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OSTEOLOGICAL COMPARISON OF PREHISTORIC NATIVE AMERICANS FROM SOUTHWEST VIRGINIA AND EAST TENNESSEE MORTUARY CAVES

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The remains of at least 160 individuals from 15 burial caves in Southwest Virginia and East Tennessee are compared in terms of their temporal and spatial context, age and sex profiles, incidence of pathologies, and degree and type of postmortem alteration of bone. Individuals appear to have been interred predominantly as primary inhumations. Dental pathologies are frequent for these Late Woodland/Mississippian period interments, but overall levels of nutritional stress and trauma appear low. This suggests a generally good level of health for these prehistoric Native Americans.

Caves used as mortuary facilities for prehistoric Native Americans are known throughout the southeastern United States; investigations of them have provided a wealth of information about their inhabitants (e.g., Walthall & DeJarnette, 1974). There are two areas in the Southeast where prehistoric burial caves are especially common–northern Alabama and southwest Virginia. The Copena mortuary complex of the Middle Tennessee River valley of Alabama dates to the Middle Woodland period (ca. A.D. 0 - 500) (Walthall & DeJarnette, 1974; Willey et al., 1988). In addition to the distinctive Copena burial mounds, over 30 nearby caves were used as mortuary sites, containing both extended burials and cremations (Walthall & DeJarnette, 1974).

A cluster of mortuary caves is also documented in southwest Virginia along several tributaries of the Tennessee River (Clark, 1978; Willey & Crothers, 1986; Willey et al., 1988; Boyd & Boyd, 1992) and even extends into east Tennessee (Tucker, 1989; Whyte & Kimball, 1995). This cave region is our focus in this paper. At least 38 prehistoric mortuary caves have been identified in southwest Virginia and east Tennessee (Table 1). This number is a minimum estimate because there are probably many more undocumented mortuary caves in this region. Most of these caves are thought to date to the Late Woodland period in Virginia (ca. A.D. 900 - 1600), or anywhere from the Middle Woodland to Early Mississippian periods in Tennessee (ca. A.D. 350 - 1300) (Clark, 1978; Willey et al., 1988; Kimball & Whyte, 1994).

Over 520 prehistoric Native American individuals have been exhumed or identified from southwest Virginia and east Tennessee caves (Table 1). Many of these bones have never been fully analyzed by professional osteologists. Recently, skeletal remains of at least 160 individuals from 15 of these prehistoric burial caves have been intensively studied by the authors. Remains from two caves (44LE169 and 40JN159) were examined as part of professional archaeological salvage excavations. Collections from the other 13 caves were obtained and analyzed as part of the Marginella Burial Cave Project (MBCP) under the direction of David Hubbard and

Table 1. Recorded burial caves in southwest Virginia and east Tennessee (revised from Clark, 1978).

Site Number/Name	County	Number of Burials
44LE9	Lee	100
44LE11*	Lee	6
44LE15	Lee	+
44LE16	Lee	+
44LE28	Lee	+
44LE169*	Lee	6
44LE258*	Lee	1
44LE280*	Lee	8
44LE261*	Lee	4
44LE281*	Lee	1
44LE260*	Lee	3
44SC6	Scott	+
44SC10	Scott	+
44SC44	Scott	+
44SC140*	Scott	2
44RU6	Russell	113
44RU10	Russell	+
44RU12	Russell	+
44RU29	Russell	+
44TZ5	Tazewell	102
44TZ92	Tazewell	11
44WG3*	Washington	20
44WG14	Washinton	+
44WG397*	Washington	2
Nick Site*	Washington	2
44SM6	Smyth	1
44SM12	Smyth	1
44SM13*	Smyth	1
44SM24	Smyth	+
44SM28	Smyth	2
44SM34	Smyth	+
44SM48	Smyth	+
Cave 2	Smyth	+
Cave 3	Smyth	6
44MY482*	Montgomery	4
Long Cave*	Pulaski	1
40JN159*	Johnson (TN)	99
40CE20	Claiborne (TN)	25
Total		521+

Note: skeletal collections from cave sites with an asterisk (*) have been examined in detail by the authors; unless otherwise noted, all counties are located in southwest Virginia; a (+) indicates some human remains were noted.

Michael Barber (this volume). In this paper we present the results of that skeletal analysis, including information relating to demographic characteristics of the individuals represented (age at death, sex), health and disease indicators (infection, nutritional stress, oral health, arthritis), and lifestyle (trauma). In addition, examples of postmortem alteration of bone are discussed in terms of causative biological and cultural agents. A comparison of these sites with previously documented southwest Virginia and east Tennessee sites reveals biological, cultural, temporal, and postdepositional patterns. Our goals are twofold: 1) to present summary information about the biocultural characteristics of prehistoric Native Americans from cave sites of this region; and 2) to understand relationships among southwest Virginia and east Tennessee mortuary caves and their human interments.

ARCHAEOLOGICAL BACKGROUND

Table 1 presents site information for burial caves from southwest Virginia and east Tennessee. With the exception of one cave each in Montgomery and Pulaski Counties, all of the southwest Virginia cave sites discussed herein are found in the following counties: Lee, Russell, Scott, Smyth, Tazewell, and Washington (Figure 1). The two East Tennessee caves listed in Table 1–Lake Hole Cave (40JN159) in Johnson County and Ausmus Cave (40CE20) in Claiborne County–are located to the south of these southwest Virginia counties and are likely a part of this regional cluster.

The most intensively and extensively investigated burial cave in this region is Lake Hole Cave (Kimball et al., 1992; Boyd & Boyd, 1993; Whyte & Kimball, 1995; Whyte & Kimball, this volume). The cave, located in the Cherokee National Forest, had been extensively looted. After apprehension of the looters, the U.S. Forest Service (in consultation with the Eastern Band of the Cherokee) contracted with archaeologists at Appalachian State University, Boone, North Carolina, to excavate the disturbed portions of the cave. All sediments from these controlled excavations were removed from the cave and water screened through nested 0.64 cm and 0.32 cm mesh screen.

A bone awl produced an uncorrected Accelerator Mass Spectrometer date of 790 B.P. ± 60 years (Tom Whyte, 1995, personal communication). When corrected, using dendrocalibration formulae derived from Stuiver and Reimer (1993), this date calibrates to A.D. 1260 with a one sigma age range of A.D. 1210 - 1290. This date differs from the only other radiocarbon dated burial cave in this region. A sample of human bone from Higginbotham Cave (44TZ5) in Tazewell County, Virginia, produced an uncorrected date of 535 ± 65 years (Clark, 1978), calibrating to a corrected date of A.D. 1410 with a one sigma age range of A.D. 1390 - 1440. While both of these dates fall within the same general time period (Late Woodland of Virginia or Mississippian of east Tennessee), the Lake Hole Cave date of A.D. 1260 is considerably earlier than Higginbotham and reflects the time span over which these burial caves were used.

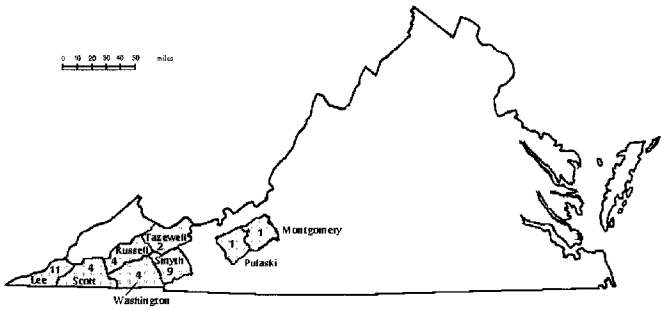

Figure 1. Map of Virginia showing locations and frequencies of southwest Virginia mortuary caves.

A total of 12,841 human bones, bone fragments, and teeth representing all skeletal elements (Whyte & Kimball, 1995; Whyte & Kimball, this volume) was recovered from Lake Hole Cave. This collection, although biased through the wishes of the Cherokee to excavate only the looter-disturbed deposits, represents the most complete and extensive skeletal database from any of the discussed burial caves.

The other skeletal collections from burial caves analyzed in this study are less complete and informative. For example, most of the Bone Cave (44LE169) skeletal sample is only from limited Phase II site testing (Kimball & Whyte, 1994). Collections from both the Ton (44WG3) and Mer (44LE280) sites were recovered by the Marginella Burial Cave Project (MBCP) from third party intermediaries after looting. Most of the other skeletal samples represent only surface collections by the MBCP from looter disturbed sites. More extensive test excavations were not permitted by state law. Controlled excavation of all of these sites would surely produce far greater amounts of bone and more secure information about these individuals. Even with these limitations and biases, biological and cultural characteristics of those interred in these caves can be compiled and compared.

RESULTS AND DISCUSSION

DEMOGRAPHIC PARAMETERS

Table 2 presents summary information for all human bone and teeth personally analyzed by the authors from the 15 burial caves. Calculations of Minimum Number of Individuals (MNI) are also provided. MNI estimates vary widely for the sites from as little as one or two individuals from the Mud (44LE258), Born (44WG397), Scott Born, (44SC140), Stead (44SM13), Burt, (44LE281), and Nick sites to a high of 99 individuals from Lake Hole Cave (40JN159). Of course, these estimations vary directly with the amount of bone obtained from each site. There is a clear pattern, however, of all ages and sexes being represented in the skeletal remains from these sites. This is also true of other recently studied burial caves in Virginia and Tennessee. Bull Thistle Cave (44TZ92) in Tazewell County, Virginia, contained the remains of at least 11

Table 2. Summary information on skeletal collections from 15 analyzed sites.

Site	Total Number of Bones	Total Number of Teeth	MNI Adult Male	MNI Adult Female	MNI Adult Indeterminate	MNI Subadult	Mode of Collection
44LE11 Indian Burial Cave	98	-	3	1	1	1	surface collection (a)
44 LE258 Mud Site	3	-	-	-	1	-	surface collection (a)
44LE280 Mer	144	16	3	3	-	2	surface collection (a) excavation by vandals
44LE261 Kull	65	-	-	2	1	1	surface collection (a)
44LE281 Burt	-	4	-	-	1	-	surface collection (e)
44le260 Curry	29	-	1	-	1	1	surface collection (a)
44LE169 Bone Cave	1650	39	1	-	2	3	surface collection (d) controlled excavation
44WG3 Ton Site	126	34	12	5	-	3	excavation by vandals
Nick	8	-	1	1	-	-	surface collection (a)
44SM13 Stead Site	-	2	-	-	1	-	surface collection (a)
44SC140 Scott Born	3	-	1	-	-	1	surface collection (c)
44MY482 Adam's Cave	24	8	1	1	-	2	surface collection (b)
Long Cave	2	-	1	-	-	-	surface collection (a)
44WG397 Born Site	7	-	1	-	-	1	surface collection (a)
40JN159 Lake Hole Cave	11,977	864	19	11	19	50	excavation by vandals controlled excavation
TOTALS	14,136	967	44	24	27	65	

Note: Collections from all sites except Lake Hole Cave were obtained as part of the Marginella Burial Cave Project.
(a) = surface collections from looted sites
(b) = surface collection from site historically disturbed by saltpeter mining
(c) = surface collection after minimal caver disturbance
(d) = surface collection after disturbance by local vagrants and children
(e) = surface collection from erosional disturbance

individuals, including 8 adults (2 males, 2 females, 4 indeterminate sex), one adolescent, and two young children (Willey & Crothers, 1986). Officer Cave (40WH98) in White County in middle Tennessee contained the remains of at least 15 individuals, including 9 adults (4 males, 4 females, 1 indeterminate sex) and 6 subadults (including two infants, three children, and one adolescent 12 - 14 years old) (Willey, et al., 1988). Finally, Ausmus burial Cave (40CE20) in east Tennessee contained a minimum of 25 individuals of all ages and both sexes (Tucker, 1989). The high number of young infants, one year old or less, from Lake Hole Cave (at least 17 of the 99 individuals) is the direct result of the use of water screening through small mesh as an excavation recovery technique (Whyte & Kimball, 1995). It is clear that, even for Lake Hole Cave, these are indeed *minimum* estimates of the numbers of individuals interred in these sites and that there is no interment bias by age or sex of the people buried in these caves.

PALEOPATHOLOGY

Table 3 summarizes the presence and frequency of major pathologies for the five sites analyzed with substantial sample sizes–Ton (44WG3), Mer (44LE280), Bone Cave (44LE169), Indian Burial Cave (44LE11), and Lake Hole Cave (40JN159). Identification of pathologies is based on descriptions and illustrations in Ortner and Putschar (1981), Ortner and Aufderheide (1991), and White (1991). The most common pathologies represented in the skeletal collections included dental disease (caries, abscesses, antemortem tooth loss), indicators of possible nutritional deficiencies, non-specific infection or generalized stress (porotic hyperostosis, enamel hypoplasia, osteitis, periostitis, osteomyelitis), trauma, and degenerative osteoarthritis.

Dental caries rates were high for all of the analyzed sites for which teeth were available (no teeth were collected from Indian Burial Cave), affecting between 13.5 and 50.0% of the total number of adult teeth examined from each site (Figure 2). These caries rates are well within the range of agricultural populations (Smith, 1983). A high percentage of adult mandible and maxilla (jaw) fragments manifested antemortem tooth loss, ranging between 25.0 and 61.5% of all fragments (Figure 2). This tooth loss surely occurred as a result of dental infection, abscess, and decay of the adult dentition and further sup-

Table 3. Pathologies of skeletal collections from selected cave sites.

Pathology	Ton		Mer		Indian Burial Cave		Bone Cave		Lake Hole	
dental caries	7/31	22.6%	8/16	50%	-	-	13/30	43.3%	83/614	13.5%
abscess	-	-	-	-	-	-	3/8	37.5%	2/45	4.4%
tooth loss	8/13	61.5%	2/5	40.0%	-	-	2/8	25.0%	26/45	57.8%
porotic hyperostosis	3/5	60.0%	-	-	-	-	-	-	21/43	57.8%
enamel hypoplasia	1/31	3.2%	1/16	6.3%	-	-	3/30	10.0%	17/614	2.8%
non-specific infection	5/121	4.1%	6/144	4.2%	-	-	2/326	0.6%	73/3349	2.2%
arthritis	-	-	3/120	2.5%	1/65	1.5%	4/254	1.6%	93/3576	2.6%
trauma	-	-	2/120	1.7%	2/65	3.1%	1/254	0.4%	25/3916	0.6%

Note: Dental caries and enamel hypoplasia percentages are based on total number of adult teeth; abscess and tooth loss percentages are based on total adult maxilla and mandible fragments. Bone Cave percentages are based on identifiable bone fragments only.

ports the contention that the individuals from these sites were part of an agricultural (maize-based) society. A high caries rate (23.5%) was also observed for Officer Cave but not Ausmus Cave (5.6%) (Willey, et al., 1988; Tucker, 1989).

Nutritional or disease stress was also indicated by the high percentage of frontal fragments with pitting in the eye orbits from the Ton site and Lake Hole Cave (Table 3 & Figure 3). This condition, called porotic hyperostosis or cribra orbitalia, has been linked to chronic iron-deficiency anemia in some subadults or to the secondary effects of chronic disease (Stuart-Macadam, 1991). Lowered iron levels in the blood of individuals may actually be a positive adaptive physiological response in regions with large numbers of pathogens, because pathogens are less likely to attack successfully or reproduce within such a host (Stuart-Macadam, 1992).

The occurrence of enamel hypoplasia (grooves or pits) (see Goodman & Rose, 1990) on some adult teeth suggests periodic stress during childhood. The frequency was overall very low for these sites. Finally, one adult tibia from the Ton site and three tibiae and one femur from Lake Hole Cave were bowed. Bowing of long bone shafts may be produced by a variety of factors (e.g., malnutrition, trauma, disease) (Ortner & Putschar, 1981).

Frequencies of non-specific infection were also low. Most included moderate osteoporotic pitting of the cranium (affecting 5% of the skull fragments at Lake Hole Cave) and periostitis (pitting and bone remodelling) on arm and, especially, leg bones. On at least six long bones from Lake Hole cave and one fibula from Bone cave, more advanced osteomyelitis was present. According to Ortner and Putschar (1981), this non-specific infectious state involves bone marrow and is often accompanied by a cloaca for pus drainage, which is often part of the

Figure 2. Mandibles from 44WG3 with extensive premortem tooth loss and caries.

Figure 3. Porotic hyperostosis on upper left eye orbit of cranial fragment from 44WG3 (near upper left corner of scale).

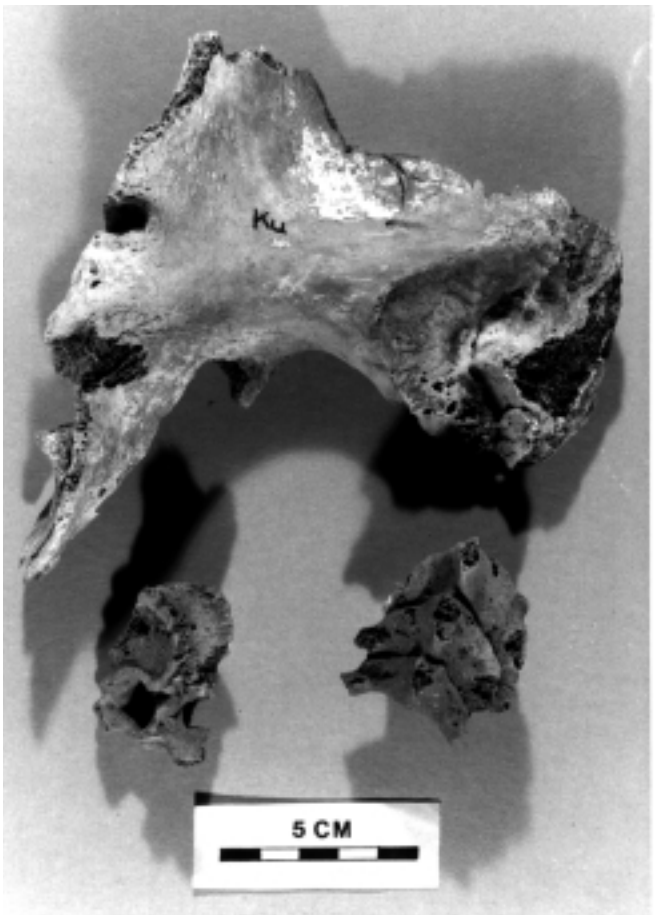

Figure 4. Arthritic lipping and abcess on right innominate (top), Arthritis on thoracic vertebra (bottom left), and 3 fused thoracic vertebrae (bottom right). All 44LE261.

reactive process to traumatic injury. At Lake Hole Cave, non-specific infection was most commonly seen on the leg bones. Over 7% of all leg bones (26/337 total femora, tibiae, patellae, and fibulae) were affected. This same pattern of periostitis distribution was observed by Willey and colleagues (1988) at Officer Cave. They (Willey, et al., 1988:64) note: "The tibia (lower leg) is a common location for infectious disease and trauma because it is vulnerable to blows, has a large subcutaneous area, few capillaries, and slow blood flow."

Degenerative osteoarthritis was also commonly recorded from these skeletal samples (Figure 4). For example, at Lake Hole Cave, 8.96% of all vertebrae, 5.45% of all clavicles, 3.2% of all feet, and 2.15% of all elbow and wrist areas of the arms manifested osteoarthritis. This condition is particularly common in the vertebrae and long bone joints of older individuals and is indicated by the presence of osteophytes (bony lipping and spurs) and eburnation (wear and polishing) on joint surfaces (White, 1991).

A few traumatic injuries, predominantly in the form of healed postcranial fractures of the ribs, legs, and arms, were noted at Mer, Indian Burial Cave, and Bone Cave, and at Lake Hole Cave (Table 3). Of the 25 traumatic injuries noted for Lake Hole cave, most were healed fractures of the legs (7/25) or ribs (5/25). As stated previously, periostitis and osteomyelitis, infectious conditions often initiated by traumat-

Figure 5. Rodent-gnawed right humerus (top) and right tibia (bottom) shafts from 44LE261.

ic injury, were also most common on the leg bones of Lake Hole Cave individuals.

POSTMORTEM AND POSTDEPOSITIONAL ALTERATION OF BONE

The most dramatic post-depositional or post-mortem alteration of many of the bones from these caves has been produced by animals (Figure 5). Carnivore gnawing of the spongy ends of long bones and highly patterned rodent gnawing of bony projections (see White, 1991:363-365 for a discussion and illustrations) obliterated the external features of some bones. For example, over 49% of the 144 Mer site bones were rodent gnawed. At Indian Burial Cave, 29.7% of bones were rodent gnawed and 16.2% were carnivore chewed. All of these cave sites clearly suffered from extensive alteration and movement of bones by burrowing and denning animals.

Burned human bones were rare for all sites; however, 53 calcined bone fragments were recovered from two excavation units at Lake Hole Cave, suggesting the possibility that at least two cremations were placed in the cave. Evidence for cremations in burial caves has been noted by Clark (1978) for Higginbotham Cave and Willey, et al. (1988) for Officer Cave. This mode of post-mortem human alteration of the dead appears to be rare for these cave sites, however.

Some researchers (Boyd & Boyd, 1992; Kimball & Whyte, 1994) have suggested that the disarticulated human remains in these sites may represent the remnants of secondary bundle burials, in which the bones of individuals previously interred elsewhere were collected after decay. While this mode of interment may have been used by these prehistoric Indians, the extensive bioturbation, erosional processes, and human looting that have affected these sites could have easily produced the scattering or clustering of bones seen today. The recovery of numerous small bones (such as the hyoid, hand and feet bones, fetal, and infant bones) from Lake Hole Cave indicates that most individuals at this and possibly the other cave sites were placed in these sites shortly after death. The predominance of primary interment as a mode of burial is also supported by informants' comments suggesting the presence of articulated skeletons with artifacts in many southwest Virginia cave sites (David Hubbard, 1995, personal communication).

SUMMARY AND CONCLUSIONS

From a detailed review of the skeletal biology of human remains from 15 Southwest Virginia and East Tennessee prehistoric burial caves and a comparison with previously studied caves, several patterns emerge:

1. While burial caves may have been used for over 1000 years in this region (Wiley, et al., 1988; Boyd & Boyd, 1992; Kimball & Whyte, 1994), radiocarbon dates and artifact evidence suggest their most common use between circa A.D. 900 – 1400.

2. These caves were cemeteries, with all ages and sexes interred within them.

3. The skeletal remains predominantly represent primary burials, although other forms of interment (such as cremation and secondary burial) occurred in some cases.

4. High caries and antemortem tooth loss rates for nearly all sites indicate that the interred were from maize-based agricultural societies (although the low caries frequency at Ausmus Cave suggests greater variability in diet).

5. The overall low rates of non-specific infection on the skeletal remains suggest that, except for dental disease, the general level of health for individuals was good (i.e., they successfully met nutritional and pathogenic challenges).

6. Trauma frequencies suggest that the likelihood for injury to the skeleton was low.

7. Extensive natural and human disturbance to these sites have altered much of their contextual information, thus requiring careful investigation and stronger efforts at preservation of these sacred sites.

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