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Characterising the exploitation of avian resources: An experimental combination of lithic use-wear, residue and taphonomic analyses

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ABSTRACT

Pilot experiments involving the butchering of bird carcasses and the use of non-retouched flint flakes were performed. The executed actions comprised skinning and defeathering various avifaunal species (*Circaetus gallicus* and *Gyps fulvus*). The main aim of this experimental programme was to document the use-wear on flint implements employed in the treatment of the avifaunal carcasses in order to help researchers identify this activity in the archaeological record. An additional focus of this study concerned the experimental organic residues (soft tissue and feathers) associated with the bird species used in the experiments. For each residue type, a detailed chemical elemental analysis and morphological characterisation were performed, with the aim of creating an experimental database for comparison with the micro-residues that will potentially be found on archaeological stone tools. For microscopic observations, we employed both Scanning Electron Microscopy (SEM) and Optical Light Microscopy (OLM). A detailed description of the use-wear features and residue types was achieved through a systematic comparison of micrographs taken with both techniques. In addition, EDS (energy-dispersive x-ray spectroscopy) was applied to determine the elemental composition of the residues. Taphonomic analysis of the bones of the carcasses used in the experimental programme was performed with the principal aim of comparing the distribution of cut marks on bones with the use-wear pattern on the lithic implements employed. Future developments of our research will improve the methodology by expanding the experimental programme and by applying it to archaeological collections (at sites where the processing of these kinds of animals has already been identified).

1. Introduction

Feathers form a highly complex integumentary appendage found in the avian class, and they are characterised by an organised branched structure that grows according to a unique mechanism (Chuong and Widelitz, 1998). Feathers have always been admired by various cultures around the world and incorporated into both composite tools and garments. In the Americas, for example, indigenous cultures from Alaska to Patagonia employed feathers displaying an astonishing variety of shapes, sizes and colours to create items of both social and ritual significance. Colour plays a particularly important role in the selection of plumage for ornamental purposes. Efforts intended to change or emphasise tonalities have been documented in some native populations (Azevedo Luíndia, 2004) and the predetermined combination of feathers with different colours during the manufacture of artefacts is sometimes connected with deep symbolism (Lívero Sampaio and Pobikrowska Tardivo, 2010). In ecosystems rich in avian species, feathers have repeatedly been used as ornaments in diadems, headdresses, wristbands, earrings, cloaks, capes and sceptres (Levine, 1991; Lívero Sampaio and Pobikrowska Tardivo, 2010). Further, in geographical areas where the same colourful specimens were not available, feathers appear as a constant within the material culture (Levine, 1991; Pearlstein et al., 2012). Feathers have also been technologically important, featuring in complex *chaînes opératoires* like the fletching of arrows (Bartram, 1997; González-Ruibal et al., 2001) and the making of artificial flies for fishing. Moreover, on the basis of rock art paintings, the worldwide use of plumage throughout prehistory has been extensively documented,

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from its utilisation in ornaments and rituals to its employment in the fletching activity (Obermaier and Wernert, 1919; Jordá Cerdá, 1971; Pessis, 2003; Borgens do Lago, 2008; Martin, 2008; Viñas, 2014). Sometimes pigments with different and lighter tonalities from the substrate of the paintings were used to highlight ornamental feathers (Viñas and Morote, 2013).

Although the ethnographic literature has established that birds have been hunted for both their meat and plumage, the importance of avian resources during prehistory has only recently become a topic of investigation. The exploitation of bird carcasses is usually inferred from taphonomic studies (Fiore et al., 2004; Blasco and Fernández Peris, 2009, 2012; Peresani et al., 2011; Finlayson et al., 2012; Morin and Laroulandie, 2012; Blasco et al., 2014; Romandini et al., 2014; Radovčić et al., 2015), whereas direct evidence of bird residues, such as feather fragments, is much more difficult to document because of preservation constraints. When they are documented, feathers usually appear as micro-fragment remains on the surfaces of stone tools (Robertson, 2002; Dove et al., 2005; Hardy and Moncel, 2011). Sometimes, the identification of birds from archaeological residues has been performed to the level of either species (Dove and Peurach, 2002; Dove et al., 2005) or order (Hardy et al., 2001, 2013; Robertson, 2002).

Because this kind of evidence is rarely encountered, a refined methodology for its documentation and description has yet to be formulated. This is why we have focused on the creation of a suitable methodology for identifying the exploitation of avifaunal resources during prehistoric times. Based on the assumption that lithic tools were employed to butcher the animals and, subsequently, to work the plumage (if employing it for ornamental or technological purposes), we considered the two types of evidence most likely preserved in the archaeological record: use-wear and micro-residues of organic matter. Therefore, evidence related to experimental avian bones and experimental flint tools was documented in an attempt to understand whether or not cut marks on the bones were correlated with the identified use-wear on stone tools. The proposed methodology combines lithic and faunal examinations, with special attention to the microscopic characterisation of feather fragments adhered to the lithic surfaces. Especially regarding residue identification, a strong methodological foundation is needed for the analysis of the archaeological material. Researchers have yet to establish an experimental reference for comparison with the archaeological evidence. Before we attempt to identify ancient feather fragments on lithic tools, we need to clearly define their diagnostic attributes that are discernible under the microscope and to select the microscopic techniques that will provide the best results.

1.1. Feather structure

Feathers are highly ordered, branched structures that are intricately formed in order to endure the aerodynamic forces involved in flight. They also play a fundamental role in the thermo-regulation of birds. A combination of stiffness and

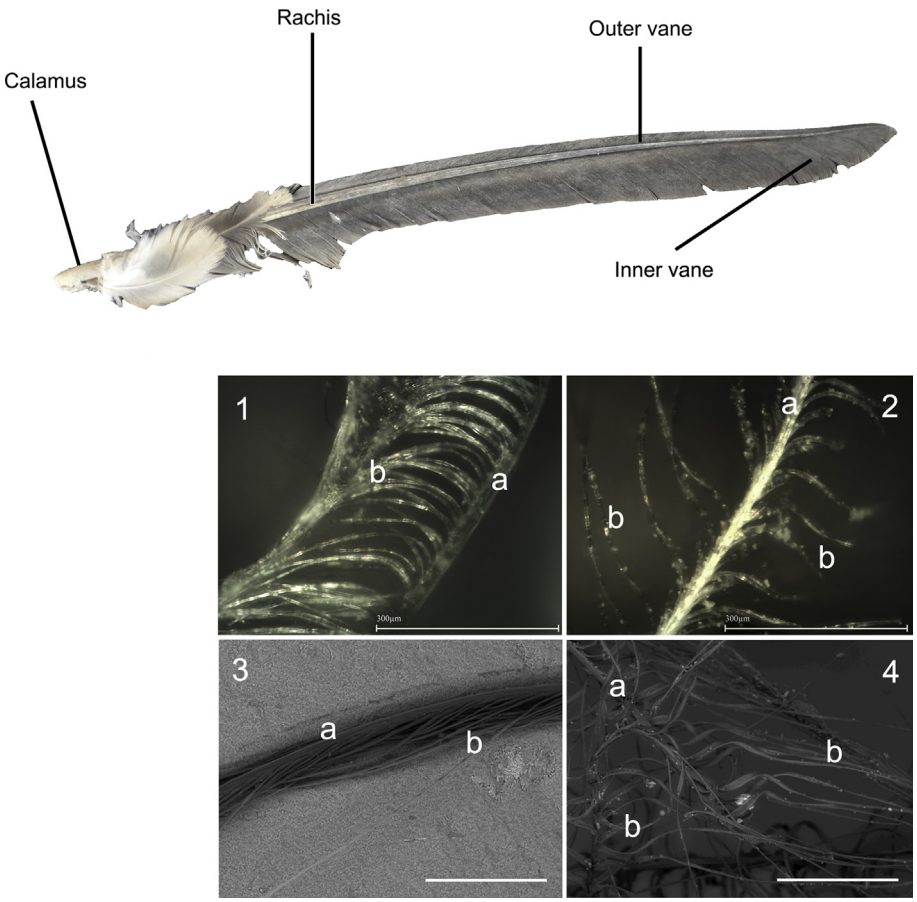

Fig. 1. A vulture (*Gyps fulvus*) contour feather composed of a longitudinal central shaft called rachis, to which the vanes are attached. Vanes are divided into downy (plumulaceous) barbs, located in the proximal part, and the pennaceous barbs. Barbs are magnified in the micrographs, illustrating the barbs (b) attached to the ramus (a). In the OLM pictures the birefringence character of barbules is visible, whereas SEM images enable us to better appreciate the micro-structure of barbs and barbules. (OLM pictures, 1–2: mag. = 200× scale bar = 300 μm; SEM pictures 3–4: mag. = 510× scale bar = 200 μm).

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