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ORNITHOARCHAEOLOGY: THE VARIOUS ASPECTS OF THE CLASSIFICATION OF BIRD REMAINS FROM ARCHAEOLOGICAL SITES

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ABSTRACT: Bird remains are regular, though not always abundant, elements in faunal assemblages of archaeological nature. The paper is a theoretical discussion on the importance of these remains from the standpoint of two aspects of their research: feasibility of their identification and reliability of use as palaeoenvironmental indicators.

KEYWORDS: ARCHAEOZOOLOGY, BIRDS, ANALYSIS, IDENTIFICATION, PALAEOENVIRONMENTAL INDICATORS, EUROPE

RESUMEN: Los restos aviares suelen ser componentes regulares, si bien casi nunca abundantes, de las asociaciones faunísticas de naturaleza arqueológica. Este trabajo medita, desde una perspectiva teórica, acerca de dos aspectos relacionados con su estudio: la viabilidad de las identificaciones y su operatividad como indicadores paleoambientales.

PALABRAS CLAVE: ARQUEOZOOLOGIA, AVES, ANALISIS, IDENTIFICACION, INDICADORES PALEOAMBIENTALES, EUROPA

INTRODUCTION: BIRDS AS ARCHAEOLOGICAL TOOLS

Ornithoarchaeology is a promising field of archaeozoological research. Up until the present few bone reports have been exclusively devoted to bird remains and, when so, emphasis was seldomly laid on the non-biological aspects of the assemblages (Bochenski, 1974; Mourer-Chauviré, 1975; Elorza, 1990). One of the reasons for this is the fact that, of all the disciplines that have converged on the analysis of birds from archaeological sites, paleontology is undoubtedly the one with the most pervasive influence. There are historical reasons for this state of affairs. Among these, the restriction of good reference collections to paleontological research units or institutes, either independent or within a museum's superstructure, has played a decisive role in making paleontology such a prominent science within ornithoarchaeology.

Bird remains are not abundant elements of vertebrate taxocenosis and the exceptions known (La Fage, Binagady, Rancho la Brea, etc...) tend to confirm this pattern (Behrensmeyer et al., 1992). On the other hand, birds and their products have been, and still are, locally important resources for hunter-gatherer types of strategies and many species have been raised to symbolic status or regarded as sources of wisdom, courage or beauty. In due time many bird species turned into domesticates (Mason, 1985).

It was the realization of the potential usefulness of these cultural aspects which gave the impetus to ornithoarchaeological research within the last decade or so (Vilette, 1985). Having had no formal training in this field but ample experience in ornithology, I would like to comment upon two mainly biological problems of ornithoarchaeological studies (identification and paleoecological inference of bird remains) from the perspective of an uninitiated, culturally oriented, researcher.

BIRD BONES: A CASE STUDY IN IDENTIFICATION

In principle, the taxonomic determination of bird remains is not different from that of other animal groups and constitutes, contrary to what some authors openly state[1], a complex, non quantifiable process which not only requires a more or less automatic matching between objects, but also demands a careful evaluation of intraspecific vs. interspecific variability plus a knowledge of the reliability of particular osteological features as specific discriminators (Morales, 1989). As is the case with all archaeozoological materials, a comparative collection is absolutely necessary to carry out meaningful work in ornithoarchaeology, and the scarceness in the past of good reference collections has forced many people to either build their own or else turn to another subject[2]. Worse still, the lack of comparative material has also delayed the publication of atlases which, for the European bird faunas, started as late as 1967 (Munich's first thesis on the comparative osteology of European families; see, for a non-exhaustive list of papers, some of the references at the end of this work). Atlases, however, are not a good solution in the case of bird bone identification since, on top of their general drawbacks (i.e. a typological approach to the identification of natural objects, a preferential use of whole bones rather than fragments, etc...), they add new ones which render them impractical.

These additional drawbacks relate to the particulars of avian osteology and avian assemblages. For one thing, though never too abundant, bird assemblages are indeed diverse, in terms of total number of remains per species and, occasionally, in terms of total number of species. This statement is, of course, only meaningful when one compares, for any one site, these two parameters with their equivalent ones in other animal groups (in particular, mammals and molluscs), especially when sediments have been water-sieved or floated. One can readily check this by examining regional studies involving the analysis of many sites (Baird, 1989; Mourer-Chauviré, 1975; Vilette, 1983). Why this pattern is so prevalent is still open to debate, but perhaps the mobility of birds influences the degree to which their capture is unpredictable by comparison with that of less mobile groups. Birds, moreover, are also the most diverse group of terrestrial vertebrates. These contingencies mean that, in order for an atlas of bird bones to be useful, it would either have to include a far higher number of species than is the case for mammals or else specialize itself in single bones, regions or taxonomic groups[3].

The second drawback, avian osteology, is an equally serious one, for in many large groups of birds (i.e., passerines, ducks, etc...) anatomical features tend to be rather homogeneous. In order to resolve a determination one needs to have a minimum acquaintance with the lability or stability of particular features and this, naturally, implies turning away fromtypological classification as much as possible[4].

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(1) - Estévez (1991:61), for example, writes that "The task of taxonomic classification in essentially a mechanical process which only requires a good reference collection ... and to know and compare the relevant features of the item" ("La tarea de clasificación taxonómica es en esencia un proceso mecánico para el cual sólo es preciso tener una buena colección de referencias ... y conocer y comparar los caracteres significativos de la pieza").

(2) - Mourer-Chauviré describes a most common pattern for birds specialists, having started work with a collection (Milne-Edward's) in a very poor state of preservation, then shifting to a more reliable one (Regalia's) before finally deciding to build her own one at Lyon (Mourer-Chauviré, 1975:12).

(3) - This is, in fact, what happens in many cases. Munich's thesis (see bibliography) or works such as that of Moreno (1985, 1986, 1987) concentrate on bird families or orders while works like those of Selstam & Selstam (1975) concentrate on particular bones. The most usual approach is a combination of these two (Miles-Gilbert et al., 1985).

(4) - This being of the reasons why we are so reluctant to acept Bochenski & Tomek's recently defended idea that, in order to identify a bird remain, on most occassions, one specimen is often enough (Bochenski & Tomek, in press).

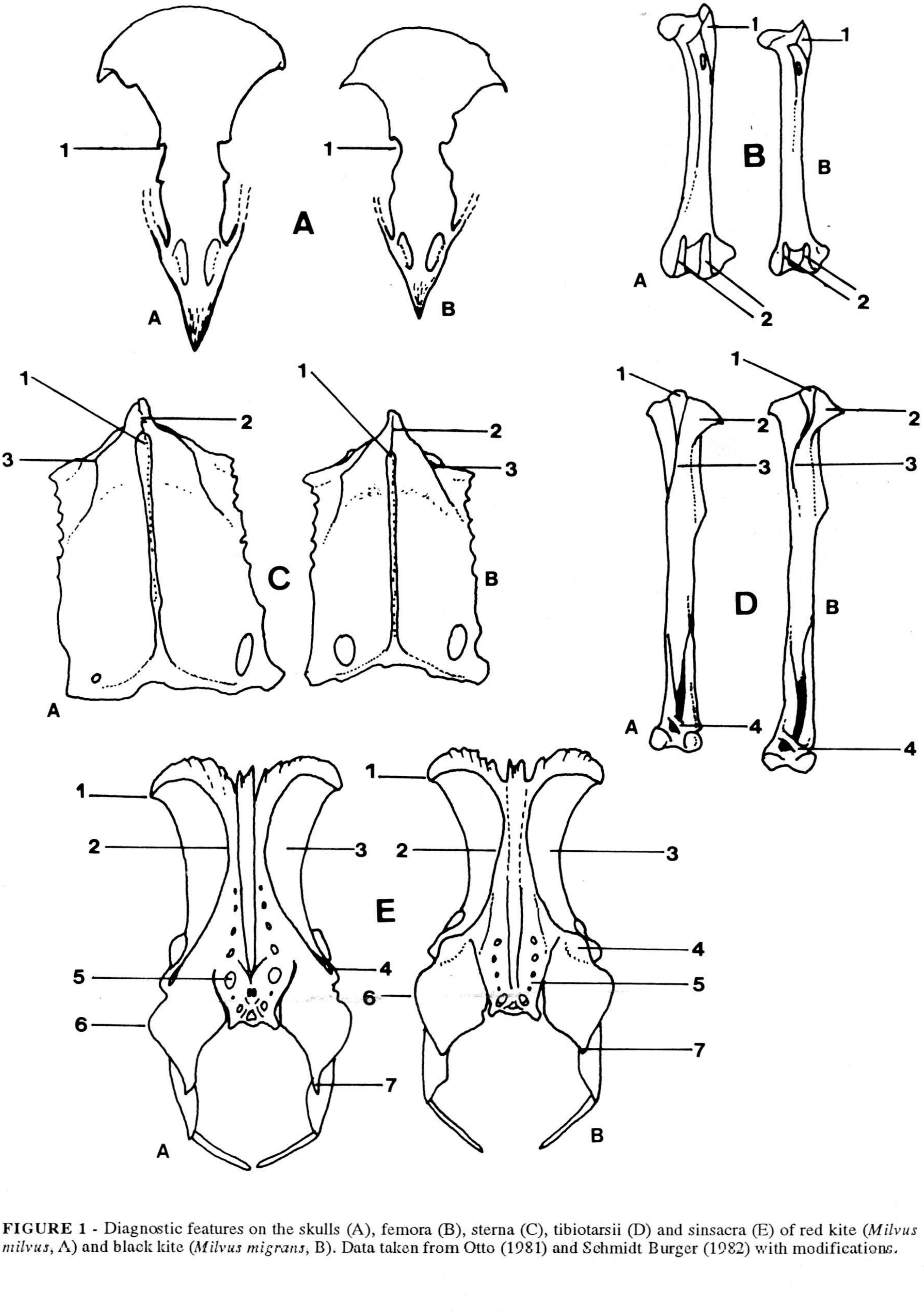

FIGURE 1 - Diagnostic features on the skulls (A), femora (B), sterna (C), tibiotarsii (D) and sinsacra (E) of red kite (*Milvus milvus*, A) and black kite (*Milvus migrans*, B). Data taken from Otto (1981) and Schmidt Burger (1982) with modifications.

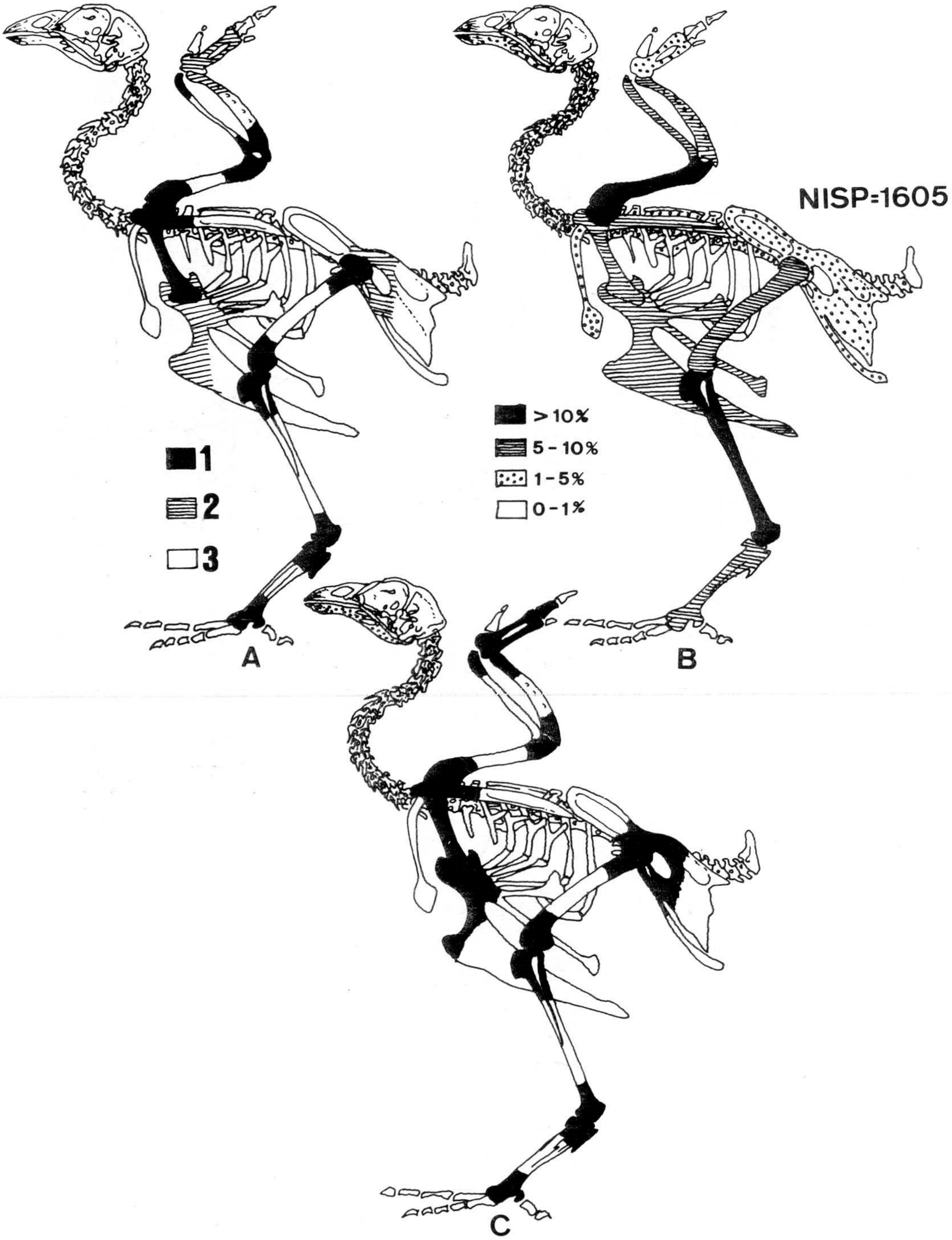

FIGURE 2 - A three-category scale of usefulness of different bone portions from the avian skeleton (1: diagnostic and very frequent element or portion; 2: diagnostic element or portion; 3: neither .... nor ....) (A) based on a combined value of skeletal frequencies from Spanish archaeological assemblages (B) and a qualitative estimation of the most diagnostic osteological elements in birds (C).

Perhaps an example can be more illustrative of this situation. For many years we tended to consider most of the osteological differences between our single comparative specimens of black kite (*Milvus migrans*) and red kite (*Milvus milvus*) as rather good discriminators. Later came the works of Otto (1981) and Schmidt-burger (1982) which considerably reduced our number of discriminant features (Figure 1). Finally we decided to build up our own comparative series for both species realizing then that even some of the characters provided by these two authors can be often shaky. Nowadays most of our kite remains come up in the bone reports as unspecified *Milvus sp.*. To the eyes of the unexperienced observer we have grown clumsier with time!. This example will be also taken in the following section but its lesson is clear enough: beware of character lability even when identifying low-diversity bird taxa!.

When one is not fully aware of these drawbacks, strange things may happen. Thus, while agreeing with Baird's statement that numbers of species identifications in birds in general are higher than is the case with other proxy indicators of environment (he refers to microfloral and micromammalian assemblages in Australia, providing a figure of 64% NISP-identified to species level in birds), one can't help feeling depressed to see that on many French sites 100% of all the bird remains have been classified to species level! (Mourer-Chauviré, 1975; Vilette, 1983). For one thing, not all bird bones are equally "informative" nor are different bone portions (Figure 2). In other cases depression gives way to suspicion. How can one accept the simultaneous occurrence of all three species of buzzards of the genus *Buteo* in a Basque prehistoric site, or that of the rock partridge (*Alectoris cf. graeca*) and the barbary partridge (*A. barbara*) in early postglacial sites in Catalonia, without a single reference in the text to such a peculiar association? (Elorza, 1990; Vilette, 1983). These cases, together with similar ones (i.e. systematic identification of thrushes (*Turdus sp.*) to species level, etc...) make one wonder if other researchers have been misled by intraspecific variation of bird bones to the extent that we have been in some instances.

With atlases or with reference collections, the fact remains that some species can be anatomically identified with almost any element in their skeleton (i.e. gannet (*Sula bassana*) while many others (i.e. ducks, passerines) can, with difficulties, be classified down to species level with much fewer whole bones (i.e. humerus, coracoid). From this perspective it would be methodologically unsound to evaluate an assemblage's diversity by simple, unponderated, calculation of NISP and still more dangerous to turn these NISP into MNI and consider these modified NISP (or, worse still, their percentages) as measures of abundance in order to infer hunting strategies, paleoenviroments, etc... . This is a point which many authors who regularly use MNI do not comment upon, but which could lead to a lot of erroneous hypothesizing as so many authors, have repeatedly stressed (Mourer-Chauviré, 1975; Vilette, 1983; Grayson, 1984; Estévez, 1991).

Anatomical and taxonomical determination is a time-consuming process. If one does not know where to place emphasis, the analysis might require an effort which, in terms of the quality of information retrieved, might not be worth the trouble. Hesse & Wapnish (1985:69) provide some guidelines which should help people in organizing themselves. Two of their recomendations [no. 3 (i.e. "several taxa might tell the same tale") and no. 4 (i.e. "general categories may be adequate for estimating diversity")] are invoking the phenomenon of partial (i.e. incomplete) identification as a means of sparing needless (or, at least, not so productive) effort and deserve some coment from the standpoint of ornithoarchaeological analysis.

In the case of diversity estimation, one should always bear in mind that bird remains are usually scarce in anthropic sites (thus with a very low NISP/MNI ratio) and very seldom appear as whole skeletons (Figure 2; but see also Figure 3). In such instances the chances are high that different species will have different skeletal spectra and that, for any single bone category, few species will coincide (Mourer-Chauviré, 1983; Ericsson, 1987; Livingston, 1989). How then would one possibly know if a raptor scapula belongs to the same taxon of a raptor coracoid if it was not by identifying both bones all the way down to species (or, perhaps, genus) level? "general categories" (i.e. raptors, waterfowl, etc...) are of little use in measurements of diversity, and the same applies if by general categories one is referring to the upper levels of the taxonomic hierarchy (i.e. families and orders). Even if one could sort out 5 morphotypes of raptor scapulae, chances are that one would need to check whether these corresponded to intraspecific or interspecific variability cases. Estimating diversity with taxa of unknown identity is only acceptable where unknown taxa are, at least, positively known to be something different from the remaining ones. To establish that 5 taxa of raptors are present on a site is probably not such a long way from establishing that those 5 taxa correspond to 5 different species/genera even though some of these remained unknown (providing you're working with a reference collection!)[5].

If one now entertains the idea that "several taxa might tell the same tale" one rapidly discovers that life is never so easy, at least for an ornithoarchaeologist. Most biological "tales" are far from a straightforward "all or none" business, so, that when Hesse & Wapnish write that a few species of migratory ducks may document the season of occupation of a site "without laborious examination of all avian bones" one can't help thinking about contexts and the species involved. Would these belong to the group of partial or facultative migrants? where is the site located and how old is it? if the species are not target species, unequivocal indicators of migration having taken place, there would be a need to contrast these results with concordant data in other groups of fauna, birds included. In anthropic sites, moreover, one has to account for human interference (i.e. perhaps birds had been transported from somewhere else; perhaps people were just collecting and using their feathers and bones came as an occasional by product of the activity of skinning carcasses, etc...). All this leads us into another facet of archaeozoological identification.

From the strictly anthropological standpoint, as important as the anatomical/taxonomical determination of the remains would be a taphonomical classification of the specimens. Gautier's "taphonomic groups" provide a useful framework of research but small samples might provide us with, at best, a rough determination of groups (domestic, commensal, hunted, etc...) (Gautier, 1987). Larger samples, on the other hand, usually offer the possibility of checking for signs which will allow a more precise classification of bones according to their taphonomic histories. When this possibility is enhanced by the use of complementary data, one can sometimes witness the extent to which conventional (i.e. anatomical/taxonomical) determinations disagree with taphonomical ones (Figure 3). In the case of the medieval site of Calatrava, for example, it was very clear that domestic fowl (*Gallus gallus*) belonged to different categories according to their taphonomy: (1) consumed specimens (burned, with intentional fracturing, cutmarks and gnaw marks) and (2) corpses (articulated skeletons with no manipulative traces whatsoever) indicating a rapid episode of killing and burial which, with the help of documentary evidence, we believe can be traced back to the storming of the Muslim city by Christian troops in August 1212 AD (Morales et al., in prep.).

Obviously, there is more to archaeozoological determination than just taxonomy and anatomy. For the reasons previously outlined, a good reference collection needs something more than just

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(5) - There are, of course, more sound "ecological" reasons for rejecting the argument that "general categories may be adequate for estimating diversity" (Magurran, 1988).

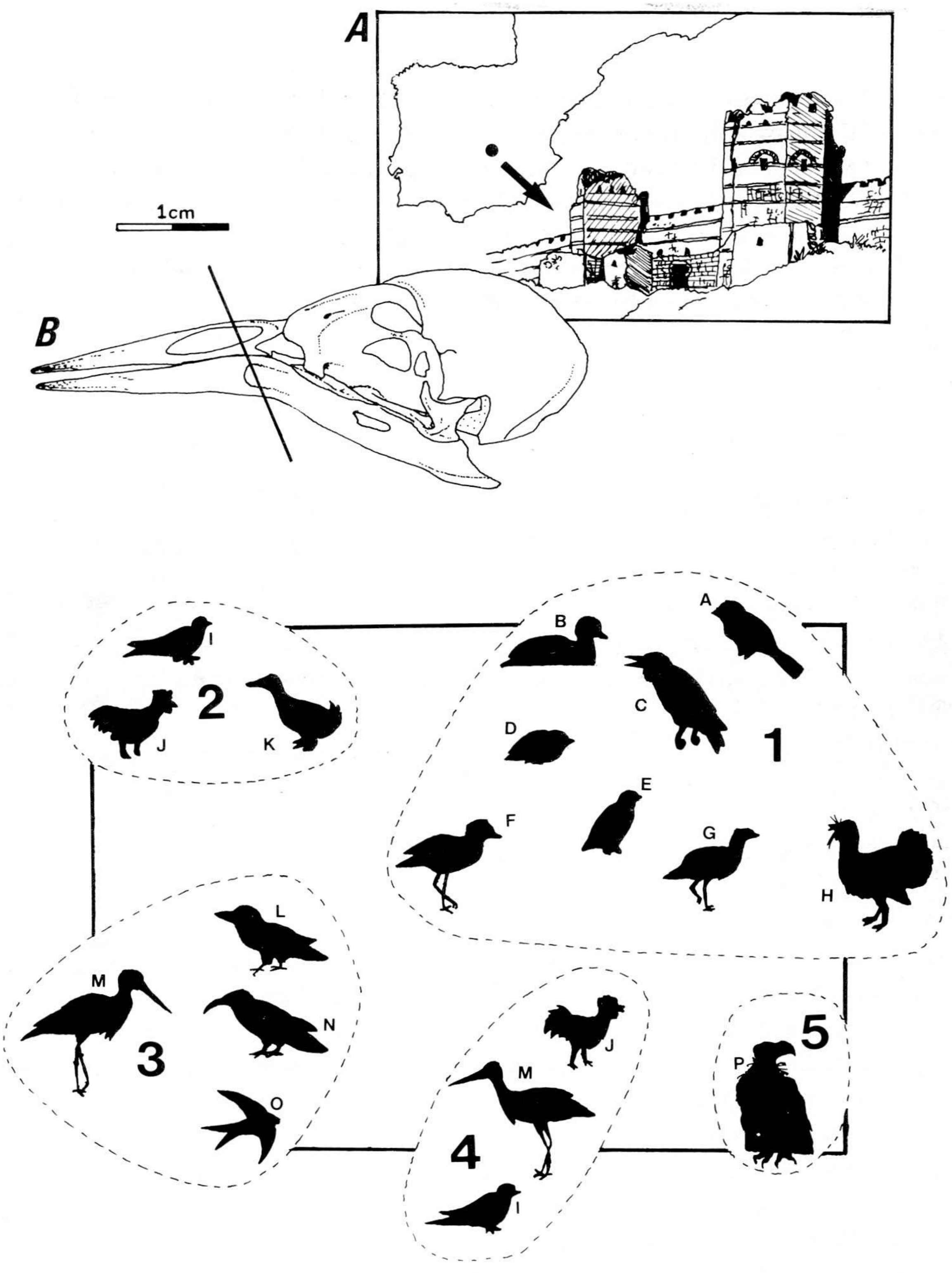

FIGURE 3 - A taphonomical classification of the bird assemblage from the Muslim city of Calatrava La Vieja (prov. Ciudad Real, Southern Spain) (A). 1: hunted taxa; 2: domesticates; 3: urban birds; 4: corpses; 5: taxa of uncertain taphonomic origin. Taxa codes are as follows: A: *Miliaria calandra*; B: *Fulica atra*; C: *Sturnus spp.*; D: *Coturnix coturnix*; E: *Alectoris rufa*; F: *Burhinus oedicnemus*; G: *Tetrax tetrax*; H: *Otis tarda*; I: *Columba livia*; J: *Gallus gallus f. domestica*; K: *Anas platyrhynchos f. domestica*; L: *Corvus monedula*; M: *Ciconia ciconia*; N: *Pyrrhocorax pyrrhocorax*; O: *Hirundo rustica*; P: *Aegypius monachus*. Though the assignment of certain taxa to a particular taphonomic group is, in view of scarce or conflicting osteological information, occasionally uncertain, the taphonomical analysis reveals data of unusual relevance in taxonomical/anatomical determinations. In Calatrava, for example, industrial processing of starlings is revealed by a series of specific fractures of the skeleton such as the systematic oblique chopmarks to remove their bills (B). Data taken from Aguilar (1991) and Morales et al. (in preparation).

complete adult specimens of a selection of species. All the possible species must be available for comparisons, if trustworthy identifications are to be made. In the case of avian remains, the osteological sample should require the presence of males and females, chicks and juvenile birds (occasionally the target groups of human exploitation) as well as bones of animals which have been naturally or experimentally cut, fractured, burned, chewed, preyed upon or digested. Whole and broken eggshells[6] and loose feathers would also be welcome items. Unfortunately, most official reference collections are not interested in such a wide array of "leftovers". Bad news for ornithoarchaeologists! ....

BIRDS AS PALEOECOLOGICAL INDICATORS

The use of birds as paleoecological indicators is based upon the concept of modern analogues and constitutes another way of classifying them. The fragmentary nature of most anthropic assemblages precludes the retrieval of complete avian communities, so ornithoarchaeologists must work only with partial analogues (i.e. the combined environmental data provided by the taxa recovered). The feasibility of paleoenvironmental reconstructions will thus directly depend on the number of partial analogues involved and on the quality and quantity of the information provided by them (Baird, 1989).

Though partial analogues will be unable to determine a series of features of former environments (i.e. trophic chains, population densities, etc...), ornithoarchaeologists are more specifically concerned with certain aspects of the interrelationship between man and birds (i.e., changes in geographical ranges, cropping strategies, habitats exploited, etc...).

In principle, birds constitute optimum subjects for paleoecological analysis. This is so, among other things, because:

(1) birds are a highly diversified group with good chances of coming up in archaeological sediments (despite normally low NISP numbers). The number of partial analogues one can potentially take into account is high and this, in turn, gives strength to the inferential process.

(2) The biology of birds is usually well known, even in the case of many exotic species, insuring a degree of confidence in the reconstruction of environments unmatched in the remaining groups of the animal kingdom[7].

(3) The degree of precision in the identification of avian remains is rather high, with 60-100% of all items being classified down to species level (Baird, 1989; Morales & Hernández, unpubl. data; but see comments on this point in the previous section). Since similar species often exhibit different biological habits, this point is of utmost importance and stresses the need for a precise taxonomical determination of the remains.

When relying on analogues, the most important assumption one probably has to make is that: "... the modern distribution of a species indicates all the possible combinations of environmental factors, both physical and biological, that the species can tolerate" (Lundelius, 1983:126). In the view

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(6) - see the paper by Sidell in this same volume on the possibilities of eggshell identification.

(7) - Baird claims that this amount of knowledge is possible because: "... the limits of species in birds may be clearly perceived by humans because both taxa are visually auditory oriented" (Baird, 1989:242). But there might be equally important reasons for this being so (i.e. possibility of studing animals in their natural surroundings).

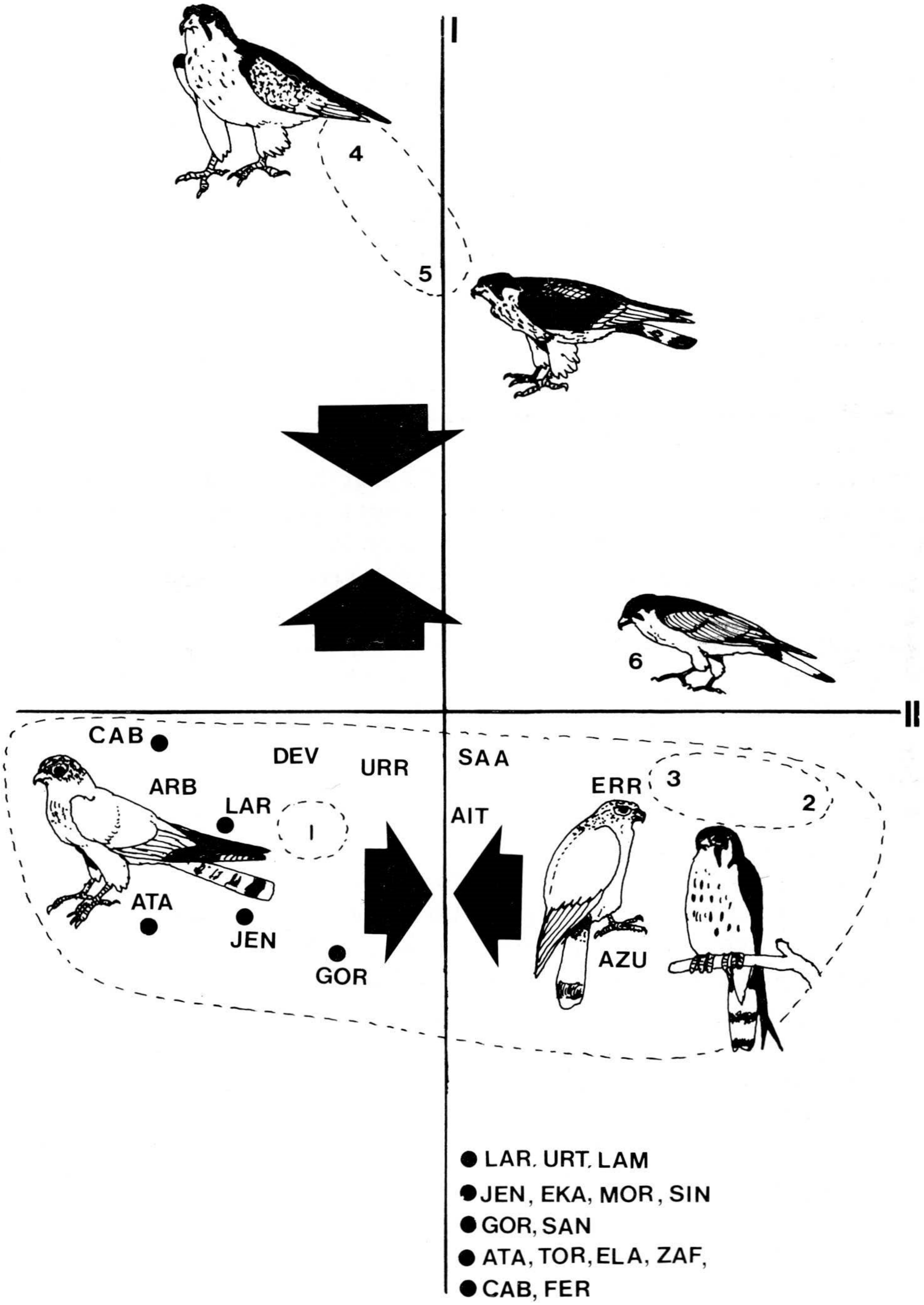

FIGURE 4 - Results from a correspondence analysis confronting taxa from the genus *Falco* with the sites where they have been retrieved. The main confrontation (big arrows) occurs along the first axis (I) between anthropophylous (1: *F. tinnunculus*; 2: *F. naumanni*; 3: *F. subbuteo*) and anthropophobous (4: *F. rusticolus*; 5: *F. peregrinus*) species. A second order confrontation, along the second axis (II) (smaller arrows) segregates year-long residents (1) from aestival breeders (2 & 3) which associate themselves with some paleolithic summer camps (ERR, AZU). Merlins (*F. columbarius*, 6) do not take part in any association due possibly to their low retrieval frequencies. Multiple points, with several sites included, are indicated by black dots (taken, with modifications, from Hernández & Aguilar, in press, where site codes are explained).

of man's impact on the distribution of many species we now know this might not always be the case. Assumptions on the correlation of distribution and structure of the vegetation and concordant changes of vegetation with macroclimate might also be important in this context (Kikkawa, 1968; Nix, 1982; Baird, 1989).

All this theoretical framework is not devoid of drawbacks (we have already mentioned some) but, of course, the most important point is that animals do not behave as automatons. Thus, though most species have preferences for a particular set of environmental parameters, there normally exists a wide range of variation which precludes automatic assignment to, say, a taxonomically specific type of vegetation. Being quite mobile endotherms, birds can change habits and ranges quite fast, sometimes instantaneously (Morales, 1990). Migration is one of the habits that seems to have undergone dramatic changes in the recent past. In fact, many biologists now believe that the whole Holarctic Ethiopian neotropical bird migration system is a recent event in the geological history of the planet, dating back to the start of the Pleistocene glaciations (i.e. 1-1.5 million years) though some authors believe it to be as recent as 10,000-5,000 years (Bernis, 1966; Alerstam, 1990). But we need not go so far back in time: it is within the last 8 years that populations of white storks (*Ciconia ciconia*) have become year round residents in the Iberian Peninsula (Lázaro, 1984; Bernis, 1988). The Sahelian drought as well as the habit of seeking food in refuse dumps have a lot to do with such a change (refuse heaps have become a major source of food in the last 20 years for no less than 20 species of Iberian birds including many gulls and raptors) (Berthold et al., 1992). Even circadian rhythms can change quickly: some kestrel (*Falco naumanni*) populations in Andalusia (S. Spain) forage insects with bats during night hours around the well-lighted monuments of Sevilla (Andrana & Franco, 1974).

All this plasticity casts some doubts on the apparently sensible ecological classifications of avifaunas made by different authors (Voous, 1960).

The problem we can run into is not just one of consistent application of standards nor one of methodological misdoing, but, rather one of adequacy of the inferential basis and one of whether one can, or cannot, test the validity of this inferential basis with the data at hand. The suggestions of the different authors on how to deal with migratory species (discussed in the previous section) exemplify these constraints very clearly (Mourer-Chauviré, 1975:23; Vilette, 1983:62).

It should be obvious that in order to obtain an appropiate paleoenvironmental reconstruction and to reckon ecological features in a bird assemblage in addition to the highest number of reliable items (i.e. taxa)[8] one should also try to obtain as much complementary information as possible. Only from the confrontation of a high number of variables can we hope to see patterns emerging, even though in order to do so one might need the help of multivariate statistics (Figure 4). Pattern interpretation should come afterwards, despite what some authors state (Torres, 1988; Estévez, 1991).

It is hoped that, in the future, we will be able to refine some inferential techniques; however, the refinement of the analogue theory through the analysis of species' ranges, in order to obtain more reliable estimates of rainfall, temperature and vegetation by defining the "bioclimatic envelopes" proposed by Baird (1989:243), is still conditioned by the quality and quantity of the information provided by the partial analogues available today.

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(8) - When one looks at the number of "indicator" species (sensu Vilette, 1983; "target" species sensu Baird, 1989) in the European avifauna one is indeed shoked to discover their appallingly low number. Most European birds can characterize biotopes only in the coarsest of ways (i.e. "woodland", "marine environment", etc...) and, if their distributions correlate with vegetation, they usually do so on a physiognomic basis rather than on a taxonomic one.

CONCLUSIONS

Ornithoarchaeology has a good chance of developing into a separate subdiscipline of archaeozoological studies. Ornithologists have already done an enormous amount of work in describing and quantifying the biology, evolution and behaviour of many species of birds, and many of their theories will have a perfect testing ground in the temporal perspective provided by subfossil samples.

Ornithoarchaeology can not only benefit from this knowledge but can also design a coordinated program of research to create data bases on the distribution of species in the recent past, the impact of human activities on avian populations and the ways in which these activities have shaped the recent microevolutionary dynamics of birds. Such knowledge might prove invaluable for programs of conservation in the future.

It is hoped that the problems outlined in previous parragraphs will contribute to stimulate students and to create the sense of cooperative work for whom this meeting has been a first step.

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