



## Ecological Modelling and Indigenous Systems of Resource Use: Some Examples from the Amazon of South Venezuela

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"These Canibals are of a good stature, bigge, and tall of bodie,  
and very cleane made of their lims, very sufficient to behold;  
but they are a kind of lasie people, that care not for any thing,  
but will lie all day lasing in their houses, and never goe abroad  
but for their victuals".

(Purchas 1905:259)

### Ecological Modelling

The study of lowland South American societies using an ecological approach does not have a long history, but, perhaps more than in any other area of comparable dimensions, has generated a heated but fertile controversy which has focussed on attempts to discover the extent to which aspects of the external environment may mould the form of human societies.

Even amongst those anthropologists who accept that environmental parameters exert an important influence on the form of Amazonian societies and have employed an 'ecological' approach in elucidating the extent of these influences, there exist, however, significantly different premises. At the risk of simplification and of treading on the toes of a number of these ecological anthropologists, it is possible to divide the pro-environmental-

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influences lobby into two camps—though since some of these anthropologists do not appear to be aware of the confusion in premises underlying much of the ensuing debates the task is not easy.

On the one hand, anthropologists have used the methods of the biological ecologists to weigh, measure and monitor the physical interactions observable between human populations and their environment. Supposedly on the basis of this factual data, and in conjunction with our gradually developing knowledge of tropical forest ecosystems and their resource potentials, such anthropologists have attempted to go beyond mere description to explain various aspects of Amerindian societies and cultures in terms of adaptive strategies that optimize or improve resource use. Thus Meggers (1971), reviewing the information presented in some early ethnographic material, has attempted to explain cultural praxis in terms of environmental constraints, emphasizing in particular the poverty of Amazonian soils and the consequent necessity for long fallow periods in the cycle of shifting agriculture. Senilicide, infanticide, post-partum sex taboos, agriculture and beer fermentation are all aspects of these cultures that Meggers interprets as adaptive responses that optimize the Amerindians' relationship to the counterfeit paradise that is Amazonia. In the same vein Lathrap (1970) has described a population pump operating from the rich soils of the *varzea* alluvia in the Amazon lowlands. These relatively rich soils, close to (Lathrap argues) plentiful fish populations and abundant riverine hunting reserves, have allowed dynamic population increases, causing successive waves of Indians to be pumped out from this cultural heartland into the relatively resource-poor interfluvial areas where the cultures have degenerated and dispersed (see Roosevelt 1980 for a reasoned critique). The argument shared by Lathrap and Meggers, that it is a combination of shifting agriculture and the poverty of Amazonian soils that sets upper limits to population density and thus "cultural development," has been questioned by Carneiro (1973) who has suggested that, on the contrary, Amazonian forests are exploited at well below their carrying capacity for shifting agriculture. Consequently Gross (1975) has suggested that it is protein availability rather than access to ready supplies of starchy foods that has been the major limiting factor in Amazonian habitats, while on the other hand it has been argued that it is the ready availability of agricultural land that explains the low cultural level in Amazonia (Carneiro 1970) and the ease of shifting agriculture that explains the lack of centralized authority in Amazonian societies (Leeds 1969).

It should be emphasized that the models of external constraint proposed by these authors range from the mildest forms of 'environmental possibilism' to the most uni-directional models of 'environmental determinism'; what they all hold in common, however, is the attempt to explain observable behaviour primarily in terms of an adaptation to the external environment,

as described by tropical forest ecologists. The most outspoken champion of this camp, Marvin Harris (1974, 1977, 1979*a*, 1979*b*), has dealt in particular with the case of the Yanomamö. Using an approach which he describes as one of 'techno-demo-eco-econo-determinism' (Harris 1975), he has proposed that many aspects of Yanomamö society (infanticide, warfare, settlement patterns and subsistence) are the result of chronic protein shortage caused by environmental depletion (1974, 1977) or rather are evidence of an overall strategy that effectively allows the Yanomamö an adequate diet in a protein poor environment (1979*b*). Harris's contentions have stimulated acrimonious debates (Colchester 1982*a*) which have in turn led to some very detailed field research into Amerindian practices of resource use (e.g., Vickers 1976, 1980; Chagnon and Hames 1979; Lizot 1977, 1978; Bergman 1980; Beckerman 1980*a*), the most useful conclusions being that the need is for multifactorial rather than unifactorial models to explain Amerindian behaviour.

On the other hand, other anthropologists have attempted a quite distinct task which is to interpret Amerindian conceptual systems in terms of the concepts of ecological modelling. Here the attempt is to approach the same issue, Amerindian adaptation and survival, from a different direction by showing how the cultural *reason* (rather than behaviour) of the Amerindians themselves is comparable to the ecological perspective of modern biologists. The prime exponent of this approach is Reichel-Dolmatoff (1976) who interprets Tukano concepts of vital energy and the dangers attendant on the excess consumption of foods or indulgence in sex as analogous to the ecologists' concepts of energetics and negative feedback. Similarly McDonald (1977) has argued that the system of food taboos found in many Amazonian societies is a kind of 'Primitive Environmental Protection Agency'. This argument has surfaced repeatedly under a number of guises (Heinen 1972; Heinen and Ruddle 1974; Ross 1978) but has never been backed by convincing statistical demonstrations that food prohibitions can or actually do optimize hunting returns and/or conserve scarce resources. Notwithstanding it has become almost commonplace in some circles to accept that the Amerindians are, in their own way, fully cognizant of the dangers of environmental overexploitation and ultimately it has even been claimed that they have their own "conservationist cosmovision" (Seijas and Arvelo-Jiménez 1979).

At the risk of exaggerating the differences between these two 'ecological' approaches one might summarize by saying that while the first group of anthropologists attempt to understand Amerindians as natural components of the ecosystem, the latter group portray the Amerindians as ecologists in their own right.

These two 'ecological anthropologies' differ essentially in the role that they ascribe systems of thought in the process of adaptation. The former

consider cosmologies as epiphenomenal to cultural evolution, while the latter consider them integral to the adaptive process. It is for this reason that Marvin Harris, spokesman of the former camp, can dismiss Sahlins's critique of materialist anthropology (Sahlins 1976) as a confusion of 'emic' and 'etic' approaches (Harris 1979a:333). Harris, we should recall, considers that "free will and moral choice have had virtually no significant effect upon the direction taken thus far by evolving systems of social life" (Harris 1977:11) and eschews explanations of social praxis by reference to 'emic' data (cf. Gross et al. 1979; Werner et al. 1980).

I have dealt elsewhere with some of the theoretical problems attendant on Harris's cultural materialist approach, which I shall refer to as "etic biofunctionalism" (Colchester 1978, 1982b), though we may note in passing that his postulation of teleonomic (Huxley 1956) change in cultural adaptation lacks entirely a model of the *process* by which advantageous behaviours are discovered, selected and retained.

The model of the "emic biofunctionalists", as I shall refer to the eco-anthropologists of the Reichel-Dolmatoff camp, while processually more plausible (Orlove 1980), assumes that the teleologic by which societies evolve is also an ecologic. Sahlins's critique of this approach (Sahlins 1976) is thus a direct challenge to such an anthropology, for he sees in this attempt to impute 'Practical Reason' to members of tribal societies an ethnocentric assumption of a universal bourgeois rationalism, a concept as repugnant to Sahlins as was the concept of a Universal Economic Man to Malinowski (Schneider 1974).

In the following brief perusal of Amazonian economies my concern is not so much with the theoretical problems that face the "biofunctionalists" but with the factual basis for their proposal of an Amerindian 'conservation consciousness'. Do the *ethnographic* facts substantiate the assertion that the Amerindians pursue a form of practical reason based on an 'ecologic'?

#### Systems of Resource Use: Some Facts

First we must recall that both the 'emic' and 'etic' biofunctionalists are attempting to explain the same facts, in particular that, in marked contrast to the destructive and exploitative approach of the Neo-Americans to the tropical rain forests (Goodland and Irwin 1975; Davis 1977; Bourne 1978; but see Moran 1980), Amazonian Indians do appear to have been surviving in the same forests without causing marked environmental impoverishment or degradation.

Although it seems certainly true that the aboriginal Amerindian techniques of resource use were relatively undestructive to the Amazonian habitat, compared to recent development programmes, it does not immediately follow that these traditional societies have "lived for millennia in

effective harmony with their environment' (Seijas and Arvelo-Jiménez 1979, my translation) or that "their economy is in harmony with the possibilities of the natural environment and is perfectly integrated with it" (Lizot 1977:515).<sup>1</sup> For example, it has been argued that the big-mammal extinctions at the end of the Pleistocene were caused by overhunting (Martin 1975; Martin and Wright 1967) and attempts have even been made to trace the progress of the Amerindians across the Americas by dating the extinction of these mammal species (Hester 1967). It has also been suggested that some of the savannahs within the Amazonian area are anthropogenic, the result of overintensive agriculture. One of the most dramatic examples of environmental transformation caused by agriculture has been documented by Gordon among the Sinu of the sixteenth and eighteenth centuries (Gordon 1957). Recently Smole (1976) has suggested that the savannahs of the Parima hills, on the watershed between the Amazon and the Orinoco, were caused by overintensive land use in the Yanoama heartland. While it is not certain that it was the Yanomamö, or other Amerindians, who have been the immediate cause of these savannahs, it is clear that a number of other environmental factors are implicated in the process of savannization such as exaggerated seasonality, poor drainage, irregular water tables and particularly nutrient-poor soils (Eden 1970; Sarmiento and Monasterio 1975; Huber 1979). Recent publications emphasize that white sand soils are unusually prone to deflection from climax (Stark 1978; Anderson 1981) and that natural cycles of savannization may have been an important part of Amazonian history. However, though these suggestions of anthropogenic environmental degradation are not conclusive they emphasize that it would be overhasty to accept uncritically the assumption that the traditional Amerindians were in a stabilized adaptation to their habitat.

Whatever the truth of the degree of the stability in pre-Columbian Amazonian populations, post-Columbian Amazonia has witnessed radical transformations in Amazonian societies. Even in areas not directly invaded by Neo-Americans there have been dramatic disturbances of Indian demography (notably due to the introduction of Old World viral infections) and changes in technology that have extensively modified the Indians' economies. The consequences of these changes are complex and varied but increasingly there are reports of environmental impoverishment associated with modern Amerindian practices of resource use.

The greater efficiency of steel tools compared to the stone axes traditionally used by the Amerindians is not in doubt (cf. Clastres 1977:165). Archaeologists experimenting with both types of tools show unequivocally

<sup>1</sup>Reichel-Dolmatoff (1976:318) does not fall into this trap of idealizing Amerindian societies, as being "in harmony with nature", favouring a more dynamic vision of Amazonian society.

that the steel tools are much more efficient (5–10 times as efficient: Stelcl and Marina 1970; Saraydar and Shimada 1971; Coles 1979; Harding and Young 1979) and numerous accounts from the Indians and from other stone age peoples adopting steel tools confirm this (Purchas 1905:429–430; Sharp 1952; Holmberg 1954; Salisbury 1962; Harner 1963; Kozak 1972; Lizot 1976*a*; Laming-Emperaire 1978; Kloos 1977; Kozak et al. 1979). The changeover from stone to steel axes has transformed the means by which Yanomamö collect forest products. Whereas in the past honey, caterpillars and fruits were all harvested by first climbing trees and then laboriously chopping off single branches or making holes in the trunk, today the Yanomamö tend to fell entire trees. The consequences may be the local elimination of certain species (Anderson 1977).

Similarly the transition from the use of bows and arrows or blowpipes to the use of shotguns for hunting has dramatically increased the effectiveness of the hunter's technology (Hames 1979; E. B. Ross 1978; J. B. Ross 1980) with unfortunate consequences for the fauna. Local extinctions of large mammals and big birds around Amerindian settlements probably occurred under traditional circumstances (cf. Hames 1980; Vickers 1980; Beckerman 1980*b*) but are seriously exaggerated when hunting is intensified due to the more efficient technology, the decreased mobility of the settlements and the increased local demand for meat due to increases in settlement size (Lizot 1976*a*; Colchester and Lister 1978; Colchester 1982*b*). Particularly pernicious to the fauna has been the use of electric torches (flashlights) for night shooting, a practice which has caused the dramatic decline of animal populations on riverbanks. Rivers that once abounded with capybara and other caviomorph rodents, alligators, caimans, deer and tapir are now practically deserted over long reaches; the indirect consequences may be more serious than is imagined (Fittkau 1970, 1973).

As the Amerindians come to impoverish their local environments they become increasingly dependent on the new technology for survival, and, in turn, they become more reliant on trade to acquire it. The dependence of the Amerindians on traded goods has provoked marked reorientations in their economic practices. Where traditional forms of environmental exploitation were once limited by the satisfaction of the local group's demands, the need to produce surpluses, to exchange for industrial products, has meant that local environments are today coming under increasing pressure to provide abundant supplies of marketable commodities.

In the Ventuari region of South Venezuela the Amerindians have adopted numerous strategies to produce marketable commodities including latex, timber, cattle, garden products, meat, animal skins and the products of their traditional material cultures. Labour, sex, and credit have also been marketed (Colchester and Lister 1978). The dependence of the Amerindians on industrial products has caused widespread relocations of the populations (Conaway 1976; Primov 1979; Colchester 1982*b*). As the Amerindians

have come to be clustered about the missions and *criollo* townships on the lower rivers, in order to be in easy reach for trading, the pressure on the local environments has become exaggerated. Subsequently in order to overcome the decreasing efficiency of the traditional production techniques in the impoverished habitats, the Amerindians have adopted mechanization as a solution—motor vehicles to transport their products to market, outboard engines to reach their ever more distant gardens, agricultural machinery to process foods for trade. The result is a yet further increase in their dependence on trade and technology. Moreover the increasing technological burden, as well as other infrastructural developments (airstrips, schools, dispensaries, shops, mission buildings, etc.), only makes settlement relocation even more difficult.

For the local environment the effects are readily apparent. The long-term burden of overhunting creates large areas where game is virtually unobtainable (cf. Lizot 1976a; Vickers 1980). Exaggerated agricultural production for surplus and for communities that are unusually sedentary means that gardens become remote from the settlements and are only accessible on a daily basis because of the use of outboard engines or jeeps. Fallow periods become much reduced and some gardens are not fallowed at all but are instead sown with grasses for cattle raising. In consequence forest regeneration successions are deflected by the soil degeneration (Gomez-Pompa et al. 1972; Goodland and Irwin 1975) and due to inadequate provision of stands of primary forest in the vicinity to allow the reintroduction of the seeds of climax species, an effect, perhaps, exaggerated by the elimination of animal vectors through overhunting. Especially where forest regeneration successions are purposefully replaced by grazing successions, some areas rapidly take on the characteristics of local savannahs (Colchester and Lister 1978).

It would be wrong to exaggerate the wider effects of these local changes in the ecosystem; at present, at least in the Ventuari area, the Amerindian population density remains low and there are large areas between the centres where habitats are relatively undisturbed. In environmental terms the present, as opposed to future, risks of these examples of ecosystem degradation may be slight. In human terms, however, the process is alarming, not just because the effects of the process may be effectively to diminish the nutritional, physical and material well-being of the Amerindians, but also because these changes make the survival of their traditional cultures nigh impossible.

#### **Amazonian Indians, Conservationists or Opportunists?**

The process by which relatively undestructive subsistence economies become disturbed by contact with occidental society and which results in the creation of vicious cycles of positive feedback leading to environmental degeneration has also been described in other regions (e.g., Weiss 1980).

Weiss calls the result "The Development Paradox", where "the availability of money results in lower nutritional status" (Weiss 1980:151), a paradox not limited to fourth-world populations (New Internationalist Dec. 1978; São Paulo Justice and Peace Commission 1978; Dewey 1979, 1981) and, like Boyden (1972, 1973), he describes the process as "cultural maladaptation".

The questions that require answering, however, are how and why these breakdowns in traditional subsistence economies occur? If, as the "emic biofunctionalists" have argued, there is a "cosmivision that underlies the whole way of life of the natives that is eminently conservationist" (Seijas and Arvelo-Jiménez 1979), why have small changes in economy, such as the replacement of a stone axe with a steel one, provoked the failure of the Indians' conceptual system to control their actual behaviour? While in the lowland communities it might seem arguable that the process of "maladaptation" has coincided with, and been caused by, the process of acculturation, such arguments are unconvincing in the case of the Yanoama where virtually unchanged social and conceptual systems operate alongside transformed economies. We are especially led to doubt that acculturation is the direct cause of the Amerindians' changed relationship to their environment if we remember that Reichel-Dolmatoff's prime informant on the Tukano's purported skills as ecological analysts has lived for years in occidental society (Reichel-Dolmatoff 1971:xiii-xiv).

Two conclusions seem possible given these facts. On the one hand it may be argued that this apparent inability of "emic" systems effectively to control "etic" behaviour is evidence of their epiphenomenal status, an argument put forward by Werner et al. (1980) and implicit in the position of Harris (1974, 1977, 1979*a*) in his discussion of 'bovicide' among the Hindu. Alternatively, as I shall argue, it may be that the real "emic" process by which the Amerindians respond to their environment has been misconstrued.

For example, Henley (1982:50-52) has been equally skeptical of the reality of an Amerindian "conservation consciousness". His studies lead him to describe the Panare's attitude to resource use as "prodigal". Such an attitude of primitive peoples towards resource use has been widely remarked on in the literature (Sahlins 1972). However, by itself, appreciation of this characteristic of Indian thought does not bring us nearer understanding the process by which traditional Amazonian societies maintained a relatively undestructive relationship with their environment. To discover this process we must look for the cues that the Amerindians respond to, in modifying their systems of resource use.

The argument of the "emic biofunctionalists" summarized above rests on the contention that the Amerindians, first, directly recognise the depletion of natural resources as a threat to their own survival and secondly,



aware of this, take active steps to moderate their use of the environment. Two forms of control have been emphasized, conscious regulation of the human population numbers (Arvelo-Jiménez 1971:94; Reichel-Dolmatoff 1976; Seijas and Arvelo-Jiménez 1979) and active control of hunting behaviour. Only one attempt has been made to furnish statistical proof of the effectiveness of these controls (McDonald 1977), by detailing the systems of food prohibitions prevalent throughout Amazonia.

Rather than discuss the merits of McDonald's speculative manipulation of numbers, I shall attempt to evaluate the plausibility of his suggestions by reference to the Sanema Indians of South Venezuela, who have a system of food prohibitions that has been documented in greater detail than in any other Amazonian group (Taylor 1972, 1974, 1979; Colchester 1982*b*).

The Sanema, the northern Yanoama, believe that the main cause of illness is the result of meat eating, since the spirits of the hunted and killed animals attempt to take revenge on humans. Some animals are so dangerous to eat as to be prohibited for the entire population (see Table 1) but the majority are only prohibited to certain segments of the population as defined by age, sex and reproductive status: individuals in these segments only eat foods 'prohibited' them at the risk of falling ill.

There are several very strong reasons for believing that this system of food prohibitions has a negligible effect on hunting practice. First it must be pointed out that the prohibitions are on *eating*, not *killing*, the game. Secondly, the Sanema norm is for game to be widely shared within a community and the social pressures that oblige sharing are very strong and effective. Consequently a hunter's own prohibitions or those in his immediate hearth group need not dissuade him from killing animals in the forests

TABLE 1. Sanema Indian Food Prohibitions

<i>Sanema name</i>	<i>Zoological identification</i>	<i>English name</i>
olasuma	<i>Cyclopes didactyla</i>	silky anteater
ila holishi	<i>Canis thous</i>	savannah fox
hanakasa	<i>Mustela frenata</i>	weasel
hāho	<i>Sylvilagus brasiliensis</i>	rabbit
wisha nabi	<i>Saimiri sciureus</i>	squirrel monkey
mōna <sup>a</sup>	<i>Inia geoffrensis</i>	river dolphin
kaimania <sup>a</sup>	<i>Crocodylus intermedius</i>	caiman
kaimania	<i>Melanosuchus niger</i>	caiman
kaiyuwe <sup>a</sup>	<i>Phalacrocorax olivaceus</i>	cormorant
ādādā <sup>a</sup>	<i>Anhinga anhinga</i>	darter
moma	<i>Harpia harpyja</i>	harpy eagle
moma	<i>Morphnus guianensis</i>	crested eagle

<sup>a</sup>Yekuana names used by the Sanema.

since other members of the local group will be able to eat the game even if he cannot. Besides, so strong are the norms of food sharing that Sanema hunters anyway partake only sparingly of the game that they have themselves killed. Similarly, among the Yanomami (Lizot 1976*b*) and the Guayaki (Clastres 1972) a hunter never eats the game he has killed; accordingly, Lizot (1976*b*) has explained the Yanomami system of food prohibitions as a mechanism for encouraging food distribution from young producers (to whom many foods are prohibited) to older dependents (to whom few foods are prohibited) (cf. Leakey and Lewin 1978:90). Norms of meat sharing are almost universal in hunting societies. Because few foods are prohibited to all a population and because food sharing is the norm, a hunter can always find mouths to consume almost any game he brings home; since he gains prestige and respect for bringing home meat, the possible limiting effect that *dietary* prohibitions have on *hunting* behaviour is considerably attenuated.

Actually to evaluate whether or not food prohibitions do affect hunting behaviour is very difficult by monitoring hunting returns because of the impossibility of establishing controls and because so many other variables affect hunting performance. But it should be noted that there are occasions when food prohibitions actually seem to increase the pressure on the environment; sometimes unfavourable meats like anteaters, though killed, are wasted because they are considered harmful. During my eighteen months living among the Sanema as a hearth member, the only occasion I noted a direct relation between a food prohibition and a hunting response was when a hunter returned from the chase bearing a large male howler monkey. After handing the animal over to the women for butchery he explained that he was going hunting again because, as his wife was pregnant, they could not eat male howler monkey. He returned later having successfully bagged an agouti.

An alternative and much simpler model, that not only explains how the Amerindians have in the past limited their pressure on the environment but also explains how this system of control breaks down with the transformation in technology, follows the proposal that human behaviour obeys "Zipf's law", also known as "the least effort principle" (Zipf 1949), which states that humans will act to minimize work expenditure, on average, over time, to the best of their predictability (cf. Gross et al. 1979:1049). Lizot (1978:96) has proposed that just such a principle operates in the functioning of Yanomami society;<sup>2</sup> the "least effort principle" corresponds to an Amerindian attitude widely remarked on in the literature, their "laziness". A

<sup>2</sup>A recent publication by Behrens (1981) suggests that the Shipibo act to minimize Time Allocation on subsistence tasks. It would be interesting to see if Behrens gets a closer fit from his data if he assumes they minimize Effort.

model of Amerindian behaviour that incorporates "Zipf's law" does not correspond exactly to that of the "etic biofunctionalists" because it implies (with the phrase "to the best of their predictability") that human modes of thought mediate between humanity and the environment and control behaviour. In other words, humans act rather than behave (Reynolds 1976: xv). Sahllins's opposition between "Culture" and "Practical Reason" (Sahllins 1976) is a false one; humans attempt to minimize work effort not only within the limits imposed by the external environment but also within the systems of concepts by which they perceive it. An action which appears to the "etic" analyst to be suboptimal may be considered optimal to the actors because they predict different consequences. An example from my own fieldwork neatly illustrates this point.

A river bird common in the Upper Ventuari (and throughout Amazonia) is the neotropic cormorant (*Phalacrocorax olivaceus*). Canoeing along the narrow rivers causes these birds, which usually live dispersed along the river's length, to become concentrated into flocks as they flee the steadily moving canoe; they present easy targets to Indians standing in the bows. The (Carib-speaking) Yekuana shoot and eat these birds, just as might be predicted by "etic biofunctionalists". However, the Sanema Indians who live sympatrically with the Yekuana never kill them, for reasons that only "emic" ethnography will reveal—to the Sanema they are evil spirits that are dangerous to eat. Since these two peoples predict quite different consequences from the eating of these birds their behaviours towards them are correspondingly distinct. The assumption of what we might call "cultural practicality" (to collapse the false dichotomy offered us by Sahllins) as basic to Amerindian thought is, of course, implicit in the suggestions of the "emic biofunctionalists" criticized above. However, their suggestion that pragmatic, eco-logic structures cosmology itself will fail to explain the variation between these two groups' beliefs concerning cormorants.

Instead of assuming that the environmental cue that Amerindians traditionally respond to in controlling their pressure on resources is the quantitative decline of actual floral or faunal populations, a simpler model closer to "Zipf's law" suggests that the dominant cues are the Indians' own hunger and tiredness. When the Sanema discuss faunal depletion near their villages they do so subjectively. Rather than objectively noting that curassow populations have been diminished or that white-lipped peccaries are not present in the vicinity, they point out that "we now have to go all the way to the *madapada* creek to find curassows", "we have not killed peccaries here for two years", "you have to work hard near Cacuri to get game". . . .

The Amerindians accordingly act in ways that, they predict, will minimize their work effort. Village micromovements are made to locate houses near to producing gardens (cf. Chagnon 1968); treks are undertaken to remote forests when crops fail or local hunting is poor (Lizot 1974, 1978); collecting

activities are undertaken on the spur of the moment when abundances are noted (cf. Fuentes 1979). In short the economy, far from being planned and objectively controlled, is opportunistic and controlled subjectively.

In the context of the simple traditional technology, the consequences of this attitude to work are that the pressure on resources is spread evenly. Hunters will not bother to hunt scarce species (they don't need supernatural sanctions to oblige such behaviour [Ross 1978]); areas that are sparse in game will rarely be visited (cf. Hames 1980); populations will abandon areas where garden sites become hard to find (Reid 1979). In the stone age these kinds of choices would have been more obvious because the total effort of subsistence was greater.

The Amerindians' responses to the introduction of modern technology are also made wholly intelligible according to such a model. The fact that steel tools greatly decrease work inputs made them immediately acceptable to the Indians. Laborious trading expeditions and distant population relocations to optimize access to these useful tools were obvious consequences. The new tools considerably increased production efficiency but a common response was not so much to increase production as to reduce labour inputs and increase leisure (Codere 1950; Salisbury 1962; Harner 1963; Clastres 1977).

The changes in technology may markedly change the proportional contribution of different aspects of the economy to subsistence, while the demands of the external market may further exaggerate the significance of certain production techniques at the expense of others. Diversity in systems of resource use is lost and correspondingly the concentration on certain resources may decrease the natural diversity. Relatively insensitive to the objective evidence of resource depletion and responding to the changed circumstances primarily to reduce labour inputs and increase material well-being, the Indians have effected major changes in their economic systems. Agricultural production has been greatly increased while the reliance on foraging has declined. Dogs and shotguns have encouraged the Indians to hunt big mammals and reptiles, animals which were once hard to corner and kill. Moreover, since their knowledge of external market forces is minimal and they are new to modern tools and machines, their ability to predict the longer term consequences of their economic options is limited. Suboptimal, or "maladaptive", decisions are made as a consequence and they become exploited in their relations with the *criollos* and exploitative in their relationship with the environment. It is not long before they become trapped into spiralling positive feedback loops. The contrast between the two systems of resource use is illustrated in Figures 1 and 2. Both models assume that the Amerindians obey "Zipf's law" responding to the same cues in modifying their actual behaviour, but the different technologies produce radically different effects.

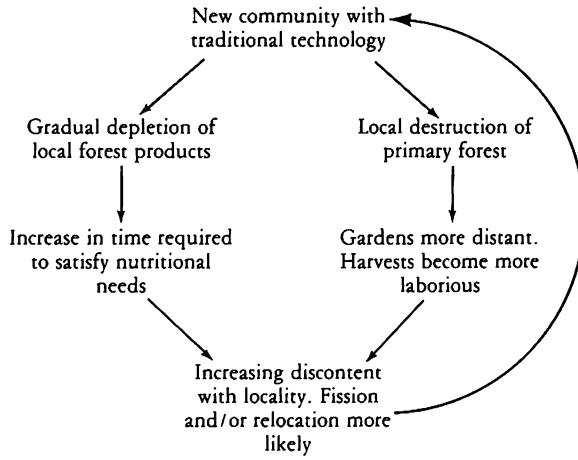


FIGURE 1. Traditional system of resource use. Negative feedback cycle prevents excessive long-term use of local environment.

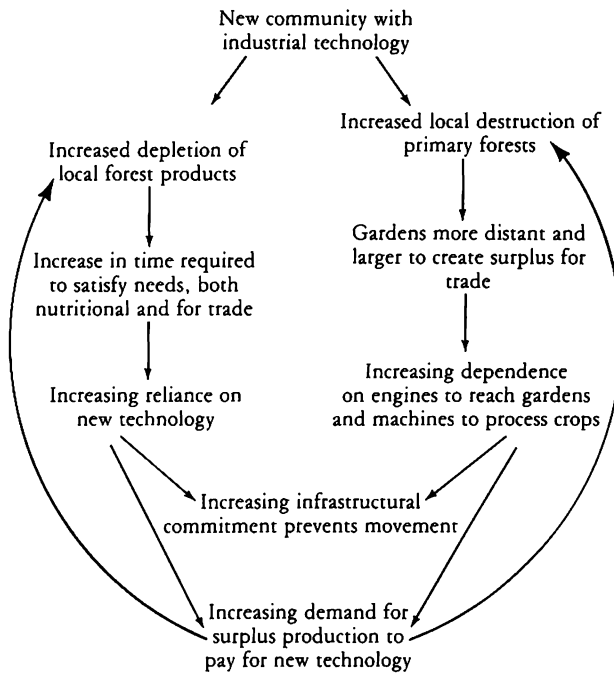


FIGURE 2. Modern system of resource use. Positive feedback cycle exaggerates speed of environment destruction leading to increasing dependence on outside society.

## Conclusions

This proposal concerning the form of Amerindian 'cultural practicality', including the general proposition—far from surprising—that the Indians will tend to act in ways that, they *think*, will minimize work effort, may have some important implications for ecological anthropologists. First of all it follows that neither 'etic' nor 'emic' research strategies will, by themselves, provide adequate information to create convincing explanations of how and why societies work. 'Etic' analysis, by itself, however 'actor-based' the attempted approach, will fail to explain the *process* of decision making by which individuals adjust their societies to their environment (Harris almost admits as much himself [1979a:59]; and see Orlove 1980); while contrarily 'emic' descriptions by themselves may fail to describe accurately how people actually behave. Only by integrating (which is not to say confusing) the two approaches can a viable ecological anthropology hope to develop. 'Statistical' (Lévi-Strauss 1963:283), 'generalized' (Sahlins and Service 1960) and 'probabilistic' (Harris 1979a) models of social adaptation may have some guiding merit, but it is only by dealing in detail with societies as integral wholes that we can hope to understand them.<sup>3</sup>

## Abstract

*This paper briefly summarizes the use of ecological models in the study of lowland South American Indian societies. Rejecting models that imply or describe unidirectional influences between environment and culture, the article also develops a criticism of the trend, discernible in Amazonian anthropology, to portray the Amerindians as ecological brokers who astutely manage their modes of resource use in order to effect an harmonious and conservationist form of environmental exploitation. Working from the growing body of ethnographic material on Amazonian societies and, in particular, field research carried out in South Venezuela, the author suggests that Amazonian Indians have an opportunistic rather than conservationist attitude to their environment. Evidence for this contention is adduced in*

<sup>3</sup>It should be noted that the models that I have adduced entirely ignore the important variable of human demography. There are a number of reasons for this. First, to burden this paper with a discussion of Amerindian demography would have made it overly long. Secondly, there is every reason to believe that patterns of mortality, fertility and morbidity are very different all over Amazonia today from pre-Columbian times. Thirdly, trustworthy data on Amerindian demography is anyway sparse. Elsewhere (Colchester 1982b) I have tried to treat this thorny topic with some care, but professional attempts by demographers to deal with Amazonian populations from an ecological perspective are urgently needed. In passing, we may note that none of the "biofunctionalists'" assertions concerning population control mechanisms have been satisfactorily substantiated.

*particular from the study of the effects of technological change. The conclusions are evaluated in terms of Sablins's opposition between "Culture" and "Practical Reason," which the author rejects, recommending that, instead, ecological anthropologists should focus their research on discovering actual forms of "cultural practicality".*

### *Resumen*

*Este artículo contiene una síntesis de lo que son los modelos ecológicos y su utilización en el estudio de grupos indígenas ubicados en las tierras bajas de América del Sur. El autor rechaza los modelos que implican influencias unidireccionales entre el medio ambiente y la cultura, y el artículo desarrolla una crítica a una corriente de la antropología amazónica que tiende a presentar a los indígenas como agentes de negocios ecológicos, que usan con habilidad sus recursos naturales y cuya explotación del medio ambiente es armoniosa y conservacionista. Partiendo de un corpus creciente de material etnográfico sobre las sociedades amazónicas y, sobre todo, de investigaciones llevadas a cabo por el autor en el sur de Venezuela, el trabajo sugiere que la actitud que despliegan los indígenas de la Amazonia hacia el medio ambiente es más oportunista que conservacionista. La evidencia más concreta que confirma ese argumento se encuentra en los estudios que se han hecho sobre los efectos del cambio tecnológico. Las conclusiones de esta contribución se evalúan a la luz de la oposición que establece Sablins entre la "Cultura" y la "Racionalidad Práctica", oposición rechazada por el autor quien nos recomienda enfocar nuestros estudios de manera tal que podamos descubrir las formas actuales de una "Factibilidad Cultural".*

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