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The Role of Birds in Upper Paleolithic Contexts: An Analysis of the Griffon Vulture (*Gyps fulvus*) Wing Remains From the San Teodoro Cave (Acquedolci, Sicily)

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ABSTRACT

The analysis of avian remains from archaeological contexts provides valuable insights into human subsistence strategies, symbolic behaviors, and human–environment interactions. Birds of prey, and large diurnal raptors in particular, are rarely documented in Paleolithic assemblages, and their presence is generally interpreted as nonalimentary. This paper presents the zooarchaeological and taphonomic study of seven avian skeletal elements attributable to a single individual of griffon vulture (*Gyps fulvus*), recovered from Epigravettian levels of San Teodoro Cave (Acquedolci, Sicily), in association with ochre. The assemblage is composed exclusively of elements belonging to the right wing. The ulna exhibits a series of short, oblique incisions located along the dorsal diaphysis, whose morphology and anatomical distribution are compatible with anthropogenic manipulation potentially related to feather removal, although alternative functional interpretations cannot be entirely excluded. In addition, all elements display traces of red ochre on their cortical surfaces, documented through microscopic observation. The anatomical selectivity of the assemblage, together with cut marks consistent with intentional processing, argues a nondietary interpretation and instead suggests a targeted use of the vulture wing as raw material, possibly related to the extraction of feathers or other visually salient elements. Comparisons with coeval Upper Paleolithic sites across the Mediterranean indicate that similar practices were widespread. Within the insular context of Sicily, however, this represents an exceptional and unprecedented case, highlighting the role of a more complex and intriguing ritual and symbolic behavior among Epigravettian hunter-gatherer groups.

1 | Introduction

The study of avian remains from archaeological contexts provides a key perspective for investigating human subsistence strategies, behavioral variability, and symbolic practices in Paleolithic societies. Although birds are generally less abundant in faunal assemblages than mammals, partly due to taphonomic biases related to bone fragility and recovery methods, their remains represent an important source of information for reconstructing human-environment interactions, technological choices, and cultural behaviors (Laroulandie 2000; Serjeantson 2009).

For a long time, the exploitation of birds was considered technologically demanding and therefore largely associated with

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anatomically modern humans; however, this view has been substantially revised over the last two decades, as zooarchaeological and taphonomic studies have demonstrated that avian resources were already exploited during the Middle Paleolithic, both for subsistence and nonalimentary purposes (e.g., Peresani et al. 2011; Morin and Laroulandie 2012; Finlayson et al. 2012; Blasco et al. 2013; Laroulandie et al. 2016).

Across Europe and the Mediterranean, avian remains from Middle and Upper Paleolithic sites exhibit a broad spectrum of anthropogenic modifications, including cut marks, intentional disarticulation, burning, and selection of anatomical elements (e.g., Cassoli and Tagliacozzo 1997; Peresani et al. 2011; Finlayson et al. 2012; Morin and Laroulandie 2012; Romandini et al. 2014; Radovčić et al. 2015; Fiore et al. 2016; Laroulandie et al. 2016; Valle et al. 2016; Laroulandie 2016; Gala et al. 2018; Hussain 2019; Fiore et al. 2022; Lloveras et al. 2022; Carrera and Martini 2026). These assemblages indicate that birds were integrated into prehistoric lifeways, with different *taxa* exploited according to ecological availability, technological knowledge, and cultural preferences. Analogous evidence has also been reported in later contexts, including the Mesolithic (e.g., Gala et al. 2016). Within this broad category, large diurnal raptors occupy a distinctive position in the archaeological record; in particular, vultures and other necrophagous species are of significant interest. Their ecological characteristics (obligate or facultative scavenging behavior, large body size, soaring flight, and preference for rocky environments) would have made them highly visible elements of Pleistocene landscapes. Raptors nesting on cliffs and frequenting carcasses would have shared spatial and ecological niches with human groups occupying caves and exploiting large ungulates, facilitating repeated encounters (Finlayson et al. 2012; Morin and Laroulandie 2012). This ecological proximity likely contributed to the development of complex human–raptor interactions, ranging from opportunistic exploitation to culturally mediated practices (Finlayson and Finlayson 2016). Furthermore, we cannot exclude that the ecology of these animals and their relationship with death may have exerted some attraction or the construction of scenarios and behaviors that celebrate and exalt this association.

From a strictly economic perspective, raptors provide limited nutritional return and are rarely represented by complete carcasses, suggesting that their exploitation was unlikely driven exclusively by subsistence needs (Morin and Laroulandie 2012). Instead, archaeological evidence repeatedly points to targeted anatomical selection (e.g., Livingston 1989; Bovy 2002), particularly involving wing elements (e.g., Conard et al. 2009; Peresani et al. 2011). Cut marks located near feather attachment areas on ulnae, radii, and carpometacarpi have been interpreted as the result of intentional manipulation, potentially aimed at feather removal or wing disarticulation (Peresani et al. 2011; Finlayson et al. 2012; Pedergnana and Blasco 2016). Importantly, these modifications often occur in the absence of other skeletal elements, reinforcing the interpretation of selective exploitation rather than whole-carcass processing (Morin and Laroulandie 2012). Similar patterns have been observed at several key Paleolithic sites across Europe and the Mediterranean, suggesting that such practices were neither isolated nor incidental, but meaningful and embedded within a broader symbolic landscape (Morin and Laroulandie 2012; Romandini et al. 2014; Romandini et al. 2016; Fiore et al. 2016).

The presence of a griffon remain in the Pleistocene deposits of San Teodoro (ST) Cave has previously been reported in the literature (Pavia 2001). These remains consist of a single avian fragment attributed to *Gyps melitensis* and associated with the "*Elephas mnaidriensis* Faunal Complex", which includes fossil remains of *Hippopotamus pentlandi*, *Cervus elaphus siciliae*, and other endemic vertebrates (Mangano 2005). Although their general stratigraphic attribution to Pleistocene, spatial provenance and depositional circumstances of this griffon remain are insufficiently documented.

Within this framework, the discovery of a griffon vulture wing in the Epigravettian levels of ST Cave (Acquedolci, Messina; Figure 1A,B) in correspondence with the areas of the Epigravettian burials described by Graziosi (1947), provides an exceptional case study of this phenomenon.

2 | Archaeological Context

San Teodoro Acquedolci represents one of the most significant Epigravettian prehistoric sites in the central Mediterranean. It yielded the remains of seven burials during excavations

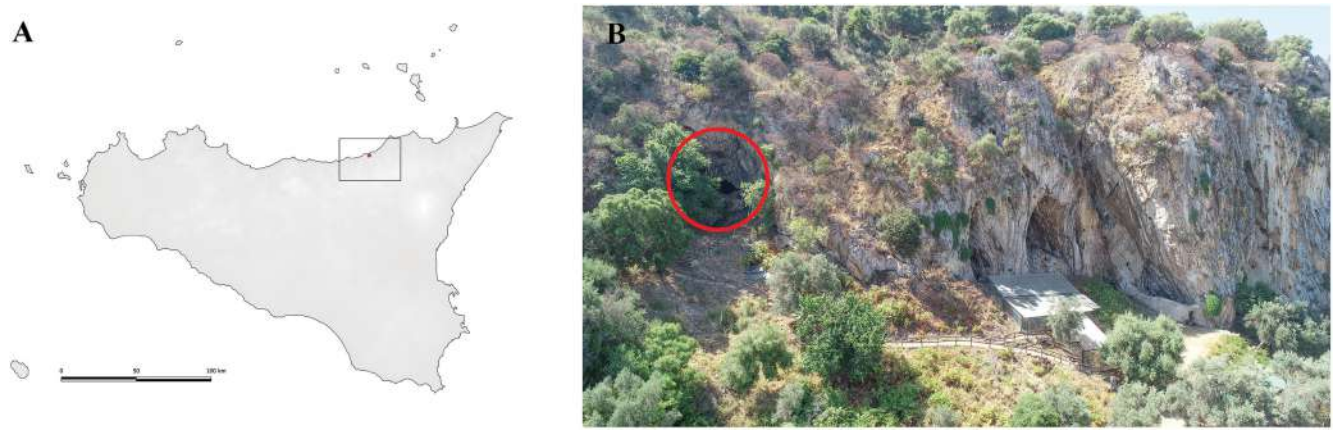

FIGURE 1 | San Teodoro Cave (Acquedolci, Sicily). (A) Regional setting of Sicily with the location of ST Cave. (B) View of the limestone cliff hosting the cave, showing the cave entrance highlighted by a red circle. [Colour figure can be viewed at wileyonlinelibrary.com]

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conducted by Maviglia and then by Graziosi, beginning in 1937 (for a story of the studies, see Sìneo 2024).

Since the early 2000s, the site has been the focus of renewed and systematic research aimed at re-evaluating the stratigraphic sequence and refining the cultural and chronological attribution of the archaeological deposits. Recent excavation campaigns have adopted a multidisciplinary approach, integrating archaeological, archaeozoological, geoarchaeological, and paleoenvironmental analyses (Garilli, Vita, Mulone, et al. 2020; Garilli, Vita, La Parola, et al. 2020). These studies have significantly improved the resolution of site formation processes and human occupation patterns, confirming San Teodoro Cave as a key reference within the broader context of Epigravettian settlement in the central Mediterranean, and as the oldest described in Sicily (Forgia et al. 2025; Figure 1B).

The *Gyps fulvus* remains were recovered in 2021 during the excavations from Stratigraphic Unit 5 (SU 5) in square G22 (Figure 2A). SU 5 (Figure 2B) is one of the residues of the Epigravettian layers, the edge of the stratigraphy of the Epigravettian burials excavated by Maviglia and Graziosi between 1937 and 1942 and fortunately survived the Bonfiglio excavations in 1998 (Garilli, Vita, Mulone, et al. 2020; Figure 2A). It overlies (or probably cuts) the layer E by Graziosi (Garilli, Vita, Mulone, et al. 2020; Forgia et al. 2025). The *Gyps* specimens were recovered with other faunal remains (Figure 3); notably, the assemblage also included a first human phalanx of the third finger of the hand (laterality is not appreciable as the proximal epiphysis is partially damaged), covered in ochre. The occurrence of human bone and griffon wing elements within SU 5 suggests a possible connection with Epigravettian funerary practices. From this perspective,

FIGURE 3 | Part of the faunal assemblage recovered from Stratigraphic Unit 5 (SU 5) and the human first phalanx of the third finger, highlighted by a red frame, covered in ochre. [Colour figure can be viewed at wileyonlinelibrary.com]

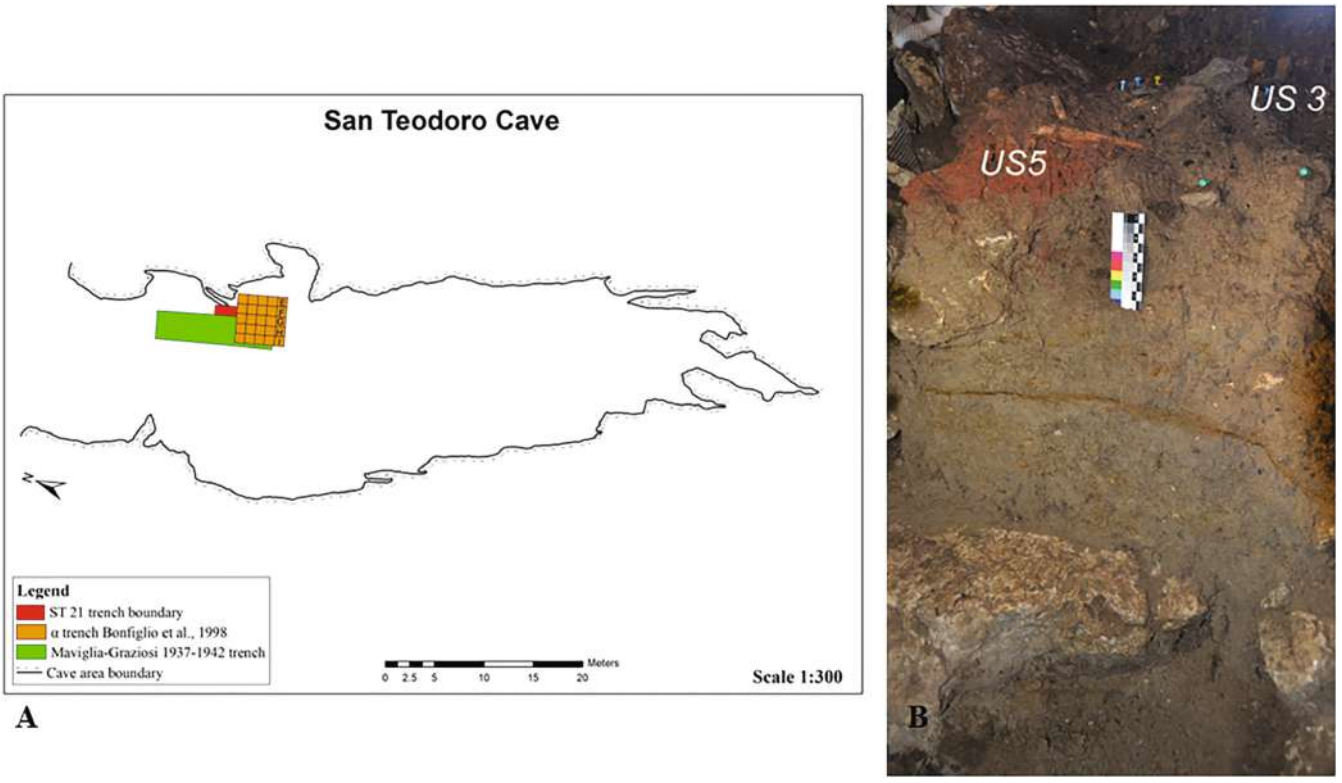

FIGURE 2 | (A) Planimetric map of the ST cave. The area highlighted in red marks the trench opened in 2021, where a reworked deposit was identified. At its right edge, the small Epigravettian deposit (G22) is preserved, limited to just a few square centimeters. The remaining trenches refer to those excavated by Maviglia and Graziosi (Graziosi 1947) and by Bonfiglio during earlier excavation campaigns. (B) Stratigraphic profile showing the archaeological unit (SU 5), from which the griffon vulture remains were recovered. [Colour figure can be viewed at wileyonlinelibrary.com]

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SU 5 may reflect a disturbance of the original Epigravettian funerary context, expressed through the redeposition of materials that were originally part of a human burial. This interpretation is further supported by the presence of ochre covering all the griffon anatomical elements.

No anatomical connections were identified among the griffon vulture wing elements during excavation. However, the bones were found in very close spatial proximity within an extremely limited area of the deposit. While this concentration is compatible with the hypothesis of a disturbance affecting the funerary context, the absence of articulated remains prevents a direct demonstration of anatomical association. However, the stratigraphic relationship with SU 3, which corresponds to the earliest currently known human presence (16.5 and 16 ka cal BP) inside the Cave, remains unclear due to the extremely limited extent of the preserved archaeological deposit. Restricted to only a few square centimeters, SU 5 may represent the infilling of an ancient cut into earlier Epigravettian levels (Forgia et al. 2025; Figure 2B), suggesting a localized disturbance that reworked materials originally associated with the Epigravettian funerary context, and preventing the reconstruction of a meaningful spatial distribution of the *G. fulvus* remains in relation to other archaeological materials (e.g., faunal remains and lithic artifacts). However, the direct radiocarbon dating of the Gyps remains (15.036–14.295 cal BP) firmly places this specimen within the Epigravettian period.[1]

3 | Materials and Methods

Taxonomic and anatomical identification was carried out through direct comparison with modern reference collections housed at the University of Florence, the Museo di Storia Naturale La Specola (Firenze), and the Museo di Zoologia "P. Doderlein" (Palermo; Figure 4), which provided comparative specimens of modern large raptors and Accipitridae. Osteological terminology follows Baumel and Witmer (1993).

All specimens were subjected to a detailed taphonomic assessment aimed at identifying surface modifications and postdepositional alterations. Initial observations were conducted at the macroscopic level. Subsequently, surfaces were examined using the Hirox Digital Microscope (HRX-01) at the University of Ferrara, allowing high-resolution documentation of surface micro-topography.

Surface modifications were documented following standard taphonomic criteria, with particular attention to the identification of cut marks, scraping traces, fractures, and other anthropogenic alterations (Shipman and Rose 1983; Domínguez-Rodrigo et al. 2009; Rufà et al. 2023). Nonanthropogenic modifications, including root etching, manganese staining, weathering, and carnivore or rodent gnawing, were also systematically recorded.

Particular emphasis was placed on the analysis of surface modifications observed on the ulna. In large diurnal raptors, this element bears well-developed attachment areas for secondary flight feathers and is therefore especially informative for assessing potential feather-related manipulation. The location and orientation of observed marks were evaluated in relation to known feather attachment zones, following comparative criteria established in experimental and archaeological studies (Pedergnana and Blasco 2016; Blasco et al. 2019). Each trace was described according to its morphology (straight or curved), number of striations, location on anatomical element, orientation (oblique, longitudinal, and transversal), spatial distribution (isolated or clustered), and dimensions. The identification and interpretation of cut marks followed the criteria proposed by Shipman and Rose (1983), Lyman (1994), and Domínguez-Rodrigo et al. (2009).

Traces of red pigmentation observed on several specimens were investigated through scanning electron microscopy (SEM) coupled with energy-dispersive x-ray spectroscopy (EDS). Analyses were conducted to characterize the elemental composition of the pigment residues and to distinguish mineral pigment from postdepositional staining.

4 | Results

Osteological analysis indicates that all seven remains belong to a single large diurnal raptor, identified as griffon vulture (*G. fulvus*; Figure 5): ulna, radius, carpometacarpus, three phalanges (phalanx digiti alulae, phalanx proximalis digiti majoris, and phalanx distalis digiti majoris), and the os carpi ulnare. Notably, all elements are attributable to the right wing, with no representation of cranial, axial, pelvic, or hindlimb elements.

The avian bone fragments analyzed show variable degrees of surface preservation. In several areas, compacted sediment and pigment residues partially obscure the bone surface, limiting the visibility of some micro-features. Despite these alterations, several surface modifications remain sufficiently well preserved to allow a morphological and spatial analysis. The observed traces (Figure 6) were classified into two main categories: (1) nonanthropogenic modifications related to postdepositional processes and (2) modifications consistent with anthropogenic activity.

Nonanthropogenic modifications are represented by diffuse and variably oriented striations distributed across broader areas of the bone surface. These traces lack clear clustering and show no consistent orientation relative to the longitudinal axis of the bone. In addition, the cortical surface locally exhibits superficial corrosion, granular textures, and small pits (pitting), consistent with chemical diagenesis related to prolonged interaction with the sedimentary matrix (Fernández-Jalvo and Andrews 2016). Additional nonanthropogenic alterations are observed on the lateral surface of the ulna (Figure 6B1), where linear modifications present a deep but smoothed U-shaped cross-section, poorly defined and rounded margins, and an irregular trajectory. These traces show bifurcation, forming Y-shaped patterns with secondary branches departing from a main groove. Such features are incompatible with the narrow V-shaped profile and the sharp and regular boundaries typically associated with cut marks and are more consistent with structural alteration of the cortical surface during diagenesis or sedimentary abrasion. Other traces (B2) are arranged in a clustered and subparallel pattern, appear to have irregular

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FIGURE 4 | Legend on next page.

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FIGURE 4 | Comparative view of the griffon skeletal elements recovered at San Teodoro Cave (left) and the corresponding homologous elements from a modern reference specimen (right) of *Gyps fulvus* housed in the Museo di Zoologia "P. Doderlein" (Palermo). The comparison highlights the morphological correspondence between the archaeological remains and the reference material, supporting the taxonomic and anatomical identification. Scale bar: 5 cm. [Colour figure can be viewed at wileyonlinelibrary.com]

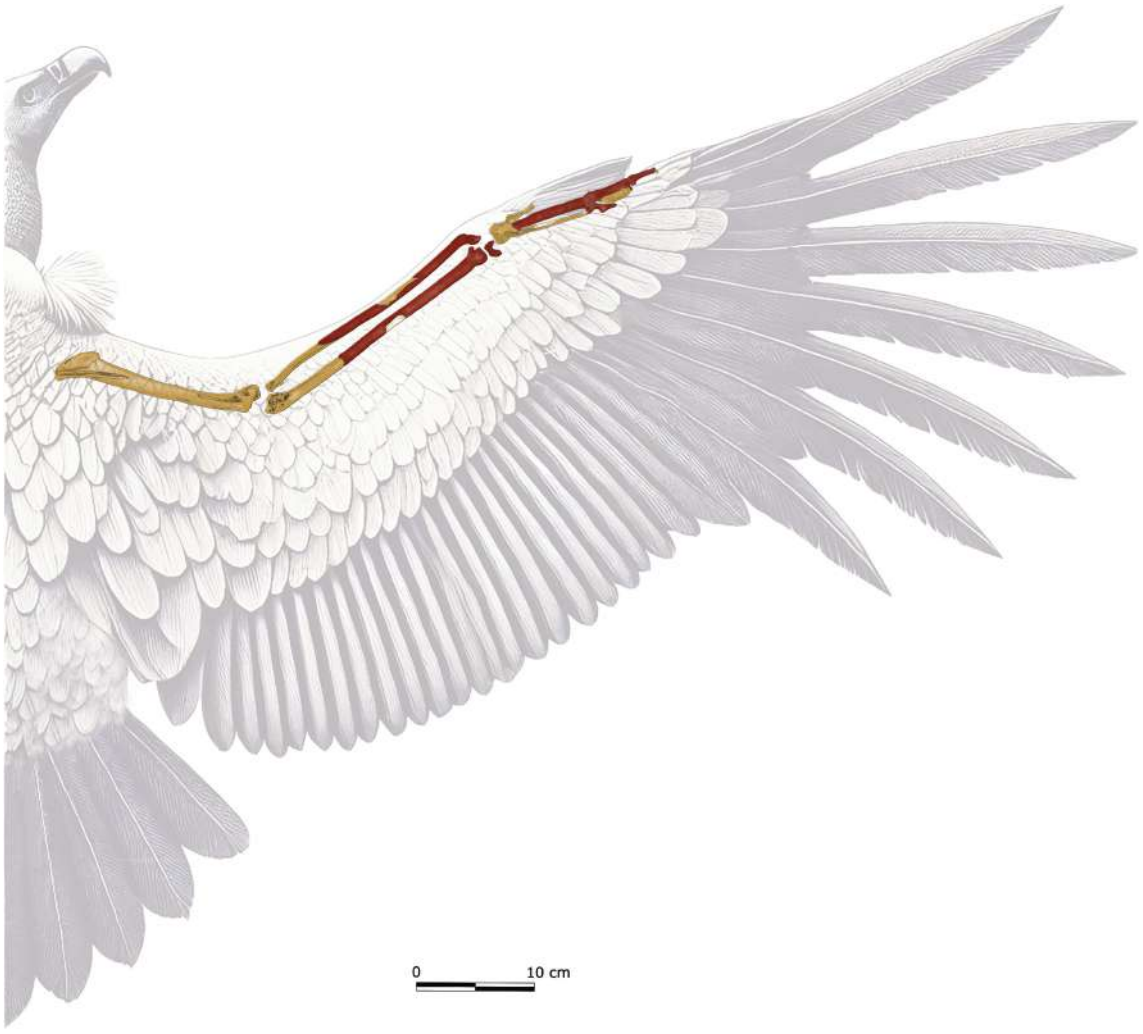

FIGURE 5 | Schematic representation of a griffon vulture (*Gyps fulvus*). The image shows the skeletal elements of the right wing of a griffon vulture, where the parts of bone recovered at ST Cave (Acquedolci, Sicily) are highlighted in red. [Colour figure can be viewed at wileyonlinelibrary.com]

margins. They are typically random, variably oriented, and widely distributed traces produced by trampling or sedimentary abrasion.

Modifications consistent with anthropogenic activity are instead represented by localized concentrations of linear striations confined to restricted areas of the shaft of the ulna, particularly along the dorsal diaphysis. These traces consist of short, straight, and parallel incisions (Figure 6A2,A3), closely spaced, with an oblique orientation with respect to the longitudinal axis of the bone. These marks display a regular morphology, sharp and well-defined margins, and, where observable, a narrow V-shaped or U-shaped cross-section. Their parallel arrangement and paired distribution, rather than dispersed, are difficult to reconcile with natural processes such as trampling or sedimentary abrasion, which typically produce irregular, sinuous, and randomly oriented traces (Shipman and Rose 1983; Domínguez-Rodrigo et al. 2009; Fernández-Jalvo and Andrews 2016). These features are therefore interpreted as cut marks produced by a sharp-edged lithic tool.

A distinct type of modification is represented by a long groove oriented longitudinally along the axis of the bone and terminating within a concretion (Figure 6A1). This trace lacks diagnostic features such as a consistent cross-sectional morphology or internal microstriations.

In addition to these diagnostic traces, other areas of the ulna show clusters of closely spaced, subparallel striations (Figure 6A4). These marks are short to moderately elongated,

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FIGURE 6 | Legend on next page.

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FIGURE 6 | Microscopic surface modifications observed on the ulna fragment with the 3D HIROX digital microscope. (A1) Long groove oriented parallel to the long axis of the bone and terminating within a concretion, interpreted as an ambiguous trace. (A2 and A3) Two short, straight and parallel linear incisions, equidistant from each other showing sharp V-shaped cross-sections consistent with cut marks produced by a lithic tool. (A4) The surface exhibits a cluster of short, closely spaced striations, each measuring only a few millimeters in length and showing a broadly similar orientation across the affected area (B1–B2) nonanthropogenic striations with irregular morphology and variable orientation. [Colour figure can be viewed at wileyonlinelibrary.com]

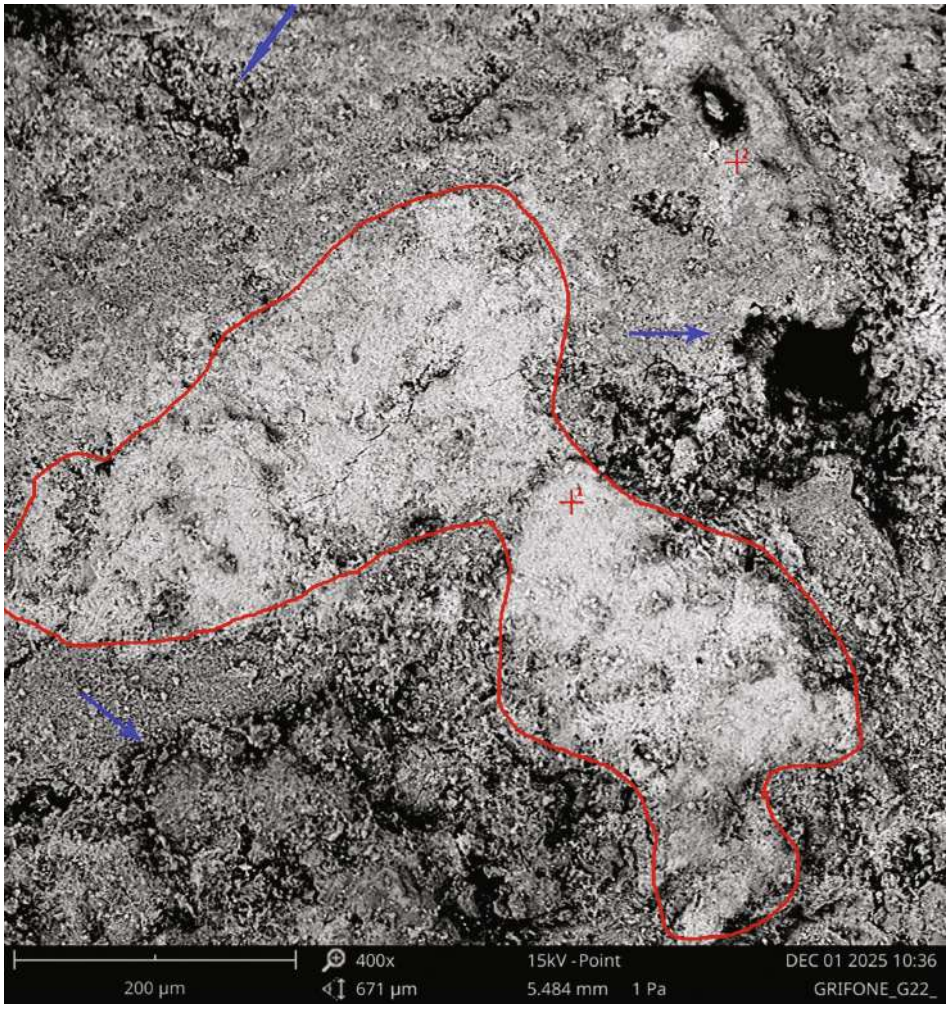

FIGURE 7 | SEM analysis highlighting bone surface microtopography and pigment distribution. Red dashed lines indicate areas with ochre concentration, blue arrows mark postdepositional microfractures and surface porosity, and numbered red crosses show EDS analysis spots. [Colour figure can be viewed at wileyonlinelibrary.com]

with a slightly curved to substraight morphology and moderately well-defined margins. They display a localized and partially organized pattern, differing from the diffuse and randomly oriented distribution typical of trampling or sedimentary abrasion. However, the absence of clearly observable diagnostic features, such as well-defined cross-sections or internal microstriations, prevents a definitive attribution. These traces are therefore considered compatible with anthropogenic activity, possibly related to repeated tool contact or scraping, although their attribution remains cautious.

Overall, the combination of morphology, orientation, and spatial distribution supports a distinction between nonanthropogenic and anthropogenic modifications. The coexistence of clearly natural alterations alongside structured and localized incisions strengthens the interpretation of deliberate and repeated human actions applied to functionally relevant areas of the wing element.

The osteological elements display visible traces of red pigmentation on the cortical surface. SEM image of the bone fragment showing a discontinuous ochre coating that appears fine-grained and texturally heterogeneous, consisting of compact aggregates interspersed with small, distinguishable crystalline particles (Figure 7). The distribution of these crystals across the surface is uneven, forming areas of denser accumulation alongside zones where the coating becomes thinner and more dispersed.

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This microstructural variability suggests that the ochre is composed of a mixture of iron oxides/hydroxides and minor mineral components, producing an irregular and discontinuous surface layer over the bone fragment.

The SEM–EDS analysis conducted on the bone fragment reveals a surface characterized by micro-fractures and porosity typical of altered bone tissue, upon which a clear coating of ochreous material is visible. The EDS data confirm the presence of an iron-rich ochre layer, where the high percentages of Fe and O (spot 1) indicate the occurrence of iron oxides/hydroxides; only XRD analysis would allow the specific identification of phases such as hematite. The presence of elements such as Si, Al, Mg, and K suggests clay components commonly associated with natural ochres. In areas where the coating is thinner or absent, the chemical composition is once again consistent with bone apatite, reflected by the high values of Ca and P (spot 2).

5 | Discussion

The ecological and behavioral characteristics of griffon vultures provide an important basis for interpreting their archaeological occurrence. *Gyps fulvus* is a large diurnal raptor of the family Accipitridae and an obligate scavenger of the Mediterranean region, specialized in carrion consumption and adapted to long-distance soaring flight, with a wingspan reaching up to 2.5 m (Del Hoyo et al. 1994; Houston 1974).

This species typically nests and roosts on rocky cliffs, caves, and steep escarpments (Cramp 1998; Donázar 1993), often in environments that overlap with those occupied by prehistoric human groups. This ecological proximity would have resulted in recurrent opportunities for interaction, particularly around carcasses of large ungulates, exploited by both humans and vultures (Blasco et al. 2013; Finlayson et al. 2012).

In Late Pleistocene Sicily, paleoenvironmental reconstructions indicate the presence of open landscapes interspersed with rocky reliefs, suitable for large herbivores and scavenging raptors (Masini et al. 2008). Within this setting, vultures would have been attracted to human-related carcass processing areas, creating predictable interaction zones (Morin and Laroulandie 2012). Such conditions would have provided opportunities not only for passive observation but also for active engagement, including capture or targeted exploitation (Finlayson et al. 2012; Finlayson and Finlayson 2016; Laroulandie et al. 2016). Although direct palaeontological evidence of *G. fulvus* on the island during this period remains scarce, the species is well documented across the Mediterranean basin throughout the Late Quaternary (Tyrberg 1998), and its historical presence on the island is firmly attested until modern times (Del Hoyo et al. 1994; Donázar 1993).

This ecological context provides the basis for interpreting the taphonomic evidence observed on the San Teodoro specimen. The analysis revealed the presence of different categories of surface modifications, including clearly nonanthropogenic traces (e.g., root etching and sedimentary abrasion) and localized, structured modifications consistent with anthropogenic activity. The distinction between these categories is supported by differences in morphology, orientation, and spatial distribution. Diffuse and randomly oriented striations are consistent with postdepositional processes, whereas the presence of short, parallel incisions and clustered subparallel striations confined to restricted and anatomically meaningful areas of the ulna supports their interpretation as the result of deliberate and repeated tool actions.

In particular, the localization of these modifications on the dorsal diaphysis, corresponding to the attachment areas of the secondary remiges, suggests targeted manipulation of the wing rather than generalized carcass processing. Experimental studies have shown that feather removal from large raptors produces clusters of closely spaced, subparallel striations resulting from repeated scraping or cutting motions (Pedergnana and Blasco 2016; Blasco et al. 2019; Rufà et al. 2023), a pattern consistent with that observed on the ST specimen.

The anatomical representation of the assemblage, limited to wing elements, further supports this hypothesis. In large raptors, wings and feathers are visually prominent and structurally robust, and their selective removal has been widely associated with nonsubsistence activities (Peresani et al. 2011; Pedergnana and Blasco 2016; Romandini et al. 2014).

Similar evidence has been documented in several Upper Paleolithic contexts. At sites such as Fumane Cave (Peresani et al. 2011) and Grotta del Romito (Carrera and Martini 2026), comparable patterns have been documented on ulnae of large raptors and interpreted as evidence of intentional feather removal rather than subsistence-related processing.

At a broader Mediterranean scale, comparable evidence has been reported from Gibraltar, where Neanderthals exploited wings of raptors and corvids in contexts not directly related to dietary or subsistence practices (Finlayson et al. 2012). Further north, cut-marked skeletal elements of wings and legs of diurnal raptors have been documented in France, as well as in Central and Eastern Europe, often in association with symbolic artifacts (Bocheński et al. 2009; Morin and Laroulandie 2012; Romandini et al. 2014; Radovčić et al. 2015; Laroulandie et al. 2016).

Taphonomic studies from large Upper Paleolithic assemblages, such as Pavlov I (Czech Republic), further show that raptor wings were selectively introduced into archaeological assemblages and that their surface modifications are best explained by feather exploitation for symbolic or technological purposes rather than dietary use (Bocheński et al. 2009). Furthermore, wing bones of large birds have been widely used as raw material for musical instruments, tools, and ornaments (Conard et al. 2009; Romandini et al. 2014). Although these examples differ functionally from the ST assemblage, they demonstrate a long-standing and recurrent interest in avian wing elements. This broader perspective reinforces the interpretation that targeted manipulation of raptor wings was a widespread behavioral pattern among Late Pleistocene hunter-gatherers.

Within this broader context, the SU 5 assemblage at San Teodoro Cave becomes particularly relevant. Although a direct association between the vulture remains and the Epigravettian burials cannot be conclusively demonstrated, their stratigraphic position suggests that the assemblage may be linked to a disturbed

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funerary context. At the same time, the radiocarbon date obtained for the griffon vulture remains (15.036–14.295 cal BP) is consistent with the chronological range of the Epigravettian burials previously documented at the site (Forgia et al. 2025) and therefore suggests a possible association with such contexts. The co-occurrence of the human remains, faunal elements, and ochre within a restricted and reworked deposit is consistent with redeposition processes affecting earlier burial deposits.

In this perspective, the presence of a griffon vulture wing element showing evidence of deliberate manipulation, combined with the application of ochre, suggests that the assemblage is unlikely to result from purely subsistence-related activities. Instead, it may reflect a more complex behavioral sphere, involving symbolic or ritual practices associated with funerary contexts. The griffon vulture occupies a distinctive position at the interface between human and animal worlds. Its large size, soaring flight, and ecological association with death and carcasses would have made it a highly visible and potentially symbolically salient species within Pleistocene landscapes. While such analogies cannot be directly projected onto Epigravettian Sicily, they provide a useful interpretative background for understanding the recurrent presence of wings, feathers, and other visually salient avian elements in nonsubsistence contexts.

Experimental and archaeological studies provide a robust framework for interpreting the surface modifications observed on the ST ulna. Controlled experiments involving the processing of *G. fulvus* carcasses demonstrate that feather extraction frequently produces not only isolated cut marks but also clusters of tightly spaced, parallel striations resulting from repeated scraping or unidirectional tool movements along the bone surface (Pedergnana and Blasco 2016; Blasco et al. 2019; Rufà et al. 2023). These scraping traces are typically confined to functionally relevant areas of the wing and differ markedly from the sinuous, irregular patterns generated by root etching or sedimentary abrasion. At the same time, a cautious approach remains necessary. The disturbed nature of the deposit, the limited spatial resolution of the context, and the partial preservation of bone surfaces (sometimes obscured by ochre and sediment) prevent a fully definitive assessment. The coexistence of diagnostic, ambiguous, and nonanthropogenic traces contributes to a more robust and nuanced understanding of the assemblage.

The interpretation of the ST assemblage does not rely on symbolic analogies alone. Instead, it is grounded in a convergence of archaeological signals: anatomical selectivity, presence of cut marks compatible with intentional manipulation, and association with ochre and human remains. Taken together, these features suggest that the griffon vulture wing was not introduced into the site accidentally nor processed for nutritional purposes. This finding, therefore, contributes to a growing body of evidence indicating that highly symbolic or nondietary engagements with birds of prey were widespread and deeply rooted in Upper Paleolithic societies.

6 | Conclusions

The griffon vulture remains from the site of ST Cave, in association with ochre, represent a rare and significant contribution to the study of human–avian interactions during the Late Upper Paleolithic. These remains illustrate the potential and the limits of interpreting the archaeological significance of avian skeletal elements in relation to their stratigraphic and depositional context. Furthermore, these bones have been modified and manipulated, and the analysis of these activities shows the difficulty of interpreting the taphonomic meaning of these modifications. While some surface modifications remain ambiguous because of postdepositional processes and conservation constraints, others display morphological and spatial characteristics consistent with anthropogenic action, comparable to patterns documented in well-established Middle and Upper Paleolithic contexts across Italy, the Mediterranean, and beyond.

Within this broader context, the ST evidence fits into a recurrent archaeological pattern involving the selective exploitation of raptor wings, most plausibly linked to the acquisition of feathers and other visually salient elements. Such practices are widely interpreted as indicators of symbolic or socially mediated behavior, reflecting complex relationships between humans and birds of prey that extend well beyond purely functional concerns.

Furthermore, this is the first well-documented case of targeted exploitation of a large necrophagous raptor in Sicily. The insular context enhances the significance of the finding, demonstrating that behaviors previously documented mainly in continental Europe were also present in Mediterranean island environments during the Epigravettian. The ST assemblage therefore contributes to a more nuanced understanding of symbolic behavior among Late Upper Paleolithic hunter-gatherers and highlights the need for further research on the role of avifauna within prehistoric cultural and symbolic systems.

Author Contributions

Field work: V.F., G.V., and L.S. Analysis and data curation: A.R., R.M., F.L.P., F.M., G.V., L.S. Conceptualization: A.R., G.V., R.M., and L.S. Writing: A.R., R.M., G.V., and L.S. Original draft preparation: A.R. Topography and images: A.R., F.S., and R.M. Funds: L.S.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1] Radiocarbon analysis performed at the [14]Chrono Centre, Queen's University Belfast (Laboratory Identification: UBA-56404).

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