ARTICLE 13: RESULTS OF MACROBOTANICAL ANALYSIS FOR THE PROYECTO PREHISTORICO ARENAL: PRELIMINARY EVIDENCE OF RESOURCE USE AND SUBSISTENCE STRATEGIES

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ABSTRACT

Macrobotanical analysis was conducted on paleobotanical remains collected from nine sites that date from the Tronadora phase (1000 B.C. – 500 B.C.) through the Tilarán phase (A.D. 1000–1500). The macrobotanical remains indicate utilization of domesticated seed crops and tree crops, although root crops probably were also cultivated. The results of macrobotanical analysis provide preliminary evidence for use of multiple subsistence strategies involving domesticated and wild plant resources.

INTRODUCTION

A major research objective of the Proyecto Prehistórico Arenal's 1984 season was to determine the subsistence strategies utilized by the prehistoric inhabitants of the project area and, if possible, to determine the relative importance of a maize based agricultural system (Sheets, personal communication 1983). Delineation of subsistence strategies would facilitate modeling adaptative cultural processes of prehistoric populations inhabiting a volcanically active area, such as the Cuenca de Arenal. Subsistence data for the project are derived from analysis of pollen, phytolith and macrobotanical samples and carbon isotopes from human skeletal remains. The following report is a preliminary summation of the macrobotanical data base compiled during the 1984 field season. Results of analysis for the other three categories of subsistence data will be presented at a later date.

STRUCTURE OF THE MACROBOTANICAL ASSEMBLAGE

The macrobotanical assemblage is limited to two categories: vegetal remains and small–scale remains from flotation samples. Unlike materials found at the El Tajo site (Article 1), there were no casts of vegetal material preserved in compacted volcanic ash noted during 1984 excavations. The two categories of macrobotanical remains are separated by size and collection mode. Vegetal remains, which are visible during excavation, were collected in the field by the excavators, depending upon their condition and provenience. The small–scale remains were retrieved from soil samples processed in the laboratory with a simple water flotation technique (Struever 1968). Usually, for the recovery of subsistence information, flotation samples are collected from features, living surfaces and trash deposists. However, the lack of well–defined features or living surfaces found during excavation required modification in sampling strategy and flotation samples were

collected from burials, strata containing cultural debris, or areas of high organic content.

Flotation processing for the recovery of small–scale botanical remains has not been used as a retrieval technique in Costa Rican excavations, although waterscreening has been conducted on occasion, with fairly good results (Snarskis, personal communication 1984). Nonetheless, based on flotation results from other tropical study areas (Turner and Miksicek 1984), flotation recovery was experimented with in the attempt to:(1) recover small–scale remains, invisible during excavation and often destroyed or bypassed in waterscreening, that would indicate use of wild and pioneer plants important in many multiple cropping agricultural subsistence systems (Bye 1981), and (2) to test the applicability of this recovery technique for future use in the study area.

Fourteen flotation samples from five sites were collected and processed, using a bucket and sieve mode of flotation. Sample size collected was not standardized, so the amount of soil floated varied from 500 ml to 2.5l per sample. Vegetal material was air dried and analyzed without further processing. All macrobotanical remains were sorted and analyzed using a binocular microscope (10 x –70 x power). Aida Blanco Vargas (Museo Nacional de Costa Rica) and Dr. Michael Snarskis (Universidad Nacional de Costa Rica) aided in identification of unfamiliar botanical material. Table 1 provides the provenience and temporal–stratigraphic association of the macrobotanical remains.

RESULTS

Results of analysis are presented in Tables 2 and 3. As indicated by Table 2, flotation was not very productive. There was a higher percent retrieval of noncharred remains than charred remains from the flotation samples. The occurrence of noncharred remains is considered to be the result of recent contamination. In more arid environments it cannot necessarily be assumed that noncharred botanical remains are contaminants, although this is a point of debate in the literature (c. f. Keepax 1977; Lopinot and Brussel 1982; Matthews and Benz 1983). Nonetheless, given the poor preservation potential for organic remains in tropical rainforest soils, it is believed all noncharred remains recovered from the samples are contaminants. None of the noncharred material was obviously modern, e. g., containing intact embryos, although no estimation can be given to the relative age of these remains. The continual reworking of the soil by rodents, roots, and insects is believed to be the probable agent of contamination.

The recovery of vegetal remains was more rewarding (Table 3) and indicates that the preservation in the project area for charred, durable botanical remains (e.g., nut fragments, thick–walled seeds, corn) is adequate. The most frequently recovered type of vegetal material was wood. Although no features were uncovered that could be positively be identified as hearths, fire-altered features, or construction features, most of the sites excavated contained dispersed remains of charred wood. Because of the lack of well-defined living surfaces and features, it is difficult to interpret the cultural association of the charred wood. Some of the charcoal may be contaminants from historic clearing and burning of the site areas for pasture. Some may be debris broadcast by prehistoric clearing activities or, on the other hand, some of the charred wood may indicate the presence and exploitation of prehistoric wood resources. The lack of time and comparative material precluded identification of the wood charcoal beyond the class level, although it is believed that all the wood is within the class of Dicotyledoneae.

Domesticated crops are represented by corn kernels, cupules, and a cob fragment

TABLE 1

PROVENIENCE OF MACROBOTANICAL REMAINS

Site/Lot	Float Sample No.	Vegetal	Phase*	Stratigraphic** Association	Feature Association
G150/D5	—	X	Silencio	50	—
/D6	2	X	Silencio	62	Burial 5
/G2	—	X	Silencio		—
/H1	5	X	Silencio	30	—
/H2	—	X	Silencio	30A	—
/H3	1	X	Silencio	30	—
/H4	4	X	Silencio	50	—
/H6	3	—	ND	60	—
G151/A	—	X	Arenal	50	—
G153/A	—	X	Silencio		—
G154/A2	1	X	Tilarán	30	—
/D2	—	X	ND	30	—
/E2	—	X	ND	30	—
/I1	—	X	ND	30	—
/I/A1	2	X	ND	30	—
/I/B1	—	X	Tilarán	30	—
/I/C1	3	X	ND	30	—
/I/C2	—	X	ND	30	—
/J1	—	X	ND	30	—
G155/general	—	X	Arenal	?	—
G156/C2	—	X	Tronadora	?	—
G161/B2	—	X	Tilarán		—
/B3	—	X	Arenal/ Tilarán		—
/B5	1	—	ND	50	1&2
/C7	—	X	ND		—
/D1	—	X	ND		—
/D2	—	X	Tilarán		—
G163/B1	—	X	ND		—
/B3	1	—	ND		1
/C1	—	X	Tronadora/ Arenal		—

/C2	3	--	Tronadora	--
/D1	2	--	Tronadora	2
G169/general	--	X	Tilarán	--
/C4	--	X	ND	--
/D3	--	X	Silencio	--
/D6	--	X	ND	--
/E3	--	X	Silencio/ Tilarán	--
/F2	--	X	Silencio/ Tilarán	--

* based on Article 9
** based on Article 3 and Article 4
X vegetal material collected
ND no phase assigned either because of inadequate sample size or lack of diagnostic sherd.

(Zea mays), two bean cotyledons *(Phaseolus vulgaris)*, and avocado seed fragments *(Persea americana)*. Some of the other vegetal remains resemble palm, cucurbita,or leguminous taxa, and may be evidence of other cultivated or encouraged resources, although this is difficult to determine because of the lack of positive identification. Remains of what may be *jícaro (Crescentia alata)* were recovered from three sites. The *Jícaro* fruit is not cited as domesticated or humanly edible (Janzen 1983), although the hollowed out, gourd–like pericarp can serve as a container similar to the bottle gourd *(Lagenaria siceraria)* *Jícaro* trees were not noted in the immediate project area, which may be due to either inappropriate habitat or historic disturbance. If the lack of *jícaro* trees is due to habitat requirements, and the prehistoric remains have been correctly identified, then the occurrence of *jícaro* indicates the use of an exotic botanical resource that had to be brought into the study area.

The remaining vegetal materials are predominantly fragments of seeds and fruits that could not be classified at the time of analysis. With further analytical work it should be possible to distinguish a wider range of domesticated, encouraged, and wild plant resources.

DISCUSSION

Macrobotanical remains were retrieved from nine sites, four of which were within the Laguna de Arenal shoreline survey area (Article 4). Five sites yielded direct evidence for cultivation of corn, beans, or avocado (Table 4). The sites containing cultigens date to the Tronadora Phase (1000 B. C. – 500 B. C.), the Silencio phase (A. D. 600 –1000) and the Tilarán Phase (A. D. 1000–1500). The noticeable lack of cultigens from sites assigned to the Arenal Phase (500 B. C. –A. D. 500) probably is a result of limited excavation of Arenal Phase sites and does not reflect a hiatus in maize agricultural practices and reversion to total reliance on vegecultural crops.

The evidence for beans and avocado is limited. Two fragments of avocado seeds

TABLE 2

RESULTS OF FLOTATION ANALYSIS

PROVENIENCE

Taxon Part	G150						G154		G155		G161		G163	
	H3 No.1	D6-B5 No.2	H6 No.3	H4 No.4	H1 No.5	A2 No.1	I/A1 No.2	I/C1 No.3	C2 No.1	C3 No.2	B5 F1&2 No.1	B3 F1 No.1	D1 F2 No.2	C2 No.3
Dicotyledoneae wood	x/C			x/C	x/C		x/C	x/C						
Caryophyllaceae *Stellaria* sp. seed									1/N				3/N	
Compositae achene	5/N	x/N		2/N	x/N				2/N		1/N			2/N
Graminae fruit									1/N			1/N		
stem	1f/C													
Zea mays kernel								1f/C						
cupule		x/C												1f/C
Oxalidaceae *Oxalis* sp. seed									1/N		1/N			
Solanaceae *Physalis* sp. seed													2/N	
Indeterminate seed	1/c	1/N		1/N		1/N	2/N		4/N	5/N	3/N		1/N	4/N
fruit					1/N									
wood	x/C				x/C									
stem	1f/C													
Residue	r	r	r	r	r	r	r	r	r	r	r	r	r	r

X Presence noted,
C Charred
N Noncharred
f fragment
r residue retained
B5 Burial 5
F1 or F2 Feature 1 or Feature 2

TABLE 3

RESULTS OF ANALYSIS OF VEGETAL REMAINS

PROVENIENCE

Taxon Part				G150				G151	G153			G154	
	D5	D6	G2	H1	H2	H3	H4	A	A	A2	D2	I1	I/A1
Dicotyledoneae													
wood			x/C	x/C	x/C	x/C	x/C	x/C	x/C	x/C			x/C
Bignoniaceae													
Crescentia alata													
pericarp										2f/C*		x/C*	x/C*
Curcubitaceae													
pericarp													x/C
Graminae													
fruit													
Zea mays													
kernel										3f/C	1f/C	1f/C	
cupule		2/C											
cob													
Lauraceae													
Pesea americana													
seed											3f/C*		
Leguminosae													
Phaseolus vulgaris													
cotyledon				1/C									
Palmae													
seed											1f/C*		
Indeterminate													
seed													
fruit									3/C	5/C	4/C		
wood				x/C						x/C		x/C	
bark													

C charred
f gragment
x presence noted, no quantity
* tentative identification

TABLE 3 con't

PROVENIENCE

Taxon Part		G154		G155	G156			G161			G163
	I/B1	I/C2	J1	no lot	C2	B2	B3	D1	D2	B1	C1
Dicotyledoneae											
wood	x/C	x/C				x/C	x/C	x/C			x/C
Bignoniaceae											
Crescentia alata											
pericarp	x/C*	2f/C*							3f/C*		
Cucurbitaceae											
pericarp											
Gramineae											
fruit											
Zea mays											
kernel		2f/C	4f/C							2/C*	
cupule		1f/C									
cob											1f/C
Lauraceae											
Persea americana											
seed		1f/C									
Leguminosae											
Phaseolus vulgaris											
cotyledon											
Palmae											
seed											
Indeterminate											
seed		1/C	1/C	1/C							
fruit			4/C	1/C							
wood					x/C						
bark											

TABLE 3 con't

PROVENIENCE

Taxon Part		G169				
	no lot	C4	D3	D6	E3	F2
Dicotyledoneae						
wood		x/C	x/C	x/C	x/C	x/C
Bignoniaceae						
Crescentia alata						
pericarp	4f/C					
Cucurbitaceae						
pericarp	2f/C					

Graminae	
fruit	
Zea mays	
kernel	
cupule	
cob	
Lauraceae	
Persea americana	
seed	
Leguminosae	
Phaseolus vulgaris	
cotyledon	1f/C
Palmae	
seed	
Indeterminate	
seed	
fruit	
wood	x/C
bark	

TABLE 4

Occurrence of Cultigens

Site/Phase Lot/Strat	*Zea Mays*	*Phaseolus vulgaris*	*Persea americana*
G150/Silencio			
D6/S.62	X		
H1/S.30		X	
G154/Tilarán			
A2/S.30	X		
D2/S.30	X		X
I1/S.30	X		
IC2/S.30	X		X
J1/S.30	X		
G161/Tilarán			
C7/S. White 1	X		
G163/Tronadora			
B1/S. 50	X		
C2/S. 60	X		
G169/Tilarán			
general		X	

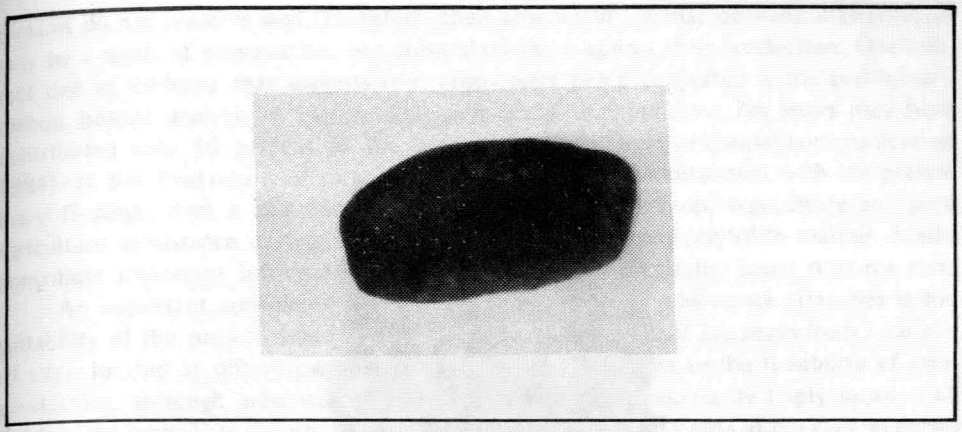

Figure 1. Bean cotyledon (Phaseolus vulgaris) *from G–150H1. Length 0.9 cm; width 0.5 cm.*

were tentatively identified from one site; G–154, a late habitation site. The bean cotyledons were retrieved from G–150 (Fig. 1), and G–169. The former site is a major cemetery and the latter site is a habitation with a probable funerary component. The cotyledons were not found in association with burials but were collected from excavation units located away from the main tomb complexes.

The most frequently recovered cultivar was corn, remains of which were retrieved from four sites that represent two different site types. Based upon the ceramic and lithic artifacts (Article 9, Article 4) sites G–154, G–161 and G–163 are considered to be habitation sites and, as already noted, G–150 is a large cemetery site. The remains of corn from this latter site consist of a few fragmentary cupules found in association with Burial 5 (Lot D6), within Unit 62, a mixed cultural and natural deposit. The charred nature of the cupules suggests that the corn was probably not intentionally included as part of the burial assemblage but was trash unintentionally incorporated in the tomb fill. This interpretation of the remains is consistent with the suggestion presented by Bradley (Article 6) that material culture items, typical of hatitation sites, can be expected at large cemeteries as the result of post-interment activities that involve temporary habitation at the cemetery.

A small 10 rowed cob fragment, 1.6 cm long by 1.1 cm wide (Fig. 2), was recovered from G–161C7. Based on the ceramics and stratigraphy, Lot C7 dates to the Tilarán Phase. Without comparative material and limited by a single specimen, identification as to race or variety could not be made at the time of analysis. Nonetheless, the morphological characteristics of the fragment were in good condition and, if compared to known corn types from other contemporaneous sites, it may be possible to assign the cob to a race or variety.

Site G–163, located on the present shore of Lake Arenal, is the earliest and only site investigated that dated primarily to the Tronadora Phase, the Middle Formative period (Article 9). A charred corn cupule was tentatively identified from a flotation sample collected from beneath Feature 2 (Lot C2), a cluster of three oxidized rocks that may be a disturbed hearth located at the interface of Unit 60 and Aguacate. Also,

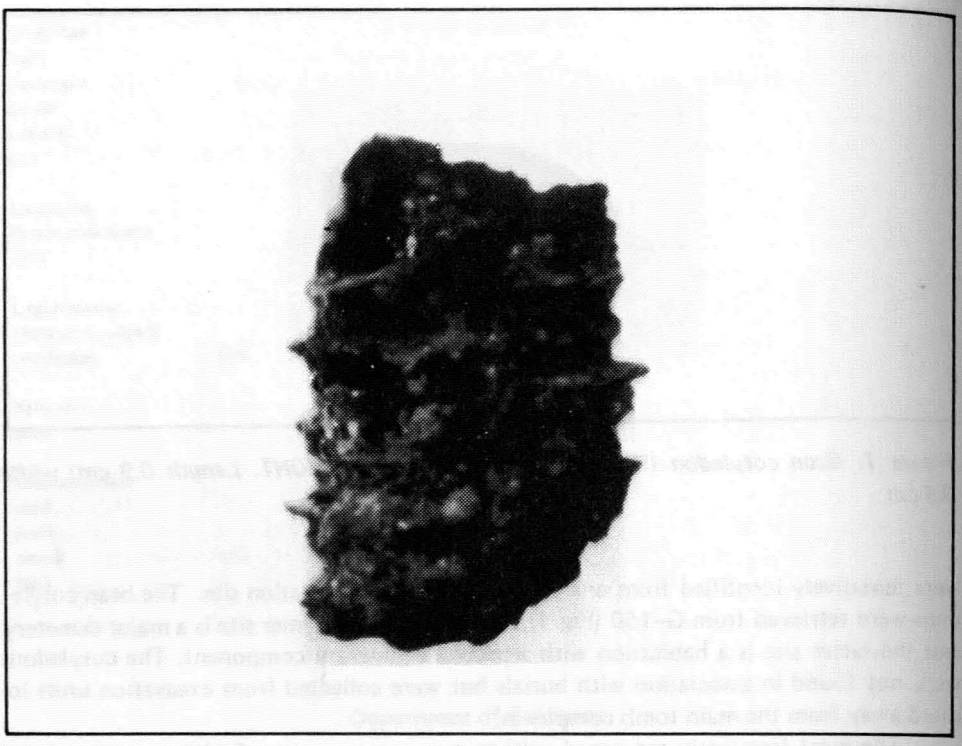

Figure 2. Ten-rowed cob fragment of Zea mays *recovered from G–161C7. Length 1.7 cm; width 1.15 cm.*

two fused fruits which may be corn kernels, were recovered from this site. However, given the condition of the remains, the classification as *Zea mays* needs to be verified. If the identification can be verified, these remains will represent the earliest macrobotanical evidence of corn recovered from controlled excavations in the Arenal area.

Beyond the evidence of cultigens, it is difficult to assess the content of the botanical subsistence resource base because of the lack of remains from flotation and the limited positive identifications of the vegetal material. Initially, it was hoped that the flotation results would help identify some of the smaller sized wild and pioneer plant resources. However, given the lack of well–defined features, living surfaces, etc., and the minimal preservation potential for the project area, the paucity of small–scale remains is not surprising, although the 14 samples floated for this project cannot be considered an adequate test of this recovery method. Given better preserved or defined cultural strata and improved flotation techniques, it is believed that flotation recovery would yield greater subsistence data.

One important factor to take into account when evaluating possible subsistence strategies is the lack of vegecultural products among the macrobotanical remains. In some cases, negative evidence is as meaningful for interpretations as positive evidence. In this case, the lack of macrobotanical remains indicative of root crops does not necessarily imply their absence in the subsistence regime because these types of soft tissue

remains do not preserve well. Therefore, their absence in the macrobotanical assemblage may be a result of preservation, not cultural selection against their production. One indirect line of evidence that suggests root crops were being cultivated is the preliminary carbon isotope analysis of human skeletal material that indicates *Zea mays* may have contributed only 10 percent to the prehistoric diet (Sheets, personal communication 1984). If the final results of carbon isotope analysis remain consistent with the preliminary findings, then a case can be made for a mixed tree crop, vegeculture and seed agriculture subsistence strategy. The results of both pollen and phytolith analysis should contribute important information in establishing the botanically based resource mix.

An important consideration in developing models of subsistence strategies is the suitability of the project area for agriculture. The occurrence of *Zea mays* from a variety of sites, located at differing elevations and landforms, attests to the feasibility of corn production, although presence of corn at a site does not necessarily imply location of fields in the immediate vicinity of a site. For example, the corn found at the G–150 cemetery probably was brought from an associated habitation site. The soils within the project area are classified as Typic Hydrandept (Tosi 1980), which is a fertile soil type derived from volcanic ash, and all the recorded sites are within this soil class. The sites are considered to be within two precipitation provinces: humid and perhumid (Article 1, Article 4). The humid province is rated the better of the two for production of annual crops and the perhumid province is considered adequate for permanent or semi–permanent crops (Tosi 1980). Given these environmental characteristics, as well as suitable depth of soil and cultivatable landforms, the project area appears to be adequate for both seed–based agriculture and vegeculture. If the division between site location within the two different precipitation provinces is sufficiently distinctive it may be possible through pollen, phytolith, and macrobotanical analysis, to substantiate that occupants of sites located within one province were practicing or relying upon an agricultural system different from that practiced in the other province.

The best preserved and most recurrent type of macrobotanical material was wood charcoal. It is believed that this category of macrobotanical remains has the potential for being developed into a significant data base for future studies in the Cuenca de Arenal. Remains of wood can be used to aid in reconstruction of the prehistoric environment and to give an indication of change in vegetation community structure from both natural and cultural disturbance. Also, trees are sensitive to climatic variation, on both a microclimatic and regional level. Therefore, wood remains can be used to substantiate paleoclimatic studies. They can also be used in formulating hypotheses concerning climatic effect on subsistence strategies, such as might be seen between those goups living in the humid province versus those living in a perhumid province.

Beyond the environmental significance that wood remains can have, there are several cultural implications that can be drawn from this category of macrobotanical remains. Obviously, genera of wood recovered from secure cultural proveniences imply cultural selection. These remains can indicate primary selection for the wood itself or may be a secondary indication of other primary tree–based resources, like fruits or seeds, that do not preserve well in the archaeological record. Wood remains can also be used to generate hypotheses concerning changes in resource utilization due to such factors as changes in settlement pattern, population expansion, or resource availability (Kohler and Matthews 1984; Pearsall 1983). To develop the potential of this part of the macrobotanical data base will necessitate such activities as compiling a present day comparative

wood collection, refining identification of wood charcoal remains, establishing sources of error in the data base, and recovering wood from better defined living surfaces and domestic features than those excavated during the 1984 field season. Nonetheless, future studies utilizing the results of wood charcoal analysis could prove very beneficial in providing data for modeling subsistence strategies and cultural processes.

SUMMARY

The macrobotanical remains from sites tested as part of the 1984 field season of Proyecto Prehistórico Arenal provide preliminary evidence for the practice of a seed based agricultural subsistence strategy. If the identification of the *Zea mays* cupule and kernels can be verified, then the macrobotanical remains confirm the utilization of maize agriculture by groups occupying the project area from as early as the Tronadora Phase (1000–500 B. C.) through the Tilarán Phase (A.D. 1000–1500). Other vegetal remains suggest that tree crops were also being exploited, although, except for the fragments of avocado seeds, none of these vegetal remains could be positively identified as domesticated resources.

Vegeculture probably was practiced, in addition to seed agriculture and exploitation of tree crops. The habitat requirements for vegeculture are adequate in occupied parts of the study area, the preliminary carbon isotope data indicate a low dietary contribution by corn and vegeculture is a common subsistence strategy for the tropics in Middle America. The results of the pollen and phytolith analysis will undoubtedly provide better evidence for the practice of vegeculture than can be found from macrobotanical analysis, due to the poor preservation potential of root crop debris. The problems with preservation and poorly defined living surfaces are considered to be partially responsible for the poor flotation results. Given the successful application of this recovery method in other tropical areas, it is believed use of flotation has the potential for recovering plant remains that represent gathered or encouraged resources but that are too small to be collected through normal excavation procedures.

The ubiquitous occurrence of wood suggests a data base that can be expanded and manipulated in future studies. Wood charcoal can provide both enviromental and cultural information which in turn can be used in subsistence studies, settlement pattern studies, and vegetation community reconstructions.

Given the preliminary nature of the macrobotanical data base and the incomplete pollen, phytolith, and carbon isotope analysis, the potential subsistence strategies utilized through time in the Tilarán–Arenal area cannot be determined at this point. The use of seed–base agriculture and tree crops is indicated by remains identified in the macrobotanical assemblage. The use of root crops is inferred through other lines of reasoning. Reconstructing subsistence strategies utilized by the prehistoric people will require better defined and preserved cultural features and expansion of the various subsistence–related data bases. Furthermore, with the expansion of these data bases, meaningful expectations can be derived to facilitate modeling adaptative cultural processes that were instrinsic to the survival of the prehistoric peoples in the volcanically active area of the Cuenca de Arenal.

ACKNOWLEDGEMENTS

I would like to thank Aida Blanco Vargas and Michael Snarskis for their time and help in identifying some of the macrobotanical remains. Earl Bolton's timely assistance in floating samples was also greatly appreciated. I would like to express my gratitude to Donna Gerst (USA Peace Corps) for extending to me the solitude of her apartment and access to her library of horticultural literature. Finally, I would like to thank Payson Sheets for allowing me the opportunity to expand my professional horizons through this project.