

Nota Científica

NEW DATA AND OBSERVATIONS ON KLEPTOPARASITIC BEHAVIOUR IN DUNG BEETLES FROM TEMPERATE REGIONS (COLEOPTERA: SCARABAEOIDEA)

RESUMEN. En esta note se proporcionan nuevos datos procedentes de observaciones de campo, acerca del cleptoparasitismo en diversas especies de áreas templadas de la región Paleártica: *Aphodius (Calamosternus) granarius* (L., 1767), *Onthophagus meki* (Illiger, 1803), *O. taurus* (Schreber, 1759) y *O. furcatus* (Fabricius, 1781). Esta es la primera constancia fehaciente de este tipo de comportamiento en la región Paleártica, entre especies de Scarabaeidae: los especies paracóprides (*Onthophagus*) se han encontrado cleptoparasitando a un rodador (*Scarabaeus cicatricosus*). Estos datos han permitido discutir las implicaciones ecológicas y evolutivas de este comportamiento, analizando si debe considerarse al cleptoparasitismo como un encuentro fortuito de los recursos o una estrategia opcional u obligada de búsqueda activa de los mismos. Se sugiere el uso restringido del término "cleptoparasitismo" para nombrar estas estrategias de búsqueda activa.

Kleptoparasitism is the name given to the utilization, by some Scarabaeoidea coprophage species of the food reserves accumulated by other Scarabeid species for their feeding and reproduction (Paulian, 1943. *Les Coléoptères: Formes, mœurs, rôles*. Paris). In the temperate regions, the comparatively small sized endocoprid species of Aphodiidae are kleptoparasites of species from the Geotrupidae and Scarabaeidae families (see Hammond 1976, *Col. Bull.* 30: 245-249; Veiga 1985, *Bol. Soc. Port. Entomol.* supp. 1: 133-134 and references cited therein). However, Fabre's observations (1987, *Souvenirs Entomologiques*, Paris) suggest a fortuitous occurrence of one species of *Onthophagus* (probably referable of *Caccobius schreberi* (L.) in the balls of *Scarabaeus sacer* L..

This feeding and/or reproductive strategy is more common in tropical and subtropical regions where competition for resources is more intense (Hanski & Cambefort 1991. In: *Dung Beetles Ecology*: 305-329. New Jersey), and in arid regions where the scarcity of resources is extreme (Rougon & Rougon 1980, *Comp. Rendus de l'Acad. Sci. Française*, 291: 417-419; Lumaret 1989, *Bull. Ecol.* 20: 51-57). Kleptoparasites account for nearly 10 % of dung beetle species in the Ivory Coast (Cambefort 1991, In: *Dung Beetles Ecology*: 156-178. New Jersey).

In agreement with Hammond (*op cit*), the central point in the kleptoparasitism behaviour is: either the kleptoparasites find resources by chance [e.g.: passive carrying by large tunnelers (Rougon & Rougon 1991, In: *Dung Beetles Ecology*: 230-241. New Jersey.); accidental encounter as a consequence of dweller's free-life larvae (Klemperer 1980, *Environ. Entomol.* 5: 143-151)], or the kleptoparasites actively seek out, for

This work has been supported by D.G.I.C.Y.T. grant PB89/0081. The order of author's names was established at random.

eating/breeding, the dung rolled/buried by larger species. As Rougon & Rougon (1991 *op cit*) have rightly pointed out, both processes probably occur, although there are not many positive observations from the field.

Beside Fabre's suggestion, in this paper we give some new data relating to first field observations on kleptoparasites of rollers in the Palearctic Region. We also try to clarify the conceptual meaning of this term, and finally some reflections about ecologic and evolutive of this behaviour are also made.

Aphodius (Calamosternus) granarius (L.) is a cosmopolitan species, and while not very abundant in coprophage communities, it certainly is relatively frequent. Due to its widespread distribution and its well-documented polyphagous habits (see, for instance, Lumaret 1990. *Atlas des Coléoptères Scarabeides Laparosticti de France*. Paris), it can be considered a species of great ecological capacity. Even so, up until now it has not been found as a kleptoparasite in the burrows of other species. In a recent study of the Balearic Islands, the authors have found larvae and adults using excrement buried by other species for their own feeding. In fact, on March 26 1990, five recently emerged adults, along with a good number of larvae of *A. granarius*, were found within the pedotrophic nest of a mating *Copris hispanus* (L.) couple, which was supplied with a cake of 260 g of cow dung. The larvae were found within the layer of excrement that lined the nesting chamber. The nest was located in Alcaufar, Menorca (U.T.M.: 31SFE1010). On June 10, 1989, in a rocky site of Garganta de San Martín, located in Central Massif of Gredos (U.T.M.: 30TTK773564), nine adults of *A. granarius* were found inside Spanish Ibex (*Capra pyrenaica victoriae*) excrement that had been buried by *Thorectes escorialensis* Jekel, at an altitude of 2,200 meters.

In accordance with these observations, it seems clear that both the adults and larvae of this species might be considered to be kleptoparasites in the excrement accumulated by other phylogenetically distant species. It is not clear if this behaviour is accidental or if it forms part of the active reproduction strategy of the females of *A. granarius*. The observation from Gredos fits in with any interpretation previously published in the literature, while the observation from Menorca does not *a priori* exclude an active search for oviposition in the nesting dung already-buried by the host.

Recently we have found evidence that some species of *Onthophagus* actively seeks and uses the supplies obtained by *Scarabaeus cicatricosus* (Lucas), which is endemic to the Southeast of the Iberian Peninsula. At least three typically coprophagous species of *Onthophagus* occurring in a large geographic range and showing a wide niche breadth, display clearly optional kleptoparasitic behaviour: they are *Onthophagus maki* (Illiger), *O. taurus* (Schreber) and *O. furcatus* (Fabricius).

The observations in question were made in the Estación Biológica de Doñana (U.T.M.: 29SQA2496) on April 26, 1992. In essence, the behaviour was the same mentioned by other authors, but observed for the first time in species of Scarabaeidae in the Palearctic Region: species "...are attracted to the balls being rolled, which they follow, flying very close to the ground in a zigzag manner. Eventually they reach the ball, into which they immediately plunge." (Cambefort & Hanski 1991, In: *Dung Beetles Ecology*: 36-51. New Jersey). This behaviour corresponds to one of the two subguilds recognized by Cambefort (*op cit*): the kleptoparasites of rollers.

Hardly had two minutes elapsed after excrement was put in place, when the first individuals of *S. cicatricosus* and *Onthophagus* appeared. Once the dung beetle had formed its ball (which took them only about three minutes), they began rolling it a distance of 8 to 11 m (on occasion, even further) from its source before burying it. While the dung was being rolled, one individual or more of kleptoparasitic species began following the ball roller, flying along just above ground level, repeatedly trying to get inside the ball, until finally achieving their aim.

Twenty one balls formed by *S. cicatricosus* were examined: 8 (38%) of them did not contain kleptoparasites; 7 contained an average of 3 individuals of *O. maki* per ball; 2 an average of 1.5 individuals of *O. taurus* per ball; 3 an average of 3.5 individuals of *O. maki* and 1.5 of *O. taurus*; and one ball contained 4 individuals of the three species (1 of *O. furcatus*, 2 of *O. maki*, and 1 of *O. taurus*). On several occasions we observed 3 or 4 kleptoparasitic individuals destroy a dung ball while it was being rolled, thus impeding its use by the host. In this circumstance, its dung-beetle owner either abandoned the ball or continued rolling one of the remaining fragments. On one occasion we followed the rolling and burial of a ball in which several kleptoparasites had buried themselves, but do not know what took place inside the nest chamber. The diameter of the ball ranged from 16 to 30 mm, 3 to 5 times the length of the kleptoparasitic species.

These observations along with those reported in the literature, seem to confirm that kleptoparasitism is a term which has been used to name three types of behaviour with similar consequences (profiting from supplies accumulated by another species) but different origins: fortuitous finding of supplies or optional strategy of active searching, which may be particularly likely to lead to a third behaviour: the obligatory kleptoparasitism (Hammond *op cit*). The ecological and evolutionary implications depend on which of these three place. In all cases, it would seem clear that interspecific competition could occur. One of the most striking pieces of evidence of competition seems to be the aggressive larval behaviour discussed by Klempner (*op cit* and references therein). However, the killing of the offspring of the host species (Hammond, *op cit*), has not been verified in the field (Rougon & Rougon 1991, *op cit*).

There is none clear evidence on the obligatory kleptoparasitism. Exclusion experiments indicated that *O. acuminatus* tunneled deep into the soil and were found waiting in empty burrows, the nest building by *Dichotomius satanas* (Gill 1991, In: *Dung Beetles Ecology*: 211-229. New Jersey)). However, the same author indicates that kleptoparasitism is a facultative strategy depending on the dung-patch size. Data summarized by Cambefort (*op cit*) don't permit either to confirm if the kleptoparasitism behaviour in dung beetles of African Tropical Savannas, is an obligate strategy.

Therefore, the main question still is the following: is kleptoparasitism an active search for resources to steal, and/or the ideal place to lay eggs in ?. If so, the possibilities for competition increase; thus this behaviour would mean the adoption of kleptoparasitism as an adaptative strategy. We conclude that at present, the term "kleptoparasite behaviour" should be reserved for active search strategies, to be interpreted either as a facultative behaviour or as an obligate one.

Fermín Martín-Piera & Jorge M. Lobo
Museo Nacional de Ciencias Naturales (C.S.I.C.)
Departamento Biodiversidad
c/ José Gutiérrez Abascal, 2. 28006. Madrid, ESPAÑA