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Abstract: Human consumption of bird meat in modern societies comes in two ways: as embryos -i.e., eggs- and as hatched individuals, either young or adults. Poultry provide nowadays about one-third of the animal proteins and fat in human diets, but the bird-human interface is possibly an ancient one. Hundreds of species are kept as pets and non-edible products, such as feathers or eggshells are used by traditional cultures in all continents as body ornaments, headdresses or jewelry. Regarding early humans, it has been proposed that Neanderthals decorated themselves with raptors and corvid feathers. It is also known that they consumed birds, including pigeons, according to cut marks in bone remains. Even if birds may be perceived as elusive prey due to their flight capabilities, they are forced to incubate their eggs in a fixed position, the nest, where the nestlings grow until they reach full size. This makes eggs, nestlings and brooding adults easy prey. Roosting birds are practically defenseless against stealth predators. And humans may become such when they learn to interpret cues left behind by the birds themselves. Birds share a common sensitive world with humans. Most birds are diurnal as we are, and they rely on visual and auditive cues for communication, that we may learn to interpret, or that we can even imitate.

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We understand that the Corresponding Author is the sole contact for the Editorial process. He/she is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

Signed by all authors as follows:

Juan José Negro
Ruth Blasco
Jordi Rosell
Clive Finlayson

Sevilla, 30th of May 2015

Dear Sir,

Please find enclosed herewith our manuscript entitled **“Potential exploitation of avian resources by early humans: an overview from ethnographic and historical data”** that we submit to be considered for publication in Quaternary International, and that stems for our oral presentation at the “Human-Bird Interaction” symposium held at the UISPP World Conference in Burgos 2014.

Yours sincerely (on behalf of all authors)

A handwritten signature in blue ink, consisting of stylized, overlapping loops and a long horizontal stroke extending to the right.

Juan J. Negro, PhD.

Potential exploitation of avian resources by early humans: an overview from ethnographic and historical data

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Abstract

Human consumption of bird meat in modern societies comes in two ways: as embryos –i.e., eggs- and as hatched individuals, either young or adults. Poultry provide nowadays about one-third of the animal proteins and fat in human diets, but the bird-human interface is possibly an ancient one. Hundreds of species are kept as pets and non-edible products, such as feathers or eggshells are used by traditional cultures in all

continents as body ornaments, headdresses or jewelry. Regarding early humans, it has been proposed that Neanderthals decorated themselves with raptors and corvid feathers. It is also known that they consumed birds, including pigeons, according to cut marks in bone remains. Even if birds may be perceived as elusive prey due to their flight capabilities, they are forced to incubate their eggs in a fixed position, the nest, where the nestlings grow until they reach full size. This makes eggs, nestlings and brooding adults easy prey. Roosting birds are practically defenseless against stealth predators. And humans may become such when they learn to interpret cues left behind by the birds themselves. Birds share a common sensitive world with humans. Most birds are diurnal as we are, and they rely on visual and auditive cues for communication, that we may learn to interpret, or that we can even imitate.

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Raptor, feather, bird egg, Neanderthal diet, ornamentation, bone cut marks.

1. Introduction

Early hominins, and specially Neanderthals, have typically been depicted as hunter-gatherers relying on the capture of large mammalian prey for animal protein and fat acquisition, prey that they would hunt with stone implements or sharpened wooden sticks (e.g., Thieme, 1997; Villa and Lenoir, 2009). Alternatively, these early humans, even if possessing tool-carving abilities, are sometimes described as fearful carrion eaters taking advantage of the partially-eaten remains left behind by large carnivores (e.g., Blumenschine, 1986; Binford, 1984, 1988). Yet there is little reference in the literature to other potential food items of animal origin pre-dating anatomically modern humans (*Homo sapiens*) (Klein 1999), excepting perhaps recent interpretations of bird-product use by Neanderthals in their Eurasian distribution. This may include meat consumption, but also the ornamental use of feathers (Peresani et al. 2011, Finlayson et al. 2012) or of other anatomical parts, such as the talons of large raptors (Morin and Laroulandie 2012, Romandini et al., 2014; Radovicic et al. 2015). Cut marks on pigeon (*Columba livia/oenas*) bone remains found, e.g., in Gibraltar testify that these relatively small birds were a staple prey along millennia for cave-dwelling Neanderthals (Blasco et al. 2014). However, the prevailing paradigm among Palaeolithic archaeologists today is still one which regards flying birds to have been difficult prey to capture and beyond the capabilities of all hominins prior to 50 kya and non-modern hominins, including the Neanderthals, even after the 50 kya threshold (Finlayson et al. 2012).

A majority of bird species are of very small size (the mean body mass for the bird Class is 37 g, and few species weigh more than 1 kg, Blackburn and Gaston 1994), so that, if consumed, many birds may have been eaten on the spot, leaving no trace in archaeological sites. However, birds are ubiquitous in any environment, from deserts to frozen lands at high latitudes or high mountains, and therefore become a potential food reserve for any carnivore including humans.

Here we explore the possible ways in which early humans may have had access to bird products as food or for other applications. We emphasize “access” because birds are considered elusive prey for terrestrial carnivores due to their flight capabilities (Klein

et al. 2001, 2002), but we will also discuss potential uses other than food. To carry out this exercise, we will analyse bird traits that make them susceptible to become the prey of humans, and concurrently we will expose human abilities to detect and hunt birds when they are grounded, by hand or with simple technologies such as clubs.

1.1. Bird use by modern humans

Bird meat consumption in modern societies comes in two ways: as embryos –i.e., eggs- and as hatched individuals, either young or adults. Compared to the available species, about 10,000 in the world (Clements et al. 2014), the number of avian species domesticated for their eggs or meat is however very reduced at a global scale (two galliforms -the chicken and the turkey-, a few waterfowl -geese and ducks-, the pigeon (*Columba livia*) and the Japanese quail (*Coturnix japonica*). Many other species are, however, hunted and eaten regularly. Birds (poultry, mainly farmed chicken) provide today about one-third of the animal proteins and fats contained in human diets (Food and Agriculture Organization 2015), but the interaction among humans and birds is possibly an ancient one, and as such it has remain important until today. Hundreds of species are kept as pets, a few others are used themselves as hunting or fishing weapons (the falconry birds and the cormorants, respectively –citation-), and non-edible products, such as feathers or eggshells are used by traditional cultures in all continents as body ornaments, headdresses, jewelry or as water containers. Etched ostrich eggshell fragments dated 60,000 years BP found in Africa have been interpreted as fragments of water canteens, in the same way as surviving traditional bushmen from the Kalahari use today emptied ostrich (*Struthio camelus*) eggs to store water underground in the desert (Texier et al. 2010).

1.2. Why birds may be an integral part of the diet of early humans

Apart from their presence in all kind of habitats, and therefore co-occurring in all areas inhabited by early humans, birds possess a number of characteristics making them potential dietary items: (a) first of all, they are edible, with only four species out of

10,000 known to be venomous –and this only externally because of poisonous feathers (Dumbacher et al. 2004)-. (b) they are generally non-dangerous behaviourally, excepting the large birds of prey and owls in the adult state, that may attack intruders approaching their nests. (c) a majority of avian species are diurnal, as humans are, so that a temporal coincidence in activity patterns occurs. (d) Except the owls and a handful of nocturnal birds, the vast majority spend the night at roost sites, where they become defenceless. (e) for breeding, and contrary to mammals, most birds attach themselves to nest sites where they lay their eggs and raise their nestlings –the latter applies to altricial or semialtricial species. (f) last, humans share with birds the same sensory world. They are visually oriented animals, with auditive calls following close and, however, showing in general reduced olfactory capabilities, at least compared to mammals (Roper 1999). This may explain why birds cannot easily detect approaching predators by smell and rely almost exclusively on vision for protection.

2. Avian products as food

The easiest edible bird items for a human are the eggs. They are nutritious providing fat, protein, albumin and the essential carotenoids so abundant in the coloured yolk (Surai and Noble 2013). Although fragile, eggs may be transported in a bag or basket and they may be stored for days before they get rotten. Ethnographic examples of wild eggs collection abound both in developed countries and among tribal people. Bird eggs were even collected for the beauty of their shells, and as recently as the late XIXth century and early XXth century –the heyday of oology-, eggers and oologists abounded in western countries (Henderson 2007). Massive gathering of eggs at seabirds colonies is still practised today by local communities in many places, including Madagascar in the southern hemisphere (Le Corre & Bemanaja 2009) or the Faroe islands (Denmark) in the northern hemisphere (Moller 2006). In coastal areas, egg harvesting also include the digging of sea turtle nests, which is still practised at sandy beaches in places like Central America (Campbell et al. 2007). Accounts of seabird eggs for human consumption in California in the XIXth century or in Hawaii until the early XXth century have also been reported (Henderson 2007). More recently and well into the XXth

century, 300,000 eggs of the black-footed penguin were sold annually only on Dassen Island, off the west coast of South Africa (Sparks and Soper 1967). On the Falkland islands (UK) off the Argentinian coast, Gentoo penguins provided large amounts of eggs during the traditional “egging week” -Falklanders were said to consume 61 penguin eggs per head annually (Strange 1981) until recently-. Less known examples include the harvesting of waterfowl eggs in wetlands, such as in current Doñana National Park (southern Spain), where the practice, locally known as “hueveo” (that may be translated as “egging”), was discontinued in the 1960’s once legal protection for the marshes was achieved in the area (Tijeras and Cobo 2013).

Early humans surely found bird eggs at hand whenever they were available (i.e., spring and summer in mid and high latitudes, at the peak of the bird breeding seasons, or anytime of the year in intertropical or equatorial areas). This resource is easy to harvest, as bird colonies are predictable in time and space, the only risk incurred being to descend or climb up to the nest-site if located in rocky outcrops, coastal cliffs or trees. In shallow water marshlands, the harvest would have been straightforward as nest-sites are built over the water among vegetation, barring perhaps the risk of drowning or getting trapped in quick sands. For birds breeding on the ground, such as ostriches or the other ratites -tinamous, rheas, or emus-, galliforms (including partridges, quails and pheasants), or species in the Otidae family (bustards and allies), the only challenge would have been to find the otherwise well camouflaged nest-site.

Once bird eggs hatch, nestlings occupy the nest-site (in altricial or semi-precocial species). The fledgling state, when the juveniles fly from the nest, comes after weeks or even months after hatching, depending on the species-specific pattern of development. Sea petrels, even laying a single egg, stay longer than any other species of similar sizes: several months in the case of the larger albatrosses (Warham 1996). Precisely petrel nestlings, which accumulate thick fat reserves, are coveted by humans for food. In the Canary islands, there is evidence that Cory’s Shearwaters (*Calonectris borealis*) were harvested and eaten by Guanche aboriginals before European colonization took place in the 15th century (Rando et al. 1997) and are still illegally poached (Lopez Darias et al. 2011) by hand at the nest burrow. In the Faroe islands –

with a human population of about 50,000 people-, between 50,000 and 100,000 juvenile fulmars (*Fulmarus glacialis*) are harvested annually (Moller 2006).

Nestlings of any bird species are different to other vertebrates in that they achieve or even surpass adult body mass while still flightless at the nest . From the perspective of an intelligent predator (i.e., a human collector), the optimal hunting strategy in terms of protein and fat return would be to differ the harvest until the nestlings reach maximum size but are still bound to the nest-site.

A variation of the direct nestling harvest at the nest has been practised in Spain at lean times and at large eagle nests (particularly golden eagles, *Aquila chrysaetos*): the prey delivered by the adults –mainly rabbits and hares- was regularly collected by the human hunter by climbing the nest, while the nestlings were left alive (B. Varillas, personal comment).

Last, adult birds are a great potential food resource by themselves. As stated above, flying species are hard to catch during the day, but they spend the night forcibly at roost sites, where they become much more vulnerable. Roost sites tend to be located on places that cannot be easily escalated by nocturnal mammalian predators. As such, roost places are typically on tree-tops, caves, rocky outcrops, cliffs, predator-free islands or directly on water bodies (as waterfowl, flamingos or cranes do). None-the-less, humans, even with no special technology and directly with their bare hands (and brains), are known to overcome these obstacles.

Early ethnographic accounts of aboriginals describe their prowess at capturing different bird species without sophisticated technologies: the Reverend Thomas Bridge described (Bridge 1997), for example, the hunt of cormorants at night by the last Fueguino aboriginals in Tierra del Fuego (around current Ushuaia, Argentina) in the mid XIXth century. These people anchored in the stone age descended seacliffs at night on windy nights to surprise roosting cormorants by hands or using wood clubs. No other technology, except the occasional use of rudimentary ropes, was used . As a curiosity, live trapped cormorants were forced to emit alarm calls that attracted other cormorants which were subsequently clubbed to death by the hunters.

Another account of bird capturing with simple technologies and/or bare hands was given by Price (1939) on Australian aborigines: “they hunted birds of all sizes – emus, turkeys, swans, ducks, parrots and cockatoos. To catch flying birds such as parrots, the Aborigines set nets across trees. Boomerangs were thrown above the flock. Thinking these were hawks, the birds dived down and were caught in the nets. In the summer, hunters would capture ducks by submerging themselves up to their necks in water holes, holding small branches to hide their heads. When a duck came close, the hunter would grasp its legs and drown it.”

Curiously enough, the netting technique described above is still practised nowadays by Basque pigeon hunters. They use flying disks thrown from towers to divert wood pigeon (*Columba palumbus*) flocks to mountain passages where high nets are installed for their capture. This hunting technique has been documented since the XVth century (Leremboure 1950).

Native Americans were also known to hunt eagles alive by digging holes on the ground, and no less than 16 different tribes were known to practice pit-trapping (Wilson 1928), where the hunter would enter the pit before sunrise so that no human activity would be visible to the eagles, and a carcass should be placed on top that would attract the eagles (mainly golden eagles and bald eagles *Haliaeetus leucocephalus*). Eagles were captured by grabbing their talons by hand from the inside. As with the pigeon net-hunting above, this technique is used contemporarily by professional raptor biologists trapping live eagles for marking purposes (Bloom et al. 2007).

Yet another traditional hunting method for birds relying entirely in the skill of the hunter and not so much on technology is to lure them to the hunter imitating their calls with the voice or using leaves or whistles to produce sounds. There are accounts for this hunting method among Native Americans, but also among Maoris in New Zealand at the time of European settlement (<http://www.teara.govt.nz/en/te-tahere-manu-bird-catching/page-5>).

Regarding possible ways of bird meat conservation for future use, there is at least one current example. Inuits from Greenland preserve whole little auks (with feathers and limbs) in the hollowed-out body of a seal. Around 50-500 birds are stuffed at a time,

most of the air is extracted, the seal skin sewn and seal fat is smeared over all over the join, which acts as a repellent to flies. The seal skin is then left under a pile of rocks to ferment for a minimum of three months to a maximum of 18 months. Once fermented, this food known as kiviaq is eaten in the winter time as a delicacy.

(<http://www.bbc.co.uk/blogs/legacy/food/2011/01/rotten-seabirds-for-supper.shtml>).

All these historic and ethnographic examples show the relative simplicity of catching some species of birds if certain behavioral and ecological aspects are known. Thus, it is possible to think that the continued observation of the landscape by Pleistocene human groups could have led them to incorporate birds as a potential source of food. However, although catching birds seems to have had its origins in very ancient times, the evidence is still limited and, in some cases, unclear. The first traces of human consumption of birds date to Early Pleistocene, and correspond to one cut-marked radius of a large-sized bird coming from level TE9a of the Sima del Elefante site (1.2 Ma, Spain) (Huguet et al., 2013), and several incisions on a distal tarsometatarsus also of a large-sized bird from Dursunlu (0.9 Ma, Turkey) (Güleç et al., 2009).

This scarcity of evidence seems to continue during all the pre-Upper Palaeolithic period, with a certain increase at the end of the early Late Pleistocene. One of the oldest examples lies in subunit TD10-1 of the Gran Dolina site (MIS 9, Spain), where some bird bone fragments (two small corvids, one Passeriforme, and one unidentified bird) exhibited cut-marks (Blasco et al., 2013). A different case is observed at the archaeological site of Payre (MIS 8-5, France), where the lithic residue and use-wear analyses showed indirect evidence of the human processing of birds by identifying barbules trapped on artifacts from level G (Hardy and Moncel, 2011). The UA25 of Lazaret Cave (France), on the other hand, yielded one pigeon humerus with cut-marks, among a significant avian accumulation (Roger, 2004). Anthropogenic incisions were also identified on a carpometacarpus of *Cygnus* sp. and a humerus of *Anas* sp. at the Mousterian site of Salzgitter-Lebenstedt (Germany) (Gaudzinski-Windheuser and Niven, 2009), as well as a proximal femur of Golden Eagle and a distal humerus of an indeterminate Falcon from the Middle Palaeolithic context of Les Fieux (France) (Gerbe

et al., 2014) and Noisetier (Morin and Laroulandie, 2012). However, all these evidence seem to be related to occasional events, from which a regular procurement cannot be inferred; although the potential for including these animals as prey should remain.

An exception to the sporadic character of the evidence could be found in the site of Bolomor Cave (MIS 9-5e, Spain), where the processing and consumption of small prey seem to be recurrent along its stratigraphic sequence (Blasco et al., 2013). For example, human-induced damage was observed on eight diving ducks of the genus *Aythya* at level XI (MIS 6) (Blasco and Fernández Peris, 2009), on a humerus of swan (*Cygnus olor*) at level XII (MIS 6-7; Blasco et al., 2010; Blasco and Fernández Peris, 2012a), two coracoides of an indeterminate Galliforme and *Anas* sp., two humeri of Anatidae and Phasianidae, one femur of Phasianidae, five ulnae of *Anas* sp., Phasianidae, and indeterminate Passeriforme at level XVII (MIS 9; Blasco, 2011; Blasco et al., 2013), as well as on 32 bone fragments of different avian species (Passeriformes, Corvidae, Galliformes, Columbidae and Anatidae) at level IV (~MIS 5e; Blasco et al., 2012a, 2012b, Blasco et al., 2013). It is possible that the specific ecological conditions of this site, which is located in an ecotone that combines rugged terrain with wooded vegetation in gullies and areas with mid-mountain slopes and plains in valleys (which possess water resources such as rivers, lakes and lagoons), favored the exploitation of a broad spectrum of resources, including different species of birds (Blasco et al., 2013). Therefore, the case of this locality can be used to infer the human potential to develop strategies to catch flying birds, if available, with a certain degree of regularity since at least the Middle Pleistocene. Another significant case can be found at the end of the period, during the MIS 3, in Gibraltar. In Gorham's Cave, the regular procurement and use of rock doves for food along several stratigraphic layers of the site suggests a strong link between the Neanderthal groups and these animals in this specific geographical area (Blasco et al., 2014). According to these authors, the long relationship of these birds with human groups through the time period could have been favored by several specific behavioral features of these birds, primarily their habit of nesting on cliffs, their colonial and territorial habits, and their high capacity for reproduction, which would make them a sustainable resource.

3. Uses of bird products other than food

Modern humans use feathers as ornaments in all cultures. Whether in headdresses, hats, helmets, clothing or as décor for spears or other implements, feathers have been broadly used in historical times as depicted in paintings and other ancient artworks. One of the best known artworks made out of feathers is Montezuma's headdress, containing Quetzal feathers. It may have been composed several centuries ago at the time of the conquest of Mexico by Cortés and it is still preserved at the Museum of Ethnology in Vienna, attesting that well preserved feathers may last hundreds of years. Nevertheless, these items in direct contact with the ground could be rapidly disintegrated by feather-degrading bacteria in the soil (Grande et al., 2004).

Symbolic or religious value has been attributed to feathers in many cultures, including eagle feathers among Native Americans, feathers from psittacidae among Central and South American aboriginals, the capes and cloaks of Hawaiian royalty, or the Huia feathers inherited through generations of Maoris in New Zealand. And this behaviour seems to be rooted in more ancient times; bones and claws of white-tailed eagles have been found at many Mesolithic and Neolithic sites in Germany, which indicates these large birds may have continued to have symbolic meaning for past communities in Central Europe and, by extension, in other geographical areas (Amkreutz and Corbey 2008).

But, early humans may have also used bird feathers as functional, ornamental and symbolic items. Recently, the hypothesis that Neanderthals exploited birds for the use of their feathers or claws as personal items has been posed. Raptors (Orders Accipitriformes and Falconiformes) and corvids (Family Corvidae in the Order Passeriformes) were among the bird taxa found associated with Neanderthals at Fumane Cave (Peresani et al., 2011) and Rio Secco (Romandini et al., 2014) in Italy, Grotte de l'Hyène (Fiore et al., 2004), Pech de l'Azé (Soressi et al., 2008; Dibble et al., 2009), Combe-Grenal, Les Fieux, (Morin and Laroulandie, 2012) and Mandrin Cave (Romandini et al., 2014) in France, Gorham's and Vanguard Caves in Gibraltar (Finlayson et al., 2012) and Krapina in Croatia (Radovic et al. 2015). All these sites provide evidence of human damage on specific locations of bird skeleton leading to

propose the use of non-edible resources for other purposes beyond feeding. For example, in order to identify the feather removal, we should consider that if the processing of raptors and corvids by Neanderthals had been related to consumption, then it would have expected a concentration of anthropic marks in parts of the anatomy linked to the fleshy regions of the body (e.g. the sternum, which holds the large pectoral muscles, and the femur). Instead, it is the wing bones, low in meat but anchors for the large flight feathers, which were processed. The overrepresentation of raptor and corvid wing bones with clear anthropogenic modifications has therefore been interpreted as related to the procurement of feathers for non-alimentary purposes (Peresani et al., 2011; Finlayson et al. 2012), in the same way than the cut marks and specific polishes on talons have been interpreted as related to the procurement of claws for ornamentation (e.g., Morin and Laroulandie, 2012, Radovic et al. 2015). It is worth mentioning the case of the Krapina Neanderthal in present-day Croatia, since eight white-tailed eagle (*Haliaeetus albicilla*) talons were found together, dating to approximately 130 kyrs ago. They, in addition to incisions, exhibit edge smoothing of the cuts, surface abrasion and small nicks, which have been interpreted as an early example of jewellery, as they could have been part of an used bracelet or necklace, predating the arrival of anatomically modern humans in Europe (Radovic et al. 2015). Although in Krapina, the authors propose the hypothesis of capture from the presence of at least three individuals in the same deposit (Radovic et al., 2015), the acquisition of talons in other localities could have been conducted both processing freshly hunted bird and/or collecting on an already dead individual (Morin and Laroulandie, 2012, Romandini et al., 2014).

Last, it cannot be discarded that early humans used feathers for one of their primary uses in the birds themselves: thermal insulation. The duvet comforter is still one of the best possible bed covers, but it may have been copied from incubating or brooding birds by humans of any time period, who possibly observed how numerous bird species lined their nests with feathers for insulation. Down remains have been found in Viking boats sunk and preserved in mud, and written records of Eider (*Somateria mollissima*) down collection extend back 900 years in Iceland (Walton and Coulson 2015).

4. Conclusions

The bird-human interface is possibly an ancient one. Birds are edible, and particularly at the egg or nestling stage, they are easy to catch if their behaviour is known. Birds are widespread in any landscape, their nest-sites are often conspicuous and their contents are seasonally predictable. Birds do not pose dangers to humans, contrary to many mammals or snakes and lizards, which bite or may even kill humans. Prior to domestication, wild birds may have been important in human diets as backup resources, as they remain today for many peoples in different continents (e.g., Whytock et al. 2014), including developed countries.

The prevailing paradigm stating that the systematic exploitation of flying birds for food is considered to be a hallmark of behavioural modernity, exclusive to anatomically modern *Homo sapiens* after 50 ka, is being challenged with the recent findings of bird remains at Neanderthal sites showing human-induced damage, such as cut-marks, intentional bone breakage (e.g., peeling), burning patterns and human tooth marks. Thus, birds may have been a sporadic or regular component in the diets of early humans, including non-modern ones. Those same non-modern humans and the peoples who replaced them in Europe starting 40 ka, seemingly also collected bird remains –feathers and talons- for symbolic use (e.g., Peresani et al., 2011; Finlayson et al., 2012; Morin and Laroulandie, 2012; Romandini et al., 2014; Radovic et al., 2015), but they also consumed birds, such as the ubiquitous rock dove, for protracted periods of time (e.g., Roger, 2004; Blasco et al., 2013, 2014).

Although the evidence stands up for a processing and consumption of birds in early periods, other Pleistocene sites support the hypothesis of non-anthropogenic avian bone accumulations in Middle Palaeolithic contexts, suggesting a complex scenario in which foraging strategies seem to be more diverse than previously thought.

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