

Research articleSubmitted: March 21st, 2016 - Accepted: June 10th, 2016 - Published: June 30th, 2016***Deraeocoris schach*, a new predator of *Euphydryas aurinia* and other heteropteran feeding habits on caterpillar web (Heteroptera: Miridae; Lepidoptera: Nymphalidae)**

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manuela.pinzari@uniroma2.it**Abstract**

In this paper, preliminary results on a field study aiming to identify predators of the Marsh Fritillary *Euphydryas aurinia* (Rottemburg, 1775) in Central Italy are presented. Several heteropterans were found on the larval nests of *E. aurinia* for dietary reasons: *Deraeocoris schach* (Fabricius, 1781) that is a predator of Marsh Fritillary larvae, *Palomena prasina* (Linnaeus, 1761) and *Spilostethus saxatilis* (Scopoli, 1763) that feed on the droppings of larvae; *Graphosoma lineatum italicum* (Müller, 1766) that visits the larval web during winter diapause.

Key words: *Euphydryas aurinia*, *Deraeocoris schach*, predator, heteropterans.

Introduction

In the context of a previous survey study (Pinzari et al. 2010, 2013) on the Lepidoptera in Central Apennines (Lazio, Italy), during the past five years a population of *E. aurinia* spp. *provincialis* (Boisduval, 1828) was studied, focusing on several aspects of the species biology and in particular on larval behaviour and host plants (Pinzari, Pinzari and Sbordonì, unpublished data).

The species has six larval instars (three pre-diapause instars and three post-diapause instars); the first five instars are gregarious, while the sixth is solitary. In the early stages, larvae feed gregariously within a communal silken web and move from a plant to plant as their host plants are consumed; fourth instar larvae do not feed prior to diapause and overwinter in a larval web (hibernaculum), usually close to the ground and incorporating a few dead leaves which are spun tightly together. When the fourth instar larvae emerge from the winter diapause they still show the gregarious behaviour and use basking behaviour as a way of thermoregulating (Porter 1981, 1982). Larvae start to disperse in their fifth instar and feed solitarily (Warren 1996; Kuussaari et al. 2004). Finally they pupate close to the ground, usually on plant stems (Warren 1996).

E. aurinia's host plants have been shown to vary across the range of this butterfly and they belong mainly to the families Dipsacaceae, Caprifoliaceae and Gentianaceae. In the study area the larvae feed on different plants, namely *Gentiana cruciata* L., *Cephalaria leucantha* (L.) Roem &

Schult, *Lonicera caprifolium* L. and *Scabiosa columbaria* L. (Pinzari, Pinzari and Sbordonì, unpublished data), with spiders and different insects (Orthoptera, Heteroptera, Diptera, Hymenoptera and Blattellidae) that usually frequent the larval nests of *E. aurinia*.

In literature predation by Heteroptera has been observed in the American Checkerspot, *E. editha* (Boisduval, 1852) and *E. gillettii* (Barnes, 1897), and the European Checkerspot, *E. maturna* (L., 1758). In particular Moore (1989) reported that an unidentified species of stilt bug (Berytidae) consumed part or all of several egg clusters in *E. editha*. In *E. gillettii*, Williams et al. (1984) said that up to 30% of the egg masses are lost entirely during the developmental period due to heavy predation; the predators of eggs and larvae are erythroid mites, beetle larvae, moose and cattle including not identified myrid bugs. Additionally, Van Nahuys & Hanski (2004) list predation on neonate *E. gillettii* by unspecified Miridae. As for *E. maturna*, Vrabec & Jindra (1998) documented attacks by *P. bidens* to butterfly larvae on nests in ash tree in Central Bohemia. In *E. aurinia aurinia*, two reviews (Ehrlich & Hanski 2004; Van Nahuys & Hanski 2004) citing Wilkinson (1907) reported larvae and adults of heteropterans as predators but the species were not identified.

At present, among the heteropterans, only *Picromerus bidens* (Fam. Pentatomidae) is known as a regular predator of the *Euphydryas aurinia aurinia*: "The bugs attack both exposed caterpillars either inactive caterpillars hidden in silken webs. When feeding on exposed caterpillars, the

bug typically approached the larval mass, stalked a larva with proboscis, walked a few centimeters away and sucked with its proboscis protruding onwards. After consuming the butterfly larva the bug returns to the larval group and select another caterpillar. When attacking larvae hidden in the web, the bug first explored web surface, trying to locate an opening, then punctured the encasing silk and poked its proboscis within the web for a few seconds, until it pierced a larva” (Konvička et al. 2005). Moreover, two attacks were also observed by nymphs of *P. bidens* to handicapped adult butterflies. The authors believe that *P. bidens* can act as a substantial mortality factor in small colonies of *E. aurinia aurinia* (Konvička et al. 2005).

The main purpose of this paper is to show the preliminary results of a field study aiming to identify predators of the Marsh Fritillary *Euphydryas aurinia* spp. *provincialis* in Central Italy. I report here the observations of predation by the myrid bug *Deraeocoris schach* (Fabricius, 1781) on post-hibernation larvae of *E. aurinia*. Additionally, other species of heteropterans associated to the checkerspot host plants were noted.

Material and methods

Observations were carried out in some areas located between 900 and 1300 m in the surroundings of Vallemare (42.4836N, 13.1148E) in the Central Apennines (Rieti, Italy). The Hemiptera were photographed in the field and/or collected on sight. The specimens are kept in Pinzari Collection.

The determination of the Heteropterans was made on the basis of the habitus of specimens and by photographs taken in the wild with the support of Paride Dioli (Sondrio, Italy).

Results

HETEROPTERA

Fam. Miridae

Deraeocoris schach (Fabricius, 1781)

Records. Italy, Vallemare (RI), Colle Marcone, 1121 m, 22 Aug 2014, Manuela Pinzari lgt, 1 adult.

Distribution. *Deraeocoris schach* is a southern European species that is present throughout the Mediterranean region. In Italy it is particularly widespread in the Central-Southern Regions and Sicily, while in the Northern Regions and Sardinia it is known for sporadic locations (Carapezza & Faraci 2005; Carapezza 2007).

Biology. The biology is little known; however it belongs to

a genus including several species well known as predators of lepidopteran larvae (Stultz 1955; Parrella et al. 1981; Wheeler 2000, 2001). Moreover, it was listed among predators of the species of the family Aphididae, harmful to pome and stone fruit trees (Erkin 1983). Adults are found from May to August on different plants: *Clematis* sp., *Echium* sp., *Lapatera* sp., *Spartium* sp., *Juniperus* sp. and *Quercus* sp. The species overwinters as eggs (Wagner & Weber 1964).

Notes. On 22 August, 2014 (12 P.M.) I observed a single adult (male) of *D. schach* on a larval web on *S. columbaria* and *L. caprifolium*; the bug attacked a caterpillar of *E. aurinia* a few centimeters away from the larval nest and with its rostrum sucked it (Fig. 1).

Fam. Lygaeidae

Spilostethus saxatilis (Scopoli, 1763)

Records. Italy, Vallemare (RI), Fonte Perara, 980 m, 12 Aug 2012, Mario & Manuela Pinzari lgt, 1 adult; ibidem, 17 Aug 2012, 1 adult; Vallemare (RI), Tornante Pian Matano - Malepasso, 1170 m, 22 Aug 2012, Mario & Manuela Pinzari lgt, 1 nymph; ibidem, 31 Aug 2014, Mario & Manuela Pinzari lgt, 1 adult.

Distribution. *S. saxatilis* is a Turano-European-Mediterranean species. Widely distributed in Italy, including Sardinia and Sicily (Péricart 1998).

Biology. As many other widely distributed species, this is a phytophagous species that feeds on both herbaceous and shrub plants belonging mainly to the families Rosaceae, Apiaceae and Asteraceae (Dioli 1997; Péricart 1998). According to Putshkov, both larvae and adults also feed on seeds of Poaceae and Dicotyledons (Péricart 1998). In Italy, the species is linked to *Mentha longifolia* L. Huds. (Péricart 1998) and *Colchicum autumnale* L. (Dioli 1997).

Notes. On August 22, 2012 a single nymph was observed on a pre-diapause nest of *E. aurinia* in Hairpin Pian Matano 1250 m; it was eating the excrements of the caterpillars (Fig. 2). Furthermore, in August several adults of *S. saxatilis* were observed on *E. aurinia* larval nests on *Gentiana cruciata*, in Fonte Perara 1000 m; some of these nests were still occupied by caterpillars and some had been abandoned by larvae after exhausting the host plant; each nest was always occupied by a single adult and this showed a cautious behaviour whenever I came close to it; in particular, the bug quickly moved and hid in the vegetation to prevent probably a potential danger or predator attack. I have seen an adult of *S. saxatilis* inside a nest abandoned by *E. aurinia* caterpillars, but never bugs eating the

faeces of caterpillars or preying larvae. A large group of adults was also observed sitting on *Gentiana cruciata* in Cagno, 1500 m, where *E. aurinia* was reported (Pinzari et al. 2010) but there were neither nests nor larvae. Until now the association between *Gentiana* and *S. saxatilis* for feeding reason was unknown.

Fam. Pentatomidae

Palomena prasina (Linnaeus, 1761)

Records. Italy, Vallemare (RI), Colle Marcone, 1121 m, 17 Aug 2014, Mario Pinzari lgt, 1 second instar nymph (Fig. 3A); ibidem, 25 Aug 2014, Manuela Pinzari lgt, 1 third instar nymph (Fig. 3B).

Distribution. Subcosmopolitan, worldwide distributed in all the tropical, subtropical and warm regions of Europe, Asia, Africa and the Americas (Panizzi et al. 2000).

Biology. The species has up to five generations per year and is highly polyphagous, with a preference for leguminous plants; it is considered as a pest of several crops (Panizzi et al. 2000).

Notes. Nymphs of *P. prasina* were observed twice on the same nest of *E. aurinia* against its host plants *S. columbaria* and *L. caprifolium*. In the first case (17 Aug 2014), a 2nd instar nymph was eating the faeces of caterpillars (Fig. 3A), in the second case (25 Aug 2014), a 3rd instar nymph was only recorded over the larval web (Fig. 3B).

Graphosoma lineatum italicum (Müller, 1766)

Records. Italy, Vallemare (RI), Fonte Perara, 980 m, 17 Aug 2012, Mario Pinzari lgt, 1 ♂, 1 ♀, pair; ibidem, 6 Oct 2012, Mario Pinzari lgt, 1 fifth instar nymph.

Distribution. *G. lineatum* (Linnaeus, 1758) is a common Palearctic species subdivided into two subspecies: *G. lineatum italicum* is present in Italy in all regions excluding Sardinia where the nominotypical subspecies occurs (Pérricart 2010).

Biology. *G. lineatum* is a phytophagous true bug associated with host plants of the family Apiaceae (Dioli 1995; Johansen et al. 2010). During spring and early summer adult mate and oviposit several times before death. In late summer the fifth instar larvae moult into prehibernating adults (Johansen et al. 2010). After winter they feed on seeds of their host plants as well from the white flowering.

Notes. Adults of *G. lineatum* were observed in copulation on a stem of *S. columbaria* nearby a nest of *E. aurinia*,

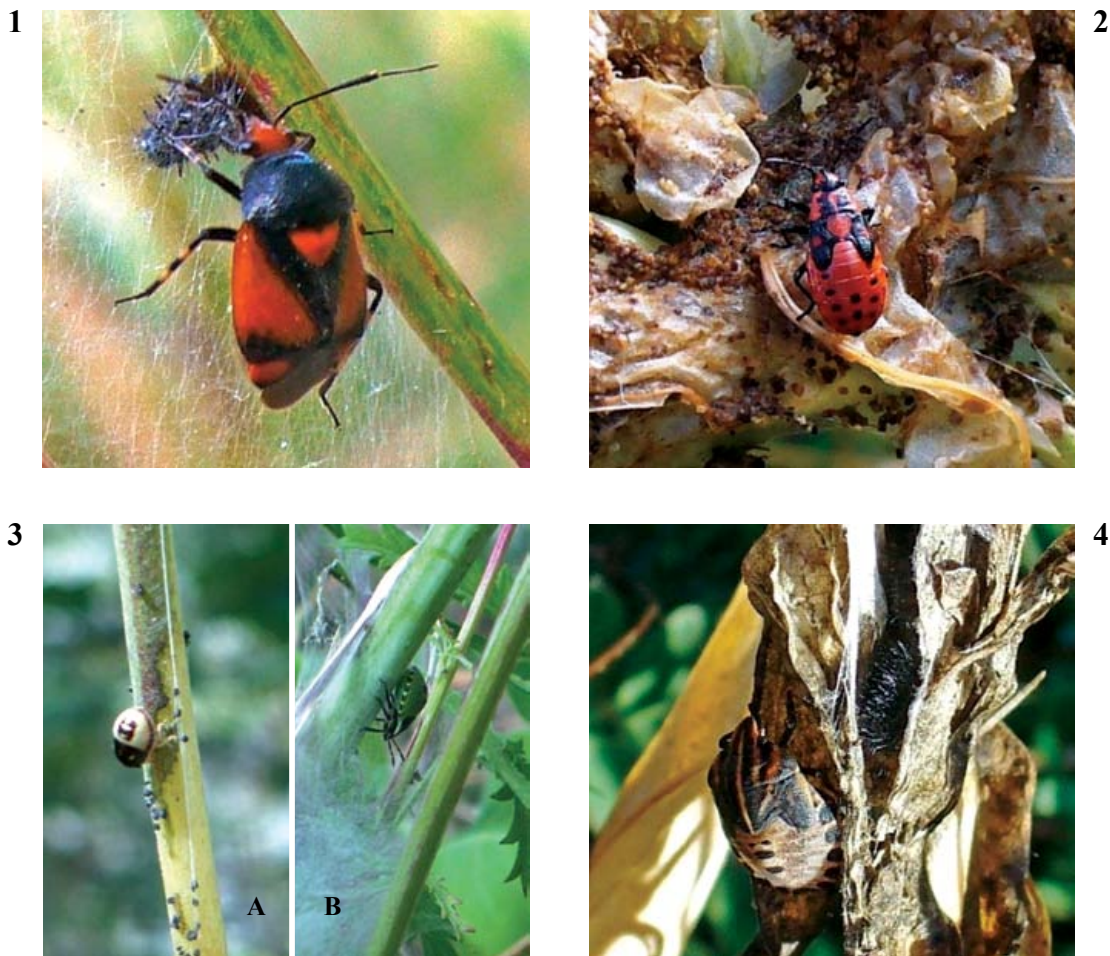
whose larvae had abandoned to move to another host plant, *G. cruciata*. On October 6, 2012 a final instar nymph was photographed on another nest on *G. cruciata*; this nest did not show any larva outside and the larvae of *E. aurinia* were at IV instar and already in diapause (Fig. 4). The observed nymph of *G. lineatum* was totally inactive.

Discussion

A single case of predation of *E. aurinia* larvae by *Deraeocoris schach* was observed in the study area. *D. schach* is a predator of small insects as other bugs of the genus *Deraeocoris*. The single observation of predatory behaviour in *D. schach* does not allow affirming that this species is a habitual predator of *E. aurinia* larvae like it is reported for *Picromerus bidens* L., 1758 (Hemiptera, Pentatomidae) by Konvička et al. (2005). A dedicated study on predatory behaviour on *E. aurinia* caterpillars would be needed to support our observations on *D. schach*. It would be fascinating to study whether this bug and other predatory heteropterans may act as a mortality factor on population of *E. a. provincialis* as suggested for some *Euphydryas* butterflies (Vrabec & Jindra 1998; Konvička et al. 2005).

The other heteropterans, *Palomena prasina* and *Spilostethus saxatilis*, are typically phytophagous and nymphs were mostly frequent on the *E. aurinia* nests showing a coprophagous feeding behaviour on larval droppings. The fact that bird and insect droppings are an attractive food source to phytophagous bugs was previously documented, and it is likely due to the uric acid (an insoluble compound rich in nitrogen) component of the faeces. Nitrogen is a major limiting factor in the diet of most phytophagous invertebrates (Chapman 2013). Uric acid is the end product of purine metabolism in both birds and insects, and is not normally utilized as a nutrient by animals. Limiting nutrients such as nitrogen and sodium are often obtained via extra-phytophagous feeding in insects. In literature there have been two previous records of this behaviour on bird droppings recorded for six species of nymphal Pentatomidae (Londt & Reavell 1982) including *P. prasina* (Ramsay 2013) suggesting that such behaviour recycles uric acid and supplements the bug's diet. Accordingly, my observations on nymph coprophagy in *P. prasina* and *S. saxatilis* let me suppose that not adult but only the juveniles stage of these species needs to integrate the diet with nutrients included in butterfly larval excrements. Further observations would be needed to understand a potential association of *Graphosoma lineatum* to *E. aurinia* caterpillars.

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Figs 1-4 – 1, *Deraeocoris schach* (Fabricius 1781), an adult that sucks a caterpillar of *E. aurinia* from a nest on the hostplants *S. columbaria* and *L. caprifolium*. (Photo by Manuela Pinzari); 2, *Spilostethus saxatilis* (Scopoli 1763), a nymph that feeds caterpillar droppings on larval web of *E. aurinia* on *G. cruciata*. (Photo by Mario Pinzari); 3, *Palomena prasina* (Linnaeus 1761): A, 2nd instar nymph that feeds larval droppings; B, 3rd instar nymph on a nest on *S. columbaria*. (Photo by Manuela Pinzari); 4, *Graphosoma lineatum italicum* (Müller, 1766), a final instar nymph on *E. aurinia* hibernating nest on *G. cruciata*. (Photo by Mario Pinzari).

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