

ISSN 1121-9238

# A T T I

DELLA

# ACCADEMIA PONTANIANA

NUOVA SERIE - VOLUME LXXII

ANNO ACCADEMICO 2023

DLXXXI DALLA FONDAZIONE

## The vulture paradox

Nota di OTTAVIO SOPPELSA e LUCIA TANCREDI  
presentata dal Socio ord. res. STEFANO PALMIERI  
e dal Socio corr. FERDINANDO SALEMME

## ESTRATTO



GIANNINI EDITORE

NAPOLI 2024



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# ATTI

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Il presente volume è stato pubblicato grazie al contributo di

Università di Napoli “Federico II”



Ministero della Cultura



Regione Campania

Progetto finanziato con la L.R. n. 7/2003  
contributi per la promozione culturale anno 2023



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### Significance Statement

The sudden disappearance of vultures in Italy has led to the belief that these animals are part of the myth and exist 'elsewhere'. In specific historical moments, humanity, in exploiting resources, did not consider the importance and dignity of other species. The probable cause of the vultures' disappearance in Southern Italy is here presented.

### Abstract

In Italy, numerous species of avifauna have disappeared without reasons or convincing explanations. The historical presence of cranes, bustards, large birds of prey, especially vultures has left only toponymic (i.e., zoonymic) evidence, or legends and myths. Tracks of vultures are lost in a period after the *De arte venandi cum avibus* of Fredericus II and before the natural history writings of the sixteenth century authors. The use of ancient documents included in the *Archivi Napolitani*, such as the reconstructed Angevin Chancery, has made possible data mining and has provided new opportunities, also for understanding the past history of the Italian fauna. Following a patient collection of data, the extinction in Italy of *Aegyptius monachus*, *Gyps fulvus* and of those which were considered *magnaes aves* finds its explanation in an unusual use.

**Keywords:** *Aegyptius monachus*; *Gyps fulvus*; Italian vulture extinction; Angevin Chancery; feather; Quarrel; Archery.

### Introduction

Eighth century BC, on some hills of central Italy, two twin brothers are observing the sky and waiting for an auspice: whoever sees the highest number of vultures will found Rome. Various ancient authors report that Remus saw six vultures and Romulus twelve (Carandini 2006).

To confirm the sacredness of these birds for the peoples of ancient Italy, remains of vultures have been found in a sacrificial stipe of the second half of the sixth century BC, near the *Lapis niger* in the *Comitium* area of the Roman Forum, probable site of the cenotaph of Romulus (Blanc GA, Blanc AC 1958). Artemidorus Daldianus states: «Ἔμαθον δὲ τι καὶ ἐν Ἰταλία νόμιμον παλαιόν. Γῦπας οὐκ ἀναιροῦσι καὶ τοὺς ἐπιθεμένους αὐτοῖς ἀσεβεῖν νομίζουσι.» (I also knew of an ancient law in Italy. They

do not kill vultures and think that when they sacrifice them, they commit a sacrilege. Artemidorus *Onirocriticon* I, 8).

Vultures were therefore considered important for *auspicia* and *auguria*; in fact, both words have *au-* ‘bird’ (Capdeville 2016) as part their theme. The attestations that vultures were protagonists in the *signa ex avibus* (ornithomancy) even after the period of the foundation of Rome are encountered in various classical authors; according to Plutarch, the soothsayers, since it was difficult to see young individuals, did not consider vultures as natural beings, but sent by divinity (Plut. Πρωμολος IX, 7). Pliny narrates that the most knowledgeable among the haruspices of his time, Umbricius, says that they fly to the place where cadavers will be found three days in advance (Plin. *NH* X, 7). In addition, their feathers have been used for cultic ornamentations: those of *Neophron percnopterus* (Linnaeus, 1758) adorned the head of Isis (= Hera), while *Gypaetus barbatus* (Linnaeus, 1758) was sacred to *Mut*, who was represented with a vulture-shaped headdress (Blanc GA, Blanc AC 1958).

Older attestations of their presence in Italy date back to the Bronze Age; at La Starza, near Ariano Irpino (province of Avellino, Campania, Italy), the distal part of a vulture humerus attributable to *Gyps fulvus* (Hablizl, 1783) or *Aegyptius monachus* (Linnaeus, 1766) has been found (Albarella 1997). According to some authors, however, the interspecific relationships between humans and vultures may be considered among the oldest in genus *Homo* (Morelli et alii 2015); this relationship was considered symbiotic because, if in a first phase vultures signaled meat on the landscape to humans (Shipman 1985; O’Connell et alii 1988), subsequently, in exchange for access to carcasses of domestic animal and food debris, these scavengers removed carrion quickly and efficiently, so reducing possible sources of contagious diseases for humans (Ogada et alii 2012; Moleón et alii 2014).

Vultures have also been employed in a variety of ways, and this fostered commercial exploitation, causing their original sacred role to be progressively forgotten.

Pliny treats vultures in several books of his *Naturalis Historia* (*NH*) focusing on zoological aspects (*NH* X) and citing numerous medical and magical uses (*NH* XXVIII–XXX). The various therapies of the Plinian pharmacopoeia are again reported in the *Epistula vulturis* (*EV*), a document dated to the ninth century (Mackinney 1943). As many as seven of the seventeen remedies proposed in *EV* are drawn from Pliny. The curable ailments range from headaches (*NH* XXIX, 36; *EV* 1 and 2) to eye affections (*NH* XXIX, 38; *EV* 5), from epilepsy (*NH* XXX, 27; *EV* 6) to dermatological problems (*NH* XXX, 26; *EV* 7), from effects on women about to give birth (*NH* XXX, 44; *EV* 13) to tendon problems (*NH* XXX, 36; *EV* 16). Various magical uses are also mentioned in the *NH*: carrying a vulture heart was considered useful against the attack of snakes, beasts, ladrones and the wrath of monarchs (*NH* XXIX, 24); burnt feathers would scare away snakes; the heart of a pullus carried as an amulet would be efficacious against epilepsy (*NH* XXX, 27); finally, the right part of an adult’s lung wrapped in crane leather and tied up would have been an aphrodisiac (*NH* XXX, 49).

Various classical authors write about the use of a particular hunting tool that was helpful in fowling (*aucupium*): the *linea pinnis distincta*, consisting of a rope garnished of black feathers alternating with white feathers and maneuvered by beaters to bring game into the nets (Verg. *Georg.* III, 371–375; Grat. I, 75–91; Nemes. I, 299–316).



Because of the fear it produced on animals, it was also called *formido* (Sen. *De ira* II, 11, 5). Grattius informs us that the *linea pinnis* was composed of white swan feathers and black vulture feathers («vulture [...] ab atro»), suggesting that the involved bird was *A. monachus* (Grat. I, 79).

Fredericus II, in his *De arte venandi cum avibus*, gives important information both in the text and in the miniatures, by which it is evident that vultures were common in the thirteenth century: «Et si unus de ipsis subito descenderit ad cadaver [...] congregant se multi, ubi erit corpus» (if one of them descends on a carrion [...] many gather in the place where the body is found. Fredericus II *De Arte* I, 41).

From the twelfth century onwards, there are records of the use of vulture feathers to produce a crossbow bolt called quarrel (such feathers are locally employed in archery still today). It is said, in fact, that these feathers remain intact even after years of use and that their great economic value allows the Iltorobo (clan of the Maasai tribe) to exchange a vulture's wing for a goat or a dozen arrows (Muiruri and Maundu 2012). In Japan, the arrows had three vanes about 15 cm long, generally prepared with vulture or eagle feathers (Barbantini 1954).

In the sixteenth century the calamus of their feathers was employed to produce musical instruments such as harpsichords and spinets because of its hardness resembling that of bone (Galilei 1581).

It should be noted that Natural historians of the sixteenth century discussed vultures by often referring to ancient literature. In the works of Gesner (1555) and Aldrovandi (1599), the information on the uses of these birds refers either to Belon (1555) or to the treatises of the classical authors (Grattius, Pliny, Plutarchos, etc.). Aldrovandi (1599, p. 241) refers that it is very rare to see *A. monachus* in flatlands in Italy, Germany, and France, except in winter when specimens are observed seeking shelter, so in fact both describing the phenomenon of erratism still observed today (de la Puente et alii 2011; Monsarrat et alii 2013) and confirming local extinction.

Francesco Cetti (1776, p. 12) reports the presence of *A. monachus* in Sardinia and states that it is more abundant than *G. fulvus* and *G. barbatus*.

In the nineteenth century various authors give brief and unconfirmed information: *A. monachus* is reported as sighted “sometimes on the highest peaks of Terra di Lavoro” (Zuccagni-Orlandini 1844, p. 102), but Oronzio Gabriele Costa, zoologist at the University of Naples, writes: “It is said to be on the high mountains of the Kingdom of Naples [...]; but I know of no certain case: nor has any hunter ever seen or killed it” (Costa OG 1857, p. 7) and adds: “bird proper to the highest mountains of Europe, the Indies and Egypt. Among us it was on Tifata mountains, whence a living one was taken in Naples some years ago. In Calabria ultra near Reggio another one from neighboring Sicily was killed. However, seeing it is always rare” (Costa OG 1857, p. 84). Paolo Savi, from Tuscany, says that *A. monachus* is common in Sardinia, where it is stationary, and lists the places where it might be found, including Sicily (Savi 1873, p. 98). Doderlein gives contrary information, reporting that he showed a specimen from Sardinia to Sicilian hunters and mountaineers, not receiving any confirmation. He further speculates that *A. monachus* would have moved away from Sicily due to changed agrarian conditions, so concentrating in Sardinia and northern Africa, and thus implying to its absence also in continental Italy (Doderlein 1869, p. 26). *G. fulvus*, on

the other hand, has a more stable presence not only in Sardinia but also in Sicily; Doderlein (1869, p. 24) reports it as “quite common in the high central mountains of the Island”. A final confirmation of the absence of these birds in Italy is obtained by trade manuals of the nineteenth century that report for vulture feathers those of the ‘American ostrich’, *Rhea americana* (Enciclopedia del negoziante 1843, p. 1051).

Presence of vultures is also manifested through the toponyms that characterize the Italian territory. Place names often remain, surviving local extinctions, and signaling the historical presence of species (Boisseau, Yalden 1998; Poole 2015; Tattoni 2019).

The origins and etymologies of various toponyms are beyond the scope of this work, but we must note that there are numerous places names that attest, with varying degrees of probability, the historical presence of vultures in Italy. Some examples for Southern Italy are: Volturara, Vulture, Vuturo, Buturo etc., but we could also mention names such as that of Velia that would join the root *voltur* to an ancient Etruscan or Mediterranean oronym (Capponi 1979).

For being locally extinct or rare species, the zoonyms designating vultures in Italy are also varied and present in many regions. The comparatively larger number of Sardinian and Sicilian names confirms the long presence of vultures in these large Italian islands. The most used zoonym is obviously ‘vulture’ and its variants but often some characteristics indicate a precise species: the beard for *Gypaetus barbatus* is found in *antruxiu barbudu* (Sardinia) or *aciddazzu barbatu* and *vuturu barbatu* (Sicily); the white color for *Neophron percnopterus* is met in *avvoltoio bianco* (Tuscany) and *vuturu iancu* (Sicily) and the black color of *Aegypius monachus* in *avvoltoio nero* (Italy), *bentruxiu nieddu* (Sardinia), *vuturu niuru* (Sicily). There is no shortage of references to eating habits, such as, for *Gypaetus barbatus*, breaking and eating bones, already attested by the Latin names *ossafrangens*, *ossifragor*, *ossifragus*, *oxifragos*, *oxifragus* (Fredericus II *De Arte*) and by *laynera*, which derives from the predation of lambs (Pfister 1984). Finally, several zoonyms recall hunting methods such as *mangia scecchi* (eating donkeys). Various are the appellations for *Gyps fulvus*, among which are *grifone* and *auciello grifone* (Soppelsa 2016), which designate a magical bird, perhaps related to the role of quarryman and guardian of the gold mines reported by Pliny (*NH VII*, 2).

All the evidence indicated above makes conclusive the importance that Italic peoples attributed to vultures in general and testifies their continue presence in the past. Their sudden disappearance, however, made them species ‘from other places’ (allochthonous species), occurring in popular knowledge more in reference to fairy tales, fables, myths, and legends than to their even occasional presence.

At present, with the word vulture are indicated for Europe four species of the family Accipitridae: *Aegypius monachus* (Linnaeus, 1766), *Gyps fulvus* (Hablizl, 1783), *Gypaetus barbatus* (Linnaeus, 1758) and *Neophron percnopterus* (Linnaeus, 1758). But what did the Italic peoples mean by *vultur*? Did the concept of *vultur* change in the medieval period?

Pliny, in addition to the numerous information he gives us about these birds, also differentiates their names. However, it would be difficult to extricate oneself among the epithets of vultures and eagles in classical texts, both because of linguistic transformations and because sometimes the distinction between them is not clear.

Fredericus II, the most influential medieval author on ornithological matters, calls *ossafrangens* the species *G. barbatus* and adds that it always feeds on carrion or animal remains, outlining a difference in terms between the *vultures* and the *ossafrangentes* (Fredericus II *De Arte* I, 36). Throughout his work, in fact, Fredericus II refers to *G. barbatus* always with the term *ossafrangens* and never with the word *vultur*. Moreover, referring to *vultures* he says that they have the head devoid of plumage «Et cum intromittant capud suum et collum per strictum foramen corii intus in cadaver» (since they introduce the head and neck into the carrion through a tight laceration of the skin. Fredericus II *De Arte* I, 41), narrowing the field only to the species *A. monachus* and *G. fulvus*. As for the Egyptian vulture, Fredericus II tells us that a species of birds «que sunt albe, habentes extremitates alarum nigras, croceum colorem secundum rostrum usque ad medium capitis, hee carent plumis et lanulis» (which are white, have the ends of the wings black, the beak yellow, are devoid of feathers and down to the middle of the head. Fredericus II *De Arte* I, 128) not considering in any way the term *vultur* for *N. percnopterus*.

For centuries, vultures have characterized the landscape of Italy, but at a certain point they disappear, leaving only allegorical images and the worst metaphors: putrid animals, carrion eaters, vile and opportunists; nothing remains more of that figure deified by the Egyptians and used by the founders of Rome as a favorable omen. The testimonies of the ancient relationship between the Italic peoples and the vultures, the presence in Italy of transhumant pastoralism, that had great importance at least until the beginning of the twentieth century, the succession of bloody battles with corpses often left on the ground, make it at least unusual that *A. monachus* has been preserved in Spain, Greece and Turkey, but not in Italy (Poulakakis et alii 2008; Baccetti et alii 2021) and that *G. fulvus*, also following reintroduction operations, is still Critically Endangered (Lo Valvo and Scalisi 2004; Rondinini et alii 2013; Baccetti et alii 2021).

When did vultures disappear from Italian landscapes and what causes determined their extinction? The disappearance of the vulture population in peninsular Italy and the causes that determined it are the subject of this publication.

## *Material and Methods*

### Study area and period

The time span in which the investigation is concentrated goes from the coronation of Charles I (1266) until immediately before the death of Robert I of Anjou (1343). In this period historical events took place that repeatedly upset the borders and peoples of the investigated territory. The initial area consisted of the Kingdom of Sicily, which included the current regions of: Sicily, Campania, Calabria, Basilicata, Puglia, Abruzzo, Molise and a part of Southern Lazio. In 1282, at the outbreak of the War of the Sicilian Vesper (Amari 1969), the Angevins lost Sicily and the Kingdom of Naples was born. During the first phase of the war (1282-1302) the borders underwent numerous transformations that involved the whole of Sicily and Calabria. The battles that followed unabated were fought by land and sea between the Sicilian-Aragonese and Angevin armies. This war lasted a total of ninety years, during which a huge amount of resources and armaments was used (Amari 1969).

## Material

To verify the hypothesis that Angevin wars were largely responsible for the disappearance of vultures from the Italian landscapes, the precious historical sources of the Neapolitan archives (Palmieri 2002) have been used, and in particular the so-called reconstruction of the Angevin Chancery (AC). In World War II, German troops, during their retreat in 1943, set fire to the archives of the AC. “I am with the same spirit of those who have seen the dearest person die, but with the mind of those who measure the immensity of loss for our tradition and for historical science”, are the words of Benedetto Croce (1987), describing in few lines the gravity and inevitability of what happened. However, evil madness was contrasted with creative madness: editions of documents, historical literature, manuscripts, transcripts, and notes from researchers around the world were collected to give new life to the Angevin Chancery. This great endeavor, started in the same year 1943 by a group of scholars, allowed the Angevin Chancery Reconstruction (ACR) (Mazzoleni J 1987; Palmieri 2010).

A first analysis of the AC has indicated a great use of vulture feathers to produce a particular crossbow bolt: the quarrel. It was therefore decided to evaluate the quantities of vultures used for fletching.

The ACR consists of 50 volumes to which other sources must be added, corresponding to authors who had already published texts drawing on the original documents. The following works, therefore, contain useful material:

ACR: (1950–2010) *I registri della Cancelleria Angioina ricostruiti da Riccardo Filangieri con la collaborazione degli Archivisti napoletani* ([www.accademiapon-taniana.it/pubblicazioni/](http://www.accademiapon-taniana.it/pubblicazioni/)).

Scotti A.A. (1824) *Syllabus membranarum ad Regiae Siclae archivum pertinentium*, vol. I.

de Aprea A. (1845) *Syllabus membranarum ad Regiae Siclae archivum pertinentium*, vol. II, pars II.

Caggese R. (1922-1930) *Roberto d'Angiò e i suoi tempi*.

Camera M. (1841-1860) *Annali delle due Sicilie dall'origine e fondazione della monarchia fino a tutto il Regno dell'augusto sovrano Carlo III Borbone*.

Minieri Riccio C. (1873) *Diario angioino dal 4 gennaio 1284 al 7 gennaio 1285 formato su' Registri Angioini del Grande Archivio di Napoli*.

Minieri Riccio C. (1874) *Alcuni fatti riguardanti Carlo I di Angiò dal 6 di agosto 1252 al 30 di dicembre 1270 tratti dall'Archivio Angioino di Napoli*.

Minieri Riccio C. (1876) *Memorie della guerra di Sicilia negli anni 1282, 1283, 1284 tratte da' registri angioini dell'Archivio di Stato di Napoli*.

Minieri Riccio C. (1879) *Il Regno di Carlo I.° d'Angiò dal 2 Gennaio 1273 al 31 Dicembre 1283*.

Minieri Riccio C. (1882, 1883) *Genealogia di Carlo II d'Angiò Re di Napoli*.

Bevere R. (1897) *Ordigni ed utensili per l'esercizio di arti ed industrie. Mezzi di trasporto ed armi in uso nelle province napoletane dal XII al XVI secolo*.

To estimate the quantity of quarrels that could be fletched with one single vulture specimen, data were collected from the literature (Fraigneau 2021) and from the Featherbase website ([www.featherbase.info/el/home](http://www.featherbase.info/el/home), last consultation 2023) for *Gyps fulvus*, from literature (Fraigneau 2021) and from comparative measurements of pho-

tographic images (de la Puente, Elorriaga 2012) for *Aegyptius monachus*. For both species we measured the feathers of taxidermized specimens preserved in the Museum of Zoology of the Università degli Studi di Napoli Federico II (*A. monachus* 3 specimens, codes: Z4631, Z4632, Z4633; *G. fulvus* 5 specimens, codes: Z4625, Z4626, Z4627, Z4628, AR52/2016).

#### Data collection

The collection of data from the AC was carried out producing a database; in particular, direct and indirect references to vultures were collected: dates, indictions, recipients of orders, places, materials (feathers, iron, shafts, etc.) and requested artifacts (crossbows, quarrels, crates, etc.), prices, recipients of the artifacts.

A database was also built to collect data on the feathers morphometry of *A. monachus* and *G. fulvus* to calculate how many vanes can be produced for a single individual.

The Excel software (Microsoft Corporation, USA) was used to compile the databases and carry out the processing.

The QGIS 3.22 software was used for the cartographic processing.

#### Results

The collection of data concerning vultures from the AC allows us to retrace their vicissitudes chronologically. About 300 records concerning direct and indirect data on quarrels from which the required quantities could be obtained were archived from the entire AC collection. To distinguish the data from literature citations, the indication of the register in Roman number, and the relative document in Arabic number (e.g.: Mazzoleni J 1964: LXXX, 737) are reported as well. For data collected by authors who drew on the originals, thus predating the 1943 and ACR, only the book page number of the document is provided (es.: Minieri Riccio 1874, p. 19).

The first item concerning the production of quarrels in the AC dates to 31 Dec 1266 (Minieri Riccio 1874, p. 19), while vulture feathers are mentioned for the first time on 6 Feb 1270.

Depending on the need for war supplies, the demands for quarrels become increasingly more pressing. On 9 Feb 1274, the *Iustitarius* (chief judicial officer) of Capitanata (Filangieri 1959a: LV, 16) and Basilicata (Scotti 1824, p. 91) were asked for «alas, et caudas» (wings and tails) without limits, to be brought to Iohannes Armenus, castellan of Castrum Capuanum (today Castel Capuano) of Naples, with the penalty of 200 gold unciae if the order was not carried out «firmiter et expresse» (firmly and quickly) (Scotti 1824, p. 91); the price of 10 gold *grana* is also indicated «pro singulis duabus alis et cauda una integris» (for each pair of wings and one intact tail. Camera 1860, p. 246).

The demand for quarrels continues, with fletching of vulture feathers; on 13 Sept 1275, for the first time, feathers of goose, eagle and other large birds were also requested in the territories of Abruzzo and Terra Laboris to be brought to the *accillator* (artilleryman) of Castrum Capuanum (Filangieri 1959b: LXIX, 92). Still in Feb 1276 the *Iustitarii* of Basilicata and Capitanata are asked for wings and tails of vultures,

cranes, eagles and other large birds (Figure 1), which are found in those regions (Filangieri 1959b: LXXII, 71).

To confirm that the quarrels are a precious asset, on 3 Jun 1276 they became object of an investigation by the Angevin *Curia*: Calquerius de Tolone, commander of the ship of the *Curia* named San Marco, to whom 41,000 quarrels to be delivered to Brindisi were entrusted, delivered only the fourth part with a «deficit quarrellorum qualitas et quantitas» (deficit in quality and quantity), *i.e.*, with 30,600 quarrels disappear during the journey (Filangieri 1959b: LXXII, 217). Given the risk of punishment, a possible hypothesis which might be formulated, is that Calquerius was bribed to hand them in to some opposing faction.

On 31 Aug 1277, King Charles ordered Raynaldus of master Symundus, Nicolaus of master Antenor, Matheus of master Hugo, Angelus of master Robertus, Basilius de Anguerrano, Iacobus de Peregrino, and Ioculanus de Corneto to capture eagles, vultures and bustards and, to avoid distractions, ordered that they be «liberos et exemptos» (free and exempt) from other offices (Mazzoleni J 1961: LXXVI, 303). Interestingly, today the bird called bustard, *Otis tarda* Linnaeus, 1758, is accidental in Italy, and the crane, *Grus grus* (Linnaeus, 1758), is in the Regionally Extinct category of IUCN, although globally is recorded as Least Concern (Rondinini et alii 2013).

On 29 Jul 1280, for the first time, in the requests for feathers to be used for the fletching, vultures are not mentioned (Minieri Riccio 1879, p. 14; Mazzoleni J and Orefice 1976: C, 134), but in Sept of that same year the *Iustitiarius* of Principatus is shown the places where there is greater chance of capturing them (Mazzoleni J and Orefice 1978: CVI, 30). This sequence of events seems to highlight an evident difficulty in finding vultures; in fact, the *Curia* at first asks only for feathers of eagles and other birds, and shortly after indicates the places where vultures are found. The indications are repeated on 10 Dec 1281 with the addition of places where it is possible to produce the quarrels «melius et citius ac cum minoribus expensis» (better, faster and with less expense. Mazzoleni J and Orefice 1978: CVI, 44).

By now the vultures in Southern Italy are scarce and the catches occur with expeditions to the island of Corfu (13 Feb 1282) «pro habendis eorum pennis ad opus quarrellorum nostrorum» (to have their feathers to make the quarrels. Mazzoleni J and Orefice 1978: CVI, 112). Despite this, the price paid for a pair of wings and one tail will remain 10 gold *grana* until Jun 1282 (Mazzoleni J and Orefice 1978: CVII, 146) (Table 1).

Unusual is the order of 22 Nov 1283, which asks good feathers from vultures and other large birds but, this time, explicitly declaring that eagle feathers are not wanted «que ad hec prorsus inutile reputatur» (as they are considered useless to the fletching. Mazzoleni J and Orefice 1979: CXVIII, 4); this recommendation is repeated several times in Oct 1284 (Minieri Riccio 1876, p. 526). The exclusion of eagle feathers may be explained by a piece of information reported by Pliny: «aquilarum pinnae mixtas reliquarum alitum pinnas devorant» (the feathers of eagles mixed with those of other birds consume them. Plin. *NH* X, 4), and by Manuel Philès (1275-1345) who provides a more technical explanation and chronologically close to the notes of the AC: if the craftsman hides in the quiver an arrow fletched with eagle feathers, it consumes all the others (Philès vv. 80-82). Olaus Magnus confirms this and adds that they especially



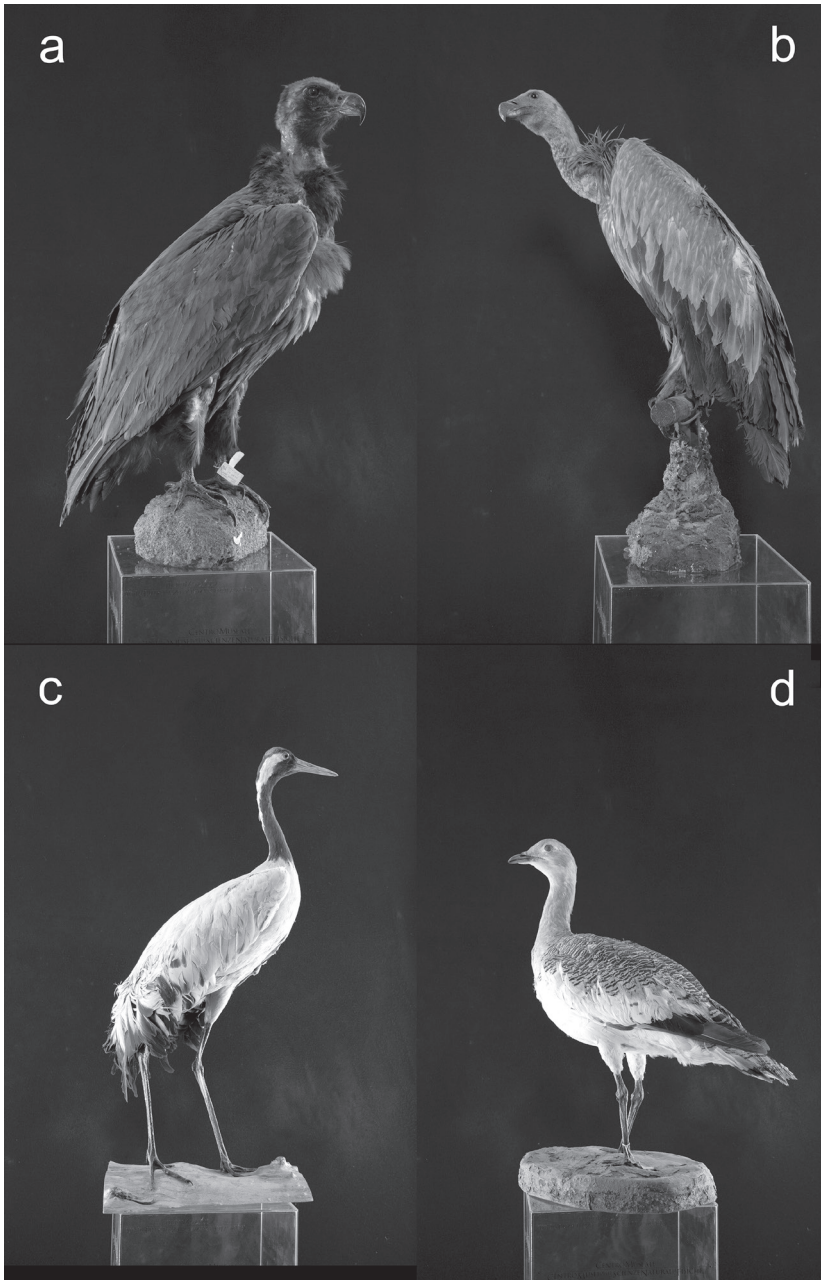


Fig. 1. Vultures and *magnaes aves*. a) *Aegypius monachus* (cod. Z4632), female, place of origin Monte di Capo Terra [Capoterra], Cagliari (Sardinia); b) *Gyps fulvus* (cod. AR52/2016), juvenile; c) *Grus grus* (cod. AR177/2018); d) *Otis tarda* (cod. Z4852), male, place of origin Foggia (Apulia), collection date 5 Jan 1934. Information from the Catalogue of the Museum of Zoology of the Università degli Studi di Napoli Federico II.

ruin the feathers of goose (Magnus 1555, XIX, 7). Probably the Angevin archers had observed this on their feathers!

On 9 Oct 1284, the last explicit request for vulture feathers occurs: King Charles I commissioned 50,000 arrows for bows, well fitted on shafts, and fletched with feathers of vulture and other large birds, reiterating not to use eagle feathers (Minieri Riccio 1876, p. 527). Regardless, in a list of expenses incurred by Petrus de Capuacio (16 May 1301 - 5 Jan 1302) there is a reference to a reimbursement for vulture feathers, albeit with no specification of their use (Egidi 1917, p. 335).

In the period from Oct 1284 to Jul 1289, neither quarrels nor vultures appear. This absence of requests is probably due to the interregnum period brought about by the imprisonment of Charles II (5 Jun 1284 - 27 Oct 1288) and by the death of Charles I (7 Jan 1285). At this stage, in fact, Robert of Artois becomes regent by testamentary will of Charles I, to the side of whom the Pope (nominally liege lord of the 'feudal' Kingdom of Naples) places Cardinal Gerardus Blancus from Parma. Hostilities resumed after the coronation of Charles II (29 May 1289) and the pope's dissolution of his oaths made to the Aragonese (Léonard 1967).

At the end of the thirteenth century we observe a decline in the populations of vultures and *magnae aves*, as since then the requests for the fletching will be of goose feathers: on 25 Jul 1305, only goose feathers are purchased to fletch the quarrels (de Aprea 1845, p. 130), and in 1316 a request is made to procure a «magna pennarum anserum quantitate» (large quantity of goose feathers) to fletch the quarrels of the *Curia* (Camera 1860, p. 246). In Oct 1321 a «non parva pennarum anserum quantitas» (not small quantity of goose feathers) is again required, and 200 thousand quarrels are ordered in Aversa, 120 thousand in Teano, 200 thousand in San Germano, 100 thousand in Capua (Caggese 1930, p. 203). In Jul 1325, Robert of Anjou orders six hundred thousand quarrels fletched with feathers of vultures or geese at the price of one gold uncia and two *tari* for every thousand (Minieri Riccio 1882, p. 489). It is considered unlikely that thousands of monk or griffon vultures would still be available, but the custom of using vulture feathers could justify the request.

After this, the fletching with vulture feathers is soon forgotten. The French author Pierre Belon, in his work of 1555, about the use of vulture feathers for the preparation of arrows, reports that the peasants of Crete, of various mountainous countries, of the Egyptian plains and of the Arabian desert capture vultures to sell their skins to leather workers and the feathers of the wings and tail to the artillerymen to fletch arrows, completely ignoring that two centuries earlier his Anjou countrymen had produced and covered Southern Italy with millions of quarrels made with vulture feathers.

Matteo Camera (1860, p. 246) notices the considerable number of vultures employed and expresses a judgment: "It seems inconceivable, that this African bird, we mean the vulture, at that time so common among us, at present has become rare." Only in 1929 science understood the important ecological role of vultures; it was the government of Somalia, at the time an Italian colony, which, in reorganizing the matter of hunting, drew up a new general regulations on hunting (Regolamento generale sulla caccia 1930) in which the capture of vultures was prohibited because of their usefulness.



Table 1. Explicit requests for feathers of vultures and other large bird species present in the AC.

date (indiction)	registers and documents AC	vulture	eagle	large birds	goose	crane	bustard	sparrow- hawk	References
06/02/1270 (13)	reg. 5, f. 119 t.	s							Filangieri 1951, p. 165
30/11/1270 (14)	reg. 10, f. 21 t.	s							Mazzoleni J 1955, p. 30
11/05/1273 (1)	reg. 14, f. 283	s							Palmieri 2010, p. 183
09/02/1274 (3)	arca H, fasc. 86, n. 5	s [10]							Scotti 1824, p. 91, Camera 1860, p. 246
09/02/1274 (3)	arca I, fasc. 20, n. 5	s							Filangieri 1959a, p. 276
28/05/1274 (2)	reg. 14, f. 283	s							Palmieri 2010, p. 183
09/06/1275 (3)	reg. 19, f. 107	s							Cubellis 1996, p. 125
13/09/1275 (4)	reg. 24, f. 35	s	s	s	s				Filangieri 1959b, p. 18
16/02/1276 (4)	reg. 9, f. 130 t.	s	s	s		s			Filangieri 1959b, p. 213
16/06/1277 (5)	reg. 27, f. 84 t.	s [10]	s						Mazzoleni J 1961, p. 181
31/08/1277 (5)	reg. 27, f. 93	s	s				s		Mazzoleni J 1961, p. 187
?/02/1278 (6)	reg. 1, f. 137 t.	s							Palmieri 1999, p. 577
05/08/1278 (6)	reg. 1, f. 126 t. and reg. 26, f. 212 t.	s [10]	s [10]						Mazzoleni J 1964, p. 366
29/07/1280 (9)	reg. 40, ff. 21 and t.		s	s					Minieri Riccio 1879, p. 15
15/09/1281 (10)	reg. 44, f. 36	s							Mazzoleni J et alii 1978, p. 96
10/12/1281 (10)	reg. 44, f. 36	s							Mazzoleni J et alii 1978, p. 97
13/02/1282 (10)	reg. 44, f. 90	s		s					Mazzoleni J et alii 1978, p. 112
20/06/1282 (10)	reg. 44, f. 106	s [10]	s [10]					s [10]	Mazzoleni J et alii 1978, p. 118
25/08/1282 (10)	reg. 39, f. 4	s							Mazzoleni J et alii 1978, p. 135
22/11/1283 (12)	reg. 12, f. 42 t.	s	n	s					Mazzoleni J et alii 1979, p. 200
07/10/1284 (13)	reg. 45, ff. 6 and t.	s	n	s					Minieri Riccio 1873, p. 52
09/10/1284 (13)	reg. 45, f. 46	s	n	s					Minieri Riccio 1876, p. 527
25/07/1305 (3)	arca B, fasc. 32, n. 9				s				de Aprea 1845, p. 130
1316 (15)	reg. 1316 lit. C, f. 23 t.				s				Camera 1860, p. 246
08/10/1321 (5)	reg. 232, f. 142 t.				s				Caggese 1930, p. 203
03/07/1325 (8)	reg. 314, f. 300 t.	s			s				Minieri Riccio 1882, p. 489

Legend: s = requests; n = to be avoided; [] = cost of an intact pair of wings and one tail in *grana*.  
Abbreviations: reg.= register, fasc.= fascicle, f.= folio.

### *Quarrel production*

To estimate how many dart vanes are obtained for each vulture specimen, data were collected on the morphometry of the two possible species used and on the composition of the two types of quarrels, the so-called one-foot quarrels and the two-foot ones, which were fletched with vulture feathers.

Du Cange defines the *quadrellus* as «Tela balistarum, brevia, spissiora, et forma quadrata, unde nomen nostris Quarreaux» (Du Cange 1886) (crossbow bolts, short, thick and square-shaped, hence our name *Quarreaux*). The variants are numerous and range from *quadrellum*, *quar(r)ellus*, *cairellus*, *quadril(l)us*, *cuadrella*, *corellum*, *carella*, *carrelli*, *quadrum*. The ‘square shape’ refers to the square-based pyramidal

point that promoted greater penetration into the metal of armor and made the wounds difficult to heal. The point is followed by a wooden shaft that ends, a few centimeters from the nock, with a fletching consisting of two vanes, preferably of feathers, although in their absence they could also be made of papyrus or parchment paper (Bevere 1897, p. 729; Palmieri 2010: LIX, 423), wood, copper, or iron foils (Angelucci 1886, p. 25).

The presence of the quarrels is already found in a text by Guillelmus Brito (active between the 12th and 13th centuries), which narrates the death of King Richard I of England Lionheart in 1199 near Chalûs, today in Alta Vienne department (Nouvelle-Aquitaine), hit in a scapula by a quarrel thrown from a tower (Brito 1878); Richard died of gangrene after a few days. In the manuscript of the *Chronica Majora* of Matthew Paris (1250-1259), a crossbow is depicted on Richard's coat of arms, which is turned upside-down to indicate his death.

During the reign of Fredericus II, one-foot, two-foot and *de torno* crossbows are already mentioned, whereas the word *quadrellum* does not appear. In the Registers of the Chancery of Fredericus II the bolts used are called *munitiones* (de Vineis 2002). The quarrels were considered necessary weapons for galleys (Du Cange 1886), because crossbows, especially the one-foot type, were extremely maneuverable.

The origin of the quarrels may however be older; in fact, near Avellino there is a municipality called Quadrelle, which in ancient times was considered 'the land of quarrels' and whose coat of arms bears the inscription *Universitas terrae quadrellarum*. In the oldest acts, moreover, the village is named *quadrellarum oppidum*. The etymology of the name could be derived from *quadrum telum* or better in the plural *quadra tela*, i.e., square arrows, from this the word *quadrella* would be taken its origin, and then, Quadrelle. The hypothesis would be supported both by the abundance of timber production and by the consequent abundance of carpenters (Pagano 1931). There is, in addition, a document of the AC dated 10 Dec 1281, in which the *Iustitiarius* of Principatus is instructed to have the quarrels produced near Avellino, San Severino, Monteforte and Forino, all localities near Quadrelle, where there is both abundance of timber and masters capable of manufacturing them (Mazzoleni J and Orefice 1978: CVI, 44).

The construction of the quarrels involved various materials: wood for the shafts, iron for the points, feathers and even grinding wheels, files, coals, glue. The various stages of manufacture also corresponded to as many professional figures. *Tenditores* were hunters, generally falconers, who caught vultures with nets and traps of various kinds to procure feathers; they tried to preserve the integrity of the feathers by leaving them attached to the wings and tails that they would then deliver to the *accillatores* in Castrum Capuanum (Mazzoleni J 1964: LXXX, 737). Carpenters produced the quarrel shafts and often worked directly at the timber harvesting sites (Mazzoleni J and Orefice 1978: CVI, 44). Blacksmiths transformed iron into points with square pyramidal cusps and tangs with gorbias to house the shafts (Minieri Riccio 1874, p. 39). The filers had to finish the points before forging (Minieri Riccio 1874, p. 39; Mazzoleni J 1955: XXIV, 124). The *accillatores*, who were divided according to the tasks into those who attached the points and the fletchers who worked the feathers to turn them into vanes; the latter also had to melt the leather glue (Mazzoleni J 1964: LXXX, 220; Mazzoleni

J and Orefice 1978: CVII, 74) for use in the last operations of quarrel preparation, i.e., the fletching (Mazzoleni J 1955: XXIV, 124). Carpenters were still needed to produce specific crates to store the quarrels. Generally, a one-foot quarrel chest held a thousand (Minieri Riccio 1879, p. 14; Mazzoleni J and Orefice 1979: CXVI, 25; CXIX, 627; CXX, 545). Finally, to keep stocks efficient and to prevent them from being attacked by mold or spoiling, there were several *servientes* necessary for the custody of the quarrels (Cubellis 1996: XLII, 27).

The main place of production of the quarrels was the *accillaria* located in Castrum Capuanum in Naples (Palmieri 2017); Here resided the head of the *accillatores* and most of the professional figures necessary for producing and preserving the quarrels. The Castrum Salvatoris ad Mare, also known as Castel dell'Ovo (Filangieri 1959a: LXVIII, 182) was also used as an arms depot. There were other places of quarrel production as well, in particular in Amalfi, Sant'Agata, Avellino and Eboli for the large presence of blacksmiths, or Avellino, San Severino, Monteforte and Forino as there was both abundance of timber and masters capable of manufacturing quarrels (Mazzoleni J and Orefice 1978: CVI, 31); we also remember: Aversa, Teano, San Germano, Capua (Caggesi 1930, p. 203).

The most widely employed types of quarrels were one-foot, two-foot and *de torno*. Many have assumed that the expressions one-foot and two-foot indicate the loading mode; on the contrary, it seems that the names referred to a measure. Afan de Rivera (1840) reports that in the Kingdom of Naples artillery had always employed the so-called 'foot of the King of France' (equaling 326.6 mm), which dates to the Carolingian period. This valuable information leads us to assume that the one-foot quarrels correspond to a length of about 32.7 cm and the two-foot to 65.3 cm (Table 2). The length of the quarrels *de torno*, on the other hand, can only be inferred based on the size of the crossbow tiller reported in the AC which was 6 palms (Cubellis 1996: XLIII, 27), i.e., 158.2 cm; in any case, a quarrel *de torno* was used in a crossbow (Table 2) which required a mechanism called *tornus* to be loaded.

Between 1306 and 1307 the *Statutum quarrellorum* was issued to establish the number of quarrel points that had to be produced by a *cantàro* (a measure equaling about 89.1 kg) of coarse iron. The document, which has gaps, reads «Quarelli ... MCC ad unum pedem et Quarrelli ... MMMMMMMMLX ... ad duos pedes». If this were the case, the weight of a one-foot quarrel would be 7.5 times heavier than a two-foot quarrel, which was twice as long (Table 2). It is assumed, therefore, that the gap that precedes «... MCC» included the characters which would bring to 10200 the number of one-foot quarrels produced. The *Statutum quarrellorum* also fixed the price of a *cantaro* of coarse iron at 25 *tari*, equal to 500 *grana* (Mazzoleni B 1980: IX, 46).

The shafts had to be straight and well proportioned (Minieri Riccio 1882, p. 489), preferably in beech wood (Minieri Riccio 1882, p. 489; 1883, p. 202), although other timbers could also be used.

In the manufacture of a quarrel, the cost of feathers was higher than that of machined iron points and greatly affected the final price, being 18.5%, excluding the fletching that had to take place when the quarrel was finished.

Table 2. Outline of the types and characteristics of the quarrels.

Features	1-foot quarrel	2-foot quarrel	q. <i>de torno</i>	years
shaft length (cm)	32.7 (a)	65.3 (a)	158.2 (b)	1271
point weight (g)	8.7 (c)	9.8 (c)	150 (f)	1306-1307
points produced for <i>cantaro</i> of iron (n°)	10200 (c)	9060 (c)	594 (f)	1306-1307
iron cost of points 1000 ( <i>grana</i> )	49 (c)	55.2 (c)		1306-1307
quarrels cost for 1000 ( <i>grana</i> )	345 (d)	375 (d)		1284
vanes cost per 1000 quarrels ( <i>grana</i> )	63.7 (e)			1274 to 1282
equivalence of crossbows production (n°)	4 (b)	2 (b)	1 (b)	1272
crossbows annual production request (n°)	50 (b)	30 (b)	20 (b)	1272
quarrels annual production request (n°)	80000 (b)	20000 (b)		1272

References: (a) Afan de Rivera 1840; (b) Cubellis 1996 (the measure refers to the tiller); (c) Mazzoleni B 1980; (d) Minieri Riccio 1876; (e) Scotti 1824; Mazzoleni J 1961, 1964; Mazzoleni J and Orefice 1978; (f) De Luca, Farinelli 2002.

### *Techniques and places of capture*

We learn from the AC that those who caught the vultures were called *tenditores* (Mazzoleni J 1961: LXXVI, 281; 1964: LXXX, 737; Mazzoleni J and Orefice 1978: CVI, 112). From various sources we may hypothesize the capture techniques. Already Pliny observes that large birds need a long run or a raised place to take flight (Plin. *NH* X, 54). Francesco Cetti (1776, pp. 26-27), on the other hand, describes in detail the phases of vulture catching by the shepherds of Sardinia. They dig a pit into which a dead animal, usually a cow or a horse, is placed. When the vultures are satiated, they are impeded in the flight by their own weight and by the location, and the shepherds kill them with a pole within the pit itself. Some hunters, however, roast a dog to attract the vultures (Cetti 1776, pp. 26-27). Montillot (1891, p. 10) adds that the hunters hide in a pit 50 cm deep, 2 m long and 70 cm wide. Because of the pressing demand of feathers, it cannot be excluded that carcass poisoning was also used, as is the case today (Ogada et alii 2012), or that vultures were even captured while intent on feeding on corpses that fell in battle.

The places where vultures were caught (Table 3) are listed in two documents of the AC, one dated 15 Sept 1281 (Mazzoleni J and Orefice 1978: CVI, 30), the other 10 Dec 1281 (Mazzoleni J and Orefice 1978: CVI, 44).

At present all the places listed fall within the province of Avellino, except Rocchetta Sant'Antonio which is in the province of Foggia. Castles are present in various of the localities, and the landscape is characterized by rolling hills interspersed with valleys. Today, the entire area is scattered with wind turbines (Figure 2).

Table 3. Localities recommended in the orders of the regia *Curia* of 10 Dec 1281 for vulture capture (Mazzoleni J and Orefice 1978: CVI, 30 and 44).

Toponym	Current municipality	Longitude	Latitude	Elevation a.s.l. (m)
Nuscum	Nusco	15.0868	40.8890	914
Guardia Lombardorum	Guardia Lombardi	15.2092	40.9537	998
Bisaccia	Bisaccia	15.3753	41.0145	860
Carbonaria	Aquilonia (old)	15.4882	40.9953	680
Petra Palumba	Aquilonia	15.5530	40.9680	541
Mons Viridis	Monteverde	15.5349	41.0010	740
Rocca Sancti Antimi	Rocchetta Sant'Antonio	15.4575	41.1005	630
Laquaedonia	Lacedonia	15.4236	41.0502	732



Fig. 2. Typical landscape for vulture, characterized by rolling hills interspersed with valleys, today scattered with wind turbines (Monteverde, province of Avellino).

### *Estimation of vultures «ad impennandos quadrellos»*

To reach an estimate of the vultures potentially used in the manufacture of quarrels, it is first necessary to determine how many dart vanes could be produced from a vulture specimen.

The bolt vanes are obtained from the two vanes of the feather vexillum. To ensure a correct flight trajectory, an arrow or bolt must be equipped with feathers coming from the same wing (Leper, Rots 2020).

Crossbow bolt fletching was usually less extensive than that of an arrow, in general, bolts had only two vanes set 180 degrees apart, instead of the three that arrows had (Arnold 1995; De Luca 2003; Gorman 2016). The fletching length is estimated to be between 10 and 15 cm (Leper, Rots 2020).

For the calculation of the number of vanes that can be obtained from one specimen of *A. monachus* or *G. fulvus*, the following points have been considered:

Table 4. Number of vanes (100 mm) obtainable from feathers of a specimen (1 tail and 2 wings).

feather		<i>Gyps fulvus</i>			<i>Aegypius monachus</i>		
type	useful vanes	total length	useful length	quarrel vanes (n°)	total length	useful length	quarrel vanes (n°)
R7	2	344.5	167.5	2	-	-	-
R6	2	352.0	175.0	2	382.0	218.0	4
R5	2	351.0	174.0	2	381.5	217.5	4
R4	2	350.0	173.0	2	380.4	216.4	4
R3	2	356.5	179.5	2	387.5	223.5	4
R2	2	356.0	179.0	2	387.0	223.0	4
R1	2	355.0	178.0	2	385.5	221.5	4
R1	2	355.0	178.0	2	385.5	221.5	4
R2	2	356.0	179.0	2	387.0	223.0	4
R3	2	356.5	179.5	2	387.5	223.5	4
R4	2	350.0	173.0	2	380.5	216.5	4
R5	2	351.0	174.0	2	381.5	217.5	4
R6	2	352.0	175.0	2	382.0	218.0	4
R7	2	344.5	167.5	2	-	-	-
P10	1	424.0	247.0	4	462.0	298.0	4
P9	1	508.5	331.5	6	550.0	386.0	6
P8	1	532.0	355.0	6	578.2	414.2	8
P7	1	551.0	374.0	6	599.0	435.0	8
P6	1	564.5	387.5	6	613.5	449.5	8
P5	1	563.0	386.0	6	611.0	447.0	8
P4	1	519.0	342.0	6	564.0	400.0	8
P3	1	461.0	284.0	4	501.0	337.0	6
P2	1	431.0	254.0	4	468.5	304.5	6
P1	1	418.0	241.0	4	454.5	290.5	4
S1	2	405.0	228.0	8	440.0	276.0	8
S2	2	408.0	231.0	8	443.5	279.5	8
S3	2	413.5	236.5	8	449.5	285.5	8
S4	2	416.0	239.0	8	452.0	288.0	8
S5	2	406.5	229.5	8	442.0	278.0	8
S6	2	406.0	229.0	8	441.5	277.5	8
S7	2	401.5	224.5	8	436.5	272.5	8
S8	2	396.5	219.5	8	431.0	267.0	8
S9	2	392.0	215.0	8	426.0	262.0	8
S10	2	391.5	214.5	8	425.5	261.5	8
S11	2	389.0	212.0	8	423.0	259.0	8
S12	2	386.5	209.5	8	420.0	256.0	8
S13	2	384.5	207.5	8	418.0	254.0	8
S14	2	382.5	205.5	8	415.5	251.5	8
S15	2	386.0	209.0	8	419.0	255.0	8
S16	2	383.5	206.5	8	417.0	253.0	8
S17	2	384.0	207.0	8	417.0	253.0	8
S18	2	382.0	205.0	8	415.5	251.5	8
S19	2	382.0	205.0	8	415.5	251.5	8
S23	2	383.5	206.5	8	417.0	253.0	8
S21	2	382.5	205.5	8	416.0	252.0	8
S22	2	383.5	206.5	8	417.0	253.0	8
S23	2	383.5	206.5	8	417.0	253.0	8
S24	2	383.0	206.0	8	416.5	252.5	8
S25	2	367.5	190.5	4	399.5	235.5	8
S26	2	322.5	145.5	4	-	-	-
S27	2	223.5	46.5	0	-	-	-
				280			314

Legend: R = rectrices; P = primaries; S = secondaries. R7 records for *A. monachus* have not been reported because this species has twelve rectrices only. Average dimensions in mm.

The asymmetry of the primaries: both for *G. fulvus* and for *A. monachus* the primaries (P) have, in our opinion, only one side (inner vane) useful for obtaining vanes; for secondaries (S) and for rectrices (R) it is possible to use both vanes of the vexillum. The remiges must be multiplied by two wings.

- The number of remiges that can be used.
- The length that varies from feather to feather.
- The presence of 12 rectrices for *A. monachus* and 14 for *G. fulvus*.
- The feathers cannot be used in full, the calamus and the distal end of the feathers must be excluded from the estimate, the former because it has no barbs, the latter because the rachis is too thin to be worked and glued to a quarrel.
- For *G. fulvus*, we considered a 77 mm calamus and a 100 mm tip scrap; for *A. monachus* a calamus of 84 mm and a scrap of 80 mm.

It was then estimated how many 100 mm vanes can be obtained for each feather (Table 4). For an individual of *A. monachus* a theoretical maximum of 314 vanes can be obtained, while for an individual of *G. fulvus* 280.

Based on the requests of quarrels gathered from the AC, it can be estimated how many vulture individuals are needed for the fletching. For the calculation, *Curia*'s orders of quarrels where the request included fletching with vulture feathers or, at the least, mixed fletching which included vulture feathers were considered.

Three periods can therefore be established that characterize the demand for quarrels. The first period, from 1266 to 1282, is marked by continuous requests for quarrels to control the territory. The second period starts in 1282, with the beginning of the first phase of the War of the Sicilian Vesper and ends in 1302 with the Peace of Caltabellotta. The third and final period runs from 1302 to 1338 in which the last request for quarrels in the documents of the AC is found. In this period there are no references to vultures, and the requests are for quarrels with fletching of goose feathers (Table 1).

The estimates have excluded the quarrels *de torno*, as they are so large that they cannot be stabilized by any type of natural feather. In fact, they had wooden vanes or sheets of copper or iron (Angelucci 1886, p. 25). The quantities of the quarrels *de torno* are however low: throughout the period considered (1266-1338) a request for 32,590 pieces was found (Table 5).

Table 5. Number of quarrels (one-foot and two-foot) reported in the AC and estimated number of individuals of *A. monachus* and *G. fulvus* needed for fletching.

Period considered (yrs)	quarrels		estimate individuals	
	total requests	fletched also with vulture feathers	<i>Aegyptus monachus</i>	<i>Gyps fulvus</i>
1266-1282 (ca. 16) before WoV	2085585	2085585	13284	14897
1282-1302 (ca. 20) during WoV	2989028	2989028	19038	21350
1302-1338 (ca. 36) after WoV	2175000	–	–	–
1266-1338 (ca. 72)	7249613	5074613	32322	36247

Abbreviations: WoV = War of the Vesper.



Although the estimate is theoretical and approximate, it is confirmed in a document present in the AC dated 9 Sept 1272, in which the *Curia* agrees with the *accillator* of Castrum Capuanum a production of 100,000 quarrels per year and precisely 80,000 one-foot quarrels and 20,000 two-foot ones (Cubellis 1996: XLII, 27). In 72 years, therefore, the production of Castrum Capuanum alone would amount to 7 million 2 hundred thousand quarrels, a quantity very close to that estimated.

### *Discussion*

To understand the reason for choosing vulture feathers to fletch arrows and bolts, we must start from the end, indeed from two centuries after the end. The disappearance of vultures led to the use of other species for fletching but, a few decades after the arrival of Europeans in the Americas, among the various birds observed, the *gallina olorosa* (from the Spanish smelly hen) was considered suitable only “for fletching the arrows and viretons” (Oviedo y Valdés 1534, p. 34). This is the saprophagous species *Coragyps atratus* (Bechstein, 1793), known today with the common name of urubù.

The use of scavengers for arrow-fletching in different historical times suggests that feathers have unique characteristics. What do feathers of birds that differ in size, place and kinship have in common? Possibly, the trophic role of scavengers, which involves long periods of gliding flight and no swooping down to pounce on prey. This makes the feathers of these birds long, resistant and elastic at the right point, more elastic than those of eagles and hawks, which make important swoops, and more rigid than those of the goshawks, which fly among the trees.

This hypothesis is also supported by an unusual use that has been made of vulture feathers by performers of conjuring tricks: when tight, these feathers take up very little space, are very elastic, do not crease, and come back immediately to their shape, and this makes it possible to hide large quantities in the sleeve (Bosco 1873, p. 39).

An early 18th century text indicates that the species of choice was *A. monachus*: «Alie d’avoltoio si vendono a uccello, cioè 2 alie e 1 coda per 1 ucciello, e di 30 penne per alia e di 12 penne per coda se sono appiccate, e se non sono appiccate, si se ne dà 100 penne per un ucciello» (Vulture wings are sold per bird, that is, two wings and one tail for one bird, and 30 feathers per wing and 12 feathers per tail are given if they are pinned, and if they are not pinned, give 100 feathers for one bird. Balducci Pegolotti 1936, pp. 224-225). This would make it clear that the marketed species is *A. monachus*, having 12 rectrices compared to *G. fulvus* which has 14. Another important piece of information is that if the feathers are not ‘pinned’ to the wings and tail, 100 are required for one individual to be counted (Balducci Pegolotti 1936, pp. 224-225).

In fact, for the purposes of quarrel production the important feathers are the 12 rectrices, the 10 primaries and the 25 secondaries for two wings, for a total of 82 feathers, but the others would certainly have been used for ornamental or medical purposes. The integrity of the feathers sold ‘pinned’ would have paid off even if fewer than 100.

The estimate of the vulture individuals killed based on the number of quarrels requested by the Angevin *Curia* has various limits, among which we mention: i) it is



not possible to distinguish between the use of the two vulture species; ii) during the first (1266-1282) and the second period (1282-1302) considered, other species such as cranes, bustards and even more generally large birds were also requested as possible alternatives; iii) different quarrel characteristics (e.g. longer fledging) could modify the estimate.

However, it must be considered that, given the high number of requests, it is believed that the *tenditores* did not exclude *G. fulvus* from captures and that the *accilatores* did not complain too much when receiving feathers. The Angevin *Curia*, in fact, was ready to impose sanctions in case of non-compliance; moreover, applying the principle of parsimony, also known as Occam's razor, one might wonder why feathers of other birds should be used if vulture feathers, being still available, were better. Regarding the characteristics of the quarrels, possible variations could only increase the number of feathers needed. In addition to these reasons, there are several other elements by which we suspect that the limits of the analysis described above may result in an underestimate of the number of vultures killed. The main factors which make an underestimation likely are:

- i) The incompleteness of the AC, considering that only about a half of the documents was recovered (Mazzoleni J 1987).
- ii) The fact that during their lifetime, individuals are subject to feather molting. It is observed that from the second year *A. monachus* begins to change the primary remiges and in the following years presents more than one front of molt. The molt for specimens of Greece and Spain begins in spring (May) and stops in the following autumn (Oct) (de la Puente, Elorriaga 2012). Other studies state that the molting process is also similar in *G. fulvus* and that it occurs not only for the primaries but for all other feathers as well (Zuberogoitia et alii 2013). Any damage to the feathers that would make them unfit in the preparation of quarrels must also be considered.
- iii) When individuals were hunted during hatching or the parental care period, it was not only the captured adults that perished, but also the new generation. *A. monachus*, in fact, mates once a year (Oct-Nov), incubates from Jan to Apr, and for about 160 days the parents feed the juveniles. Considering that it takes between 4 and 5 years to reach sexual maturity and that only one egg is usually fertilized in each season, killing the adults certainly compromises the survival of the new generation (Heredia 1996; Skartsi et alii 2008; Vasilakis et alii 2008). Similar is the condition of *G. fulvus* (Xirouchakis 2010). In addition, when populations are reduced, slow reproduction rates make recovery difficult (van Dooren 2011; Ogada et alii 2012). Reduction of the number of individuals also results in the well-known problems suffered by small populations (encounter rate, inbreeding, etc.), and, eventually, numbers of individuals below the minimum viable population are reached.
- iiii) The length of bolt-vanes could be more than 10 cm especially for two-foot quarrels.
- v) Scrap and production waste, which cannot be measured.
- vi) The estimates indicated above were made only for quarrels produced by the Angevins!

By processing the data obtained from the AC, in addition to the estimate of individuals killed, other valuable information is obtained. Quarrel production was concentrated in Castrum Capuanum but involved a vast territory around Vesuvius. When coming from the places where quarrels were made, Volturara Irpina, confirming its name, was the gateway to the *Vulturaria tellus*, the vulture hunting area of the Kingdom of Naples. This area, starting from the Piana del Dragone, extended through the hills of Principatus until it reached Monteverde and proceeded North towards Volturara Appula, in Capitanata, and Southeast towards Rionero in Vulture, in Basilicata (Figure 3).



Fig. 3. Quarrel production sites (square) and vulture capture sites (circle). The relevant toponyms (triangle) that fall in the area are also showed. Satellite layer from Google.

The *tenditores* were also dedicated to catching rapacious birds for falconry. Their expertise and techniques had certainly been refined during the reign of Fredericus II, as can be observed by the miniatures in *De arte venandi cum avibus*. Arts and crafts were often transferred from father to son, so when Charles I took the kingdom over, he found already trained professionals, who had contributed to many observations of Fredericus, captures and experiments which showed passion and respect for birdlife. Together with the sovereign, they had found the nests of the monk vulture, discovering that it lays only one egg (Fredericus II *De Arte* I, 100), and, using *ciliatio*, they understood that it was not the sense of smell that attracted the *vultures* towards the corpses, as hitherto believed, but sight (Fredericus II *De Arte* I, 41). We can, therefore, imagine that the *tenditores* had skills to optimize capture and try to take specimens with as many useful feathers as possible. Knowledge of the times and of the hatching period of the vultures may have allowed hunters to avoid leaving orphaned juveniles in the nests, but the pressing and sudden demands certainly did not allow for the scheduling of the catch. Frequent battles, especially during the War of the Vesper, determined requests at all times of the year and with quantities not always fulfilled by vultures

alone. It is evident from the AC documents that the *Curia* constantly asked for vulture feathers, suggested the best localities to take them and put them before those of any other species, continuing to ask for them even after their unavailability. It must therefore be assumed that these requests were fulfilled whenever possible.

From 31 Dec 1266, in the various places of the Kingdom the manufacture of well over 7 million quarrels was ordered. The Angevins, defined by Dante Alighieri «mala signoria» (Alighieri *Paradiso* VIII, 73), to impose their dominion, flooded the whole south of Italy with quarrels, but the most intense period of production and use was during the War of the Sicilian Vesper. Soon, therefore, constant captures caused a decrease in the number of specimens available and, since that time, the royal requests include also other birds with long and resistant feathers; finally, in 1305 requests are made for goose feathers, probably because since bred, was the only species able to ensure the high numbers of vanes requested.

Already between 1284 and 1294 some requests do not mention vultures. Probably in the hectic phases of the War of the Sicilian Vesper no subtlety was allowed about fletching, as all means were acceptable to respond to the Sicilian-Aragonese army.

Between 1294 and 1302 no requests have been detected. If the lack of documents in the AC may be explained with the fact that reconstruction of the archives is not yet complete, the absence of requests from the other sources may testify a real decrease in quarrels production. Since 1302, then, the requests include copious quantities of goose feathers and as noted above, the single document of 3 Jul 1325, which asks for vulture or goose feathers seems more likely an attempt, than a real possibility of having the black feathers.

It should be noted that the Angevin domination of Southern Italy was a consequence of the feud between Guelphs and Ghibellines, a conflict that involved much of the Italian territory and that laid the foundations for the discontent that exploded with the bloody and protracted War of the Vesper, a war fought on several fronts in an all-round conflict. If for Southern Italy the AC contains traces (and only from one faction) of the resources involved and, among these, of the quarrel number, it is likely that the same thing happened in other places. AC can therefore be considered as an indicator of what has probably occurred in the rest of Italy as well.

The War of the Vesper, one of the greatest conflicts of the Middle Ages, the war that divided Southern Italy, which saw foreign armies fighting using the resources of the land, most likely caused the local extinction of vultures and the decline of all the *magna aves*. In addition to thousands of individuals of *Aegypius monachus* and *Gyps fulvus*, a large number of cranes, bustards, eagles, sparrowhawks, and geese lost their lives as well. The desolation left in the avifaunistic heritage finds a laconic testimony in a 1340 locution: «in defectu pennarum avium» (in the absence of bird feathers) the fletching could also be made of paper (Bevere 1897, p. 729).

### Conclusions

Although one cannot attribute with certainty the extinction of vultures in Southern Italy to the pressing Angevin requests for quarrels, this surely was the main cause of

their decline. A significant contribution to vultures' extinction in peninsular Italy has likely been provided also by the other States where fletched bolts with vulture feathers were produced.

The more than 7 million quarrels produced since 1266 resulted not only in the extinction of *Aegypius monachus* and the rarefaction of *Gyps fulvus* but also in the decline of all other species with which they were fletched. This would explain why eagles, bustards, and cranes are also rare or extinct species in Italian territory. In fact, already towards the end of the War of the Sicilian Vesper, fletching with goose feathers were required.

Today, vultures are in danger of extinction from human persecution, urban sprawl, habitat destruction, agriculture intensification, pesticides, power lines, wind turbines and poisoning.

Thanks to the recovery of the AC, which represents a window into time, it was possible to shed light on the causes of vultures' disappearance in Italy.

These birds, fed by transhumance and corpses left on the battlefields, were sought after to fletch bolts, especially crossbow quarrels.

That war which fed them, took their life away!

## **Acknowledgements**

We are much indebted with: Dr. Stefano Palmieri (Secretary General of the Academia Pontaniana and Head of the Reconstruction of the AC project) for historical review, checking of references to AC documents and learned suggestions; Prof. Piergiulio Cappelletti (Director of the Museum Center) and Dr. Roberta Improta (Scientific Director of the Museum of Zoology of the Università degli Studi di Napoli Federico II) for allowing data collection and photographs of bird specimens in their collections; Prof. Paolo Caputo (Director of Botanical Garden of the Università degli Studi di Napoli Federico II) for critical reading of an advanced draft and helpful advice; Dr. Maria Catapano for her advice on the numerous translations from Latin and Greek; Dr. Giovanna Ameno for locating some rare publications; all the scholars who made the AC reconstruction possible.

## **Data Availability**

Most of the data used to support the findings of this study are available from the Accademia Pontaniana.

## **Conflicts of Interest**

The authors have no conflicts of interest to declare.

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Regist. Tribunale di Napoli n. 1629 del 2 aprile 1963  
OFFICINE GRAFICHE FRANCESCO GIANNINI & FIGLI S.P.A.  
Proprietà della testata: Accademia Pontaniana, via Mezzocannone, 8 - 80134 Napoli  
Direttore responsabile: accademico Domenico Conte

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*Finito di stampare nel mese di febbraio 2024*

ISBN: 978-8869063480



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