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Are gregarious red-black shieldbugs, *Graphosoma lineatum* (Hemiptera: Pentatomidae), really aposematic? An experimental approach

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ABSTRACT

Hypothesis: The coloration of the red-black shieldbug has a warning function. This quality can be lowered when the shieldbug is presented on a fragmented background.

Organism: We offered wild-coloured and artificially deaposematized (painted brown) red-black shieldbugs (*Graphosoma lineatum*) to avian predators (*Parus major*, *Parus caeruleus*).

Site of experiments: The experiments were conducted in a cage (0.7 m × 0.7 m × 0.7 m) fitted with a one-way mirror.

Methods: In succession, we offered five shieldbugs to each bird. We presented the shieldbugs on contrasting (white) and matching (imitating the shieldbug's habitat and imitating the striated shieldbug pattern) backgrounds.

Results: The blue tits avoided all shieldbugs offered to them regardless of their coloration. The great tits attacked both colour forms, but the brown one more frequently. The wild-coloured shieldbugs were significantly better protected against repeated attacks. Shieldbugs presented on any of the matching backgrounds were attacked less frequently than when presented on the white background.

Keywords: disruptive coloration, *Parus caeruleus*, *Parus major*, warning coloration.

INTRODUCTION

Warning (aposematic) colouration, which provides protection to a defended species against visually oriented predators (usually birds), is a controversial topic in evolutionary ecology. The initial evolution of aposematic anti-predator signalling is expected to increase predation risk before reaching a stage when local predators are able to learn to avoid the unpalatable prey (see Lindström *et al.*, 2001; Marples *et al.*, 2005). Fisher (1958) presented the idea of aggregation benefit through the survival of related individuals. However, Riipi *et al.* (2001) showed that grouping would have been highly beneficial for aposematic prey individuals, surrounded by naive predators, without requiring any kin selection. They proposed four possible non-kin selection mechanisms: non-linear growth of detectability

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