughout the hunt. In order to preserve the sense of group responsibility and to maintain a functional hunting group over a long period of time, men with close kinship relations who play the central part in hunting activities form the core of the group, and such a composition is the most suitable type for a social group to use in acting as a unit in cooperative activity. The formation of partilineal bands should be discussed not only in relation to hunting, but also with regard to the combination of all the other activities, but it should be emphasized that the bond of strong cooperation among male hunters during the hunting activities is one of the biggest factors in the formation of these groups.

5. DISCUSSION

In this paper, two gathering-hunting peoples, the G/ana San who live in an open arid area, and the Mbuti Pygmies who live in a wet forest, have been compared in terms of the adaptive modes of living in their respective natural environments, with a particular focus on their respective hunting activities.

In summary, and drawing on the results of recent field research in the study of the predatory (hunting) behavior of several species of mammals, there are several points concerning the origin of hunting among humans and the formation of social group units that merit discussion.

Almost all species of non-human primates include animal food in their menu, such as insects, birds' eggs, nestlings or lizards. Quite a large number of species prey on rodents and other small mammals. The basic food of primates is plants, but most species like animal food and try to obtain it, as Teleki [1975] has pointed out. Therefore it may be assumed that primates overall have a generally omnivorous subsistence pattern.

There are abundant observations of chimpanzees and baboons engaged in carnivorous behavior, even going so far as to include middle-sized mammals such as even-toed ungulates and other primates. Kordtland [1972] says that chimpanzee predatory behavior is not aimed at the acquisition of food but is displacement occurring at times of social stress, and sometimes it is only the expression of aggressive behavior against enemies or competitors. Recently, in the Gombe Stream National Park, Teleki observed chimpanzees stalking their prey for over an hour, in order to sneak up on it. In order to hunt and kill prey successfully a group of 2-5 adult chimpanzees cooperate to such a degree that they exhibit a skillful spatial arrangement to ensure that their quarry is unable to escape [TELEKI 1975]. Nishida (personal communication), in the few cases of chimpanzee behaviour he observed in the Kasoge area, recorded examples of carnivorous behaviour which indicate that chimpanzees hunt with the clear recognition that their objective is to acquire food.

As far as the frequency of human hunting and primate predatory behavior is concerned, that of humans is higher than other primates in absolute terms, and there is a qualitative difference between the two behaviours. It is impossible to make simple comparisons, but Table 5 gives the comparative references for the hunting objects of African gathering-hunting peoples, chimpanzees and baboons. Animal names written in italics are shown as those frequently captured by the respective group of people or animal species. The special features shown by this table are: 1) that all groups concentrate on seizing prey limited to 1 or 2 small mammals weighing less than 10 kg; 2) that a special characteristic of human hunting is that its objects include large mammals; 3) that chimpanzees and baboons limit their hunting to small animals, except that the young of middle-sized mammals are an object.

Predatory behaviour among chimpanzees and baboons has been frequently observed in the Gombe Stream National Park and in the Gil Gil area of Kenya, where both the chimpanzees and baboons are provisioned, if the forests are opened up

Table 5. Mammals hunted by human gatherer-hunters, chimpanzee and baboon in Africa.

Weight of adult animal	G/ana	Mbuti	Hadza	Chimpanzee	Baboon
over 1,000 kg	giraffe	elephant hippopotamus	giraffe		
100-1,000 kg	eland kudu wildebeest gemsbok hartebeest	buffalo okapi bongo	rhinoceros buffalo eland wildebeest hartebeest zebra waterbuck		
20-100 kg	warthog leopard cheetah springbok	bush pig yellow-backed duiker chimpanzee baboon Petter's duiker Bay duiker	warthog impala springbok baboon Thomson's gazelle	bush pig (young) bushbuck (young) <i>baboon</i> (young)	impala (young) bushbuck (young) <i>Thomson's gazelle</i> (young)
10-20 kg	porcupine bush duiker caracal jackal	Gabon duiker black-fronted duiker chevrotain mangabey	porcupine jackal		bush duiker (young)
below 10 kg	<i>steenbok</i> Cape fox bat-eared fox <i>springhare</i> genet hare mongoose squirrel	red colobus Abyssinian colobus Angolan colobus <i>blue duiker</i> blue monkey red-tailed monkey Bate's pygmy antelope	<i>klipspringer</i> <i>dik-dik</i> bat-eared fox hare	<i>red colobus</i> klipspringer suni blue monkey red-tailed monkey vervet monkey	steenbok klipspringer dik-dik vervet monkey <i>hare</i> mongoose squirrel galago

and the environment undergoes major changes. Primates which formerly were fundamentally omnivorous, have developed what was a latent potentiality for ingesting small mammals, thus modifying their diet. Such behavior, in the case of chimpanzees and baboons, emerges as a chance occurrence. The social stresses which were brought about by the contact with men, for example by provisionization, presumably increased that behaviour, which had been relatively rare under natural conditions.

When chimpanzees hunt something like a division of labor is seen. And it is also known that a distribution takes place among the individuals who happen to be present. Furthermore, hunting is an activity of males, and only rarely do females engage in it. Thus, data hinting at possible origins of human hunting behavior are collected for the chimpanzee, but when compared with the human case where hunting has been established as an important link in subsistence activities, such data provide only a seed for possible germination.

The most significant feature in human hunting, in contrast to predation by non-human primates, has previously been noted as the capture of large mammals; and when it occurred, it took place more or less cooperatively. As has been noted, this is related closely to the structure of the band society supported by systems of labor division or sharing. But an analogous phenomenon can be seen in other carnivore societies, where food consists of large game animals, rather than in primate societies.

King has reviewed the research on the behavior and societies of social carnivores, and recognizes important correlations between hunting behavior and social structure, especially in the spotted hyena, the lion and the wolf [KING 1975]. Detailed research has been done by Schaller [1972], Kruuk [1972], and Mech [1970] on each of these three carnivore species. A special feature of all three of these species is the formation of complex individual hunting teams in order to attack large mammals weighing over

Table 6. Social units of three social carnivores and their characteristics.

		lion	spotted hyena	wolf
Stable unit (large-sized group)	name of unit	pride	clan	pack
	average size	15	approximately 50	7
	maximum size	40	80	36
	integration	strong	comparatively weak	very strong
Subgroup	average size	4-6	1-4	5-6
	maximum size	14	25	
Life style		territorial, but some temporarily nomadic	territorial, but some nomadic	territorial
	Territorial behavior	control of food, strong in foci of activity	defense of land	defense of land

from Schaller [1972], Kruuk [1972] and Mech [1970]

300 kilograms. Compared with this, the cheetah and the leopard hunt alone and only kill animals weighing sixty kilograms at most. In the social group unit, daily activities which include hunting are carried out in sub-group units comprising a few individuals. These sub-groups constitute functional groups without a fixed membership, but the several sub-groups among which fission and fusion takes place belong to one large group with highly ranked structure. The size of the social unit and the degree of its integration differ according to the species (Table 6). The size of the sub-group is based on the balance between the numbers necessary for group hunting and the share of game each will receive, and is fixed according to the species. That is, when the hunting group becomes larger than necessary, the rate of success does not change; and the quantity of meat distributed to each individual decreases proportionate to the increase in the number of animals. Sub-groups serve as the functional groups which perform daily activities and the large groups chiefly perform the role of maintaining the territory. When defense of the land or of animals killed is called for, it is observed that the sub-groups sometimes do not have sufficient strength and the larger group is required. For these species it has been verified that the sheer number of individuals is the most powerful force when enemies of the same species are concerned.

The behavior and attitudes of humans concerning territoriality, as opposed to carnivorous animals, are quite different. Animals recognize each other's territory and usually do not violate another's domain. Should an animal unwillingly encroach upon another's territory during the pursuit of prey, and should the owners of that territory give chase the intruder immediately withdraws, and only rarely does a fight ensue. Among human bands there is a thorough recognition of the sphere of activity, and the personnel and the methods of hunting and migration are agreed upon on the basis of each way of life. The G/ana, whose residential groups do not have a fixed membership, naturally do not exhibit clear territoriality; while the Mbuti bands are considered territorial, with the hunting territory fixed for each band, and little encroachment on the territory of the other Mbuti bands in daily activities. Invasion of another's grounds in pursuit of game is admissible, and unlike other predators, defensive behavior or fighting against the invaders does not occur.

Hunters and gatherers create various refined and skillful systems which make it difficult to compare the territoriality of human societies with that of animal societies. Certain species of carnivores have a dual structure resembling that of human gathering hunting societies. Probably this dual structure in social grouping has developed together with the cooperative hunting of large animals. Thus, there are many analogous points between the behaviors and the societies of carnivores and human beings such as that infants are helpless and need long periods of nurturance, which require safe nests and dwellings. These points must necessarily be included in the study of the comparative ecology of African gatherer-hunters.

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