

## Archaeological Site Formation: Understanding Lake Margin Contexts

Allan Gavin Thayer Morton

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### Reviewed by PARTH R. CHAUHAN

Stone Age Institute & CRAFT Research Center (Indiana University), 1392 W. Dittmore Road, Gosport, IN 47433, USA

Site formation studies form a vital and indispensable component of palaeoanthropological research. Such approaches regarding the depositional environments of Paleolithic sites, lithic assemblage scatters, and associated material such as vertebrate fauna, are highly necessary to establish not only the contextual integrity of the information but also to make accurate inferences regarding early human behavior and ecological adaptive strategies. In the present volume, the author (A.G.T. Morton) attempts to address and interpret the formation of Plio-Pleistocene archaeological sites primarily within lacustrine environments. This topic is discussed through multiple empirical, theoretical, and experimental aspects and the volume is organized into six chapters with their respective parts and sub-sections. These are Introduction, Experimental Methodology, Experimental Results, Experimental Results and Alternative Model Analogues, Application of the Experimental Results, and a Conclusion chapter. The chapters are followed by two appendices (“Description of the Experiments” and “Additional Studies”), a glossary, and a bibliography. The majority of the evidence discussed comprises published archaeological examples from African contexts and the results from the numerous types of experiments carried out by Morton.

In the Introduction chapter, Morton provides readers with a background to site-formation studies and emphasizes their relevance to making inferences about the archaeological record. Considering the vast amount of site formation data available, Morton’s introduction may seem proportionately short and several important references are missing. At the same time, it is challenging and virtually impossible to cover or refer to all relevant studies and the author mostly has focused on those related to his present study. Classic studies by investigators such as C.K. Brain, G. Isaac, D. Gifford-Gonzalez, A. Beherensmeyer, and K. Schick (among others) are listed as examples of different types of site-formation observations or actualistic studies carried out in the past. Interspersed with relevant and related quotes from these studies, the chapter also outlines important factors of site-formation (e.g., taphonomy) and some theoretical arguments associated with such concepts. Morton also provides a brief introduction of the structure of this book and the intrinsic scope of the topic—lake-margin processes and associated archaeological occurrences. A table of important sites occurring in lake-margin contexts is provided on page five, although an additional column representing the respective age estimates for these occurrences would have been extremely useful. As the author states (p.

4): “The primary goal of this study is to provide a means of increasing the confidence level of archaeological interpretations by providing a methodology for the identification of the formation processes and the degree of modification.” He also stresses that “An understanding of the formation agencies is essential, but the absolute requirement is to draw inferences from the archaeological record that have behavioral significance.”

The second chapter outlines the methodology employed by Morton, namely identifying and applying different properties of lacustrine environments and associated depositional processes. Discrete concepts and attributes such as coastal processes, beach processes, waves, and particle transport are discussed at varying lengths. Numerous tables and figures accompany the text and some of the more important and useful ones include a flow chart on taphonomic bias (p. 9), general attributes related to site-formation studies (p. 11), factors of post-depositional disturbance and associated archaeological signatures (pp. 12–13), and schematic models of site disturbance (pp. 14, 16), among others. Another key feature of this part of the chapter is the inclusion of various mathematical models and equations that reflect respective rates of theoretically-predictable disturbance levels through various processes. However, Figures 2.2 and 2.3 may have been, perhaps, more visually informative in the form of 3-D block diagrams. In their current form, these two figures appear to be over-simplified and are difficult to distinguish and interpret at first glance. The focus of lake-margin processes further establishes the context for the following chapters which treat the author’s results from his own actualistic studies. In addition to the field observations, Morton also highlights results from controlled laboratory experiments such as the artificial flume at the Department of Geography, University of Cambridge, U.K. The associated attribute analyses during such experiments are also listed and explained for the archaeological and faunal specimens, respectively. The latter material was collected from the Koobi Fora area at Lake Turkana, Kenya and these data were further supplemented with observations on human skeletal elements at Lake Erie, Ohio, USA.

Chapter Three is devoted to the results of the experiments. To interpret some of the accumulated data, certain statistical methods such as the Corey Shape Index for quantifying angularity or sphericity have been employed. Direct challenges and problems with some of the approaches are also mentioned such as the random physical properties of wave action and impact. Although the author acknowledges the methodological risk of processing such data, he justi-

fies it by relying on the sheer volume of the processed data to factor out to the most accurate mean results. Despite the application of these various methods, Morton does not provide any tables of the excessive standard deviations that he also acknowledges—thus dangerously downplaying the negative impact of expected error margins. Each of the experiments carried out by Morton are described in greater detail in this chapter (and also as Appendix A at the end of the volume). These individual and extensive experiments include 1) wave tank experiments in energy fluctuations; 2) wave tank experiments in lacustrine transgressions; 3) wave tank experiments in lacustrine regressions; 4) artifact dispersal in an adjusting profile; 5) modes of artifact movement; 6) artifact clustering; 7) artifact orientation; 8) ideal artifact forms; 9) scatter patterns, 10) lithic accumulations; 11) lithic transportability (natural and wave tank settings including site elongation); and, finally, 12) skeletal element transport and orientation. In conjunction with each of the experiments, archaeological case studies are compared to the laboratory experiments (e.g., Cobinosh Island in Canada for understanding lake wave energy fluctuations).

To understand and interpret the nature of natural artifact dispersal and transport in such settings, “flint artifacts were manufactured, weighed, and measured and placed in the surf at varying profile locations...” (p. 28) in the experimental tank. Unfortunately, Morton does not reveal the typology of the artifacts utilized in the study nor show any figures either of them or general figures of his experiments at Lake Turkana and Lake Erie. This natural setting (Lake Turkana) was utilized also to understand the orientation of artifacts in relation to fluctuating wave profiles. These observations and resulting interpretations are particularly strong as Morton draws his inferences from seventy-five such orientation experiments. In addition to artifacts with a long axis, (specifically, replicated bifaces and trihedral picks), I think additional types such as asymmetrical and ovate flakes and irregular angular cores could also have yielded meaningful data. Nonetheless, a negative relationship (correlation coefficient of -0.69) was noted between artifact weight and percentage frequency of the specimens oriented parallel to the shoreline although the smaller bifaces tended to orient first. Such experiments can go a long way in helping to explain or reconstruct environments of deposition of Paleolithic sites (as evident from the Kalambo Falls study used as an example by Morton).

An additional 130 experiments were carried out at Koobi Fora to reveal the morphological types of artifacts (flat versus cubic or angular specimens) most susceptible to certain types of movement. The resulting data were further quantified using t-tests. Three-dimensional artifact scatter patterns (as opposed to the traditional two-dimensional method) were assessed through thirty flintknapping experiments resulting in 8,763 fragments of lithic debris. Artifact accumulations were studied by constructing concrete pillars representing natural obstacles such as shoreline vegetation, for example. Specimens were covered with aluminum foil so they could be located (following burial) using a metal detector. Lithic transportability experiments were

conducted at Lake Turkana (fine sand context), Lake Ontario (coarse sand context), and Lake Simcoe (fine gravel context). Two important facts were verified—that “significant vertical dispersal can result from lacustrine processes” and “smaller artifacts are more susceptible to vertical dispersal” (p. 54). To supplement the lithic transport studies, Morton also carried out similar experiments on faunal specimens at Lake Turkana, as well as Lake Erie. Fresh and weathered skeletal elements belonging to *Capra hircus*, *Canis familiaris*, and *Camelus dromedarius* were collected, weighed, measured, and grouped before being placed in the water at the Koobi Fora lake margins. At Lake Erie, bones of *Homo sapiens* obtained from Cuyahoga Community College at Cleveland, Ohio, were utilized for experiments by research assistants from the same college. One of the most surprising conclusions drawn from this set of faunal experiments was that “No difference could be discerned in the pattern of orientation between *Camelus* and human bones” (p. 62).

In Chapter Four, Morton successfully compares the results of his experiments on lake margin contexts to other types of geomorphological and associated post-depositional processes such as fluvial transport, downslope dispersal, horizontal and vertical dispersal from trampling, vertisol impact, and various types of bioturbation. Detailed comparisons also are made between classic studies published by Boaz, Voorhies, Beherensmeyer, Speth, and Spenneman, for example. Three broad modes of bone dispersal are discussed in turn—geological, hydraulic, and biological. While the majority of the chapter is dedicated to faunal transport, the impact on artifact assemblages is also included and related studies are highlighted. The comparison of associated data between lacustrine and other types of disturbance factors are conveniently displayed in a series of tables (pp. 82–94).

These are followed by probably the most important chapter of the book—Chapter Five or Application of the Experimental Results. Here, Morton attempts to correlate and compare his experimental results with published empirical data from two excavated Plio-Pleistocene sites, Naiyena Engol and Senga 5A. Brief histories of investigations are provided for both sites and the author addresses individual aspects and attributes such as profile adjustment, particle interaction, artifact shapes, site elongation, scatter patterns; similar observations on the associated faunal elements are also made. Lithic assemblage compositions and specimen conjoining results are also taken into account, as are intrasite variation and spatial gaps with varying artifact frequencies. Finally, the collective impact of the various modes of post-depositional processes are assessed for each site. The general conclusions reached for Naiyena Engol are that the site is heavily disturbed, particularly through artifact winnowing through fluvial action, although the small scale of the excavations are also noted to be a limiting factor for accurate inferences on site formation and hominin behavior. The Senga 5A site was included because of the long-standing uncertainties of its palaeoecological context. Based on the methods outlined and applied by Morton, “no evidence could be found for any amount of site reworking

due to lacustrine processes" (p. 120); this broadly supports J. de Heinzelin's earlier interpretation of minimal reworking and colluvial deposition. This is further supported by observations on assemblage compositions and artifact size and shape frequency distributions, though minimal disturbance from downslope dispersal, trampling, and bioturbation are also indicated.

In the final chapter (Six), Morton summarizes and organizes the previously discussed data and salient conclusions into four broad categories: a) discerned framework, b) established methodologies, c) updated principles, and d) identified patterns. As he clearly concludes:

"The primary goal of this study has been to provide a means of increasing the confidence level of archaeological interpretations by instituting a series of indicators for the identification of formation processes. These categories of procedural aspects of site formation offer vital information not only for archaeological sites with a known lacustrine component, but virtually any occurrence with an uncertain depositional history. Due to the fact that the majority of Early Stone Age sites in East Africa have been recovered from Fluvio-Lacustrine sediments, a better knowledge of the processes occurring at a lake margin is vital to enhancing the strength of inferences made from their analysis" (pp. 122–123).

In some respects, Morton attempts to do too much *with* too much and the data, methods, and inferences appear overwhelming at first. In other words, there is no single focus on any particular aspect or discrete concept as both

lithic and faunal assemblages are analyzed but have very contrasting morphological and physical properties including post-depositional life-histories. Considering that site-formation studies are an extremely vast subject that incorporate numerous methods and concepts, Morton does not justify the accuracy and applicability of his faunal data sets, resulting in slightly taphonomically-biased and limited conclusions. It should also be realized that only two published case studies are discussed in the end (Naiyena Engol and Senga 5A), leaving ample scope for further comparative work—based on Morton's results—from published data on equally or more important sites in palaeo-lacustrine settings (e.g., Koobi Fora, Olduvai Gorge). Finally, the glossary at the end of the book, though useful, could have been more comprehensive.

On a more positive note, an important benefit readers can gain from this book is an introduction to an array of diverse methods that can be utilized to generate site-formation interpretations. For example, this volume will quickly become a valuable reference source and an important analytical guide and starting point for investigators working on prehistoric archaeological sites in lake-margin contexts, regardless of their chronology. The primary expediency of the volume will be the suites of criteria Morton has aptly organized into comprehensive and clear methodological tables. As more Plio-Pleistocene sites are excavated in the future, such integrative and multi-perspective methods will be an indispensable approach for arriving at the most accurate inferences regarding lake-margin contexts.