**ANTHRENUS MUSEORUM** (COLEOPTERA: DERMESTIDAE), AN EGG PREDATOR OF _LYMANTRIA DISPAR_ (LEPIDOPTERA: LYMANTRIIDAE) IN CONNECTICUT AND A REVIEW OF DERMESTIDS AS GYPSY MOTH EGG PREDATORS

Paul W. Schaefer², R. S. Beal, Jr.³

ABSTRACT: Larvae of *Anthrenus museorum* were collected in egg masses of *Lymantria dispar* in Tolland Co., Connecticut, in March 1982. Field evidence and subsequent laboratory rearing confirmed predation on viable moth eggs. In Japan and South Korea, several new collection records and a possible new species of *Trogoderma* from Japan are reported. The first recovery of *Cryptorhopalum ruficorne* in Delaware is included. Dermestids in the role as predators on gypsy moth eggs worldwide and at high moth populations the impact may be significant. This form of egg predation has not been thoroughly studied.

Dermestid beetles (Coleoptera: Dermestidae) are known principally as pests of stored products, carpets, dried animal tissues (e.g. skins, furs, feathers, insect collections), and a wide variety of other organic matter (Griswold 1941; Hinton 1945). A catalogue of the Dermestidae of the world, including distributions, was compiled by Mroczkowski (1968).

The association of dermestid beetles with gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae), eggs was recognized long ago (Forbush & Fernald 1896; Burgess 1899) but the significance and impact of this association remain elusive. There have been many anecdotal accounts of finding larval dermestids feeding in gypsy moth egg clusters but little has been done to clarify the impact of this predation, with the possible exception of the study by Nonveiller (1959). Usually larvae are found to have hollowed out a portion of an egg mass. Few have determined to what extent this form of egg predation has contributed to gypsy moth egg mortality. In the process of tunneling within an egg mass, disruption of the protective setae covering the egg mass occurs. It has been suggested that this is important since it enhances parasitism by egg parasitoids, e.g., *Ooencyrtus kuvanae* (Howard) (Hymenoptera: Encyrtidae) and *Anastatus japonicus* Ashm. (Hymenoptera: Eupelmidae), by making more eggs in a cluster accessible to these parasitoids (Mason & Ticehurst 1984). Under field conditions, Nonveiller (1959) concluded that dermestids had a significant impact on gypsy moth egg survival under outbreak conditions, sometimes ac-

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counting for up to 50% mortality of viable eggs; many dermestids were also found in old egg clusters where they were clearly feeding as necrophagans and not predators. At lower population levels the impact is greatly diminished (Nonveiller 1959). It appears that mortality of the gypsy moth egg stage due to dermestid predation is directly density dependent; this has yet to be experimentally confirmed.

FIELD COLLECTION

**North America**: The senior author collected a number of dermestid larvae in egg masses of gypsy moth at Willington, Tolland Co., Connecticut, on March 16, 1982. Egg masses with dermestid larvae were found under the eaves and roof overhang on a building adjacent to gypsy moth infested forests. At least one predatory larva was found in a gypsy moth egg mass on a *Quercus rubra* L. trunk adjacent to the building. As egg masses were scraped off the building, tunneling and apparent destruction of viable eggs were evident. Collected dermestid larvae were returned to the laboratory and allowed to complete development in the presence of the remains of the field collected egg masses or on laboratory reared eggs. In total, 14 adult dermestids were reared from the Willington material.

These adults, subsequently identified as *Anthrenus museorum* (L.) (Coleoptera: Dermestidae), were introduced into pint paper cartons and provided with laboratory reared gypsy moth egg masses. During exposure to fresh gypsy moth egg masses, viable eggs were deposited; subsequently a new generation of dermestids was reared exclusively on gypsy moth eggs. Development of the laboratory reared generation occurred at ambient laboratory room temperatures (ca. 18-26°C.) and emergence of the adults occurred in March, 1983. Thus partial development of the parental generation and complete development of the progeny occurred within one year. This record of *A. museorum* as a predator on viable gypsy moth eggs in Connecticut is the first North American record. It is also the first confirmed occurrence of the species in Connecticut, previous authors often mistaking *A. castaneae* Melsheimer for this species.

Gypsy moth egg masses collected in Newark, Delaware, on April 4, 1983, were isolated in pint paper cartons. The following month, three adults of the dermestid *Cryptorhopalum ruficorne* LeConte emerged, a first record of this association in Delaware, although *C. ruficorne* was reported as a predator of gypsy moth eggs in nearby states (Mason & Ticehurst 1984; Beal 1985).

**Japan and South Korea**: During the collection of gypsy moth egg masses in our previously reported study (1975-78) of egg parasitism (Schaefer et al. 1988), a collection of dermestids was obtained concurrently. Dermestid larvae were isolated and reared on available field collected gypsy moth eggs. Emerging adults were killed, pinned and labeled. Although some of those records

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4 First identified in 1983 by J. M. Kingsolver, USDA, SEL, Beltsville, MD (now retired).
were published previously (Schaefer, 1980; 1981), all of our dermestid records are included in Table 1.


**BRIEF REVIEW OF DERMESTIDS AS GYPSY MOTH EGG PREDATORS**

In North America, there are relatively few references to the presence of Dermestidae in gypsy moth egg masses (Table 1). Burgess (1899) reported finding *A. verbasci* (L.) larvae feeding on gypsy moth egg masses in Massachusetts in October, and that adults appeared the following May. Hoebeke et al. (1985) illustrated and provided a key to identify eastern North American species of *Anthrenus*, including both *A. verbasci* and *A. museorum*, and Griswold (1941) studied the biology of *A. verbasci* in detail. Campbell (1967) stated that unidentified dermestid larvae were occasionally seen preying on gypsy moth eggs in northeastern New York. In central Pennsylvania, Brown and Cameron (1982) listed larvae of *Dermestes lardarius* L. as a predator associated with gypsy moth eggs. Also in Pennsylvania and in West Virginia, larvae of *C. ruficorne* were found attacking gypsy moth eggs (Mason & Ticehurst 1984) and, as mentioned above, P.W.S. confirmed *C. ruficorne* in this same role in Delaware. All these North American records and all other known records worldwide are included in Table 1, which is an updated version of the basic table of predators first compiled by Brown and Cameron (1982).

In other areas of the world, especially in Eurasia, there are considerably more records of dermestid associations with gypsy moth eggs. The most common genera are *Anthrenus*, *Atttagenus*, *Dermestes*, *Megatoma* and *Trogoderma*. Of apparent lesser frequency are species in the genera *Globicorns*, *Ctesias*, and *Zhantievus*. Nonveiller (1959) found six new dermestid species feeding in gypsy moth egg masses and of these, *Megatoma pici* was the most abundant. Interestingly, Nonveiller found that larvae of *M. pici* were fairly mobile and larvae would readily move between different egg masses. All of these dermestid beetles appear highly opportunistic; no doubt any insect egg mass similar to those produced by gypsy moths will be suitable for attack. For example, in India, *Lymantria obfuscata* (L.), often referred to as the Indian gypsy moth, has the same egg laying behavior. Its eggs are reportedly attacked by "*Anthrenus sp. prob. museorum*", and an *Orphinus* sp. (Dharmadhikari et al. 1985). Howard (1897) and Burgess (1899) record dermestids also attacking eggs of white-marked tussock moth, *Orgyia leucostigma* (J. E. Smith) (Lymantriidae), which are deposited in a hardened foam-like material.
Table 1: World list of Dermestidae reported as predators (or apparent predators) of gypsy moth eggs, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae).

<table>
<thead>
<tr>
<th>Species (Alphabetically listed)</th>
<th>Location</th>
<th>Reference/Collector/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EUROPE AND ASIA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Anthrenus museorum</em> (L.)</td>
<td>Japan</td>
<td>Schaefer 1980</td>
</tr>
<tr>
<td><em>Anthrenus museorum</em> <em>verbasci</em> (L.)</td>
<td>South Korea</td>
<td>Schaefer (1976)</td>
</tr>
<tr>
<td></td>
<td>Japan (Kyushu &amp; Honshu)</td>
<td>Schaefer (1976)</td>
</tr>
<tr>
<td><em>Attagus unicolor unicolor</em> Brah. (?)</td>
<td>European SSR</td>
<td>Karnozhikii 1957</td>
</tr>
<tr>
<td><em>Attagus unicolor japonicus</em> Reitter</td>
<td>Japan (Kyushu &amp; Honshu)</td>
<td>Schaefer (1976)</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>Schaefer 1980</td>
</tr>
<tr>
<td></td>
<td>Ukraine</td>
<td>Kotenko 1982</td>
</tr>
<tr>
<td><em>Attagus unicolor unicolor</em> Brah. (?)</td>
<td>Russia</td>
<td>Nonveiller 1959</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>Schaefer 1976</td>
</tr>
<tr>
<td></td>
<td>Europe</td>
<td>Thompson &amp; Simmonds 1964b</td>
</tr>
<tr>
<td><em>Ctesias serra</em> F.</td>
<td>Yugoslavia</td>
<td>Nonveiller 1959</td>
</tr>
<tr>
<td><em>Dermestes ater</em> De Geer</td>
<td>Azerbaijan</td>
<td>Aliev <em>et al.</em> 1974</td>
</tr>
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<td></td>
<td>Ukraine</td>
<td>Kotenko 1982</td>
</tr>
<tr>
<td><em>Dermestes ater</em> bicolor F.</td>
<td>Yugoslavia</td>
<td>Nonveiller 1959</td>
</tr>
<tr>
<td><em>Dermestes ater</em> erichsoni Gangl.</td>
<td>Bulgaria</td>
<td>Schedl 1936; Karnozhikii 1957; Nonveiller 1959; Stefanov &amp; Keremidchliev 1961b</td>
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<td></td>
<td>Romania</td>
<td>Pirvescu 1978; Teodorescu 1980</td>
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<td></td>
<td>Russia</td>
<td>Shapiro 1956; Vorontsov 1950; Nonveiller 1959; Kotenko 1982</td>
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<tr>
<td></td>
<td>Ukraine</td>
<td>Nonveiller 1959; Kolomiets 1987; Picard 1921; Nonveiller 1959; Schedl 1936; Karnozhikii 1957; Nonveiller 1959; Stefanov &amp; Keremidchliev 1961b; Shapiro 1956; Vorontsov 1950; Prota 1966</td>
</tr>
<tr>
<td><em>Dermestes ater</em> lardarius L.</td>
<td>Italy</td>
<td>Prota 1966</td>
</tr>
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<td></td>
<td>Azerb.</td>
<td>Aliev <em>et al.</em> 1974</td>
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<tr>
<td></td>
<td>Europe</td>
<td>Burgess &amp; Crossman 1929b</td>
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<tr>
<td></td>
<td>Russia</td>
<td>Shapiro 1956; Vorontsov 1950; Nonveiller 1959; Kotenko 1982</td>
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<td></td>
<td>Ukraine</td>
<td>Nonveiller 1959; Luciano &amp; Prota 1983; Shapiro 1956; Vorontsov 1950; Nonveiller 1959; Kotenko 1982</td>
</tr>
<tr>
<td><em>Dermestes ater</em> undulatus Brah.</td>
<td>Italy (Sardinia)</td>
<td>Luciano &amp; Prota 1983</td>
</tr>
<tr>
<td></td>
<td>Russia</td>
<td>Shapiro 1956; Vorontsov 1950; Nonveiller 1959; Kotenko 1982</td>
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<tr>
<td></td>
<td>Ukraine</td>
<td>Nonveiller 1959; Zelinskaya 1981</td>
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<td></td>
<td>Japan</td>
<td>Schaefer 1980</td>
</tr>
<tr>
<td><em>Dermestes ater</em> sp.</td>
<td>Yugoslavia</td>
<td>Nonveiller 1959</td>
</tr>
<tr>
<td></td>
<td>Ukraine</td>
<td>Zelinskaya 1981</td>
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<tr>
<td><em>Dermestes ater</em> spp.</td>
<td></td>
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</tr>
</tbody>
</table>
Globicorinus nigripes F.
Megatoma conpera Solskij
pici Kalik
pubescens Zetterstedt
undata L.

Yugoslavia
Russia Far East
Yugoslavia
Yugoslavia
Romania

Orphinus sp.
Trogoderma sp.
varium (Matsumura & Yokoyama)
sp. possibly undescribed c

Yugoslavia
Japan
Ukraine
Japan (Kyushu & Shikoku)
Japan (Shikoku)

Unidentified

Japan
Schaefer (1976)
Kotenko 1982
Schaefer (1976)
Schaefer (1976)

AFRICA

Anthrenus verbasci (L.)
vladimiri Menier & Villemant

Morocco
Morocco

Dermestes lardarius L.

No. Africa

Trogoderma versicolor Creitz

versicolor var.
meridionale Kraatz
sp.

Morocco
Morocco

Zhantievus lymantriae Beal

Morocco

Hérard & Fraval 1980
DeLepiney 1927 b

NORTH AMERICA

Anthrenus museorum (L.)
verbasci (L.)

Connecticut
Massachusetts
Pennsylvania & West Virginia
Delaware
Pennsylvania
Massachusetts

Schaefer (1982) d
Burgess 1899; Howard 1910
Mason & Ticehurst 1984;
Beal 1985
Schaefer (1983) e
Brown & Cameron 1982
Howard 1910

Cryptorhopalum ruficorne LeConte

Unidentified

New York
Campbell 1967 b

b Years given in parentheses are years of specimen collection. Specimens collected by the senior author in the 1970’s were identified by Sadanari Hisamatsu (1977) and/or by John M. Kingsolver (1979). Years not in parentheses refer to date of publication; see Literature Cited.

c Cited in Griffiths 1976.

d D. G. H. Halstead, in litt.


f Listed in Griffiths’ (1976) table but text does not substantiate a North American record associated with egg masses, however a record coming from a pupal mass is recorded.
We believe that, in time, many other associations will become known as other species of opportunistic dermestids are found to take advantage of the nutritional resources and protected niches represented by individual masses containing hundreds of gypsy moth eggs. This will be especially true as the invading gypsy moth in North America moves into new geographical areas and comes in contact with other dermestid species for the first time.

ACKNOWLEDGMENTS

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