Overcrowding Leads to Lethal Oviposition Mistakes in the Baltimore Checkerspot, Euphydryas phaeton Drury (Nymphalidae)

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OVERCROWDING LEADS TO LETHAL OVIPOSITION MISTAKES IN THE BALTIMORE CHECKERSPOT, *EUPHYDRYAS PHAETON* DRURY (NYMPHALIDAE)

Additional key words: *Asclepias syriaca*, Milkweed, *Plantago lanceolata*, Plantain, population explosion

Errors in oviposition choice have the potential to expand host plant range or, alternatively, result in death of offspring hatching from eggs laid on inappropriate host plant species (Chew 1977, Larsson and Ekbom 1995). *Euphydryas phaeton* Drury (Nymphalidae), the Baltimore Checkerspot, has relatively recently expanded its oviposition range to include the introduced plant species, Narrow-leaved or Ribwort Plantain, *Plantago lanceolata* L. (Plantaginaceae) (Stamp 1979, Bowers et al. 1992). *Plantago lanceolata* has proven to be a suitable host plant and populations of *E. phaeton* in certain parts of the Northeast are flourishing on this host (Bowers et al. 1992, Bowers, pers. obs.; 4th of July butterfly count Rhode Island/Tiverton circle, 2012). *Plantago lanceolata* was introduced into North America approximately 200 years ago (Cavers et al. 1980) and a variety of native lepidopterans (including both specialist and generalist taxa) have incorporated this species into their diet (Robinson et al. 2002). The primary native ovipostion host plant for *E. phaeton* is Turtlehead, *Chelone glabra* L. (Plantaginaceae), a species that is found in wetlands and is becoming less common as wetlands are disappearing. *Aureolaria flava* (L.) Farw. (Orobanchaceae) is used as an oviposition plant for populations designated as the subspecies *E. phaeton ozarkae* (Masters 1968) in the Midwest.

Euphydryas phaeton is a specialist on plants that contain iridoid glycosides (Bowers 1980, Bowers et al. 1992) and the incorporation of *P. lanceolata* as an oviposition plant is likely due, at least in part, to the similarity in the iridoid glycoside profiles of *P. lanceolata* and *C. glabra* (Bowers et al. 1992). Iridoid glycosides are bitter compounds found in plants in more than 50 families (Jensen 1991). Both Turtlehead and Ribwort Plantain contain the same two iridoid glycosides, aucubin and catalpol (Bowers et al. 1992). All host plant species on which Baltimore Checkerspot larvae feed contain iridoid glycosides (Bowers 1980, Bowers et al. 1992) and these insects have the ability to sequester these compounds, rendering them unpalatable to many of their natural enemies (Bowers 1980, Bowers and Farley 1990). While *E. phaeton* populations on Turtlehead are typically relatively small and localized, populations on Ribwort Plantain may become quite large. For example, in a survey of a *P. lanceolata*-feeding population in southeastern Massachusetts in the early 1990's, counts of post-diapause larvae at two different sites estimated thousands to tens of thousands of individuals (Bowers, pers. obs.).

A more recent survey of adults from a population on June 19, 2010, in Bristol, Rhode Island, in a field of approximately seven acres, revealed a population estimate of over 3,200 individuals of *E. phaeton*. Counts of adults from 2009 had shown similarly high numbers (E. Marks, pers. obs.). This population uses *P. lanceolata* for both oviposition and larval feeding, and at the time of the survey, although old flowering stalks of *P. lanceolata* were observed, all plants that we found had been eaten down to the ground. On the day of the survey, both adult males and females were observed and late instars and uneclosed pupae were common. Larvae had dispersed out of the field, through the woods (approximately 8–10 meters), apparently in search of food, and were seen in large numbers on the side of the road. The only other potential host plant observed at this site was *Nuttalanthus* (formerly *Linaria*) *canadensis* (L.) D.A. Sutton (Plantaginaceae), which also contains iridoid glycosides (Mizouchi et al. 2011); however, this is not a preferred host plant (Bowers, pers. obs.). No *Plantago major*, another potential host plant, was observed at this site.

Large numbers of adults were observed nectaring on Common Milkweed, *Asclepias syriaca* L. (Asclepiadaceae) present in the field. To our surprise, we also found several egg masses of *E. phaeton* on this plant (Fig. 1)! *Asclepias syriaca*, like other milkweeds, contains a very different group of chemical compounds, cardiac glycosides (Malcolm 1991). These compounds are responsible for the unpalatability of the Monarch, *Danaus plexippus* L. (Nymphalidae) and the latex produced by milkweeds is rich in these compounds and deterrent and toxic to a variety of herbivores (Malcolm 1991). Although extensive searches were not made, no egg masses were observed on other plant species.

A search of 157 ramets of *A. syriaca* over 30 cm in height revealed 19 *E. phaeton* egg masses or their remains occurring on 15 individual plants, four plants had two egg masses. In some cases, egg masses were next to each other on the same leaf; in others they were on different leaves (Fig. 1A, B, D). On three individual ramets, larvae had moved from their egg masses to the top of the plant and were starting to make webs (Fig

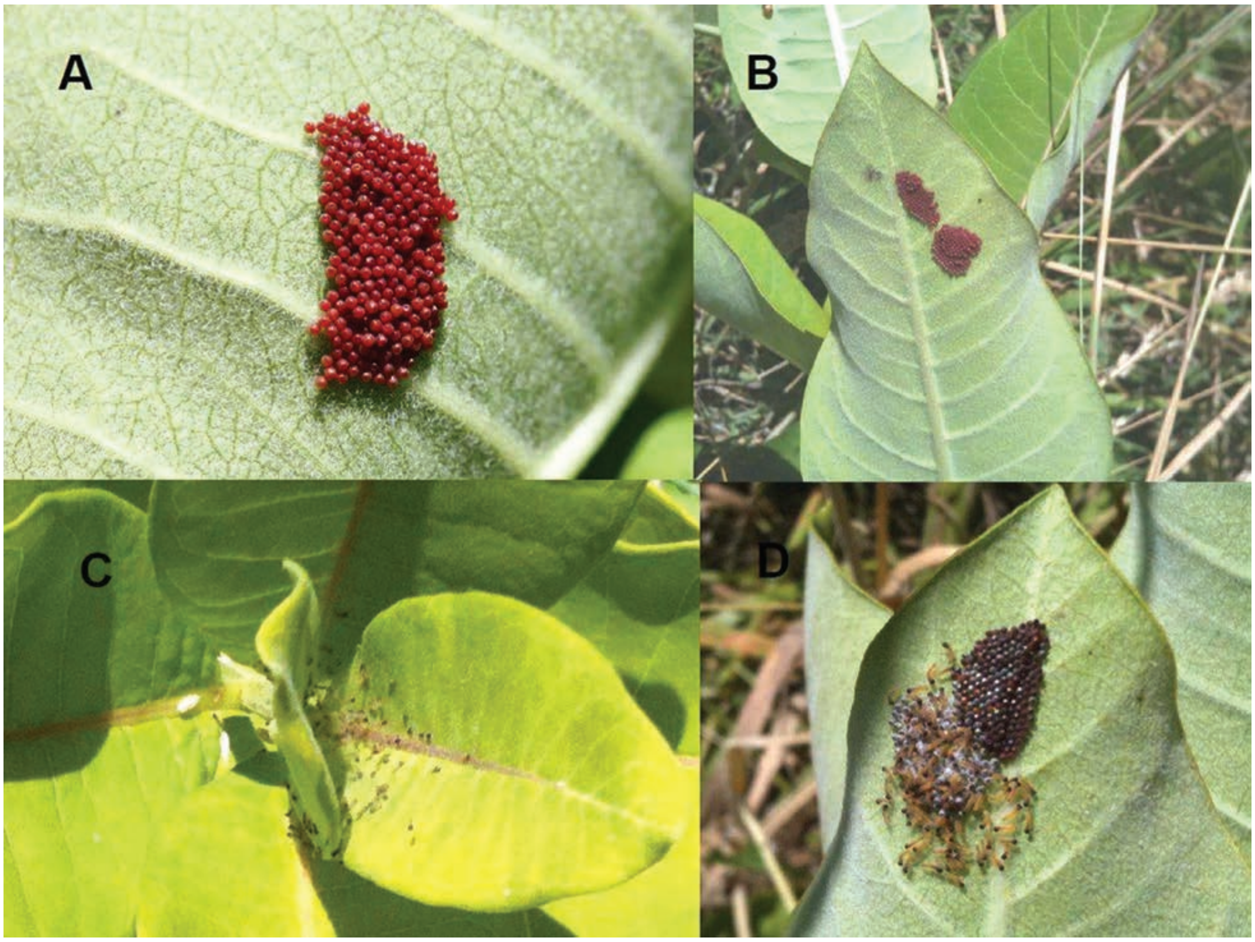

FIG. 1. **A.** Single egg mass of *E. phaeton* on *A syriaca* leaf. **B.** Two *E. phaeton* egg masses on *A syriaca* leaf. **C.** Newly hatched *E. phaeton* larvae that had left the site of their egg mass and moved to the top of the *A. syriaca* ramet. **D.** A mass of newly hatched *E. phaeton* larvae next to an unhatched egg mass on *A. syriaca*.

1C), typical behavior for newly hatched *E. phaeton* larvae. In one of these, most larvae were dead. In at least two other cases, empty egg cases were observed and there were many dead and no living larvae. Given the cardiac glycoside and latex content of this milkweed, it is highly unlikely that any larvae would survive and a later visit provided no evidence of successful larval establishment.

The obvious question is, why did *E. phaeton* females oviposit on a completely unsuitable host plant? There are several contributing factors to this oviposition mistake. First, the appropriate oviposition plant, *Plantago lanceolata*, was unavailable, since the post-diapause larvae had decimated these individuals, eating them down to the ground. Second, *Asclepias syriaca* was one of the most common nectar sources in this population and adults were abundant on the flowers during our survey; thus females would frequently encounter this plant. Third, although females unable to find suitable oviposition plants are likely to disperse, this field was surrounded by unsuitable habitat (forest) that discouraged dispersal. Finally, this milkweed has a growth form quite similar to the native host plant, Turtlehead; although the chemical cues would be quite different. As a result, females searching for a suitable oviposition site could make such an oviposition error, which will be lethal for their offspring. Thus overcrowding and decimation of the suitable host plant species, *P. lanceolata*, by post-diapause larvae led to inappropriate oviposition choices by female *E. phaeton*.

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