Korta rapporter *Short communications*

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Is the Kestrel *Falco tinnunculus* able to discriminate against obnoxious beetles?

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As insects are often a food source that many raptors depend upon, knowledge of the life histories of insects in their diets may give insight into the foraging habits of these predators.

The Kestrel *Falco tinnunculus* Linnaeus feeds especially on small sized mammals, but beetles can be an important alternative prey group at various latitudes, and it has been postulated that the energy costs involved in catching insects are relatively smaller than for other prey due to their higher densities and limited means of protection (e. g. Lovari 1975, Itämies & Korpimäki 1987, Carrillo et al. 1994). However, many beetles are known to secrete obnoxious compounds (cf. Dettner 1987) which could be an important defensive system against predation by birds and other vertebrates.

With the exception of the subfamily Pimeliinae and few non-pimeliine genera, adult tenebrionid beetles (Coleoptera Tenebrionidae) are characterized by the possession of glands that produce quinoic and other obnoxious secretions (Dettner 1987, Doyen 1993). It has long been speculated that such tenebrionids use their secretions to escape predation, but only a limited amount of evidence supports this idea (Doyen 1974, Doyen & Somerby 1974). In fact, adult tenebrionids are preyed on by a number of vertebrates, including the Kestrel (e. g. Slobodchikoff 1978, Parmenter & MacMahon 1988, Kok & Louw 1994, Fattorini et al. 1999), but nothing is known about the effectiveness of the repulsive secretions produced by obnoxious tenebrionids in avoiding Kestrel predation.

The aim of this research was to study if species lacking defensive glands are eaten by the Kestrel more often than obnoxious species. The study was carried out on the Kestrel population in the urban habitat of Rome (Italy), a city holding a large breeding population of Kestrels since the XIX Century (cf. Salvati et al. 1999) and a rich tenebrionid fauna with several species commonly occurring in archaeological areas (Carpaneto & Fattorini 1999). The diet has been studied from 1996 to 1997 by pellet analysis, and a complete account of methods and insect remnants can be found in Fattorini et al. (1999).

On a total of 2361 identified prey items found in Kestrel pellets, insects accounted for 46.9%. Beetles were the main prey category, accounting for 66.5% of the total insect prey. Tenebrionids accounted for 2.3% of the total prey and for 9.1% of the beetles identified to family. Identified tenebrionids ranged from 9 to 40 mm in size, including: *Asida luigionii* Leoni (9–11 mm, 18 spms), *Akis bacarozzo* (Schrank) (16–20 mm, 11 spms), *Akis italica* Solier (19–24 mm, 5 spms), *Akis* sp. (16–24 mm, 6 spms), *Scaurus striatus* Fabricius (13–18 mm, 7 spms), *Blaps gigas* Linnaeus (30–40 mm, 1 spm.), and *Blaps* sp. (21–26 mm, 1 spm.). Other five tenebrionid specimens were not possible to be identified to species. The genera *Asida* and *Akis* are known to lack defensive glands, while *Scaurus* and *Blaps* are obnoxious beetles. As a whole, the Kestrel preyed significantly more on non obnoxious (81.6% of identified tenebrionids) than obnoxious (18.4%) beetles (χ^2=19.61; df=1; P<0.001; n=49 – on the basis of the null hypothesis of non differential predation, the expected value of the two categories was calculated dividing by two the total number of the identified tenebrionids).

All tenebrionids taken by the Kestrel in Rome are soil-dwelling wingless species, in accordance with the hunting techniques of the raptor, which catches generally in open areas taking especially surface-active soil beetles (Fattorini et al. 1999).

Moreover, all these species are slow-moving, crepuscolar or nocturnal feeders, with a cryptic diurnal activity during which they commonly occur under stones. Such habits have been regarded as activity patterns reducing predation pressure (Kok & Louw 1994). The occurence of these beetles in Kestrel pellets actually confirms that this raptor, even if mainly diurnal, also hunts before sunrise and at twilight (cf. Itämies & Korpimäki 1987, Sachslehner 1996). In addition, all the above mentioned tenebrionid species are city-colonizing beetles especially common in large ruderal areas, where also urban Kestrels easily find many possible nest sites (cf. Piattella et al. 1999, Salvati et al. 1999).

The proportion between non obnoxious and obnoxious tenebrionids shows that Kestrels actually tend to avoid species with defensive secretions. Tenebrionids with defensive secretions are avoided by the Channel Island Fox (Doyen 1974) and it has been postulated that unpalatable tenebrionids could be aposematic even if black colored (Doyen & Somerby 1974). However, there is no clear evidence that Kestrels may learn to discriminate against every obnoxious tenebrionid prey, but an important role in raptor learning could be played by the size of the prey. In fact, among the tenebrionids taken by the Kestrel, *Blaps* spp., the largest and probably most obnoxious specimens, were found in pellets only as single legs. Most probably, when attacked by Kestrels, these large sized beetles discharge their defensive secretions causing the predators to desist. By contrast, small sized species (including most of the obnoxious tenebrionids taken by the Kestrel) occurred in pellets as large remnants, suggesting that they are swallowed as whole specimens. Even if obnoxious, swallowed prey beetles are eaten before their glands are discharged. As a result, the Kestrel could be unable to discriminate against them because the secretions that might subsequently be ejected inside the Kestrel's stomach may have no effects or too delayed effects for an effective learning.

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References

Carpaneto, G. M. & Fattorini, S. 1999. Extinction of scarab and tenebrionid beetles (Coleoptera Scarabaeoidea; Coleoptera Tenebrionidae) in urban ecosystems: a case study of Rome (Italy). *Ecologia, IX Congresso Nazionale Società Italiana di Ecologia,* 157.

Carrillo, J., Hernández E. C., Nogales M., Delgado G., García R. & Ramos, T. 1994. Geographic variation in the spring diet of *Falco tinnunculus* L. on the islands of Fuerteventura and El Hierro (Canary Islands). *Bonn. zool. Beitr.* 45(1):39–48.

Dettner, K. 1987. Chemosystematics and evolution of beetle chemical defenses. *Ann. Rev. Entomol.* 32:17–48.

Doyen, J. T. 1974. Differential predation of darkling ground beetles (Coleoptera: Tenebrionidae) by the Channel Islands Fox. *Pan-Pac. Entomol.* 50:86–87.

Doyen, J. T. 1993. Cladistic relationships among pimeliine Tenebrionidae. *J. New York Entomol. Soc.* 101(4):443–514.

Doyen, J. T. & Somerby, R. 1974. Phenetic similarity and Müllerian mimicry among darkling ground beetles (Coleoptera: Tenebrionidae). *Can. Entomol.* 106:759–772.

Fattorini, S., Manganaro, A., Piattella, E. & Salvati, L. 1999. Role of the beetles in raptor diets from a Mediterranean urban area (Coleoptera). *Fragm. entomol.* 31(1):57–69.

Itämies, J. & Korpimäki, E. 1987. Insect food of the Kestrel, *Falco tinnunculus,* during breeding in western Finland. *Aquilo Ser. Zool.* 25:21–31.

Kok, O. & Louw, S. 1994. Bird and mammal predators of curculionid and tenebrionid beetles in semi-arid regions of South Africa. *J. Afr. Zool.* 108: 555–563.

Lovari, S. 1975. The feeding habits of four raptors in Central Italy. *Raptor Research* 8 (3–4) (1974): 45–57.

Piattella, E., Salvati L., Manganaro A. & Fattorini, S. 1999. Spatial and temporal variations in the diet of the Common Kestrel (*Falco tinnunculus*) in urban Rome, Italy. *J. Raptor Res.* 33(2):172–175.

Sachslehner, L. M. 1996. "Nachtaktiver" Turmfalke (*Falco tinnunculus* L.) jagt Eulenfalter am beleuchteten Stephansdom in Wien – Können Turmfalken im oberen UV-Bereich sehen? *Ökol. Vögel (Ecol. Birds),* 18 (1): 55–64.

Salvati, L., Manganaro A., Fattorini S. & Piattella, E. 1999. Population features of Kestrels *Falco tinnunculus* in urban, suburban and rural areas in Central Italy. *Acta orn.* 34(1):53–58.

Slobodchikoff, C. N. 1978. Habitat use by mimetic coastal tenebrionid beetles. *Am. Midl. Nat.* 99(1):45–57.

Sammanfattning

Kan tornfalken skilja ut illasmakande skalbaggar?

Tornfalken lever främst på små däggdjur, men skalbaggar kan utgöra ett betydelsefullt alternativ. Det har föreslagits att energikostnaderna för att fånga insekter kan vara lägre än för andra byten därför att de förekommer med högre tätheter och är mindre väl skyddade. Emellertid kan många skalbaggar utsöndra illaluktande ämnen som kan utgöra ett försvar mot fåglar och andra ryggradsdjur. De flesta adulta skalbaggar av familjen Tenebrionidae utsöndrar sådana ämnen. Men ändå fångar både tornfalkar och andra ryggradsdjur sådana skalbaggar, och mycket litet är känt om hur effektiva ämnena är som skydd mot predatorer.

Målet med denna studie var att se om skalbaggar som saknade körtlar som producerade illasmakande (illaluktande) ämnen togs i mindre omfattning än de som hade sådana körtlar. Studien utfördes i stadsmiljö i Rom, där det finns både en stark population av tornfalkar och en rik fauna av olika skalbaggar inom familjen Tenebrionidae. Tornfalkarnas diet analyserades med hjälp av spybollar åren 1996 och 1997.

Totalt identifierades 2361 födoobjekt, varav 46,9% var insekter. Av insekterna var 66,5% skalbaggar. Tenebrionider utgjorde 2,3% av totala antalet och 9,1% av skalbaggarna. De var av storleken 9–40 mm och inkluderade *Asida luigionii* (9–11 mm, 18 stycken), *Akis bacarozzo* (16–20 mm, 11 st.), *Akis italica* (19–24 mm, 6 st.), *Scaurus striatus* (13–18 mm, 7 st.), *Blaps gigas* (30–40 mm, 1 st.) och *Blaps* sp. (21–26 mm, 1 st.). *Asida* och *Akis* saknar försvarskörtlar medan *Scaurus* och *Blaps* har sådana. Resultatet av analysen blev att tornfalkarna konsumerade klart mera av de icke illaluktande arterna (81,6%) än av de som saknade körtlar (18,4%). Skillnaden är signifikant under antagandet att de borde ha konsumerat i proportion till arternas förekomst.

Alla tenebrionider som togs av tornfalkarna var marklevande vinglösa arter, vilket är förväntat med hänsyn till tornfalkens vana att jaga ytaktiva skalbaggar i öppen terräng. Vidare är alla arter sådana som rör sig långsamt i skymningen eller under natten och gömmer sig under stenar på dagen, vilket visar att falkarna jagade i gryning och skymning.

Undersökningen visar att tornfalkarna tenderade att undvika illasmakande skalbaggar. Samma undvikande har man funnit hos rävar. Hur tornfalkarna lär sig vilka skalbaggar som skall undvikas är oklart. En möjlighet är bytenas storlek, eftersom de största arterna (släktet *Blaps*), också de som producerar mest illaluktande substans, bara identifierades i form av enstaka ben, medan de mindre arterna förekom som mer eller mindre hela djur, uppenbarligen svalda hela.

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Ekstremt stort grågåsekuld *Anser anser*: Adoption eller ægdumpning af flere hunner?

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Söderholm (2000) skriver om et ekstremt stort kuld af grågås *Anser anser* med 15 dununger. Mine erfaringer viser, at alle hans vurderinger er forkerte med hensyn til hans argumentation for, at det var to eller flere hunner, der havde lagt æg i samme rede, og det ikke var to eller flere kuld, der er slået sammen efter klækningen, uden at han diskuterer adoption. Jeg skal ikke her komme ind på de talrige diskussioner om fordele og ulemper ved adoption (se f.eks. Power et al. 1989).

Forudsætningen for at vurdere en hvilken som helst adfærd hos grågæs, i dette tilfælde et formodet unormalt stort kuld kræver, at man dagligt i årtier har studeret en farveringmærket population og deres adfærd, og kender alderen på hver eneste gås i populationen, idet det ellers ikke er muligt at afgøre, hvorvidt en tilfældig iagttagelse er normal eller ej. Selvom jeg har studeret grågæs dagligt i 39 år, kan jeg stadig iagttage forskellig former for adfærd, som jeg ikke har iagttaget tidligere. Da forfatteren kun lejlighedsvis har studeret en, hvad jeg formoder, ikke farveringmærket population af grågæs i årene 1993–1999 og kun set 78 kuld, tror jeg ikke, at han har den fornødne erfaring med hensyn til at vurdere en enkelt iagttagelse, hvor han tidligere ikke har inventeret gæs (Söderholm & Eriksson 1999).

I 1959 påbegyndte Zoologisk Museum, København, et projekt med at ringmærke grågæs med farvede fodringe og individuelle farvekoder i Utterslev Mose, København (55° 43' N, 12° 30' E) med henblik på at undersøge populationsdynamik m.v., hvilket jeg har studeret siden 1962, efter at man anmodede om oplysninger om disse farveringmærkede grågæs (Petersen & Preuss 1962). Siden da har jeg anvendt ca. 25.000 timer og gjort ca. 100.000 individuelle notater over gæssene, hvilket nu er under videre bearbejdelse, idet dette store materiale kan give mange nye og detaljerede oplysninger om grågåsens biologi, som er baseret på Zoologisk Museums farveringmærkning.

Jeg har tidligere skrevet flere artikler om grågæssene (Jensen et al. 1971, Jensen 1973, 1974, 1975, 1976a, 1976b, 1977, 1980, 1998 og 1999), hvortil