

The Plecopteroid, Blattoid, and Orthopteroid Orders

1. Introduction

This chapter deals with the following 10 orders: Plecoptera, Embioptera, Dictyoptera, Isoptera, Grylloblattodea, Dermaptera, Phasmida, Orthoptera, Zoraptera, and the recently established Mantophasmatodea. Members of these orders can be distinguished from other exopterygotes [the hemipteroid orders (Chapter 8)] by the following features: generalized biting mouthparts, wing venation usually well developed with numerous crossveins (though less netlike than that of Paleoptera), cerci present, terminalia of male may be asymmetrical and reduced, many Malpighian tubules, and generalized nervous system with several discrete abdominal ganglia. However, as discussed in Chapter 2, the existence of these common features should not be taken as confirmation that these orders constitute a monophyletic group.

2. Plecoptera

SYNONYMS: Perlaria, Perlida

COMMON NAME: stoneflies

Moderate-sized to fairly large soft-bodied insects; head with long setaceous antennae, weak mandibulate mouthparts, well-developed compound eyes and two or three ocelli; thorax almost always with two pairs of membranous wings (sometimes reduced), hind pair in most species with a large anal lobe, venation frequently specialized, legs identical and with a three-segmented tarsus; abdomen of most species terminated by long multiannulate cerci, females lacking a true ovipositor, males without gonostyles and phallic organs on abdominal segment 9.

Larvae aquatic, generally resembling adults except for presence of a varied number of tracheal gills.

More than 2000 species of this very ancient order have been described, including just over 600 from North America, about 30 from Britain, and 200 from Australia. Though the order has representatives on all continents except Antarctica, most families have a rather restricted distribution.

Structure

Adult. The plecopteran head is prognathous and bears a pair of elongate, multianulate antennae, well-developed compound eyes, three (rarely two) ocelli, and weak, often non-functional biting-type mouthparts. Usually all the mouthparts are present, but in members of a few families the mandibles are vestigial. The thorax is primitive. Its segments are free and the prothorax is large. Two pairs of membranous wings are nearly always present, though brachypterous and apterous species occur at high altitudes and latitudes. The hind wing typically has a large anal fan, but this is reduced in the more advanced families. The wing venation is generally primitive, but considerable variation is seen within the order. In members of primitive families a typical archdictyon is developed to a greater or lesser degree; in those of advanced groups the number of branches of the longitudinal veins and the number of crossveins are greatly reduced. The abdomen contains 10 complete segments, with the 11th represented by the epiproct, paraprocts, and long cerci. In Nemouridae, however, the latter are reduced to an unsegmented structure used in copulation.

The esophagus is very long, the gizzard rudimentary, and midgut and hindgut short. There are between 20 and 100 Malpighian tubules. In primitive families the central nervous system includes three thoracic and eight abdominal ganglia, but in advanced groups the sixth to eighth abdominal ganglia fuse. The tracheal system opens to the exterior via two thoracic and eight abdominal spiracles. In males the testes meet in the midline, but their products are carried by separate vasa deferentia to a pair of seminal vesicles. Usually there is a median ejaculatory duct, but in some species the vasa deferentia remain separate until they reach the median gonopore located behind the ninth abdominal segment. In females the panoistic ovarioles arise from a common duct that joins the oviducts of each side. A spermatheca is usually present.

Larva. In general form larvae resemble adults, except for the absence of wings and the presence, in most species, of several pairs of gills. Primitively there are five or six pairs of abdominal gills, but in members of more advanced groups these are reduced in number and secondary gill structures may appear on more anterior regions of the body (mentum, submentum, neck, thorax, and coxae) or may encircle the anus. In addition to gas exchange, the gills are important osmoregulators, equipped with chloride-uptake cells, as is also seen in larval Ephemeroptera. In many species the legs are fringed with hairs that assist swimming.

Life History and Habits

Adult stoneflies are weak flyers and seldom found far from the banks of streams or edges of lakes where they rest, often well camouflaged, on vegetation, rocks, logs, etc. Nocturnal species usually hide in crevices or among vegetation during the day. Many stoneflies do not feed as adults. Others feed on lichens, acellular algae, pollen, bark, and rotten wood.

Prior to mating, many Arctoperlaria tap the substrate with the tip of the abdomen (drumming). Males initiate the drumming and virgin females respond. The drumming is species-specific and serves to bring the partners together (Stewart and Maketon, 1990). Mating usually occurs in daylight, on the ground, though a few species are nocturnal. Large numbers of eggs are laid, singly or, more often, in batches of 100 or more. In flying species females hover over the water and dip the abdomen beneath the surface. Brachypterous and apterous forms crawl to the water's edge, or below the water surface, in order to oviposit. Eggs of many species develop adhesive properties on contact with water. Embryonic development is usually direct, though eggs of some species may survive drought conditions in