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## **Eleonora's Falcons (*Falco eleonora*) hunting for roller dung beetles (*Scarabaeus* sp.)**

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**Abstract** - Coming from an occasional observation in Sardinia, this has been an unusual attempt to identify an insect taxon in images of falcon predatory actions in the air and has resulted in the first report of *Scarabaeus* sp. in the diet of *Falco eleonora*. Provided this is confirmed as a recurrent food choice, Eleonora's Falcons and elsewhere declining dung beetles would share enough distribution and phenology to form a predator-prey relationship worthy of further investigation.

**Key words:** Sardinia, unusual predator-prey relationship, novel survey method, environmental conservation

**Riassunto** - Falchi della regina (*Falco eleonora*) a caccia di scarabei stercorari (*Scarabaeus* sp.).

Derivato da un'osservazione occasionale in Sardegna, questo è stato un inconsueto tentativo di identificare una categoria di insetti in immagini di azioni predatorie di falchi in aria e ha prodotto la prima segnalazione di *Scarabaeus* sp. nella dieta di *Falco eleonora*. Se questa scelta alimentare si confermasse ricorrente, il Falco della regina e alcuni scarabei stercorari, altrove in declino, avrebbero in comune sufficiente distribuzione e fenologia da costituire una relazione predatore-preda meritevole di ulteriori ricerche.

**Parole chiave:** Sardegna, inconsueta relazione preda-predatore, nuovo metodo d'indagine, conservazione dell'ambiente

Eleonora's Falcons *Falco eleonora* have attracted much attention for their spectacular hunts above the sea for the migrating small passerines that approach the cliffs where the falcons are raising their chicks, and for their ability to store such prey. However, during the rest of the year, these falcons mainly eat insects. Insect availability prior to egg-laying can affect clutch size (Xirouchakis et al., 2012) and be important even throughout the breeding season (Xirouchakis et al., 2019). Ristow (2004) highlighted the dependence of Eleonora's Falcons on insects to the extent of proposing that this was

the origin of the species' coloniality. Unfortunately, there are hindrances to paying attention to insect prey. 1) While both the falcons and their bird prey are under the usual conservation attention for birds, most of the insect prey is not of conservation concern. 2) Compared to bird prey, insects are swiftly eaten instead of being carried to the nesting site, and their remnants, found only in pellets, are less informative. 3) Identifying an insect taxon by observing falcons foraging in the air is a difficult task. Some high-quality photographs on the Internet permit an approximate recognition of the hunted insect (not below the family rank), but linking the image to the local insect fauna is out of the usual scope of the photographers. The occasional observation reported here led me to speculate about the possible significance of both the animals involved and the mode of documenting their interaction.

On May 28, 2024, at 9:40 local time, I was on the outskirts of Urzulei, Sardinia, when I noticed several Eleonora's Falcons hunting for flying insects above partly cultivated terrain (40.09°N, 9.51°E, 515 m). I observed their uninterrupted foraging activity for 10 minutes, after which I moved by car for another 15 minutes to reach a vantage point at a higher elevation. There, I had enough field of view to estimate the number of falcons, from 10 to 20, and I observed them for 30 minutes. They showed the same foraging behaviour seen beforehand, although at that time above pastureland (40.10°N, 9.53°E, 737 m). In both cases, I was able to obtain some videos of their hunts by using a "bridge" camera equipped with a 480-mm-equivalent maximum focal length. The falcons employed various techniques to approach the prey (Fig. 1), but in every case, they grabbed it by joining their feet and ate it in more than one bite. This meant rather bulky prey because smaller insects, such as winged ants, are usually captured with only one foot and eaten immediately (Spina, 1992; Ristow, 2004). When I saw them in enlarged video frames, the insects looked like black, compact, and flat beetles with prominent legs and reminded me of the roller dung beetles I had seen flying in nearby places, *Scarabaeus (Ateuchetus) laticollis* and *Scarabaeus typhon*. Both species fly with the elytra nearly closed above the wings, thus maintaining a flat appearance, and the posterior legs extended from the body (Fig. 2). Compared to the larger *typhon*, *laticollis* better fits the size comparison with the feet of the predator in my images, which show the body of the beetle about two-thirds of the length of the middle toe of the falcon. Moreover, *laticollis* is more diurnal than *typhon* (Lumaret, 1990) and probably more abundant in Sardinia, in line with Byk & Piętka's (2018) observation of a "swarm" of *laticollis* near Cuglieri, where "in the afternoon of a sunny May day, hundreds of specimens could be admired in the air and on the ground."

This is the first report of Eleonora's Falcons preying on roller dung beetles (tribe Scarabaeini). Lists of Eleonora's Falcon food include earth-boring dung beetles, identified as Geotrupinae (Ristow, 2004) or *Geotrupes* sp. (Bakour & Moulai, 2019). The entry "Scarabaeidae" in some lists (e.g., Xirouchakis et al., 2019) is insufficiently informative because the family includes a vast array of

beetles, most of which are not dung beetles. Less than 20 km from my observation sites, Eleonora's Falcons regularly breed on the cliffs of the Gulf of Orosei. During a boat trip to Cape Monte Santo 12 days beforehand, I had noticed several falcons flying around cavities in a high rocky wall overlooking the sea (40.06°N, 9.73°E). Moltoni (1971) reported a count of over one hundred birds obtained in the same place on June 25, 1957. Interestingly, he had found Eleonora's Falcons on the slopes of the Gennargentu Massif, which means about 30 km inland, seven and five days beforehand. Although Moltoni's observations and mine probably concerned birds already settled on nesting grounds, their presence inland was in the period of pre-breeding movements (see Kassara et al., 2022 and the literature therein). On the other hand, while performing an August-to-October biennial census of the Orosei colony, Carrai et al. (2003) noticed a tendency of the falcons to head inland rather than to the sea for foraging. Xirouchakis et al. (2019) found that inland predation in Greece took place from mid-July through September, encompassing the falcons' breeding period.

Did I observe a rare, or overlooked, predator-prey relationship? I believe that it passed unnoticed, for two reasons. 1) It might be a locally common occurrence because the Orosei colony is a little-studied one and is near the Gennargentu Massif. In this large and rather wild mountain area, Eleonora's Falcons might enjoy a wider range of feeding opportunities than those that breed on small islets, far from the mainland areas where they may be forced to forage in the pre-breeding period or when passerine migration is weak (see Mellone et al., 2013; Gangoso et al., 2020). 2) Although the roller dung beetles of the Mediterranean region are mainly species of coastal habitats, where Eleonora's Falcons breed, they might have become rare prey because their populations have markedly decreased. Compared to other dung beetles, large-bodied rollers are more affected by veterinary medicinal products because they arrive more quickly at livestock dung and their populations grow at lower rates (Numa et al., 2020). However, if livestock were not managed through drugs polluting the food chain, *Scarabaeus (Ateuchetus) laticollis* might be an especially suitable prey for Eleonora's Falcons, not only for its marked diurnality but also because the adults are active from early spring to late autumn (Lumaret, 1990), encompassing both the pre-breeding and the breeding periods of the falcons. With a general lack of wild ungulates along the Mediterranean coasts, both the abundance and the composition of livestock should be evaluated as the main dung source for this and similar beetles. In the area of the present observations, in addition to widespread sheep, goats, and donkeys, I found small-sized cattle that were roaming freely even in habitats that seemed more typical of goats. Cattle should deserve special consideration because their massive dung stays wet for longer, an advantage for the beetles (see Lumaret & Kirk, 1987). As a first step toward comprehensive research, image identifications such as the one reported here might be useful for understanding in what environment the falcons find dung beetles or other insects in question. It might even be a necessary

step outside the breeding period, when, otherwise, insect remnants should be searched for in the pellet production of wandering birds. In the case of pellet collection at nesting sites, a comparison with the insects being preyed upon might lead to an understanding of how far a particular food source is from the nesting site. Clearly, locating and observing falcons hunting far from a colony would be an energy-consuming task for researchers, but citizen science might help by providing informative images without the need for excessive tools.

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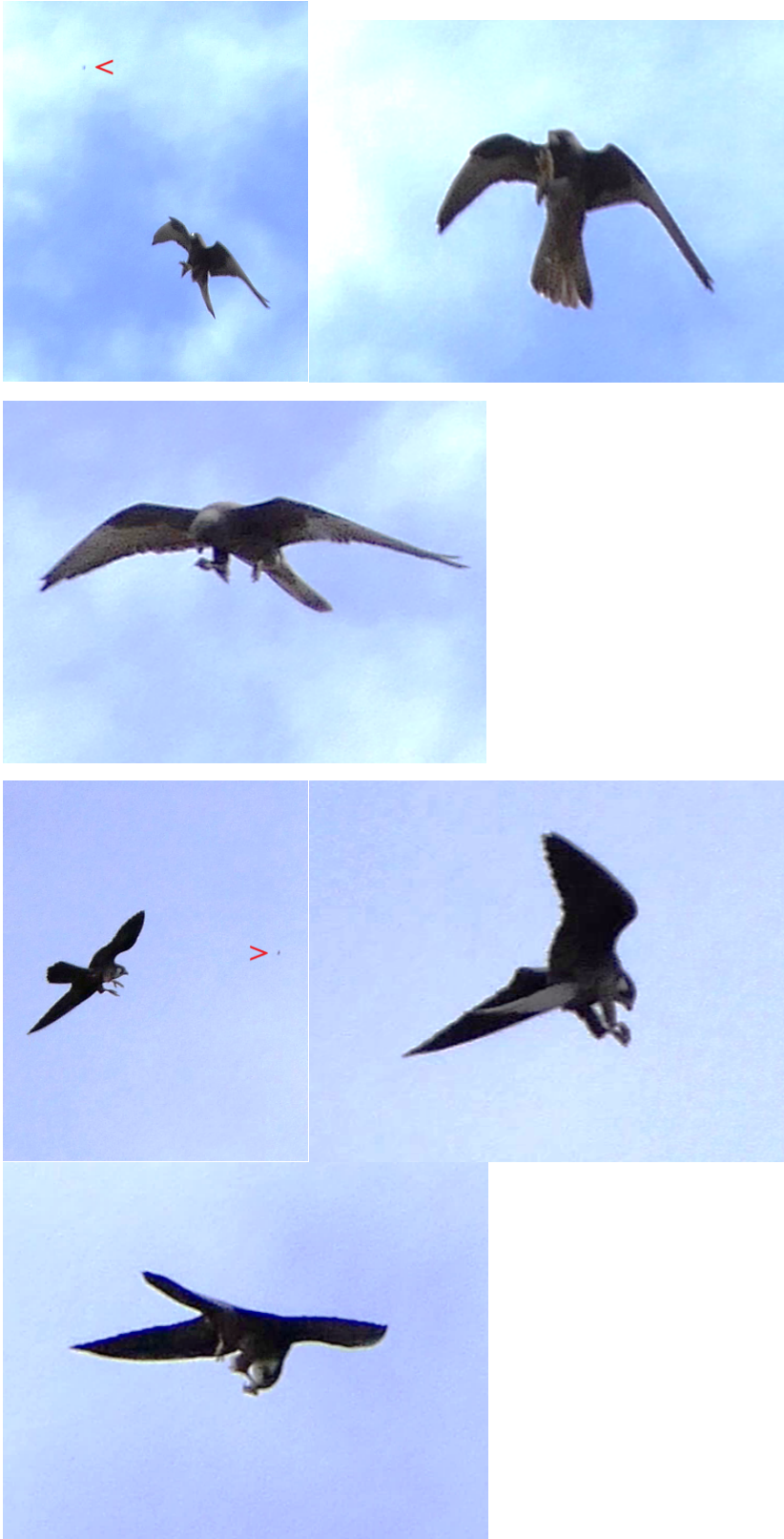


Fig. 1. The predatory sequences of two Eleonora's Falcons on roller dung beetles. Urzulei, Sardinia, 28 May 2024. / Le sequenze predatorie di due Falchi della regina su scarabei stercorari. Urzulei, Sardegna, 28 maggio 2024.



Fig. 2. The insect in the first image of Fig. 1 compared to the flight attitude of *Scarabaeus (Ateuchetus) laticollis* in a photograph by Mazzei (2006), from Lazio. This is most probably the species in the now-described predations. The insect on the left, in front view, looks unbalanced on a vertical plane, probably due to the air turbulence the approaching falcon produced. / L'insetto nella prima immagine di Fig. 1 a confronto con l'assetto di volo di *Scarabaeus (Ateuchetus) laticollis* in una fotografia di Mazzei (2006), dal Lazio. Questa è in tutta probabilità la specie nelle predazioni ora descritte. L'insetto a sinistra, in vista frontale, appare sbilanciato su un piano verticale, probabilmente per la turbolenza prodotta nell'aria dall'avvicinarsi del falco.