RICE RATS AND SALADOID PEOPLE AS SEEN AT HOPE ESTATE

Elizabeth S. Wing

ABSTRACT

Rice rats (Oryzomyini) are a common element of Lesser Antillean sites and are particularly abundant in early ceramic sites. Data from one such site, Hope Estate (SM026) on St. Martin, provide information on the sustainability of these animals to an extended period of human predation. Rice rats increase in relative abundance throughout the occupation of almost 1000 years. A demographic shift from predominantly adult to relatively more juvenile individuals takes place during this time period. I interpret this change to be the response of the density dependent rodent population to human predation. No evidence for overexploitation, such as a decline in size of the rice rats or decrease in their relative importance in the faunal assemblage, can be demonstrated.

RESUMEN

Las ratas arroceras (Oryzomyini) constituyen un elemento común en los sitios de Antillas Menores, y son particularmente abundantes en sitios cerámicos tempranos. Datos de uno de estos sitios, Hope Estate (SM026) en St. Martin, proveen información sobre la sostenibilidad de estos animales por un extenso período de predación humana. La abundancia relativa de ratas arroceras se incrementa a traves de la ocupación de casi 1000 años. Durante este período se registra un cambio demográfico desde individuos predominantemente adultos a individuos relativamente más juveniles. Yo interpreto este cambio como una respuesta de la densidad dependiente de las poblaciones de ratas a la predación humana. Evidencia de sobre-explotación, como una declinación en el tamaño de ratas arroceras o disminución de la importancia relativa de éstas en la comunidad faunística del sitio, no puede ser demostrada.

RÉSUMÉ

Les rats de riz (Oryzomyini) sont un élément commun aux sites des Petites Antilles. Ils sont abundants particulièrement aux premiers sites céramiques. Las données d'une de ces sites, Hope Estate (SM026) à St. Martin, donne d'information sur le maintien de ces animaux à une période étendue de chasse humaine. Les rats de riz augmentent en abundance rélative partout l'habitation de presque mil ans. Pendant cette période il y a un changement démographique d'une prédominance des adultes jusqu'à rélativement plus de jeunes individus. J'interprète ce changement comme une réponse de la populations des rongeurs, dépendant de leur densité, à la chasse humaine. On ne peut pas démontrer d'évidence pour une exploitation trop grande, comme un déclin des formats des rats de riz ou une diminution de leur importance rélative dans l'assemblage des animaux.

KEYWORDS: Rice rats, Exploitation, Zooarcheology.

INTRODUCTION

Two basic observations have been made with respect to the faunal remains associated with Caribbean archaeological sites. They are that the earliest ceramic period deposits, known as the Saladoid period, contain a greater relative abundance of terrestrial vertebrate (Wing 1989) and land crab remains (Rainey 1940) than later ceramic period sites. Many of these early site are located further inland even though this distance is only in the order of about 2 km. These two characteristics are related as conservation of energy, basis of catchment analysis, would predict greatest exploitation of those resources closest to the habitation site. One explanation put forth for what it is interpreted as a decline in the exploitation of these terrestrial resources in later sites is that these resources could not withstand the ever increasing predation by growing human populations during the ceramic period occupation of the West Indies. We have the opportunity to examine one aspect of this predation through study of the remains of rice rats associated with almost 1000 years of occupation at the Hope Estate Site located on the island of St. Martin in the northern Lesser Antilles (Figure 1).

The Hope Estate Site is an excellent site for faunal analysis with abundant well preserved animal remains. The site is situated at about 50 m elevation and approximately 2 km from the northwest coast of St. Martin. Faunal remains are well preserved over a long period of occupation which was essentially uninterrupted from 560 B.C. to A.D. 460.

The primary subjects of this study are the rice rats and their association with the entire fauna throughout the occupation of the site. The rice rats belong to the tribe Oryzomyini and are members of an undescribed species that is now extinct. They are smaller than the large West Indian rice rat belonging to the genus *Megalomys.* A review of the taxonomy of the West Indian rice rats is now under way by Michael Carleton, Smithsonian Institution, and until this is done I will refer to the small species only as oryzomyines. Since all West Indian rice rats are now extinct, we have to rely on general characteristics of living species to reconstruct their behavior and their reproductive potential as a prey species.

The species of rice rats that is well studied is the marsh rice rat, *Oryzomys palustris* (Nowak 1991; Wolfe 1982). Its range extends throughout southeastern United States where it prefers wetland environments and meadows. They are short lived, not living much more than a year (Negus et al. 1961). They reach sexual maturity as soon as 50 days of age and may have as many as six litters in their short life time (ibid.). Litter size is density dependent. Field studies of rice rats on Breton Island, Gulf of Mexico, demonstrated that during a period of high population density the mean litter size was 3.7 (2 - 5) whereas when populations had declined mean litter size was 6 (4 - 7) (ibid.). The general characteristics of the marsh rice rat as a short lived animal capable of producing many litters with numbers of young per litter dependent on population density and with a preference for moist habitats may also apply to the West Indian species.

With these characteristics in mind, my expectations are that over exploitation of rice rats during the 1000 years of occupation at Hope Estate would result in the following changes: 1. a relative decrease in rice rats in the total vertebrate fauna; 2. a relative increase in young animals in response to decreased population density; and 3. a decrease in size as a result of selection of larger individuals.

MATERIALS AND METHODS

Faunal samples were recovered during the excavation of the site in 1988 by Jay Haviser (1991). Faunal remains excavated by him from test units T20, A3, and A5 form the basis of this paper. Units A3 and A5 are from the primary midden area sector XVII and unit T20 is from the secondary midden in sector XXII. The material was recovered by sieving with 2.8 mm gauge screen. This size screen is adequate for recovery of most small animal remains so sieving is not expected to have biased the results significantly. Fewer rodent cheek teeth are found than expected based on the numbers of mandibles and maxilla that were recovered (Figure 2). However, 214 mandibles with at least one cheek tooth in place were recovered allowing analysis of tooth wear patterns.

The contexts analyzed are bracketed by ^{14}C dates that are as follows (Haviser 1991:666):
T20 Lv 3A and B ± 560 B.C. (2510 ± 40 B.P. PITT-0450)
350 B.C. (2300 ± 55 B.P. PITT-0449)
A3 Lv 7 - A.D. 290 (1660 ± 55 B.P. PITT-0452)
A3 Lv 2 - A.D. 460 (1490 ± 35 B.P. PITT-0445).

The secondary midden, T20, is a ceramic period deposit that appears to precede the Saladoid occupation and is called early ceramic by Haviser (1991). A gap exists in the sequence of occupation between the secondary midden and the primary midden, A3 and A5.

The faunal samples are large including 1626 skeletal fragments identified as oryzomyine rodent. Because of the importance of comparing the relative abundance of rodents in the context of the entire fauna, calculations are based on minimum numbers of individuals (MNI). Calculations of MNI diminish some of the biases inherent in comparing the abundance of different classes and phyla that could have contributed very different numbers of identifiable elements to the faunal assemblage. By conservative calculation the sample includes 183 MNI rice rats in a total vertebrate fauna of 489 MNI. Comparisons of the relative importance of different components of the faunal assemblages are based on MNI (Tables 1-5). The data from unit A3 and A5 are combined as they are adjacent units in a single excavation trench. The data from levels 3 and 4 of the A3 and A5 unit are combined to increase that sample size, each of which are small by themselves. The significance of the differences between the faunal components of different levels is established using chi square.

Age of the rice rats is based on four different wear stages of the cheek dentition (Table 6). Stage 1 is unworn molars. Stage 2 is slight wear on the tips of the cones. These two stages are categorized as juvenile although the actual reproductive status is, of course, not known. Stage 3 is substantial wear. Stage 4 is wear to the point that the tooth surface is flat and dentine is entirely exposed. This stage includes two dentitions that have extreme and uneven wear. Individuals with wear stages 3 or 4 are assumed to be adult though not animals that have attained full growth. Despite some dentition with extreme wear no limb elements show complete fusion with both proximal and distal epiphyses.

A range of measurements are taken to describe the size of the Hope Estate rice rats relative to populations on neighboring islands, to document possible changes in size through time, and to estimate body weight by allometric methods (Table 7 - 9). Measurements taken include the alveolar length of the upper and lower cheek tooth row; lengths of the humerus, femur, and tibia; greatest width of the femur head; and width of the occipital condyles. The lengths of the limb elements are of specimens that lack one epiphysis (proximal epiphysis in the humerus, distal in the femur, and proximal in the tibia). Thus, the measurement represents animals that have not attained full skeletal maturity but rather the size of the individuals represented in the segment of the population that was exploited. The molars of rice rats have closed roots and therefore will not continue to grow throughout life. Once the teeth are fully erupted measurements of the alveolar cheek tooth row do not change with the age of the animal. A summary of the measurements of the lower cheek tooth row of specimens throughout the deposit is presented on Table 7. A test for the difference between means of the lower cheek tooth measurements is done with a student's t test.

Measurements of specimens from other sites are taken in the same way (Table 8). It is interesting to note that only specimens that are close in size to the genus *Megalomys* from the Brook Site on Antigua include some post-cranial elements that are completely fused. Measurement of these are not included in the comparison. Comparative measurements come from Rendezvous Bay Site, Anguilla (Wing ms); Kelbey's Ridge hearth, Saba (Wing ms); Golden Rock Site, St. Eustatius (van der Klift 1992); Sugar Factory Pier, St. Kitts (Wing and Scudder 1980); and the Brook Site, Antigua.

Measurements that are related allometrically with body weight are the greatest diameter of the head of the femur and the width of the occipital condyles (Table 9). Those relationships can be described by the following two formulas: 1. $\text{Log } Y = 2.5569(\text{Log } X) + 0.8671$ where Y is body weight in gms and X is the diameter of the femur head in mm. 2. $\text{Log } Y = 3.2659(\text{Log } X) - 0.9421$ where Y is body weight in gms and X is the width of the occipital condyles in mm (Wing and Brown 1979). These allometric formulas are derived from measurements taken from a series of land mammal specimens, including small rodents, with known body weights. Such estimates are useful for making predictions about the potential importance of rice rats in the prehistoric diet. Estimates of the potential meat weight contribution by other animals such as crabs and fishes are made in the same way. Usable meat weight of a mammal is approximately 65 percent of body weight, for crabs is approximately 50 percent, and for bony fishes is about 84 percent (ibid.).

RESULTS

It is clear from these data that rice rats remains are an important component in the faunal assemblage and that their importance increases through time (Table 1-4). A comparison between the numbers of rice rats and the most important birds, the doves (Columbidae) and the thrashers *(Margarops fuscatus)*, shows a significant increase in rice rats between the earliest context, the secondary midden T20, and the lowest level examined from the primary midden, A3 and 5 Level 6 (Table 1). However, within the A3 and 5 unit the relationship between the abundance of rice rats and birds remains constant.

The comparison can be expanded to examine the relative abundance of rice rats and the other most important vertebrate component, the fishes. A relative increase of rice rats through time is evident. This increase in rice rats is significant between each successive context except between level 5 and the combined data from the upper most two levels 4 and 3 (Table 2).

When all of the terrestrial vertebrates are compared with the aquatic component the earliest two contexts (T20 and A3 and 5 level 6) do not differ (Table 3). As we already saw the large numbers of birds in the secondary midden make up the difference in the terrestrial component of T20. The increase in terrestrial vertebrates in level 5 is significant. Although the trend of increase of rice rats and the more inclusive category, terrestrial vertebrates, through time can be seen, the rate of increase in the most recent component, Level 3 and 4, is not significant (Table 2 and 3).

Land crabs in the family Gecarcinidae and land hermit crabs, *Coenobíta clypeatus*, constitute an important component of Saladoid sites. A comparison between the relative abundance of land crabs and rice rats is instructive for an understanding of the reliance that was placed on land resources (Table 4). Throughout the time period being discussed, land crabs decrease in abundance and land vertebrates increase and this steady change is significant within the primary midden. However, no change in relative abundance between terrestrial fauna (crabs and all land vertebrates) and fishes is evident (Table 5). In other words, the decrease in crabs is made up for by the increase in land vertebrates. It would be interesting to know whether the importance of molluscan remains changes through time. The most important mollusc is the West Indian topshell, *Cittarium pica,* but comparative data on abundance are not available.

A close look at the rice rat remains reveals some fluctuation in their size through time based on the means of the length of the lower cheek tooth row (Table 7). All comparisons between the means of this measurement in the same levels of the two neighboring units, A3 and A5, show no significant differences. The only statistically significant difference, at the .05 level of probability, is between the means of 6.9 mm in level 3 of units A3 and A5 and 6.6 mm in A5 level 4. The difference between the means in A3 level 3 and level 4 is not significant.

The rice rats at Hope Estate are slightly smaller than those from sites on neighboring islands in every measurement taken (Table 8). No significant difference is seen in the largest Hope Estate mean (6.9 mm) of the lower cheek tooth row from A3 level 3 and the mean (7 mm) of that measurement from Saba (KR). The size differences of the animals from Hope Estate and those from the Brook Site on Antigua is probably at the generic level. The Antiguan rice rat is comparable in size to *Megalomys,* a genus that occurs elsewhere in the Lesser Antilles (Wing et al. 1968). The mean of the lower cheek tooth series in the Brook Site sample is 9.5 mm. The length of the lower molar series is reported to be 9 mm for the species *M. desmaresti* from Martinique and 8 mm for *M. luciae* from St. Lucia (Elliot 1904).

Estimates of body weight of the rice rat are both 144 gms (Table 9). This is in contrast to the estimated average weight of the crabs which is an average of 214 gms, and the most common fishes which are 531 gms for grouper, 775 gms for grunt, and 473 gms for parrotfishes. These estimates are made using the same methods as is used to estimate the body weight of rice rats (deFrance 1988; Wing and Brown 1979).

A change in the age composition of the individuals in the four contexts of the primary midden, units A3 and A5, is evident (Table 6). Rice rat remains from the secondary midden are too scarce to be included in an examination of demography. In the lowest two levels, 6 and 5, adult animals (tooth wear stages 3 and 4) predominate constituting 62 and 60 percent of those animals. Contrary to this, the animals in the level 4 are predominantly juvenile (tooth wear stages 1 and 2) constituting 62 percent. In level 3 juvenile and adult animal are equally divided when data from the two units are combined. The two units, A3 and A5, in level 3 differ in this respect giving opposite demographic patterns, a preponderance of adults in A5 and juveniles in A3.

DISCUSSION

The trend seen in the increase in rice rats remains throughout the occupation at Hope Estate is demonstrated in relative and absolute quantities in comparison to remains of fishes and land crabs. Accompanying the increase in rice rats in the primary midden is an increase in birds. The rate of this increase in rice rats is not significant in the 1979), upper most level, the combined data from Level 3 and 4, except in respect to the decline in numbers of crabs. This faltering in the trend of ever increasing exploitation of rice rats may be the first evidence for the effects of overexploitation of these rodents.

If the diminishing numbers of crabs was a result of over exploitation, as has been claimed (Goodwin 1979), they were more sensitive to the effects of human predation than rice rats. The decline of crab claws noted by Goodwin in the upper most levels of the Cayon site (St. Kitts) might be the effect of the usual decrease in sample size seen in the top layers of all sites probably the result of gradual abandonment of the size and taphonomic factors. At Hope Estate we see the decline in crab remains met by an increase in rice rat remains so that throughout the occupation terrestrial fauna, including land crabs and vertebrates, and aquatic vertebrates, including small sea turtles and fishes, remains in equilibrium (Table 4 and 5). When crabs are removed from consideration and only terrestrial and aquatic vertebrates are compared, a significant increase in terrestrial animals occurs in level 5 and continues in the combined levels 3 and 4 (Table 3).

The age composition of the rice rats reveals a predominance of adult individuals with moderate to heavy tooth wear in the two lower levels and a preponderance of juveniles with no or slight tooth wear in the upper two levels. One would expect fluctuations in the demographic profile as was seen in the rice rat populations on Breton Island (Negus et al. 1961). Though we do not know how long a time period each level of the site took to accumulate I think one must assume that it was fairly long and the demographic profile of one level may include in it many fluctuations. The profile we can document represents the general demographic trend in the face of human predation. In level 4 there is a significant change from a population of two thirds adult animals to a preponderance of juvenile individuals. This may represent the response of the rice rats to lower population density caused by human predation during the occupation when level 5 and 6 were deposited. This response would come in the form of large litters and thus relatively more young animals in the population. This profile breaks down in level 3 where in one unit, A5, adults predominate and in the other, A3, juveniles are more abundant. This may simply represent a partial relaxation in the intensity of the predation as other evidence points to a decreased rate in the rise in the intensity of exploitation of rice rats.

Size in the individuals as seen in measurements of the lower cheek tooth row appears to fluctuate but the difference in the means of these measurements is only statistically significant between level A5 Lv 4 and both A3 Lv 3 and A5 Lv 3. These means are the extremes, 6.9 mm and 6.6 mm but fall within one standard deviation. These larger animals from the top levels may simply be size differences resulting from random variation in the population. It is these animals in the upper most level 3 that are the exception to the trend seen in the rest of the site. They may have resulted from some management or manipulation by the people who caught them. Whether human predation propelled the size change can not be determined at this time.

It should be noted that the mean size of the lower tooth row from level 3 does not differ from those from the hearth at Kelbey's Ridge on the near-by island of Saba. The means for this measurement are the same at the Golden Rock site on St. Eustatius. Detailed study of the rice rats on these neighboring islands should be made to see whether the changes in the size of this one element seen at Hope Estate also occur at other sites. Establishment of a pattern of changes in age structure and size may suggest that they are the result of long term human predation or management of these animals.

Estimates of their body weight and the potential contribution to the prehistoric diet at Hope Estate is small even though they are relatively large rice rats. Potential usable meat from these two most important land animals would have been approximately the same (94 gms and 107 gms respectively) but substantially less than what could have been provided by the average sized fish (approximately 500 gms). By these estimates crabs and rice rats would have yielded approximately the same amount of meat per animal and approximately one fifth of the meat potentially yielded by the average sized fish that was caught. The motivation to continue to catch these animals that could have contributed so relatively little meat to the prehistoric diet must have been strong.

To return to the original expectation of changes that would occur if rice rats were overexploited: a decline in the relative importance of rice rats in the faunal assemblage through time, a predominance of juvenile animals, and a decrease in size of the individuals through time. These expectations are only partially met. Rice Rats increase in relative abundance throughout the entire occupation analyzed though the rate of increase diminishes in the upper most levels (3 and 4) of the site. Following the greatest increase in rice rats their demographic pattern changed from one of two thirds adults to two thirds juveniles. However, this shift to juveniles is not sustained in the top level of both units. The size of the individuals in this top level are larger but this must be attributed to fluctuations in size rather than human selection. If similar patterns are seen in other collections the question of human selection or manipulation can be revisited. The data do suggest that there was strong motivation to continue to catch rice rats and that their populations withstood the pressures of predation at least until the end of the occupation of the segment of the site examined.

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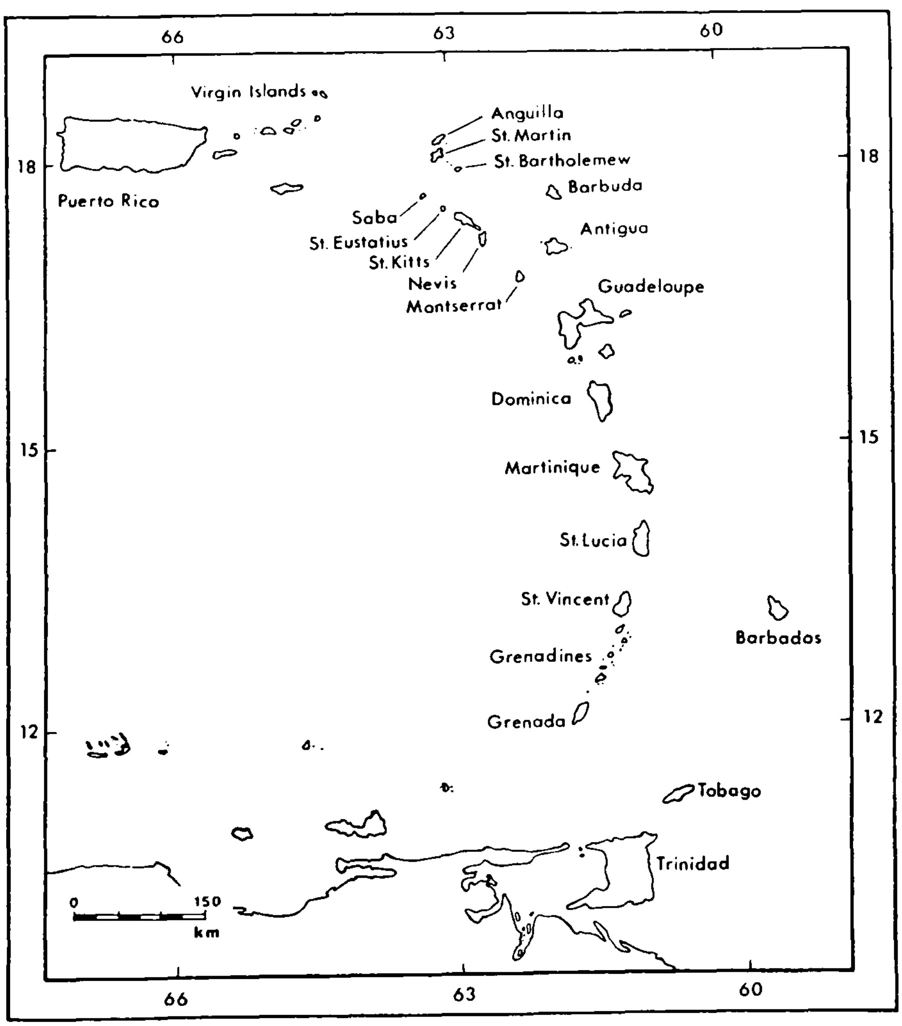

Fig. 1. Map of the Lesser Antilles showing islands mentioned in the text (from Woods 1989).

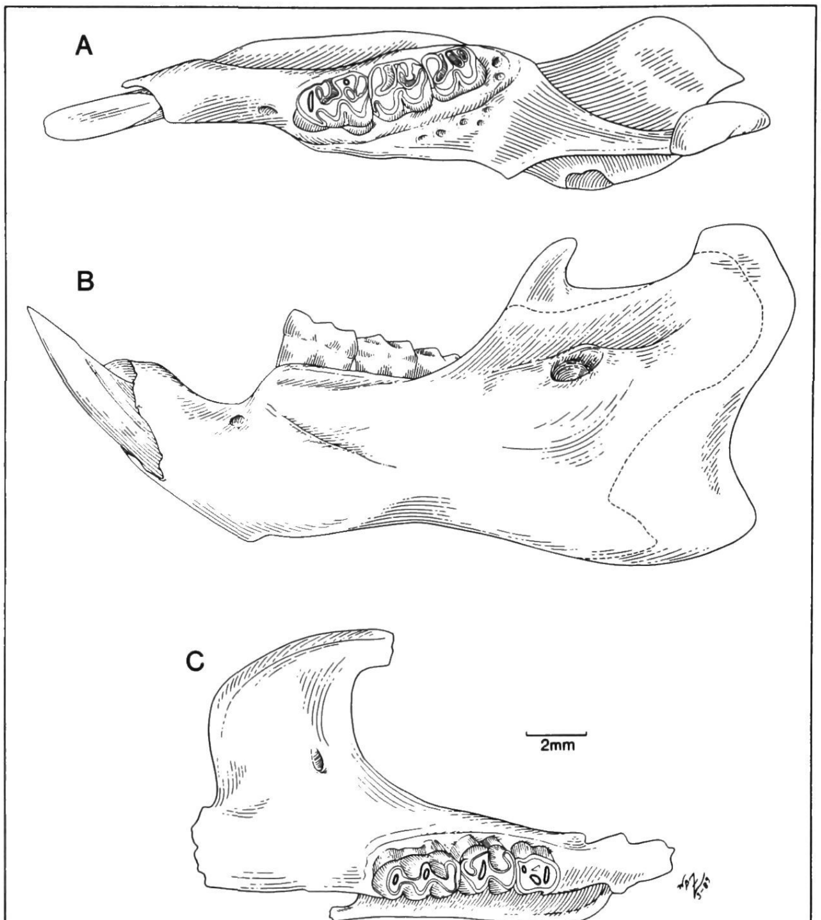

Fig. 2. *Illustration of left mandible (A. dorsal view, B. labial view) and left maxilla (C. ventral view) of the rice rat from Hope Estate (SM026 XVII A3 Level 5). Drawn by Wendy Zomlefer.*

Table 1. A comparison between the relative abundance of rice rats and two terrestrial birds, doves and thrashers, at Hope Estate (units T20 level 3A and B; A3 and 5 level 6 level 5, level 4 and 3) based on minimum numbers of individuals (MNI).

TAXA	T20		A3 and 5					
	Lv 3 A&B		Lv 6		Lc 5		Lv 4&3	
	MNI	%	MNI	%	MNI	%	MNI	%
rice rats	3	14*	37	70*	66	72	77	70
doves and thrashers	18	86*	16	30*	26	28	33	30
MNI Total	21	100	53	100	92	100	110	100

Table 2. A comparison between rice rats and fishes in the same contexts as Table 1.

TAXA	T20		A3 and 5					
	Level 3A&B		Level 6		Level 5		Level 4&3	
	MNI	%	MNI	%	MNI	%	MNI	%
rice rats	3	9*	37	35*	66	59*	77	65
fishes	30	91*	69	65*	46	41*	41	35
MNI Total	33	100	106	100	112	100	118	100

Table 3. A comparison between terrestrial and aquatic vertebrates in the same contexts as Table 1.

TAXA	T20		A3 and 5					
	Level 3A&B		Level 6		Level 5		Level 4&3	
	MNI	%	MNI	%	MNI	%	MNI	%
terrestrial	26	46	60	47*	100	69*	117	74
aquatic	30	54	69	54*	46	32*	41	26
MNI Total	56	100	129	100	146	100	158	100

Table 4. A comparison between land crabs and rice rats in units T20 level 3A and B and A3 level 6, level 5, and level 4 and 3 based on MNI.

TAXA	T20		A3					
	Level 3A&B		Level 6		Level 5		Level 4&3	
	MNI	%	MNI	%	MNI	%	MNI	%
crabs	49	94	150	87*	79	64*	6	12*
rice rats	3	6	22	13*	44	36*	42	88*
MNI Total	52	100	172	100	123	100	48	100

Table 5. A comparison between total terrestrial fauna, vertebrate and invertebrate, and aquatic vertebrates in the same contexts as Table 4.

TAXA	T20				A3			
	Level 3A&		Level 6		Level 5		Level 4&3	
	MNI	%	MNI	%	MNI	%	MNI	%
terrestrial fauna	75	71	184	80	14	86	66	79
aquatic vetebrates	30	29	46	20	24	14	18	21
MNI Total	105	100	320	100	167	100	84	100

Table 6. Demographic profile of rice rats based on tooth wear stages seen in the lower cheek teeth in units A3 and 5 levels 3 through 6.

WEAR STAGES					A3 and A5			
	Level 6		Level 5		Level 4		Level 3	
	N	%	N	%	N	%	N	%
1	1	_	11	_	4	_	0	_
2	13	_	2	_	24	_	24	_
total juvenile	14	38	33	30	28	62	24	50
3	14	_	30	_	11	_	21	_
4	9	_	19	_	6	_	3	_
total adult	23	62	49	60	17	38	24	50
A5								
juvenile	9	50	10	39	10	53	5	31
adult	9	50	16	62	9	47	11	69
A3								
juvenile	5	26	23	41	18	69	19	59
	14	74	33	59	8	31	13	41

Table 7. Measurement of the alveolar length of the lower cheek tooth row (mm) throughout the deposit.

LEVEL	NUMBER	MEAN	RANGE	STANDARD DEVIATION
A3 Lv 3	19	6.9	6.6-7.3	0.269
A5 Lv 3	23	6.9	6.4-7.5	0.259
A3 Lv 4	14	6.8	6.0-7.3	0.341
A5 Lv 4	14	6.6	5.9-7.0	0.325
A3 Lv 5	35	6.7	5.9-7.5	0.325
A5 Lv 5	14	6.8	6.2-7.5	0.334
A5 Lv 6	8	6.7	6.3-7.2	0.295
T20 Lv 3A	1	6.8		

Table 8. Summary of measurements of oryzomyine remains from Hope Estate (HE A3 Lv5) St. Martin, Rendezvous Bay (RB) Anguilla, Kelbey's Ridge (KR) Saba, Golden Rock (GR) St. Eustatius, Sugar Factory Pier (SFP) St. Kitts, Brook Site (BS) Antigua. The measurements (all taken in mm) include the upper cheek tooth row (upper), lower cheek tooth row (lower), humerus length without proximal epiphysis (humerus), femur without distal epiphysis (femur), diameter of the femur head (head), tibia without proximal epiphysis (tibia). N is the number of specimens and X is the mean.

SITE	UPPER		LOWER		HOMERUS		FEMUR		HEAD		TIBIA	
	N	X	N	X	N	X	N	X	N	X	N	X
HE	12	6.5	35	6.7	10	20.6	8	30.9	23	3.2	9	34.6
RB	1	6.5		_		_		_		_		_
KR	2	7.4	25	7.0	1	21.6		_	1	3.5		_
GR	5	6.8	19	7.0	4	21.5	3	31.7	4	3.6	5	35.1
SFP	2	7.7	16	6.9	6	22.3	13	34.6	22	3.4	5	36.7
BS		_	8	9.5	2	27.6	3	42.0	12	4.8	2	45.7

Table 9. Allometric relationships between skeletal dimension (mm) and body weight (gm) may be used to estimate weight using established least square formulas (Wing and Brown 1979). Two measurements used for these estimates are the diameter of the femur head and the width of the occipital condyles.

SITE	FEMUR HEAD	ESTIMATED WEIGHT	OCCIPITAL CONDYLE	ESTIMATED WEIGHT
HE	3.2	144	8.9	144
KR	3.5	181	-	-
GR	3.6	195	_	-
SFP	3.4	168	9.1	155
BS	4.8	406	-	

* Significant at the 95% confidence level P<0.05)