



Figure 1. Scanning electron micrograph of the respiratory process of a tachinid puparium (unfortunately a bit molded). It is unusual because it is covered by lepidopteran scales due to the development of the maggot in an adult moth. Bar: 100  $\mu\text{m}$ .

Figure 2. The beautifully aposematic and day-active *Dinia* and *Parethria* (Ctenuchini) gathering PAs are probably well protected against vertebrate predators – but vulnerable to parasitic flies.

# Adult Lepidoptera are not parasitised — or are they?

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Adult butterflies and moths are a major food resource for all kinds of vertebrates and invertebrates but, it seems, not for parasites and parasitoids. Although Lepidoptera are the most collected and most reared insects, and there is a wealth of knowledge about parasitoids of their eggs, larvae and pupae, almost nothing is known on parasitisation of adults. Why is that so? For several other insect orders (e.g. Coleoptera, Hymenoptera, Orthoptera) there is considerable knowledge of adult parasites and parasitoids (Clausen 1940, Godfray 1994, Feener & Brown 1997, Stireman et al. 2006, and refs therein).

Is there a bias due to collecting practices? Many lepidopterists rear butterflies and moths in captivity to

get perfect specimens for their cabinets. These are usually killed instantly to preserve them in the best possible condition. If adults are kept alive, e.g. for egg-laying, they are normally housed in cages where the emergence of a maggot is unlikely to be noticed—within minutes it would hide for pupation. Thus, is there little chance for parasites or parasitoids to reveal themselves to science? For many lepidopterists parasitoids are more a nuisance than a fascinating subject—and many observations may have been made but remain unreported in the literature. The very few records of adult parasitisation in Lepidoptera which I could find (Table 1) are accidental and do not encourage us to look for or expect to find parasites or parasitoids in adult Lepidoptera.

Adult lepidopteran host		Parasite / parasitoid		Reference
<i>Nyssia lapponaria</i>	Geometridae	<i>Phryxe vulgaris</i>	Tachinidae	Cockayne 1911
<i>Zygaena lonicerae</i>	Zygaenidae			Edelsten 1933
<i>Schistostege decussata</i>	Geometridae	indet.		Smith 1981
<i>Morpho thesus</i>	Morphidae	indet.		DeVries & Wolf 1979
<i>Actinote diceus</i>	Nymphalidae: Acraeinae	<i>Arachnidomyia</i> sp.	Sarcophagidae	Greeney & Stireman 2001
<i>Cucullia lucifuga</i>	Noctuidae	<i>Arachnidomyia</i> (as <i>Sarcophaga</i> ) <i>aldrichi</i>		McCabe 1998

Published records of Diptera parasitising adult Lepidoptera. Further, Haber (1978) reports: "Parasitoids of adult ithomiines ... include ... a larval dipteran that lives as an internal parasite on the female reproductive system" but he does not give any further details.

In the course of chemoecological studies on a community of Ctenuchini (Arctiidae) in Costa Rica we have found 1–5 dipteran maggots in adult moths which had been collected at light and/or pyrrolizidine alkaloid baits. Details are to be reported elsewhere when the project is further advanced. So far, we have found maggots in 6 ctenuchine species of 6 genera, and in one case the infection rate was almost 30%. This suggests that parasitisation of adult Lepidoptera by tachinids is anything but exceptional. The many questions that immediately arise include "how do the maggots influence the fitness of their host?", "what is their host specificity?", and "when does infection occur?", but at present we have nothing other than speculation.

Tachinidae, which are normally thought of as straight-forward host-killing parasitoids, do not in fact always kill their hosts (e.g., DeVries 1984), and occasionally it might happen that a larva-pupal parasitoid does not hatch 'in time' and then emerges from an adult moth or butterfly (Jim Mallet, pers. comm.). Also, colleagues mention that 'every now and then' when setting Lepidoptera specimens a maggot can appear, and that structures which could stem from parasites are found when investigating KOH macerated material in the context of genitalia studies (Axel Hausmann, pers. comm.). "I have found the odd fly puparia in my glassine envelopes, but have not done anything with that story of long ago" (Phil DeVries, pers. comm.).

This note is meant to draw attention to and stimulate a close look at parasitisation of adult Lepidoptera. Not only insects but also other endoparasites of adult Lepidoptera such as nematodes are worth considering. The author would greatly appreciate receiving any comments, observations or references.

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