Taphonomy of *Stegodon orientalis* at Panxian Dadong, a Middle Pleistocene site in Guizhou, South China

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SUMMARY: Panxian Dadong is a large karstic cave in the mountains of western Guizhou province. Archaeological excavations at Dadong have yielded a rich faunal sample in association with stone artifacts and human remains. *Stegodon orientalis* is an important component of the faunal sample, which is predominated by large-bodied mammals. This study was initiated with three main objectives: 1) to describe the sample of stegodont dental and skeletal material, 2) to develop a set of characteristics which can be used to identify fragmentary stegodont dental material, and 3) to produce an age at death profile for the stegodont sample. Ultimately, this study is intended to support other taphonomic and zooarchaeological studies undertaken at Dadong with the goal of determining how faunal material was introduced to the cave.

1. Panxian Dadong Fauna

1.1 Age and composition

The Dadong faunal sample consists of a variety of species characteristic of southern China. A Middle Pleistocene age is verified by U-series and ESR dates ranging between 130-250 ka for the archaeological layers (Shen *et al.* 1997, Rink *et al.,* in press). The sample is predominated by large-bodied animals that would not ordinarily inhabit caves, such as *Stegodon orientalis*, *Rhinoceros sinensis*, and the giant tapir *Megatapirus augustus*, and a diversity of bovids and cervids. The most commonly identified species in the sample is *Rhinoceros sinensis*, which comprises 24% of the total elements identifiable to taxon, followed by *Stegodon* at 13%.

1.2 The stegodont component

The sample consists of 215 isolated or fragmentary teeth, four skull fragments, and 45 postcranial elements. The postcrania include 8 axial elements and 37 appendicular elements. Based on the number and representation of skeletal elements and their stratigraphic positions, the minimum number of stegodonts preserved at Dadong is three. The number and diversity of dental remains suggests that a greater number of individuals is represented.

2. Analysis of the Stegodont dentition

2.1 Methodology for identifying fragmentary specimens to specific tooth classes

The fragmentary nature of the Dadong stegodont dental remains complicates their identification to specific tooth classes. In this study, the tooth class designations dp2, dp3, dp4, M1, M2, and M3 are used. To assist in tooth class assignment, the Dadong material is compared with the Yanjinggou sample from Sichuan province (Colbert & Hooijer 1953).

Specimens were initially separated into two groups: those identifiable to class (Group 1, N=41) and those unidentified to class (Group 2, N=174). The majority of deciduous premolars in Group 1 were identifiable to quadrant, although it was difficult to identify molars by

element and position. For most purposes in this paper, they are grouped together.

Each Group 1 specimen was described, drawn, photographed, and measured. The results of the analysis of the Group 1 specimens were then used to evaluate Group 2. Variables used included: mesiodistal tooth length, crown height, maximum crest height, base to crest along midline, crest length (buccolingual diameter of each crest), crest width at lateral edges, crest width at midline, enamel thickness at crest apex, enamel thickness at midpoint of crest face, number of conelets, crest occlusal wear score, dentin exposure score, and calculus thickness score.

Penultimate ridge crest height, a measurement Colbert and Hooijer (1953) used to characterize teeth by class, shows progressive increase between successive tooth classes. For the Dadong sample, this variable is a fairly effective discriminator between tooth classes, but several successive classes have overlapping ranges. It was therefore necessary to use several measures to confidently assign the fragmentary Group 2 specimens to tooth class (Tab. 1).

Group 1 is dominated by deciduous premolars, while Group 2 contains a greater number of molars. For those teeth that can be identified to a quadrant, the numbers of maxillary and mandibular teeth are approximately equal. Based on table 1, the largest class is dp4, with a total of 47 specimens. This would mean an MNI of 12 stegodonts.

As many specimens in Group 2 could only be distinguished as premolars or molars, it is also useful to look at a simplified distribution (Tab. 2). This increases the number of both dps and molars identified to general class groupings. The far greater number of dps, (evident in either table, but especially in table 2), suggests that the Dadong fauna has predominantly young stegodonts.

Tab.1 - Tooth Class Distribution.

Tooth	Group 1	Group 2	Total
dp2	13	4	17
dp3	15	30	45
dp4	9	38	47
M	4	48	52
Tusk	0	1	1
Tooth germs	0	4	4
Unidentified	0	49	49
	41	174	215

Tab.2 - Generalized Tooth Class Distribution.

Tooth	Group 1	Group 2	Total
dp	37	93	130
M	4	48	52
Unidentified	0	28	28
Tusk	0	1	1
Tooth germs	0	4	4
	41	174	215

The differing tooth class profiles for Group 1 and Group 2 reflect two biases that are associated with use of fragmentary stegodont material. It appears that the small, dense dp2s have a greater possibility of being recovered in relatively complete form. Teeth with greater numbers of crests are more likely to be recovered as fragments. In the Group 1 sample, 92% of the dp2s are complete, while only 40% of the dp3s, 33% of the dp4s, and none of the molars are complete.

2.2 Determination of dental age and construction of a dental age profile

Following Haynes (1991), we assign specimens to one of five 12-year age categories. Our dental age profile represents the developmental age of source individuals, but because some of the record may be made up of teeth shed naturally, it is not really an age at death profile. It is an age of dental remains profile. The lack of distinction among molars means specimens that potentially belong in older age categories cannot be aged, and are absent in the profile. In addition, each specimen that cannot be refit or associated with other teeth is considered to represent an individual. If all the teeth identifiable by class are assigned to an age category in Haynes's system, all but two fall into the first category (0-12 yrs). There are clearly some other adult individuals, represented by fragmentary molars and two fairly complete M3s, but it is not possible to assign them to a specific category of animals over 12 years of age. This makes it difficult to interpret the sample in terms of model mortality profiles.

3. Evidence for Human activity and selection of Stegodonts

3.1 Mortality profiles

Haynes (1991) describes four distinct mortality profiles for proboscideans. Type A shows the greatest portion of individuals in the first category of subadults with each successive category represented by decreasing proportions. Type B is bimodal, with few prime age adults. Type C is dominated by prime-age adults, and Type D is patternless. The Dadong sample, with its greater preservation of dps, would resemble either Type A or Type B (Haynes 1991). Even if it were possible to assign the 52 molars to age categories, the sample would still have a distribution that has predominantly younger individuals. This assumes that no portion of the sample has been preferentially removed through excessive breakage or other taphonomic factors.

3.2 Accumulation and transport factors

Stegodont material at Dadong may have accumulated through the natural death of animals, the natural loss of deciduous teeth, water transport, predation by large carnivores or humans, or transport by porcupines. From analysis of the dental remains, it appears that there was differential selection of younger animals. While several activities might produce this distribution, human activity may have played an important role. Carnivores are rare at Dadong (4% of the sample identifiable to taxon), and there are few that would have preyed upon animals the size of stegodonts. Bone-collecting porcupines would have had difficulty transporting all but the smallest Stegodont elements. Human activity is well documented at Dadong. Stone tools and human teeth are present in levels with stegodont materials (Schepartz *et al.,* in press). Locally available chert, basalt and limestone were used to make flake tools. Retouch is not intensive on most of the tools and classic Levallois features are not present. No evidence of processing has been found on stegodont bones, but cutmarks, percussion damage and burning are evident in other portions of the faunal assemblage. There is also evidence for selective transport of large mammal appendicular elements (Schepartz et al. in press), and the possible use of rhinoceros teeth as raw material for tools (Miller-Antonio *et al.* 2000).

4. Conclusions

Analysis of stegodont dental and skeletal

material illustrates that the Dadong sample consists primarily of younger individuals aged 0-12 years. A combination of tooth measures and morphological characteristics was used to identify fragmentary specimens and increase the analytical sample. This study supports the results of other taphonomic work that suggests humans played an important role in the formation of the Dadong faunal assemblage.

5. References

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