Does the Mimetic Posture of Macaria aemulataria (Walker) (Geometridae) Larvae Enhance Survival Against Bird Predation?

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DOES THE MIMETIC POSTURE OF *MACARIA AEMULATARIA* (WALKER) (GEOMETRIDAE) LARVAE ENHANCE SURVIVAL AGAINST BIRD PREDATION?

Additional key words: predator-prey interaction, defense, behavior, caterpillar

Mimicry, in which one organism resembles another, is a widespread and important phenomenon in behavioral ecology (Wickler 1968; Ruxton *et al.* 2004). Mimesis, or the mimicry of inanimate objects such as twigs, leaves, bird droppings, the odor of plants, and so on, is also well known (Cott 1940; Edmunds 1974; Akino *et al.* 2004). Mimicry may include changes in morphological (e.g., hairs and spines) and behavioral traits, chemistry, and ecology, all aimed at enhancing escape and/or survival from predation (Edmunds 1974; Endler 1986). However, tests of the effectiveness of different forms of mimicry or mimesis, as anti-predator (sensu latu) defenses, are less common (but see Portugal & Trigo 2005). In this study we experimentally evaluated the survival advantage of the mimetic posture of larvae of *Macaria aemulataria* (Walker) (Geometridae) against a visually hunting predator, the tufted titmouse, *Baeolophus bicolor* (Paridae).

Macaria aemulataria has four instars and all are mimetic of leaf parts. Small instars tend to mimic the lateral ribs of leaves whereas larger instars tend to mimic the mid rib and petiole of leaves. Caterpillars occasionally feed during the day, but immediately stop feeding and return to their mimetic posture when birds land or move in their vicinity (I. Castellanos personal observation). They remain motionless in response to substrate-borne vibrations produced by foraging birds, but hang on a silk thread in response to substrate-borne vibrations generated by foraging invertebrate predators (Castellanos & Barbosa 2006). *Macaria aemulataria* is a specialist on species of *Acer* in riparian forests in Maryland, and has about three generations per year (Castellanos unpublished data). *Macaria aemulataria* larvae used in this study originated from adults collected at Patuxent Wildlife Refuge Research Center, Maryland (39° 03.639'N, 76° 44.244'W). Females from the field were allowed to oviposit in the laboratory and their larvae were reared individually in 237-ml plastic containers with *Acer negundo* L. (box elder) leaves before they were used in a trial.

The tufted titmouse is an omnivorous bird whose diet includes mainly arthropods, primarily caterpillars (Bent 1946). Its foraging behavior is characteristic of other passerine birds that also forage for arthropods among the foliage of forest trees (Robinson & Holmes 1982; Grubb & Pravosudov 1994). They typically attack prey items by employing a gleaning maneuver consisting of flights between branches and jumps along branches, taking stationary prey items after landing on a branch (Grubb & Pravosudov 1994). They tend to wait before either moving to another perch or before pursuing and capturing a detected prey (Robinson & Holmes 1982; I. Castellanos personal observations). Bird individuals used in this study were captured from a wooded area in Glenn Dale, Maryland (IACUC Permit No. R-02-38), and released in the same area after the trials ended.

Determination of mimesis as an anti-predator defense against birds. A branch with leaves from a box elder tree was placed inside a 1.25 × 1.25 × 0.65 m cage made of wooden frames and fish-netting, at an angle of approximately 75 degrees from the floor of the cage. We used these branches because *A. negundo* has symmetrical compound leaves and thus provides the ability to symmetrically present potential predators with equidistant prey options. To determine if the posture taken by fourth instars (and assumed to represent leaf-vein mimesis) enhances *M. aemulataria* survival against the tufted titmice, an individual fourth instar *M. aemulataria* was placed on each of nine branches (74.09 ± 3.14 cm (mean ± SEM) long) and allowed to settle for half an hour. This was sufficient time for a larva to assume a mimetic posture on a leaf, i.e., parallel and adjacent to the mid-vein. After the caterpillar chose a leaflet for posturing, another individual fourth instar was placed on the opposite leaflet at an equal distance from the branch. This caterpillar was placed perpendicularly to the mid-vein of the leaflet. In one of the nine trials, the released caterpillar selected a lateral leaf vein. In that trial the control larva was positioned perpendicular to the appropriate lateral vein on the opposing leaflet. In order to fix the position of the experimental caterpillar to a leaflet, two drops of glue were used, one to attach its thoracic legs and the other to attach its prolegs. To control for any effect of the glue, two drops of glue were placed on the leaflet that the normally posturing larva had selected. The distance between the mimetic and the control caterpillars was 16.18 ± 1.97 cm (mean ± SEM).

A single bird was introduced to the cage, where it could choose between the two caterpillars. Observations were conducted behind a black cloth through a 15 × 2 cm opening. Nine trials were conducted, each with a different bird, and for each trial the bird was exposed to different caterpillars on different branches. All trials were conducted in a naturally sunlit room at an ambient temperature of 25 ± 2°C. The choice of a caterpillar by the birds was analyzed with a binomial probability test (Sokal & Rohlf 1995).

In all nine trials, the birds took the non-mimetic (perpendicular to mid-vein) caterpillar. The probability that this result was due to chance is 0.002. Thus, we conclude that the birds did not readily perceive the mimetically positioned larvae. Given that in the field there are many other larvae that are not vein mimics (Barbosa & Caldas 2007), regardless of the proximate mechanisms, the mimetic coloration and perching behavior of larvae of *M. aemulataria* appears to enhance survival against bird predation.

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