Short communication

Association of *Pica* magpies with grazing ungulates: a clue to the genus' origins

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Abstract - The habits of *Pica* in the less man-modified of its various habitats and its similarities with the closely related *Ptilostomus* suggest that association with wild ungulates has been crucial in the evolution of the genus. The shape and colours of (sub-)tropical forest ancestors may have served as pre-adaptations for the association with steppe ungulates in periods of colder and drier climate in south-eastern Asia, within the present-day range of the basal form of *sericea*. Subsequently, through symbiosis with several ungulate species, *Pica* may have reached a Holarctic distribution. Retention of the ancestral traits may have permitted *Pica* to re-adapt to milder climates at the margins of its range, and thus produce ecologically different, though morphologically still similar, populations. Its flexible association with large mammals, mainly used as indirect food sources, may finally have led *Pica* to adapt to life with humans, even in largely artificial environments, provided that they still offered some short grass to forage in.

Key words: *Pica*, morphology, steppe, ungulates, symbiosis, phylogeny.

Riassunto - Associazione delle gazze *Pica* a ungulati brucanti: un suggerimento per le origini del genere.

I modi di vita delle varie forme (di classificazione ancora incerta) delle gazze del genere *Pica* negli habitat meno modificati dall'uomo e le somiglianze con il Piapiac *Ptilostomus afer*, corvide africano strettamente legato ai grandi erbivori di savana, suggeriscono che nell'evoluzione di *Pica* sia stata cruciale l'associazione a ungulati, attualmente utilizzati in vari modi: punti di osservazione per individuare dall'alto piccole prede al suolo, ricerca di ectoparassiti e alimentazione diretta su ferite e cadaveri. La coda lunga (organo di equilibrio) e la colorazione vistosa (possibile segnale anche interspecifico) suggeriscono che caratteri derivati da antenati di foresta (sub)tropicale siano serviti come preadattamenti per associarsi a ungulati di steppa in climi successivamente più freddi e secchi nell'Asia sudorientale, entro l'areale odierno della forma *sericea*, che include alcuni genotipi probabilmente alla base di tutto il genere. Grazie alla simbiosi con ungulati, *Pica* potrebbe avere conseguito l'attuale distribuzione geografica, mentre la conservazione di alcuni caratteri ancestrali potrebbe aver permesso un riadattamento a climi più miti ai margini dell'areale. L'associazione flessibile con grandi erbivori potrebbe infine aver condotto *Pica* ad adattarsi all'uomo perfino in ambienti molto artificiali, ma ancora con almeno un elemento di habitat naturale: erba corta in cui cercare cibo.

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Distributed from whole Europe and North-West Africa to Kamchatka, Russian Far East, South China and parts of North America, the genus *Pica* is unique in the crow family for combining a variety of habitats with a substantial uniformity in morphology. Morphological (and perhaps more often geographical) considerations have produced a few subdivisions within this genus, but molecular analysis (Lee *et al.*, 2003; Haring *et al.*, 2007) suggests that this classification is inaccurate both at the species and the subspecies levels. Therefore, when dealing with *Pica* "forms" relevant to this paper, which is aimed at explaining general traits of a monophyletic genus, I shall avoid both binomials and trinomials, only using the last name of the relevant taxon.

In contrast with the Holarctic distribution, the shape and colours of these magpies are rather reminiscent of tropical birds. Their habitats (photographs in Birkhead, 1991) seem to have little in common as for the complex vegetation, from bramble bush few centimetres off the ground to clumps of mistletoe in tall trees, where they hide their otherwise conspicuous nests, but some rather short grass, where they prey on small animals, is a constant feature. Even in urban environments (Kang *et al.*, 2012) their preferred habitats include grass patches, where grass is usually kept short by humans. The rounded wings, long graduated tail and bold coloration recall the several other corvids that keep traces of a magpie-like appearance both in their scientific and common names, especially the *Urocissa* "magpies" of tropical and subtropical south-eastern Asia. However, all of these birds are phylogenically rather distant from *Pica* (Ericson *et al.*, 2005) and inhabit more wooded areas. A more sustained flight and a usually walking, instead of hopping, gait on the ground are obvious adaptations of *Pica* to more open spaces. The walking gait and connected preference for foraging in short grass have apparently never been related to the frequently observed association with grazing ungulates.

The Piapiac *Ptilostomus afer*, of a monotypic genus phylogenically close to *Pica* (Ericson *et al.*, 2005), similarly occurs in grassland with clumps of taller vegetation and associates with grazing ungulates. In both cases, un-

gulates offer food through the ectoparasites on the mammal's body and the many small animals that can be caught from the ground nearby, because both occurrence and detectability of the latter is favoured by the presence and movements of a grazer. *Ptilostomus* features a strange tail, as long and graduated as in a "magpie" but pointed and stiff like the shorter tail of *Buphagus*, the oxpeckers, probable competitors of *Ptilostomus* in foraging association with ungulates (Londei, 2016). The longer tail of *Ptilostomus* equally serves as a third leg to improve the equilibrium of a longer-legged bird on a moving ungulate. The long tail of *Pica* is usually understood as an adaptation to dodging flight amidst dense vegetation and as a display organ, two obvious tail functions in the aforesaid, magpie-like more arboreal corvids. However, the comparatively stiffer (rather *Ptilostomus*-like) tail of *Pica* may have an additional function, that of a balancing organ to stand on large mammals. Studies of the "variable honest information on quality" the tail of *Pica* may give (Blanco & de la Puente, 2002) should include this possibility, too.

Maybe because the "Common Magpie" is often associated with man in heavily altered environments in Europe, the association of *Pica* with grazing ungulates has apparently never been addressed as a possible reason for the wide distribution of the genus. The following understudied Italian case suggests that even European birds may easily revert to more natural living conditions. Magpies have long been absent from Sardinia, the second largest Mediterranean island. Introduced *Pica* magpies of unsure origin, but with morphological traits of the European form *galliae* (pers. obs.), were discovered in 1982 (Torre & Delitala, 1983) on the Asinara, a 51-km^2 island close to the north-western tip of the Sardinian mainland. The Asinara has few human settlements since the end of the 19th century, because it was first a quarantine location, later a prison and is now a natural reserve, with bushy vegetation dominant over grass. Through an adjacent peninsula *Pica* entered the Sardinian mainland in the 1980s, but it is still rather confined to near the coast, where pasture prevails over cultivated fields, contrary to further inland. I surveyed the Asinara in April 2007 and obtained sightings in seven sites: within 100 m from the birds, one site included human habitations, four included at least one of the ungulate species of the reserve (feral donkey *Equus asinus*, wild boar *Sus scrofa*, or mouflon *Ovis musimon*) and three had a prevalence of grass over bush. During surveys of the Sardinian mainland, in April 2007 and January 2011, I obtained similar habitat preferences from a total of 15 sighting sites: only two sites included human habitations, 11 included free-ranging domestic ungulates and 12 had grass prevailing over bush. These few data suggest a magpie preference to live near free-living ungulates than near humans.

Ancient living conditions of *Pica* may still occur in *hudsonia*, the more widespread and morphologically conservative form of the North American two. Accepting that they had common ancestors in birds crossing the Bering land bridge (Lee *et al.*, 2003) and that, in modern times, a retreat of *hudsonia* from many parts of its former range was caused by the demise of the bison *Bison bison* (Houston, 1977 and Smith, 1996 in Trost, 1999), it is reasonable to assume that *Pica* reached North America in association with ungulates. Its habit of gleaning ticks from various North American ungulates suggests a symbiotic, somewhat mutualistic association. Samuel & Welch (1991) experimentally showed the tendency of naive birds to cache blood-engorged ticks and hypothesized a less mutualistic association with the moose *Alces alces*, to the advantage of the birds: the cached ticks forgotten by the birds would be favoured in winter survival and multiply in spring, thus producing a double source of food, new ticks and the carcasses of the moose dead from tick-related problems. Anecdotal accounts from the days of the Wild West (Linsdale, 1937 in Birkhead, 1991) depict magpies as a serious problem for farmers and mule-packers, as abundant birds would be used to attack their animals, enlarging existing wounds even to the victim's death and consumption. Therefore, no matter whether mutualistic or parasitic, the association of *Pica* with ungulates would be a substantial one. Assuming enough mutualism, a further uninvestigated possibility would be that the bold coloration of *Pica*, originally perhaps only a means for intraspecific recognition among forest birds, later also served to be easily recognized as a beneficial bird by mammals. Interestingly, the less conspicuous, overall dark *Ptilostomus* has a light-coloured wing panel which flashes up surprisingly bright during flight. Madge & Burn (1994) remarked the Piapiac's "appearance of having two-toned wings in flight, especially if seen from below and against the light", which is just what an ungulate would see of a bird landing on its back. *Pica* shows a similarly translucent wing panel in flight.

Pica may have originated within the present-day range of the form *sericea*, which includes "basal" genotypes of the genus (Lee *et al.*, 2003) and inhabits those parts of China and neighbouring countries that are to some extent reached by the climate-mitigating influence of the sea. Unfortunately, this is a region of man-modified landscapes since long time. Less heavily altered environment is found at the margins of *sericea* range. In Mongolia *sericea* meets *leucoptera* (Eck, 1997), which may be closer than *sericea* to the direct ancestors of both the European and the North American forms (Lee *et al.*, 2003; Haring *et al.*, 2007) and occurs in vast expanses of grassland. Mey (1988) reported that *Pica* was the most frequent bird at temporary yurt camps in central Mongolia. His explanation for such abundance, synanthropy, conflicts with his report of much less occurrence at stable human settlements in the same region. Therefore, in my opinion, *Pica* abundance depended on the presence of domestic ungulates rather than of their owners. The climate of central Mongolia is similar to the "Cold Type Steppe Dry Climate" that Linsdale (1937 in Birkhead, 1991) said characteristic of the habitat of *hudsonia*. While most of the Mongolian grassland, heavily grazed by livestock, is now rather unnatural, protected areas with wild ungulates and (suitably for nesting) a more varied steppe vegetation, may still represent a habitat in which *Pica* evolved (Fig. 1a). It may be worth noting that not only *leucoptera*, but also other Central Asian forms and *hudsonia* all tend to have a higher tail/wing length ratio than several forms, including *sericea*, that live in closer spaces (see Birkhead,

Fig. 1 - *Pica* at habitat extremes: a) a herd of reintroduced Przewalski's horse, *Equus ferus przewalskii*, amidst the varied steppe vegetation of the Hustai Nuruu National Park, Mongolia, with a bird (arrow) taking ectoparasites from the back of a resting horse; b) a bird (arrow) within the city of Milan, Italy, searching for insects in a small patch of short grass surrounded by buildings. The buildings provide *Pica* with possible lookout points, like the backs of ungulates in grazed grassland. (Photo by the author).

1991 and Eck, 1997). Relatively longer tails would appear disadvantageous in more open, windier spaces, unless this was understood as a more advanced stage in the adaptation to ungulates.

During the cold periods of Pleistocene steppe replaced forest in south-eastern China (Kahlke, 1994 in Haring *et al.*, 2007) and thus *Pica* ancestors may have adapted to grassland there. Pollen records suggest that, in glacial periods of the last million years, steppe vegetation comparable to that of present-day Inner Mongolia reached the coast of South China Sea (Sun *et al.*, 2003) and ungulate fossil species from Pleistocene are widespread in China, with steppe typical animals found south-east of the range of their extant relatives (Wu, 1994). As tropical and Subtropical evergreen forest survived in parts of this region during the glacial periods (Sun *et al.*, 2003), the most conservative *Pica* genotypes (in the form *sericea*) may have survived in such refugia, while the genus was expanding to a Holarctic distribution in association with steppe ungulates. More general retention of ancestral traits of a sub-tropical bird may have permitted *Pica* to re-adapt to milder climates at seaside margins of its range, thus producing such distinct forms as *asirensis* of south-west Saudi Arabia and *nuttalli* of south-west USA. Although *Pica* made more progress in symbiosis than did most of the many corvids that occasionally feed on or near ungulates, its specialization was not complete. Its adaptation to interact opportunistically with larger animals as indirect food sources may have favoured *Pica* in approaching people too, from hunting tribes to large towns, so that birds now often nest in man-made artefacts instead of dense vegetation. However, even urban birds require some short-grass areas to plunge in from elevated watching points and catch small prey (Fig. 1b), just as if they were in a primeval steppe grazed by large mammals.

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