## CHAPTER 12-8
TERRESTRIAL INSECTS:
HOLOMETABOLA – MEGALOPTERA
AND NEUROPTERA

### TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEGALOPTERA – Alderflies, Dobsonflies, and Fishflies</td>
<td>12-8-2</td>
</tr>
<tr>
<td>NEUROPTERA - Lacewings</td>
<td>12-8-3</td>
</tr>
<tr>
<td>Osmylidae</td>
<td>12-8-3</td>
</tr>
<tr>
<td>Chrysopidae</td>
<td>12-8-4</td>
</tr>
<tr>
<td>Summary</td>
<td>12-8-6</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>12-8-6</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>12-8-6</td>
</tr>
</tbody>
</table>
MEGALOPTERA – Alderflies, Dobsonflies and Fishflies

This is a small order and most are aquatic as larvae. Nevertheless, some members of the Corydalidae (dobsonflies) pupate under mosses, a stage lasting about two weeks (Needham et al. 1901). These species include *Chauliodes pectinicornis* (Figure 1-Figure 2), *C. rastricornis* (Figure 3-Figure 4), and *Nigronia serricornis* (Figure 5-Figure 6).
Barnard (1931) reported pupae of alderflies (Sialidae) from Sphagnum and other wet or aquatic mosses that grew near or in streams and waterfalls in South Africa. These alderflies required that the mosses be wet.

**NEUROPTERA – Lacewings**

Not many members of Neuroptera use bryophytes, but Richards and Davies (1977) reported that lacewing larvae search for prey in mosses.

**Osmylidae**

The larvae of *Osmylus* (Figure 7) live in the mosses on the banks of woodland streams (Elliott 1996). Even the adults are typically found near these small streams that have mossy banks suitable for larval development. In Great Britain, the larvae can be found in these mosses throughout the year. In the winter they migrate deep into the moss rhizoids where they hibernate.

The female *Osmylus fulvicephalus* (Figure 7) lays about 30 eggs 2-3 days after mating (Elliott 1996). These often are laid in small groups. When deposited on mosses they are laid singly or in pairs on the undersides of leaves and near the water (Lestage 1920; David 1936; Ward 1965). The eggs are cylindrical and slightly flattened. These white eggs darken to brown within a few days, making them less obvious than the white version. Eggs hatch in 4-22 days, depending on the temperature (Withycombe 1923; David 1936; Ward 1965).

When the larvae of the giant lacewing, *Osmylus fulvicephalus* (Figure 7), emerge, they burrow into the mosses (Elliott et al. 1996) and live among damp mosses in the splash zones of river banks and streams (Plant 1994; Roper 2001). These larvae are only 5 mm when they hatch, but reach 15 mm by the third (final) instar from which they develop into pupae (Elliott 1996).

In this moss habitat *Osmylus fulvicephalus* (Figure 7) larvae are able to eat small arthropods (Elliott et al. 1996). They strike at movement and inject enzymes that paralyze the prey. When they hatch, the first instar larvae eat mites and Collembola, but second and third instars switch to
eating larvae of small Diptera. The common Chironomidae (midge) are paralyzed in 10 seconds by the enzymes. They then suck the contents out of the prey. The larvae may dive into the water to find prey, but if they are forced to remain submerged they die within 8-28 days (Ward 1965).

The third (and final) larval instar overwinters in diapause and is able to withstand total immersion during flooding (Elliott et al. 1996). When spring arrives, the larvae make a cocoon, incorporating some of the moss in the cocoon, then pupate for 10-14 days before cutting their way out with their mandibles. They then emerge as adults (Figure 8) without further feeding. The adults fly about over the water surfaces in their woodland homes in the evening (crepuscular) (Elliott 1996).

Figure 8. Osmylus fulvicephalus adult, a species that lays its eggs on moss leaves. Photo from <www.invertebradosdehuesca.com>, through Creative Commons.

Larvae of the green lacewing Leucochrysa pavida (Figure 10-Figure 13) (Slocum & Lawrey 1976) and the brown lacewing (Anonymous 2015) take their camouflage with them. They make packets of lichen fragments, bark, pollen grains, fungal spores, and moss fragments that they attach to spines on their backs (Slocum & Lawrey 1976). Likewise, immature brown lacewings use lichen and moss coverings to camouflage and protect them from predators and to disguise themselves from their prey (Insects 2014).

Figure 10. Leucochrysa pavida larva with lichen back pack. This species also uses mosses. Photo by Jim McCormac, with permission.

**Chrysopidae**

The modern Chrysopidae are not known to live among bryophytes, but they sometimes wear them. The larvae attach various pieces of debris, including bits of mosses and lichens, on their backs (Figure 9) (Skorepa & Sharp 1971; Slocum & Lawrey 1976; Eisner et al. 2002; Pérez-de la Fuente et al. 2012; Anonymous 2015; Newman et al. 2015). This cloak provides camouflage that hides them from both predators and prey.

Figure 9. Chrysopidae larva with cloak of debris and lichens. Note the head and large jaws at right. Photo by David Illig, through Creative Commons.

Figure 11. Leucochrysa pavida larva with lichen back pack, ventral view. Photo by Jim McCormac, with permission.
Fossil evidence suggests that some larvae of the Chrysopidae have been associated with liverworts (Liu et al. 2018). *Phyllochrysa huangi* larvae (Figure 15, Figure 16) from Burmese amber (Upper Cretaceous ~100 million years old) exhibit "distinctive foliote lobes" on the thorax and abdomen. This mimicry permits individuals to hide from prey (Figure 16) or to be ambush predators because the larvae are hard to distinguish from their background vegetation.

*Hallucinocrysa diogenesi* (Figure 14) is a fossil lacewing that attached plant fibers, bark, leaves, algae, mosses, snail shells, and corpses of its food prey on its back (Pérez-de la Fuente et al. 2012). These were held in place by the bristles on the backs of the larvae.

The shape of this larva is similar to that of bryophytes (Figure 16, Figure 17). Furthermore, its head is small and concealed under the anterior thoracic lobe (Figure 16) (PPI 2018). Antennae are extremely long with enlarged ends. The researchers found several amber fossil bryophyte species with similar morphologies (Figure 17), including size, leaf shape and arrangement, leaf folds, and lines.
Acknowledgments

Bernard Goffinet alerted me to the story on fossil Phyllochrysa huangi larvae that mimicked liverworts. Thank you to all the photographers who placed their images online with Creative Commons permission and to those who gave me permission to use their images.

Literature Cited


Summary

The Megaloptera and Neuroptera are small orders. Hence there are few bryophyte dwellers. Some members of Megaloptera pupate under mosses. In the Neuroptera, the best known bryophyte-dwelling genus is Osmylus. Leucochrysa pavida makes packets of camouflage that include moss fragments among other objects.


