COPROPHAGOUS FEEDING BEHAVIOUR BY TWO SPECIES OF NYMPHAL PENTATOMID

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ABSTRACT

Final instar nymphs of the shieldbugs *Palomena prasina* (L.) and *Pentatoma rufipes* (L.) were observed feeding in the white part of bird droppings. This part consists mostly of uric acid, an insoluble compound rich in nitrogen, but potentially a rich source of nutrients to the nymphs if they possess the necessary metabolising endosymbiont bacteria found in other hemipteran groups. This is only the second recorded occurrence of coprophagy in nymphal Pentatomidae. A review of coprophagous feeding behaviour in the Pentatomoidea identified six species of Pentatomidae and one species of Scutelleridae. Coprophagous feeding remains unconfirmed in Cydnidae.

INTRODUCTION AND OBSERVATIONS

On 8th July 2007 final instar nymphs of *Palomena prasina* (L.) (Pentatomidae; Carpocorini) and *Pentatoma rufipes* (L.) (Pentatomidae: Pentatomini) were observed feeding on the white part of fresh bird droppings on wooden fence posts along a woodland margin in Wokingham, Berkshire (SU826695). In each case only a single nymph was recorded of each species exhibiting this feeding behaviour.

There has been only one previous record of this behaviour recorded in the literature for species of nymphal Pentatomidae (Londt & Reavell, 1982), suggesting that such behaviour is rare or at least rarely recorded. As the white part of bird droppings consists mostly of uric acid, it is suggested that these nymphs were specifically seeking out a source of dietary uric acid in order to supplement their diet.

DISCUSSION

Adler and Wheeler (1984) suggested that bird droppings are an attractive food source to seed-eating bugs as they contain partially digested seeds, however, in both instances involved here the bugs were feeding on the liquid white part of the droppings. This part of bird droppings consists mostly of uric acid, an insoluble compound rich in nitrogen (Hill *et al.*, 2012). Nitrogen is a major limiting factor in the diet of most phytophagous invertebrates (Chapman, 2013). Limiting nutrients such as N and Na are often obtained via extra-phytophagal feeding in insects, such as through the 'mud-puddling' behaviour exhibited by butterflies in the tropics, where sodium and other limiting minerals are obtained by feeding from the margins of drying puddles (Beck, Mühlenberg & Fielder, 1999).

Uric acid is the end product of purine metabolism in both birds and insects, and is not normally utilised as a nutrient by animals. However, in some cases where it is known to be recycled (e.g. in cockroaches (Dictyoptera) and termites (Isoptera)) the necessary metabolic conversion is done by symbiotic bacteria, either within the gut or fat body (Sabree, Kambhampatic & Moran, 2009). Within the Hemiptera, presence of endosymbionts has been confirmed in the Sternorrhyncha, which are obligate sap feeders, and this endosymbiotic association is essential for the synthesis of amino

Table 1. Pentatomids showing coprophagy

Tribe	Species	Food source	Reference
Carpocorini	*Palomena prasina* (L.)	Bird droppings	This paper
Halyini	*Orthoschizops ?obsoletus* Dallas	Lizard dung	Londt & Reavell (1982)
Halyini	*Orthoschizops ?plagosa* Distant	Lizard dung	Londt & Reavell (1982)
Halyini	*Brochymena carolinensis* (Westwood)	Bird droppings	Adler & Wheeler (1984)
Pentatomini	*Pentatoma rufipes* (L.)	Bird droppings	This paper
Podopini	*Podops inuncta* (F.)	Mammal dung	Adler & Wheeler (1984); Southwood & Leston (1959)

acids, the building blocks of proteins (Baumann, 2005). Similar endosymbiotic associations have also been recorded in the Coccoidea and Auchenorrhyncha (Gruwell, Morse & Normark, 2007).

Within the Hemiptera-Heteroptera, the shield bug *Parastrachia japonensis* (Scott) (Parastrachiidae) is capable of recycling uric acid (Kashima, Nakamura & Tojo, 2006; Hosokawa *et al*., 2010) due to the presence of symbionts in the gut, and a similar mechanism has been suggested for other shield bugs including *Plautia stali* Scott (Pentatomidae) (Kashima, Nakamura & Tojo, 2006). It is unclear if both *P. prasina* and *P. rufipes* nymphs have a mechanism to recycle uric acid, but if present it suggests that gut endosymbionts capable of recycling uric acid might be more widespread than previously thought amongst the Pentatomidae. Coprophagy has however, only rarely been recorded in the Pentatomidae, with a total of six species in which it has been definitely observed (see Table 1).

Londt and Reavell (1982) noted two species of *Orthoschizops* spp. (Pentatomidae: Halyini) feeding on lizard dung in South Africa. These were an adult female of *O. ? plagosa* Distant and a male, female and two final instar nymphs of *O. ? obsoletus* Dallas. The latter is the only other instance of nymphal feeding on dung recorded in the literature. They also noted *Solenostethium liligerum* Thunberg (Scutelleridae) feeding on goat dung in Botswana, apparently the only literature record of this family exhibiting coprophagy.

Adler and Wheeler (1984) recorded two species of Pentatomidae with coprophagous feeding behaviour: a female *Brochymena carolinensis* (Westwood) (Pentatomidae: Halyini) on bird droppings in the United States, and *Podops inuncta* (F.) (Pentatomidae: Podopini) on mammal dung, the latter cited from Southwood and Leston (1959) in Britain. The only other recorded occurrence of potential coprophagy is by Constant (2007), who noted a single occurrence of an adult *Sciocoris* (species indet.) (Pentatomidae: Sciocorini) on dog droppings, but he did not observe feeding taking place and hence it is not included in Table 1.

Ten species of Cydnidae have been recorded from pitfall traps baited with human excrement in Asia (Lis, 1994; Constant, 2007), though none was observed to feed directly, in common with the two other species of Cydnidae listed by Adler and Wheeler (1984). Therefore coprophagous feeding behaviour in the strictest sense has never been observed directly in the Cydnidae.

Coprophagous feeding behaviour in the Pentatomoidea has been recorded in six species in four tribes of the Pentatomidae with a single observation in the Scutelleridae. It is likely that other examples of this rarely recorded feeding behaviour will be detected as its occurrence does not appear to be confined to any particular family or tribe within the Pentatomoidea.

Additional examples of coprophagous feeding behaviour seem most likely in the Halyini, as it has been recorded in three species in this tribe from North America and Africa (Londt & Reavell, 1982; Adler & Wheeler, 1984). The observations on nymphs presented here add two additional species and two tribes, neither of which have previously been recorded as coprophagous.

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