MITES (ACARI) IN ARCHAEOLOGY

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Summary

Acaro-archaeology forms a new specialisation within the Dutch zooarchaeology. Acaro-archaeology is the study of the remains of mites (Acari) in an archaeological context. Some relevant characteristics of the most frequently encountered groups of mites are given as well as their mean identification percentages in archaeological samples and some potential applications.

Introduction

Zooarchaeology involves the study of the remains of animals found in an archaeological context. The purpose of this study is primarily to give a contribution to our knowledge of the mode of life as well as of the abiotic and biotic environment of people in the past. Obviously, additional information concerning for instance palaeoclimatology, zoogeography or the evolution of species, races or domesticated animals also emerges from these studies. These "secondary" results are of course by no means less interesting than the purely archaeological ones and they should not be underestimated or ignored in any zooarchaeological publication. After all, the borderland between archaeology and the natural sciences forms a fascinating but still underexplored area of research.

Zooarchaeology comprises several specialised subroutines dealing for instance with a specific taxonomic group like fishes (Ichtyo-archaeology, Brinkhuizen 1989) or with a group of animals hunted for a particular purpose, like the use of their fur and/or meat (Zeieler, 1987), or with a certain developmental stage of the animals involved (Prummel, 1987). It is clear that the study of the remains of mites (Acari) found in an archaeological context (Acaro-archaeology) is one of the first-mentioned specialisations within the zooarchaeology.

In this article I would like to illustrate some of the possibilities and restrictions of the use of the most frequently encountered groups of mites (Oribatida, Uropodina and Gamasina) in archaeological deposits.

Methods and Material

The most efficient method of extraction of the remains of arthropods from archaeological deposits is the paraffin-flotation method as described by Kenward, Hall and Jones (1980). With some minor modifications this method has proved to be highly
suitable for the retrieval of the remains of mites from archaeological samples (Schelvis, 1987). In this article I would like to pay more attention to the mites themselves than to the methods of extraction or how the results of the analysis can be used in an archaeological interpretation such as reconstructing the environment (Schelvis, subm.).

Fig.1 A recent (top) and a subfossil (bottom) individual of the oribatid mite Oppiella subpectinata (Oudemans 1900).
A  Oribatida (Beetlemites)

Representatives of this order of the Acari are the most frequently encountered mites in archaeological samples. Oribatids usually dominate the mite fauna of the soil and litter which partly explains their high numbers in archaeological deposits. However, since their remains also tend to be the most numerous in those deposits formed in places which are normally not dominated by oribatids there must exist a selective preservation process which enlarges the relative abundance of the oribatid remains. Apparently, the completely fused and usually heavily sclerotized exoskeleton of the higher oribatid (Fig.1) is less susceptible to mechanical destruction than the generally more segmented one of the representatives of the other orders of the Acari. Another reason for this overrepresentation of the oribatids might be that they are more easily trapped in unfavourable conditions from which they can not escape. Unlike many of the Uropodina and Gamasina, oribatids hardly ever show phoretic behaviour. Even though oribatids tend to be overrepresented in practically every archaeological mite death assemblage (Acaro-thanatoecosmos) the comparison of their relative abundance in different samples can provide information on how "dirty" a sampled site was. Samples taken from middens or cesspits for instance show lower relative abundances of oribatids than samples from wells.

An advantage of this preponderance of oribatids in archaeological deposits is that an archaeological interpretation on the basis of a mite death assemblage dominated by oribatids tends to reflect the ecological conditions of the immediate surroundings of the sampled site because of the above mentioned restricted dispersion capacity of oribatids. Furthermore, the order of the Oribatida is probably the most extensively studied of all the acarine orders as far as its ecological preferences are concerned. Especially in the north of Germany elaborate studies on the (co-) occurrence of oribatid mites have been conducted by Strenzke (1952) and by Künstle (1957). The results of these studies are also applicable to the Netherlands and together with the study of the Dutch oribatids by van der Hammen (1952) they provide the ecological framework on which the interpretations of my archaeological samples are based. To keep up to date with the advances in Dutch acarology a close cooperation with the Research Institute for Nature management in Arnhem is an essential and highly acknowledged prerequisite for my studies.

Not only the relative abundances and identities of the mite remains can be used in an archaeological interpretation, the state of preservation may also provide information concerning the circumstances under which the deposit was formed. The complex of processes, taking place from the moment a zooarchaeological object gets deposited until the moment that it is retrieved, is commonly referred to as taphonomy. Taphonomic processes may result in altered chemical properties, changes in colour or structure, increased fragmentation, etc. All these changes result in the final state of preservation. Erickson (1988) has defined five taphonomical classes of preservation quality for oribatid mites. The distribution of the mite remains over these five classes can provide additional information about the possible post mortem transport of the mites that are found as well as about some ecological parameters during the period of deposition of the mite remains.

An example of this type of information is the possibility of distinguishing the difference in use of Sphagnum mosses. On the basis of the distribution over the taphonomical classes of Limnozetes ciliatus (Schrank 1803) it should be possible to establish wether the Sphagnum originates from peat used for fuel or from living Sphagnum used for hygienic purposes.

B  Gamasida; Uropodina

The Uropodina as a whole can be considered as characteristic of environments that are rich in decaying organic matter. Uropodids are regularly encountered in low frequencies of up to ten percent in most archaeological mite death assemblages and they are then usually regarded as indicators of anthropogenic contributions to the deposit. Sometimes up to 30 or 40 percent of the mite remains that are found in an archaeological
sample belong to the Uropodina. In these cases the sample was always taken from deposits known to consist almost entirely of animal dung or human faeces.

The main problem with the uropodids is that they are more difficult to identify than the oribatids. Although Hirschmann & Zirngiebl-Nicol (1961–1967) provide useful identification keys and illustrations, the mean percentage of identification of uropodid mite remains in an archaeological sample is usually considerably lower than the percentage of identification of the Oribatida. This is mainly caused by the generally high frequency of the immature stages which are even more difficult to identify than the adult ones. Furthermore, the ecological preferences of the uropodid species are relatively poorly known. Therefore, the relative importance of the Uropodina in the acaro-archaeology is still rather low.

C  Gamasida: Gamasina

Despite the fact that the remains of representatives of the Gamasina are not very common in archaeological mite death assemblages they could potentially provide a lot of interesting information. A considerable contribution to our knowledge of the ecological preferences of the gamasid mites is provided by Karg (1971) who also gives very useful identification keys and illustrations. Many of the often highly specific relationships between gamasids and their prey and/or phoretic hosts are also given by Karg. One potentially very promising application of gamasid remains in acaro-archaeology is the identification of the animal species that has produced a particular dung deposit on the basis of the remains of characteristic gamasid mites in this deposit. Mahmood & Al-Dumaimi (1988) have demonstrated that the manure from cattle, horse and sheep can be distinguished on the basis of the mesostigmatic mites living in the manure. The occurrence and relative abundances of the Gamasina in particular and to a lesser extent of the Uropodina are characteristic for the type of manure. Preliminary results of my own studies on the mites living in and on cattle and sheep manure in the Netherlands also show differences in the species composition of the mite faunas.

The main disadvantage of the use of the gamasids in an archaeological context is that their remains are relatively difficult to identify because important identification features such as the epistome and hypostome are usually missing. In the very common family Parasitidae the males are normally identified on the basis of the size, shape and number of the apophyses on the second leg. In an archaeological sample practically all the mites have lost their legs and only the females, which are identified on the basis of genital structures, can be identified.

D  Other mites

When we follow the classification of van der Hammen (1973) three other orders of mites occur in the Netherlands that could be encountered in zooarchaeological investigations: the Acarida, the Actinedida and the Ixodida (ticks). The first two orders are generally very weakly sclerotized and their remains will therefore hardly ever be preserved in archaeological deposits. A notable exception is formed by the Hypopi of the Acarida; this facultative developmental stage is specially adapted for phoretic behaviour. Because they are relatively robustly build these immature stages are sometimes encountered in archaeological mite death assemblages. Although these minute remains can sometimes be identified, the amount of ecological information derived from them is usually minimal because of the above mentioned phoretic behaviour. The usually flying phoretic host may have travelled a long distance from a variety of habitats before it accidentally lost its "guest" on the sampled site.

So far I have not yet found any representatives of the Actinedida or the Ixodida in archaeological samples.
Results

Table I. gives the mean identification percentage (and the standard deviation, \(\sigma_n\)) of the Oribatida, the Uropodina, the Gamasina and the total mite death assemblages from eleven archaeological samples from the Netherlands.

<table>
<thead>
<tr>
<th></th>
<th>Oribatida</th>
<th>Uropodina</th>
<th>Gamasina</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id.%</td>
<td>93.1</td>
<td>64.8</td>
<td>18.1</td>
<td>85.2</td>
</tr>
<tr>
<td>(\sigma_{n-1})</td>
<td>3.8</td>
<td>26.9</td>
<td>17.8</td>
<td>8.5</td>
</tr>
</tbody>
</table>

From this table it is evident that there is a huge difference between the (sub-)orders of the Acari as far as their identification percentage in archaeological samples is concerned. The Oribatida are the least problematic in this respect. It is therefore not surprising that so far the best results in Acaro-archaeology were achieved by studying the remains of oribatid mites. Some examples are: the reconstruction of local environments (Schelvis, subm.), the reconstruction of the filling history and salinification of a late Neolithic well (Schelvis, in press A) and the possibility to monitor the use of bricks and tiles in the development of a medieval town (Schelvis, in press B).

References


