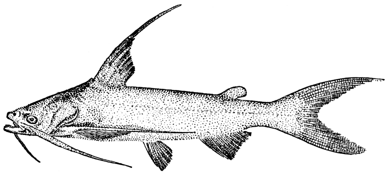

CHAPTER 7
AN INTERPRETATION OF GUALE HUNTING STRATEGY BASED ON WHITE-TAILED DEER INCREMENT STRUCTURES

Similarities between the Spanish and Guale diets suggest a creolization of Guale and Spanish cultures, but parallels between animal remains from inside the mission compound and those of Pueblo Santa Catalina de Guale suggest that most of the animal-derived nutrients consumed within the mission compound were obtained by Guale hunters instead of by Spaniards (see chaps. 5 and 6). Guale neophytes were expected to contribute to the economic success of Santa Catalina de Guale and Spanish Florida through tithes of goods and services. This hypothesis is supported by the types of white-tailed deer (*Odocoileus virginianus*) elements recovered from the Plaza Complex compared to those from the pueblo (figs. 6.9 and 6.10).

If most of the hunting for Mission Santa Catalina de Guale was done by Guale hunters, then the deer remains from the Plaza Complex cocina (Structure 2) should reflect Guale exploitation strategies. Insights into Guale exploitation strategies are found in cementum increments in deer teeth recovered from the cocina. This chapter discusses the age of deer hunted and the season in which they were killed based on data derived from a study of these increments.

HUNTING STRATEGIES

By combining evidence for targeted age groups and seasonal hunting behavior, it is possible to interpret relationships between human populations and resources exploited. According to Don Dumond (1972: 288), decisions about these relationships "...involve a balance among three components—the satisfaction of material wants, the satisfaction of affective relationships (including purely symbolic ones, as with gods), and the expenditure of least effort."

People are subject to the same ecological constraints as other animals, but they also are subject to cultural constraints. These cultural constraints change with the introduction of new cultural influences such as those associated with colonization. In the 17th century, Guale hunters had to satisfy both their own needs and desires in addition to those of Spanish missionaries and soldiers. Thus, Guale hunters not only had to develop an effective relationship with their prey within the constraints of their own culture, but also within the constraints presented by the imposition of cultural practices preferred by Spaniards.

As stated by Dumond (1972), satisfying material wants and creating effective relationships must occur while minimizing energy expenditure. To examine how energy expenditure may have been minimized during deer hunting, two strategies are considered: (1) conservationist; and (2) optimal foraging. A conservation strategy incurs short-term costs in exchange for long-term benefits such as a sustainable harvest (Alvard, 1994). For example, animals that could be acquired with less energy expended, while providing greater quantities of meat, may not be harvested so that the overall population of the prey species can maintain a healthy level for many generations. Conversely, optimal foraging assumes that hunters maximize a short-term rate of harvesting by targeting animals that provide the greatest amount of meat with a minimum of energy expended (Alvard, 1994; Pyke et al., 1977; Stephens and Krebs, 1986). Both of these culling behaviors satisfy material wants, develop effective hunter-prey relationships, and assure that the least amount of energy is expended. Under these models, the conservation strategy satisfies goals with a long-term perspective in mind, whereas optimum foraging satisfies goals for the short term. To these benefits, we might add the advantages of establishing effective relationships with Spaniards. Typically, an animal's age and sex are considered when examining culling behaviors, though cementum increment analysis can only address age.

In his study of the Piro of Amazonian Peru, Michael Alvard (1994) distinguishes between conservation and optimum foraging behaviors by identifying the age classes of prey species targeted by hunters. He argues that conservation behavior is demonstrated by the presence of animals from age groups that would maximize the health of the overall prey population. In the case of deer, hunters would target males from many age classes, regardless of the meat yield afforded by the large body size of adult males. This would insure population growth. For large deer populations, females also would be targeted. For optimum foraging behavior, a greater proportion of prime-aged deer, those that were neither juveniles nor very old animals, would be taken (Alvard, 1994). Targeting large, prime-aged, healthy animals regardless of sex would maximize short-term resource acquisition while increasing meat yield.

Age estimates derived from increment analysis of deer teeth recovered from the cocina might indicate whether Guale hunters practiced a form of optimum foraging strategy or a conservation strategy. An optimum foraging strategy would include prime-aged adult animals in a proportion similar to or greater than that characterizing the prey population (Alvard, 1994). A strategy focused on conserving prime-aged adults would include a higher number of very young and very old animals. This culling behavior enhances survival opportunities for the prime-aged animals.

Although either of these hunting strategies could be employed during any season of the year, these behaviors may have varied from season to season on St. Catherines Island. Reasons for seasonal fluctuations in strategy are difficult to isolate. Hunting schedules are frequently coordinated with the labor demands or residential schedules of people living at the site. Caution must be exercised in making this assumption because people may occupy a site year-round but may not hunt a specific taxon during every season. Additionally, a strategy could be employed during one year and not the next because of factors such as warfare, weather, or illness in the community. Variability of strategies is a possibility that is difficult to extrapolate from a single archaeological sample. This is especially true for studies of the Guale people on St. Catherines Island due to the cultural changes brought about by Spanish influence and the specific behaviors represented by the cocina deposit.

In the case of Santa Catalina de Guale, it seems unlikely that people were absent from the mission compound or adjacent pueblo for an entire season. It is more likely that Guale and Spanish people were present at the mission throughout the year and that scheduling conflicts between farming or other resource opportunities affected hunting schedules. Additional factors could be related to labor or other economic demands and religious or other cultural constraints imposed by the missionaries on the Guale neophytes.

INCREMENT STRUCTURES

Incremental studies, such as those of cementum, provide estimates of age and season at death by examining the growth banding found in some vertebrate and invertebrate structures. These bands provide valuable information about environmental and metabolic changes experienced by certain organisms throughout their lives. In many cases, these changes occur in regular, annual patterns. Through this patterning the age of the organism and the season it died can be discerned. Increment structures indicating age at death provide information about culling strategies, while increment structures indicating season at death provide insight into hunting schedules. Thus, increment analysis of prey species can be used as a means to interpret human behavior associated with acquisition of these animals.

Cementum is found on the roots of all mammalian teeth. Its function is to hold the tooth into the mandible or maxilla (Hillson, 2005: 193–198; Lieberman, 1994; Lieberman et al., 1990; Stallibrass, 1982). Cementum primarily consists of the mineral hydroxyapatite deposited in lattice spaces between intrinsic and extrinsic collagen known as Sharpey's fibers (Knox and

Aukhil, 1988; Lieberman, 1994; McAllister et al., 1990). The density of the deposited hydroxyapatite and the angle of Sharpey's fibers are responsible for the production of visible incremental banding in cementum.

Hydroxyapatite is deposited more slowly during periods of nutritional stress, producing a relatively dense cementum layer (Lieberman, 1994). As nutrition improves, the rate of hydroxyapatite deposition increases, producing a less dense cementum band. The stresses associated with mastication influence the orientation of Sharpey's fibers in ungulates (Lieberman, 1994; Weinand, 2000). When teeth are subjected to increased occlusal strain, the fibers become more vertically oriented relative to the long axis of the tooth. The position of these fibers is fixed within the cementum band once the hydroxyapatite is deposited. In wild mammals, changes in fiber orientation and cementum density occur simultaneously and, for most temperate locales, twice a year, as found in deer on the Georgia coast (Weinand, 2000).

When thin sections of a tooth are viewed under a microscope, changes in fiber orientation and cementum density appear as regions of light and dark bands. Under cross-polarized light, Sharpey's fibers that are more vertically oriented combined with high cementum density will appear dark or opaque. Bands with less-vertically oriented fibers and less-dense cementum will appear light or transparent.

During spring and summer, lush grasses and leaves available to deer are nutritionally rich and easy to masticate. This is the time of year when the light or transparent band is produced. During fall and winter, deer switch to a diet of acorns and less-succulent browse (Warren et al., 1990). These foods are more difficult to masticate and may be less nutritionally rich, thus producing the characteristic dark or opaque band. The time of year when vegetation quality changes varies from one geographic locale to another; therefore, a reference collection of mandibles from modern animals, from the specific region of study, is invaluable as an aid to interpretation.

MATERIALS AND ANALYTICAL METHODS

This study is based on a modern reference collection of mandibles from 23 male and 24 female deer of various ages collected over a 12-month period from Skidaway Island, Georgia (Weinand, 2000). Two male and two female mandibles were collected each month from June 1995, until May 1996. In June 1996, only one male and two female mandibles were obtained. Skidaway Island is located approximately 30 km north of St. Catherines Island (fig. 1.2). It is assumed that the environment of St. Catherines Island during the First Spanish period was similar to the present environment of Skidaway Island, though future research should test this assumption in view of evidence for drought conditions that prevailed in the region during the 17th century (Blanton and Thomas, 2008). Thin sections of the reference deer teeth show that banding occurs in well-defined increments and that the "winter" opaque band is laid down between late August and March in deer on the Georgia coast (Weinand, 2000).

Eleven mandibular (lower) first molars were selected from the cocina archaeofaunal collection (Structure 2). Because thin-sectioning is a destructive process, as much information as possible was recorded for the archaeological specimens before they were sectioned. In addition to measurements (table 7.1), photographs were taken of each specimen prior to sectioning. When possible, age estimates were made based on tooth wear following guidelines established by C.W. Severinghaus (1949). Age estimates derived from tooth wear were used only as a tool to corroborate age estimates derived from the increments, but are not part of this study.

The molars were prepared using standard petrographic techniques. Three sections were cut from each tooth and mounted for grinding. The thin-section slides were examined under a polarized-light microscope to estimate age and season at death. Age was estimated to the nearest half-year based on characteristics of the outermost band. If the outermost band was transparent, the size of the band was compared to the other completed transparent bands. Three categories were created to record the size of the final transparent band ($T < ½$, $T = ½$, and $T > ½$). If the outermost band was opaque, regardless of width, it was recorded as "O." An arbitrary number was assigned to each thin section on a scale from one to five to indicate the level of confidence in the estimate; one is least confident and five is most confident. Photomicrographs were taken of all thin-sectioned specimens.

Although 11 specimens were studied, this

TABLE 7.1
Archaeological Collection: Measurements of Deer Dentition in mm[a]

Specimen no.	Tooth	TRL	TW	TL	MinCH	MaxCH
DW00100	LfM1	—	9.6	12.9	2.4	7.2
DW00101	RtM1	—	8.9	15.0	2.8	7.1
DW00102	LfM1	—	9.1	14.8	2.7	8.0
DW00103	LfM1	—	8.6	13.5	3.6	9.5
DW00104	LfM1	—	8.2	13.4	3.2	9.3
DW00105	RtM1	78.1	8.4	13.5	3.3	7.7
DW00106	RtM1	—	9.3	13.5	2.0	7.2
DW00107	RtM1	76.8	9.3	13.1	2.0	7.4
DW00108[b]	RtM1	—	—	—	—	—
DW00109	LfM1	—	9.5	14.9	5.3	9.5
DW00110	LfM1	—	8.2	13.3	1.2	3.8

[a] Key to abbreviations: LfM, left molar; RtM, right molar; TRL, tooth row length; TW, tooth width; TL, tooth length; MinCH, minimum crown height; MaxCH, maximum crown height. All teeth are from the mandible.

[b] Tooth damaged during extraction.

does not mean that 11 Minimum Number of Individuals (MNI) are represented in the sample. Six of the teeth examined are lower left first molars and five are lower right first molars. Based on symmetry of paired elements, a minimum number of six individuals (MNI = 6) can be confidently assumed. However, the measurements of these teeth indicate that this estimate may be low (table 7.1), and cementum increments suggest that the molars in this study may be from as many as 10 individuals.

RESULTS OF INCREMENT STUDY

The number of bands and increment characteristics indicate that the ages at death for the individuals represented by these thin sections range from one year (DW00103) to more than six years (DW00110). Age estimates for the specimens are presented in table 7.2. Seven of the specimens are from prime-aged adults, ranging from 2 to 3.5 years old at death; three of the specimens are from deer less than 1.5 years old at death; and one is from an animal 6 years of age or older. The average age at death for deer represented by these specimens is slightly less than 3 years. In most cases, the degree of confidence is high (table 7.2).

Estimates of season at death for the deer in this collection indicate a gap in the data that corresponds with late summer. Five specimens are estimated to be from individuals that died in spring or early summer (table 7.2). Two of these specimens (DW00103 and DW00106) show outer transparent bands less than the half-width of previous, completed transparent bands (T < ½). Three specimens (DW00100, DW00102, and DW00110) are from animals with outer transparent bands approximately equal to the half-width of previous, completed transparent bands (T = ½). The remaining six specimens (DW00101, DW00104, DW00105, DW00107, DW00108, and DW00109) have opaque bands (O) at the outer edge of the tooth, indicating a fall or winter death. The only season not represented is the late summer (T > ½).

FIRST SPANISH PERIOD DEER-HUNTING STRATEGIES

The inhabitants of Mission Santa Catalina de Guale used subadults and young adults in greater numbers than they did juvenile or older adult deer, thereby conforming to Alvard's (1994) definition of hunting under the optimum foraging model. If the Guale objective was to conserve deer on the island, more juvenile and old-age individuals should be present in the cocina deer sampled for this study.

The results of the increment study approximate the ages of deer estimated using epiphyseal fusion and tooth eruption sequences in the larger Plaza Complex and pueblo assemblages (see appendix A for methods). Using epiphyseal fusion and tooth eruption sequences, deer individuals are classified only as juvenile, subadult, and adult. Thus a direct comparison with the age classes derived from the increment study is not possible, but a clear preference for subadult individuals is evident in the larger Plaza Complex and pueblo assemblages. Of those deer individuals for which age at death could be estimated in the Plaza Complex assemblage using fusion and tooth eruption sequences, 11% were juveniles at death, 52% were subadults, and 37% were adults (table 5.8). Of those deer individuals for which age at death could be estimated in the pueblo assemblage 25% were juveniles at death, 37% were subadults, and 37% were adults (table 6.18). The cocina collection might reflect Spanish preferences for the tender meat and prime hides of subadult animals. The hunting emphasis, reflected in both assemblages, was on subadults or young adults, rather than on juveniles and older adults.

Although Guale hunters supplying the mission compound took deer from every age class, the majority of the deer represented in the increment study were middle-aged when they died. This is consistent with the optimum foraging pattern described by Alvard (1994). In a natural environment, juveniles (< 1.5 years) would be the predominant age class represented. If conservation of the island's deer population was the Guale objective, juveniles should have been targeted in order to increase the number of larger adult individuals in the island's deer population. Instead, it appears that the acquisition of larger, "prime-aged" individuals was more important. "Prime-aged" is used here to define animals that had reached maximum body size but did not possess some of negative characteristics of older prey such as more blemishes to the hide and tougher muscle tissue compared to a younger cohort.

TABLE 7.2
Archaeological Collection: Deer Cementum Increment Analysis Results[a]

Specimen no.	Age	Season at death	OB	Confidence (1 –5)
DW00100	3 yr	Spring/early summer	T = ½	3
DW00101	3.5 yr	Fall/winter	O	4
DW00102	3 yr	Spring/early summer	T = ½	4
DW00103	1 yr	Spring/early summer	T < ½	5
DW00104	2.5 yr	Fall/winter	O	4
DW00105	1.5 yr	Fall/winter	O	3
DW00106	2 yr	Spring/early summer	T < ½	4
DW00107	3.5 yr	Fall/winter	O	4
DW00108	2.5 yr	Fall/winter	O	4
DW00109	1.5 yr	Fall/winter	O	2
DW00110	6 + yr	Spring/early summer	T = ½	4

[a] Key to abbreviations: OB, outermost band; T, transparent band under polarized light; O, opaque band under polarized light. Confidence refers to degree of confidence, where 1 is least confident and 5 is most confident.

Two individuals identified by the increment analysis are not considered prime-aged. These are a yearling and an aged adult. The aged adult was at least six years old and possibly older. No fawns were identified in the cocina collection through incremental analysis. This may reflect taphonomic processes or sampling decisions rather than human subsistence behavior. The Plaza Complex assemblage does contain young deer; three of the 27 deer individuals are juveniles and one was probably a fawn at death (table 5.8).

The absence of specimens representing late summer deaths cannot be ignored. It is possible that this small sample simply does not contain specimens from this time of year. It is equally possible that the inhabitants of the site did not devote much time to hunting deer in the late summer. The late summer is very hot in the Georgia Bight and meat would spoil quickly. Hunting also may have conflicted with other aspects of the Guale schedule at this time.

The season of death is unclear for individuals displaying outer transparent bands equal to the half-width of the previous, completed transparent bands. The reference collection contains a single male specimen (DW00049) killed on May 31, 1996, displaying the same amount of cementum growth (see Weinand, 2000). Because this is the only representative of the T = ½ category in the comparative collection, it is difficult to account for individual variation among modern individuals, or to interpret the archaeological specimens. For this reason, archaeological specimens exhibiting T = ½ banding are grouped into a spring/early summer category.

As previously stated, an MNI of six was originally estimated for the archaeological deer materials based on symmetry. Age and season at death using increment analysis, however, indicates that there may be at least 10 individuals in this study. This larger estimate is based on age estimates as well as tooth dimensions. The 1-year-old, 2-year-old, and old-age specimens (6 + years) are represented by single teeth and thus represent single individuals (MNI = 3). Four teeth were estimated to be from 3-year-old and 3.5-year-old deer. However, the two teeth estimated to be from 3-year-old individuals were both from the left mandible (MNI = 2). The two teeth estimated to be from 3.5-year-old individuals were both from the right mandible (MNI = 2). Two pairs of specimens were assigned similar ages, but originated from opposite mandibles. Although these specimens would ordinarily represent two individuals based on symmetry, one pair (DW00105 and DW00109) differed in tooth width (TW) and tooth length (TL) by more than 1 mm. Further, these two teeth differed in minimum crown height (MinCH) by more than 2 mm. These teeth are therefore estimated to be from two different 1.5-year-old deer (MNI = 2). The remaining pair (DW00104 and DW00105) came from 2.5-year-old specimens but, due to damage, could not be evaluated like the previous pair. Therefore, these teeth are assumed to have come from the same individual (MNI = 1).

The intent of the increment study was to compare optimal foraging and conservation behaviors. It is unclear if the optimal foraging strategy, as indicated by the data, was influenced by Spanish demands for prime venison and skins, or increased farming requirements and religious schedules. From ethnohistorical evidence it is known that, in Spain, venison was generally esteemed and reserved only for the Spanish upper class (e.g., Townsend, 1814: 370-371). This may have placed added pressure on Guale hunters to obtain deer in ratios less beneficial to conservation of the resource. Spanish demands for prime deer hides, with few blemishes, also might have influenced the age group targeted.

The absence of evidence for hunting in the late summer does not mean that hunting did not take place at that time of year. It does, however, suggest that hunting was less common in the late summer than during other parts of the year. Future research should address the annual cycle at the mission. Farming schedules and weather may be particularly useful in explaining the absence of deer killed in the late summer. Harvesting crops may have been more important than hunting during the late summer and it is also very hot on the Georgia coast at that time of the year. Meat would spoil quickly and storms can be intense.

Cementum increments were not examined for the pre-Hispanic period because the focus of the research was on the Guale hunting strategy under the mission system. An examination of hunting strategies on the island prior to the 17th century using increment analysis should be included in future research on the island. Such work might explore whether a late summer hiatus in hunting was a typical hunting strategy before the 17th century. Additional research also might explore the association between farming and hunting strategies. Specifically, did the prefarming hunting strategy continue once farming began on the coast in general and on the island in particular?

CONCLUSIONS

In the 17th century, Guale hunters used an optimum foraging strategy, instead of a conservationist strategy, to hunt deer on the island. Subadult and young adult deer were the primary sources of meat. This hunting strategy was probably followed throughout the year, though the data reported here show a noteworthy absence of deer killed during the late summer. Reasons for the absence of late-summer kills are unclear, but a shift in the exploitation strategy could have been a result of farming schedules, other hunting and fishing demands, and the difficulty of hunting and preserving meat during the hot days at summer's end. Given the importance of attending daily religious instruction and rituals, it is unlikely that neophytes were absent from the mission for great lengths of time. Although this study demonstrates that Guale hunters followed a specific hunting strategy in the 17th century, the degree to which Spanish-imposed responsibilities altered hunting traditions from those practiced before the 17th century should be examined through future research.