A PRELIMINARY REPORT ON THE USE OF VERTEBRATE FAUNA AT TIKAL, GUATEMALA

Hattula MOHOLY-NAGY
University of Pennsylvania Museum

This paper summarizes preliminary research on unworked and worked vertebrate remains recovered by the Tikal Project of the University of Pennsylvania Museum between 1956 and 1969. The sample comprises over 25,000 unworked animal or unidentified remains, over 5700 human remains, nearly 1200 artifacts, and over 500 pieces of bone debitage. Thirty-one orders and 100 species were identified by experts. Nearly all of this material is fragmentary.

Most vertebrates came from the local low bush or *monte bajo* habitat. But as early as the Middle Preclassic period, fauna was imported from other areas, first for ritual purposes, but later for food during Late Preclassic and Classic times. Vertebrates, including humans, had technomic, sociotechnic, and ideotechnic functions. A ritual complex of animals and bone artifacts associated with the elite was especially prominent in offerings in caches and burials during the Classic period. Due to the generally poor preservation of bone, its concentration at the center of the city, and changes in vertebrate utilization through time, it is not possible to determine differences in meat consumption that were due to differences in social rank.

Fourteen seasons of excavation by the Tikal Project of the University of Pennsylvania Museum (Fig. 1) between 1956 and 1969 recovered a large collection of fauna, including unworked animal and human remains, and bone artifacts and the debitage created by their production. Because little has yet been published on the use of vertebrates at Tikal, it seemed useful to present a survey of the Tikal Project collections here.

I will briefly describe the nature of the sample and its classification, and then habitat types and associated species. The results of analysis of the spatial distribution of worked and unworked bone throughout the settlement, tentative social correlates suggested by the nature of the associated structure groups, and excavation contexts and ascribed cultural functions follow. I conclude with a summary

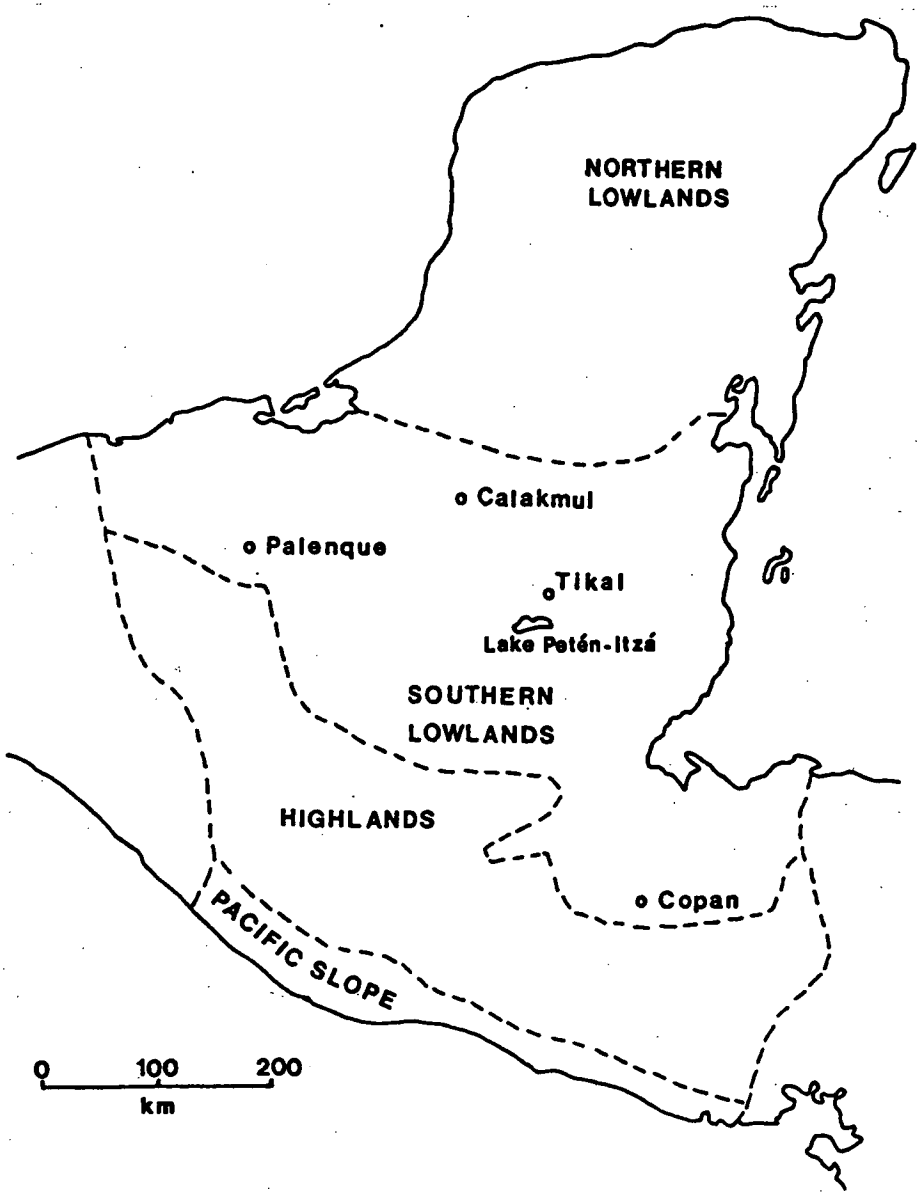

FIG. 1.—Map showing the location of Tikal.

of vertebrate use during the approximately 1500 years of permanent settlement, divided into major epochs of Middle Preclassic, Late Preclassic, Classic, and Terminal Classic periods (Fig. 2).

Period	*Long Count*	*Date*	*Ceramics*
Early Postclassic			Caban
		950 A.C.	
Terminal Classic			Eznab
	10.3.0.0.0	889 A.C	
Late Classic			Imix
	9.13.0.0.0	692 A.C	
Intermediate Classic			Ik
	9.6.0.0.0	554 A.C.	
Early Classic			Manik
	8.11.0.0.0	250 A.C.	
Protoclassic			Cimi
		150 A.C.	
Late Preclassic (late)			Cauac
		1 A.C.	
Late Preclassic (early)			Chuen
		350 B.C.	
Middle Preclassic (late)			Tzec
		600 B. C.	
Middle Preclassic (early)			Eb
		800 B.C.	

FIG. 2.—Chronological chart.

THE SAMPLE

CLASSIFICATION

I classified the recovered faunal remains into four groups according to their past use and the way they were handled in the field laboratory: unworked human remains, unworked animal and undentified remains, artifacts and ecofacts, and debitage.

STRENGTHS AND WEAKNESSES

The sample should be considered as biased in favor of humans and larger mammals, such as white-tailed deer, peccaries, and dogs. Preservation of bone

was not good, particularly in general excavations, that is, in middens and construction fill. Poor preservation does not appear to be related to the soil, which is slightly alkaline (Pohl 1976: 26, 81), but is probably due to the humid climate and to cultural factors, including the use of animals as food, ancient site maintenance practices, and the presence of dogs. Furthermore, only special deposits, that is, burials, votive caches, and deposits of problematical nature, were screened. Fragile, especially non-mammalian, remains are almost certainly underrepresented.

Another serious problem is that we did not have a standardized way of handling unworked faunal material once it reached the field lab. It was not weighed and it was not counted in a consistent manner. Most human and animal skeletons from special deposits were usually, but not invariably, counted as one unit. Individual bones, teeth, or bone fragments from general excavations, however, were also counted as one unit without trying to determine the minimum number of individuals present. This situation naturally poses serious difficulties in attempts to compare the relative importance of different kinds of species. Data are better for bone artifacts, which were always counted individually. Like other kinds of material culture, artifacts recovered from special deposits were usually complete, while artifacts recovered from general excavations were usually incomplete and in fragments.

On the other hand, the strengths of the collection are its considerable size and diversity, and excellent control of provenience, recovery context, and chronology.

Size and Diversity of the Collection

Of the total sample of over 33,000 bones, teeth, spines, scutes, antlers, carapaces, and eggshells, over 25,000 were unworked animal and unidentified remains and over 5700 were unworked human remains. There were almost 1200 bone artifacts, mostly incomplete, and over 500 pieces of production debitage.

Experts identified 31 orders and 100 species in the sample. These can be conveniently grouped into seven material categories (Fig. 3):

(1) somewhat over one-third of the unworked remains were non-human mammals, and about one-fourth of these were bats, rats, mice, gophers, and shrews that appear to have entered archaeological context on their own or as owl pellets.

(2) a little less than a quarter were human. Human remains were found in all kinds of recovery contexts at Tikal, not just special deposits.

(3) somewhat over one-fifth could not be identified.

These three categories account for approximately 80% of the recovered unworked bones. The remaining 20% of identified occurrences, in order of importance, were

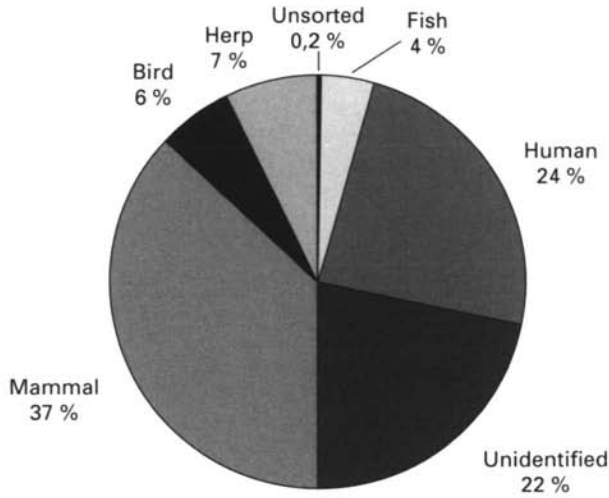

FIG. 3.—Percentages of material categories of the unworked bone sample.

(4) amphibians and reptiles
(5) birds
(6) fishes, overwhelmingly the tail spines of stingrays placed in special deposits, and
(7) eight occurrences of unsorted, unworked faunal remains.

Besides the unworked remains, approximately 1195 artifacts and approximately 520 pieces of debitage were recovered.

HABITATS AND ASSOCIATED SPECIES

Following the work of Mary Pohl (1976: 44-45) I have assumed that five types of habitats existed in the immediate area of Tikal during most of its occupation:

(1) high bush or *monte alto*, the undisturbed forest
(2) low bush or *monte bajo*, including fallowed fields
(3) seasonally flooded land or *bajo*, characterized by dense vegetation and few animals
(4) aquatic habitats, the natural and artificial waterholes or *aguadas* of Tikal, which has no permanent streams
(5) densely forested margins of aquatic habitats

Furthermore, vertebrates were also brought to the site from at least four other habitats:

(6) the savannas of the Central Petén to the southwest of Tikal, a region of grassland dotted with clumps of trees

(7) larger, permanent water sources, such as the rivers and streams at the peripheries of the Petén, and lakes such as Lake Petén-Itzá, a day's walk from Tikal

(8) cloud forests of the Guatemalan Highlands, the home of the quetzal

(9) the Atlantic Ocean, particularly the coast of Belize, which produced small, but steady quantities of marine fishes of predominantly ritual function.

Most of the vertebrates identified from archaeological context came from the low bush, but some animals, especially game mammals, are not habitat specific (Pohl 1976: 137). Identified species whose preferred habitat is low bush included white-tailed deer (*Odocoileus virginianus*), collared peccary (*Dicotyles tajacu nigrasens*), howler monkey (*Alouatta villosa*), hispid pocket gopher (*Heterogeomys hispidus yucatensis*), puma (*Felis concolor*), ocellated turkey (*Agriocharis ocellatus*), and blue-crowned motmot (*Momotus momota*). Together with the domestic dog (*Canis familiaris*), they comprised most of the vertebrate remains recovered from general excavations.

Identified vertebrates whose preferred habitat is the high bush included brocket deer (*Mazama americana*), white-lipped peccary (*Tayassu pecari ringens*), spider monkey (*Ateles geoffroyi*), and great curassow (*Crax rubra*).

Animals that prefer densely forested water margins included spotted cavy (*Cuniculus paca*), agouti (*Dasyprocta punctata yucatanica*), armadillo (*Dasypus novemcinctus*), common opossum (*Didelphis marsupialis*), four-eyed opossum (*Philander opossum*), and tapir (*Tapirus bairdi*).

Local aquatic habitats provided crocodiles (*Crocodylus sp.*), several types of turtles, and small freshwater fishes.

Among the exotic vertebrates identified at Tikal, iguanas (*Ctenosaura similis*) and rabbits (*Sylvilagus sp.*) were obtained from the savanna, other species of crocodiles, *blanca* turtles (*Dermatemys mawei*), and at least two kinds of catfish (*Rhamdia guatemalensis* and *Ictalurus sp.*) came from larger permanent sources of water, quetzals (*Pharomachris mocinno*) came from the Guatemalan Highlands, and stingray spines and occasional whole stingrays (*Dasyatis say*), dermal spines of porcupine fishes (*Diodon sp.*), sawfish nose barbs (*Pristis sp.*), and at least the pharyngeal grinders of stoplight parrotfishes (*Sparisoma viride*) came from the Atlantic.

Although I feel it is quite likely that Tikal also imported some ready-made bone artifacts, I have, as yet, no firm evidence for this. On the other hand, the presence of debitage demonstrates that local production of artifacts from animal and human bone was carried on from Middle Preclassic into Terminal Classic times.

RESULTS OF ANALYSIS

Spatial Distribution

In order to study the spatial distribution of material culture at Tikal, an extensive settlement of more than 16sq km, I divided the site into 26 concentric zones, centered on Square 5D of the Tikal Map (Carr and Hazard 1961), the civic-ceremonial heart of the city during most of its occupation (Coe 1990). Zone 1 has a radius of 0.25 km. Zones 2-26 each have a radius of 0.5 km (Fig. 4). Zone 0 refers to finds without provenience and Zone 99 to finds from sites beyond the limits of the Tikal National Park.

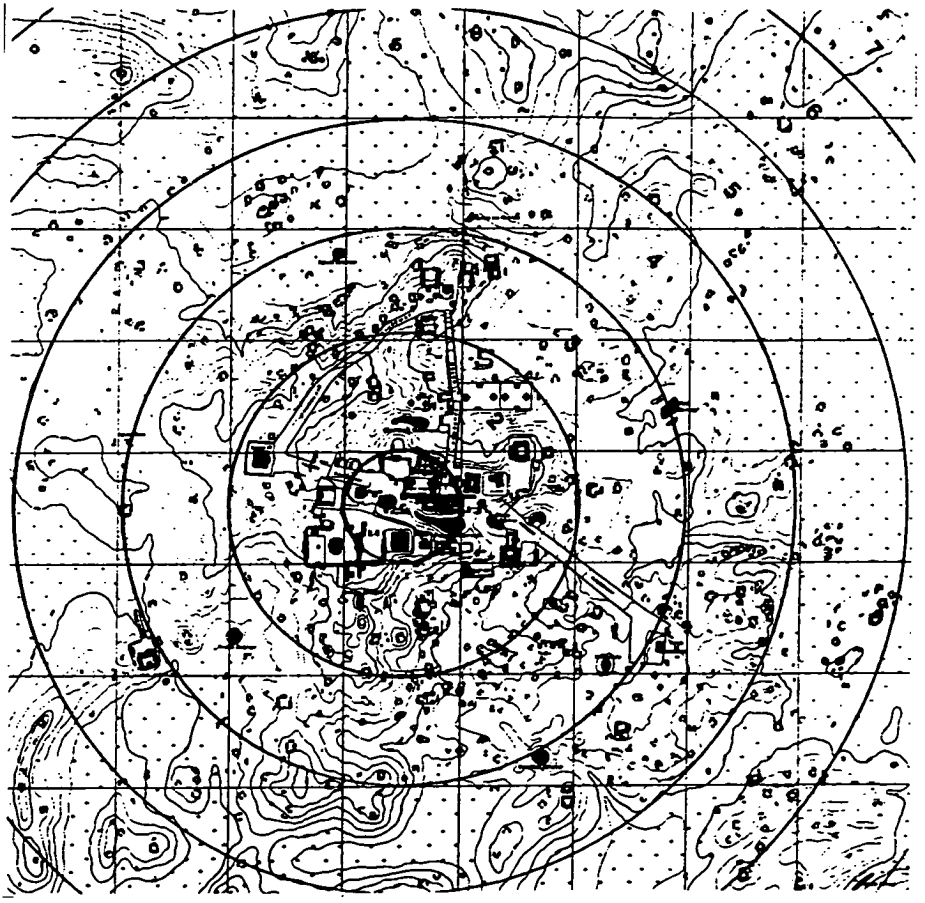

Fig. 4.—Concentric half-kilometer zones superimposed on the map of Tikal.

One of the most interesting features of the spatial distribution of unworked and worked bone is their concentration at the center of the settlement (Fig. 5). More than 99% of the entire sample was excavated from Zones 1-5, which included 84% of all the lots excavated by the Tikal Project. 0.5% of the sample came from Zones 6-26, which included 16% of excavated lots. A similar distribution of bone was noted for Copan (Webster and Gonlin 1988: 187-188).

Unworked remains, as expressed in occurrence per excavated lot, declined rapidly from the center towards the periphery of the site. Several zones produced no bone at all. Worked bone, however, was relatively more frequent in Zone 3, an area of fairly dense settlement. Zone 2 produced the most debitage, almost all of it from one large Late Classic to Terminal Classic midden in Twin Pyramid Complex 5C-1 (Jones 1969: 23).

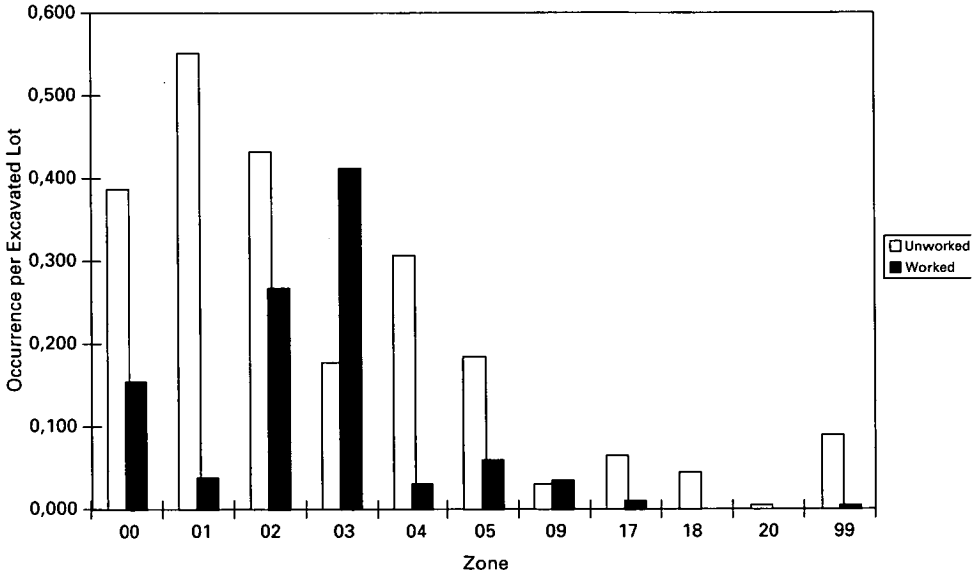

FIG. 5.—Relative frequencies of unworked and worked bone by zone.

STRUCTURE GROUPS AND SOCIAL CORRELATES

We have accepted the assumption that variability in architecture differences in function (e.g., Harrison 1970) and that variability in residential architecture indicates differences in social rank (e.g., Chase and Chase 1992). Five types of structure groups may be distinguished by the Early Classic period:

(1) non-residential Civic-Ceremonial Groups, such as Group 5D-2 comprising the North Acropolis and Great Plaza (Coe 1990) or Twin Pyramid Groups (Jones 1969).

(2) Range Structure Groups, such as Group 5D-11, the Central Acropolis (Harrison 1970), composed predominantly of multi-roomed range-structures or palaces, the residences of Tikal's elite.

(3) Intermediate Structure Groups, such as Group 7F-1 (Haviland 1981) or Group 6D-V (Iglesias 1987), the residences of lower ranking elite.

(4) Small Structure Groups, such as Groups 4F-1 and 4F-2 (Haviland 1985), the most numerous type at the site, thought to have been the residences of most of Tikal's inhabitants.

(5) Minor Centers, such as Uolantun (Puleston 1983: Fig. 12), found only Tikal's Peripheral Area (Coe and Haviland 1982: Fig. 14). These structure groups, which appear to have functioned as administrative nodes, include temples, range structures, small structures, and occasionally stone monuments. I have assumed they had a socially heterogeneous population that would have included social ranks ranging from minor elite to commoners and slaves. But because of their peripheral position, their excavated bone inventories are very meager.

In the city's central area, that is, in Zones 1 through 5, the unworked and worked vertebrate remains found in Civic-Ceremonial, Range Structure, and Intermediate Structure Groups differ notably in quantity and diversity from those found in Small Structure Groups. This is primarily due to the circumstance that by the Classic period these groups form a continuum with regard to the frequency and elaboration of the special deposits associated with them.

Burials were associated with all of these groups, but those placed in Civic-Ceremonial Groups were by far the most elaborate. Nearly all of the stone monuments, and the caches placed with monuments and with temples, were encountered in Civic-Ceremonial Groups. Caches were occasionally placed in temples and range structures in Range Structure and Intermediate Structure Groups. They are extremely rare in Small Structure Groups.

Besides the contents of their associated special deposits, Civic-Ceremonial Groups also produced a diverse inventory of unworked and worked bone from construction fill, much of which consisted of redeposited middens carried in from nearby residential structure groups. Bone also came from household middens deposited after the original ceremonial function of a group had been abandoned, for example, the large deposit of debitage from Civic-Ceremonial Group 5C-1, mentioned above.

As to the question of whether there were differences in meat consumption that can be related to inequalities in socioeconomic status (e.g., Shaw 1991), I feel

that, at present, there are not enough data to make an accurate assessment of three important variables. The greatest problem is the uneven spatial distribution of osseous remains. This means, for example, that low ranking Small Structure Groups towards the center of Tikal, produced more food animal remains than presumably higher ranking Minor Centers on the peripheries. Furthermore, the social rank of some structure groups appears to have changed over time in ways that we did not detect in the architecture. For example, the burials associated with Small Structure Group 6E-1 indicated that its residents were of higher rank in Late Preclassic times than they were during the subsequent Classic period when the detectable buildings were constructed. Finally, as I will explain below, reliance on different animals seems to have shifted over time. Therefore, the composition of a recovered bone sample may well have been more influenced by its date than the rank of the consumers.

What we can say at this point is that residents of the central part of Tikal as a whole, regardless of their social rank, appeared to have had access to all major food animals, including white-tailed deer.

Recovery Context and Function

Some kinds of unworked vertebrates and bone artifacts were associated with different recovery contexts, which implies that they had different cultural functions.

A complex of animal species and bone artifacts began to take on ideotechnic function by the later Middle Preclassic period, indicated by their almost exclusive occurrence in burials and in deposits of problematical nature. This ideotechnic and sociotechnic complex is discussed in more detail below. It became more prominent during the Late Preclassic period in the structure caches and chamber burials of Tikal's early ruling elite, and it continued to gain in importance in the Classic period. The general impression, at all times, is that the animals offered (Fig. 6) were not usually eaten, and that the artifacts had no secondary technomic function. During the Classic period artifacts associated with persons of lower rank occurred in simple burials, burials of problematical nature, and general excavations. At present no unworked animal remains can be confidently identified as markers of low rank, in constrast to vertebrates like the quetzal or the jaguar, which were markers of high rank.

Other kinds of artifacts found in general excavations and deposits of problematical nature are considered to have had primarily utilitarian function. These include various kinds of awls, needles, awl-like object with spatulate ends, flakers, centrally-perforated disks, *pulidores* that were made of longbones with one cut, usually beveled and worn end, and atlatl finger-grips.

Vertebrate	Burials	Chamber Burials	Structure Caches	Monument Caches	Also in General Excavations
Stingray spines	LP-IC	LP-LC	EC-LC		
Porcupine fish spines			EC-LC		
Unidentified fish				EC-LC	
Sawfish nose barbs			LC		
Marine toad	LC				LP-EC
Iguana	LC		EC		C-TC
Snake	IC-LC		EC-IC	EC, LC	C-TC
Turtle (local)		EC	EC		LP-TC
Turtle (blanca)		EC	EC		PrC-TC
Crocodile		EC	EC		EC-LC
Turkey		EC			IC-TC
Quail		LP-EC			EC-TC
Other Birds	TC	EC	EC		LP-TC
Humans	MP-TC	LP-LC	LP-IC	EC-LC	MP-TC
Armadillo scales	LC				LC-TC
Deer		EC-LC			MP-TC
Jaguar		IC-TC			TC
Dog			LP		MP-TC

MP: Middle Preclassic; LP: Late Preclassic; C: Classic; PrC: Protoclassic;
EC: Early Classic; IC: Intermediate Classic; LC: Late Classic; TC; Terminal Classic.

FIG. 6.—The occurrence of numerically important vertebrates in special deposits.

CHRONOLOGICAL SUMMARY

THE MIDDLE PRECLASSIC PERIOD

Vertebrates were used throughout the entire span of occupation of Tikal, from early Middle Preclassic into Terminal Classic times. They were an important source of food at all times. They also provided the raw materias for a craft industry carried on by specialists. Debitage indicates local production.

The few excavation lots that contained materials of unmixed Middle Preclassic date came primarily from test pits, chultuns, and construction fill. There were also problematical deposits and burials in simple graves.

Humans, dogs, rodents, and white-tailed deer were identified among the unworked bones from general excavations. All of these species continued to occur throughout the occupation of the settlement.

A stingray spine occurred with PD. 88, a burial of problematical nature of late Middle Preclassic date. This spine is the earliest occurrence of marine fishes at Tikal. The bringing in of marine fishes, or parts thereof, for ritual purposes became increasingly important in subsequent periods, until the end of the Late Classic period. Over 90% of all recovered marine fish remains consisted of stingray spines from special deposits of all periods, from the Middle Preclassic to the end of the Late Classic. Stingray spines appear to have been used only for blood-letting rituals, and they were placed with some types of burials, structure caches, and problematical deposits from the Middle Preclassic until the end of the Late Classic period.

Little worked bone was recovered, but fragments of tubular beads made from sections of animal longbones, tubes, awl-like objects with spatuate ends, and debitage were already present.

The Late Preclassic Period

Excavation lots of the Late Preclassic and Protoclassic period came predominantly from construction fill and chultun fill. There was a minor amount of undisturbed midden material. Besides the simple burials and various kinds of deposits of problematical nature that were made throughout Tikal's occupation, special deposits now included the first chamber burials, structure caches, and special-purpose lithic dumps made in chultuns and around the exteriors of some chamber burials.

In addition to the species already present in Middle Preclassic times, Late Preclassic general excavations also included various kinds of birds, marine toad, snakes, lizards, turtles, brocket deer, agouti, opossum, ocelot, pocket gopher, collared peccary, rabbit, and tapir. Vertebrates probably imported for food appeared toward the end of this period and included *blanca* turtles from permanent rivers, iguanas from the savanna, and parrotfish, identified from pharyngeal grinders, from the Atlantic coast. The use of turtles and dogs as meat may have peaked at this time, but given the nature of the collection, it is hard to be sure.

The earliest occurrence of birds, either body parts or entire skeletons, in the burials of high ranking persons dates to this time. The longbone of a black-throated bobwhite (*Colinus nigrogularis*) was found in Burial 166, dated to the late Late Preclassic period. This tradition peaked in the Early Classic, but was still practiced in Terminal Classic times.

New bone artifact types appearing now included presumably utilitarian items such as awls and bodkins, pins and needles, and flakers, as well as markers of social rank such as earspools, clasps for multistrand *Spondylus* bead bracelets, centrally perforated bone disks, and perforated animal canines, mostly of dogs, but also including jaguar and peccary. Bone earspools and clasps apparently went out

of vogue by the end of the period, but perforated disks were used through Intermediate Classic times and perforated animal canines until the abandonment of the city.

The Classic Period

Most of the recovered material culture from Tikal pertains to the approximately 600 years of the Classic period. The proportion of material from undisturbed middens increased, while that from construction fill declined. Monument caches appeared at the beginning of the period and continued in a fairly standardized form until the end of the Late Classic and the so-called Lowland Maya Collapse. Structure caches, on the other hand, seem to have peaked in significance during the late Early Classic and Intermediate Classic periods.

During the Early Classic period the high-status ritual complex associated with the elite included worked and unworked stingray spines, imitation stingray spines carved from the bones of terrestrial mammals, the remains of other marine fishes such as porcupine fishes, reptiles such as crocodiles, turtles, and venomous snakes, several species of small birds, worked and unworked deer phalanges, rare bone «Charlie Chaplins» (i.e., small cutout figurines), and small bone sculptures. Late Classic additions to this complex included sawfish nose barbs, jaguar paws used as mittens and boots by royal dancer-impersonators (Culbert 1993: Fig. 81 a), sets of worked bones, some of them engraved with pictures and hieroglyphs, and tweezers with shell overlays, while deer phalanges and Charlies no longer occur. Of special interest is the lack of diversity in vertebrate remains from monument caches, which included no worked bone, and only vertebrae from unidentified fishes, vertebrae from venomous snakes like the fer-de-lance and rattlesnake, and human remains, mostly of subadults.

New types of sociotechnic artifacts associated with low rank that appear in Classic period simple burials and problematical deposits include pendants of various forms, inlays, ladles, tubes, and rasps.

New species identified in general excavations include ocellated turkey and other large birds such as guan, curassow, chachalaca, and motmot, and mammals such as howler monkey, spider monkey, spotted cavy, armadillo, white-lipped peccary, puma, anteater, and gray fox. A late Early Classic problematical deposit in Group 6C-1 included an unusual group of meat-eating birds: turkey vulture (*Cathartes aura*), roadside hawk (*Buteo magnirostris*), gray hawk (*Buteo nitidus*), great black hawk (*Buteogallus urubitinga*), and common black hawk (*Buteogallus anthracinus*). During the course of the Classic, there seems to have been increased emphasis on deer and large birds as sources of meat.

Cut pieces of flatbone of uncertain use, tie rods for the curtain holders on masonry range structures, and *pulidores* were among the new types of artifacts of uti-

litarian function that appeared during the Classic period. Where identifications were possible, it was found that many utilitarian and ceremonial artifacts, as well as debitage, were of human bone.

The Terminal Classic Period

The post-Collapse Terminal Classic period is well represented in the Tikal sample. Approximately 90% of remains of this period came from middens found on the floors of range structures in the central part of the site, for example, in Groups 5D-10 and 5D-11, and was, therefore, fairly well preserved. It included unworked and worked bone, including debitage. Some bone was also recovered from burials and problematical deposits. By this time the erection of stone monuments and large masonry buildings had ceased, and the chamber burials and cached offerings associated with them also vanished.

Unworked Terminal Classic materials from general excavations, show continuity with those of the Late Classic with no numerically important additions or losses. Birds identified as ocellated turkey and roseate spoonbill (*Ajaja ajaia*) had been included in two problematical deposits that also included the remains of children.

Permanent occupation of the city is thought to have ended around the middle of the tenth century. The few items of material culture that can be dated to the Early Postclassic period are generally regarded as evidence of transient and sporadic activity (e.g., Culbert 1993: Fig. 98 g; Haviland 1985: 97).

REFERENCES

Carr, Robert F. and James E. Hazard (1961). *Map of the Ruins of Tikal, El Petén, Guatemala.* Tikal Report 11. University Museum. University of Pennsylvania. Philadelphia.

Chase, Diane Z. and Arlen F. Chase (Eds.) (1992). *Mesoamerican Elites: An Archaeological Assessment.* University of Oklahoma Press. Norman.

Coe, William R. (1990). *Excavations in the Great Plaza, North Terrace, and North Acropolis of Tikal.* Tikal Report 14. University Museum. University of Pennsylvania. Philadelphia.

Coe, William R. and William A. Haviland (1982). *Introduction to the Archaeology of Tikal, Guatemala.* Tikal Report 12. University Museum. University of Pennsylvania. Philadelphia.

Culbert, T. Patrick (1993). *The Ceramics of Tikal: Vessels from the Burials, Caches, and Problematical Deposits.* Tikal Report 25, Part A. University Museum. University of Pennsylvania. Philadelphia.

Harrison, Peter D. (1970). *The Central Acropolis, Tikal, Guatemala: A Preliminary Study of the Function of Its Structural Components During the Late Classic Period.* Ph. D. Dissertation in Anthropology, University of Pennsylvania. University Microfilms. Ann Arbor.

HAVILAND, William A. (1981). Dower Houses and Minor Centers at Tikal, Guatemala: An Investigation into the Identification of Valid Units in Settlement Hierarchies. In *Lowland Maya Settlement Patterns*. Ed. W. Ashmore, pp. 89-117. University of New Mexico Press. Albuquerque.

—— (1985). *Excavations in Small Residential Groups of Tikal: Groups 4F-1 and 4F-2*. Tikal Report 19. University Museum. University of Pennsylvania. Philadelphia.

IGLESIAS PONCE DE LEÓN, María Josefa (1987). *Excavaciones en el Grupo Habitacional 6D-V, Tikal, Guatemala*. Ph.D. Dissertation, Departamento de Historia de América II (Antropología Americana), Facultad de Geografía e Historia, U.C.M. Editorial de la Universidad Complutense de Madrid.

JONES, Christopher (1969). *The Twin-Pyramid Group Pattern: A Classic Maya Architectural Assemblage at Tikal, Guatemala*. Ph. D. Dissertation in Anthropology, University of Pennsylvania. Philadelphia.

POHL, Mary (1976). *Ethnozoology of the Maya: An Analysis of Fauna from Five Sites in the Peten, Guatemala*. Ph. D. Dissertation, Department of Anthropology, Harvard University. Cambridge.

PULESTON, Dennis E. (1983). *The Settlement Survey of Tikal*. Tikal Report 13. Ed. William A. Haviland. University Museum. University of Pennsylvania. Philadelphia.

SHAW, Leslie C. (1991). *The Articulation of Social Inequality and Faunal Resource Use in the Preclassic Community of Colha, Northern Belize*. Ph. D. Dissertation in Anthropology, University of Massachusetts at Amherst.

WEBSTER, David L. and Nancy GONLIN (1988). Household Remains of the Humblest Maya. *Journal of Field Archaeology* 15: 169-190.