FOODWAYS AT THE JOSEPH DE LEON SITE (SA 26-1), ST. AUGUSTINE, FLORIDA

Elizabeth J. Reitz
Florida State Museum
University of Florida

Analysis of collections excavated from historic sites frequently indicate that domestic animals provided most of the faunal biomass. The Joseph de Leon site (SA 26-1) from the 16th Century Spanish occupation at St. Augustine, Florida, is an exception to this general rule. Analysis of the faunal materials from this site indicate that emphasis was placed primarily on marine resources. This suggests that a mass-capture technique, probably a net, was in use by the resident. The possible net technology is correlated with the material culture assemblage to suggest a high social standing for the 16th Century occupant at the site.

Faunal assemblages recovered from historical contexts during archaeological investigations usually are found to be dominated by domestic animals. It should not be assumed on this basis, however, that analysis of faunal assemblages from colonial contexts provides no insight into adaptive strategies followed by North American colonists. Colonial faunal collections generally include some wild species, suggesting that wild resources figured to some extent in the subsistence strategies practiced by the historic occupants at these sites. The extent to which wild resources were utilized is of interest for this reason. Occasionally a major divergence from the general historic adaptive pattern in which domestic animals figured prominantly is observed. These variations on the dominant pattern underscore the importance of faunal analysis for historic occupations. One such variation will be presented here.

Analysis of the Joseph de Leon fauna is valuable for two reasons. First, it is a unique collection for St. Augustine, and possibly for most North American colonial occupations, in terms of the

the importance of wild fauna in the diet. Secondly, the faunal assemblage provides information on the biotopes exploited and capture techniques employed. This information allows for speculation on the social status of the 16th Century resident at the site based on the correlation of the faunal assemblage with the material culture data. This emphasizes the importance of studying the total site assemblage rather than ~~just~~ a single isolated component.

SPANISH ST. AUGUSTINE AND THE FAUNAL RECORD

St. Augustine is located on the Atlantic coast of Florida (Fig. 1). The town is somewhat protected from the Atlantic Ocean by Anastasia Island, a low barrier island east of the town. Between the town and Anastasia lies a rich estuarine environment with an inner bay, salt marshes, tidal creeks, and mud flats. The town itself occupies a low, sandy peninsula between the Matanzas River and Santa Maria Creek. To the west lies the San Sebastian River. Beyond this river the land slowly rises to a relatively flat interior of pine flatwoods, with occasional swamps and freshwater streams.

St. Augustine was founded in 1565 by Spain and occupied by Spaniards until 1763. The garrison at the town was commanded to prevent foreign intrusion on the Atlantic coast, protect the Spanish treasure fleet which sailed just off the Florida coast on its journey from Cuba to Spain, and aid victims of shipwreck. Throughout the Spanish occupation most of the residents were soldiers, government officials, their dependents, and missionaries. Although it is not known who lived at the de Leon site in the 16th Century, presumably the resident was from one of these groups.

In the 16th Century food was obtained from two major sources: an annual subsidy and local food production. Most of the residents at St. Augustine received an income of coinage and rations from the Spanish crown in return for execution of their official duties (Bushnell 1978b). Rations included items such as beans, rice, flour, and corn, as well as salt pork and beef. Payment of the subsidy, known as the situado, was irregular at best. Several years might lapse between shipments, and those goods which did arrive were often of poor quality or completely spoiled (Tepaske 1958).

According to official reports sent from St. Augustine to Spain, efforts to produce food locally were not successful (Conner 1927-1930). This failure was blamed on poor soil, bad weather, pressing military duties, and marauding Indians. There were fields planted near the Spanish town in the 16th Century (Chatelain 1941:Maps 2,3,4), although these may have been Indian fields (Deagan personal communication). The initial colonization introduced the usual European barnyard animals: pig (*Sus scrofa*); cow (*Bos taurus*), chicken (*Gallus gallus*); horse (*Equus cabellus*); goat (*Capra hircus*); and sheep (*Ovis aries*) (Lyon 1977). These may have not been plentiful. In the 1570's there were said to be only 50 wild, skinny hogs which fed on shellfish, some chickens which also fed on shellfish, and only 50 royal cattle on an island (Caceres 1574). Insects, disease, Indian raids, and improvident husbandry were blamed for this condition. According to the documents this situation improved only slightly over the years, with hunger and privation reported repeatedly throughout the Spanish occupation.

Eleven faunal components from the First Spanish Period have been analyzed (Cumbaa 1975; Reitz 1979). From these studies, a pattern of animal resource use in Spanish St. Augustine has emerged (Table 1). As was anticipated, domestic animals contributed the bulk of the biomass, followed by wild terrestrial animals, fish, and small components of aquatic reptiles and wild birds. Although cattle (Bos taurus) and pigs (Sus scrofa) usually were found to be the dominant species in terms of biomass contribution, animals such as deer (Odocoileus virginianus), sea catfish (Ariidae), drum (Sciaenidae), and mullet (Mugil sp.) were prominant in the species used. The de Leon example is one of the two cases from Spanish St. Augustine in which a diet based on domestic meat was not found in the faunal record. The other exception, the 17th Century component from SA 36-4, will not be discussed here (cf Reitz 1979).

THE JOSEPH DE LEON FAUNAL AND CULTURAL ASSEMBLAGES

The Leon site (SA 26-1) is located within the bounds of the 16th Century town (Fig. 2) as defined by Kathleen A. Deagan (1978). The site takes its name from the 18th Century First Spanish Period owner of the lot since it is not known who lived there in the 16th Century. SA 26-1 has been discussed by Deagan(1978, 1979) and in Masters Theses by Theresa Singleton (1977) and Chad Braley(1977). It should be noted that this site, SA 26-1, is not the same as the Francisco Ponce de Leon or Palm Row site (SA 36-4) excavated by Deagan in 1978 and being analyzed by Charles B. Poe as part of his Masters Thesis (Poe in prep). Both sites are occasionally referred to as the de Leon site.

The faunal materials were recovered during the course of the archaeological excavations at the site conducted by Deagan in 1976 and 1977. The collection was recovered using a ¼-inch mesh screen with water assistance. This same technique was used at the other First Spanish Period sties referred to here. The faunal assemblage was studied at the Zooarchaeological Laboratory, Florida State Museum, University of Florida, Gainesville. A sample from the Leon collection was analyzed by Kathleen F. Johnson, L. Jill Loucks, and Robin Smith in 1977. The results of their work was included by Singleton in her Thesis (1977). The remainder of the collection was analyzed later (Reitz 1979).

By and large the techniques employed in the study of the faunal sample were standard ones. Specimens from each taxon were counted and weighed. Minimum Numbers of Individuals (MNI) were determined using the principle of paired elements proposed by Theodore White (1953) and modified by Donald K. Grayson (1973). In determining MNI, separate 16th Century Features from the site were considered individually and separate from non-Feature materials of the same time period. All non-Feature provinences were lumped, as were levels within Features.

Shellfish were excluded from the analysis. It is clear from the documentary evidence (Grinan 1757; Garcia 1902; Tepaske 1964; Lyon 1977) and from the condition of the sites themselves that shellfish were heavily used at St. Augustine. They were used, however, both as building material and as food. It is impossible to tell for a given shell whether it was used exclusively as a food source, a building material, or was first used as food and later as construction material. In addition, invertebrate remains were not systematically collected and so could not be quantified. It is doubtful that shellfish substantially influenced the subsistence strategy of the human populations being studied here due to their low nutritive value (Watt and Merrill 1963; Parmalee and Klippel 1974). It should also be noted that a single oyster roast can produce a very impressive mound of shells. For these reasons analysis was confined to vertebrate remains.

The biomass data used here were obtained using the scaling theory and allometric formula (Prange et al. 1979; Wing and Brown in press), and should be distinguished from similar data obtained by other analyists using the live weight or edible meat weight techniques proposed by White (1953). The biomass method employed here is based upon the principle that the proportions of animals tend to change with increasing size. As body weight increases there must be an increase in the proportion of the toal body weight contributed by the skeleton. This phenomenon has been extensively studied by zoologists and has been demonstrated to be a sound relationship (Pedley 1977). Its utility for use in the interpretation of zooarchaeological data has been explored to a limited extent (Casteel 1978; Emerson 1978; Smith 1975; Wing and Brown in press).

Equations and straight lines relating body weight to skeletal weight were constructed through least squares analysis of logarithmic data. The relationship between body weight and skeletal weight is described by the allometric equation

$$Y = aX^b$$

(Prange et al. 1979). For archaeological materials, Y is the archaeological bone weight measured in kilograms and X is the biomass, so that the equation must be transformed to

$$X = [Y/a]^{1/b}.$$

B is the slope of the log-log equation, and a is the Y-intercept of the log-log regression line. Values for a and b are constants, obtained either from the literature on allometry (Prange et al. 1979), or from calculations based upon the Florida State Museum's collections (Wing and Brown in press). The allometric constants are presented in Table 2.

It should be noted that biomass data obtained in this manner for archaeological faunal materials estimates only the amount of biomass represented by the measured quantity of bone. It does not approximate the total live weight of the animal used at the site and does not involve the assumption that the entire animal was consumed at the site. Nor does it require assumptions about the portions of the animal consumed as the edible meat ratio requires. This is a conservative estimate of biomass determined from the faunal material actually represented and recovered from the site.

It might be assumed that the dominance of the wild fauna found at SA 26-1 might be a result of the technique used to obtain the biomass figures. Since the same techniques ~~was~~ were used for all of the faunal materials analyzed from the First Spanish Period it must be concluded that the dominance of the wild fauna found at this site is due to some factor other than the recovery techniques or analytical techniques.

The biomass of the amphibians could not be obtained using the allometric formula since the comparative data needed to obtain the constants was lacking. The standard proportion of

$$\frac{\text{comparative skeletal weight}}{\text{comparative live weight}} = \frac{\text{bone weight}}{X}$$

was used instead. The pickled weight of the southern toad (*Bufo terrestrialis*), 28.5 gms, and a bone weight obtained from a toad skeleton of comparable size, 4.4 gms, was used for all amphibians.

Diversity and Evenness were measured using the Shannon-Weaver Diversity Index and the Sheldon Evenness Index (Cumbaa 1975; Hardesty 1975; Wing 1973, 1976). Diversity is a measure of the number of different species used at the site (Shannon and Weaver 1949). Equitability is a measure of the degree of dependence on the utilized resources and the effective variety of species used at the site based upon the even, or uneven, use of individual taxa (Sheldon 1969). Use of these indices allows discussion of food habits in terms of the variety of animals used at the site (diversity) and the equitability with which those species were relied upon in the diet.

The results of the analysis of the SA 26-1 faunal collections are presented in Table 3. For analytical purposes the taxa for which MNI had been determined were grouped into six categories: domestic animals, including chicken (<u>Gallus gallus</u>); wild terrestrail animals, including the terrestrail gopher tortoise (<u>Gopherus polyphemus</u>); cartilagenous and bony fish; aquatic reptiles; wild birds; and commensal species (Table 4). Rats, snakes, and amphibians were interpreted as commensal species. Both rats and toads are common around houses at St. Augustine today, and the snakes may have been attracted by these, or by the chickens. It should be noted that in calculating the biomass for each of these six categories only those taxa for which MNI had been determined were included. Taxa such as Unidentified Mammal, Carnivora, or Colubridae, for which MNI was not calculated, were not included in the summary of MNI and biomass by group (Table 4).

The faunal assemblage from SA 26-1 is unusual because of the low contribution of domestic animals to the total amount of biomass of of species for which MNI had been determined (Table 4). Domestic animals contributed only 32% of the biomass while wild fauna combined contributed 68% of the biomass. Fish alone contributed 74% of the individuals and 46% of the biomass, the highest percentage contribution of this category to any of the First Spanish Period faunal collections. This dominance of wild faunal biomass, and of fish biomass, over domestic animals is the reverse of what would have been expected from the site based on the data summarized in Table 1.

While the species used at SA 26-1 are those generally found at most Spanish St. Augustine sites, the role of these species in the total diet is unexpected. As can be seen in Figures 3 through 9, the SA 26-1 faunal collection represents an extreme in distribution of almost every major animal identified from St. Augustine, not only for the 16th Century, but for Spanish St. Augustine as a whole. Pig (Sus scrofa) was the major domestic species, with 24% of the biomass and 3% of the individuals. Cattle (Bos taurus) contributed only 4% of the biomass and 0.4% of the individuals. Chicken (Gallus gallus) comprised as much biomass as cattle (4%) and more individuals (3%). The dominant wild terrestrial species was deer (Odocoileus virginianus) which contributed 15% of the biomass and 2% of the individuals. Mullet (Mugil sp.) were the most prominant fish species, contributing 15% of the biomass and 37% of the individuals. The role of mullet in the diet is emphasized by the fact that this fish contributed as much biomass to the diet as did deer. Drum (Sciaenidae) followed closely with 14% of the biomass and individuals. Sea catfish (Ariidae) constituted 10% of the biomass for which MNI had been determined and an equal amount of individuals.

The faunal collection form the Leon site is noteworthy for an additional reason. It is the only site from the 16th Century from which goat or sheep (Capra or Ovis sp.) has been identified. The two elements unfortunately could not be identified to genus. These animals contributed only 0.2% of the individuals and 0.1% of the biomass for species for which MNI had been determined, but their very presence is unexpected.

The unique quality of the faunal assemblage from this site corresponds with the novelty of the ceramic assemblage as well. This is the only site from St. Augustine to this date from which Mesoamerican colonial wares, Feldspar Inlaid redware, and burnish redware have been recovered (Singleton 1977; Deagan 1979). In addition, there are more majolica sherds from this site, representing a greater diversity of types than found at other 16th Century excavations from St. Augustine. There was also a greater variety and quantity of glass fragments and more nails found here.

DISCUSSION

While all of the common domestic animals except chicken (Gallus gallus) are present below the normal level at SA 26-1, the unexpectedly low percentage of domestic individuals and biomass from this lot can be attributed principally to the low presence of cattle (Bos taurus) in the collection. Documents for the time period indicate that the Spanish residents found it difficult to protect their domestic livestock, especially cattle, from Indian raids, disease, and storms (Conner 1925). Cattle require more care than do pigs (Sus scrofa) and chickens (Weeden 1890; Booth 1971; Rouse 1977). A common husbandry technique for all three animals was to turn them loose to forage on their own (Weeden 1890; Arnade 1965; Sauer 1969; Booth 1971; Rouse 1977;

Bushnell 1978a). Cattle in particular may have been scarce in the 16th Century and those that were available may have been difficult to capture or tend.

The findings from the Leon site might be interpreted to mean that cattle (Bos taurus) were not generally a major part of the 16th Century adaptation, were it not for the fact that at other 16th Century sites cattle are found in larger quantities (Reitz 1979). At Lester's Gallery (SA 29-2) cattle constituted 7% of the individuals and 63% of the biomass, figures which approach the mean for the entire First Spanish Period. SA 29-2 may not be a reliable indicator due to the small sample (MNI of 29 and biomass of 12 kgs). At the 16th Century component of SA 36-4, the Palm Row site, cattle represented 50% of the biomass and 2% of the MNI where the total MNI was 119 and the total biomass was 44 kgs. It appears that cattle in the 16th Century were generally more available than inferred from the SA 26-1 collection.

Figure 5 shows the range in the percentage contribution of beef biomass and MNI for all of the First Spanish Period sites divided into 16th and 18th Century columns, excluding the 17th Century site. This figure demonstrates that cattle, while present in the 16th Century, were not as widely relied upon as they were in the 18th Century. We may be seeing at SA 26-1 a case of differential access to a resource that was more scarce in the 16th Century than in the 18th Century.

In light of the difficulty reported in raising cattle, the use made of pigs (Sus scrofa) and chickens (Gallus gallus) is interesting (Figs 3 and 6). It is probably significant that pigs in the 16th Century were more heavily used than in the 18th Century considering the hardy, resourceful nature of these animals (Towne and Wentworth 1950). Only one of the 16th Century sites (SA 34-1) contained more pig biomass, although several sites had more individuals. Chickens also forage well for themselves (Booth 1971) and these were used at SA 26-1 in greater quantities than at other First Spanish Period sites.

In conjunction with domestic animals, wild terrestrial animals, particularly deer (Odocoileus virginianus) were used (Fig. 4). Most of the species are attracted to gardens, corn fields, hen houses, and garbage dumps (Reitz 1979). The presence of these species may indicate capture of these animals during their evening raids on such locations, probably in the immediate vicinity of the town.

For whatever reason, the orientation of the subsistence activity of the 16th Century resident at the Leon site was toward the St. Augustine Inlet area rather than to domestic or wild terrestrial fauna. While mullet (Mugil sp.) are major components of all Spanish St. Augustine collections, at SA 26-1, the use of this fish was greater than elsewhere (Fig. 7). The moderate MNI diversity value 2.86, at SA 26-1 and the low evenness of species utilized, based on MNI , 0.68, in part reflects the unusual presence of mullet in th is collection. Biomass diversity and equitablity values were 2.45 and 0.54 respectively, and also demonstrate the uneven use of mullet by the resident. While these values are not particularly low, SA 26-1 is the most diverse and least equitable faunal assemblage in terms of MNI from the 16th Century and the most diverse site of all of the St. Augustine sites regardless of time period when considered in terms of biomass. The prominance of mullet is probably the major factor in this. Figure 7 shows the range in the percentage contribution of mullet biomass and MNI. Once again SA 26-1 is at the extreme. As with cattle, the 16th Century range is wider than the 18th Century range in general.

Mullet are good indicators of the dominant capture technique used at the site to procure fish. Mullet are herbivorous fish with very small, delicate mouths (McLane 1955). They rarely take a hook, although they can be snagged occasionally. Since they school in large groups, they are successfully taken in large numbers using nets. By day, schools of mullet are found in mid-channel of bays, larger tidal creeks, and brackish rivers. They also follow the incoming into smaller creeks where they are not usually found. In addition mullet are attracted to areas where garbage is dumped into the bay. Mullet could easily have been taken with a net during the day almost anywhere around St. Augustine in large quantities.

Drum (Sciaenidae) and catfish (Ariidae) are also common fish in the immediate area of the town (Figs. 7 and 8). While drum occur throughout the water column by day, depending upon the species (McClane 1974), they are found feeding in large schools near the surface of the water at night (McLane 1955). They also follow the tide into small tidal creeks as do mullet. By day, members of the sea catfish family are bottom-feeders, but they also feed at night in large groups near the surface and follow the tide up smaller creeks (McLane 1955). Species of these families are commonly taken using some arrangement of hooks and line, but may be taken with nets, seines, and weirs as well (Hilliard 1972). The presence of these families in large numbers suggests a mass-capture technique such as a net rather than hook and line.

It is known that nets were available in St. Augustine in the 16th Century. Fray Andres de San Miguel in his journey down the Atlantic coast in 1595 reported the use of nets by Spaniards in conjunction with boats and weirs (Garcia 1902). For at least part of the 16th Century, however, the use of nets was the exclusive priveledge of the Adelantado and Governors of Florida (Caceres 1574).Nonetheless, it could be that the 16th Century resident at SA 26-1 owned a net or was a member of a group owning a net, and consequently had access to larger quantities of mullet and other fish than the residents at the other sites studied.

SOCIAL STATUS AND FAUNAL COLLECTIONS

The social status of the 16th Century resident at the Leon site is unknown. It may be possible,however, to infer social status from the presence of the hypothetical net in conjunction with the material culture assemblage.Manufacture and maintanence of a net is expensive both in terms of capital outlay and of time. It is in recognition of this fact that it is common to find fishing equipment owned by a fishing group, or used by special arrangement with the owner. Ownership of fishing equipment, such as nets and boats, earns the owner special consideration in the division of the catch (Nietschmann 1973). When a group of people use a net or boat the equipment gets a share if it is not communally owned by the fishing group. In essence the owner of the equipment receives a double portion compared to other members of the party. While the increased production made possible through the use of such equipment may offset the extra cost interms of calories expended and obtained, the actual financial burden that such special equipment represents cannot be ignored when dealing with a stratified society such as that of Spanish St. Augustine where nets may have been reserved for the elite.

The larger quantities of mullet can be interpreted to indicate greater capital outlay by the 16th Century resident at the Leon site than by the other occupants whose debris has been studied so far. The large numbers of this fish indicate that a net was used either by household members, or by a fisherman whose catch was purchased by the household. In either case the resident of the lot was able to afford such things in a town chronically short of cash (Bushnell 1978b). This suggests that the residents at SA 26-1 enjoyed higher social standing in the town than the other residents studied so far.

Before accepting the possibility that the occupant at SA 26-1 may have been of the social elite, two other findings from the site should be considered. First, cattle were apparently a scarce resource in the 16th Century, and the resident at SA 26-1 did not have the same access to this resource as other 16th Century residents. This might indicate a lower social standing. On the other hand, the diversity of the material culture assemblage implies high social status. The interpretation that high mullet use indicates a net, which in turn suggests higher social standing correlates well with the interpretation suggested by the diversity in the material culture collections from the site, and it is this interpretation that is accepted here.

There is unfortunately no way to test this hypothesis at this time. As more faunal analysis is done on 16th Century sites from St.

Augustine it will be interesting to observe if the pattern of domestic biomass dominance, which at the moment appears to be the norm for both 16th and 18th Century collections, continues to prevail. It may be that the Joseph de Leon site faunal collection will prove to be the normal pattern for 16th Century subsistence activities rather than the varient that it appears to be at this time. In which case a re-interpretation will be necessary.

CONCLUSION

Analysis of the faunal assemblage from the Joseph de Leon site (SA 26-1) from St. Augustine has provided an opportunity to discuss two factors. The first of these is that not all historic, colonial sites yield faunal collections in which domestic animals proved to be the major animal resource. Secondly, the types of species identified provided information about the site's occupant not available in the documents. In this case, the dominant presence of an estuarine, herbivorous fish indicates not only the biotope most frequently exploited in the subsistence activity of the site's household, but the capture technique probably employed. By correlating this information with the material culture assemblage it has been possible to suggest which of two possible interpretations of social status is the most likely. In this way a pattern against which to measure sites to be analyzed in the future has been provided. While it may be that future studies will require a modification of the interpretation made here, the possibility that social status can be infered from the fauna at St. Augustine merits further study.

The information presented here has wider application. It may be that other colonial sites will be found where the major animal resources were wild rather than domestic. It should not be assumed that all colonists relied solely on domestic animals. As more historic collections are analyzed, it will be interesting to see if other correlations can be made between faunal collections and social status, preferably where the social status of the resident is known from the documents. Finally, analysis of the Joseph de Leon faunal materials demonstrates the value of considering the faunal and material culture assemblages as a unit rather than as discrete collections.

ACKNOWLEDGEMENTS

I would like to thank the Historic St. Augustine Preservation Board and Kathleen A. Deagan for the opportunity to work with the Joseph de Leon faunal materials. Elizabeth S. Wing, Kathleen A. Deagan, and Charles H. Fairbanks have read an earlier version of this paper, and I appreciate their helpful suggestions. ~~They should not be held responsible for the interpretation of these data, however.~~ Additionally I appreciate the assistance of Theresa Singleton. These people should not be held responsible for the interpretation of these data, however.

TABLE 1. SUMMARY OF MNI AND BIOMASS MEAN PERCENTILES FOR FAUNAL GROUPS IDENTIFIED FROM SPANISH ST. AUGUSTINE*

FAUNAL GROUPS	MNI	BIOMASS
DOMESTIC ANIMALS	15.8%	66.5%
WILD TERRESTRIAL	12.2%	14.2%
FISH	59.2%	17.5%
AQUATIC REPTILES	3.5%	0.8%
WILD BIRDS	5.7%	0.9%

* Table includes data from SA 26-1

TABLE 2. REGRESSION FORMULAE USED IN ESTIMATING BIOMASS OF ANIMALS REPRESENTED IN STUDY.

ANIMAL	NUMBER	FORMULAE ($Y = bX^a$)	r	MEASUREMENT
MAMMAL[1]	49	Y, Kgs. = $0.061\ (X)^{1.09}$	0.99	SKELETAL WEIGHT (Y) BODY WEIGHT (X)
BIRDS [1]	311	Y, Kgs. = $0.065\ (X)^{1.071}$	0.99	"
TURTLES	20	Y, Kgs. = $0.248\ (X)^{.8984}$	0.91	"
SNAKES [2]	17	Y, Kgs. = $0.727\ (X)^{.9857}$	0.98	"
CHONDRICHTHYES	9	Y, Kgs. = $0.0116(X)^{.9786}$	0.91	"
OSTEICHTHYES	486	Y, Kgs. = $0.0438(X)^{0.9528}$	0.92	"
non-PERCIFORMES	406	Y, Kgs. = $0.0468(X)^{1.021}$	0.95	"
SILURIFORMES	13	Y, Kgs. = $0.0433(X)^{0.887}$	0.96	"
PLEURONECTIFORMES	20	Y, Kgs. = $0.053\ (X)^{1.081}$	0.97	"
PERCIFORMES	406	Y, Kgs. = $0.0401(X)^{.9061}$	0.89	"
SERRANIDAE	33	Y, Kgs. = $0.0364(X)^{0.9374}$	0.96	"
SPARIDAE	22	Y, Kgs. = $0.0803(X)^{1.055}$	0.99	"
SCIAENIDAE	63	Y, Kgs. = $0.0380(X)^{1.012}$	0.93	"
CENTRACHIDAE	29	Y, Kgs. = $0.0759(X)^{0.9749}$	0.83	"

[1] Prange et al, in press
[2] Arlene Fradkin, personal communication

TABLE 3. SPECIES LIST FOR THE LORENZO JOSEF DE LEON SITE (SA 26-1)

SPECIES	NO. FRAGMENTS	NO. MNI	%MNI	WT,GMS.	BIOMASS,KGS.	% BIOMASS
Unidentified Mammal	4290			2866.4	34.19	22.92
Didelphis virginiana Opossum	1	1	0.2	1.1	0.03	0.02
Sylvilagus sp. Rabbit	48	7	1.6	32.0	0.55	0.4
Sciurus sp. Squirrel	2	1	0.2	0.5	0.01	0.007
Sigmodon hispidus Hispid Cotton Rat	2	2	0.4	1.0	0.02	0.01
Rattus rattus Roof Rat	2	2	0.4	1.1	0.03	0.02
Carnivora Carnivore	1			0.7	0.02	0.01
Canidae Dog Family	1			6.2	0.12	0.08
cf. *Canis* sp. possible Dog	1			2.3	0.05	0.03
Canis familiaris Domestic Dog	2	1	0.2	1.0	0.02	0.01
Procyon lotor Raccoon	6	5	1.1	11.1	0.21	0.1
Felidae Cat Family	2			1.0	0.02	0.01
Felis domesticus Domestic Cat	3	3	0.7	8.3	0.16	0.1
Artiodactyl Ungulates	40			88.2	1.40	0.9
Sus scrofa Pig	152	14	3.1	982.3	12.80	8.6
Odocoileus virginianus White-tailed Deer	73	10	2.2	600.7	8.15	5.5
Bos taurus Cow	7	2	0.4	145.5	2.22	1.5

TABLE 3 (cont.)

SPECIES	NO. FRAGMENTS	NO.MNI	% MNI	WT,GMS.	BIOMASS,KGS.	%BIOMASS
Capra/Ovis sp.						
Goat or Sheep	2	1	0.2	3.1	0.07	0.05
Unidentified Bird	339			112.7	1.67	1.1
Branta canadensis						
Canada Goose	1	1	0.2	2.9	0.06	0.04
Anatidae						
Duck Family	2			1.8	0.04	0.03
Anas cf. *platyrhincos*						
possible Mallard	2			2.8	0.05	0.03
Anas platyrhincos						
Mallard	7	3	0.7	12.2	0.21	0.1
Anas rubripes						
Black Duck	1	1	0.2	1.1	0.02	0.01
Anas cf. *fulvigula*						
possible Florida Duck	1	1	0.2	2.3	0.04	0.03
Anas strepera						
Gadwell	1	1	0.2	2.9	0.06	0.04
Anas carolinensis						
Green-Winged Teal	12	3	0.7	5.8	0.11	0.07
Anas discors						
Blue-winged Teal	3	1	0.2	1.5	0.03	0.02
Coragyps atratus						
Black Vulture	1	1	0.2	0.9	0.02	0.01
Accipitrinae						
Hawks, Eagles, and Kites	1	1	0.2	0.5	0.01	0.006
Colinus virginianus						
Bob-white	4	3	0.7	1.7	0.03	0.02
Gallus gallus						
Chicken	157	15	3.3	134.1	1.97	1.3
Meleagris gallopavo						
Turkey	6	2	0.4	20.5	0.34	0.2
Grus canadensis						
Sandhill Crane	2	2	0.4	7.5	0.13	0.09

TABLE 3 (cont.)

SPECIES	NO. FRAGMENTS	NO.MNI	%MNI	WT,GMS.	BIOMASS,KGS.	%BIOMASS
Rallidae						
Rail and Coot Family	1			0.5	0.01	0.007
Charadrius vociferus						
Killdeer	1	1	0.2	0.4	0.009	0.006
Capella gallinago						
Wilson's Snipe	3	2	0.4	2.1	0.04	0.03
Catoptrophorus semipalmatus						
Willet	3	2	0.4	1.2	0.02	0.01
Zenaidura macroura						
Mourning Dove	1	1	0.2	0.7	0.02	0.01
Passeriformes						
Perching Birds	7			1.9	0.04	0.03
Corvidae						
Jays and Crows	1			0.5	0.01	0.007
Corvus ossifragus						
Fish Crow	1	1	0.2	0.6	0.01	0.007
Turdidae						
Thurshes and Bluebirds	1	1	0.2	0.7	0.02	0.01
Unidentified Turtle	485			243.3	0.98	0.7
Kinosternon sp.						
Mud Turtle	2	1	0.2	0.9	0.002	0.001
Emydidae						
Box and Water Turtles	1			2.5	0.01	0.007
Terrapene carolina						
Box Turtle	2	1	0.2	3.0	0.02	0.01
Malaclemys terrapin						
Diamondback Terrapin	20	3	0.7	14.6	0.07	0.05
Chrysemys cf. *scripta*						
possible Yellow-bellied Turtle	1	1	0.2	1.2	0.007	0.005
cf. *Gopherus polyphemus*						
possible Gopher Tortoise	11			23.7	0.16	0.1
Gopherus polyphemus						
Gopher Tortoise	190	12	2.7	257.0	1.42	1.0

TABLE 3 (cont.)

SPECIES	NO. FRAGMENTS	NO.MNI	%MNI	WT.GMS.	BIOMASS,KGS.	%BIOMASS
Cheloniidae Sea Turtles	3	2	2.7	3.5	0.009	0.006
Colubridae Snakes	1			0.6	0.008	0.005
Nerodia sp. Water Snake	1	1	0.2	0.1	0.001	0.001
Coluber constricta Racer	52	1	0.2	3.7	0.05	0.03
Agkistrodon piscivorous Cotton mouth Snake	2	1	0.2	1.4	0.02	0.01
Unidentified Amphibian	1			0.4	0.003	0.002
Rana/*Bufo* sp. Frog or Toad	38			5.8	0.04	0.03
Bufo sp. Toad	7	4	0.9	1.8	0.01	0.007
Rana sp. Frog	1	1	0.2	0.5	0.003	0.002
Chondrichthyes Cartilageneous Fish	3			1.2	0.10	0.07
Carcharhinidae Requiem Sharks	6			2.0	0.17	0.1
Carcharhinus sp. Requiem Sharks	38			53.7	4.79	3.2
Carcharhinus leucas Bull Shark	2	2	0.4	0.3	0.02	0.01
Carcharhinus milberti Sandbar Shark	5	3	0.7	6.7	0.57	0.4
Galeocerdo cuvieri Tiger Shark	4	4	0.9	7.0	0.60	0.4
Sphyrna sp. Hammerhead Sharks	19			14.0	0.21	0.8
Sphyrna mokorran Great Hammerhead Shark	1	1	0.2	0.7	0.06	0.04

TABLE 3 (cont)

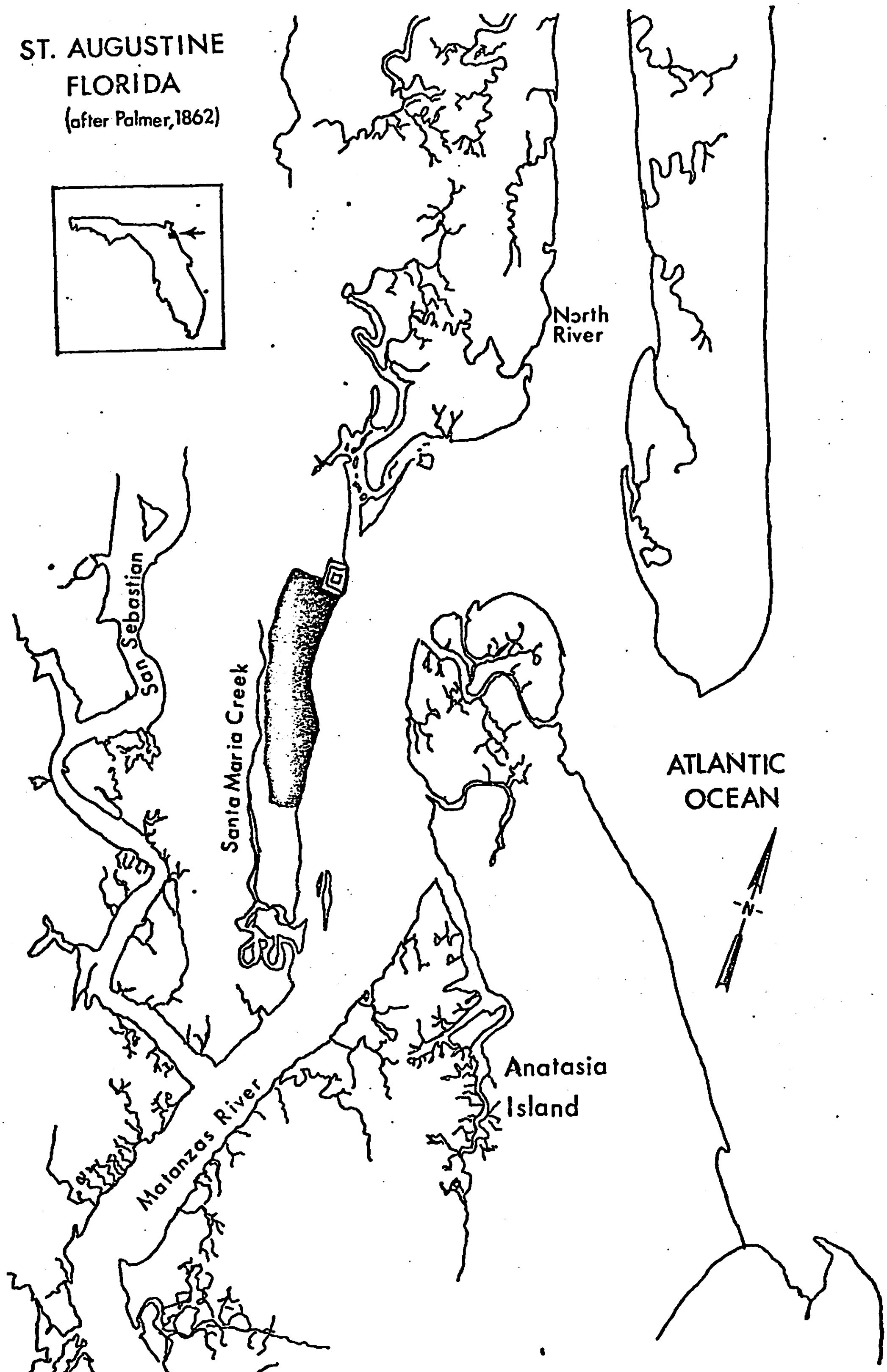
SPECIES	NO. FRAGMENTS	NO.MNI	%MNI	WT.GMS.	BIOMASS,KGS.	%BIOMASS
Sphyrna tiburo						
Bonnethead Shark	15	2	0.4	7.4	0.63	0.4
Sphyrna zygaena						
Smooth Hammerhead Shark	2	2	0.4	1.1	0.09	0.06
Pristis cf. pectinata						
possible Smalltooth Sawfish	1	1	0.2	7.3	0.62	0.4
Unidentified Fish	7268			1636.6	44.70	29.96
Ictaluridae						
Freshwater Catfishes	4	2	0.4	1.8	0.03	0.02
Ariidae						
Sea Catfishes	391			76.4	1.90	1.3
Arius felis						
Sea Catfish	621	39	8.6	179.0	4.95	3.3
Bagre marinus						
Gafftopsail Catfish	33	5	1.1	13.4	0.27	0.18
Opsanus tau						
Oyster Toadfish	1	1	0.2	0.4	0.009	0.006
Centropomus sp.						
Snook	3	1	0.2	2.8	0.05	0.03
Centropristis sp.						
Sea Bass	1	1	0.2	0.4	0.008	0.005
Micropterus salmoides						
Largemouth Bass	1	1	0.2	0.6	0.007	0.005
Pomatomus saltatrix						
Bluefish	4	2	0.4	1.4	0.03	0.02
Sparidae						
Porgies	1			0.4	0.007	0.005
Archosargus probatocephalus						
Sheepshead	163	22	4.9	47.8	0.61	0.4
Sciaenidae						
Drum Family	707			140.6	3.64	2.4
Cynoscion sp.						
Sea Trout	63	12	2.7	15.0	0.40	0.3

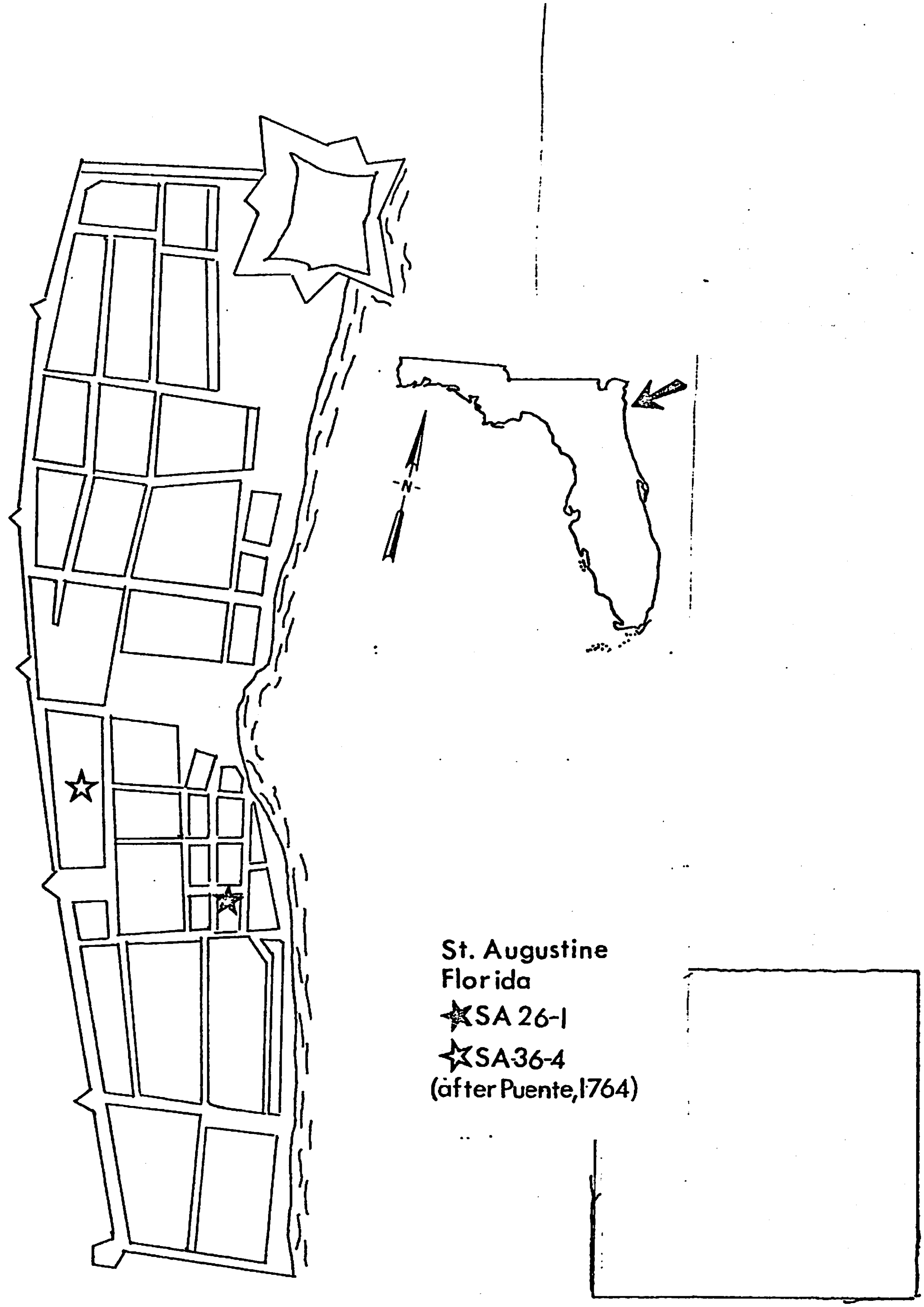
TABLE 3 (cont)

SPECIES	NO.FRAGMENTS	NO.MNI	%MNI	WT.GRM.	BIOMASS,KGS.	%BIOMASS
Cynoscion nebulosis						
Spotted Sea Trout	15			2.2	0.06	0.04
Leiostomus xanthurus						
Spot	2	2	0.4	0.8	0.02	0.01
Menticirrhus sp.						
Kingfish	14	6	1.3	4.9	0.13	0.09
Micropogonias undulatus						
Atlantic Croaker	27	8	1.8	8.7	0.23	0.15
Pogonias cromis						
Black Drum	94	16	3.5	84.5	2.20	1.50
Scianops ocellata						
Red Drum or Red Fish	176	23	5.1	170.4	4.41	3.0
Mugil sp.						
Mullet	2001	168	37.3	269.0	8.17	5.5
Paralichthyes lethostigma						
Southern Flounder	113	9	2.0	32.2	0.63	0.4
Unidentified Bone				204.0		
TOTAL	24238	453		8631.0	149.17	

TABLE 4. SUMMARY OF MNI AND BIOMASS FROM SA 26-1, BY GROUP.

GROUP	MNI		BIOMASS	
	#	%	KGS	%
DOMESTIC ANIMALS	36	8.0	17.24	32.1
WILD TERRESTRIAL	37	8.2	10.39	19.3
WILD BIRDS	28	6.2	1.18	2.2
AQUATIC REPTILES	7	1.6	0.09	0.2
FISH AND SHARKS	333	73.5	24.74	46.0
COMMENSAL SPECIES	12	2.7	0.13	0.2
TOTALS	453		53.77	


ST. AUGUSTINE
FLORIDA
(after Palmer, 1862)
North River
San Sebastian
Santa Maria Creek
ATLANTIC OCEAN
N
Anatasia Island
Matanzas River


N
St. Augustine
Florida
SA 26-1
SA-36-4
(after Puente, 1764)

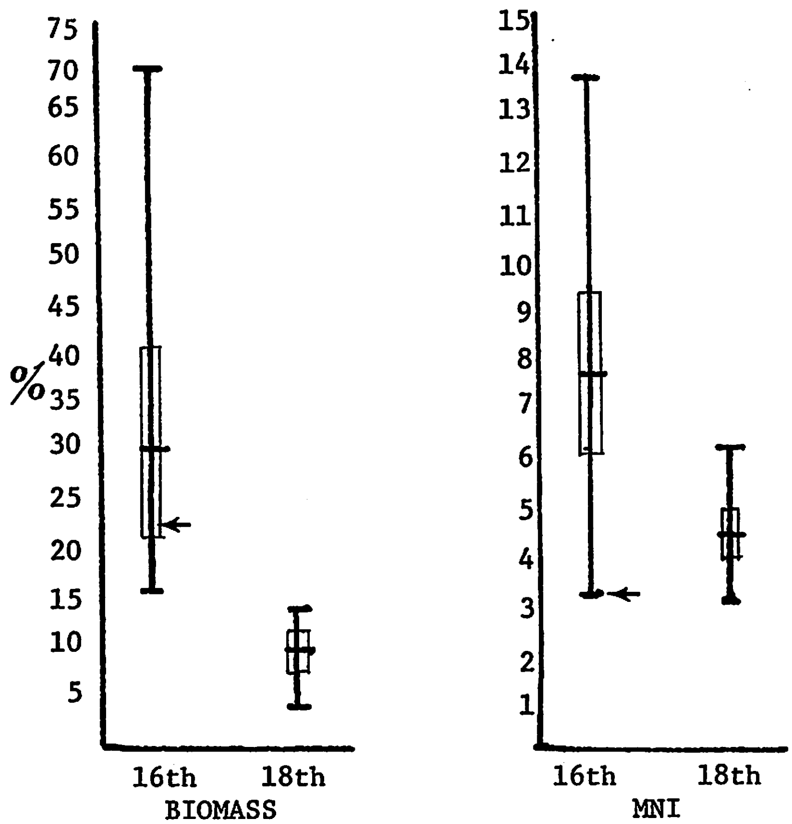


FIG. 3 RANGE AND MEAN OF PERCENTILE CONTRIBUTION OF SUS SCROFA BIOMASS AND MNI FOR 16TH AND 18TH CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

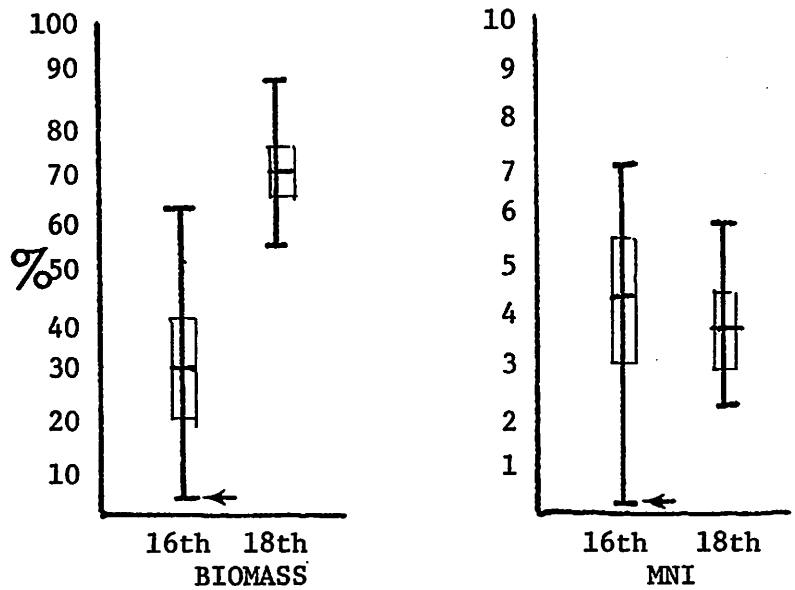


FIG. 5 RANGE AND MEAN PERCENTILE CONTRIBUTION OF <u>BOS TAURUS</u> BIOMASS AND MNI FOR 16TH AND 18TH CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

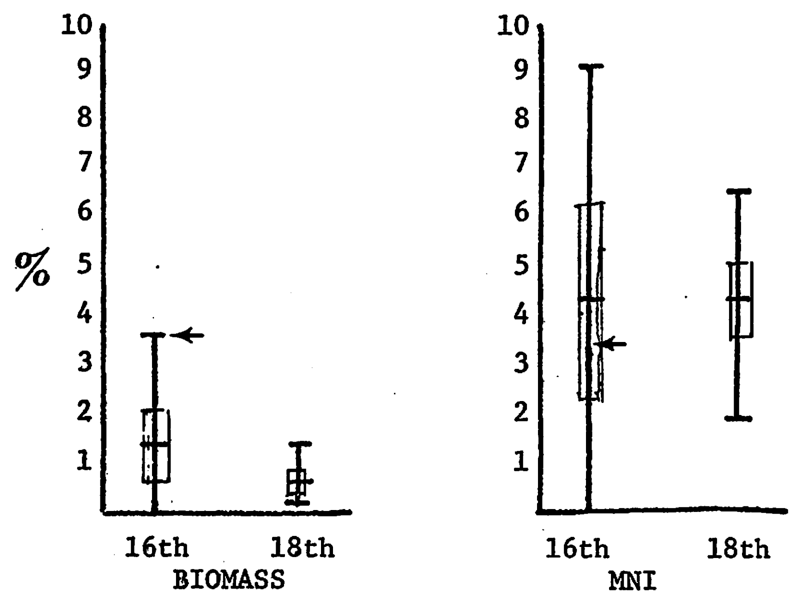


FIG. 4 RANGE AND MEAN PERCENTILE CONTRIBUTION OF GALLUS GALLUS BIOMASS AND MNI FOR 16TH AND 18TH CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

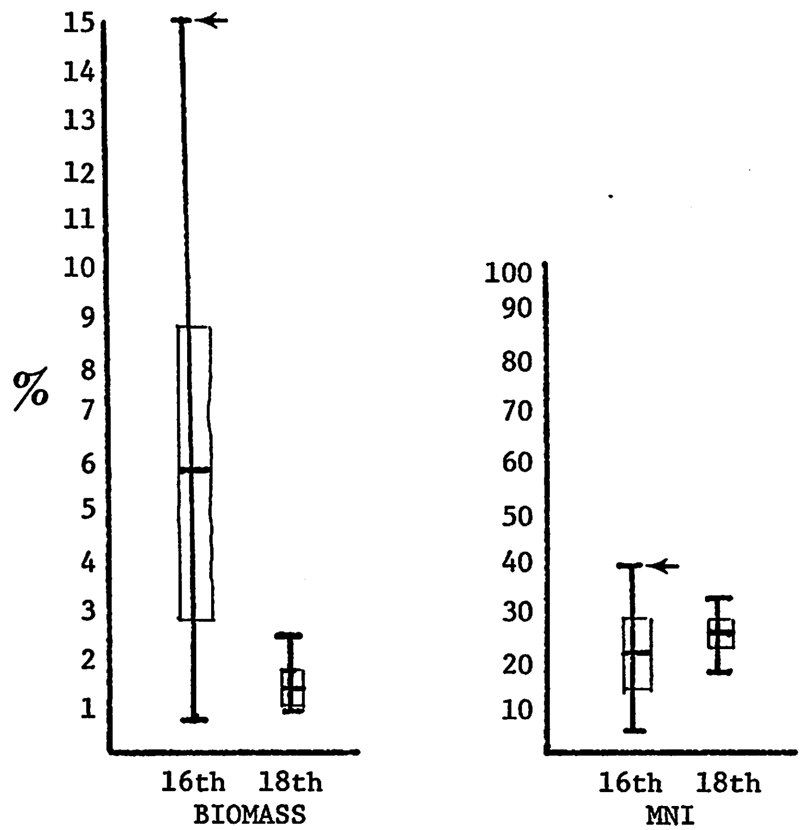


FIG. 6 RANGE AND MEAN PERCENTILE CONTRIBUTION OF _MUGIL_ SP. BIOMASS AND MNI FOR 16TH AND 18TH CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

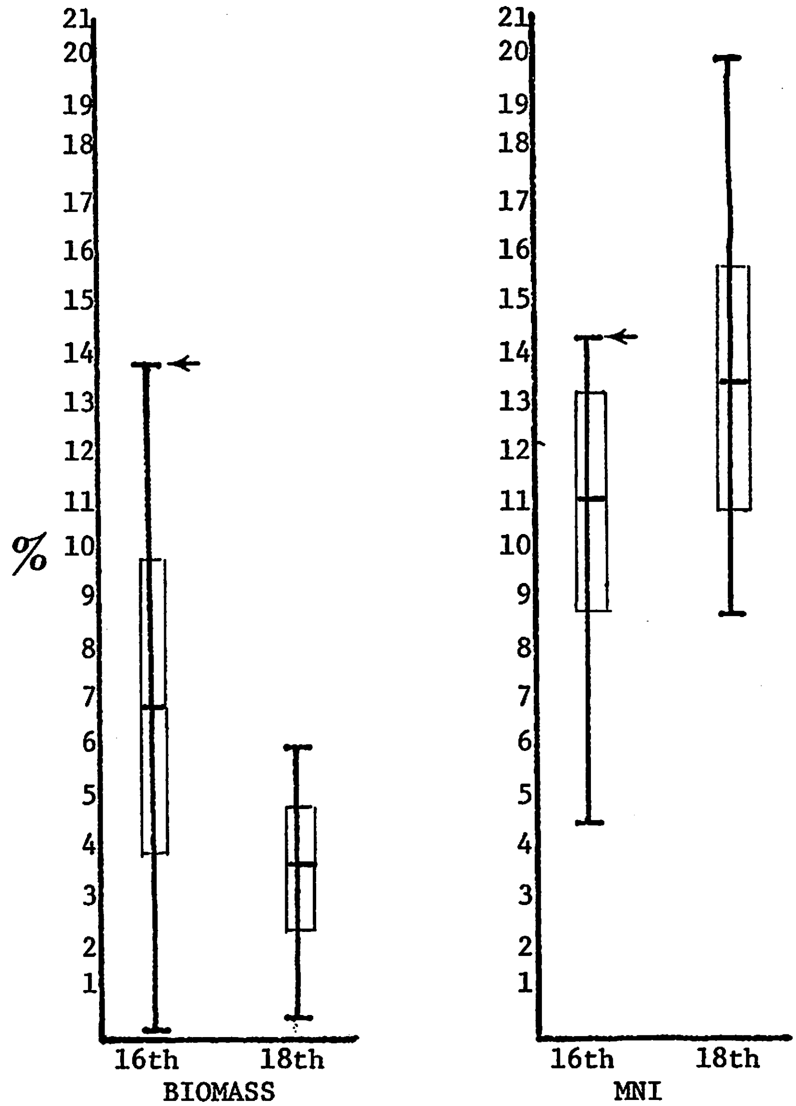


FIG. 7 RANGE AND MEAN PERCENTILE CONTRIBUTION OF SCIAENIDAE BIOMASS AND MNI FOR 16TH AND 18th CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

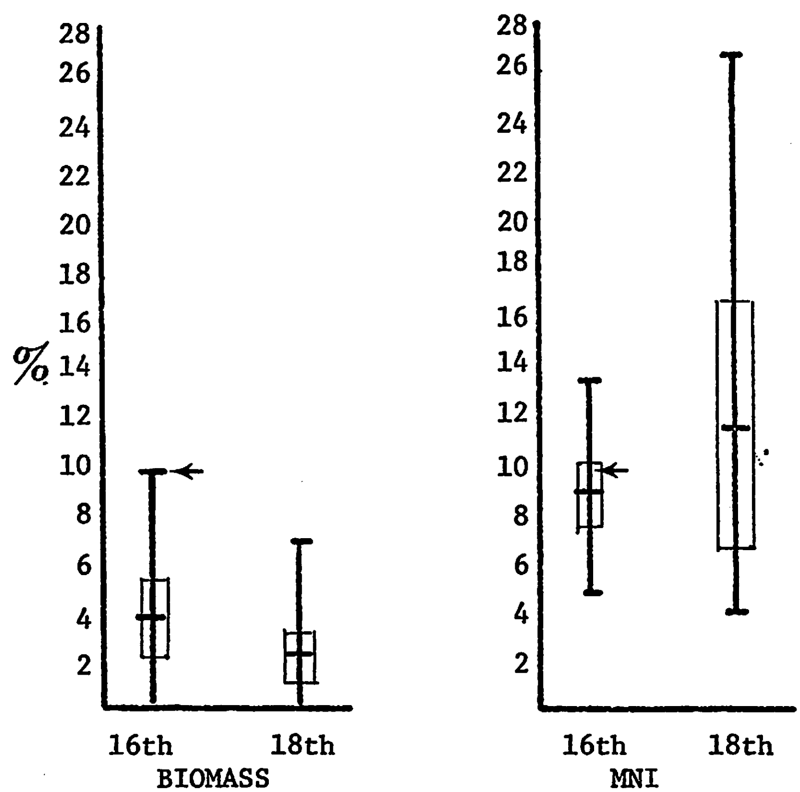


FIG. 8 RANGE AND MEAN PERCENTILE CONTRIBUTION OF ARIIDAE BIOMASS AND MNI FOR 16TH AND 18TH CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

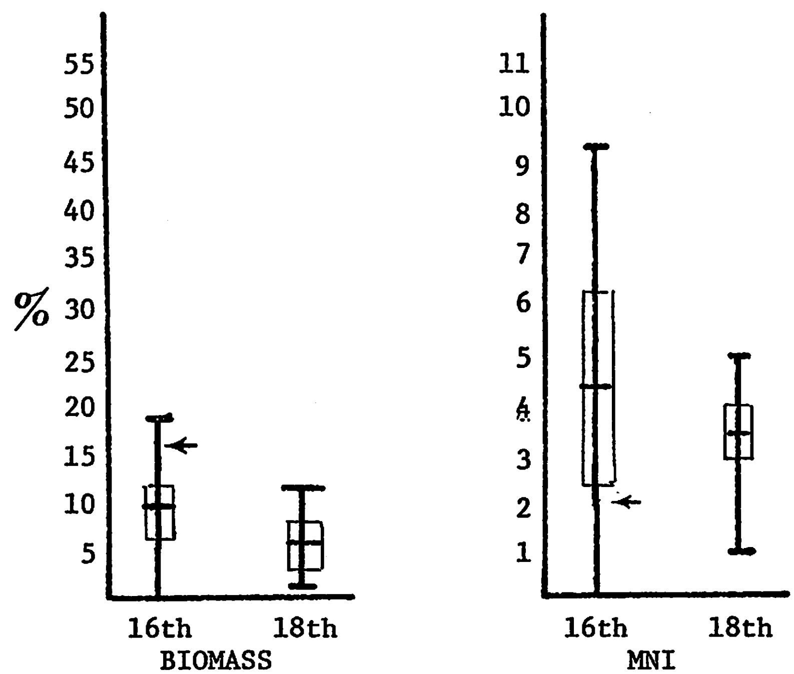


FIG. 9 RANGE AND MEAN OF PERCENTILE CONTRIBUTION OF <u>ODOCOILEUS VIRGINIANUS</u> BIOMASS AND MNI FOR 16TH AND 18TH CENTURY SPANISH ST. AUGUSTINE SITES. SA 26-1 INDICATED BY ARROW.

BIBLIOGRAPHY

Arnade, Charles W.
1965 "Cattle Raising in Spanish Florida." St. Augustine Historical Society Publication 21 (1961).

Booth, Sally S.
1971 Hung, Strung, and Potted: A History of Eating in Colonial America. Clarkson N. Potter, New York.

Braley, Chad O.
1977 "Excavations at the Joseph de Leon Site, 1977 Season." MA on file, Historic St. Augustine Preservation Board, St. Augustine.

Bushnell, Amy
1978a "The Menendez Marquez Cattle Barony at La Chua and the Determinants of Economic Expansion in Seventeenth Century Florida." Florida Historical Quarterly 56:4:407-431.

1978b Privilege and Obligation: The Officials of the Florida Caja Real, 1565-1702. Ph.D. Dissertation. University of Florida, Gainesville.

Caceres, Alonso de
1574 Manuscript. 1-1-1/19 R^{0} 33. J. T. Conner Papers, Reel 2. P.K. Yonge Library, University of Florida, Gainesville.

Casteel, Richard W.
1978 "Faunal Assemblages and the 'Wiegemethode' or Weight Method." Journal of Field Archaeology 5:72-77.

Chatelain, Verne E.
1941 "The Defenses of Spanish Florida: 1565-1763." Carnegie Institution Publication 511.

Conner, Jeannette T., trans. and ed.
1927-1930 Colonial Records of Spanish Florida, 2 vols. Vol 1, 1570-1577; Vol. 2, 1577-1580. Florida State Historical Society, Deland.

Cumbaa, Stephen L.
1975 Patterns of Resource Use and Cross-Cultural Dietary Change in the Spanish Colonial Period. Ph.D. Dissertation. University of Florida, Gainesville.

Deagan, Kathleen A.
1978 "Archeological Strategy in the Investigation of an Unknown Era: Sixteenth Century St. Augustine." Project Report to St. Augustine Restoration Foundation, St. Augustine.

Deagan, Kathleen A.
1979 "The Material Assemblage of 16th Century Spanish Florida." Historical Archaeology

Emerson, Thomas E.
1978 "New Method for Calculating the Live Weight of the Northern White-tailed Deer from Osteoarchaeological Material." Mid-Continental Journal of Archaeology 3:1:35-44.

Garcia, Genaro
1902 Dos Antiguas Relaciones de la Florida. J. Aguilar Vera y Comp., Mexico City.

Grayson, Donald K.
1973 "On Methodology of Faunal Analysis." American Antiquity 38: 4:432-438.

Grinan, Pedro Sanchez
1757 "Relacion MSS 11.265: 1725, 1750, 1792, 1800." trans. by Jesus Maria Belmonte. MS on file, Historic St. Augustine Preservation Board, St. Augustine.

Hardesty, Donald L.
1975 "The Niche Concept: Suggestions for Its Use in Human Ecology." Human Ecology 3:2:71-85.

Hilliard, Sam B.
1972 Hogmeat and Hoecake: Food Supply in the Old South, 1840-1860. Southern Illinois University Press, Carbondale.

Lyon, Eugene
1977 The Enterprise of Florida. University of Florida Press, Gainesville.

McClane, A. J.
1974 Field Guide to Saltwater Fishes of North America. Holt, Rinehart, and Winston, New York.

McLane, William McNair
1955 The Fishes of the St. Johns River System. Ph.D. Dissertation. University of Florida, Gainesville.

Nietschmann, B.
1973 Between Land and Water: The Subsistence Ecology of the Miskito Indians, Eastern Nicaragua. Seminar Press, New York.

Parmalee, Paul, and Walter E. Klippel
1974 "Freshwater Mussels as a Prehistoric Food Resource." American Antiquity 39:3:421-434.

Pedley, T. J. ,ed.
1977Scale Effects in Animal Locomotion. Academic Press, New York.

Poe, Charles Boyce
in prep Status Variability in 18th Century Criollo Culture. MA Thesis. Florida State University, Tallahassee.

Prange,Henry E., John F. Anderson, and Hermann Rahn
1979 "Scaling of Skeletal Mass to Body Mass in Birds and Mammals." American Naturalist 113:1:103-122.

Reitz, Elizabeth J.
1979 Spanish and British Subsistence Strategies at St. Augustine, Florida and Frederica, Georgia, Between 1565 and 1783. Ph.D. Dissertation. University of Florida, Gainesville.

Rouse, John E.
1977 The Criollo. University of Oklahoma Press, Norman.

Sauer, Carl Ortwin
1969 The Early Spanish Main. University of California Press, Berkeley.

Shannon, C. E., and W. Weaver
1949 The Mathematical Theory of Communication. University of Illinois Press, Urbana.

Sheldon, A. L.
1969 "Equitability Indices: Dependence on the Species Count." Ecology 50:466-467.

Singleton, Theresa
1977 The Archaeology of a pre-18th Century House Site in St. Augustine. MA Thesis. University of Floirda, Gainesville.

Smith, Bruce D.
1975 "Toward a More Accurate Estimation of the Meat Yield of Animal Species at Archaeological Sites." In Archaeozoological Studies, edited by A. T. Clason, pp. 99-106. American-Elsevier Publishing Company, New York.

Tepaske, John J.
1958 "Economic Problems of Florida Governors, 1700-1763." Florida Historical Quarterly 37:1:42-52.

1964 The Governorship of Spanish Florida: 1700-1763. Duke University Press, Durham.

Towne, Charles Wayland, and E. N. Wentworth
1950 Pigs: From Cave to Cornbelt. University of Oklahoma Press, Norman.

Watt, Bernice K., and Annabell L. Merrill
1963 Composition of Foods. U.S.D.A. Agriculture Handbook 8, Washington, D. C.

Weeden, William B.
1890 Economic and Social History of New England, 1620-1789. Houghton-Mifflin, New York.

White, Theodore
1953 "A Method of Calculating the Dietary Percentage of Various Food Animals Utilized by Aboriginal Peoples." American Antiquity 18:4:396-398.

Wing, Elizabeth S.
1973 "Subsistence Sustems in the Southeast." Paper presented to the Society for American Archaeology, Memphis, Tennessee.

1976 "Ways of Going from a Sliver of Bone to a Calorie." Paper presented to the Society for American Archaeology, St. Louis, Missouri.

Wing, Elizabeth S. and Antoinette B. Brown
in press Prehistoric Foodways: Method and Theory in Paleonutrition. Academic Press, New York.

Palmer, W. R.
1862 "Preliminary Chart of St. Augustine Harbor, Florida." U.S. Coast and Geodetic Survey, Record Group 23, Chart 456, edition 1. National Archives and Records Service, Washington, D. C.

Puente, Juan Joseph Elixio de la
1764 "Plano de la Real Fuerza, Baluarte, y Linea de la Plaze de Sn. Augustin de la Florida." Buckingham Smith Collection. Reel 2, P.K. Yonge Library, University of Florida, Gainesville.