Veterinary Pediatrics of Butterflies, Moths, and Other Invertebrates

Thomas C. Emmel, PhD[a,b,c,*]

KEYWORDS
• Butterflies • Moths • *Lepidoptera* • Eggs • Larva • Pupae

In the life cycle of invertebrate animals, the typical life history includes the egg and larval stage, which may be called the pediatric phases, representing development up to the point where the animal reaches adulthood with fully functional reproductive organs and full adult characteristics of morphology, coloration, physiology, and behavior. These typical immature or pediatric stages are found in both terrestrial and aquatic invertebrates.

In insects, by far the most speciose and numerically abundant invertebrates, the metamorphosis from egg to larva to adult may include a fourth stage, between the larva and the adult, called a pupa. This pupal stage, sometimes referred to as a "resting" stage because of its general immobility, is anything but resting. Instead, there is a dramatic breakdown and reorganization of larval tissues and cellular components into the new adult tissues and organs, all within a hard pupal shell. A complete metamorphosis (such as found in the butterflies and moths of the order Lepidoptera) will progress through egg, larval, pupal, and adult stages (**Figs. 1–6**). A species with an incomplete metamorphosis lacks the pupal stage and goes through the egg, larval (or nymphal), and adult progression.

Thus, from the viewpoint of a veterinarian, dealing with pediatric concerns, we are concerned with the maladies and problems associated with the egg, larval, and (if present) pupal stages of an insect or other invertebrate life history. Such veterinary medicine concerns are literally in their infancy. While much work has been done by economic entomologists focusing on ways to kill the development stages of crop pest insect species, there has been little effort until recently to consider ways to prevent diseases and other problems that beset early insect life cycle stages. However, with

---

The author has nothing to disclose.

[a] Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611, USA
[b] McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, PO Box 112710, Gainesville, FL 32611, USA
[c] Department of Zoology, University of Florida, Gainesville, FL 32611, USA
* McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, PO Box 112710, Gainesville, FL 32611.
E-mail address: tcemmel@ufl.edu

Vet Clin Exot Anim 15 (2012) 279–288
doi:10.1016/j.cvex.2012.02.003 **vetexotic.theclinics.com**
1094-9194/12/$ – see front matter

Fig. 1. The healthy, mature caterpillar of the Monarch butterfly (*Danaus plexippus*) will evidence a firm (taut) integument and extended front and rear tentacles, feeding every hour or so. A larva infected with pathologic virus or bacteria will have a flaccid skin and drooping tentacles, and may expel (via anus and mouth) a green liquid.

the rise since the 1980s of hundreds of commercial live butterfly display houses in England and subsequently across the world, there is now a demand for the application of care standards in zoos, aquariums, museums, and private enterprises such that butterflies and other invertebrate livestock have protection approaches similar to standards set already for birds, mammals, reptiles, amphibians, and fish (**Figs. 7** and **8**). The economic value of butterfly livestock alone raised each year on butterfly farms, and displayed to the public in specially constructed butterfly houses for the public to enjoy, now exceeds $1 billion. Thus, a longer adult life, greater chances of eggs and larvae and pupae surviving to the adult stage, and greater application of maintenance issues for the health of these adults for a proper diet and protection from disease will all contribute to healthy captive animals and thus more dynamic displays of these invertebrates. Additionally, a great increase in public interest in butterfly gardening at home, coupled with hand-rearing of local and exotic species at home for personal enjoyment and even companionship, makes it useful for a veterinarian to know the basic needs for maintaining healthy invertebrates through their life cycles, especially those of the butterflies and moths that people encounter and bring into their homes in their everyday activities or that are displayed in large numbers at public attractions.

This article reviews the factors that impact the health and survival of juvenile stages of butterflies and moths in particular, and what can be done to extend veterinarian care and advice to clients regarding invertebrate problems. As with vertebrates, in practice it is far easier to exercise prevention than to find and apply cures for these problems, at our present state of knowledge.

PROBLEMS WITH BUTTERFLY AND MOTH JUVENILE STAGES

In nature, the vast majority of eggs and larvae are destroyed by predators, parasitoides, and diseases that afflict them before they reach the adult stage. Of all the eggs a female can potentially produce, less than 1% will, on the average, survive to produce a replacement adult female and male. When a butterfly species is kept in