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Forest Islands and Kayapó Resource Management in Amazonia: A Reappraisal of the *Apêtê*

EUGENE PARKER
Department of Geography
University of Maryland

> If those who plan the future of tropical areas would follow some of the fundamentals of the Kayapó system, we would be well on a path to a socially and ecologically viable system for the humid tropics.
>
> —Darrell Addison Posey, 1988

During the past decade, the work of Darrell Posey among the Gorotire Kayapó Indians of the Brazilian Amazon has gained increasing attention for its description and analysis of indigenous perceptions, concepts, and management of natural resource systems.[1] As reported by Posey, the G. Kayapó are extraordinarily astute, and adept, manipulators and managers of their local environments. He has argued that the G. Kayapó establish and maintain complex ecosystems, *increase* local biological diversity, intentionally create ecotones, and manage and manipulate forest successional stages (1984a, 1984b, 1987a). They plant thousands of useful plants along the margins of hundreds of miles of local trail systems, in defecation zones, and in natural and artificially created forest openings (1984a, 1987a, 1987b). Food plant species are planted in forest openings to increase their productivity (1982, 1985a, 1987b). They practice a form of "nomadic agriculture" (1982) and engage in the "semi-domestication" of a very large number of plant species (1985b). Swiddens are intentionally dispersed over large areas to create game reserves for future generations (1982, 1984c), and around the periphery of swiddens the G. Kayapó plant species that repel pests (1987c). The reforestation of old swiddens is intensively managed, including the modification of soils and the introduction of many species from mature forest areas (1988). Scores of useful plant species, taken from an area "larger than Western Europe," have been collected by the G. Kayapó during treks and introduced into the local area (1988). They have, over time, radically influenced the range, distribution, and diversity of plant species to such an extent, according to Posey, as to call into question the very notion of "so-called natural flora" of savanna and forest ecosystems (1984b; Anderson and Posey 1985).

This paper reports results of research conducted in the village of Gorotire in 1984 and 1987 that depart significantly from those published by Posey. Specifically, I wish to draw attention to difficulties with a crucial element of Posey's ethnoecological architecture for the G. Kayapó: the *apêtê*, or forest islands, composed of useful plant species, created and maintained by the G. Kayapó in savanna environments. The *apêtê*, resting at the foundation of the elaborate system of Kayapó ecological knowledge reported by Posey, provides much of the logic and the cohesion to his general scheme of G. Kayapó natural-resource management practices. Perhaps of equal importance, Posey has touted the practice of creating *apêtê* as a blueprint for how to "build a forest from scratch" (1984b:32). Indeed, he has advanced the proposition that the *apêtê* represents a simple, effective reforestation scheme for Amazonia (1985a:144, 156, 1987a:18; Anderson and Posey 1987:50), a claim of major import given the rate and extent of deforestation in the region. Unfortunately, *apêtê*, in the form described by Posey, do not exist.

Study Area and Population

One of the largest remaining Gê-speaking groups, the Kayapó Indians occupy a reserve of more than three million hectares in the middle Xingu River Basin of Amazonia. There are 13 Kayapó villages and perhaps as many as 3,000 Kayapó Indians, although not all villages and Kayapó Indians are located within the reserve. The largest village, Gorotire (7° 45′ S/54° 46′ W), had approximately 715 residents in mid-1987.

As Figure 1 indicates, the general region within which Gorotire is located is a broad transition zone from rain forest to the central *planalto,* a complex region of dry forest, gallery forest, savanna scrub, and savanna (the central *planalto* is often generally described as the Brazilian *cerrado*).[2] Dry forest, also called tropical forest to distinguish it from equatorial tropical rain forest, is found along the northern reach of the *cerrado,* and is considered by some researchers to be a transitional vegetative association between the *cerrado* "plains" and the Amazonian rain forests (e.g., see Askew et al. 1971). The *cerrado* sweeps up from the south and east, almost reaching Gorotire, which is located very near the southern margin of the rain forest.

The village is sited on a high bank above a major bend in the Fresco River, a tributary of the Xingu River. As Figures 1 and 2 suggest, the area surrounding Gorotire is characterized by significant landscape variation: rain forest, dry forest, gallery forest, scrub forest, savanna, savanna forest, mountains, and river valleys. The transitional nature of the general region, in which the different types of natural communities are highly intermixed, is clearly revealed in Figure 2; a walk out from the village of only a few kilometers often traverses several natural communities. Open savannas, it should be noted, are almost exclusively found in the general vicinity of the village.

Posey (1983:229) has reported that the Gorotire Kayapó recognize three major divisions of their terrestrial environment: forest *(bà),* scrub savanna or *campo cerrado (kapôt),* and mountains *(krãi).*[3] Within each division, according to Posey, they distinguish a number of discrete ecozones (natural communities); for example, they recognize almost 40 types of savanna and forest (1984d:37).

The *Apêtê*

Their Significance

The Gorotire Kayapó practice of creating forest islands in savanna environments has been reported by Posey in more than 17 papers since 1982.[4] At the practical level, *apêtê* can be viewed as resource supermarkets (Posey, as quoted in Stevens 1990) of sorts for the G. Kayapó, in that plant resources from different locations and ecological contexts have been concentrated in specific sites near the village. According to Posey, these islands represent an innovative and aggressive manipulation of the environment that maximizes the diversity and the concentration of resource species in selected settings. Of the forest islands in the savannas near Gorotire, Posey reports that 75% were actually created by the Indians (1984b:8; 1985a:141; 1987b:182). Fully 98% of plant species found in the islands he studied had perceived use-values (often multiple values), and as many as 85% of these plants were actually planted by the Indians (1985a:141). (Posey's repeated reporting of different percentages for these categories is discussed in a later section.)

At a more theoretical level, these islands represent something far more important than resource supermarkets or "food depots" (1982:23) for Posey. As noted above, the existence of *apêtê* calls into question the very idea of a "natural flora" in the savanna (Posey 1984b:32; Anderson and Posey 1987:50), and provides evidence that the G. Kayapó, in contrast to "modern" populations, actually increase ecological diversity by their use of the environment (Posey 1985a:156; Anderson and Posey 1989:172). For Posey, the creation of *apêtê* demonstrates clearly that plant distributions in Amazonia have been significantly affected by indigenous practices; 20% of *apêtê* species are from other regions (1988:90; Anderson and Posey 1985:86). Finally, *apêtê* represent for Posey a viable reforestation mechanism for the Amazon

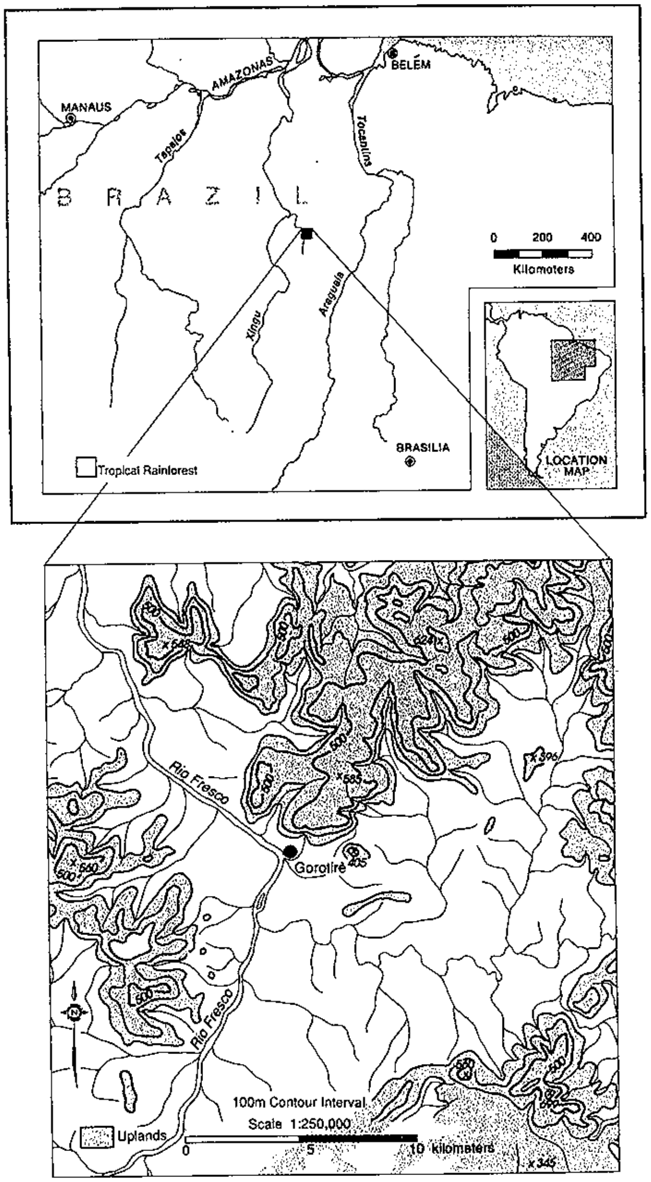

Figure 1
General study area.

region (1985a; Anderson and Posey 1987).

Making an Apêtê

As Posey reports it, the first step in the formation of an *apêtê* is the modification of the soil base: "techniques of *forest establishment* include the creation of a new soil in savanna hospitable to forest species" (1984b:10, emphasis added). Most local savanna soils are characterized by high acidity, high exchangeable aluminum content, low cation exchange capacity, and low available phosphorus. To offset these conditions, the G. Kayapó create a new soil by making compost piles in the forest and in other *apêtê* from sticks, leaves, and limbs. Allowed to rot, the

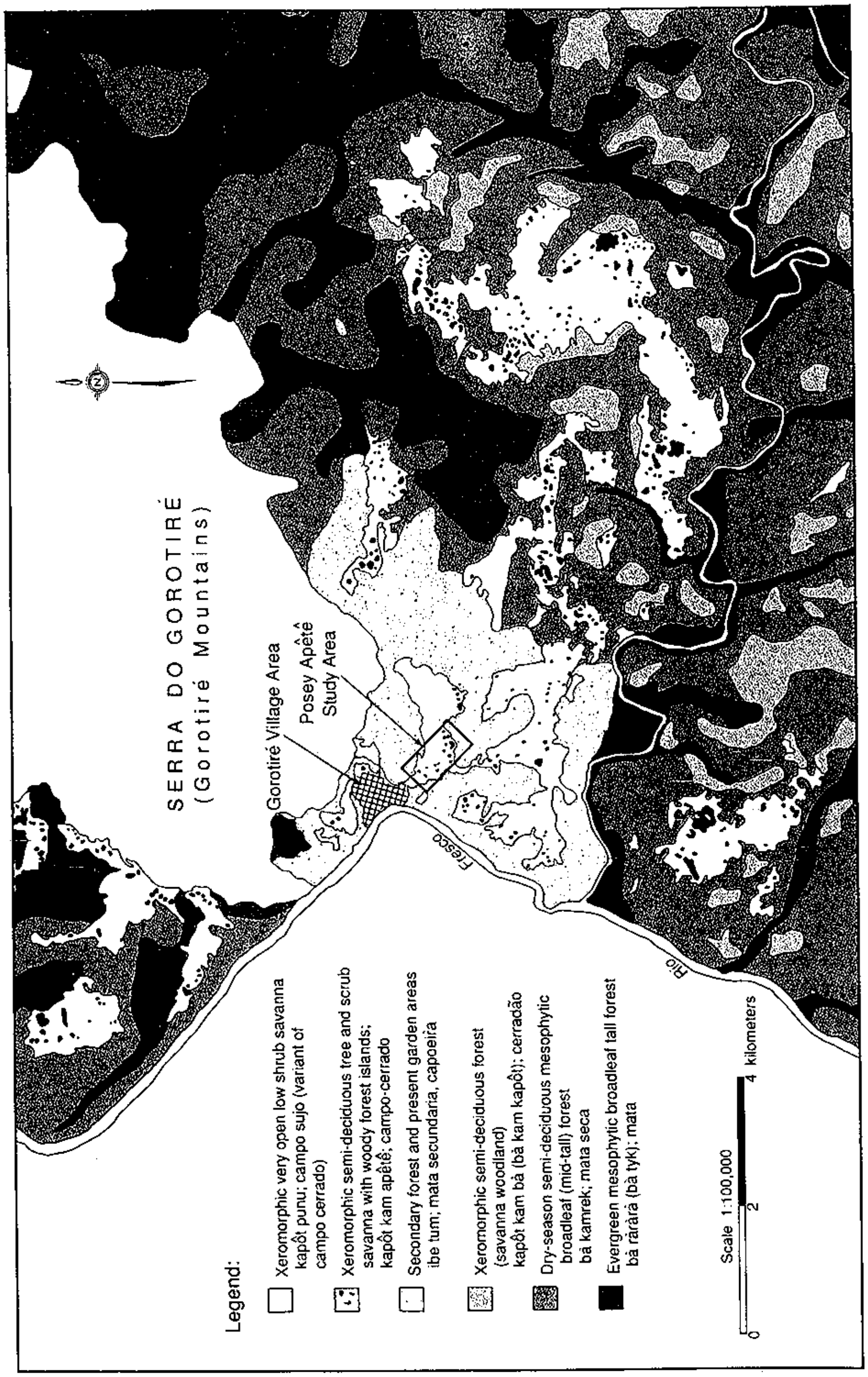

Figure 2
Natural communities of the Gorotire area.

piles are then beaten with sticks to produce a mulch. The mulch is carried to a spot in the savanna, usually a slightly depressed area so as to enhance moisture retention, and piled to form a mound. Other materials are mixed in as well: hearth debris and ashes, organic materials, portions of termite hills (*Nasutitermes* sp.), ant nests (*Azteca* sp.), slashed vegetation, and mulch from backyard gardens. The result is a low-slung mound, a few meters in diameter, into which are planted useful, sun-tolerant species that are known to be hardy enough for the rigors of the savanna (Posey 1985a:142). Through time, additional species are introduced into the incipient forest island—in the understory and around the periphery—extending both its general area and its density.

Apêtê are created and maintained by family units ("each extended family has its own forest island" [Posey 1984b:9]), generally extended matrilineal families, and are not regarded as communal property (Posey 1984b:9; Anderson and Posey 1985:82).

Classification, Internal Zones, and Transplants

Apêtê are classified according to their size and internal complexity. Posey has reported that the G. Kayapó recognize four distinct stages in the development and growth of *apêtê: apêtê-nu, apêtx, apêtê,* and *apêti.* Figure 3 represents Posey's conception of the internal organization and evolution of *apêtê;* each internal zone represents a discrete planting zone. For Posey, it is the elaboration of additional internal zones, in part a function of Kayapó management (e.g., the creation and management of the *irã*, the cleared central area), that determines to a very large extent the classification of a particular forest island.

For the Kayapó, internal zones represent different planting areas into which they introduce plant species from forest ecozones (and, to a much lesser extent, from savanna ecozones) that are conceptually linked to specific internal zones (see Table 1): "Planting zones in *apêtê* are matched with ecological types recognized by the Indians in the forest" (1985a:155).

Planting zones within *apêtê* are based upon perceived variations in shade, light, temperature, and moisture (Posey 1985a:154–155, 1990:20; Anderson and Posey 1987:49). Apparently, these diagnostic features are employed by the Indians in matching up the internal zones of *apêtê* with natural communities:

> For example, plants found in the dark, damp forest *(bà-tyk)* are likely to do well in the *a-tã-ri* or the *nhi-pôk* of an *apê-ti.* Plants that thrive in the light-penetrating forest *(bà-ràràrà)* would be planted [in the] *no-kà* or *a-kà-kôt.* Species found at the margins of the forest or the edges of other *apêtê* would be transferred to the *ja-kà* or *a-ka-kôt.* [Posey 1985a:154]

Ecological Diversity and Adaptive Solutions

As Posey describes it, then, the Gorotire Kayapó engage in the systematic collection of useful species from recognized forest communities, some at great distances from the village, and transplant them into cognitively linked internal zones of *apêtê* located near the village. The range of perceived use-values for the plant species found in *apêtê* and reported by Posey is nothing short of spectacular: food (roots, tubers, nuts, fruits), beverage, medicinal (e.g., for fevers, dizziness, head- and toothaches, diarrhea, abortion, contraception), and ceremonial plants, plants used for artistic purposes, craft plants (e.g., bows, arrows, warclubs), plants for pipes, needles, sandpaper, lip plugs, and body paints, plants possessing spiritual value and others with aesthetic importance, hunt-magic plants, war-magic plants, game-poison plants, firewood plants, numerous plants to attract game animals and birds, insect repellents, plants for fibers and wrapping material, and so on (Posey 1985a:142; Anderson and Posey 1989:160).

Apêtê, it would seem, represent a remarkably adaptive solution to the perennial problem of resource plant species with low densities and numbers, and large spatial dispersion. Equally impressive, the "*apêtê* solution" entails the creation and maintenance of forest patches in

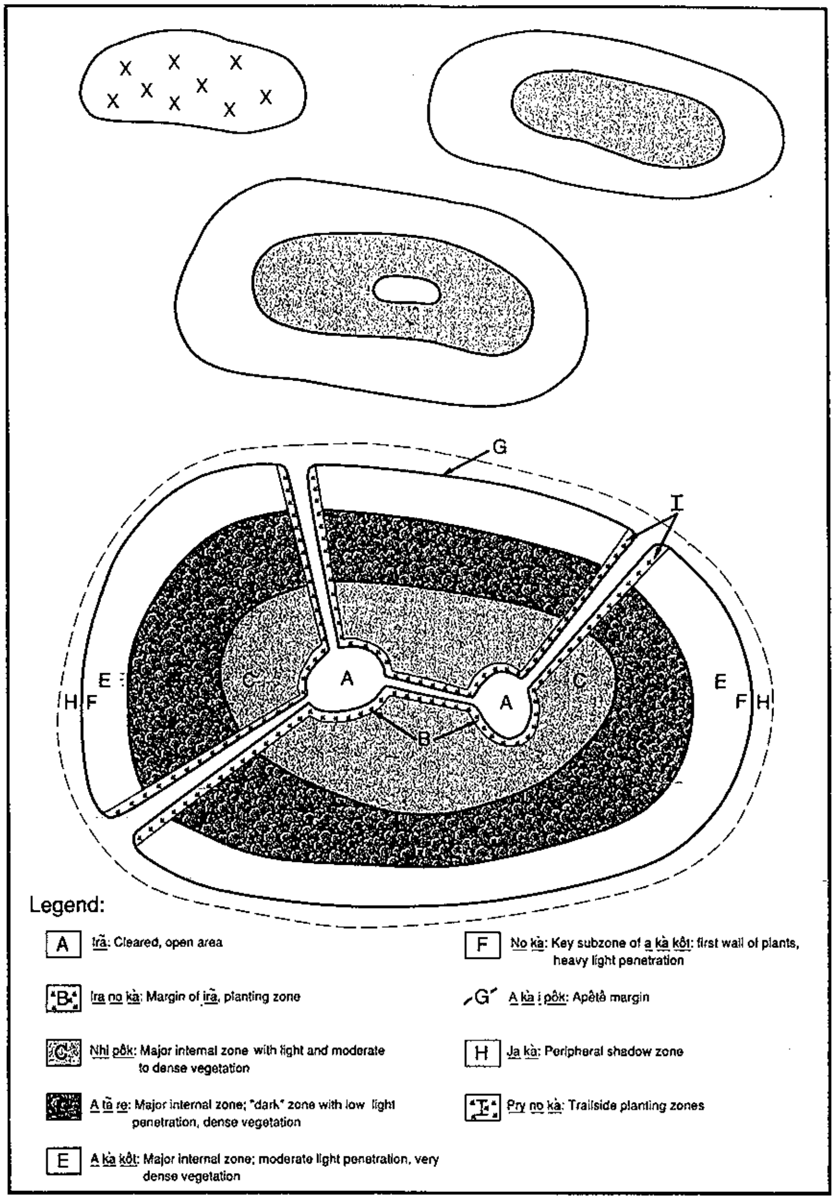

Figure 3
Stages of *apêtê* development and internal organization.

savanna environs that constitute, in effect, microlandscapes of maximum ecological diversity. In this sense, then, Posey advances the proposition that what informs G. Kayapó resource management strategies and methodologies is the recognition of the value of a "patchy" environment in which many different natural communities are found. The *apêtê*, with its collection of internal planting zones linked to different natural communities, would represent a particularly "patchy" environment. *Apêtê* are, in Posey's own words, "forest patches" in which "maximum biological diversity occurs. To put such a statement in more

Table 1
Internal *apêtê* zones and their ecological counterparts (from Posey 1985a:155).

Apêtê planting zones	Corresponding ecological units
nhi-pôk	*bà-ràràrà, bà-kamrek, bà-krê*
nô-kà	*bà-kôt, bà-ràràrà, bà-krê-ti*
ja-kà	*kapôt, bà-kôt*
irã-nô-kà	*bà-ràràrà, bà-kamrek, bà-krê*
a-ta-ri	*bà-tyk, bà-kamrek*
a-kà-kôt	*bà-ràràrà, bà-kumrenx*

ecological terms, the Indians not only recognize the richness of 'ecotones', they create them" (1985a:156, 1990:19).

Posey has described the G. Kayapó as ecological engineers (1987a:16) whose resource management strategies result in an *actual increase* in biodiversity and include reforestation methodologies ("how to build forests from scratch," 1984b:32) that have "far-reaching implications for the study of forestation in savanna and *reforestation in areas denuded by deforestation*" (1985a:156, emphasis added). This description, and the *apêtê* work in general, have captured the imagination, and spurred the hopes, of a broad range of individuals and researchers concerned with the future of Amazonia.

Methodology and Results of *Apêtê* Research

From Posey's extensive literature on *apêtê,* it would appear that the crucial evidence was collected during a three-week field period in November 1983. (Although a ten-day follow-up collection was undertaken in April 1984, the results have never been reported or incorporated into the 1983 data base.) Ten forest islands were surveyed within the area labeled "Posey Study Area" on Figure 2 and all plants above one meter were collected. Informants were interviewed about the use-value(s) of each collected plant and whether it had been planted in the *apêtê.*

Posey has been inconsistent in reporting the results of the plant survey and informant interviews, leaving readers to fend for themselves in determining the actual results. In various publications he has reported that 120 (Anderson and Posey 1985:77, 1987:48), 128 (Posey 1984c:6), and 140 (Posey 1984b:8, 1985a:141, 1987b:182) species had been collected and that 60% (Posey 1984b:8, 1987b:182), 75% (Anderson and Posey 1985:77, 1989:159; Posey 1987a:58), and 85% (Posey 1984c:6, 1985a:141) of the plants collected in *apêtê* had been planted there (Posey has reported six different combinations of plants collected and percentages planted). However, he has been consistent in stating that 75% of *apêtê* islands were created by the Gorotire Kayapó and that 98% of species collected had at least one perceived use-value. Using a simple frequency count of the differing results reported by Posey, the following seems a reasonable interpretation: 120 plant species were collected, 75% of which were reported by informants to have been planted and 98% of which had at least one perceived use-value, and 75% of the forest islands were created by the G. Kayapó.

Posey has described and discussed several reasons why the G. Kayapó engage in the practice of creating and maintaining *apêtê.* The most important is the concentration and increase of useful plant species near the village. Other reasons, clearly secondary to the concentration of useful species but still significant, according to Posey, are the use of *apêtê* for refuge and defensive purposes, and as sites for rest, relaxation, and sexual assignations.

The most important evidence that Posey has to offer is the plant collection itself. If these islands are anthropogenic in origin, if they were planted with useful species taken not only from surrounding forest types but also from very distant regions, then it would be reasonable to expect that the species composition of these islands would differ considerably from those islands not planted. Posey offers no evidence for such differences because, quite unaccountably, it apparently never occurred to him, or Anderson, the botanist who collaborated with Posey in the actual plant collection, that having a control island was crucial methodologically. The only islands they surveyed were the ten within the "Posey" study area (Figure 2). In addition, they never reported any data regarding the incidence of particular plant species found in the islands surveyed. Thus, they offer no data demonstrating that a select species' frequency of occurrence is higher than would be normally expected. And, finally, it appears that Posey never investigated the provenance of the species collected. That is to say, no effort was made to work through a herbarium collection or herbarium lists to ascertain where the species they collected are commonly found.

From the extensive published record by Posey concerning *apêtê*, now numbering at least 13 separate publications including those coauthored with Anderson, we know only that a species occurred in at least one of the ten islands surveyed, its perceived use-value, and whether it had been planted in the island.

Concentration and Increase of Useful Plant Species

As noted earlier in this discussion, the principal logic for *apêtê* is quite straightforward; *apêtê* address one of the persistent and ubiquitous problems of indigenous resource economics: low incidence and high spatial dispersion of useful plants. The attractiveness of the *apêtê* solution is in its elegance; the G. Kayapó simply relocate, concentrate, and increase the numbers of useful plant species in artificial forest islands near the village, thus resolving problems of incidence and dispersion. Useful plant species are transplanted into *apêtê* internal zones cognitively linked with the type of forest zone from which the plant was taken.

In addition to those plant species transplanted from forest zones around Gorotire, Posey contends that 20% of *apêtê* plant species come from other regions. The extent of these "other regions" is suggested by the following: "Equally amazing is that these forest islands are composed of botanical resources taken from an area the *size of Western Europe*" (Posey 1988:90, emphasis added).

Plant Collection Analysis

In April 1987, after some months of growing concern about Posey's work among the Gorotire Kayapó, I was able to undertake a series of plant collections not only in *apêtê* but also in the principal forest and savanna forest/woodland communities found in the general area. The general purpose of these collections was to obtain a preliminary data base regarding the distribution and frequency of floral species in the several communities. In addition, these collections would allow for comparative analysis, albeit tentative, of species found in these communities and those found in *apêtê*.[5]

I selected one of the larger *apêtê* originally surveyed by Posey and Anderson as well as a control island of comparable size. The control island was situated in another savanna environment, away from the Posey *apêtê* study area, its location such that none of the reasons Posey had advanced for the creation of *apêtê* by the G. Kayapó obtained (defense, illness, concentration of resources). In selecting the two islands, I controlled for general size and shape (long axis of the Posey island was 56 meters, the control island 49 meters), proximity to forest margin, direction of long axis, and nearby islands.

The *apêtê* survey consisted of demarcating a ten-meter-wide transect through the middle and along the long axis of each *apêtê*. All plants above one meter were collected (as was the case in the Posey-Anderson collection).

One additional control of sorts is worthy of mention. The actual collection and preparation of the plants in the field, and the subsequent identification of specimens, were conducted by the same individual for both my survey and Posey's: Carlos Rosário da Silva, a respected forest specialist on the botanical staff of the Museu Paraense Emílio Goeldi and one of the more experienced botanical fieldworkers in the Brazilian Amazon.

Three data sets are referred to in the following discussion. "AP1" stands for the large island I resampled, which had been part of the original 1983 Posey-Anderson island study, "CT2" represents the control island I sampled in 1987, and "PA10" refers to the original ten-island study undertaken by Posey and Anderson in 1983.

Total Species and Co-Occurrences

Posey has repeatedly asserted that the G. Kayapó, in marked contrast to other populations, actually *increase* ecological diversity through their resource management practices. This claim has considerable theoretical import given that the socioeconomic activities of virtually all societies have resulted in the simplification of their natural environment: in the reduction of ecological diversity and complexity. In support of his claim, Posey has offered as evidence the G. Kayapó practice of creating and maintaining *apêtê.*

Table 2 shows the total number of species found in each of the three *apêtê* collections. There is no significant difference in total species found in AP1 and CT2: 79 in AP1 and 75 in CT2. The additional 4 species found in AP1 might well be a function of its slight size advantage: 12% larger than CT2. In any event, a 4-species difference is inconsequential. Thus, in comparing a purported anthropogenic island (AP1)—in which upwards of 85% of species are claimed to have been transplanted from local and distant settings—with a naturally occurring island (CT2), we find that the natural island possesses roughly the same degree of ecological diversity as does the proposed anthropogenic island. Further casting doubt upon Posey's claim that the G. Kayapó actually increase ecological diversity is the fact that his survey of ten islands, in which *every* plant over one meter was collected, yielded a total of 120 species while the control island transect, in which the plant collection was limited to a 10 × 49 meter area, yielded 75 species.

Inasmuch as AP1 is one of the original PA10 islands and is claimed to be anthropogenic in origin, it would seem reasonable for us to expect the species composition of AP1 to be significantly different from that found in CT2. It would be exceedingly odd for the G. Kayapó to go to the trouble of creating and maintaining islands of transplanted species when these plant species are readily available in natural islands and/or surrounding savanna and forest ecozones.

Sixty-one percent of AP1 species (48 of 79) were also found in CT2. Given that Posey has reported that as many as 85% of PA10 species were transplants, the 61% co-occurrence seems quite remarkable. More to the point, I was able to sample only one control *apêtê;* with the very large numbers of *apêtê* found in nearby savanna, it would seem reasonable to expect that an additional number of AP1 species not found in CT2 would occur in some of these other natural islands. Of the 23 AP1 species not found in CT2, 33% (10 of 30) were also found in at least one of the 10 meter × 250 meter transect collections I conducted in dry forest, savanna woodland, and savanna forest. Thus, 58 of 79 AP1 species, or 73%, are

Table 2
Total plant species found in *apêtê* plant collections.

Apêtê	Species	Genus	Family
AP1	79	66	49
CT2	75	58	45
PA10	120	88	50
AP1 + CT2	107	83	53

available in natural communities, all of which are found in ample abundance within a couple of kilometers of the village (Figure 2).

With regard to the 21 remaining species not found in either the CT2 *apêtê* or the savanna/forest transects, 16 are included on lists of common savanna or savanna-forest species compiled by leading authorities of the Brazilian *cerrado* (Eiten 1972; Goodland and Ferri 1979; Ratter et al. 1973). If taken together, then, we can say that 75 of the 79 plant species found in AP1 were found either in the control *apêtê* or the surrounding environment, and/or were listed as common savanna or savanna-forest species.

Further evidence that *apêtê* species in general are naturally occurring, as opposed to having been planted, can be obtained by examining where *apêtê* species are also found in the local area. Because *apêtê* occur most frequently in the boundary area between dry, open forest/savanna forest and savanna (Figure 2), it should be expected that *apêtê* species, if naturally occurring, could also be found most often in those communities. Table 3 demonstrates this relationship. Of those species found both in *apêtê* (AP1, CT2, and/or PA10 collections) and in the community transect collections I conducted, the great majority (87%) were found to occur in savanna forest (37%), dry, open forest (29%), or savanna woodland (21%).

Here again, we find evidence of the fact that *apêtê* species are typical of those species found in transitional environments, exactly the sorts of environments in which *apêtê* are most often found. Moreover, the remarkable correspondence among the three *apêtê* collections with regard to the occurrence of *apêtê* species in local natural communities suggests that little difference exists between the purported anthropogenic *apêtê* (AP1 and PA10) and the natural, control *apêtê* (CT2). Such correspondence would be unexpected if 75%–85% of AP1/PA10 species were in fact transplants, particularly given that roughly 57% of AP1/PA10 species occurred in the savanna forest and/or savanna woodland transects. There are extensive areas of savanna forest and savanna woodland throughout the local area and within easy reach of the village; it makes little sense to bother transplanting species from these areas when they are so readily available.

Thirteen percent (9 species) were found to occur in the *bà ràràrà/bà tyk* forest transect, the relatively dark, dense evergreen mesophytic broadleaf tall forest (Figure 2). Interestingly, 5 of these 9 species also occurred in the control island, and 6 of the 9 are very common in at least one of the other transects I collected: *Amaioua guianensis*, commonly found in dry, open forest; *Himanthus sucuuba*, commonly found in savanna forest; *Protium unifoliolatum*, very common in dry, open forest; *Sacoglottis guianensis*, very common in dry, open forest and found in savanna forest and savanna woodland; *Siparuna guianensis*, common in savanna forest; *Virola sebifera*, common in dry, open forest and savanna forest.

Herbarium Collection

In the summer of 1988, I had the opportunity to work at the herbarium of the Museu Paraense Emílio Goeldi; both Posey and Anderson were staff researchers there, and the Museu Goeldi herbarium houses both our collections. I worked

Table 3
Occurrence of *apêtê* species in local natural communities (%).

Apêtê	Savanna woodland	Savanna forest	Dry, open forest	Tropical rain forest
AP1	20	39	30	11
CT2	20	38	27	15
PA10	24	33	30	13
Mean	21	37	29	13

through the herbarium collection folders for each of the 120 species collected in the original Posey-Anderson ten-island survey, recording the collection locale descriptions made by other researchers who had also deposited specimens of these species with the herbarium. In most cases, there were several specimens for each species. As Table 4 clearly demonstrates, the vast majority of those species collected by Posey and Anderson were commonly found (by other researchers) in savanna-forest transitions, savanna woodlands *(campo cerrado)*, savanna forest *(cerradão)*, disturbed areas (including abandoned pastures), and secondary growth areas. In sum, then, the Museu Goeldi's own herbarium collection clearly and definitively demonstrates that the species found by Posey and Anderson in their study area were precisely those *commonly found in such areas:* the disturbed margin of a savanna and forest transition.

Informant Plant Identification Interviews

In separate sessions, each plant specimen collected in the AP1/CT2 transects was shown to Beptopoop, a key Posey informant for the original PA10 study, and to Bakoti, a very well respected village elder. Information elicited included common name(s), use-value(s), where commonly found, and which, if any, animals, birds, or fish used the plant for food. Dr. Anne Gely, a French ethnobotanist then on the staff of the botany department at the Museu Goeldi, sat in on the informant interviews.

Posey reported that his informants indicated no less than 98% of the 120 PA10 plant species had at least one use-value, and that 75% (and perhaps even 85%) of these plants had actually been transplanted into the *apêtê*. Neither Beptopoop nor Bakoti provided support for Posey's claims.

Table 5 summarizes the interview results. What is most striking is the agreement between Beptopoop and Bakoti regarding the number of plants considered useless *(kaigo)*. Beptopoop described almost *half* (47%) of the AP1 plants (the anthropogenic *apêtê*) as having no value and Bakoti listed 49% as useless. Interestingly enough, the CT2 plant collection was considered by both informants to have a greater percentage of useful species. The percentage of *kaigo* species reported by both informants is particularly puzzling in the context of Posey's claim that of the 120 species collected "only *Heteropterys sp.* 2 (Malpighiaceae) and *Eugenia* cf. *protacta* (Myrtaceae) were said to be useless *(kaigo)*" (Anderson and Posey 1989:160).

A considerable percentage (25% when informant responses for AP1/CT2 were averaged) of plant specimens were considered to have value only in the sense that they served as a food source for animals, birds, or fish. Moreover, fully 15% of both AP1 and CT2 species were considered useful only because one bird species or another ate some portion of the plant. It is not entirely clear to what extent the G. Kayapó consider a nonagricultural plant useful when its only recognized value is that some faunal species uses it as a food. This point was made abundantly obvious on several occasions when Beptopoop described a plant as useless and then added as an afterthought that birds eat it.

It is clear that knowledge of what plants are consumed by which faunal species is valuable as a general piece of information about the habits of particular animals. Such knowledge is valuable simply because the natural world is better understood. Knowledge of feeding habits, of course, has a more functional value in that it can increase hunting success. However, it seems extremely unlikely that the G. Kayapó would transplant species simply because they serve as a source of food for birds when these plants occur naturally in savanna, savanna forest, and dry forest: all commonly found in the local area. More to the point, neither informant reported any AP1/CT2 species listed as a food source for animals, birds, or fish as having been planted.

If we combine the species without recognized value together with those only valuable as bird food, we find that 61% of AP1 and 51% of CT2 species have little or no value. If we take the further step of adding the additional plant species listed

Table 4
Description of collection locations for species listed in the Posey-Anderson study area (PA10) and housed at the herbarium of the Museu Goeldi, Belém.

Plant species[a]	Where found
Alibertia edulis Rich.	High campo; disturbed vegetation; margin degraded forest
Alibertia myrciifolia Schum.	*Capoeiro;* savanna-forest margin; *campina*
Alibertia verrucosa Moore	Dry forest on laterite ridge
Amaioua guianensis Aubl.	*Campina;* campo; low forest; secondary forest margin
Andira cuiabensis Benth.	*Cerrado*
Annona densicoma Mart.	*Capoeiro*
Antonia ovata Pohl	Common in campo; *campina;* low forest; *campo rupestre*
Ardisia sp.	*Campina* forest
Arrabidaea inaequalis (DC. ex. Spletz) Schum.	Campo; natural campo; disturbed areas
Bombax quaticum (Aubl.) K. Sch.	Common, frequently along margin of river
Buchenavia sp.	Common in natural campo; *campo rupestre;* flooded areas
Byrsonima coriacea (Sw.) Kunth.	Low forest; campo; *capoeiro*
Byrsonima crassifolia H.B.K.	Savanna; common in campo; common in pasture
Carprotoche sp.	*Capoeiro*
Caryocar braziliense St. Hil.	*Campo cerrado; cerrado; campina* on white sand (w/s)
Casearia arborea (Rich.) Urb.	Margin secondary forest; *capoeiro;* natural campo
Casearia sylvestris Sw.	Margin secondary forest; campo; w/s campo
Cecropia palmata Willd.	*Campina; capoeiro*
Chaetocarpus sp.	No collection folder
Clusia insignis	Disturbed w/s area; campo; *campina* on w/s
Coccoloba excelsa Benth.	Small granite islands
Coccoloba paniculata Meissn.	*Capoeiro*
Combretum rotundifolium Rich.	1 specimen, 2-year-old *capoeiro*
Crepidospermum gondotianum (Tul.) Tr. & Pl.	*Capoeiro;* pasture margin
Curatella americana L.	*Cerrado tipo campina;* savanna; "ubiquitous" in campo
Cybianthus myrianthos Miq. vel. sp. aff.	No collection folder
Cybianthus sp.	No collection folder
Dioclea macrocarpa Huber	*Capoeiro; campina; capoeiro fina* (fine or recent)
Diospyros artanthaefolia Mart. ex Miq.	*Capoeiro*
Diospyros praetermissa Sandw.	Campo; *capoeiro alta* (high)
Doliocarpus cf. *dentatus* (Aubl.) Standl.	*Cerrado tipo campina;* open forest; *capoeiro;* campo
Duquetia spixiana Mart.	*Terra firme* forest; *varzea* (flooded areas)
Emmotum fagifolium Desv.	Pasture; campo; low scrub forest
Emmotum nitens (Benth.) Miers	*Campina;* secondary forest; common in campo
Enterolobium ellipticum Benth.	No collection folder
Enterolobium schomburgkii Benth.	2-year *capoeiro;* disturbed forest areas
Erythroxylum macrophyllum Cav.	*Capoeiro;* open forest; secondary vegetation
Erythroxylum suberosum St. Hil.	Open *cerrado* w/scattered trees; *campo sujo;* campo edge
Erythroxylum subracemosum Turcz.	Margin of tree islands in *cerrado;* savanna; *cerrado*
Eugenia cf. *patrisii* Vahl.	*Capoeiro; campina* forest
Eugenia cf. *cupulata* Amsh.	*Terra firme;* gallery forest
Eugenia cf. *protacta* Berg.	*Cerrado; campina;* campo
Eugenia eurycheila Berg.	2 samples: *terra firme; igapo* (flooded forest)
Faramea cf. *longifolia*	Campo
Ficus amazonica (Miq.) Miq.	*Campina:* low *capoeiro* forest; *capoeiro*
Ficus gomelleira Kunth. & Bouche	Open *campina*
Forsteronia aff. *guianensis* M. Arg.	1 sample, forested hill
Guatteria gracilipes R. E. Fries	No collection folder
Guatteria sp.	Many exemplars from all environments
Heteropterys sp. 1 and 2	No collection folders
Himatanthus articulata (Vahl.) Wood.	*Campina;* high campo; low forest
Himatanthus sucuuba (Spruce) Wood.	Disturbed w/s *campina* forest; secondary forest; *cerrado*
Hirtella cf. *racemosa* Lam.	*Capoeiro; cerrado*
Humiriastrum cf. *cuspidatum* (Benth.) Cuatr.	*Campinarara; campina*
Hymenaea courbaril L.	No collection folder

continued on next page

Table 4 (continued)

Plant species[a]	Where found
Ilex aff. *affinis* Gardn.	*Capoeiro;* frequent in *cerrado*
Jacaranda rufa Manso	Common in *cerrado; campo cerrado; campina* on w/s
Kielmeyera cf. *rugosa* Choisy	*Cerrado; campo cerrado*
Lacistema agregatum (Berg.) Rusby	Open forest; *capoeiro*
Lasiacis aff. *ligulata* Hitchc. & Chase.	Open forest; secondary vegetation
Licania latifolia Benth. ex Hook. f.	*Capoeiro;* transitional forest; low forest; roadside
Mabea fistulifera Mart.	*Cerrado;* very common roadside; airport margin
Machaerium acutifolium Vog.	*Capoeiro; campo cerrado;* tree islands in savanna
Machaerium pilosum Benth.	*Capoeiro*
Maprounea guianensis Aubl.	Open disturbed *cerrado;* disturbed "*campina* forest"; low forest
Mascagnia sp. 1 and 2	Campo; forest w/broken canopy; disturbed forest edge
Matayba guianensis Aubl.	*Capoeiro;* savanna interspersed w/tree and scrub islands
Maytenus sp.	No collection folder
Miconia alata DC.	Campo; *cerrado* mixed w/forest patches; secondary forest
Miconia cf. *melinonis* Naud.	Campo; low campo
Miconia ciliata (Rich.) DC.	*Cerrado* forest; *cerrado* w/tree islands; margin savanna/forest
Miconia macrothyrsa Benth.	*Cerrado;* natural campo; savanna margin
Micropholis cf. *calophylloides* Pires	No collection folder
Mouriri sp.	No collection folder
Myrcia atramentifera	*Capoeiro;* secondary vegetation near airport
Myrcia fallax (Rich.) DC.	*Campina;* low forest; common *capoeiro*
Myrcia obtusa Schau.	Low *capoeiro; campo cerrado;* primary low forest
Neea sp.	Margin savanna/forest; semi-deciduous forest; *cerrado*
Oenocarpus distichus Mart.	Common in campo, *cerrado*
Ouratea nitida Engl.	*Cerrado*
Palicourea crocea (Sw.) Roem. & Schult.	Common secondary vegetation roadside; campo margin
Pera distichophylla (Mart.) Baill.	Campo; *cerrado*
Philodendron acutatum Schott.	*Capoeiro;* open rocky outcrops
Piptocarpha sp.	Secondary vegetation; border of gallery forest
Plathymenia foliolosa Benth.	*Campo sujo;* margin of pasture and forest
Protium unifoliolatum Engl.	No collection folder
Psychotria sp.	No collection folder
Qualea parviflora Mart.	*Cerrado; campo cerrado;* open *cerrado* w/scattered trees
Qualea sp.	*Campina; campo rupestre*
Roupala montana Aubl. var. *dentata*	*Campo cerrado; cerrado*
Rourea cf. *cuspidata* Benth. ex Baker	*Campina;* low forest
Sacoglottis guianensis Benth.	*Capoeiro; cerrado; campina*
Sacoglottis cf. *ceratocarpa* Ducke	*Capoeiro; campo fechado* (closed)
Sapium sp.	Low forest; *campina;* burned areas; *rupestre* vegetation
Schefflera sp.	Forest; savanna forest; *caatinga*
Serjania sp.	Secondary forest; w/s *campina;* margin of primary forest
Simarouba amara Aubl.	Edge of forest; natural campo w/groups trees; campo
Siparuna guianensis Aubl.	*Capoeiro;* high *capoeiro;* margin of forest and garden
Smilax cf. *schomburgkiana* Kunth.	No collection folder
Solanum cf. *juripeba* Rich.	*Capoeiro;* roadside
Solanum grandiflorum	Natural campo w/groups of trees
Sorocea guilleminiana Gaud.	Savanna; *cerrado;* disturbed tropical forest; disturbed forest
Styrax guyanensis A. DC.	Disturbed *varzea* forest; riverbank
Syagrus cocoides Mart.	Common in campo and *cerrado*
Syagrus comosa (Mart.) Mart.	Common in campo and *cerrado*
Symplocos guianensis (Aubl.) Gurke	*Campina;* w/s campo; secondary forest; *capoeiro*
Symplocos sp.	*Cerrado;* savanna/forest margin

Table 4 (continued)

Plant species[a]	Where found
Tabebuia serratifolia (Vahl.) Nichols.	Campo margin; roadside
Tapirira guianensis Aubl.	*Cerrado tipo campina; cerrado;* common *campina*
Tapura amazonica Poepp. & Engl.	*Capoeiro;* campo
Tetragastris altissima (Aubl.) Swart.	*Capoeiro;* very common forest
Vatairea cf. *macrocarpa* (Benth.) Ducke	*Campina tipo cerrado;* campo; common *cerrado*
Vatairea sericea (Ducke) Ducke	*Cerrado*, seasonally flooded
Virola sebifera Aubl.	Savanna; *cerrado;* dry forest; natural campo
Vismia cayennensis (Jacq.) Pers.	No collection folder
Vitex flavens H.B.K.	Campo margin; *cerrado;* area of vegetation invasion
Vochysia divergens	*Campina: cerrado*
Wulffia baccata (L.f.) Kuntze	Common in *capoeiro;* pasture/road margin

[a]Includes all specimens deposited at the herbarium with the exception of the individual exemplars collected by Posey and Anderson.

[b]*Terminology: Caatinga* (Amazon variety, also called *campina*)—No standardized use of term established but often used to distinguish open and closed savanna communities found on white sand (w/s) environments. *Campina*—Generally used to describe savanna and scrub formations on white sand but used in past to refer to small fields of savanna found within forested areas. *Campinarara* (false campina)—Outdated term used to describe transitional vegetation associations found along savanna-forest boundaries. *Campo*—General term for savanna of all types and also used to refer to grassy savannas with few or no trees or shrubs. *Campo cerrado* (often labeled *cerrado*)—Low tree and scrub savanna with short or tall grass. *Campo rupestre*—Open and closed scrub and grass savanna occurring on orthoquartzite and metaquartzite rock formations (common in Gorotire area). *Campo sujo*—Variant of *campo cerrado*, with very scattered low shrubs. *Capoeiro*—Secondary vegetation associated with recently abandoned fields and disturbed areas. *Cerrado* (sens. strict.)—Low savanna woodland with open canopy; open or closed scrub; low tree and scrub woodland. *Cerrado tipo campina*—Small areas of *cerrado* intermixed with forest associations.

Table 5
Informant descriptions of *apêtê* plant use-values.

	AP1 (%)		CT2 (%)	
	Informants		Informants	
Plant use-values	Beptopoop	Bakoti	Beptopoop	Bakoti
Kaigo	47	49	38	30
Medicinal	37	12	39	25
Animals only (including birds)	17	25	20	39
(Birds only)	(13)	(14)	(15)	(20)
Human food	0	15	4	6

as having value only as a food source for animals, the percentage of plants with little or no value increases to 69% for AP1 and to 64% for CT2.[6]

The number of plant species reported to have some sort of medicinal value was significant. Beptopoop, a principal Kayapó shaman, described 37% of AP1 species and 39% of CT2 species as having medicinal value. Again, however, we find that little difference exists between the anthropogenic island and the control island with respect to the percentage of useful species. Incidentally, Bakoti, while reporting fewer species to have medicinal value than was the case with Beptopoop, still described twice as many CT2 species as having medicinal value compared to AP1 species (25 vs. 12).

Informant statements regarding where AP1 and CT2 plants are commonly found are particularly instructive. Each of the two informants was asked to list the types of environments (forest and savanna types) in which a plant species could be expected to be encountered. It was often the case that multiple environments were mentioned. If *apêtê* are natural—and not constructed—and composed of species characteristic of the dynamic zone between savanna/savanna forest and dry forest areas, then we should expect informant descriptions of species occurrence to reflect this: Table 6 demonstrates that they did.

In the case of AP1, both informants included savanna or savanna forest for 80% of species, and dry forest for 71% of plant specimens. A remarkable 98% of plant species had either savanna/savanna forest or dry forest listed as areas within which they could be found. For 51% of AP1 plants, both savanna/savanna forest *and* dry forest were listed.

The CT2 plant distribution descriptions were much the same as those reported for AP1. Savanna/savanna forest was listed for 84%, dry forest for 72%, savanna/savanna forest or dry forest for 96%, and savanna/savanna forest and dry forest for 71%.

General Informant Interviews

My interviews in Gorotire were conducted in Portuguese, not Gê, the language of the Kayapó. With the exception of one informant, Beptopoop, Posey conducted all of his interviews with key informants in Portuguese as well (Kwyrà Kà, Irã, Ute). For the first half of my 1987 field stay, I worked with Irã, a remarkable individual and the son of Kwyrà Kà, the animal spirits shaman in the village and one of the most knowledgeable of the G. Kayapó. Irã was not only fluent in Portuguese, but was one of the very few Kayapó who could both read and write Gê. In addition to his repeated assertions to me that *apêtê* as described by Posey were nonexistent, he informed me that he had told Posey on several occasions in 1983 and 1984 that his ideas about *apêtê* were wrong.

It was Irã who first brought to my attention a linguistic objection to Posey's description of *apêtê* as anthropogenic in origin. Recall that the first stage in Posey's *apêtê* development hierarchy was labeled *apêtê-nu* (Figure 3). When I asked if a small island in the savanna was an *apêtê-nu*, Irã said that my question did not make sense. He went on to explain that the suffix *-nu* (or *-tum*) is only attached to objects or things that are of human origin. *Nu* indicates something is young or new, while *tum* indicates that something is old. So, a new garden is *puru-nu* and an old garden is *puru-tum*, and a relatively new old field is an *ibe-nu* while an older old field is an *ibe-tum* (the term *ibe* encompasses the concept of secondary forest succession). New garden and old fields, of course, are the product of human activity. Irã's objection to the description of a small wooded island being labeled *apêtê-nu* was consistent with his statement that *apêtê* are natural in origin.

During the 1987 field period, I spoke with nearly every Kayapó who was conversant in Portuguese. Not one of these individuals supported the idea that *apêtê*

Table 6
Local communities in which *apêtê* species are also found, according to informants.

	AP1 (%)			CT2 (%)		
	Informants			Informants		
Type of natural community	Beptopoop	$\bar{X}$	Bakoti	Beptopoop	$\bar{X}$	Bakoti
1. Savanna, savanna forest	78	80	82	96	84	72
2. Dry forest	63	71	79	68	72	76
1 or 2	100	98	96	99	96	93
Apêtê	22	13	4	4	6	8

were created or that they planted useful plant species in *apêtê*. I should observe that I did not invoke Posey as the source for my questions in these interviews, thus leaving the informants to believe that I was the source of the concept; this did not redound to my credit.

I interviewed several of the village elders regarding the *apêtê* problem, with Irã providing translation. In particular, I worked with Bakoti, the respected village elder mentioned earlier, and taped the interviews. Bakoti rejected every aspect of Posey's description of *apêtê* creation and management, including the notion that plants are transplanted into *apêtê*.[7] This pattern of rejection and denial was repeated again and again as I spoke with various Kayapó, including Kanhon and Totoi, the principal chiefs of the village.

During my stay, I had occasion to discuss the *apêtê* concept with Earl Trapp, a missionary who has lived among the Kayapó, including the G. Kayapó, for more than 25 years. He said he was unaware of any practice involving the creation of forest islands or of any planting taking place in *apêtê*. He also said he was unaware of any use of these islands during periods of illness (the concept of *apêtê* as refuge sites is discussed below).

Oddly enough, one of the more compelling informant refutations of the *apêtê* concept took place entirely serendipitously. Having been ill for awhile in March 1987, I was trying to leave the village to obtain medical attention. One day, having heard that a plane might pass by, I had gone out to the landing strip in hopes of hitching a ride. Durval, a Brazilian ex-missionary fluent in Gé, also awaited the plane. He was then employed by the Kayapó as the village accountant and as their translator in all negotiations with the outside. I took the opportunity to ask him about *apêtê*—I explained Posey's theory to him in detail—and he replied that he had never heard anything about the Kayapó either creating or utilizing *apêtê* in any particular way and that he thought the idea very unlikely.

The spot where we waited was on a main path from distant gardens and passing Kayapó often stop and chat with whomever is waiting by the dirt landing strip. For more than three hours (the plane never arrived), Durval queried passing Kayapó about *apêtê*: more than 20 men and women were questioned. Without exception, each individual and/or group of individuals replied that they neither created *apêtê* nor planted the plants found in *apêtê*.

Apêtê Frequency

In support of his claim that *apêtê* were anthropogenic in origin, Posey stated that the frequency of forest island occurrence in savanna notably increases the closer the savanna is to the village (1985a:141). *Apêtê* do not notably increase in frequency in savanna that is closer to the village. Figure 4, derived from Thematic Mapper–processed Landsat imagery at a 1:100,000 scale, shows Posey's assertion to be incorrect. Indeed, it would appear that precisely the opposite is the case: *apêtê* frequency is highest at greater distances from the village.

Apêtê Fire Protection

Posey also observed that *apêtê* are often protected from the regular burns of the savanna conducted during the summer months (1984b:12). I have not been in Gorotire during the drier summer months (July and August), when major campo burns are undertaken. However, in 1984 and 1987 I was in the village at the beginning of the dry season and witnessed a number of small burns (three in the general vicinity of Posey's study area) and one major burn elsewhere. I did not observe any attempt to protect *apêtê*, but it must be said that the small size of the fires might account for this.

Posey has spoken of firebreaks constructed around valued *apêtê*, but I could find no physical evidence for these (either above ground or in cursory examinations of soils for variations in ash content). Where burns had been conducted, it appeared that the fires would burn up to and just into the margin of islands but rarely penetrated (unless quite small) deep into the interior. I could distinguish little difference between *apêtê* in burn

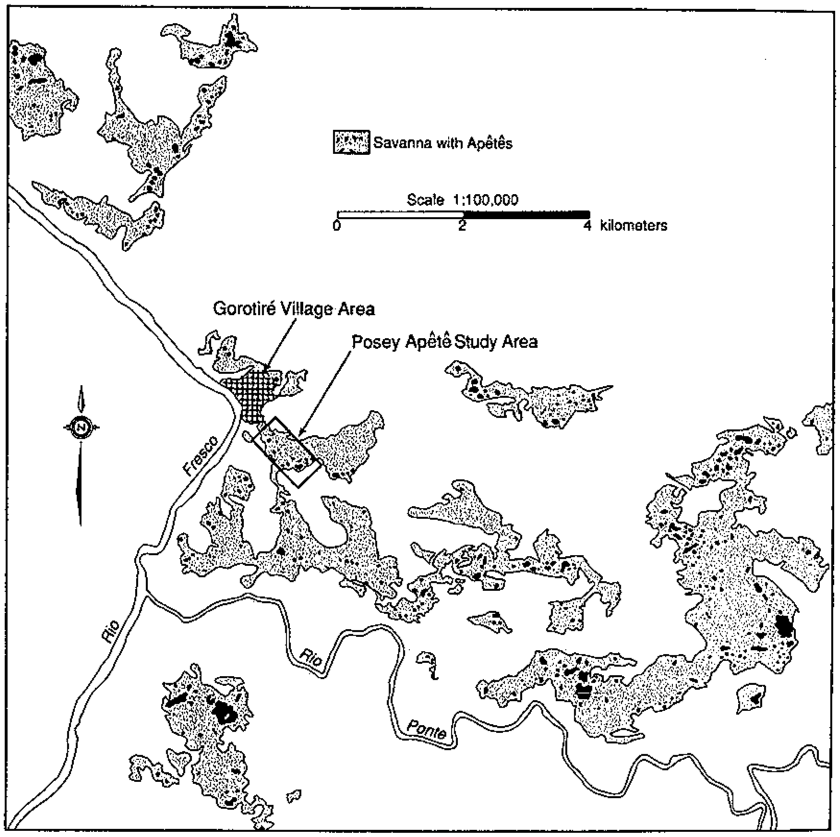

Figure 4
Frequency and distribution of major forest islands in savanna.

areas near the village and other forest islands in more distant savanna where burns had been conducted at some point. One would expect protected *apêtê* to somehow be different from those not protected; such differences were not detected. Finally, I could not find a single informant who supported Posey's claim that *apêtê* were protected during campo burns.

Additional Rationales for Constructing *Apêtê*

Refuge

Posey has repeatedly asserted that *apêtê* serve as important refuge sites for Indian families during epidemics and warfare (for women and children). The idea is that families wait out periods—"even prolonged periods" (1984b:11)—of illness and/or hostilities within the protection of the *apêtê*. He has also reported personally witnessing the refuge use of *apêtê* during a measles outbreak in 1983 (Anderson and Posey 1987:49, 1989:172).

Apêtê as refuge make little sense. The *apêtê* investigated by Posey are concentrated along the margin of the forest, less than 700 meters from the village. If one sought refuge from disease in any of these *apêtê*, both the proximity of the village and other nearby *apêtê* would keep risk high, particularly for children playing in the general area. Presumably, more than one family would be seeking refuge in *apêtê;* indeed, Posey reported that five families with young children moved to *apêtê*, where they stayed isolated until the threat had passed (Anderson and Posey

1987:49). Perhaps more problematic is the simple fact that the obvious place to go during such periods would be to one's swidden garden (Figure 5). Shelter, food, water (always nearby), and reasonable isolation (especially in comparison to the *apêtê*) are all available, plus much better opportunities for hunting. True, some food sources could be found in *apêtê*, but they are neither of the value nor the quantity that common sense dictates would be found in garden environs. All *apêtê* lack water, and their general location within the much hotter savanna environment leads to average midday temperatures several degrees higher than found in swidden sites within the forest (not to mention the immediate proximity of streams for bathing).

The problem for the refuge rationale is not resolved by arguing that Indians travel to more distant *apêtê* during periods of illness and warfare. If one is to travel that far, it would make more sense to travel to one's garden.

With regard to Posey's claim of having witnessed use of *apêtê* as refuge by Gorotire Kayapó during a measles outbreak in 1983, I was unable to obtain a single confirmation from informants, missionaries, or FUNAI (Brazilian National Indian Agency) personnel that any Indians had ever stayed in *apêtê* near the village for any reason. For that matter, no one could recall any particular threat of measles during this period.

Defense

Posey has described the use of *apêtê* for defensive purposes in terms of their value as hiding and observation posts ("parapets") and as locations from which the G. Kayapó can prepare for an approaching enemy ("lines of defense") (1985a:142). He has further argued that two stages of *apêtê* development, *apêtê poire* and *apêtê rhynh*, represent intentionally linked (joined) *apêtê* with interconnecting trails along which warriors can move, noting that the long types are "specifically for purpose of attack" (1984b:11).

The notion that *apêtê* are valued defensive "installations" seems farfetched indeed. To begin with, Figures 2 and 4 show the general location of *apêtê* not only in Posey's study locale but also in other savanna environs of the general area. It should be noted that the incidence and concentration of *apêtê* increase with proximity to the forest margin; that is, we find

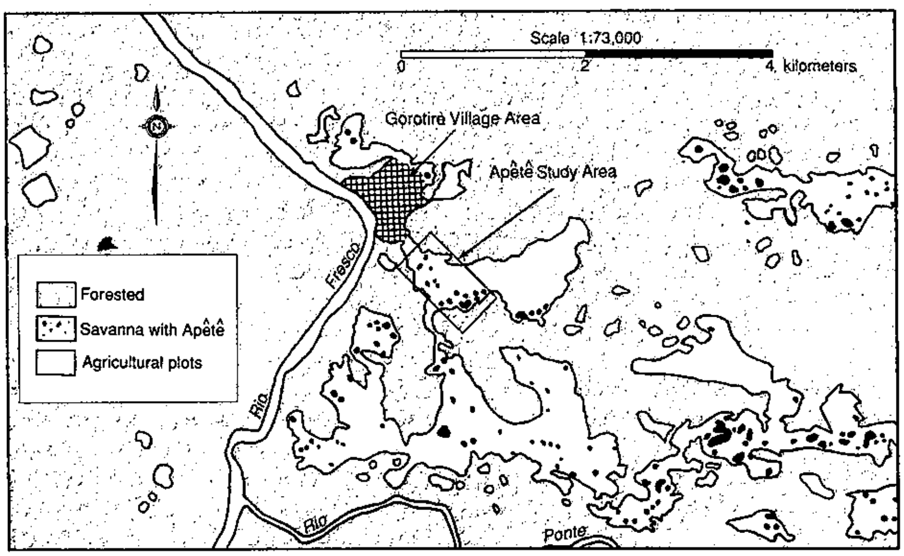

Figure 5
***Apêtê* and principal agricultural areas near Gorotire.**

the highest number of forest patches (*apêtê*) along the savanna-forest boundary. Why build *apêtê* along forest margins when the forest is already there? It would appear obvious that the forest itself would provide far greater tactical advantage and strategic flexibility in the event of an impending attack. Moreover, the very fact that *apêtê* stand apart from the forest poses problems for G. Kayapó who would use them; movement to and from the *apêtê* would increase the risk of being seen, and the communication of information from observers to the main war party (including chiefs) would necessitate departure from the *apêtê* with its attendant risk of exposure.

A far more curious aspect of this defense argument is the fact that the defensive value of *apêtê* would appear limited to those occasions when the attacking force moved through the open savanna. This would be a singularly dubious bit of strategy. The general environment provides ample opportunity for surreptitious approach. A range of low mountains rises up immediately behind the village with forest cover along the lower slopes, offering several advantageous routes for the opposing force. The extensive reach of forests (and forest cover) in the general area (Figures 2, 4) also suggests that an approach through open campo would be unlikely.

Rest and Rendezvous

The same general criticism of the defense rationale applies here as well. Why would one rest in a small forest patch in the hotter savanna environment with no water when the cooler forest and a nearby stream are available? Sexual rendezvous might take place in *apêtê*, but I should think they would be opportunistic in nature. For planned assignations, it would seem far safer to find an isolated spot within the forest where the possibility of being seen reaching and leaving the site would be considerably less than would be the case with an *apêtê* rendezvous.

Location of the PA10 Study Area

Finally, and particularly troublesome for Posey's *apêtê* claims, are the actual location and recent history of his *apêtê* study area (PA10). Figure 6 is a copy of a photograph taken from a recent article on *apêtê* (Anderson and Posey 1989:161) that shows the general area within which Posey's ten islands are found.[8] In the photograph can be seen the landing strip, a road leading to the landing strip (top left), a logging road winding away from the strip (bottom left to right), and a small building.

The building was erected, and the general area around and behind the building site cleared, by the Brazilian Air Force in the 1970s. The original idea was for a small detachment of air force personnel and aircraft to be stationed there to support government efforts to quell a land war that had arisen in the Conceição de Araguaia region just to the southeast of Gorotire. Deployment of personnel did not take place.

The building itself has been long abandoned. The G. Kayapó have neither used the building nor allowed it to be affected by the frequent burns of the nearby landing-strip area (evidence of a recent burn can be seen in the darkened areas near the lower end of the landing strip).

With this brief history of the Posey study area shown in the photograph, an altogether different reality than the one Posey has constructed suggests itself. Far from being an intensively managed area of intentionally created islands composed of useful transplants, the Posey study area is in fact an indentation in the forest margin caused by a nonindigenous population: the Brazilian Air Force. Because the area was not subsequently used or developed by the air force, and because the G. Kayapó have exercised some selective protection of the area from burns, the area is undergoing secondary forest succession. Posey's anthropogenic islands are in actuality the leading elements of a forest recapturing territory lost. They may contain useful species, and the G. Kayapó may make occasional use of these species, but they certainly were not created and maintained by Kayapó. *Apêtê* are the result of natural processes along the dynamic frontier between forest (both

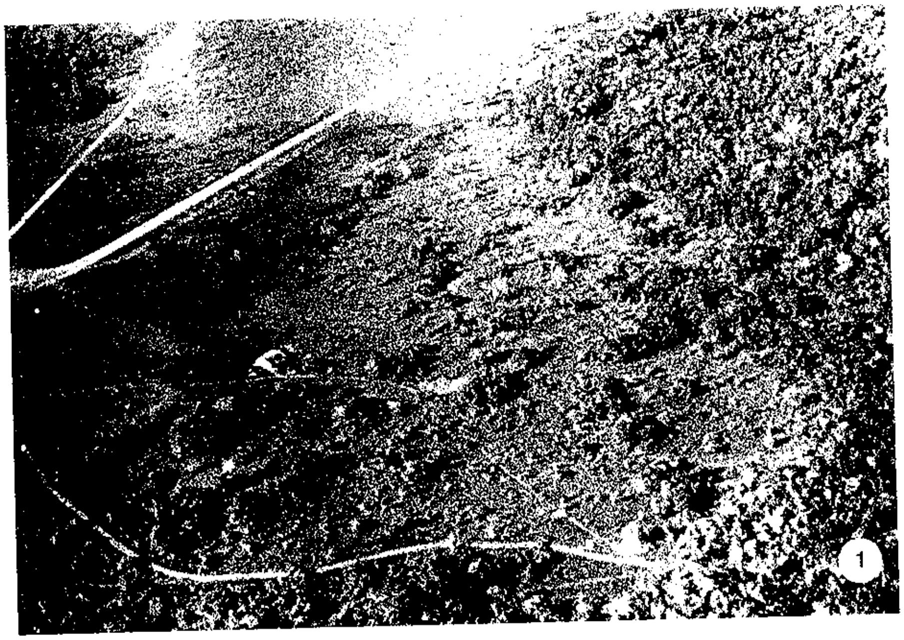

Figure 6
Aerial imagery of Posey study area. (Reprinted with permission from Anderson and Posey 1989:161. Circled number on photograph is from the original article.)

savanna and dry forest types) and the savanna.

Summary and Conclusion

Posey's work has received extraordinary attention in recent years. His published findings, particularly with regard to *apêtê*, have considerable theoretical import for tropical forest research, both human and nonhuman. He has argued that the Gorotire Kayapó actually increase ecological diversity, intentionally create and manage ecotones, transplant species from an area larger than Western Europe, and have altered the ecology of the savanna and forest so as to call into question the very notion of a "natural flora."

Unfortunately, there is no basis for accepting Posey's statements regarding *apêtê*. Despite the inconsistencies in his published findings, and notwithstanding significant problems in the methodological approach adopted by Posey (e.g., the lack of controls), *apêtê* have become firmly established in both Amazonian ethnography and in the public imagination. In this discussion, I have provided several reasons for questioning Posey's claims.

There exists no evidence that *apêtê* found in Posey's study area (e.g., AP1) possess greater ecological diversity than natural forest islands (e.g., CT2)—a key Posey claim. It was shown that a significant percentage (61%) of AP1 plants were also found in CT2. Furthermore, it was noted that the vast majority of AP1 species not found in CT2 were either common to surrounding forest or savanna-forest communities or were included on lists of common savanna plants. No evidence exists to support Posey's claim that 20% of *apêtê* species were transplanted from other regions having a total area "the size of Western Europe."

Posey's claim that *apêtê* increase in frequency as one approaches the village was shown to be incorrect. It was also noted that *apêtê* occur most often in the boundary area between savanna and dry forest, precisely the sort of dynamic environment in which small islands of forest (resulting either from forest advance or retreat) are likely to be encountered.

The review of the Museu Goeldi herbarium collection of the 120 species that Anderson and Posey collected in their ten-island study indicated that virtually all these species are common to savanna, savanna forest, dry forest, and disturbed environments: an accurate description of the PA10 study area.

Informant plant identifications yielded no evidence that AP1 species were more useful than CT2 species; ironically, the opposite proved to be the case. Almost half of the species collected in both *apêtê* were considered to have no value by both informants (compare this with Posey's report that 98% of the 120 plants collected in the PA10 study were considered useful). The great majority of both *apêtê* collections (87%) were reported by informants to be common to savanna woodland, savanna forest, and dry forest areas found throughout the local area.

The very notion that *apêtê* are created and maintained by the G. Kayapó, that these islands are composed of transplanted species, was repudiated by the villagers themselves. Repeated efforts to have them confirm Posey's scheme of things proved fruitless. The secondary rationales offered by Posey for constructing *apêtê* were shown to be less than compelling. Finally, the general features of Posey's study area were shown to be the result of environmental modification by the Brazilian Air Force, not by the Gorotire Kayapó.

Notes

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[1]The significance of Posey's work extends well beyond publications read largely by the anthropological community. He has spoken to and reported his findings for an extraordinary number of conferences, meetings, seminars, workshops, universities, and reporters. Kayapó resource management practices as described by Posey have received much attention and publicity: essayed in *Nature* (May 1984), discussed in the National Academy of Sciences landmark *Biodiversity* edited by E. O. Wilson (1988), reported in many newspapers, highlighted in the widely read *New York Times* "Science Times" section (Stevens 1990), featured in documentaries by the National Geographic Society and the British Broadcasting Company, and reported upon by CNN (several times), ABC, NBC, CBS, and NPR news organizations.

[2]The southern boundary of rain forest indicated in Figure 1 is based on the work (and published maps) of Colinvaux (1989), Eiten (1972, 1983), Goodland and Ferri (1979), Huber (1987), and Soares (1953).

[3]Terms in parentheses are Kayapó; the Portuguese term *campo cerrado* is often used in place of the English equivalent of savanna and scrub savanna.

[4]Three *apêtê* papers were coauthored with Anthony Anderson, then on the staff of the Department of Botany at the Museu Paraense Emílio Goeldi, in Belém, Pará State, Brazil. Posey was responsible for all ethnographic and cultural data relating to *apêtê*, while Anderson's role was limited largely to directing the plant collections taken within the study area demarcated by Posey.

[5]The forest and savanna-forest community transects were 10 × 250 meters with all plants >7 cm DBH (diameter at breast height) collected. Each plant was subsequently shown to at least two informants at different times and

the name(s), use-value(s), and locale where commonly found were elicited for each specimen.

[6]Calculated by averaging and adding responses of both informants for each *apêtê*. For example, AP1 mean "useless" response was 48%; bird food value only 13%; animal value (including birds) 21%: 48 + 13 = 61, and 48 + 21 = 69.

[7]In my interviews with Bakoti, I was careful not to invoke Posey as the source for the concept of *apêtê*. In a key interview session, it is clear from the tape that as we work through the concept, and as I repeatedly try new ways of getting Bakoti to confirm that the Kayapó actually do create and manage *apêtê*, Bakoti is becoming more and more amused with me. My pride increasingly wounded by his pitiful glances in my direction, I am heard to say in frustration and humiliation to Irã (in Portuguese, and not translated for Bakoti): "Well, it's not *my* idea!"

[8]A second aerial view of the study area, from a different perspective, can be found on page 48 of a 1987 article entitled "Reflorestamento Indígena" (Anderson and Posey 1987); in English the title is "Indigenous Reforestation."

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