INDIGENOUS FISHING IN THE NEOTROPICS: THE TUKANOAN UANANO OF THE BLACKWATER UAUPES RIVER BASIN IN BRAZIL AND COLOMBIA

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In the study of human ecology, the boundaries of an ecosystem must be determined by social factors. Symbolic notions such as kinship govern the way in which, the extent to which, and the directions in which resources are distributed throughout a population. Because of the rigor necessitated by ecological studies, research in human ecology has focused on the subsistence activities of single aboriginal settlements. The impact of such factors as supra-local levels of socio-economic organization have been virtually ignored. In order to evolve models which are adequate and appropriate, it is necessary to take into account the interdependencies which link settlements into indivisible socioeconomic entities. [1]

This paper therefore treats the Uaupes River Basin of the Northwest Amazon as a region, shown to encompass a number of biotopes, varying widely in fish biomass and in accessibility of fish to fisherman. The indigenous populations of the Uaupes, comprising 12 to 15 linguistically distinct groups, are likewise treated as a single population, meshed through kinship and affinal (in-law) ties into a comprehensive network. Furthermore, these ties are shown to create the channels through which resources are effectively distributed. This paper suggests that these "conceptual" links, and the ritual obligations which accompany them, permit a greater population to occupy the area than would otherwise be the case.

The fieldwork on which this paper was based was carried out between 1978 and 1981 in Brazil, predominately among the Uanano [2] speakers of the middle Uaupes. The scope of the paper, however, extends beyond the Uanano — although Uanano examples will be used to illustrate many points — to encompass the larger Uaupes area, of which the Uanano are a component part.

The indigenous cultures of the Northwest Amazon have long been observed to manifest an unusual degree of supra-local integration. In *The Handbook on South American Indians* (Goldman, Vol. III, 1948) the Northwest Amazon is treated as a single cultural complex. The "cultural homogeneity" among groups of diverse language families (Goldman 1948, Sorensen 1967), the geographically far-reaching and binding marriage ties (Jackson 1976), the emphasis on visiting and formalized exchange rituals (S. Hugh-Jones 1979), and a system of interdependent rank classes (C. Hugh-Jones 1979, Goldman 1981, Chernela 1983 a), have all been reported. Therefore the Uaupes area is an especially appropriate case in which to demonstrate that no single settlement, nor even a single language group may be viewed as an isolate from an ecologically systemic point of view.

Kinship and Marriage

The Uaupes system is highly structured, with unilineal descent and cross-cousin marriage major integrating structural principles. Rules of incest and exogamy produce an over-arching unity among diverse and sometimes distant language groups so that approximately 10,000 Indians inhabiting some 750,000 square kilometers are related either by kin or in-law ties. Uaupes social structure may be described as a system of vertical, exogamous, and hierarchically-ordered descent groups which are intersected by intermarrying, horizontal status classes. Within the descent group relations are governed by kinship and characterized by dominance and subordination. Between descent groups relationships are governed by marriage (actual or potential), which can only take place between status equals.

The highest-ordered, named group of affiliation is the unit conventionally known in the literature as the "language group," or the tribe. [3] Although exceptions exist, the language group is an exogamous unit whose most salient identifying feature (to the Indians as well as to outside observers) is its language. Uanano, Tukano, Desano, Piratapuia, Bara, Cubeo, [4] Barasana, and other groups reported in the literature, are among the 15 to 20 such language groups (the number depending

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upon total area considered) which form the constituent components in the integrating system.

The language group is in turn, comprised of sibs (or patriclans), localized [5] groups of agnates (brothers) who assume descent from one of a set of ancestral founding brothers. The founding Eldest Brother is conceptualized as the focal ancestor of the entire group; succeeding ancestral siblings, and, similarly their present-day descendants, are ranked according to a system of sequential seniority through which the entire language group is united into a comprehensive hierarchy.

The incest regulation forbids marriage or sexual relations with a member of one's own language group and, conversely, requires that one marry into a different language or kin group. This is the basic rule on which the marriage system is founded. Marriages are followed by rounds of gift-giving between wife-exchanging sibs in exchange ceremonies called *Po?oa*.

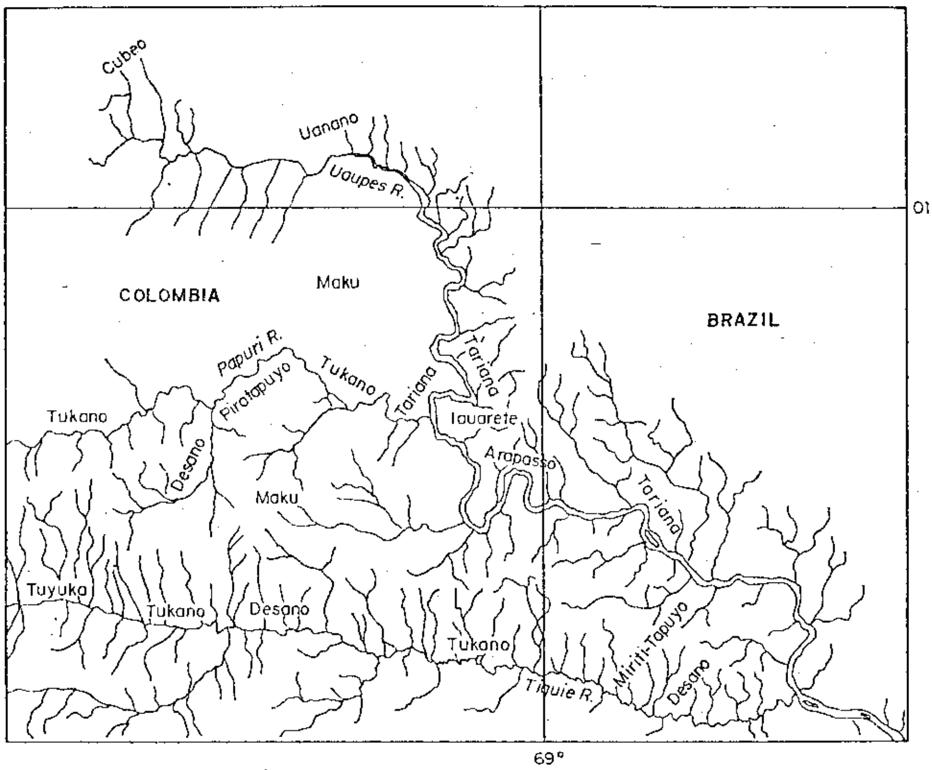


Fig. 1. Map of Study Region.

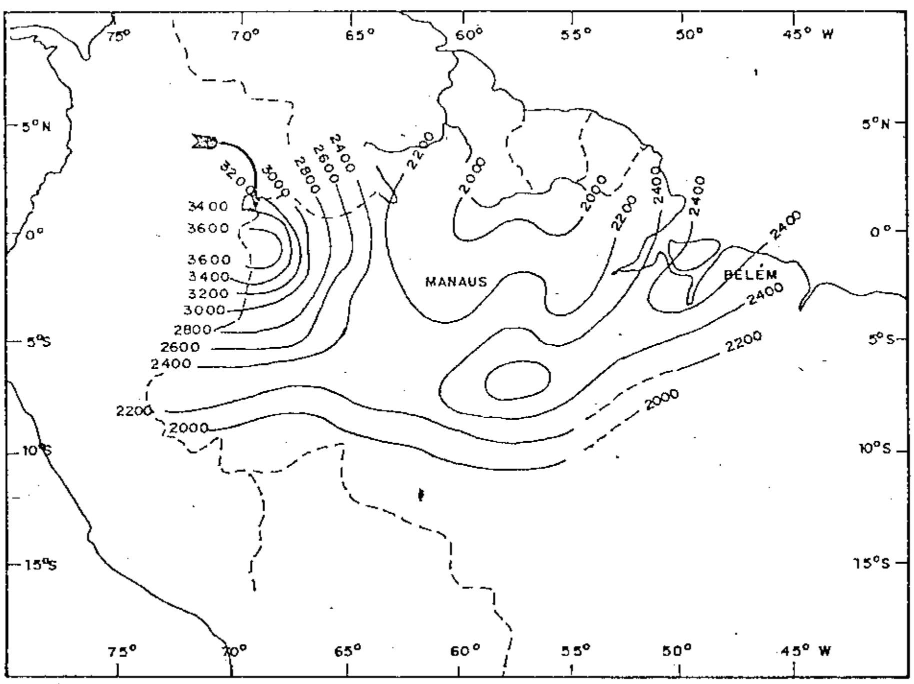


Fig 2. Annual normal rainfall for various locations in Amazonian (mm), showing location of Uanano. (From Salati *et al.*, 1978, with indicator arrow added.)

The Po?oa [6]

Resource use and distribution are ordered by the rights and obligations associated with the relationships of the groups described above. These groups (localized sibs) are linked into an exchange network of food and material goods known as the *Po?oa*. The *Po?oa* structures redistribution, governing the exchange of two categories of foodstuffs (fishes and fruits) and allowing the exchange of specialized manufactured items needed to procure or process these basic resources. The *Po?oa* circulates goods among local groups related by in-law or kin ties. The *Po?oa* is formally an expression of wife exchange: wife-exchanging sibs express their mutual gratitude and ongoing ties through ceremonial offerings. In the *Po?oa* between in-laws, payments must be different in kind but equal in value. Although the *Po?oa* is said to be an exchange between in-law groups, less formal *Po?oa* occur between fraternal sibs of the same language group. In the case of kin, any sib in need may obtain a *Po?oa* by simply approaching a more senior sib with the formal statement, "I am hungry; I want to eat . . . . ." If the solicited sib has the item requested, it cannot refuse the petition. When the item is in abundance, the solicited sib will make the ceremonial offering, and will thereby gain prestige for its generosity. A senior sib attempts to make as sumptuous a display as possible, in order to earn the reputation of "succulence," a notion equated with seniority. It may or may not ask for a *Po?oa* in return; if it does, it will name the precise item desired. Whereas in-laws are required to exchange items of equal value, kin are often exempted from repayment, although this must be the decision of the donor.

In all *Po?oa* the donor determines the timing of payment. In-law sibs, being located at great distances from one another, harvest and store food surpluses for long periods (up to two months) in advance of the presentation. They may travel for several days carrying gifts to the receiving in-laws. Fish collected is smoked daily for 4-5 days and intermittently thereafter; some fruits (for example, *Erisma spendens* Stafleu (Vochysiaceae)) are cooked and fermented in the ground.

On a daily basis, energy is extracted from the environment only to meet immediate needs. Ordinarily, an individual collects no more food than that which is to be consumed by himself and his dependents (even though the local settlement often pools and jointly eats this food). The *Po?oa* is the only occasion which compels an increase in energy expenditure (labor), the resulting increase in output (biomass collected), and where the units of production and consumption are never isomorphic.

The Uanano

The Uanano, one of the indigenous groups inhabiting the Uaupes river basin in the northwest Amazon, number between 1,200 and 1,600 persons. Ideally, the settlements of a language group form a geographic unity. The ten settlements of the Brazilian Uanano are aligned along an uninterrupted stretch of river, along the main channel of the middle Uaupes. These settlements, located from three to twenty-four kilometers apart, range in size from 30 to 150 people. Uanano men are fishermen; the women are horticulturalists. Manioc, the carbohydrate staple, provides the bulk of caloric intake. Wild fruits and insects make a contribution to the diet, but fish represents the vast bulk of animal protein sources and probably accounts for over 85% of ingested protein.

The Uaupes Environment

Rainfall and Water Level

Since the Uaupes basin has been regarded as a homogeneous environment by social scientists, I present the following data which stress instead periodicity and the uneven distribution of biogeographical features which are relevant to indigenous fishing.

The location of the Uaupes at the northwest extreme of the basin places it within Amazonia's area of maximum rainfall (see Fig. 2). For the years 1965-74, the average yearly rainfall at Iauarete in the central Uaupes was 3,743 mm. (Projeto Radambrasil: Levantamento de Recursos Naturais, V. 11, 1976). This level of annual precipitation is high, even relative to other locations in the Amazon basin.

The distinctive feature of the Uaupes basin is its flooding regime. The Uaupes system floods and drains

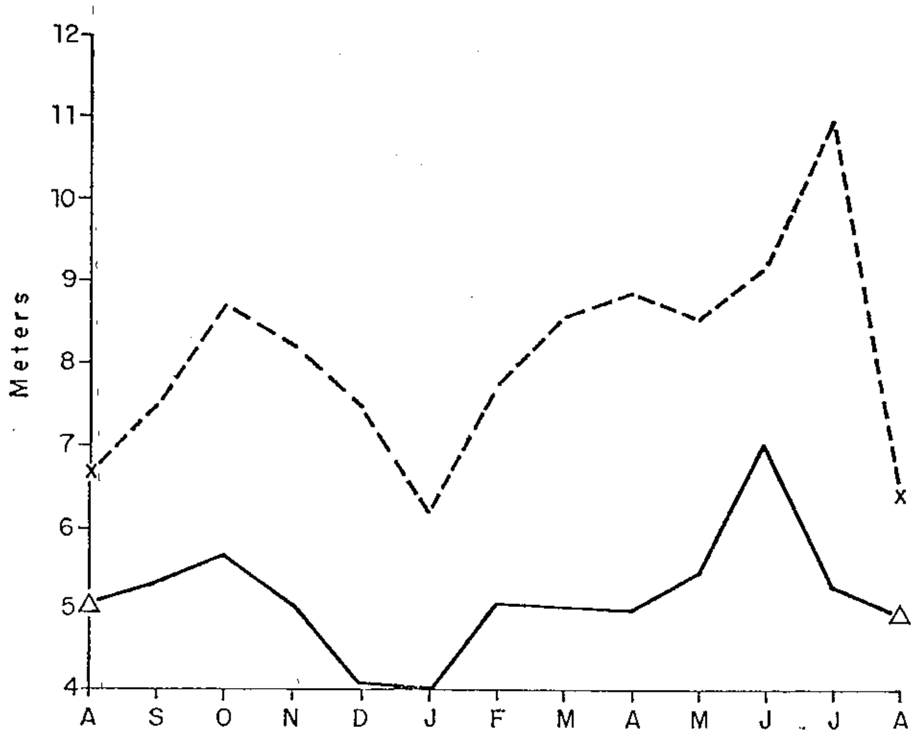


Fig. 3. Maximum and minimum water levels from August 1980 to August 1981.

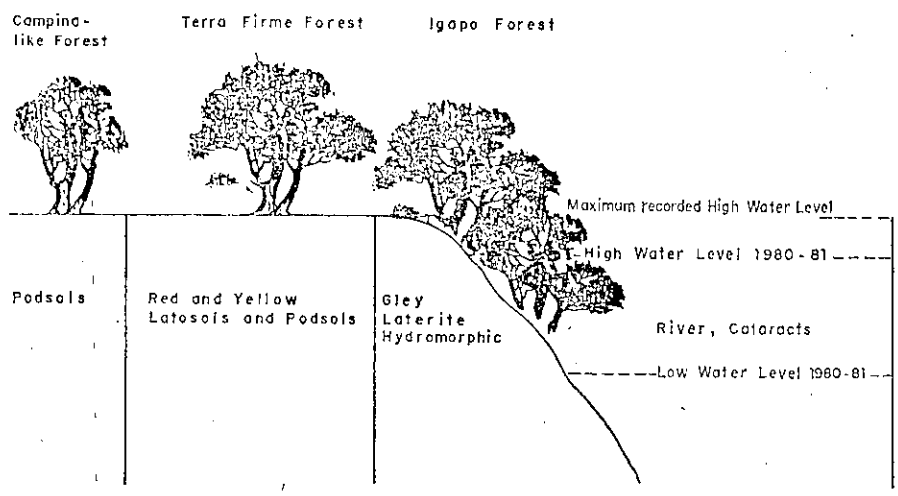


Fig. 4. Soil types and associated vegetation for the region of Yapima, Uaupes R.

twice annually as opposed to the single annual flood that typifies the rest of the basin (see Fig. 3). Seasonal fluctuations in water level result primarily from variation in rainfall affecting the upper reaches of the river system, that is, the tributary streams. Because the tributary streams of the Uaupes are located both above and below the equator, they are subject to two rainy seasons — a northern and a southern. As the contribution of one tributary system slackens, the other intensifies. Flood peaks generally occur in the months of October and April, alternating with low-water periods in January and August. February through June, and September through October, are periods of high and rising waters; November to January, and July to August, are periods of low or declining waters. Each year produces some variation in this pattern. For example, Figure 3 shows 1980-81, when an abnormal flood peak occurred in July.

Uaupes Nutrient Cycling

The Uaupes River flows over the geologically ancient granitic and gneissic Guiana shield. The impoverished parent material generates soils (latosols

TABLE I

NUTRIENT CONTENTS OF SOILS IN EASTERN UANANO AREA. (All samples collected by author and analyzed at EMBRAPA, Belem, Brazil)

Sample number	Phosphorous (in p.p.m.)		Potassium (mE/100g)		Calcium & magnesium (mE/100g)		Aluminum (mE/100g)	pH
51.941	7	low	78	medium	0.5	low	1.3	4.8
51.942	20	medium	39	low	1.3	low	0.5	4.9
51.943	3	low	18	low	0.4	low	0.8	4.8
51.944	2	low	18	low	0.5	low	1.1	4.5
51.945	3	low	16	low	0.1	low	1.1	4.5
51.946	2	low	12	low	0.3	low	1.1	4.6
51.947	2	low	16	low	0.8	low	0.8	5.0
51.948	3	low	20	low	0.6	low	0.6	4.9
51.949	4	low	21	low	0.3	low	1.5	4.8
51.950	80	high	250	high	5.7	medium	0.0	6.1
51.951	3	low	18	low	0.1	low	2.1	4.3
51.952	9	low	45	low	0.4	low	1.5	4.8
51.953	2	low	20	low	0.2	low	2.7	4.0
51.954	2	low	25	low	0.2	low	2.1	4.1
51.955	4	low	101	high	0.5	low	2.5	4.2
51.956	1	low	21	low	0.2	low	0.7	4.7
51.957	1	low	27	low	0.3	low	1.1	4.6
51.958	1	low	18	low	0.1	low	1.0	4.8
51.959	1	low	27	low	0.4	low	0.7	4.8
51.960	4	low	37	low	0.3	low	2.1	4.0
51.961	2	low	90	medium	0.1	low	0.7	4.7
51.962	2	low	37	low	0.3	low	3.9	4.2
51.963	1	low	20	low	0.2	low	1.0	4.6
51.964	1	low	18	low	0.1	low	1.0	4.5
51.965	4	low	45	low	0.3	low	6.5	4.0

and red and yellow podsols) which are characteristically acidic and weathered. They are deficient in important inorganic ions such as nitrogen and phosphorous, but rich in organic humic compounds which impart a dark brown color to the associated ground water and outflowing streams. (See Fig. 4). Data which I collected in Secchi disc readings at ten locations on the Uaupes suggest that the Uaupes is a blackwater river. [7] My findings show a mean figure of 1.4 m. for light penetration, well within the range for blackwaters. [8]

Like other blackwater rivers, the Uaupes lacks the important nutrient salts necessary for *in situ* primary production. Soil samples which I obtained along a 45 km stretch of river in the middle Uaupes (collected January 10 to March 11, 1979) reflect the low nutrient content which typifies soils generated by the Guiana shield. These data fall within the range of findings for 159 soil samples reported by the Ministerio das Minas e Energia from 44 widely dispersed locations in the Uaupes basin between 01°44'N, 69°44'W to/and 00°02'N, 66°05'E (Projeto Radambrasil: Levantamento de Recursos Naturais, Vol. 11, 1976), and substantiate the point that the nutrient deficiency of blackwater rivers is a consequence of soil type (Marlier 1967, Schmidt 1969, 1970, 1973a, 1973b, 1976). Likewise, tests for ionic composition of monthly water samples I collected, and which were analyzed in conjunction with a larger project on water chemistry conducted by Dr. Henrique Bergamin Filho, show the same low dissolved ion concentration in the waters as the soils.

A river's nutrient composition determines the production of microflora, which form the base of aquatic systems' autochtonous food chains. In blackwater rivers such as the Uaupes, with depauperate autochtonous primary production, the major sources of biomass in the system are allochtonous. Researchers now agree (Knoppel 1970, Gesiler *et. al.*, 1973, Welcomme 1979 and Goulding 1981) that most food sources in such rivers derive not from *in situ* primary production, but from sources external to the rivers. The single most important contributor of nutrients is the surrounding forest.

Input from the terrestrial fringes into the river includes: various animals, including insects (particularly ants, beetles, termites), insect larvae, arachnids, worms, crustaceans; and numerous types of plant matter, including fruits, seeds, coarse litter (wood, leaves, and stems), flowers, pollen, and microflora. These enter the aquatic system as floating debris, mud, and detritus.

While debris from the flanks continually falls into the river, flooding dramatically augments terrestrial input into the aquatic system. Water levels fluctuate significantly with seasonal rain regimes in the upper reaches of the basin. When flooding peaks, the overspill onto the banks merges the otherwise separate aquatic and terrestrial biotopes. Fish disperse onto the flooded forests and feed on the variety of abundant foods now available.

Many components of the fish populations of these rivers have evolved specialized adaptations, enabling them to exploit the increased food available during flood periods; there is evidence that some store these energy reserves as fatty deposits which assure survival during the food-scarce, low-water periods (Welcomme 1979, pp. 132, 136).

Seasons, Behavior, and Breeding Activities of Fish

Several species of fishes migrate upstream to spawn at the onset of the rainy seasons. I observed great influxes of ripe *Leporinus* spp. Anostomidae (aracu) and auchenipterid spp. with the first rise in waters in 1979. I also observed a sudden and massive influx of *Moenkhausia* sp. (caracoid) and *Bryconops sp.* (Characidae) with the secondary rise in waters in August-September, 1981. Such spawning migrations may cover long distances. Clark (pers. comm., 1982) reported similar behavior for *Leporinus* spp. in a tributary of the Guainía River near S. Carlos de Río Negro, Venezuela. It is not known how far dowstream these fishes migrate between spawnings.

The Uanano know of the relationship between their environment's bio-physical features and the life cycles of fishes. They are acutely aware of the crucial role played by the adjacent forest in providing food sources which maintain fisheries. Whereas scientists have only recently recognized the river margin's importance to fishery maintenance, the Uanano have long prohibited deforestation at the margin precisely to prevent reduction in the local fish population (Chernela 1982).

Biotopes

Of foremost importance in the utilization of Uaupes fishery resources is the variation and character of the diverse aquatic biotopes or habitats. Contrary to the viewpoint taken by most anthropologists, the Uaupes is *not* a homogeneous environment. A wide variety of biotopes exists; it has long been recognized and utilized by the Uanano. The three most important biotopes I have distinguished are: *igapos*, cataracts, and *terra firme*. Of these, the environmental features most relevant to Uanano fishing are the *igapos* and cataracts.

Igapos

The river margins can be divided into *terra firme* uplands which are never submerged, and *igapos*, floodplains which are lower in elevation and subject to seasonal immersion (Fig. 4).

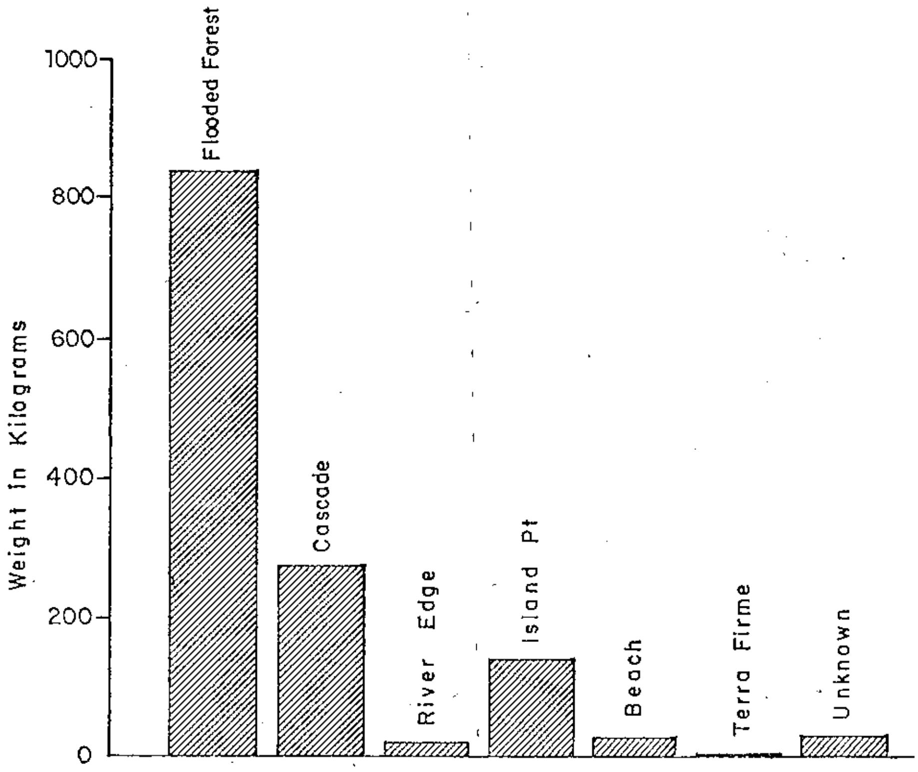


Fig. 5. Total Weight of Fishes Captured per Habitat.

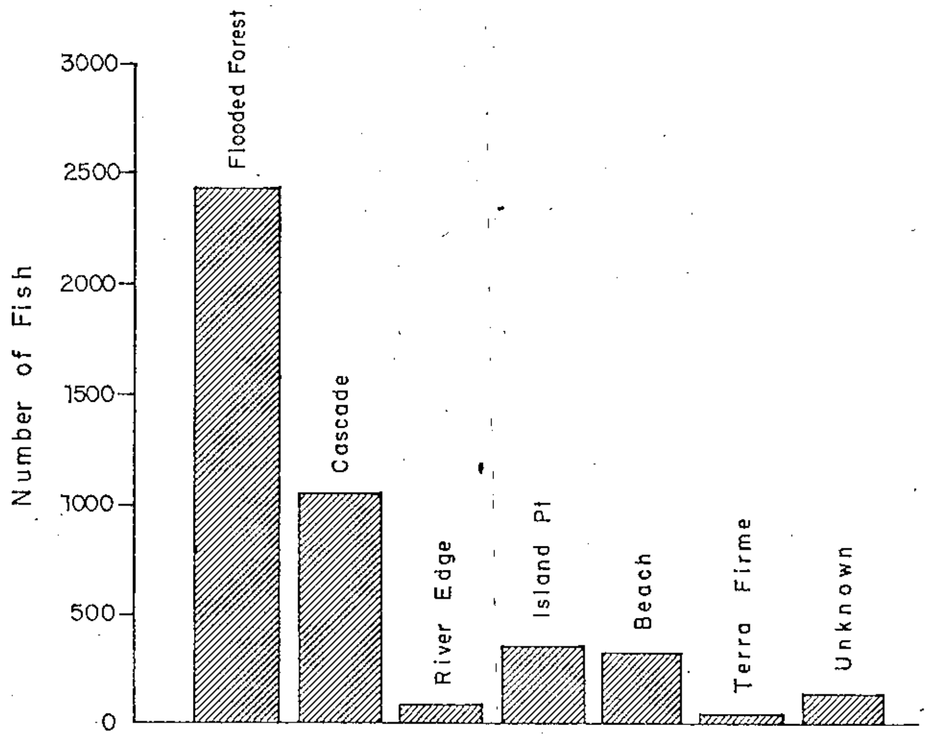


Fig. 6. Number of Fishes Captured per Habitat.

The dramatic and sudden input of available food due to flooding in the *igapo* is illustrated by calculations of the leaf fall per hectare in one year. Denise Costich (pers. comm., 1982) and others of the World Wildlife Project, "Minimum Critical Size of Ecosystems" estimate an average of 600 trees per hectare in Amazonia. They further estimate that if the leaf fall from each tree is 9.1 kg annually, one hectare would produce 6.1 m of leaf fall in the course of one year, though much of this must be resorbed by the trees. Estimating the quantity or organic material that fell onto a 25 m² glue board in one day, Geisler *et al.*, (1973) counted 56 individual items.

Margin Types

As Nigel Smith (1981) shows, the biological productivity of water bordered by *terra firme* is minimal in comparison to that of flood plain areas. My own observation and informants' reports confirm that this is the case for the Uaupes.

My data show that of 41 species of trees counted along the river margin whose fruits are eaten by fish, ten species grow on both *terra firme and igapo;* four species grow only on *terra firme;* and 27 species grow *only* in *igapo*. Furthermore, in a comparison of the numbers of fruiting individuals of these species, counted along two equal lengths of river edge — one *terra firme* and one *igapo* — we found the following results: 359 individuals counted on the *igapo* margin as compared to 46 individuals on the *terra firme* portion. These data support reports by Uaupes fishermen that the *igapo* margins are more productive fishing locations than *terra firme* locations because their greater number of trees provide fruits, flowers, and seeds, on which fishes feed. As we shall see, actual yields substantiate these reports.

Cataracts

The Uaupes River runs though gently undulating lowland terrain. The mean gradient of the river is a shallow .32 m. per km. (Bruzzi 1977, p. 13). The bed is generally composed of sand or clay. Where the river channel encounters erosion-resistant granite outcroppings, cataracts occur. The prominent naturalist Alfred Russell Wallace described the Uaupes this way when he visited it in 1852.

"The river from Jauarite may be said to average about a third of a mile wide, but the bends and turns are innumerable; and at every rapid - it almost always spreads out into such deep bays, and is divided into channels by so many rocks and islands, as to make one sometimes think that the water is suddenly flowing back in a direction contrary to that it had previously been taking. Caruru caxoeira itself is greater than any we had yet seen, — rushing amongst huge rocks down a descent of perhaps fifteen or twenty feet. The only way of passing this, was to pull the canoe over the dry rock, which rose considerably above the level of the water, and was rather rugged, being interrupted in places by breaks or steps two or three feet high." (1870, pp. 239-240).

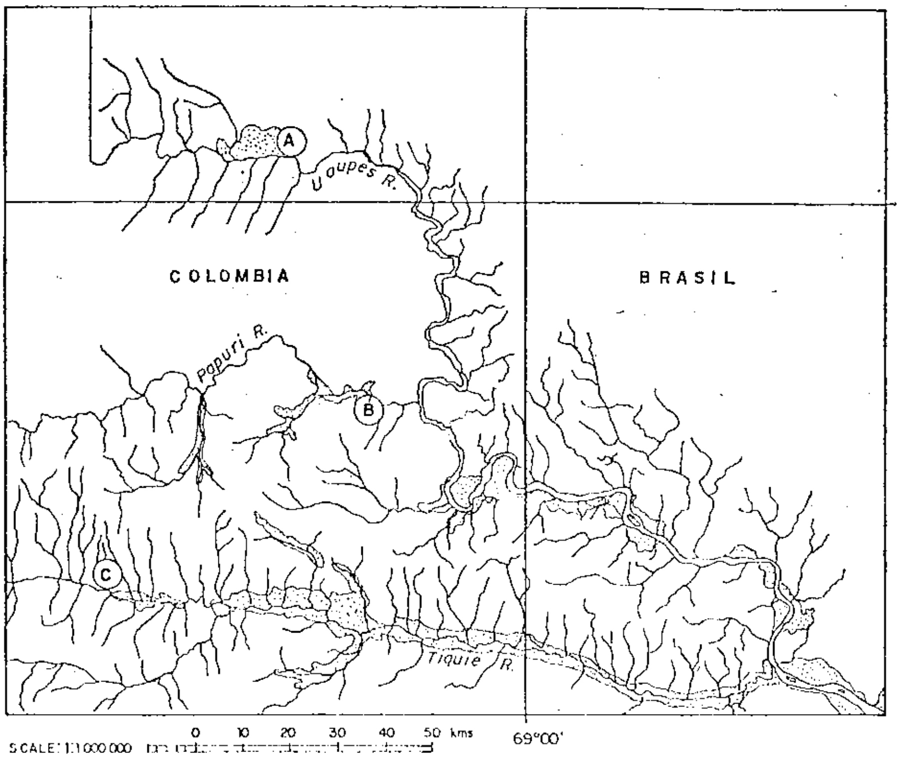


Fig. 7. Locations of high-ranked settlements in three sections of river A = the higest-ranked sib location for a designated section of river.

Dr. Hamilton Rice (1910, cited in Goldman 1963, p. 8) counted 30 major cataracts and 60 small ones, or rapids, on the main course of the river. These cataracts act as a series of locks along the river course resulting in stretches of level water interspersed with rapids.

The distinctive cataract habitat supports a specialized fauna adapted to rigorous conditions of rapid water flow, high turbulence, and oxygen saturation. The shelter, rapid flow-through and high oxygen concentration present in cataracts result in relatively high fish biomass in such habitants. The fishes inhabiting cataracts have developed behavioral and morphological specialization which distinguish them from fishes in non-cataract habitats.

Fishes and other animals living in torrential water must be able to compensate for or avoid the current in order to maintain their positions. For this reason, fishes tend to live close to the substratum where the current is greatly reduced, or in the crevices between rocks.

Cataract-dwelling fishes may be described as sedentary, as compared to those inhabiting the middle of the water column which are more typically in motion (Hynes 1970). Open-water fishes often travel in shoals for protection, whereas cataract-dwelling species utilize the crevices of stones and rocks for shelter. Hynes (1970, p. 310) suggests that a rocky area, with its complex ecosystem, and specifically with its protective crevices, permits more fishes to occupy a given volume than do open waters.

The rocks provide both shelter and food for the fish. They provide a substrate on which algae and aquatic higher plants grow. The plant communities in turn house large quantities of insect larvae on which fishes feed. I have observed a number of different catfishes living among the aquatic plants where the current is reduced. Several species of Loricariadae and Pimelodidae which the Uanano utilize occur only in cataracts.

The steepness of the gradient, the related turbidity of the water, and the length of turbid conditions vary considerably. The highest cataracts with steepest gradients are permanent, whereas lower cataracts, which typically have less pronounced gradients, are seasonal, disappearing during high-water periods. The cataract's height is the determinate feature in its function as a barrier to certain fishes. The degree of interchange across cataracts is determined by the height of the outcropping and the degree to which it extends across the river channel. Permanent cataracts can act as boundaries in the faunal distributions of certain species. For example, my observations show that the large *Arapaima gigas* (osteoglossidae), *Colossoma macropomum* (Serrasalmidae), *Colossoma macropomum* (Electrophoridae) and the *Potamotrygon* (Potamotrygonidae) are not found above the permanent cataracts at Caruru. These are representative of numerous other large fishes which never reach the Uaupes basin due to an inability to pass through the powerful rapids.

A cataract disrupts water flow in such a way that fishes passing through it are funneled through a limited number of discrete channels. This feature affects Uanano fishing practices, since channels appear and disappear predictably with the seasonal rise and fall in water levels. For example, funnel traps placed among the rocks are functional for different periods of time, depending upon trap placement in relation to water level.

Summary

In summarizing fish habitats as related to fishing, we may offer the following statements:

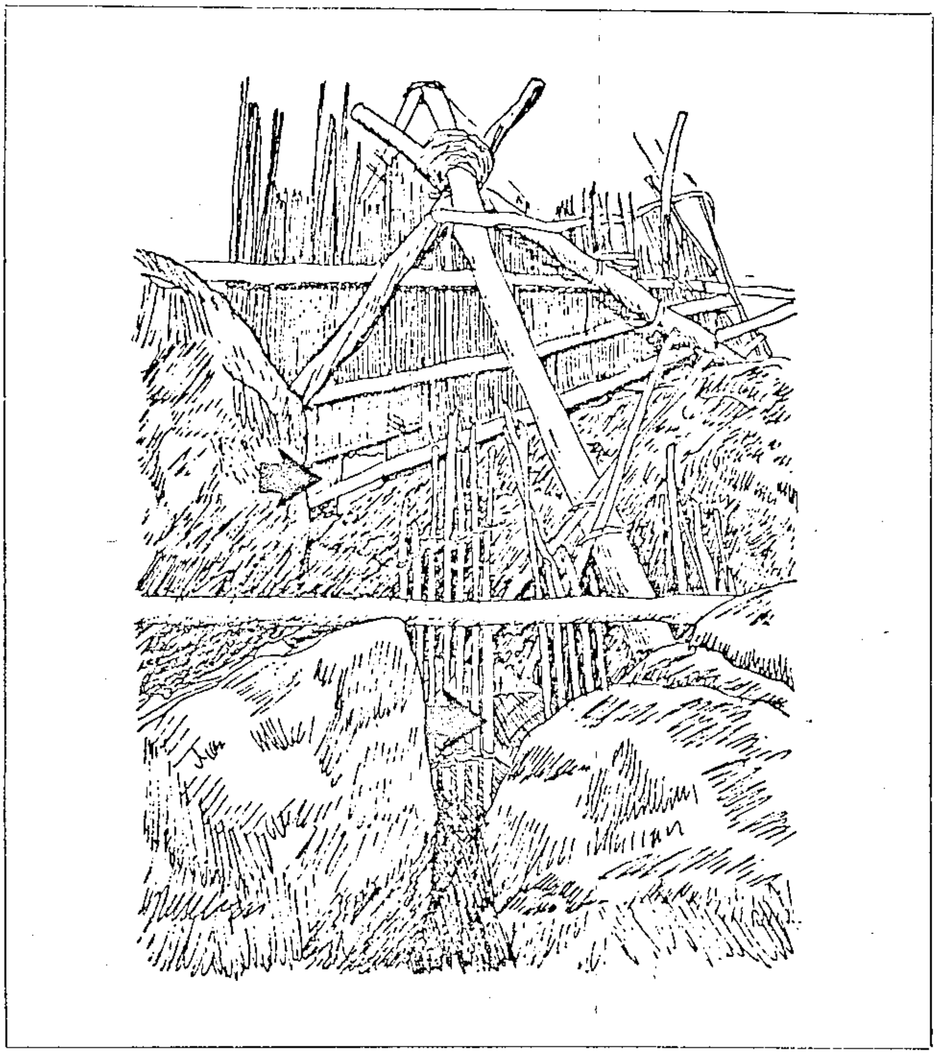
1) the black-water river is a fairly sterile environment whose food resources derive from outside the river system;

2) two habitats are more productive for fishing than others: flooded forests which provide fishes with vast quantities of otherwise unavailable foods; and cataracts, whose greater protective surfaces and crevices permit more fishes to occupy a given space than open waters, and whose aquatic plant and associated faunal communities provide greater food sources;

3) the salient feature of this environment is the appearance and disappearance of certain aquatic habitats with river level fluctuation.

The cyclical changes are predictable within limits, leading to adaptative responses in the fish population, such as specializations which increase the effective environmental heterogeneity (Roberts 1972, p. 122).

Uanano methods of fish capture take into account the feeding, reproductive, and migratory cycles of fishes that result from the pronounced seasonal fluctuations of the river system.



Basket trap fence at cataract showing one opening for trap (upper level), no longer seasonable, and lower openings with traps in place.

Resource Access at Various Habitats

Comparative Fishing Yields

We now turn to the Uanano use of fishery resources in relation to various types of habitat.

Fishing data were gathered from 1978 to 1979. Data based on 1,910 fishing man-hours, in which location was recorded for every fish captured,[9] demonstrate the dramatic variation in actual yield per habitat type. Approximately 80 fishing locations were classified into the following habitat types: (1) seasonally flooded forests; (2) cataracts; (3) river margin; (4) island point; (5) sand beach; (6) margin of *terra firme* upland; and (7) unknown.

Seasonally flooded forests, cataracts, and *terra firme* have been defined above. Island point refers to the upper or lower limit of an island; I retained this category despite the fact that some of them are seasonally flooded, since the hydrology of the island point is different from that of the margin. The category river margin was applied to a small number of fishing sites which bordered on flooded forest areas. Since their designation as *terra firme* or flooded forest varies according to the extent of flooding, I formed a separate category for these sites.

Two graphs, "Total Weight of Fishes Captured per Habitat," and "Numbers of Fishes Captured per Habitat," (Fig. 5 and 6) illustrate the dramatically higher percentage of fishes captured in areas of seasonally flooded forests as opposed to other habitats. Cataracts provide the next highest biomass of captured fish. Together, cataract and seasonally flooded forests *(igapo)* account for more than 80 percent of the sites where fishes were captured.

A comparison of Figs. 6 and 7, which illustrates the number and biomass by weight of fishes caught per habitat, shows a marked changed in relative proportions only for the beach habitat. The mean weight of the fishes captured on the beach habitat is lower, as indicated by the greater number of specimens relative to the total weight captured. Sandy beaches tend to slope gradually. The water's shallowness selects for smaller fishes and juveniles who feed on benthic organisms in the sand; it protects them from many of the deep-bodied fishes whose size restricts them from such shallow areas.

The *terra firme* yielded the fewest fishes in terms of both numbers and total biomass.

Sib Rank and Control of Fishing Sites

The indigenous groups of the Uaupes associate seniority of group status with abundance, calling the seniors "succulent." Senior sibs are expected to be generous and to present numerous *Po?oa* ceremonies. This would suggest that higher ranked sibs would inhabit locations with more abundant food supplies — particularly fish, the primary protein source. Data collected were analyzed to test this hypothesis.

As we have stated, the data show that the most productive habitats are, first, flooded forests, and, secondly, cataracts. Together, these sites account for 80 percent of all fish captured.

Sibs' proprietary rights to specific locations are fixed on the basis of ancestral emergence from a primordial anaconda. They restrict fishing within their boundaries to sib members and "authorized visitors." A great variation is found in the access of different sibs to different habitats.

Social Ideology and Settlement

According to Uanano ideology, sibs are arranged along the river as they emerged from the body of the ancestral anaconda who faced downriver. The senior chiefly groups are thought to have emerged from the head of the anaconda and the junior groups from the tail. Accordingly, the most chiefly sibs should be located downriver; the less chiefly, in descending order, should be situated upriver.

In fact, among the Uanano the more chiefly groups are located downriver; no senior groups are found upriver. Occupation of these sites is legitimized by myths of several kinds, including that of the anaconda. In addition, each chiefly sib has its own origin myth, in which its first ancestor appears at the sib's site; leaving signs of his occupation in marking the site's landscape, most typically in stone. Furthermore, chiefly sibs have litanies which repeat the sib order, and which they recite to visiting younger brother groups. These sib litanies stress "sitting" in the ancestral "sitting place," for only in this way can the ancestral soul return (Chernela, 1983b).

However, the alignment of groups departs from the strict downriver/senior, upriver/junior pattern in the following ways. First, sibs designated as "servants" live among chiefly sibs downriver. Some live in the chiefly settlements, and others live in nearby, associated settlements. However, these servant sibs are considered to be paired with specific chiefly sibs, having come to the settlement at an earlier time at the senior group's "invitation." These servants, or Wiroa, are thought to have originated not with the anaconda canoe, but later, at the hands of an ancestral Uanano shaman. They are expected to perform labor for their Chiefly hosts; in part they are expected to assist in the preparation of sumptuous *Po?oa*.

Secondly, there are exceptions to the correspondence of sib order with settlement order on the river. For example, among the Uanano, the currently highest ranked group occupies the most upriver location of the chiefly groups. This exception is related to the differential access to resources at various sites.

Sib Location and Environmental Biotypes

Since the productive *igapo* (seasonably flooded forests) and cataract habitats may be exploited in alternate seasons the most advantageous location would afford access to both. The second most desirable site could have access to one or the other habitat. The next best site would offer river frontage without either cascade or seasonally-flooded forests; i.e., a site located at a margin of *terra firme*. The least advantageous location would allow no legitimate control of river resources.

On the main channel of the Uaupes and on its largest tributary, the Papuri, the portion of river margin subject to inundation is small relative to the non-flooded margin. On the Tiquie the situation is reversed (see Fig. 7). From its confluence with the Papuri to the Colombian frontier, the Uaupes River stretches 175 kms. Only 22 kms. of its river margin, or 12 percent, is *igapo*, i.e., subject to flooding in high waters. The remaining 88 percent drains non-flooded high ground. The Papuri River is 154 kms. in length from its mouth to the Colombian border. Only 17 kms., or 11 percent of its banks are subject to flooding.

In contrast, 91 percent of the 450 kms. through which the Tiquie River runs, from its mouth to its entrance into Colombia, drains seasonally flooded forests.

The Uanano area with which I am familiar encompasses only one flooded forest. The territory controlled by the highest ranked sib includes that flooded forest and two cataracts. and is indicated by the letter *A* on Fig. 7. The flooded forest at Tucunare Igarape near Yapima, estimated on the basis of satellite photographs (Projeto Radambrasil) to cover 190 sq. kms., formerly belonged to the Biari Pona, first-ranked sib at Bucacopa. Since the demise of the Biari over the last two generations, it has been occupied by the second —and third-ranked sibs.

On the Papuri, the only flooded forest is located at the mouth of Turi Igarape. The highest ranked sib of the Tucano language group inhabits this site (Sta. Luzia), controlling both that flooded forest and a very large waterfall.

On the Tiquie, where the river's lower reaches meander through flooded forests, the highest ranked group — a Tucano sib — is located at Pari Cachoeira, the site of the *most downstream* cascade, and has within its fishing territories both flooded forests and cascades.

On each one of these river segments, the highest ranked sibs control both cascades and flooded forests. Furthermore, each of the numerous cascades which punctuate the Uanano stretch of the Uaupes belongs to one of the first-ranked chiefly sibs — the Wamisima — by virtue of their ancestors' emergence at that site from the ancestral canoe. Each chiefly settlement is located at one of these cascades.

Upriver from these sites are the settlements of the *Tibahana*, the Second Brothers. These sites are located on *terra firme* stretches of river, with neither flooded forests nor cascades. Only one, Taraqua, is adjacent to minor rapids which appear in the low-water season.

The low-ranked Wiroa are considered to have no legitimate control over river frontage. Downriver, they live among the Wamisima (First, Chiefly Brothers), and are thought to be paired with them in a servant capacity.

These observations confirm that the ideal association of rank with abundance is borne out in settlement distribution and environmental advantage. The consolidation of resources in the hands of higher ranked groups is, however, balanced by the set of obligations concomitant to rank, which requires generous redistribution of goods among in-laws and kin. The result is a major exchange network linking some 10,000 Indians in the Uaupes region, moving foodstuffs and goods among them across distances which may be great.

Former researchers have described the Uaupes as "an undifferentiated stretch of forest, streams, and rivers," where "resource homogeneity is characteristic of the region" (Jackson 1976, p. 67). We have shown that greater environmental diversity exists than has previously been noted, and that this diversity is relevant to settlement pattern, food procurement, seniority and resources access, social ties and resource distribution.

The degree of interdependence among Uaupes sibs would appear to be unusual for a tropical rainforest society, but is made understandable when related to the area's environmental features. As this paper describes, the Uaupes is not undifferentiated. To the contrary: it is characterized by dramatic contrasts in resource availability and access over time and space. The nonsynchronous peaks in abundance result in local excesses of food in different portions of the basin. These are distributed through the Po?oa exchange. The *Po?oa* structures redistribution, circulating goods among local groups according to social relationships. Differential resource access and the redistribution of goods within and among the language groups inhabiting the Uaupes Basin is crucial to any accurate analysis of the human ecology of the region.

NOTES

1. Daniel Gross (1982) has recently called the attention of anthropologists to the need for a regional approach in ecological studies.
2. The Uanano (alternately spelled Wanana, Uanana, Ananas) are also known as the Kotiria (with alternate spelling Kotita and Kotedia).
3. I follow Jackson (1974) in her use of "language group." Sorensen (1967) employs the term "tribes" while C. Hugh-Jones (1979), S. Hugh-Jones (1979) and Goldman (1963) utilize still different terminologies.
4. The Cubeo (Goldman 1963) are an exception to the rule of linguistic exogamy.
5. The ideal of complete correspondence between the sib and the local group is not always realized. Nevertheless, the sib is associated with and maintains dominion over a specific geographic locality.
6. The orthographic symbol ? is used here to indicate a glottal stop.
7. See Sioli (1968) for classification and description of Amazonian rivers.
8. Sioli (1968, pp. 591-3) gives $<$ 1.5 m. as the expected range of transparencies (as measured by Secchi disc depth readings) for blackwaters as compared to 0.1 — 0.5 for white-water and 0.6 — 4.0 for clear-water rivers.
9. For each fish captured, the following data were collected: name of fisherman; number of fishers in party; departure time; return time; method of capture; location of capture; method of preparation; time of consumption; age of consumers; and relationship of consumers to fisherman. Each individual fish was weighed, measured, and examined for certain biological features such as eggs or parasites. In addition, I assembled a study collection of over 200 fishes for identification and deposit at the Instituto Nacional de Pesquisas da Amazonia and the Museu de Zoologia of the Universidade de Sao Paulo.

REFERENCES

Bruzzi Alves da Silva, P. Alcionidio (1977): *A civilizacao Indigena do Uaupes*, Segunda Edicao, Missao Salesiana do Rio Negro, Amazonas, Brasil.

——— (1982): "An Indigenous System of Forest and Fisheries Management in the Llaupes Basin of Brasil," *Cultural Survival Quarterly*, Vol. 6, Nº 2, pp. 17-18.

Chernela, Janet M. (1983a): "Estrutura Social do Uaupes Brasileiro," *Anuario Anthropologico / 81*, Direcao Roberto Cardoso de Oliveira, Edicoes Tempo Brasileiro Brasileiro Ltda., Rio de Janeiro.

Chernela, Janet M. (1983b): Hierarchy and Economy among the Kotiria (Uanano) speaking peoples of the Northwest Amazon, Columbia University PhD Dissertation, University Microfilms International.

Geisler, R., Knoppel, H.A., and Sioli, H. (1973): "The Ecology of Freshwater Fishes in Amazonia: Present Status and Future Tasks for Research," *Applied Sciences and Development*, Tubingen, Institute for Scientific Cooperation, 2: 144-62.

Goldman, Irving (1948): "Tribes of the Uaupes-Caqueta Region," in *Handbook of South American Indians*, Vol. III, Smithsonian Institution, Washington D.C.

——— (1963): *The Cubeo: Indians of the Northwest Amazon.* Illinois Studies in Anthropology, Nº 2, University of Illinois Press.

——— (1981): "Foundations of Social Hierarchy: A Northwest Amazon Case," paper presented to the New York Academy of Sciences, February 23, 1981.

Goulding, Michael (1981): *The Fishes and the Forest*, University of California Press.

Gross, Daniel (1982): "Friends, Neighbors, and Amino Acids," paper presented at the 81st Annual Meeting of the American Anthropological Association, Dec. 3-7, Washington D.C.

Hugh-Jones, Christine (1979): *From the Milk River: Spatial and Temporal Processes in Northwest Amazonia*, Cambridge University Press.

Hugh-Jones, Stephen (1979): *The Palm and the Pleiades: Initiation and Cosmology in Northwest Amazonia*, Cambridge University Press.

Hynes, H. B. (1970): *Ecology of Running Waters*, University of Toronto Press.

Jackson, Jean E. (1974): Language Identity of the Colombian Vaupes Indians, in *Explorations in the Ethnography of Speaking*, ed. R. Bauman and J. Sherzer, pp. 50-64, New York.

——— (1976): Vaupes Marriage: A Network System in an Undifferentiated Lowland Area of South America, in *Regional Analysis*, Vol. II, Social Systems, ed. C. Smith, pp. 65-93, New York.

Knoppel, H. A. (1970): Food of Central Amazonian Fishes: Contribution to the Nutrient-ecology of Amazonian Rainforest Streams, *Amazoniana*, 2(3): 257-352.

Ministerio das Minas e Energia (1976): Projeto Radambrasil: Levantamento de Recursos Naturais, Vol. 11.

Marlier, G. (1967): Hydrobiology in the Amazon region, *Atas do Simposio sobre a Biota Amazonica*, 3: 1-7.

Roberts, T. R. (1972): Ecology of Fishes in the Amazon and Congo Basins, *Bulletin of the Museum of Comparative Zoology*, 143 (2): 117-47.

Schmidt, G. W. (1969): Vertical Distribution of Bacteria and Algae in a Tropical Lake, *Int. Rev. Ges. Hydrobiol.*, pp. 791-7.

——— (1970): Number of Bacteria and Algae and their Interrelations in Some Amazonian Waters, *Amazoniana*, 2: 393-400.

——— (1973a): Primary Production of Phytoplankton in the Three Types of Amazonian Waters, 2, *Amazoniana*, 4 (2): 139-203.

——— (1973b): Primary Productivity of Phytoplankton in a Tropical Floodplain Lake of Central Amazonia, *Amazoniana*, 4: 379-404.

——— (1976): Primary Production of Phytoplankton in the Three Types of Amazonian Waters, 4, *Amazoniana*, 5 (4): 517-28.

Sioli, H. (1968): Principal Biotypes of Primary Production in the Waters of Amazonia, *Proceedings of the Symposium on Recent Advances in Tropical Ecology*, ed. R. Misra and B. Gopal, International Society for Tropical Ecology, pp. 591-600.

Smith, Nigel (1981): *Man, Fishes, and the Amazon*, Columbia University Press, New York.

Sorensen, Arthur (1967): Multilingualism in the Northwest Amazon, *American Anthropologist*, Vol. 69, Nº 6, pp. 670-82.

Wallace, Alfred Russell (1870): *A Narrative of Travels on the Amazon and Rio Negro*, London.

Welcomme, R. L. (1979): *Fisheries Ecology of Floodplain Rivers*, Longman, New York.