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Unexpected Vegetarian Feeding Behaviour of a Predatory Tiger Beetle *Calomera littoralis nemoralis* (Olivier, 1790) (Coleoptera: Cicindelidae)

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ABSTRACT

An unexpected vegetarian feeding behaviour in a predatory tiger beetle *Calomera littoralis nemoralis* was observed on the marine sandy beach in Albania. The aggregation of some 100 beetles on an area of ca. 5 m^2 was noted during eating grains of maize as well as coocked macaroni. This is the first known case of feeding on plant grains by Cicindelidae species.

Key words: Tiger beetles, *Calomera littoralis nemoralis*, aggregation behavior, vegetarian feeding behaviour, Albania, Balkan Peninsula.

INTRODUCTION

Tiger beetles (Cicindelidae) are Coleoptera family with more than 2600 species described till now (Pearson and Cassola, 2005). The group is classified in the suborder Adephaga as both adult beetles and larvae are predators hunting mainly for various small arthropods like spiders and insects (eg. Larochelle, 1974; Pearson, 1988; Pearson and Vogler, 2001). Predation on other tiger beetle species, including cannibalistic behaviour, is known in some species too (e.g. Acorn, 1991; Cassola *et al*., 1988; Hoback *et al*., 2001). Adult Cicindelidae usually aim at their preys visually and catch them after short but fast running, interspersed with some stops (Gilbert, 1987, 1997; Pearson and Vogler, 2001). Most of studied tiger beetle species prefer to hunt individually for active and usually fast moving preys (Świecimski, 1956; Willis, 1967; Larochelle, 1974; Wilson, 1978; Gilbert, 1987, 1997; Lovari *et al*., 1992). Rarely, they scavenge on dead insects (Świecimski, 1956; Wilson, 1978; Pearson and Mury, 1979; Schultz, 1981; Pearson and Stemberger, 1980; Hori, 1982; Knisley *et al*., 1987; Pearson and Vogler, 2001; Riggins and Hoback, 2005), or even dead vertebrates (Schultz, 1981). As for now, only two species have been observed eating plant material which were the fallen fruits (Hori, 1982; Hill and Knisley, 1992).

Calomera littoralis nemoralis is one of the commonest Cicindelidae species in the Balkan Peninsula (own unpublished data), having one of the widest habitat range among all Balkan tiger beetles. It occurs in different sandy habitats like sandy

beaches, saltmarshes, banks of rivers and lakes (Jaskuła, 2011). It is one of the nine tiger beetle species known from the territory of Albania (Guéorguiev, 2007; Jaskuła, 2007; Jaskuła *et al.*, 2012).

This paper provides the first observation of feeding behavior on plant material in European Cicindelidae species.

STUDY SITE, MATERIAL AND METHOD

The observation was made in the morning hours (9.00-10:30 a.m.) on the 30th of July 2011. The study site was the seaside beach located near Fier in Albania (N40,67619 E19,33409) occupied by two species of tiger beetles: *Calomera littoralis nemoralis* (Olivier, 1790) and *Cylindera (Eugrapha) trisignata trisignata* (Dejean, 1822).

RESULTS AND DISCUSSION

Local population of the first species (ca. 90-100 individuals) was observed feeding on leftovers left by tourists on the sandy beach (Fig. 1a). The leftovers included grains of maize (*Zea mays*) and boiled peaces of macaroni. The beetles formed a kind of aggregation, as all observed specimens of *Calomera littoralis nemoralis* occurred on area of about 5m^2. None individual of *Cylindera t. trisignata* was noted in the aggregation even if the species was noted in close surroundings of the leftovers (10-15 m and more). More specimens of *Calomera littoralis nemoralis* were joining to the aggregation when they appeared near the food source. Interesting is that the specimens within aggregation were not aggressive to each other. As a result 2, 3 or even 4 individuals were observed eating the same single grain of maize (Fig. 1b-c). Some individuals were noted while feeding on boiled macaroni too (Fig. 1d).

Observations described in this paper are the first data on vegetarian behaviour among all European Cicindelidae. Moreover, this is the first record of tiger beetle feeding on plant grains. Till now only two species were noted as occasionally eating parts of plants. Hori (1982) provided data on *Cicindela japonica* feeding on fallen fruits of *Mallotus japonicus* (Euphorbiaceae) and Hill and Knisley (1992) recorded *C. repanda* feeding on fallen fruits of *Sassafras* sp. (Lauraceae), *Phytolacca* sp. (Phytolaccaceae), and *Euonymus americanus* (Celastraceae). Additionally, in the literature one can only find data about tiger beatles feeding on natural food sources, usually easy to find in habitats occupied by beetles. Generally, tiger beetles eat small and moving arthropods like insects and spiders (eg. Świecimski, 1956; Larochelle, 1974; Willson, 1978; Young, 1980; Gilbert, 1987, 1997; Lovari *et al*. 1992; Pearson and Vogler, 2001), but at least some species can eat carrion too, including dead insects and other arthropods (Schultz, 1981; Knisley *et al*., 1987; Pearson and Vogler, 2001) or even small dead vertebrates (Schultz, 1981). Therefore, *Calomera littoralis nemoralis* feeding on boiled macaroni is the first known case of such behaviour in tiger beetle species.

Mobile preys are detected visually by Cicindelidae species, and as show other studies upon different cicindelid taxa, the distance from which the hunter can locate

the prey is some 10-30 cm (eg. Świecimski, 1956; Faasch, 1968; Dreisig, 1981; Gilbert, 1986, 1987). According to Świecimski (1956) prey move is one of the most important factors determining its localization by hunting tiger beetles. On the other hand, Faasch (1968) suggests that it is only a triggering stimulus being the first step to start hunting. Interesting is that active insects, especially fast moving, were also the main type of prey preferred by *Calomera littoralis nemoralis* studied under laboratory conditions (Jaskuła - unpublished).

Fig. 1. Vegetarian feeding behavior in *Calomera littoralis nemoralis*: A - aggregation of some 60-70 specimens feeding on leftovers. B-C - groups of 3-4 specimens feeding on single grains of maize, D - male feeding on boiled macaroni.

To locate dead or immobile prey tiger beetles use their antennae and palpi (Baker & Monroe, 1995). This behaviour is also common in Cicindelidae species living on ocean and sea beaches, pond edges and tidal mud flats, when mandibles are used to probe wet soil for buried prey (Pearson and Vogler, 2001). As *Calomera littoralis nemoralis* is a typical species of sandy beaches such “testing” behaviour could be the first step for feeding on leftovers left by tourists on the Albanian sea coast.

Interest on unusual food by *Calomera littoralis nemoralis* probably can be explained by contrasting colours of the leftovers if compared to sand of the beach (light objects on relatively dark background) as it was found by Faasch (1968) in other cicindelid species.

As adult tiger beetles hunt and feed individually, creating aggregations during feeding is very rarely observed in the field in this beetle group. Pearson and Vogler (2001) provided data on *Cicindelidia sedecimpunctata* from the desert of North America, where hundred of adult beetles attacked tadpoles of spade foot toads belonging to genus

Scaphiopus (Scaphiopodidae). Dozens of specimens of *Grammognatha euphratica* were also observed on the edges of salty puddles in desert areas in Tunisia, where the beetles were attacking small aquatic crustaceans belonging to genus *Artemia* Leach (Artemiidae) (Jaskuła - pers. observ.).

Similar observation, as noted in case of grains of maize eaten by *Calomera littoralis nemoralis*, was also described for *Cicindela repanda* in the USA by Hill and Knisley (1992). In the North American tiger beetle species mainly 2-3 individuals per single fallen fruit was recorded (with minimum one and maximum 14 specimens per fruit), while the maximum number of *Calomera litoralis nemoralis* specimens per one maize grain was four.

In case of the Albanian locality only one of the two Cicindelidae species recorded in the study area fed on vegetarian food. In much smaller species - *Cylindera trisignata trisignata*, this behaviour was not observed. *C. t. trisignata* could avoid places with larger predatory species as it can be a type of prey easy to catch for *Calomera littoralis nemoralis* (hunting for smaller Cicindelidae species by their larger "cousins" are very well known in the literature - eg. Hoback *et al*., 2001; Pearson and Vogler, 2001). Secondly, the size of the leftovers could be to large as for such small beetles.

Observations described in this paper suggest that at least some species of Cicindelidae may be opportunistic feeders rather that obligatory predators. Even if under "normal" conditions alive prey is preferred, some species can supplement their diet eating food which is actually available in the occupied environment. Fruit feeding and scavenging probably may provide some important nutrients during periods of times of high energy needs (Hill and Knisley, 1992), including periods with low prey availability (Palmer, 1978; Pearson and Knisley, 1985). Such strategy probably can explain scavenging behaviour observed in *Cicindela dorsalis* on the sandy beaches of the USA. Dead insects collected by adult tiger beetles were one of the most important type of food for this species for some period (Knisley *et al*., 1987). Similar behaviour was noted also in some other groups of arthropods typical to sandy beaches, including eg. rove beetles (Staphylinidae) or crustaceans (Maun, 2009). Moreover Maun (2009) proves that among invertebrates occupying such habitats scavengers predominate. Additionally he suggests that in many predators living on sandy beaches scavenging is an opportunistic feeding strategy allowing to survive in periods with reduced availability of preys.

As a result of feeding on dead insects, crustaceans, or other types of carrion, as well as on other types of organic matter deposited on sandy beaches, at least some Cicindelidae species may occasionally contribute to the natural clearing of sandy beaches.

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