FAUNAL REMAINS FROM MIXON'S HAMMOCK, OKEFENOKEE SWAMP

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This study examines faunal materials recovered from a Savannah period aboriginal site in the Okefenokee Swamp. Overall, mammalian fauna made a small contribution to the diet with primary emphasis upon fishes and turtles. Analyses from other wetland sites within the southeastern interior show a similar pattern of resource exploitation. While the sites are located in freshwater settings, they differ in length of occupancy and time of occupation. These data demonstrate the potential productivity of wetland habitats scattered throughout the Coastal Plain offering a rich and varied subsistence available on a multi-seasonal basis.

In the past fifteen years, economic and ecological models of adaptation and behavior have come to dominate archaeological inquiry. Subsistence research is part of this trend. One result of an economic/ecological approach to subsistence investigations is the concept that site location, resource potential, and subsistence pursuits are intimately linked. In the early 1970s, E. S. Higgs and C. Vita-Finzi (1972) and Jarman (1972) applied site catchment analysis to inquiries concerning subsistence. These researchers showed that site location and the surrounding resource potential could be used to predict subsistence pursuits. Vita-Finzi and Higgs proposed that people will regularly exploit a five to ten kilometer area surrounding their residence before costs exceed benefits.

While archaeologists recognize the importance of site location to resource use, they also acknowledge other factors which contribute to differences in subsistence behavior. Procurement strategies and technology available to the occupants provide opportunities and constraints on subsistence that will be reflected in faunal analysis. Subsistence decisions are influenced by choice, demand, and labor available. While each of these cultural factors, as well as others, influence subsistence behavior, the site catchment model has archaeological validity.

Subsistence studies in the southeastern Coastal Plain have emphasized two types of aboriginal strategies, dependant upon site location and exploitable resources. Broadly defined, these strategies involve a reliance upon marine fauna in estuarine settings versus terrestrial fauna in interior settings. Excavations at sites on the southeastern Atlantic coast have consistently produced faunal samples indicating extensive use of fish and shellfish (Reitz 1987). Reitz and Quitmyer (1988) suggest that estuarine resources on the Atlantic coast sustained aboriginal populations on a multi-seasonal basis.

Animal-related subsistence strategies on the southeastern coast are relatively well documented, though the coverage is far from exhaustive. Far less is known of aboriginal animal use in the southeastern interior, particularly the interior Coastal Plain. The southeastern Coastal Plain is included in the "temperate deciduous forest" biome (Shelford 1974:56–64). As Shelford notes, this area consists of an extensive ecotone of longleaf pine (*Pinus palustris*) interspersed with magnolia and oak-hickory forests. Lewis Larson (1980) refers to the interior southeastern Coastal Plain as the pine barrens sector. According to Larson (1980:36), the interior boundary of the pine barrens is defined by the Fall Line Hills of the Atlantic and Gulf slopes, and the coastal border by the upper limits of tidal influence in rivers draining into the Atlantic Ocean and Gulf of Mexico. Prior to European disruption, the pine barrens consisted of longleaf pine forest extending over large areas of well-drained uplands, broken by localized deciduous and evergreen broadleaf forests adjacent to the rivers.

Faunal resources of the pine forests are relatively meager (Shelford 1974:78). Larson notes that terrestrial game was largely restricted to deer, bear, and wild turkey (1980:56). However, interspersed among the pine forests were poorly drained areas or water courses supporting expansive stretches of deciduous and broad leafed evergreen forest. Here faunal resources were rich, including both terrestrial and aquatic species. Larson recognized the potential productivity of the localized wetland habitats within the pine barrens sector when he noted that faunal resources there were limited primarily to floodplains, bays, and swamps (1980:52).

An archaeological faunal sample from the Okefenokee Swamp offers an opportunity to examine the contribution of southeastern interior Coastal Plain wetland habitats to human diets. In the following, data are presented from a zooarchaeological analysis of a Savannah period Mississippian site in the Oke-

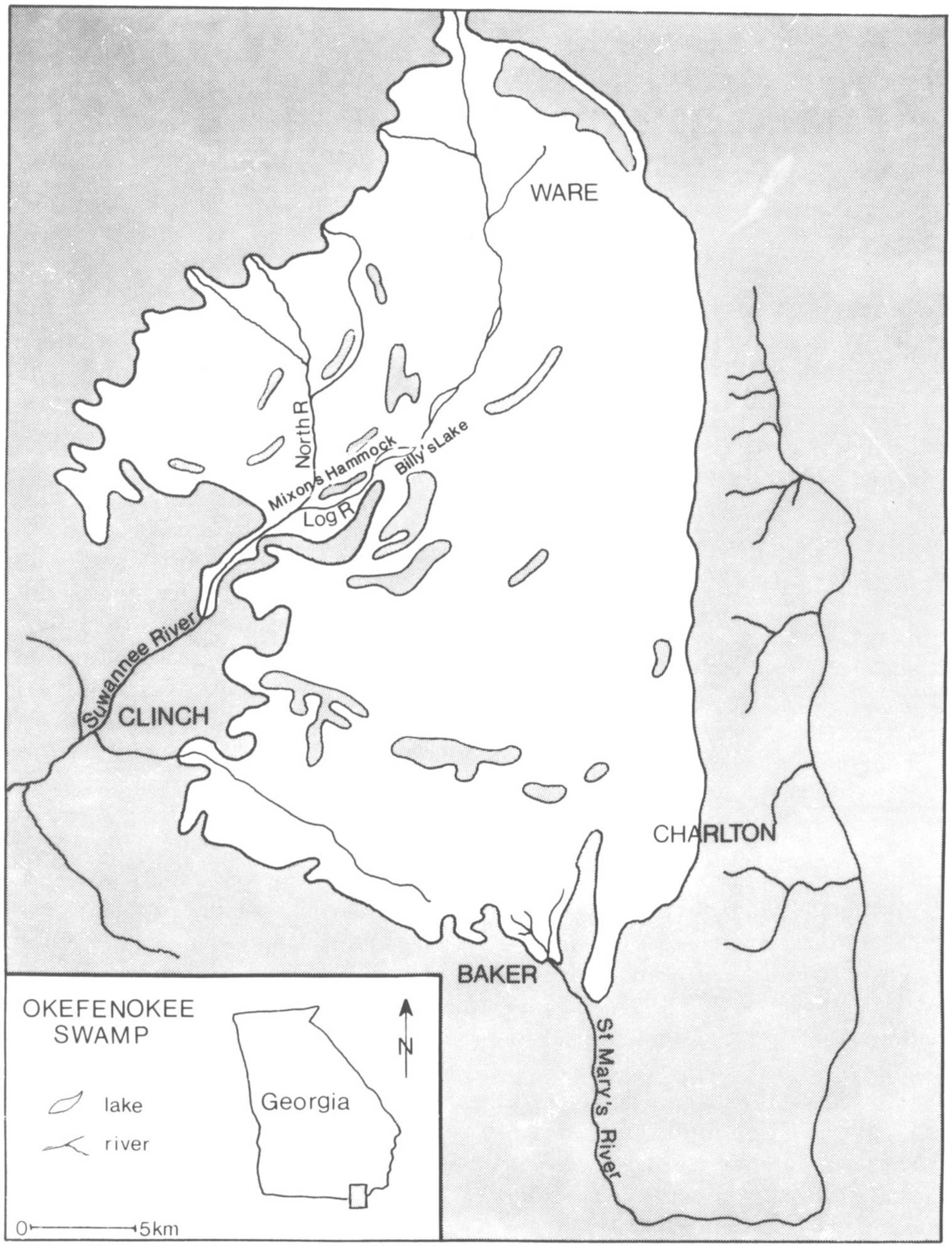

Figure 1. Location of Okefenokee Swamp and Mixon's Hammock.

fenokee Swamp. Results suggest that the Okefenokee provided a rich and varied resource base which was extensively used, and which was capable of sustaining multi-seasonal human occupation.

Okefenokee Swamp

The Okefenokee Swamp, covering almost 2,000 km^2, is the largest freshwater wetland in the United States. The swamp is located in Charlton, Clinch, Echols, and Ware Counties, Georgia and Baker and Columbia Counties, Florida (Figure 1). The Okefenokee has been described as "a most blissful spot of earth" (Harper and Presley 1974:5), with "more fish and better sport than any water space covering the same area in the world" (McQueen and Mizell 1926:47).

Debate continues concerning the origin of the swamp, but recent evidence suggests the organic substrate began developing 6,500 years ago under freshwater conditions (Cohen 1974; Laerm and Freeman 1986:14). Trowell (1979) has conducted an archaeological reconnaissance of the Okefenokee. He notes that the swamp appears to have been uninhabited prior to 4,000 B.P., although evidence of earlier occupation may be buried in the peat. Absence of substantial artifact occurrences and village/mound sites dating earlier than 1,500 years B.P. leads Trowell to suggest that between 4,000 and 1,500 years B.P., aboriginal occupation consisted of temporary camps established on the higher islands and along the swamp periphery. It was not until 1,500–2,000 years B.P. that Trowell believes permanent aboriginal settlements were established within the swamp.

The climate of the Okefenokee is subtropical due to the influence of tropical maritime air masses of the Gulf of Mexico and Atlantic Ocean. The seasons consist of dry, warm autumns; cool, moist winters; warm, moist springs, and hot, wet summers. Mean annual precipitation in the swamp is 128.5 cm with almost half of this restricted to the summer months. Winter is the driest season during which precipitation contributes less than 15 percent of the mean annual total. Mean annual temperature is 19.6° C with significant fluctuations occurring only during the winter months (Laerm and Freeman 1986:12; Rykiel 1984).

The Okefenokee Swamp is fed by rainfall and stream runoff from the northwest. Eighty-nine percent of the swamp is drained by the Suwannee River and 11 percent by St. Mary's River (Auble 1982). Waterways include prairies, streams, rivers, sloughs, ponds, and lakes. Water currents within the swamp are low to absent. Laerm and Freeman (1986:9) note that water depth may reach up to eight feet (2.5 m) but averages only two feet (0.6 m).

The vegetation of the swamp is a complex mosaic of forested uplands and wetlands. Pine (*Pinus elliotti*) forests occur only on the raised hammocks or islands, and the uplands surrounding the swamp. Semi-flooded or flooded wetlands dominate the swamp, and include scrub/shrub swamps; mixed wetland forests dominated by cypress (*Taxodium ascendens*), blackgum (*Nyssa sylvatica*), or bay (e.g., *Gordonia lasianthus*); and prairies. Prairies are shallow marshes of grasses and sedges (*Panicum* sp. and *Carex* sp.), or mixed aquatic beds of floating leaf vegetation and submerged hydrophytes. Small islands or "peat batteries" are found in the more shallow areas of the aquatic prairies (McCaffrey and Hamilton 1984).

The extent and distribution of the vertebrate fauna in the modern swamp differ somewhat from that of the recent past. Timber harvesting and water control projects are responsible for the disruption of the swamp habitat. Timber harvesting during the early twentieth century removed over 1.5 million m^3 of cypress and 0.5 million m^3 of pine from the swamp (Izlar 1984). Today, over 400 species of vertebrates live in the swamp and the surrounding uplands (Laerm et al. 1984).

Site Environment

Mixon's Hammock is located in the northwest quadrant of the Okefenokee Swamp in southwest Charlton County, Georgia (Figure 1). The hammock is bordered on the southeast by Log River and on the west by North River. Both rivers are small, sluggish tributaries which join the Suwannee River 5 km to the southwest. About 3 km northeast of the hammock is the largest lake in the swamp, Billy's Lake, over 5 km in extent.

The site is located on the extreme northern tip of Mixon's Hammock. All of the principal habitat types of the swamp are present within a 5 km radius of the site (Figure 2). Pine forests constitute only about 15 percent of this area. The remaining 85 percent is semi-flooded or flooded wetlands. Within this 5 km radius of the site, scrub/shrub swamps cover 60 percent of the area. Interspersed among the scrub/shrub swamps are mixed, forested wetlands. These semi-flooded forests constitute 17 percent of the total area. Billy's Lake accounts for 8 percent of the total.

Within one kilometer of the site, semi-flooded or flooded scrub swamps are dominant. Mixed forest wetlands of cypress and bay are present as well as upland pine forest on the hammock itself. These habitats are found throughout a 2 km radius. Aquatic prairies and pine-dominated wetlands are found within a 3 km radius of the site, while Billy's Lake falls within the 4 km radius. Pine forests are most frequently encountered in the southeastern quadrant while cypress dominated wetlands occur more often in the northern quadrant. Aquatic prairies and mixed pine wetlands are prevalent to the west of the site.

If aboriginal populations regularly exploited a 5 km catchment, a broad spectrum of terrestrial and freshwater species should be reflected in the archaeological record. Mixon's Hammock is optimally located for the exploitation of aquatic species. An abundance of semi-flooded or flooded habitats in close proximity to the site provide maximum access to aquatic species and/or terrestrial species which frequent the wetlands. Subsistence efforts directed toward the efficient exploitation of resources within close proximity to the site should be reflected archaeologically by a predominance of aquatic species in the sample.

Materials and Methods

Mixon's Hammock (9 Cr 130) was identified in 1979–1980 during a subsurface survey conducted in conjunction with the University of Georgia Institute of Ecology's Okefenokee research project (Reitz and DePratter 1984). Posthole tests revealed cultural material and part of a human burial between 10 and 45 cm below surface. In 1983, Elizabeth J. Reitz and Chester B. DePratter, representing the University of Georgia Department of Anthropology, initiated further excavations under an Antiquities Act permit. Excavations in 1983 consisted of 10 posthole tests and one 1 × 1 m test pit.

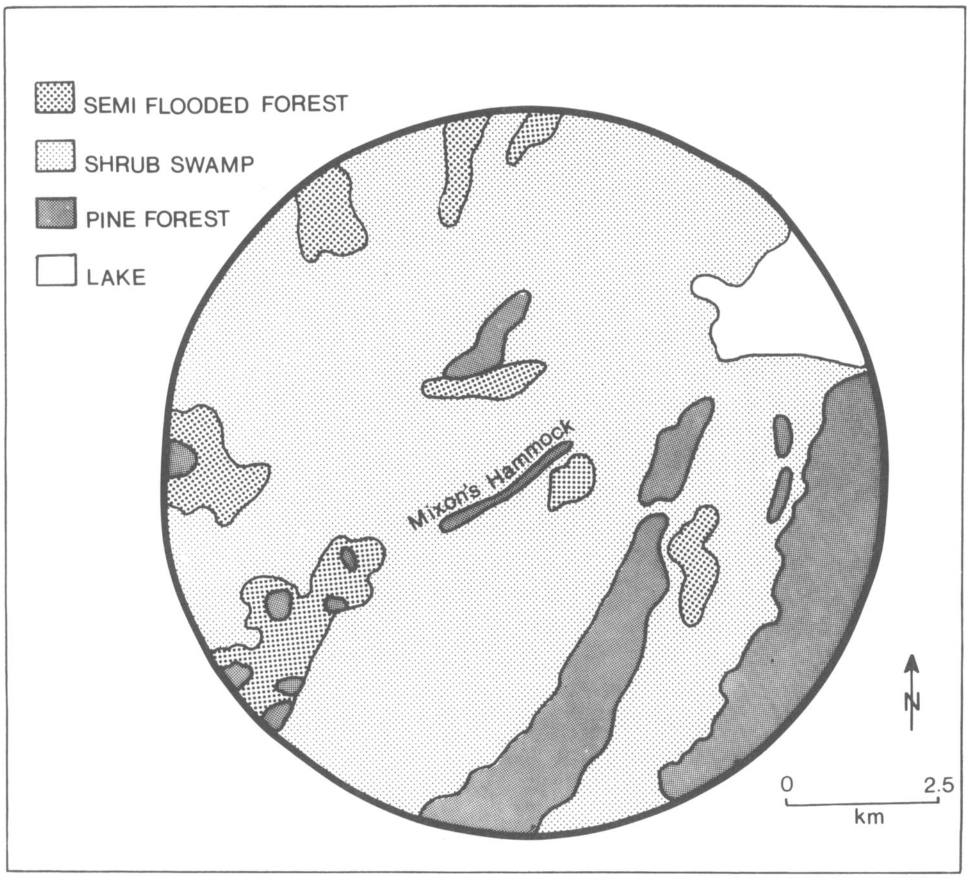

Figure 2. Principal habitat types within a five kilometer radius of Mixon's Hammock.

All materials were screened through ¼-inch wire mesh. Stratigraphy in the test pit was defined as follows. Level 1 was a gray-brown, humic soil 0–15 cm below surface containing some artifacts and bone. Level 2 was dark brown midden extending from 15–25 cm below surface and contained abundant artifacts and faunal remains. Level 3, extending from 25–30 cm below surface, consisted of light brown soil with fewer cultural materials than Level 2. Level 4 was mottled tan and white soil extending 30–45 cm below surface. Reitz and DePratter (1984) report that the relatively sparse cultural materials recovered from Level 4 were probably intrusive from Level 3. About 25 cm below surface two post holes were revealed in the southeast and southwest quadrants of the test pit. An additional cultural feature was encountered in the test pit about 30 cm below surface in the south-central quadrant. This feature was a brownish-black, basin shaped stain extending to 55 cm below surface. Although vertebrate remains were abundant, no invertebrates were recovered from the site.

Reitz and DePratter (1984) suggest that the Mixon's Hammock site was a small habitation area approximately 30 m by 35 m in extent. A total of 424 ceramic fragments were recovered. Of these sherds, 401 date to the Savannah Period, dating from about A.D. 1150–1300 (Thomas and Larsen 1979:111). Two fiber tempered sherds, dating from about 1000–2500 B.C. (Milanich and Fairbanks 1980), were recovered from the base of Feature 1. This may indicate that two occupational levels are present at the site, but further excavation would be required to confirm this. Three St. John's Plain sherds were recovered from the test pit, suggesting interaction with the St. John's region of Florida. Sixty-six flakes of Coastal Plain chert were also recovered.

The vertebrate materials recovered were examined using standard zooarchaeological methods. All identifications were made by the author, Gwyneth Duncan, and Emmett Walsh using the comparative skeletal collection of the Zooarchaeological Laboratory, University of Georgia. Bones of all taxa were counted and weighed to determine the relative abundance of identified species. A record was made of identified elements. Bone modifications were noted when observed. When preservation allowed, measurements were taken of fish atlas widths and otolith lengths.

Minimum Number of Individuals (MNI) was determined based on paired elements and size. In calculating MNI, faunal materials recovered from each post hole test were considered discrete observations due to their spatial separation. Levels within the 1 × 1 meter test pit, with the exception of Feature 1, were consolidated for analysis. Feature 1 was analyzed as a separate unit to avoid combining two possible contexts of occupation.

While MNI is a standard zooarchaeological quantification technique, the measure has several problems. MNI emphasizes small species over large ones. A further problem with MNI is the inherent assumption that the entire individual was utilized at the site. Ethnographically, this is not always the case, particularly in regard to larger animals and those utilized for special purposes (Thomas 1971; White 1953). Furthermore, the manner in which the data from the archaeological proveniences are aggregated during analysis influences MNI. The "minimum distinction method," or the aggregation of separate samples into one analytical whole, allows a conservative estimate of MNI (Grayson 1973). The quantification of the 10 post holes as discrete sample units approaches the "maximum distinction method" resulting in a larger MNI. Additionally, some elements are more readily identified than others and the taxa represented by these elements will appear more important in the species list than they were in the diet.

Biomass estimates attempt to compensate for problems encountered with MNI. Biomass provides information on the quantity of meat supplied by the animal. In some cases, the original live weight or size of the animal can also be estimated. These weights are estimated on the allometric principle body mass, skeletal mass, and skeletal dimensions change proportionally with increasing body size. The relationship between body weight and skeletal weight is described in the allometric equation

$$Y = aX^b$$

(Simpson et al. 1960:397). Many biological phenomena show allometry described by this formula (Gould 1966, 1971). In this equation, X is the skeletal weight or a linear dimension of the bone, Y is the quantity of meat or the total live weight, b is the constant of allometry (the slope of the line), and a is the Y-intercept for a log-log plot using the method of least squares regression and the best fit line (Casteel 1978; Reitz and Cordier 1983; Reitz et al. 1987; Wing and Brown 1979). A given quantity of bone or a specific skeletal dimension represents a predictable amount of tissue due to the effects of allometric growth. Values for a and b are obtained from calculations based on data from the Florida State Museum, University of Florida. The allometric values used here are presented in Table 1.

Allometry is used to predict two values. One of these is kilograms of meat represented by kilograms of bone where X is the archaeological bone weight. This is a conservative estimate of biomass determined from the faunal materials actually recovered from the site. Biomass reflects the possibility that only certain portions of the animal were used at the site. This would be the case where preserved or distributed meat was consumed. On the other hand, where X is a linear measurement of a skeletal dimension such as atlas width, scaling predicts the total live weight or length of the animal. The total live weight estimate may be used to assess the size of fish. It does not imply that the entire animal was consumed. Biomass calculations were not attempted for alligator or amphibians due to weaknesses in the present database. Biomass calculations for the Mixon's Hammock faunal remains include only those taxa for which MNI has been assigned.

Table 1. Allometric Values Used in the Study.

Classification	*n*	r^2	*log a*	*b*
Bird	307	0.97	1.04	0.91
Mammal	97	0.94	1.12	0.90
Turtle	26	0.55	0.51	0.67
Snake	26	0.97	1.17	1.01
Osteichthyes	393	0.80	0.90	0.81
Non-Perciformes	119	0.88	0.85	0.79
Siluriformes	36	0.87	1.15	0.95
Centrarchidae	38	0.80	0.76	0.84

MNI, biomass, and diversity are subject to sample size bias. Short species lists emphasizing one species relative to others are frequently a result of small sample size, as low diversity may be as well. Casteel (1978), Grayson (1979), and Wing and Brown (1979) suggest a minimum sample size of 200 individuals or 1,400 bones for a reliable interpretation.

Archaeologists may employ diversity (Shannon and Weaver 1949) and equitability (Sheldon 1969) indices to determine the degree of sample variability and specialization. The Diversity Index ranges from 0–5. Low diversity indicates a strategy focusing upon a few species whereas high diversity indicates emphasis on a large number of species. Equitability indices range from 0–1. Lower numbers reflect subsistence strategies which emphasize a few species while higher numbers reflect an evenness in species exploitation. Both indices are sample size dependant (Grayson 1979). Diversity and equitability calculations for Mixon's Hammock faunal remains were produced using both MNI and biomass estimates.

Table 2 presents a species list of vertebrates from samples examined from Mixon's Hammock.

Results

The vertebrate faunal materials recovered from Mixon's Hammock consist of 139 individuals identified from 4,795 bone fragments weighing 9.55 kg. In most cases preservation was good to excellent. Identification of vertebrate remains from Mixon's Hammock indicate that aquatic taxa formed a sub-

Table 2. Composite Species List, Mixon's Hammock, 9 Cr 131.

Taxon	Count	MNI		Weight g	Biomass	
		Count	%		kg	%
UID Bird	2			0.19		
Podilymbus podiceps Pied-billed grebe	1	1	0.7	0.48	0.01	0.01
Anas platyrhynchos Mallard	1	1	0.7	0.04	tr	0.01
UID Mammal	98	4	2.8	77.69	1.32	12.71
Lontra canadensis River otter	1	1	0.7	0.55	0.02	0.14
Procyon lotor Raccoon	1	1	0.7	0.33	0.01	0.01
Odocoilus virginianus Deer	6	4	2.8	26.01	0.49	4.73
Alligator mississippiensis Alligator	3	3	2.1	5.36		
UID Turtle	624			110.96	0.74	7.12
Chelydra serpentina Snapping turtle	6	2	1.4	4.36	0.08	0.82
Kinosternon subrubrum Mud turtle	136	10	6.9	46.97	0.42	3.99
Emydidae Pond turtle	20	7	4.8	39.04	0.37	3.48
Trionyx ferox Florida softshell turtle	4	2	1.4	1.55	0.04	0.40
UID Snake	148	2	1.4	28.04	0.40	3.79
Colubridae Non-poisonous snake	55	2	1.4	14.07	0.20	1.89
Viperidae Vipers	70	1	0.7	16.77	0.24	2.33
Crotalus spp. Rattlesnake	3	1	0.7	0.94	0.01	0.12
Agkistrodon piscivorus Cottonmouth	14	3	2.1	6.69	0.09	9.11
Rana/Bufo spp. Frog/Toad	11	1	0.7	0.60		
Rana spp. Frog	3	2	1.4	0.95		
Caudata	11	1	0.7	2.18		
Siren spp. Siren	1			0.27		
Siren *lacertina* Greater siren	9	3	2.1	3.74		
Amphiuma means Two-toed amphiuma	11	3	2.1	3.35		
UID Fish	1,685			167.54	1.87	17.93
Lepisosteus cf. *platyrhincus* Florida gar	135	8	5.5	28.66	0.43	4.08
Amia calva Bowfin	1,485	35	24.1	319.79	2.88	27.57
Esox spp. Pickerel	43	5	3.4	3.51	0.08	1.28
Erimyzon sucetta Lake chubsucker	5	2	1.4	1.05	0.03	0.29
Ictalurus spp. Catfish	111	15	10.3	16.30	0.28	4.68
Centrarchidae	32	1	0.7	6.16	0.08	1.26
Enneacanthus spp.	2	2	1.4	0.12	tr	tr
Enneacanthus gloriosus Bluespotted sunfish	1	1	0.7	0.06	tr	tr
Lepomis spp.	11	2	1.4	0.92	0.07	0.67
Lepomis gulosus Warmouth	5	5	3.4	0.62	0.01	0.10
Lepomis cf. *macrochirus* Bluegill	4	1	0.7	0.12	tr	tr

Table 2. Continued

Taxon	Count	MNI Count	MNI %	Weight g	Biomass kg	Biomass %
Lepomis punctatus						
Spotted sunfish	1	1	0.7	0.70	0.01	0.10
Micropterus salmoides						
Largemouth bass	18	8	5.5	14.27	0.16	1.49
Pomoxis nigromaculatus						
Black crappie	18	4	2.8	3.55	0.05	0.48
UID Bone				137.42		
Total	4,795	145	100.3	1,091.92		

stantial part of the diet. Fish contributed 58 percent to the total sample biomass representing 65 percent of the individuals. Bowfin (*Amia calva*) was the dominant taxon, contributing 35 individuals. Bowfin supplied 69 percent of the total fish biomass and 28 percent of the total sample biomass. Other fish predominant in the sample were gar (*Lepisosteus* cf. *platyrhincus*), and catfish (*Ictalurus* spp). Gar, represented by eight individuals, contributed 10 percent to the total fish biomass and 4 percent to the total sample biomass. Catfish supplied 15 individuals comprising 11 percent of the total fish biomass and 5 percent of the total sample biomass.

In terms of individuals and biomass, mammals were a small component of the sample. Only six individuals were identified, representing 3 percent of the individuals in the total sample and contributing 9 percent to the total sample biomass. Four deer (*Odocoileus virginianus*) were identified representing 94 percent of the total mammal biomass and 8 percent of the total sample biomass. Other mammals identified were one river otter (*Lontra canadensis*) and one raccoon (*Procyon lotor*).

Turtles identified from the faunal remains consisted of 21 individuals representing 15 percent of the total sample biomass and 15 percent of the individuals. The mud turtle (*Kinosternon subrubrum*) was the dominant taxon, contributing 46 percent of the total turtle biomass and 7 percent of the total sample biomass. Pond turtles (Emydidae) were slightly less prevalent. Seven individuals contributed 41 percent of the total turtle biomass and 6 percent of the total sample biomass. Three alligators (*Alligator mississippiensis*) were identified representing 2 percent of the individuals recovered from Mixon's Hammock. Amphibians, including frog (*Rana* spp.), siren (*Siren lacertina*), and amphiuma (*Amphiuma means*) contributed 10 individuals representing 7 percent of the total sample MNI. Snakes were a common component of the sample, particularly vipers (Viperidae). A total of seven individual snakes were identified contributing 9 percent to the total sample biomass representing 5 percent of the individuals. Cottonmouth (*Agkistrodon piscivorus*) was the dominant taxon identified to species, and was represented by three individuals. Cottonmouths contributed 17 percent to the total snake biomass and 1 percent to the total sample biomass.

Birds were conspicuously underrepresented. In the Mixon's Hammock sample, only four fragments were identified as bird. Two of the four fragments were identified to species. A pied-billed grebe (*Podilymus podiceps*), and a mallard (*Anas platyrhynchos*) contributed 0.16 percent to the total sample biomass.

Diversity and equitability measures indicate moderate diversity and high equitability. The diversity based on MNI is 2.8838, a value indicating moderate sample diversity. Equitability as calculated based on MNI is 0.8248, indicating a relatively balanced or even subsistence strategy. Diversity and equitability calculations based on biomass differed somewhat from these values. Diversity based on biomass equaled 2.0350, again indicating moderate sample diversity. The equitability based on biomass, 0.6490, indicates a less balanced strategy where fewer species dominate the sample. While the figures for diversity and equitability based on MNI versus biomass differ, they do not conflict. The calculations measure different phenomena. Those based on MNI describe strategies in terms of numbers of individuals while those based on biomass are used to describe strategies in terms of meat weights. These results indicate a subsistence strategy utilizing a moderately wide range of animals more or less equally, although a few animals contributed significantly more meat to the diet than did others.

Procurement Techniques at Mixon's Hammock

Each of the fish species and amphibians identified in the faunal materials at Mixon's Hammock may be found in sluggish water with abundant bottom vegetation (Conant 1975; Laerm and Freeman 1986). This would include all the aquatic habitats surrounding Mixon's Hammock. The ubiquitous occurrence of most of the identified fishes and amphibians in low current, weedy bottom waters prevents interpretation concerning local specialization other than to state the obvious: such habitats contributed the primary share of the animal-based portion of the diet.

A discussion of fish capture techniques at Mixon's Hammock would be largely speculative. However, size differences, knowledge of species behavior, and habitat of occurrence allow tentative conclusions. Based on differences in atlas widths, bowfin recovered from Mixon's Hammock ranged in size from several inches to several feet. The range in size of bowfin and other fishes, and their occurrence in shallow, sluggish habitats suggest that mass capture techniques may have been employed. Aquatic environments containing stagnant or low current, shallow waters are most suitable for mass capture fishing. Mass capture techniques include poison, fine mesh nets, and dip baskets.

Rostlund (1952:132) reports that fish poisoning was a common practice among some aboriginal groups in the interior Southeast. Adair (1775:402) notes that in the Southeast, fish were poisoned by ground roots scattered and dissolved in a small body of water. Fish simply floated to the top, belly-up, and were gathered in baskets. Effective poisoning of fishes would have been restricted to those species inhabiting small, quiet waters or species which would take a poisoned bait pellet. All identified species from the sample fit these criteria. However, Cumbaa (1972:51) notes that some species of fish are reported to be only marginally affected by weaker poisons. He adds that both sunfishes and lake chubsucker (*Erimyzon sucetta*) are highly susceptible to poisons. However, bowfin, catfish (*Ictalurus*), and gar, the dominant fishes recovered from Mixon's Hammock, are very tolerant of mild poisons.

Fishing techniques such as spearing or hook and line would have been practical for species such as bowfin, gar and pickerel, as well as larger individuals of other species. Bartram (1794:44,90) observed aboriginal groups in the Southeast using sharpened reed spears and hook and lines. Use of sharpened spears and fine-mesh nets would have been most effective and efficient during winter months when fishes were concentrated in deeper pools.

Evidence of Seasonality

Direct evidence for seasonal occupation was not found at Mixon's Hammock. All identified species are year-round residents of the swamp. The dominance of fishes in the sample may, however, indicate winter occupation of the site. During winter, water levels are generally low and fish tend to concentrate in deeper waters where they may be readily captured. On the other hand, alligators are not frequently encountered in the Okefenokee during winter months (B. J. Freeman, personal communication 1987). While several catfish pectoral spines were recovered from Mixon's Hammock, most were broken close to the proximal end, making clusters of growth rings difficult to distinguish. Without clear incremental growth structures, migratory species, or other indications of seasonality, it is not possible to determine if Mixon's Hammock was occupied on a seasonal or multi-seasonal basis from the vertebrate remains.

Other Aquatic Sites

The faunal materials from Mixon's Hammock indicate extensive aboriginal use of aquatic resources in a wetland environment. Perhaps the predominance of aquatic fauna is related to the uniqueness of the Okefenokee habitat. However, other faunal samples from wetland sites in the southeastern Coastal Plain display a similar predominance of aquatic species. Two wetland sites, Hontoon Island (Wing and McKean 1987) and Melton Village (Cumbaa 1972), are discussed below.

Hontoon Island is located midway along the St. John's waterway in Volusia County, Florida. The Hontoon Island site (8Vo-202) lies on the northern tip of a 1,650-acre, mixed hardwood/pine island. The island is bounded by the Hontoon Dead River to the west, the St. John's River to the north and east, and Snake Creek to the south. A large freshwater lake, Lake Beresford, lies about one kilometer to the northeast. Excavations at Hontoon Island, under the direction of Barbara Purdy of the University of Florida, indicate that the site was occupied from 500 B.C. to A.D. 1770 (Purdy 1987). Because faunal materials recovered from the Historic levels may reflect Spanish influence on the aboriginal subsistence pattern, only the results of the prehistoric horizon are considered here. All recovered materials were screened through 0.6 cm gauge mesh. The faunal remains from two test pits at Hontoon Island were analyzed by Elizabeth S. Wing and Laurie McKean of the Florida State Museum (Wing and McKean 1987). Identifications were made in 1981 and 1986 using the comparative collection housed in the zooarchaeological laboratory at the Florida State Museum.

Wing and McKean identified 112 individuals among 1,683 bone fragments from the prehistoric horizon at Hontoon Island. Of the faunal remains identified, six species are dominant: gar (*Lepisosteus* spp.), catfish (*Ictalurus* spp.), bass (*Micropterus salmoides*), mullet (*Mugil* spp.), alligator (*Alligator mississippiensis*), and slider turtle (*Chrysemys* spp.). Two terrestrial species are dominant in the sample: gopher tortoise (*Gopherus polyphemus*), and rabbit (*Sylvilagus* spp.). Two freshwater molluscs, mussel (*Elliptio buckleyi*) and pond snail (*Viviparus georgianus*), were abundant in the sample but were not quantified (Wing and McKean 1987).

Melton Village (8Al-169), is located southeast of Gainesville in Alachua County, Florida. The site consists of a single-occupation village radiocarbon dated to A.D. 220 (Cumbaa 1972:44). Cumbaa (1972:3) reports that during the occupation, vegetation surrounding the site consisted of xeric to mesic mixed hardwood forest containing a significant proportion of hickory trees. A few kilometers to the northwest, the hammock grades into pine forest. Melton Village is located at the edge of Paynes Prairie, an extensive wetland crosscut by small creeks, ponds, sloughs, and lakes. For several thousand years, this area has fluctuated between prairie and lake (Cumbaa 1972:4). Lake Newnan, a large freshwater lake, lies 5 km northeast of the site.

Excavated by Goggin in 1951 and Fairbanks in 1969, the Melton Village site produced an extensive faunal sample. Most of the faunal remains were analyzed by Stephen L. Cumbaa at the University of Florida (1972). Materials analyzed had been screened through ¼-inch wire mesh. A total of 963 individuals were identified from Melton Village vertebrate faunal remains. In terms of individuals, dominant fish species include lake chubsucker (*Erimyzon sucetta*), freshwater catfish (*Ictalurus* sp.), and gizzard shad (*Dorosoma cepedianum*). Round tailed muskrat (*Neofiber alleni*) contributed the highest number of individuals within the mammal class, closely followed by deer (*Odocoileus virginianus*). As in the Mixon's Hammock and Hontoon Island samples, birds were poorly represented. The heron family (Ardeidae) contributed the most individuals. Turtles made a respectable contribution to the diet with aquatic species (Kinosterninae, *Chrysemys* spp., and *Trionyx ferox*) dominant. Snakes and amphibians were moderately represented.

Comparison of the Three Sites

A comparison of the Okefenokee data with those of Hontoon Island and Melton Village raises a number of methodological concerns. These concerns involve sampling and recovery techniques, analytical measures, and intersite comparability. Sample size differs significantly among the three sites. The Hontoon Island collection contained the smallest number of bone fragments with a total of 1,683. Melton Village contained the highest number with approximately 55,000 fragments. Regardless of the disparity in sample size, each is greater than the 1,400 fragments suggested by Wing and Brown (1979) as minimally adequate for a representative sample. Ideally, the Hontoon Island and Mixon's Hammock collection should be larger for this kind of comparison.

Excavators employed similar screen sizes in the recovery of faunal materials from all three sites. Quarter-inch mesh (0.6 cm) screens skew the results in favor of larger taxa and elements. Usually the use of large mesh screens biases the samples in favor of terrestrial fauna and against fish and other nonmammalian taxa. While many of the smaller taxa may not be represented in the samples, this bias is shared by all three samples. The use of large mesh screens has not precluded recovery of nonmammalian subsistence evidence. However, had the excavators used smaller mesh screens at these sites, the proportions of small mammal and nonmammalian components would be greater.

A further methodological concern involves the percentage of the site each sample represents. At Mixon's Hammock, a habitation site approximately 30 × 35 m, faunal materials were recovered from a 1 × 1 m test pit and ten posthole tests. The faunal sample from Melton Village was recovered from an area measuring 100 × 150 feet (38 × 57 m) out of a total site dimension of 300 × 375 feet (114 × 140 m). In no case was the entire site sampled. Although special activity areas are probably present at all three sites, it is unlikely that these samples represent them due to the consistency of subsistence patterns.

An additional problem concerns the consistency with which analytical measures are employed. Biomass estimates may be a useful measure in zooarchaeological analyses when reported as percentages and compared across sites. However, the published results of analysis at Hontoon Island include fragment counts and weights, while those at Melton village are restricted to calculations of MNI. In neither case was biomass determined. Thus, a discussion of these three sites is limited to results based on MNI. In the future, it would be helpful if a consistent, complete record could be published of all primary data (i.e., bone count, bone weight) as well as secondary data (i.e., MNI).

In any intersite comparison, it is necessary to consider site location, length of occupation, and time of occupancy. While Mixon's Hammock, Melton Village, and Hontoon Island differ somewhat in their immediate environment, they are similar in sharing an aquatic setting. Length and period of occupancy differ significantly. Mixon's Hammock (A.D. 1100–1250) and Melton Village (A.D. 220) each represent a short term occupancy, while Hontoon Island encompasses almost 2000 years (500 B.C.–A.D. 1770). Any observed differences in exploited taxa may have far more to do with cultural adaptations during time of occupancy than features of the natural environment. Evidence of cultivated plants was recovered from Melton Village and Hontoon Island (Newsom 1987). These concerns should be kept in mind in comparing the three sites.

Summaries of the fauna from Mixon's Hammock, Hontoon Island, and Melton Village based on vertebrate class and habitat of occurrence are presented in Tables 3 and 4. Data from all three sites indicate a heavy reliance upon aquatic species. Faunal remains identified from Mixon's Hammock and Melton Vil-

Table 3. Comparison of Vertebrate Fauna from Hontoon Island, Mixon's Hammock, and Melton Village.

	Hontoon Island		Mixon's Hammock		Melton Village	
	MNI	%MNI	MNI	%MNI	MNI	%MNI
Mammal	7	6.3	6	4.3	94	9.7
Bird	16	14.4	2	1.4	27	2.8
Turtle	38	33.5	21	15.0	81	8.4
Alligator	7	6.2	3	2.2	2	0.3
Amphibian	4	3.6	10	7.2	58	6.0
Snake	2	2.7	7	5.0	43	6.5
Fish	38	33.5	90	64.6	658	67.2
Total	112	100.2	139	99.7	963	100.9

lage indicate that aquatic species were intensively exploited, contributing over 90 percent of the individuals in both samples. Aquatic species from Hontoon Island are somewhat less common, representing 76 percent of the identified taxa (Table 4).

When proximity of resources to Mixon's Hammock, Melton Village, and Hontoon Island is considered, a predominance of aquatic species in the faunal samples is expected from each site. The sites are located in freshwater settings where aquatic resources are readily and abundantly available. At Hontoon Island, terrestrial species also would have been readily accessible. Within a 5 km radius of the site, hammock and pine forests are common. The location of the site in close proximity to terrestrial habitats may account for the larger percentage of terrestrial species in the Hontoon sample.

There appear to be major differences in the use of birds among the sites. Bird remains from Mixon's Hammock and Melton village contributed less than 3 percent to the total samples. At Hontoon Island, birds accounted for almost 15 percent of the total sample. The species identified from the Mixon's Hammock sample were both water birds. With the exception of four wild turkeys (*Meleagris gallopavo*), the majority of birds from Melton's Village are associated with an aquatic habitat. The Hontoon Island sample contained both terrestrial and aquatic birds in almost equal proportion.

The greater reliance upon birds and the inclusion of a number of terrestrial species in the faunal remains at Hontoon Island are somewhat difficult to interpret. Availability seems less of a factor in this case. Laerm et al. (1984) report that over 230 species of birds inhabit the Okefenokee Swamp. Most of these are associated with water courses and pine forest and are available throughout the year. The paucity of birds in the sample from both Mixon's Hammock and Melton Village may reflect cultural preferences, technological considerations, and/or sample biases rather than availability.

Table 4. Vertebrate Fauna from Hontoon Island, Melton Village, and Mixon's Hammock by Habitat of Occurrence.

	Aquatic		Terrestrial		Aquatic/ Terrestrial	
Site	MNI	%MNI	MNI	%MNI	MNI	%MNI
Hontoon Island	85	75.9	23	20.5	4	3.5
Melton Village	867	90.0	83	8.6	13	1.4
Mixon's Hammock	127	91.4	5	3.6	7	5.0

While amphibians were poorly represented at all the sites, reptile use was variable. Mixon's Hammock contained the largest percentage of amphibians (7.2%) and Hontoon Island the least (3.6%). These differences do not appear major. However, the contribution of reptiles displayed significant differences in the three collections. At Hontoon Island, reptiles were represented by 11 taxa contributing 33.5 percent to the sample total. Of the 11 taxa, 9 were species of turtle. Both the gopher tortoise (*Gopherus polyphemus*) and pond turtle (*Pseudemys* spp.) were prevalent. At Mixon's Hammock and Melton Village, turtles contributed only half of the reptile taxa recovered. The difference may be due to the presence of gopher tortoises near Hontoon Island. Although gopher tortoises are reported from the Okefenokee Swamp (Laerm et al. 1984), their strict habitat requirements preclude their abundance in lowland, swampy areas. Gopher tortoises are terrestrial species which are only found in abundance in well drained, sand ridge and sand dune habitats (Carr 1957). Gopher tortoises would be expected to be more prevalent in the well drained pine forests of Hontoon Island than at Mixon's Hammock.

In all three sites, mammals made a negligible contribution to sample totals in terms of numbers of individuals. In no case did mammal remains exceed 10 percent of the total sample in terms of individuals. The contribution of mammalian fauna from Melton Village was the largest at 9.7 percent. However, this figure includes two species of rats (*Oryzomys palustris* and *Sigmodon hispidus*) and a mole (*Scalopus aquaticus*) which may represent commensal animals rather than dietary additions. The exclusion of these species from Melton Village and Hontoon Island would reduce the overall contribution of mammals to the diet even further. Deer were the dominant mammalian species

Table 5. Diversity and Equitability for Sites Based on MNI.

Site	Diversity	Equitability
Mixon's Hammock	2.8838	0.8248
Melton Village	2.9815	0.7782
Hontoon Island	3.3079	0.9161

exploited at Mixon's Hammock, while deer and muskrat (*Neofiber alleni*) were predominant at Melton Village. More rabbits (*Sylvilagus* spp.) were identified from Hontoon than other mammals.

Diversity and equitability indices were calculated and compared for the three sites (Table 5). In the case of diversity, sample size appears not to be a factor in the calculations. Mixon's Hammock displayed the lowest statistical diversity (2.8838), and moderate equitability (0.8248). Calculations for Melton Village produced a diversity index of 2.9815 and an equitability index of 0.7282. Hontoon Island produced the greatest statistical diversity of the samples at 3.3079 and the highest equitability at 0.9161. These figures indicate increasing sample diversity from Mixon's Hammock to Hontoon Island. Subsistence efforts at Melton Village appear to have been the most specialized and Hontoon Island the least specialized.

Conclusions

Faunal materials recovered from Mixon's Hammock in the Okefenokee Swamp allow for initial observations concerning Savannah period subsistence and resource potential in wetland habitats in the interior southeastern Coastal Plain. Vertebrate faunal remains from Mixon's Hammock indicate that aboriginal subsistence efforts focused upon the exploitation of aquatic species. Terrestrial species made a relatively minor contribution to these efforts. Two additional wetland sites, Melton Village and Hontoon Island, also demonstrate extensive use of nonmammalian fauna with an emphasis on fishes and turtles. Each of the sites demonstrate the multi-seasonal productivity of a variety of aquatic habitats within the southeastern Coastal Plain, and the importance of nonmammalian taxa in wetland subsistence strategies. These observations should be explored more thoroughly. Future research should test for subsistence change through time as well as for seasonal variations in strategies.

Intersite comparisons demonstrate several methodological issues of concern for future zooarchaeological analyses. In the case of Mixon's Hammock, multi-seasonal occupation could not be demonstrated from the faunal remains. This amplifies the need in subsistence studies for more thorough analyses, in particular the incorporation of ethnobotanical studies. Other concerns include the need for larger samples, controlled excavations using flotation and fine screens, and standardization of the analytical measures employed.

Notes

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Collections. Vertebrate samples recovered from Mixon's Hammock (9 Cr 130) are housed at the University of Georgia's Zooarchaeology Laboratory, Athens Georgia. Materials from Melton Village (8Al-169) and Hontoon Island (8Vo-202) are housed at the Florida State Museum, Gainesville, Florida.

References Cited

Adair, James
1775 *The History of the American Indians.* London.

Auble, Gregor
1982 Biogeochemistry of Okefenokee Swamp: Litterfall, Litter Decomposition, and Surface Water Dissolved Cation Concentration. Ms. on file, University of Georgia, Athens.

Bartram, William
1794 *Travels through North and South Carolina, Georgia, East and West Florida, the Cherokee Country, the Extensive Territories of the Muscogulges or Creek Confederacy, and the Country of the Choctaws.* 2nd ed. London.

Carr, Archie
1952 *Handbook of Turtles.* Cornell University Press, Ithaca.

Casteel, Richard W.
1978 Faunal Assemblages and the "wiege methode" or Weight Method. *Journal of Field Archaeology* 5:71–77.

Cohen, A. D.
1974 Petrography and Paleoecology of Holocene Peats from the Okefenokee Swamp-marsh Complex of Georgia. *Journal of Sedimentary Petrology* 44:716–726.

Conant, Roger
1975 *A Field Guide to Reptiles and Amphibians of Eastern and Central North America.* 2nd ed. The Peterson Field Guide Series. Houghton Mifflin, Boston.

Cumbaa, Stephen L.
1972 *An Intensive Harvest Economy in North Central Florida.* Master's thesis, Department of Anthropology, University of Florida, Gainesville.

Gould, S. J.
1966 Allometry and Size in Ontogeny and Phylogeny. *Biological Review of the Cambridge Philosophical Society* 41:587–640.
1971 Geometric Similarity in Allometric Growth: A Contribution to the Problem of Scaling in the Evolution of Size. *The American Naturalist* 105(942):113–137.

Grayson, Donald K.
1973 On the Methodology of Faunal Analysis. *American Antiquity* 38:432–439.
1979 On the Quantification of Vertebrate Archaeofaunas. In *Advances in Archaeological Method and Theory,* vol. 2, edited by M. B. Schiffer, pp.200–238. Academic Press, New York.

Higgs, E. S., and C. Vita-Finzi
1972 Prehistoric Economies: A Territorial Approach. In *Papers in Economic Prehistory,* edited by E. S. Higgs, pp. 27–36. Cambridge University Press, Cambridge.

Izlar, Robert L.
1984 A History of Okefenokee Logging Operations. In *The Okefenokee Swamp: Its Natural History, Geology, and Geochemistry,* edited by A. D. Cohen, D. J. Casagrande, M. J. Andrejko, and G. R. Best, pp. 5–17. Wetland Surveys, Los Alamos.

Jarman, Michael
1972 A Territorial Model for Archaeology: A Behavioral and Geographical Approach. In *Models in Archaeology,* edited by D. Clarke, pp. 705–733. Methuen, London.

Laerm, Joshua, and B. J. Freeman
1986 *Fishes of the Okefenokee Swamp.* The University of Georgia Press, Athens.

Laerm, Joshua, B. J. Freeman, Laurie J. Witt, and Lloyd E. Logan
1984 Checklist of Vertebrates of the Okefenokee Swamp: Appendix A. In *The Okefenokee Swamp: Its Natural History, Geology, and Geochemistry*, edited by A. D. Cohen, D. J. Casagrande, M. J. Andrejko, and G. R. Best, pp. 682–701. Wetland Surveys, Los Alamos.

Larson, Lewis H., Jr.
1980 *Aboriginal Subsistence Technology on the Southeastern Coastal Plain during the Historic Period*. University Presses of Florida, Gainesville.

McCaffrey, Cheryl A., and David B. Hamilton
1984 Vegetation Mapping of the Okefenokee Ecosystem. In *The Okefenokee Swamp: Its Natural History, Geology, and Geochemistry*, edited by A. D. Cohen, D. J. Casagrande, M. J. Andrejko, and G. R. Best, pp. 201–211. Wetland Surveys, Los Alamos.

McQueen, A.S., and Hamp Mizell
1926 *History of Okefenokee Swamp*. Jacobs and Co., Clinton, South Carolina.

Milanich, J., and C. H. Fairbanks
1980 *Florida Archaeology*. Academic Press, New York.

Newsom, Lee A.
1987 Analysis of Botanical Remains from Hontoon Island (8VO202), Florida: 1980–1985 Excavations. *The Florida Anthropologist* 40:47–84.

Purdy, Barbara A.
1987 Investigations at Hontoon Island (8-VO-202), An Archaeological Wetsite in Volusia County, Florida: An Overview and Chronology. *The Florida Anthropologist* 40:4–12.

Reitz, Elizabeth J.
1987 Coastal Adaptations in Georgia and the Carolinas. Paper presented at the 44th Annual Meeting of the Southeastern Archaeological Conference, Charleston.

Reitz, Elizabeth J., and Dan Cordier
1983 Use of Allometry in Zooarchaeological Analysis. In *Animals and Archaeology: 2, Shell Middens, Fishes, and Birds*, edited by C. Grigson and J. Clutton-Brock, pp.237–252. BAR International Series 183. London.

Reitz, Elizabeth J., and C. B. DePratter
1984 Mixon's Hammock Test Excavation Report. Ms. on file, Department of Anthropology, University of Georgia, Athens.

Reitz, Elizabeth J., I. R. Quitmyer, H. S. Hale, S. J. Scudder, and E. S. Wing
1986 Application of Allometry to Zooarchaeology. *American Antiquity* 52:304–317.

Reitz, Elizabeth J., Rochelle A. Marrinan, and Susan L. Scott
1987 Survey of Vertebrate Remains from Prehistoric Sites in the Savannah River Valley. *Ethnobiology* 7:195–221.

Reitz, Elizabeth J., and Irvy R. Quitmyer
1988 Faunal Remains from Two Coastal Georgia Swift Creek Sites. *Southeastern Archaeology* 7:95–108.

Rostlund, Edward
1952 *Freshwater Fish and Fishing in Native North America*. University of California Press, Los Angeles.

Rykiel, Edward J.
1977 The Okefenokee Swamp Watershed: Water Balance and Nutrient Budgets. Ms. on file, Department of Ecology, University of Georgia, Athens.
1984 General Hydrology and Mineral Budgets for Okefenokee Swamp: Ecological Significance. In *The Okefenokee Swamp: Its Natural History, Geology, and Geochemistry*, edited by A. D. Cohen, D. J. Casagrande, M. J. Andrejko, and G. R. Best, pp. 212–222. Wetland Surveys, Los Alamos.

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

Sheldon, A. L.
1969 Equitability Indices: Dependent on a Species Count. *Ecology* 50:466–467.

Shelford, Victor E.
1974 *The Ecology of North America*. University of Illinois Press, Urbana.

Simpson, George G., A. Roe, and R. C. Lewontin
1960 *Quantitative Zoology*. Harcourt, Brace, and Company, New York.

Thomas, D. H.
1971 On Distinguishing Natural from Cultural Bone in Archaeological Sites. *American Antiquity*; 36:366–371.

Thomas, D. H., and Clark S. Larsen
1979 *The Anthropology of St. Catherines Island 2. The Refuge-Deptford Mortuary Complex*. Papers of the American Museum of Natural History, vol. 56. New York.

Trowell, Chris T.
1979 A Reconnaissance of Aboriginal Okefenokee: Part 1. Ms. on file, Department of Anthropology, University of Georgia, Athens.

White, Theodore E.
1953 A Method for Calculating the Dietary Percentages of Various Food Animals Utilized by Aboriginal Peoples. *American Antiquity* 18:396–398.

Wing, Elizabeth S., and Antoinette Brown
1979 *Paleonutrition: Method and Theory in Prehistoric Foodways*. Academic Press, New York.

Wing, Elizabeth S., and Laurie McKean
1987 Preliminary Study of the Animal Remains Excavated from the Hontoon Island Site. *The Florida Anthropologist* 40:40–46.