

# TOOLACE 1.0, a Microsoft Access Based Multi-Disciplinary Application in Prehistoric Bone Tool Research

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## Abstract

The database program TOOLACE 1.0 enables a systematic description (both zoological and archaeological) of artefacts made from osseous materials (bone, antler, tooth/ivory) and has two aims: 1) to build a program on the basis of an internationally recognized standard (Schibler 1981); 2) to create an integrated zoological, technological and visual inventory, linked to our assemblage of photographic documentation and to the internet. Because TOOLACE 1.0 does not require a special basic software, anyone can access and/or expand the database anywhere in the world based on local needs. The use of this application is advantageous in broad-based analyses. Since Schibler's original bone tool typology is illustrated, the program can be profitably used by the non-specialist for the purposes of data gathering and inventory. Meanwhile, the program possesses many analytic possibilities built on the basic design of spreadsheets. TOOLACE 1.0 is therefore a useful tool in handling a special group of biological materials that are also archaeological artifacts containing a great deal of cultural information.

## Keywords

databases, bone manufacturing, archaeozoology, osseous raw materials

## 1. Introduction

With the increasing availability of mainframe computers, a typical phenomenon of the 1970s was a revolution in data processing applications and archaeozoology was no exception. It is of historical interest that one of the earliest such proposals (Reed 1971) was circulated at the Third International Congress of the Museums of Agriculture in Budapest (19–23 April 1971), also considered the time that the International Council for Archaeozoology (ICAZ), the world organization of our profession (Bartosiewicz 2002, 121) was officially established. It may also be considered typical that this initiative came from a North American scholar working in Southwest Asia, where – with the emergence of New Archaeology – scientific methods were in the forefront of archaeological research. A systematic coding system was devised by Redding *et al.* (1977), and a special section of the volume entitled “Approaches to Faunal Analysis in the Middle East” (Redding *et al.* 1978; Uerpmann 1978; Meadow 1978) synthesized the joint efforts of archaeozoologists during that decade (Clutton-Brock 1975; Gifford and Crader 1977).

With the introduction of laptop computers, digital calipers and balances, as well as varieties of commercial software, increasingly sophisticated animal bone databases could be developed already in

a DOS environment (e. g. Schibler 1998). However, systematically recorded osseous animal remains (bone, antler and tooth, simply referred to as “bone” in the rest of this article) remained a challenge. In 2005, René Kysely, an archaeozoologist from Prague, introduced an Access database for faunal analysis to researchers at the Aquincum Museum, Budapest. This application provided us with the idea of developing an archaeozoological database with a special handling surface designed to inventory and analyze modified animal bones. The Microsoft Access program is a database software well-known around the world. With the help of this easy-to-use and flexible program, it becomes possible to develop customized databases. Since the program, called TOOLACE 0.1, does not require a specific software, anybody can access and/or expand the database to meet their respective needs.

## 2. Aims and limitations

The meaningful analysis of archaeozoological assemblages requires a standardized description of masses of data characterized by multiple attributes, each with many states, for the purposes of both pattern recognition and hypothesis testing. TOOLACE 1.0, enables a systematic description (both zoological and archaeological) of bone tools and has two aims:

Initially, its typological content was based on the system of Jörg Schibler (1981) developed at the University of Basel. Thus, I developed a program based on an internationally recognized standard. In the second step, however, the full integration of zoological, technological and visual inventory was achieved, by linking data on a particular assemblage with photographic documentation and to the internet.

Although a number of typological systems for bone tools exist, the Schibler system suits prehistoric assemblages from the Carpathian Basin quite well. Schibler's system was based on many thousands of bone and antler tools from Swiss lake dwellings in both western and eastern Switzerland. The large sample size ensured increased typological variability, defining types created around objective morphology rather than assumed function. In addition, it has proved quite easy to add new types to the Schibler system.

Furthermore, the use of this application is advantageous in broad-base analysis, since Schibler's original typology is illustrated. Thus, the program can be profitably used by the non-specialist for the purposes of data gathering and inventory. Meanwhile, it possesses all the possibilities for analysis built on the basic design of spreadsheets. TOOLACE 1.0 has proved to be a useful tool for both researching and teaching by containing a special group of biological materials that are also archaeological artifacts containing a great deal of cultural information described by variables related to technology and style in combination with the indispensable zoological parameters.

### 3. Problems of recording bone tools

The basic requirement of any approach to archaeological documentation, whether computerized or not, is that various types of information need to be recorded in a format which permits their retrieval and use by the investigator and by others to whom the data is made available. In this regard, archaeozoologists have had a special advantage over archaeologists. Although (as opposed to physical anthropologists often dealing with complete skeletons) their find material, consisting largely of food refuse, tends to be recovered in a disarticulated and highly fragmented form, they still have a scientific system of reference at hand for the basic "typology". The skeleton of an identified animal precludes the need for the definition

of nomenclatures and typologies. Archaeologically relevant animals can be unambiguously described using their Linnaean names (Gentry *et al.* 2003, 647, Table 1.). Various elements of the skeleton can be entered in the database in a completely consistent manner, using terms from the *Nomina Anatomica Veterinaria* (NAV), the 1967 adaptation of the international medical nomenclature accepted in Paris in 1955 (Fehér 1980, 16). In addition to these basic attributes, the side (right/left), state of fusion, and standardized measurements (von den Driesch) of a bone can be consistently recorded. In small capacity, old computers, all variables were translated into numerical codes that can be efficiently used even today in the rapid and consistent recording of data. In order to help fast input, TOOLACE 1.0 uses the numerical codes defined in the KNOCOD system for biological variables (Uerpmann 1978). However, the verbal equivalents of these codes are automatically displayed for verification.

These technical advantages tend to be somewhat lost in the evaluation of bone tools. Due to difficulties in their interpretation, creating a comprehensive data base for these artifacts is a very complex task, since one must again deal with *bona fide* archaeological finds that comprise both zoological and cultural dimensions of information. Early coding systems developed for refuse bone by Redding *et al.* (1978) and Meadow (1978, 169) already accommodated recordings of some cultural modifications to refuse bone. Both databases included categories that facilitated the detailed descriptions of burning, fragmentation, and cultural modification. Meadow's codes allow for the recovery of information on various types of fracture and the patterning of butchering marks using unique labeling of each bone specimen for the purposes of cross-referencing at a time when 80 character punch cards contained information on each record in a database.

The complexities of recording ordinary bone modifications have been compounded with additional cultural factors in the case of bone tools. In fact, the formal use of biological (zoological/anatomical) identification may hamper the functional understanding of certain tool types defined on the basis of raw material, but with poorly understood function (Bartosiewicz and Choyke 1994). The main difficulties inherent to the standardized recording of bone artifacts are as follows:

1. Traditional archaeozoological evaluation is a precondition for the analysis of bone tools.

2. Bone tools were common and intensively used objects in all archaeological periods.
3. Some bone tools had more than one function.
4. Beyond their function, some long-term objects had value as carriers of personal or communal memories and multiple identities.
5. The appearance of iron artifacts resulted in a radical reduction in both the quantity and diversity of utilitarian bone tools.

*Ad 1.* Bone tool specialists must possess a basic knowledge of animal anatomy, as the most precise identification possible of raw materials is also critical from an archaeological standpoint. These biological data are particularly well suited for a database format because the possible states of many of the attributes are definable in a discrete fashion based on zoological criteria. This logically means that the analysis of bone tools is a special form of archaeozoological research that should concern the entire faunal assemblage. Bone as a raw material is in most cases a by-product of meat consumption and bone manufacturing should be understood within that context, even when special, non-food related substances (e. g. antler, ivory or shell) are worked. This approach is important, because (with a few exceptions) osseous raw materials are typically correlated with the quality and quantity of skeletal remains in the settlement refuse (Bartosiewicz 2006).

*Ad 2.* Bone as a potential raw material is present in all archaeological periods. This means that the typochronological evaluation of manufactured bone may sometimes be difficult, as certain types of simple bone tools may have been prepared in similar ways during different archaeological periods. On the other hand, certain, usually more complex types may have dating value. Usually, however, it is difficult to link ordinary bone tools to social status or sometimes even a broader archaeological culture.

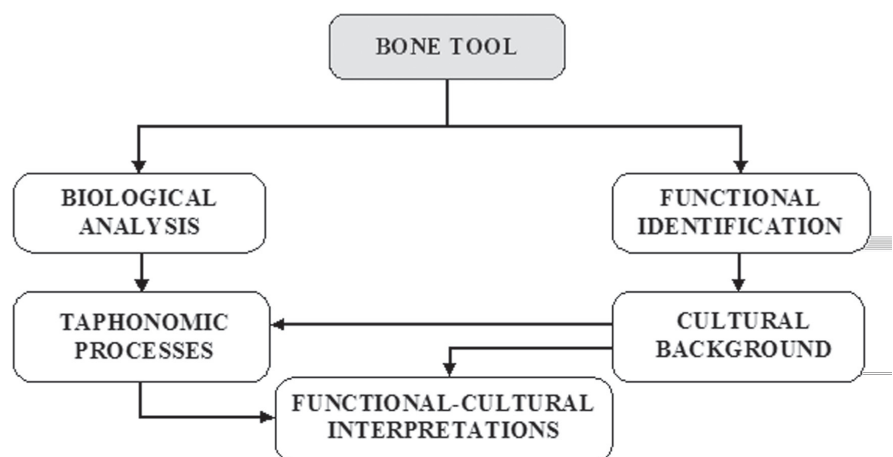
*Ad 3.* Identical looking bone tools may have functioned differently and, in fact, the same bone tool may have been used in a variety of ways. In these cases, precise description is hampered by overlapping traces of diverse use-wear.

*Ad 4.* The duration of use, i. e. working life of bone artifacts is of special interest as well. Some simple tools were

made and used in an *ad hoc* manner, while others were made from selected materials resulting from careful planning (Choyke 1983). These latter may be retained and preserved even after their “useful” working life ended. They may be regarded as tokens of personal or communal memory or passed on as heirlooms to new owners as a form of enchainment between members of a social unit (Choyke 2006). These changes in meaning are largely independent of function but may contribute to the problem of the omnipresence of bone artifacts in most archaeological periods. The phenomenon may be traced back to the problem of ownership as is sometimes the case with grave goods, when it is impossible to tell whether the deceased was the actual owner of the object.

*Ad 5.* This software user interface dominantly focuses on prehistoric material. The types, functions and use-wear are more diverse than in other archaeological periods. (See *Ad 2–4.*) On the other hand special databases have to be made for different periods before and after the appearance of iron artifacts. With this method the function or functions will be the key variables, through which these variables of the different artifacts from different periods will be comparable.

The brief review of these four questions clearly shows the complexities involved in the classification, analysis and interpretation of bone tools in comparison to refuse bone. The relationship between the natural and cultural aspects of this type of research is summarized in *Fig. 1*. The analyst must have a basic understanding of the biological nature of the raw material and its changes during the taphonomic process, i. e. the post mortem transformation of animal bones both by natural



*Fig. 1.* The analysis of bone tools from archaeological sites.

forces and human agency as part of the cultural background. Taphonomic changes, however, are not simply media-driven, but are also influenced by function (use) and cultural background. In fact, bone manufacturing itself is nothing but the post mortem change of osseous materials under human influence in a well-defined cultural setting. These effects must always be taken into consideration during the analysis of bone artifacts.

#### 4. The technical solution

Custom made, targeted data bases are of fundamental importance in reconciling the numerous aspects inherent in the analysis of worked bones. Beyond the statistical evaluation of quantities of data, they also offer help in interpreting the artifacts within a broader cultural context. Recently, at the request and under the guidance of A. Choyke, such a database was developed that aimed at meeting the special criteria set by bone tool experts, rather than general archaeozoologists. This database is not a new, independent software, but a specialized interface connected with a database structure that allows the zoological, typological and functional analysis of worked osseous materials. TOOLACE 1.0 was developed in a Microsoft Access environment. The choice of this program may be explained as follows:

1. Microsoft Access is a well-known, widely available and easy-to-use software.
2. It is designed for the development of relational databases.
3. TOOLACE 1.0 is a user interface that can be personalized for the researcher. This includes the addition of new features or the modification of existing ones.
4. The database can work in conjunction with other types of statistical software. (e. g. Microsoft Excel or Calc). The data recorded can be used and exported for additional forms of use or re-combination with other data.

Data input is carried out on three related interfaces. The main input page (Fig. 2) contains primary, general information on the individual find (e. g. site name, date, period, inventory number etc.), as well as zoological characteristics. The second input page (Fig. 3) is already devoted to special bone tool typology (based on Schibler's 1981 typology), and the modes as well as classification of manufacturing patterns. The analysis of bone and antler tools is separated on this page, since both the procurement and manufacturing of these two main types of raw material can be very different. The third page (Fig. 4) was designed for the detailed input of bone tools with pointed tips and beveled working edges. The

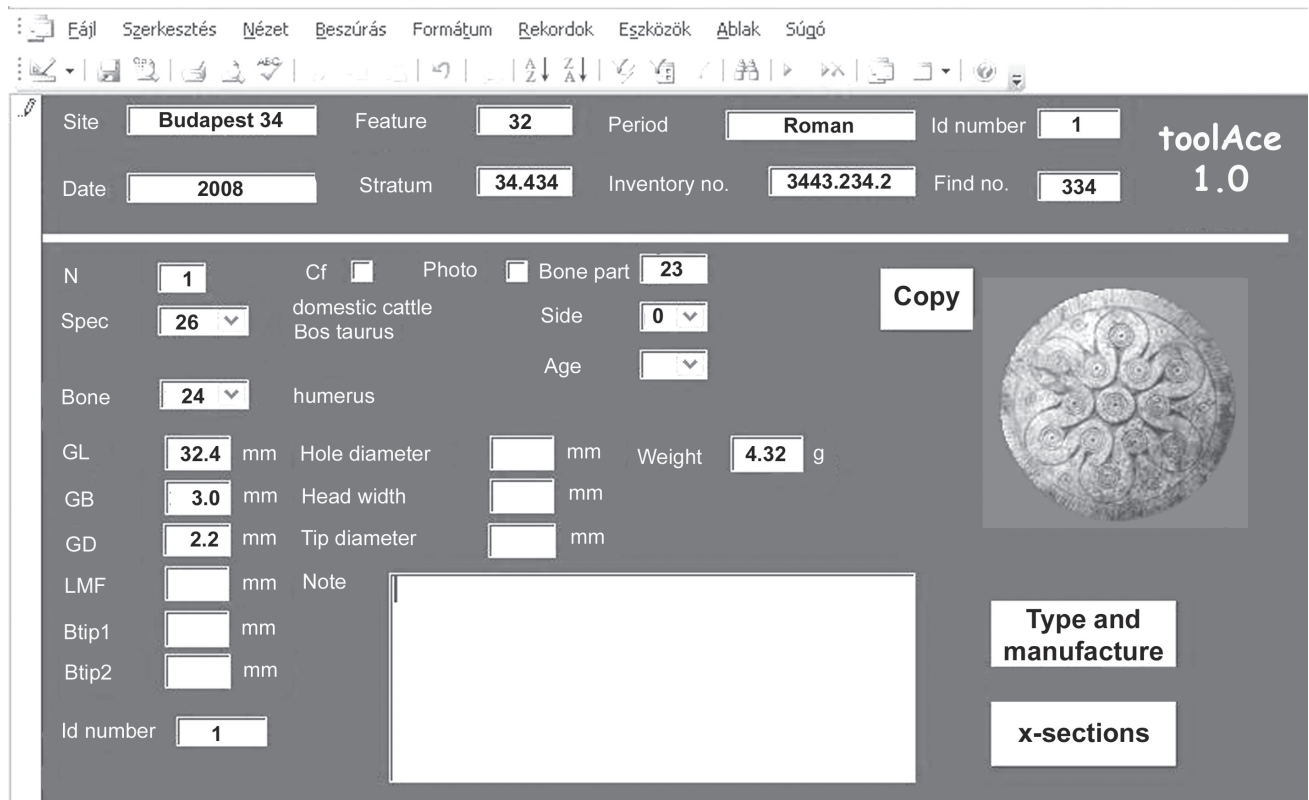


Fig. 2. The main input page showing primary, general information on the individual find.

The screenshot shows the 'Input page' of the TOOLACE 1.0 application. It features a menu bar at the top with options like 'Fájl', 'Szerkesztés', 'Nézet', 'Beszúrás', 'Formátum', 'Rekordok', 'Eszközök', 'Ablak', and 'Súgó'. Below the menu bar is a toolbar with various icons. The main area contains several input fields and dropdown menus:

- Manufacture:** 10/1, scraping+chopping to form groove
- Condition:** 3, finished+unused
- Basis:** 11, No epiphysis or otherwise worked base
- Use wear:** 12, chipped edge+parallel striations+polish
- Type:** 1/13, rib point
- Use wear locus:** 3, tip to midshaft
- Antlertype:** (empty dropdown)
- Use wear intensity:** 3, middle
- Intensity:** 30-40%
- Damage:** cracking
- Class:** II.
- Antler:** (empty dropdown)
- Curated:** no
- Shed:**
- Erosion intensity:** (dropdown menu open showing options: average, heavy, less than average, maximum, minimum, none)
- Id number:** 1

A large 'Back' button is centered in the lower part of the form.

Fig. 3. Input page showing special bone tool typology, biological identification and the modes as well as classification of manufacturing patterns.

The screenshot shows the 'Detailed input page' for bone tools with pointed tips and beveled working edges. It features a menu bar and toolbar similar to Fig. 3. The main area contains several typological sketches and input fields:

- Typological sketches:** A grid of 13 numbered sketches showing different tool shapes and cross-sections. The sketches are labeled with German terms: 1. „kreisrund“, 2. linsenförmig, 3. rechteckig m. verwundenen Kanten, 4. rechteckig „kantig“, 5. „walzenförmig“, 6. fläch-rechteckig, 7. halbkreisförmig, 8. trapezförmig, 9. unregelmässig vielskantig (meist 5-kantig), 10. dreieckig, 11. (empty), 12. hoch-rechteckig, 13. „hoch-linsenförmig“.
- Long x-section sketches:** A grid of 12 numbered sketches showing the long x-section of the tools, labeled with German terms: 1. symmetrisch achsel, 2. symmetrisch brech, 3. asymmetrisch lang zugsenkt, 4. symmetrisch kurz zugsenkt, 5. asymmetrisch stumpf (verrundet), 6. symmetrisch stumpf, flach, 7. asymmetrisch lang zugsenkt, 8. asymmetrisch kurz zugsenkt, 9. asymmetrisch stumpf, 10. asymmetrisch, 11. unregelmässig geschweungen, 12. regelmäßig gebogen.
- Input fields:**
  - x-sec point: 13
  - x-sec bevel:
  - Long x-sec point: 4
  - Long x-sec bevel:
  - Id number: 1

A large 'Back' button is centered in the lower part of the form.

Fig. 4. Detailed input page for bone tools with pointed tips and beveled working edges with typological sketches after Schibler (1981).

classification of tool types is aided by graphic keys stored in the program itself.

## 5. Conclusions

Even simple archaeozoological databases used for storing information on refuse bone tend to strongly differ in dealing with modifications caused by cultural processes which have acted on the bones. In contrast to discrete categories of biological identification, such attribute variation will either be continuous or sometimes difficult to grasp; attempts to standardize these categories will necessarily be rather subjective and tailored to the individual interests of the analyst. These problems pose cumulative difficulties in the systematic recording of bone tools.

TOOLACE 1.0 is an easy-to-use user interface of Microsoft Access, based on the typological system developed by Jörg Schibler (1981). Thus, the program was constructed on the basis of an internationally recognized standard bone tool typology. Using this program, however, it is possible to fully integrate zoological, technological and visual inventories, linking them with the file containing photographic documentation and to the internet. Since TOOLACE does not use a special basic software, the database can be accessed and/or expanded anywhere around the world, depending on the local fauna and form of bone manufacturing specific to geographical regions and time periods. All common variables can be systematically recorded and quantified, providing raw data for both descriptive statistics and more sophisticated types of analysis. Integrated osteological and cultural variables can be easily sorted, compared, grouped and exported to other types of analytical software.

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