

Malacophagy in *Cteniza sauvagesi* (Rossi, 1788) (Araneae: Ctenizidae)

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Abstract: Predation on terrestrial molluscs by spiders is a largely unknown behaviour, with few records all over the world and virtually no studies dealing with the subject. The spider *Cteniza sauvagesi* (Rossi, 1788) (Araneae: Ctenizidae) is a large trapdoor species widespread in Corsica (France) and Sardinia (Italy); its diet is usually based upon terrestrial invertebrates active on the ground at night, such as beetles and isopods. Here we record for the first time its predation upon the slug *Milax* sp. Gray, 1855 (Mollusca: Milacidae), based on one fortuitous observation in the field of an adult female feeding on a slug inside her burrow and some further malacophagy observations at night by other specimens.

Key words: Araneae, Ctenizidae, *Cteniza*, predation, molluscs, Sardinia, Italy.

Malacofagia de *Cteniza sauvagesi* (Rossi, 1788) (Araneae: Ctenizidae)

Resumen: La depredación de moluscos terrestres por parte de las arañas es un comportamiento casi completamente desconocido, con pocas evidencias en todo el mundo y prácticamente sin ningún estudio sobre el tema. La araña *Cteniza sauvagesi* (Rossi, 1788) es una robusta araña de trampa extendida en Córcega (Francia) y Cerdeña (Italia); su dieta normalmente se compone de invertebrados terrestres que andan y corren por el suelo en horas nocturnas, como coleópteros e isópodos. Aquí señalamos por primera vez la depredación de este arácnido sobre la babosa *Milax* sp. Gray 1855 (Mollusca: Milacidae), a partir de la observación casual de una hembra adulta que se alimentaba dentro de su propia guarida. Por la noche, además, se han constatado casos de otros individuos malacófagos.

Palabras clave: Araneae, Ctenizidae, *Cteniza*, depredación, moluscos, Cerdeña, Italia.

Introduction

As spiders are predominantly insectivorous predators (Foelix, 2011), predation on non-arthropod preys is therefore of special interest. In particular, according to extant records, predation by spiders upon molluscs is rare. Recent bibliographic revisions reported about 40 observations of this phenomenon (Nyffeler & Symondson, 2001; Pollard & Jackson, 2004). These observations were related to both Araneomorph and Mygalomorph spiders, with a prevalence among the latter (Pollard & Jackson, 2004). It is not clear if malacophagy is uncommon due to gastropod defenses (i.e. shell and/or mucus) (Pollard & Jackson, 2004). Lack of observations, especially in wet periods, as underlined in Nyffeler & Symondson (2001) may also have led to an underestimation of the occurrence of malacophagy in spiders. However, understanding malacophagy is important, in order to establish relationships among spiders and molluscs, the latter being detritivorous and herbivorous taxa, affecting plant-composition within ecosystems (Nyffeler & Symondson, 2001). Most reports of malacophagy are linked to occasional observations or to wider dietary studies. Malacophagy-dedicated papers are rare, with an almost unique example in Laing, 1982. Here we report for the first time on observations on malacophagy in the Ctenizidae *Cteniza sauvagesi* (Rossi, 1788). The gastropods prey involved belonged to the genus *Milax* Gray, 1855 (Mollusca: Milacidae). Observations were done on Sardinia.

Material and methods

Observations were made in and around Porto Conte Regional Park (Alghero, Sassari Province, Sardinia), in the localities of Maristella (40°35'11.27'' N; 08°13'30.23'' E) and Port' Agra (40°34'21.13'' N; 08°14'23.28'' E); studies were conducted in winter and spring, due to relative inactivity of both spiders and slugs during drier periods. Burrows (about 50 inspected) were actively looked for in Mediterranean maquis, gardens, pine forests, on small cliffs along roads and paths, and near the entrance of caves. Spiders were examined by opening trapdoors and looking on the bottom of burrows with a small torch; in some cases, spiders were also extracted from their shelter with the aid of thin sticks, and replaced inside after inspection. Nocturnal qualitative observations were especially made on 10

burrows during wet or rainy nights for about a week in winter (December 2009-January 2010) and a week in spring (April 2010), between sunset and midnight. Burrows were observed using a torch for illumination, without making vibrations on the ground in order to not influence spiders' behaviour. Photographs were taken with a Nikon D700 digital camera provided with a 105 mm lens and three flashes.

Results

In this work we present the first case of predation upon slugs by *Cteniza sauvagesi* (Rossi, 1788).

On December, 28th 2009, during an inspection on a little cliff nearby the sea (behind the reefs), the burrow of a big female was opened. Looking inside with a lamp, it was possible to see the spider on the bottom, turned (i.e. with the opisthosoma toward the entrance); as personal observations almost always show specimens waiting on the bottom with anterior legs toward the entrance, it was decided to "fish" the specimen with a small and thin branch. After extraction, it was possible to see on the bottom of the burrow something soft and smooth, that turned out to be the remains of a land slug that the spider was eating.

After this predation record, some qualitative observations were made at night in a small area particularly rich in spiders populations, in order to verify if *C. sauvagesi* regularly feeds upon gastropods. In particular, in four occasions it has been possible to observe the predatory event against slugs (genus *Milax* Gray, 1855), even though in two cases spiders didn't eat the prey. Generally, trapdoor spiders are quite shy and usually close the entrance of the burrow even if a suitable prey walks on it (M.Colombo, pers. obs.), so in most cases slugs scared spiders with their movements. In conditions where prey capture was observed, the slug was passing tangentially to the burrow, within few millimetres from its perimeter; perceiving the vibrations of the slugs' movements (or, maybe, of the dead leaves and sticks on which the prey was passing; Fig.1), the spider jumped out (Fig.2), using its anterior legs to "hug" the slug around mid-body, touching it with pedipalps (as already noticed with other preys by Decae, 1990), detaching it from the ground (this fact

made the predation slower than what usually happens with other preys, as isopods; M.Colombo, pers.obs.) and dragging it inside the burrow. As these slugs are 30-40 mm long, the prey usually folds itself while being dragged inside by the spider, as they are longer than the entrance' diameter. Specimens observed catching slugs weren't seen active for at least six nights afterwards.

Discussion

Malacophagy in arachnids is an interesting phenomenon that is well known for harvestmen; in particular, the Ischyropsalidae and Trogludidae families show many species with specific adaptations in order to prey upon gastropods (Nyffeler & Symondson, 2001). Malacophagy in spiders, on the other hand, is a relatively uncommon or at least rarely observed behaviour. In literature, few authors report predation upon slugs and snails by spiders, and often it is a case of fortuitous observations, apart from a single study (Laing, 1982). However, it is not clear yet if this lack of data is due to an effective low predation impact upon terrestrial gastropods or to a lack of research during bad weather conditions (Nyffeler & Symondson 2001; Pollard & Jackson, 2004; Quicke, 1987).

Among Araneomorphae, observations of malacophagy are known for Lycosidae, Pisauridae, Araneidae, Tetragnathidae, Pholcidae, Theridiidae and Agelenidae; among Mygalomorphae, observations are known for Hexathelidae, Dipluridae, Atypidae and Theraphosidae; Ctenizidae are quoted by Pollard & Jackson (2004). In some cases, observations were made in captivity, while other ones were made in the field; most of the record refers to feeding on snails rather than slugs.

The average mass of edible food in an individual gastropod specimen is probably relatively large as compared to general arthropod food, and therefore relatively long feeding times are recorded with this kind of prey (e.g. 17 hours in *Coelotes terrestris* (Wider, 1834); Tretzel, 1961). It might therefore be hypothesized that slugs permit quite long periods without any need of hunting, becoming an important part of *C. sauvagesi* diet (Nyffeler & Symondson, 2001). The high percentage of the body of a gastropod is potential food, so a longer period of handling is balanced by a more profitable nutrient extraction. A similar behaviour has been observed in *Atypus* sp. Latreille, 1804, with spiders ambushing snails in their silky tubes, carrying them inside and later casting empty shells outside (André & Lamy, 1941). In two of four cases, spiders attacked slugs but immediately retreated inside their burrows without catching them; unfortunately, it wasn't possible to establish if this behaviour was caused by different toxicity in very similar and related slug species, or by other factors (e.g. in the same spider species not all the individuals have the same tendency to malacophagy), as already highlighted by Tretzel (1961) and Laing (1982) for other studies.

According to previous studies, spiders that are able to eat gastropods are those that kill them faster, maybe before the prey can release its toxic mucus (Nyffeler & Symondson, 2001; Pollard & Jackson, 2004); this might fit the species reported on here, that is provided with big chelicerae and a supposedly effective rapid chewing capability.

Also, preying upon slugs seems an adaptation to periods (e.g. *Argiope bruennichi* (Scopoli, 1772) during rainy days; Quicke, 1987) or environments (e.g. *Meta menardi* (Latreille, 1804) in caves

and cellars; Smithers, 2005) where arthropods are less abundant; in the case of *C. sauvagesi*, in fact, it seems that activity period is linked with cool months (autumn, winter and spring). In summer, most specimens seal off their burrows with silk (M.Colombo, pers.obs.). It is possible, however, that slugs become part of the diet of this species only during rainy or very wet nights, while in other occasions isopods and other invertebrates constitute a larger part of the dietary spectrum.

In this study, only mature females were seen catching slugs; probably this fact is linked to a lack of data, but it would be interesting to verify if this bias is related to breeding aspects (i.e. need of energy to produce eggs) or to size aspects (i.e. only larger specimens can overcome slugs mucus) as in other species (Nyffeler & Symondson, 2001).

Malacophagy seems to be a very rare or at least rarely detected behaviour in nature among spiders, but, being an interesting ecological issue in food webs, further studies are required in order to establish how important slugs are in *Cteniza sauvagesi* diet.

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Fig. 1. A *Milax* sp. specimen near *Cteniza sauvagesis* burrow at night. **Fig. 2.** The same specimen few moments later, being grasped by the female *Cteniza sauvagesis* (photographs by Marco Colombo).