

CHAPTER 3

Continuity and Variability in Postclassic and Colonial Animal Use at Lamanai and Tipu, Belize



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Spanish arrival in the Americas precipitated dramatic changes in the political, economic, and ceremonial lives of many indigenous populations and often irrevocably altered even fundamental patterns of animal, plant, and other resource use (e.g., Reitz and Cumbaa 1983; Ruhl 1990). Recent evidence from the southern Maya Lowlands, however, suggests that in this region the Spanish faced a considerable and highly successful opposition. Here the Postclassic period was a time of great intellectual, political, and commercial activity, and initial reaction to the Spanish presence was not one of immediate submission or wholehearted acceptance. Although Spanish religious beliefs and economic and political authority were eventually accepted in the Maya Lowlands, commercial and missionizing contacts were initially brief, and the Maya retained political control for much longer than in the fully administered northern regions (Graham 1991; Jones 1989; Pendergast 1986a). To what extent was the conflict between acceptance of and resistance to the Spanish presence reflected in basic patterns of resource use in this frontier zone of resistance?

A zooarchaeological investigation of animal bone assemblages from Postclassic and early Colonial archaeological deposits at the sites of Lamanai and Tipu, Belize, provides an analysis of the effects of early Spanish contact, a dramatic source of change in other regions, on fundamental patterns of animal use at these two politically and economically important southern lowland centers. A high degree of chronological contemporaneity and environmental similarity between the two sites, as well as contextual and preservational similarity between the archaeological deposits examined, allows a direct comparison of patterns of change in the consumption of animal species and the use of ecosystems in the region. The results provide a valuable opportunity to expand on a limited body of literature discussing the effects of Spanish contact on indigenous Postclassic resource use in the southern Maya Lowlands. These two important sites have been the focus of extensive archaeological and ethnohistoric research (Graham 1987, 1991; Graham et al. 1985; Jones 1985, 1989; Pendergast 1986a, 1986b, 1990, 1991) that documents not only extraordinarily long occupation histories (Preclassic to Colonial) but also the effects of initial contact between Maya and Spanish peoples at these sites. Both centers were active participants in Postclassic mercantile spheres and as such were powerful entities in

the political scenario of the period. Evidence from ethnohistoric Spanish documents often conflicts with the archaeological records of these sites, revealing an intriguing complexity of acceptance and rejection of both religious and secular Spanish norms.

Analyses of the faunal remains from Postclassic and Colonial deposits at Lamanai and Tipu were undertaken to answer three basic questions. Does chronological variation exist in patterns of animal use during these periods of extreme internal and external cultural stress? Are patterns of dietary continuity and/or change comparable at the two sites and can they be used to suggest any panregional adaptation in animal use practices at the time of Spanish contact? And if variability exists, is it representative of a continuation of Postclassic Maya practices, or are the changes wholly without historical precedent and thereby attributable to the effects of Spanish contact?

Ecological analyses of animal community diversity reflected in faunal assemblages from the sites of Lamanai and Tipu were combined with traditional zooarchaeological analyses of chronological change in species and ecosystem utilization at each site to provide evidence for both regional and chronological patterning.¹ Ecological community statistics are most commonly used to quantify the distribution of, and the relationships between, living taxa in a natural ecosystem. As analytical tools, they are valuable additions to the techniques of faunal analysis, as they provide more detailed information on changing temporal and spatial patterns of resource use than is generally available through the simple analysis of taxa recovery frequencies and discussions of emic values of utilized species. The use of these combined measures on comparable zooarchaeological assemblages from Lamanai and Tipu allows the documentation of the variability of responses to the stresses of cultural change through the description of two successful strategies of animal use during the important transition from the Postclassic to early Colonial period.

The results of these analyses point strongly to several conclusions. Patterns of animal use at both Lamanai and Tipu changed both during the period between the Middle and Late Postclassic and during the transition to the Colonial period. There is little evidence for any relationship between the patterns seen at the two sites, and the temporal variations are more pronounced at Lamanai. Despite the regional and temporal discontinuity, however, the changes seen in the Colonial period appear to have strong roots in the Postclassic period patterns at each site. There is no appearance of a strictly Colonial animal use pattern at either Lamanai or Tipu.

Methods

The Zooarchaeological Samples

The Lamanai sample, a total of 5,737 analyzed zooarchaeological remains, is derived from four midden lots originating from Postclassic and Colonial period settlements and spanning collectively the dates from A.D. 1150 to A.D. post-1641 (Table 3.1). The four middens are securely dated and are directly associated

1. Full community descriptions are available in tabular form in Emery 1990a.

Table 3.1. Chronological Listing of Zooarchaeological Assemblages.

Date	Period	Lamanai	Tipu
A.D. 1520+	Colonial	N11-18	H12-6, 7, 8, 12, 13, 14
A.D. 1400–1520	Late Postclassic	N11-3	H12-6, 8, 12, 13
A.D. 1150–1400	Middle Postclassic	N10-9	H12-14

with three different structures, N10-9, N11-3, and N11-18. All these structures were most likely the residences of elite members of the Lamanai community, and there is no evidence for a permanent Spanish residency at the site despite the association of several European objects with the Colonial period structure (Pendergast, personal communication 1989).

The larger Tipu faunal assemblage consists of 24,590 analyzed specimens from excavations at seven separate structures in and around the main ceremonial complex of the site. Included in the sample are remains from undisturbed Middle and Late Postclassic period deposits sealed beneath later Colonial residences (structures H12-6, H12-12, H12-14), and Colonial period deposits from both these Colonial period constructions as well as Colonial residences unassociated with earlier structures (structures H12-8, H12-13). Although disturbance of stratified occupation levels is common at Tipu, zooarchaeological samples for this analysis were selected only from unmixed deposits. European artifactual material and ethnohistoric records suggest that two of the Colonial residences may have been used on a temporary basis by members of the Spanish religious order (Graham, personal communication 1986). As Tipu was a small rural community at all times, its architectural emphasis was on domestic structures. The location of the sampled structures within the site core, however, argues for the relatively high status and wealth of their inhabitants.

Assuming Sample Comparability

Basic to this analysis of variability in animal use patterns is the assumption that the sites of Lamanai and Tipu are characterized by a high degree of cultural and environmental similarity. That these sites were occupied simultaneously and were affected by the same cultural trends during the Postclassic and Colonial periods has been established through extensive archaeological analysis by Pendergast and Graham (Graham 1991; Graham et al. 1985, 1989; Pendergast 1986a, 1986b, 1991). The sites differ in their community layout, and as discussed above, in the distribution of architecture representing elite residences or ceremonial buildings. Nevertheless, the deposits examined are comparable in terms of both function and status. Although the excavated samples from Lamanai and Tipu are generally comparable, investigation at both sites was oriented toward Postclassic and Colonial structures which have some architectural complexity and which reflect the activities of the upper echelon of these periods. The faunal assemblages are not, therefore, representative of all time periods or of all members of the ancient population. The sample bias affects both assemblages,

2. The New River Lagoon system differs ecologically from the smaller, more riverine Macal. Located 70 kilometers inland from Chetumal Bay on the Caribbean coast, the lagoon is a primarily estuarine system in which certain peripheral and brackish-water species occur that are not found close to Tipu (Lovisek, personal communication 1986).

3. Original identifications by P. Baker, C. Cathcart, K. Emery, C. Neill, and C. Yasui are on file at the University of Toronto Faunal ArchaeoOsteology Laboratory.

however, and although it does not affect these analyses, it affects comparisons with other sites.

The sites are also ecologically comparable, located in the subtropical moist life zone dominated by high-canopy broadleaf forest (Hartshorn et al. 1984), and are characterized by the same general conditions of geology and climate. Both sites are also located on strategic freshwater tributaries, Lamanai on the northwest shore of the New River Lagoon, and Tipu on the west bank of the Macal River.² Terrestrial associations at both sites would have included the built environment of human habitation, cultivated lands, secondary growth or high bush, and undisturbed pristine canopy forest. Swampy, low-lying *bajo* environments were within easy reach of Maya hunters at both sites (closer at Lamanai than at Tipu), as was the pine ridge zone of the Maya Mountains. Because of the similar availability and diversity of resources, differences observed between patterns of animal exploitation cannot be explained by any difference in ecological parameters.

Finally, any analysis of variability in patterns of animal use may be confounded by biases introduced through the effects of variability in archaeological sampling strategies, taphonomy, or zooarchaeological sample sizes. Archaeological and zooarchaeological sampling strategies were identical at the two sites, although at both Lamanai and Tipu recovery methods differed between deposit types, as features, middens, and occupation surfaces were more frequently screened (1/4") or water-screened (1/16") than other deposits (Pendergast, personal communication 1988; Graham, personal communication 1987). Analysis of the taphonomic conditions of the Lamanai and Tipu samples (Emery 1990a) indicate that bone preservation did not vary significantly between deposits or sites. And although the Tipu zooarchaeological assemblage is considerably larger than the Lamanai sample, regression analyses (Emery 1990b) also show that the ecological trends and measures derived here do not result from sample size variability. These analyses are more fully described in Emery 1990a and 1990b, where the effects of intra- and intersite variability in sample composition and size were evaluated and shown to be negligible or easily circumvented by simple analytical manipulation.

Zooarchaeological Analysis and Community Statistics

The following statistical analyses are based on minimum number of individual (MNI) estimations, as the independence of this measure from discrepancies in both natural and introduced skeletal part frequencies, and its independence from the degree of fragmentation of skeletal parts, ensures a high degree of comparability between samples (Cruz-Urbe 1988). Frequencies were derived from original identification lists produced by various researchers following standardized procedures that mitigated researcher variability during initial identification.³ MNI calculations for both the Lamanai and Tipu assemblages were based on provenience units defined by the excavators as chronologically associated occupation levels within structures (Emery 1990a). Although the use of single-structure assemblages may obscure the effects of food sharing be-

tween larger residential units, it does not bias the analysis by assuming habitation associations where none have been proven.

MNI frequencies for the provenience units were grouped into three chronologically defined zooarchaeological communities at each site for the purposes of statistical description and comparison (Table 3.1). For each temporal zooarchaeological community, relative species MNI frequencies were calculated and larger taxonomic and community associations were used to describe ecosystem resource utilization patterns.

The accurate analysis of ecosystem use is based on the degree to which each animal species is associated with, or fidelic to, one or more ecological zones. To reduce the effects of natural variability in species fidelity to any single biotic community, the archaeological taxa were each allocated a percentage fidelity value for one or more of eight ecosystem associations on the basis of current knowledge of habitat preferences.⁴ These modified counts (termed eMNI here) were then used to determine proportionate representation of the various ecosystems in the zooarchaeological assemblage.

A combination of measures was used to quantify the diversity of each zooarchaeological community. These included species heterogeneity, richness, evenness, and dominance. The ecological community statistic known as diversity or heterogeneity cannot be accurately derived without reference to its two distinct components: species richness or the number of taxa present in a collection containing a specified number of individuals; and species evenness, calculated as the similarity in abundance of several taxa in a sample. The distinctions between these measures allow consideration of the different properties of the structure of the ecological community. There has been considerable debate as to the effectiveness of the various measures of diversity in archaeological studies (Cruz-Uribe 1988; Leonard and Jones 1989). An earlier study evaluated the potential of the variously proposed heterogeneity, richness, and evenness measures with respect to the Lamanai and Tipu zooarchaeological samples (Emery 1990b) and provided evidence for a lack of sample size dependency with the use of Simpson's index of heterogeneity and Odum's richness measure. Indices of general heterogeneity and richness were therefore derived using these measures. An index of species evenness was calculated using simple variance based on relative frequencies of species for each community as recommended by Bobrowsky and Ball (1989). Finally, the relative dominance of the primary (most frequently occurring) species in each community was defined as the difference between relative frequencies of occurrence of these species within the community.

Once described, the taxonomic similarities between the zooarchaeological communities were quantified using Spearman's correlation coefficient tests of sample correlation based on unranked relative species frequencies for each chronological and spatial community to provide an analysis of locational variability and changing animal use over time. A chronological analysis of change over time was made for each of the descriptives derived for the zooarchaeological communities, and changes in community diversity, species frequencies, and ecosystem resource use were all evaluated. In all cases where the

4. A detailed discussion of the derivation of ecosystem fidelity measures and the numeric equivalents used in this and other analyses can be found in Emery 1990a and 1997. Species habitat fidelities are derived from various zoological sources (e.g., Emmons 1990; Leopold 1959).

communities are compared, analyses are based on relative as opposed to absolute frequencies in order to negate the effects of sample size variability.

Results

Regional Disjunction—Chronological Continuity

Analyses of community similarity (Table 3.2), taxonomic characteristics (Tables 3.3 and 3.4), ecological community statistics (Table 3.5), and environmental use patterns (Table 3.6) combine to provide information on both diachronic and synchronic patterning in animal use at Lamanai and Tipu.

Spearman's tests of zooarchaeological community correlation, used to compare the Lamanai and Tipu chronological assemblages, reveal variability in species distributions between all the samples examined (Table 3.2). More important, however, the results indicate a significantly greater degree of variability between the sites of Lamanai and Tipu, both overall and during any one time period, than exists between the chronological communities at either site. The differences between overall patterns of animal use at these two sites are greater than the internal or temporal differences at either site. The most closely correlated communities are found at Lamanai, where the highest degree of relatedness is found between the Middle and Late Postclassic assemblages. The Tipu communities are almost equally well internally correlated overall, and the relationship between the Postclassic and Colonial communities here is also strong. The greatest divergences are found between any of the Tipu time periods and the Lamanai Colonial period, where both correlation and significance are minimal. Overall, the Spearman's tests reveal an intersite variability that is surprisingly high considering the cultural and environmental similarities between the two sites. As well, despite evidence for variability between dietary patterns over time at both Lamanai and Tipu, these results suggest a high degree of internal consistency at each site.

Analysis of the changing patterns of animal and ecosystem resource use seen over the three periods surveyed suggests that despite obvious chronological variability, there are several significant overlying trends of continuity at each site. There is evidence for a generalized stability over time at Tipu in terms of not only specific species (Figures 3.1 and 3.2) but also overall diversity of species used (Figure 3.3). This is not the rule at Lamanai, where changes in heterogeneity (Figure 3.4), community associations (Figure 3.5), and species used (Figures 3.1 and 3.2) are more dramatic while remaining directionally consistent over time. There is some evidence for a similarity of changes occurring at the two sites during the transition from Middle to Late Postclassic, and there is considerable evidence that the more dramatic changes seen at both sites during the Colonial period are direct reflections of earlier Postclassic patterns.

At both Lamanai and Tipu the Middle Postclassic period is characterized by very similar animal use patterns. High heterogeneity levels, the comparability of which is offset only partially by a lower species richness at Lamanai, are accompanied by a concentration on large mammals as well as secondary and

Table 3.2. Spearman Correlation Coefficients for Lamanai and Tipu Assemblages.

	Lamanai			Tipu	
	Middle Postclassic	Late Postclassic	Colonial	Middle Postclassic	Late Postclassic
Lamanai					
Late Postclassic	0.7902**				
Colonial	0.6301**	0.6906**			
Tipu					
Middle Postclassic	0.4660**	0.4519**	0.2343*		
Late Postclassic	0.4220**	0.4558**	0.0797	0.5267**	
Colonial	0.4874**	0.4853**	0.1603	0.4963**	0.5826**

*Significance level .05.

**Significance level .01

Table 3.3. Taxonomic Distribution of Lamanai Fauna.

	Middle Postclassic		Late Postclassic		Colonial		Total	
	MNI	%	MNI	%	MNI	%	MNI	%
Lamanai								
Carcharhinidae	—	—	—	—	1.00	0.50	1.00	0.32
Osteichthyes (5 spp.)	2.00	11.76	6.00	6.59	114.00	57.00	122.00	39.61
<i>Crocodylus moreleti</i>	1.00	5.88	1.00	1.10	2.00	1.00	4.00	1.30
Dermatemydidae	1.00	5.88	1.00	1.10	2.00	1.00	4.00	1.30
Anatidae	—	—	—	—	3.00	1.50	3.00	0.97
<i>Crax rubra</i>	1.00	5.88	8.00	8.79	8.00	4.00	17.00	5.52
Phasianidae	—	—	—	—	6.00	3.00	6.00	1.95
<i>Meleagris</i> spp.	—	—	13.00	14.29	38.00	19.00	51.00	16.56
<i>Dasyurus novemcinctus</i>	1.00	5.88	2.00	2.20	2.00	1.00	5.00	1.62
<i>Canis familiaris</i>	1.00	5.88	7.00	7.69	1.00	0.50	9.00	2.92
<i>Felis concolor</i>	1.00	5.88	2.00	2.20	1.00	0.50	4.00	1.30
<i>Panthera onca</i>	—	—	2.00	2.20	—	—	2.00	0.65
<i>Tapirus bairdii</i>	1.00	5.88	1.00	1.10	—	—	2.00	0.65
Tayassuidae	1.00	5.88	5.00	5.49	5.00	2.50	11.00	3.57
<i>Mazama americana</i>	3.00	17.65	13.00	14.29	9.00	4.50	25.00	8.12
<i>Odocoileus virginianus</i>	2.00	11.76	27.00	29.67	8.00	4.00	37.00	12.01
<i>Agouti paca</i>	1.00	5.88	3.00	3.30	—	—	4.00	1.30
<i>Dasyprocta punctata</i>	1.00	5.88	—	—	—	—	1.00	0.32
TOTAL	17.00	100.00	91.00	100.00	200.00	100.00	308.00	100.00

Note: MNI values for families have been proportionately divided into species categories where these already exist, to reduce the effects of diversity inflation.

cultivated ecosystem resources, the result in part of the importance of brocket deer at both sites and a tertiary importance of reptiles, birds, and fishes. The two sites differ only in the secondary concentration on armadillo in addition to brocket deer at Tipu and the greater importance of pristine canopy forest species here than at Lamanai. Overall, the pattern is reminiscent of that found at many other Maya lowland sites, particularly during the Terminal and Post-classic periods (Hamblin 1984; Masson 1995; Pohl 1990, 1994; Scott 1982).

Table 3.4. Taxonomic Distribution of Tipu Fauna.

	Middle Postclassic		Late Postclassic		Colonial		Total	
	MNI	%	MNI	%	MNI	%	MNI	%
Tipu								
Rajiformes	—	—	—	—	2.00	0.59	2.00	0.30
Lamnidae	—	—	1.00	0.75	1.00	0.30	2.75	0.41
Carcharhinidae	—	—	—	—	1.00	0.30	1.00	0.15
Siluriformes	1.00	2.13	1.00	0.75	6.00	1.78	10.88	1.61
Ictaluridae	—	—	—	—	1.00	0.30	1.00	0.15
Cichlidae	1.00	2.13	2.00	1.50	3.00	0.89	9.63	1.42
<i>Petenia splendida</i>	—	—	1.00	0.75	3.00	0.89	4.75	0.70
Cyprinodontiformes	—	—	—	—	1.00	0.30	1.00	0.15
Carangidae	1.00	2.13	—	—	—	—	3.13	0.46
Sparisomatinae	1.00	2.13	—	—	1.00	0.30	4.13	0.61
Scaridae	1.00	2.13	1.00	0.75	2.00	0.59	6.88	1.02
cf. Serpentes	—	—	—	—	1.00	0.30	1.00	0.15
<i>Ctenosaura similis</i>	—	—	1.50	1.13	4.66	1.38	6.16	0.91
<i>Iguana iguana</i>	2.00	4.26	1.50	1.13	2.33	0.69	5.83	0.86
<i>Crocodylus moreleti</i>	1.00	2.13	1.00	0.75	5.00	1.48	9.88	1.46
<i>Dermatemys mawii</i>	2.00	4.26	2.00	1.50	13.20	3.92	17.20	2.54
Kinosternidae (2 spp.)	—	—	2.00	1.50	9.90	2.94	11.90	1.76
Emydidae (3 spp.)	2.00	4.26	5.00	3.76	8.78	2.61	23.80	3.52
<i>Chelydra serpentina</i>	1.00	2.13	—	—	—	—	3.13	0.46
Galliformes	—	—	1.00	0.75	3.00	0.89	4.75	0.70
<i>Crax rubra</i>	2.00	4.26	5.45	4.10	8.00	2.37	15.45	2.28
<i>Penelope purpuracens</i>	—	—	1.09	0.82	—	—	1.09	0.16
<i>Ortalis vetula</i>	—	—	1.09	0.82	—	—	1.09	0.16
<i>Meleagris</i> sp.	2.00	4.26	4.36	3.28	16.00	4.75	22.36	3.30
Rallidae	—	—	1.00	0.75	—	—	1.75	0.26
Psittacidae	—	—	1.00	0.75	1.00	0.30	2.75	0.41
Didelphidae	1.00	2.13	5.00	3.76	8.00	2.37	19.89	2.94
<i>Tamandua</i> sp.	—	—	1.00	0.75	1.00	0.30	2.75	0.41
<i>Dasypus novemcinctus</i>	6.00	12.77	12.00	9.02	46.00	13.66	85.79	12.68
<i>Alouatta villosa</i>	—	—	1.50	1.13	9.00	2.67	10.50	1.55
<i>Ateles geoffroyi</i>	—	—	1.50	1.13	—	—	1.50	0.22
<i>Canis familiaris</i>	1.00	2.13	3.00	2.26	7.00	2.08	15.38	2.27
cf. <i>Canis latrans</i>	—	—	1.00	0.75	1.00	0.30	2.75	0.41
<i>Urcyon cinereoargenteus</i>	—	—	1.00	0.75	5.00	1.48	6.75	1.00
cf. <i>Felis concolor</i>	—	—	2.00	1.50	3.50	1.04	5.50	0.81
cf. <i>Panthera onca</i>	—	—	3.00	2.26	1.50	0.45	4.50	0.67
cf. <i>Felis pardalis</i>	—	—	3.00	2.26	6.00	1.78	11.26	1.66
<i>Felis wiedii</i>	—	—	1.00	0.75	—	—	1.75	0.26
<i>Felis yagouaroundi</i>	—	—	1.00	0.75	—	—	1.75	0.26
Mustelidae	—	—	—	—	1.00	0.30	1.00	0.15
<i>Procyon lotor</i>	0.50	1.06	1.00	0.75	3.00	0.89	4.50	0.67
<i>Nasua narica</i>	0.50	1.06	—	—	3.00	0.89	3.50	0.52
<i>Tapirus bairdii</i>	1.00	2.13	2.00	1.50	9.00	2.67	15.63	2.31
Tayassuidae	—	—	2.00	1.50	26.00	7.72	29.50	4.36
<i>Tayassu tajacu</i>	3.00	6.38	4.00	3.01	—	—	16.39	2.42
<i>Tayassu pecari</i>	1.00	2.13	6.00	4.51	1.00	0.30	14.64	2.16
<i>Mazama americana</i>	7.00	14.89	10.00	7.52	31.00	9.20	70.41	10.41
<i>Odocoileus virginianus</i>	4.00	8.51	9.00	6.77	24.00	7.12	52.28	7.73

Table 3.4 (continued) Taxonomic Distribution of Tipu Fauna.

	Middle Postclassic		Late Postclassic		Colonial		Total	
	MNI	%	MNI	%	MNI	%	MNI	%
Sciuridae	—	—	1.00	0.75	2.00	0.59	3.75	0.55
Geomysidae (2 spp.)	—	—	3.00	2.25	8.00	2.37	13.25	1.96
Heteromyidae (2 spp.)	—	—	1.00	0.75	1.00	0.30	2.75	0.41
Cricetidae (5 spp.)	—	—	6.00	4.50	9.00	2.67	19.50	2.89
<i>Coendou mexicana</i>	—	—	1.00	0.75	—	—	1.75	0.26
<i>Agouti paca</i>	4.00	8.51	11.00	8.27	24.00	7.12	55.78	8.24
<i>Dasyprocta punctata</i>	1.00	2.13	6.00	4.51	11.00	3.27	24.64	3.64
<i>Sylvilagus brasiliensis</i>	—	—	—	—	2.00	0.59	2.00	0.30
TOTAL	47.00	100.00	132.99	100.00	336.87	100.00	676.66	100.00

Note: MNI values for families have been proportionately divided into species categories where these already exist, to reduce the effects of diversity inflation.

Table 3.5. Ecological Community Statistics for the Lamanai and Tipu Assemblages.

	Middle Postclassic	Late Postclassic	Colonial	Total
Lamanai				
N specimens	16.00	94.00	192.00	300
No. taxa	13.00	17.00	17.00	21.00
Heterogeneity (Simpson's)	30.00	7.50	4.55	6.89
Evenness (1/variance*100)	12.94	49.28	96.90	53.81
Richness (s-1/log N)	13.64	14.78	16.81	20.82
Dominance (species a—species b)	6.25	14.89	22.11	12.33
Tipu				
N specimens	47.00	132.99	336.87	516.86
No. taxa	24.00	49.00	49.00	64.00
Heterogeneity (Simpson's)	19.39	29.55	19.10	21.19
Evenness (1/variance*100)	12.54	4.22	7.09	5.22
Richness (s-1/log N)	23.40	48.53	48.60	63.63
Dominance (species a—species b)	2.12	0.75	4.46	3.09

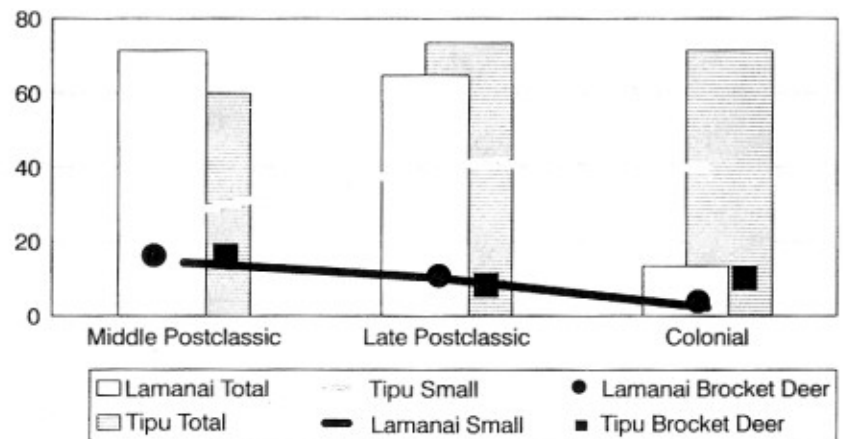
The Late Postclassic period shows an increasing disparity between the two sites in terms of both diversity of species represented and actual resources used. During the two hundred years between the Middle Postclassic period and the Late Postclassic, overall species heterogeneity at Lamanai drops dramatically as the result of a decreasing evenness of species representation and increasing species dominance as white-tailed deer becomes the most commonly used species at this site. Although mammals continue to dominate the sample, there is a slight reduction in their prominence and a generalized shift away from all smaller mammals with the exception of the domestic dog. Replacing the small mammals in importance are the avians, and in particular the turkey⁵ and curassow. The fishes also rise in importance, as do the turtles and riverine

5. The accurate identification of the ocellated (*Meleagris ocellata*) and common (*Meleagris gallopavo*) turkey is difficult and often possible only through detailed osteometric analysis. For this reason, all turkeys have been identified here as *Meleagris* spp.

Table 3.6. Ecosystem Use Distributions at Lamanai and Tipu.

	Middle Postclassic		Late Postclassic		Colonial		Total	
	eMNI	%	eMNI	%	eMNI	%	eMNI	%
Lamanai								
Canopy forest	0.50	3.85	25.00	23.72	10.50	5.22	36.00	11.27
Riverine	1.50	11.54	9.50	9.01	116.00	57.71	127.00	39.76
Shoreline	2.00	15.38	2.00	1.90	6.00	2.99	10.00	3.13
High bush	3.40	26.15	25.40	24.10	11.50	5.72	40.30	12.62
Cultivated land	1.90	14.62	26.30	24.95	51.00	25.37	79.20	24.80
Habitation	1.00	7.69	7.00	6.64	1.50	0.75	9.50	2.97
Pine ridge	2.20	16.92	9.70	9.20	4.50	2.24	16.40	5.13
Bajo	0.50	3.85	0.50	0.47	0.00	0.00	1.00	0.31
Tipu								
Canopy forest	8.00	16.67	40.00	29.01	74.00	21.96	122.00	23.33
Riverine	6.00	12.50	9.00	6.53	32.00	9.50	47.00	8.99
Shoreline	9.40	19.58	18.00	13.05	41.80	12.40	69.20	13.23
High bush	11.00	22.92	24.80	17.98	73.00	21.66	108.80	20.81
Cultivated land	7.60	15.83	22.60	16.39	52.30	15.52	82.50	15.78
Habitation	0.50	1.04	10.60	7.69	22.00	6.53	33.10	6.33
Pine ridge	4.50	9.38	11.90	8.63	35.40	10.50	51.80	9.91
Bajo	1.00	2.08	1.00	0.73	6.50	1.93	8.50	1.63

Figure 3.1 Frequency distribution of mammalian remains at Lamanai and Tipu (percentage of total MNI).



6. As a result of sporadic collection and inclusion (Pendergast, personal communication 1988), neither turtle carapace nor molluscan shell has been analyzed here, but large quantities of both turtle and *Pomacea flagellata* remains have been reported from Late Postclassic deposits at Lamanai (Pendergast 1986a; Emery 1990a), and undoubtedly their numerical inclusion in the analysis would provide evidence of a higher reliance on riverine resources than is reflected.

molluscs.⁶ Species with a high fidelity for secondary forest, cultivated land, and canopy forests occur with much greater frequency during the Late Postclassic at Lamanai, while resources from other ecosystems almost disappear.

In contrast, at the site of Tipu, overall species heterogeneity, richness, and evenness all rise to peak levels, while primary species dominance drops sharply. The brocket deer is replaced in dominance by a quartet of species—the armadillo, agouti, brocket, and white-tailed deer—and the prominence of agoutis and pacas suggests a much greater dependency on small mammals. As at Lamanai, there is a rise in species with high fidelity for secondary forest, cul-

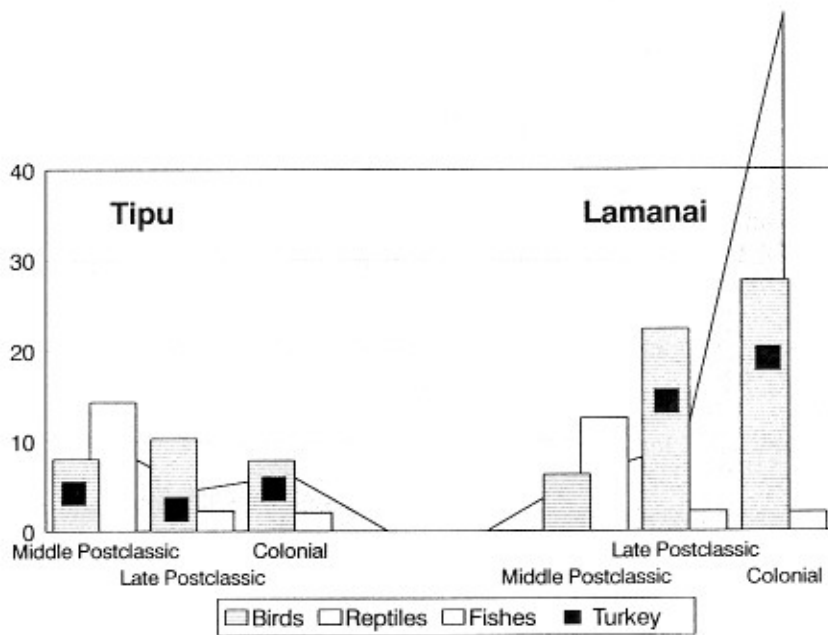


Figure 3.2 Frequency distribution of non-mammalian remains at Lamanai and Tipu (percentage of total MNI).

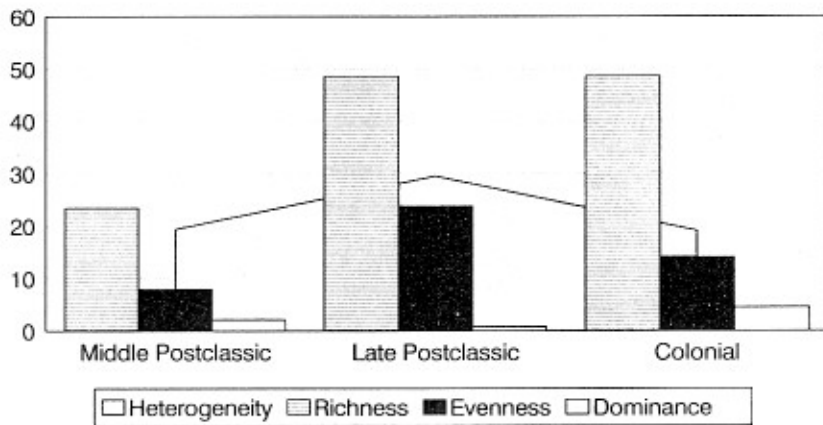


Figure 3.3 Tipu ecological community statistics of heterogeneity.

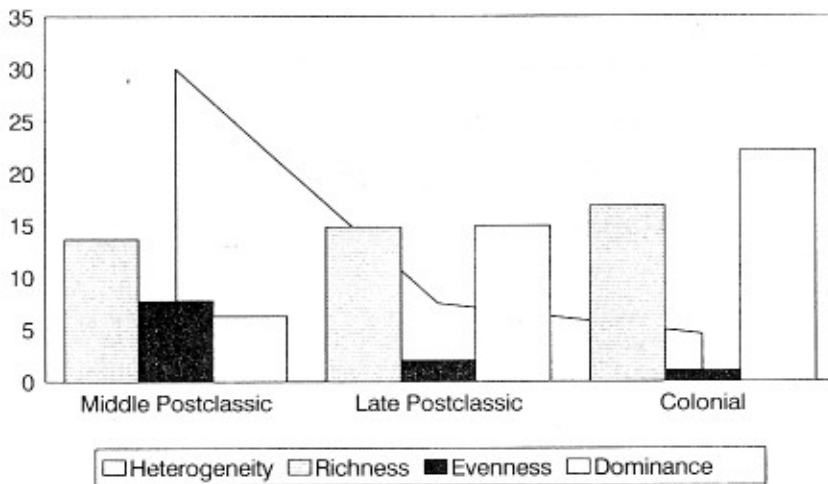


Figure 3.4 Lamanai ecological community statistics of heterogeneity.

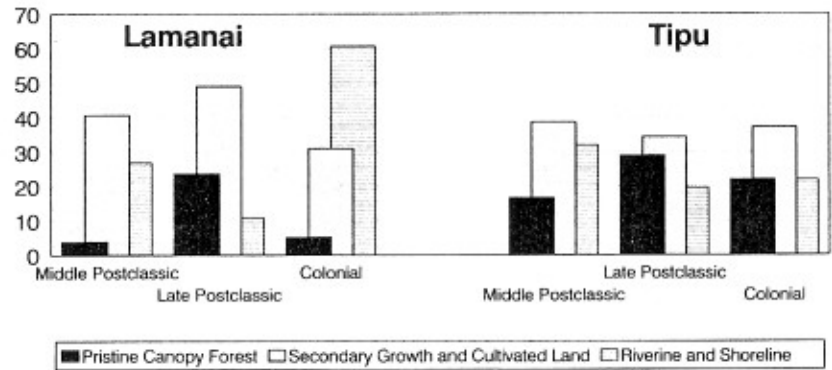


Figure 3.5 Ecosystem community associations at Lamanai and Tipu.

tivated land, and canopy forests; in contrast to the pattern at Lamanai, at Tipu the use of these resources does not indicate the exclusion of resources from other ecosystems.

During the Colonial period the faunal assemblages at Lamanai and Tipu reflect even more divergent subsistence patterns. At Lamanai the Postclassic trend of lowered diversity continues as heterogeneity and species evenness continue to fall. At the same time, species richness continues to rise despite the increasing dominance of a small number of species. Directly reminiscent of their Postclassic abundance, fish rise to an overwhelming dominance during the Colonial period. This rise is accompanied by a simultaneous increase in the importance of birds, again foreshadowed by their Postclassic frequency. Turkeys and curassows are more frequent, and several avian species appear for the first time. As a result of these two changes, riverine resources are overwhelmingly abundant while cultivated land is the only other ecosystem used to any extent. Animal use at Tipu during the Colonial period is reminiscent of the earliest Postclassic pattern of generalized resource use. Heterogeneity and species evenness fall as the armadillo becomes the focus of a clear concentration. Species richness, however, is higher than at any other time. Reflecting patterns from the Middle Postclassic, turtles rise in importance again, although this is not the case for other reptiles whose abundance dropped during the Late Postclassic. In an interesting parallel to Lamanai, turkeys rise to become the dominant avian species. At Tipu all the ecosystems are still used to a similar extent as in previous periods, and there is evidence for a rebound to a Middle Postclassic distribution in the use of species with high fidelity for secondary growth, riverine, and canopy forest ecosystems.

Trends in patterns of animal use over time at Lamanai and Tipu indicate that despite comparable heterogeneity at the two sites during the early phases of the Postclassic period, the diversity of utilized faunal species at Tipu remained high over time, whereas diversity at Lamanai dropped significantly during the Late Postclassic and continued to do so into the Colonial period. Stability over time at Tipu is reflected most prominently by the continuity in frequency of appearance of both avian species and the large mammals, particularly the peccaries and white-tailed deer, through time. However, an analysis of change in species richness and evenness over time shows that variation,

though slight, does occur at Tipu. In combination with an overall increase in both species richness and evenness, shifts in species dominance are obvious. The slight Middle Postclassic dominance of the armadillo and brocket deer shifts during the Late Postclassic to a lower primary species dominance as represented by a concentration on four codominant species. During the Colonial period there is a clear return, though, to the Middle Postclassic concentration on the armadillo as a dominant species. For the most part, during the Colonial period the Tipuans seem to have returned to an earlier pattern of concentration on a wide diversity of species, emphasizing small mammals and reptiles and, to a limited extent, fish.

Abundances remain relatively stable over time at Tipu, but they change quickly at Lamanai. The most dramatic differences in animal use appear in the Colonial period, characterized by a very high level of primary species dominance and a concentration on fish and birds. However, all the changes seen in the Colonial period at Lamanai are reflected by similar trends during the transition from the Middle to Late Postclassic period. Despite the fact that the overwhelming use of fish and the reduction in the use of large mammals at Lamanai seems to be a phenomenon of the Colonial period, this trend is also evident during the transition from the Middle to Late Postclassic period. Although the frequency of fish is much higher in the Colonial period, it has already begun to rise in the Late Postclassic period. As well, the increase in use of birds and decrease in use of reptiles and small mammals at Lamanai has its roots in the Postclassic period. Although the turkeys are much more frequent in the Colonial period than in any other period, both the turkeys and the curassow first appear at Lamanai in the Late Postclassic period.

An examination of the trends of change in the use of ecosystem resources over time emphasizes the lack of change at Tipu in most aspects, compared with the more dramatic nature of the shifts occurring at Lamanai. At Lamanai the use of resources from cultivated land and from the rivers increases over time, while the use of every other type of ecosystem decreases in frequency of occurrence in the archaeological record. The Lamanaians began to use the river systems and cultivated land resources to the virtual exclusion of all other resources. This is not the case at Tipu, where the use of the majority of resources does not change significantly and generalization of ecosystem use remains the rule.

Discussion

Patterns of both change and continuity are apparent in the Postclassic and Colonial period faunal assemblages from Lamanai and Tipu. Although there is chronological variability in the patterns of species and ecosystem use at both sites, there is clear evidence for continuity of animal use practices between the Postclassic and Colonial periods. The observed changes apparently are not the result of direct Spanish contact but are instead related to Postclassic patterns. Furthermore, although Lamanai and Tipu are environmentally similar, chronologically contemporaneous, and located within easy access of each other, the

faunal assemblages from the sites do not exhibit any similarity of diachronic variation.

Tipu is characterized by a marked heterogeneity of animal species use in combination with a highly generalized use of available ecosystems in all time periods. The frequent use of the most abundant species of the Tipu faunal assemblages (armadillo, deer, agouti, and paca), in combination with high species richness and a consistently low level of primary species dominance, is reminiscent of most lowland Mesoamerican sites. The patterns of species use are significantly different at Lamanai, where a steady decrease in heterogeneity of species use over time and a dramatic increase in primary species dominance are observed. During the Late Postclassic period at this site the primary species is the white-tailed deer, but this shifts to a clear concentration on fish and turkeys during the Colonial period.

Changes in animal and plant products use during times of societal stress have received relatively little theoretical consideration in Mesoamerican studies. Although these patterns are often analyzed with respect to the nutritional benefits and ecological adaptive value of varying strategies of the use of these products, their importance in the maintenance of external relationships through trade and tribute, and as a method of defining internal social relationships, cannot be ignored. The explanation for the chronological changes and regional variability seen in the Lamanai and Tipu zooarchaeological assemblages lies in an understanding of both the dietary and the social importance of the animal use strategies in each time period.

The Postclassic period saw the dramatic increase in Classic period patterns of maritime trade (Andrews 1990) and, coincident with it, a shift in Postclassic settlement focus toward coastal, riverine, and lacustrine shorelines throughout the southern Mesoamerican lowlands (Chase and Chase 1985). Considerable archaeological and ethnohistoric evidence shows that Lamanai and Tipu were active players in the increasing commercialism of the Postclassic period as a whole, and particularly the Late Postclassic. Both Lamanai and Tipu were also affected by the Postclassic population movements caused first by the Itza expansion and then by its eventual collapse, and both had been the recipients of large groups of Yucatecan Maya refugees during the Middle Postclassic and in the later half of the sixteenth century during the period of first Spanish contact in the northern peninsula (Graham 1991). These groups perhaps carried ideas and goods that had a major impact on the Postclassic economies of Lamanai and Tipu, causing changes in animal use practices during the transition between the Middle and Late Postclassic periods.

The appearance in Postclassic Lamanai deposits of trade goods from the Yucatán, Mayapan-style vessels, Tulum-style architectural constructions, and a new lithic technology characterized by small, side-notched arrowheads (Pendergast 1990) suggests the movement of both goods and ideas from the north. Although a secure identification of the Lamanai turkeys as wild or domestic was not possible, their frequency in the Late Postclassic deposits at Tipu and Lamanai and their later rise to dominance at Lamanai suggests that their presence may be the effect either of direct importation of the animals or of the idea of their importance by Yucatecan peoples.

A more significant arrival, though, is the bow and arrow technology, probably introduced at Lamanai in the Late Postclassic period, possibly in association with the arrival of Yucatecan refugees in the last half of the sixteenth century (Graham 1991). An interesting study of Lacandon Indian bow and arrow use indicates that several arrow types are specifically designed to shoot fish underwater and to kill birds in the tall-canopy forest (Nations and Clark 1983). The arrival of a new and more effective technology for the hunting of fishes and birds would certainly have affected the frequency of their appearance in the archaeological record. In contrast to the situation at Lamanai, the introduction of the bow and arrow seems to have been a Colonial phenomenon at Tipu (Graham 1991), and therefore the lack of a similar emphasis on these species at Tipu is not surprising.

That Lamanai was not just the passive receptacle for the diffusion of Postclassic northern traditions is emphasized by several important technological innovations at the site. Evidence for copper manufacturing and working (Pendergast 1990) and for the *in situ* development of new ceramic traditions (Graham 1987; Pendergast 1986a) suggests that Lamanai may have offered valuable commodities of its own to its trading partners. The Late Postclassic rise in fish suggests that this may have been another of those commodities.

In many cases the Postclassic settlement shift toward coast and shorelines was accompanied by a corresponding subsistence focus on aquatic resources as indicated by the presence of both aquatic faunal remains (e.g., Carr 1986; Pohl 1994; Scott 1982) and probable net weights in many archaeological deposits (e.g., Chase and Chase 1985). Several authors have suggested the importance of aquatic products as the primary protein source in the Late Postclassic period (Lange 1971; Wing 1977), and at the site of Lamanai, analyses of human bone isotope chemistry by Coyston et al. (this volume) indicate that fish were indeed an important resource during the Late Postclassic and Colonial periods. In association with their importance as subsistence resources during the Late Postclassic, the possibility of trade of piscine resources both out of sites (Hamblin 1984; Miller 1977; Mock 1997) and into them (Pollock and Ray 1957) has also been suggested by many authors. Located on the banks of an estuarine inland waterway teeming with freshwater and peripheral species, Lamanai would have been ideally situated for maximum access to both resources and trading systems. The rising frequency of fish in the archaeological record, in combination with the appearance in the Postclassic period of large numbers of standardized, fired-clay, ball net sinkers replacing the Classic period notched, reused pottery sherds (Pendergast, personal communication 1990), supports the probability of a change in the importance of fishing technologies at Lamanai during the Late Postclassic period. Certainly, the combination of human dietary studies (Coyston et al., this volume) and zooarchaeological evidence suggests that fish began to play a more significant subsistence role during this period.

It has also been suggested that one of the main foci of Postclassic commerce was an increasing demand for certain animal species for tribute and use as sacrificial victims (Pohl and Feldman 1982; White and Schwarcz 1989). Among these species are the turkey, cervids, turtles, and domestic dog. The evidence

for increasing frequencies of these species at Lamanai during the Late Postclassic period suggests they may have been traded as well, either out of or perhaps into Lamanai. Interestingly, there is no correlative evidence of rising frequencies of any of these possible tribute species at Tipu (Emery 1990a).

At the site of Lamanai, archaeological evidence for strong trade links with the politically vibrant northern Yucatán combines with evidence for increasing frequencies of animal species potentially valuable for subsistence and trade to suggest an active participation in the commercial network of the period that was dependent in part on these animals. At Tipu, where dietary heterogeneity seems to rise in the Late Postclassic, there is no evidence for any increase in the frequency of either fishes or the deer, dog, turkey, and turtles potentially important as trade items. At the same time, there is evidence at the site for a generalized reduction in all exotic species during the Late Postclassic period (Emery 1990a), indicating a reduction in contact with external, and particularly coastal, sources. The residents of Tipu were not participating in the trade of animal resources to the same extent as those at Lamanai. Possibly because of their stronger ties with the inland southern lowland polity, the residents of Tipu were not as active participants in the Yucatán-based trading systems; in fact, they reduced their trading circle to the extent that exotic resources were limited, relying instead on a continuing and even increasing diversity of local resources.

Both Lamanai and Tipu were occupied well into the period of Colonial Spanish contact. The first physical evidence for contact at Lamanai was the demolition in 1544 of a small Late Postclassic temple and the construction of a Christian church in its place (Pendergast 1986b, 1991). It was also at this time that Lamanai was brought under *encomienda* control (Jones 1985). A similar church was built at Tipu some 20 to 25 years later (Graham, personal communication 1987). The later construction at Lamanai of a second church on a much more European plan suggests an increase in both population (Pendergast 1986b) and Spanish presence at the site, which is supported by the ethnohistoric evidence for an increased use of the site for *reducciones* during this period (Pendergast 1991). At both sites, however, the Spanish presence probably did not exceed the periodic visitations characteristic of the Spanish *visita* (circuit riding) system.

The strong affiliation of the Lamanai and Tipu dietary practices with earlier Postclassic practices and the corresponding lack of discontinuity associated with the Colonial period are supported by isotopic (White and Schwarcz 1989), paleopathological (White et al. 1994), and archaeological evidence from the sites, suggesting that none of the basic patterns of existence at Lamanai or Tipu were significantly affected by the Spanish presence. Patterns of community organization (Pendergast 1986b), architectural construction, refuse handling, and ceramic and lithic production remained similar to earlier Postclassic patterns at Lamanai (Pendergast 1991). The ethnohistoric record defines an early and relatively peaceful incorporation of Christianity into the Tipu belief system, and this is supported by evidence for relatively strict Spanish control over community layout at this site (Graham 1991) as well as an incorporation of

Christian burial practices into the local system. Nevertheless, the considerable archaeological evidence for continuity with Postclassic patterns of building construction and local pottery and lithic production and use suggest that basic lifeways were relatively unaffected by the Spanish presence (Graham 1987). The lack of any zooarchaeological remains from European animals at either site is also consistent with the relative dearth of European goods in any Colonial deposits (Pendergast 1991). Despite ethnohistoric evidence suggesting the strict censoring and manipulation of traditional foods and eating habits with the arrival of the Spanish missionaries (Landa 1941), there is no evidence for a discontinuity in animal use patterns at either site. In total, the zooarchaeological evidence argues that direct Spanish influences on diet and other animal product use were transitory or nonexistent.

Changes in patterns of animal utilization occurred at both sites, however, and are particularly apparent at Lamanai. Zooarchaeological evidence from this site indicates a dependency on species with a high fidelity for riverine and cultivated land ecozones and the lack of the expected diversity of animal resources. These trends may be better understood with reference to the specifics of Colonial Tipu and Lamanai than as the result of direct Spanish intervention. Lamanai, located close to the Spanish center of control at Bacalar, functioned as a center for *reducciones* throughout its colonial history (Pendergast 1991) and was probably subject to the stresses of both population changes and unanticipated growth during this time. Zooarchaeological evidence from Lamanai indicating an expanded use of animal resources from agricultural land coincides well with the image of a population stretched to the limits of its resource availability, particularly in view of the limited experience of the newcomers in the manipulation of the Lamanai environment. The availability of both bow and arrow and fish netting technology, introduced during the Postclassic period, would have made the availability of the lagoon fishes an even more attractive dietary possibility. Finally, evidence from studies of skeletal health at Lamanai (White et al. 1994) indicating a decrease in overall health of the population during the Colonial period also supports the suggestion of Colonial period stress.

There is considerable evidence that the arrival of the Spanish signaled a disruption of the coastal trading systems so important during the Postclassic (Graham 1991), both as an effect of simple presence and through active attempts to disrupt the contacts between the Yucatán and the inland Itza peoples (Graham et al. 1985; Jones 1989). Lamanai, maintaining its vitality and rising in importance as a dominant center in the Chetumal province (Pendergast 1986b), undoubtedly remained active in the trade of important resources. It is during this period that fish remains are most abundant in the deposits at Lamanai. The inland location of Lamanai, well protected from the disruptive influence of the Spanish presence, and its continued access to peripheral fish species, left its residents ideally situated for the continuation and intensification of Postclassic patterns of fish use as a dietary species as well as in trade.

Tipu, always the more remote site, and one with less active Yucatán contacts even during the Postclassic period, remained a relatively stable community into which *reducción* populations were only infrequently introduced and at

which the patterns of life remained relatively uninterrupted (Graham 1991). The relative dietary stability at Tipu is reflected in studies of the Tipu skeletal population that indicate the maintenance of a high level of health even in the Colonial period at this site (Cohen et al. 1994).

Finally, some authors have suggested that choice of foods consumed may be less a passive response to external change than an active response to perceived societal changes (Kalcik 1984). Under Colonial conditions responses may be mediated by the extent to which prestige or even survival is attached either to the adoption of new ethnic or societal markers or to the conservation of old ones. The process of religious conversion in a missionizing situation is implicitly tied to changes in basic patterns of life involved in the maintenance of social cohesion, such as sexual practices, eating habits, and even village construction. Village pattern was often manipulated to conform to Spanish ideals, family affiliations were undermined through the outlawing of extended family residences and multiple marriages, and food and eating habits were strictly censured in many ways (Landa 1941). Kalcik's (1984) suggestion that food preferences are an active signifier of cultural and social identity is applicable to any situation in which that identity is threatened. Contact with missionizing Spaniards was a situation that severely threatened the Maya identity. The maintenance of Late Postclassic traditions of animal use at Lamanai, and the apparent return to earlier Postclassic subsistence patterns at Tipu, may signify a conscious return to traditional Maya foodways and identity.

Conclusions

The survival of both Lamanai and Tipu well into the Colonial period and the maintenance of their cultural integrity is evidence for the success of their very different strategies of animal utilization in the face of the extreme cultural stress of both the Postclassic and the Colonial periods in the southern Mesoamerican lowlands.

The benefits of dietary stability at Tipu and of variation in patterns of animal use at Lamanai may well have outweighed the costs accrued by the maintenance of these strategies. Seagraves (1974) has emphasized the advantages of environmental generalization for the preservation of cultural stability in times of external stress. At Tipu, where the diversity of species use is high at all times, the benefits of maintaining this stability in the face of several periods of dramatic cultural stress are clear.

At Lamanai economic benefits may have been the prime consideration. Maintaining and increasing a position of commercial strength provides a measure of safety during periods of cultural change, population movements, and resource stress. Cultural instability and flexibility may have been the rule throughout the Postclassic at Lamanai. This is indicated by the shifting use of both species and ecosystems, by the dramatic drop in overall heterogeneity of animal species used, and by the increasing reliance on primary dominant species. Seagraves (1974) would suggest that, in a situation of conflict with another culture, Lamanai would bear the losses. However, perhaps a position of

economic and possibly political strength would have counterbalanced the lack of resource generalization and buffered the effects of confrontation. As well, control of one of the most important routes of access between the coast and the inland jungles would have provided the Lamanaians with a strong bargaining position. In terms of cost, economic strength may have been a more effective adaptive strategy for the inhabitants of Lamanai than cultural stability through resource generalization.

Acknowledgments

This research is based on a master's thesis completed at the University of Toronto (Emery 1990a) and financially supported by that institution, an Ontario Graduate Scholarship, and various grants in the names of David Pendergast and Elizabeth Graham. A large proportion of the preliminary Tipu identifications were generously provided by Cathy Yasui and Polydora Baker. My thanks go to David Pendergast and Elizabeth Graham, who provided excavation opportunities at the sites of Lamanai and Tipu, access to the zooarchaeological samples, and most important, guidance and enthusiasm throughout the years of this research. Thanks also go to the three anonymous reviewers and Christine White, who provided both constructive criticism and editorial assistance.

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