

## Chapter V —Order Plecoptera



### (Stoneflies)

- (Williams & Feltmate, 1992)
  - Superphylum Arthropoda
    - (jointed-legged metazoan animals [Gr, *arthron* = joint; *pous* = foot])
  - Phylum Entoma
  - Subphylum Uniramia
    - (L, *unus* = one; *ramus* = branch, referring to the unbranched nature of the appendages)
  - Superclass Hexapoda
    - (Gr, *hex* = six, *pous* = foot)
  - Class Insecta
    - (L, *insectum* meaning cut into sections)
  - Subclass Ptilota
  - Infraclass Neopterygota

The Plecoptera (stoneflies), all of which are aquatic as nymphs, are considered to be the most primitive order of living Neoptera. Plecopterans number about 1718 species in 239 genera belonging to 15 families. Nymphs feed on fresh or decayed vegetable matter, but may be carnivorous in later instars.

The order Plecoptera belongs to the infraclass Neoptera because stoneflies' wings fold over their backs at rest. Wings develop in external wingpads, a characteristic that places Plecoptera in the division Exopterygota. North American stoneflies are generally divided into two groups, Euholognatha and Systellognatha, based on major differences in mouthpart morphology and, hence, feeding biology.

The taxonomy of this order, like that of the Ephemeroptera, is poorly known because the larvae of many species have not been associated with adults.

Modern plecopterans are thought to have been derived from the Protoperlaria of the Permian (360-286 million years B.P.) and the fossil record is quite respectable with more than 30 species described from the different strata of the Permian to the middle Tertiary.

### Life History

The stoneflies are terrestrial as adults, but in the nymphal stages they are strictly aquatic, and most are restricted to flowing waters of relatively high oxygen concentrations. Fertile eggs, laid over or in the water, require two to three weeks for hatching in many species, and several months among some larger forms. The nymphal instars, from 10 to over 30 moltings, occur in one to three years. Adults live from 1 to 4 weeks. Most adults are winged, although a few species are wingless (apterous) or have short wings (brachypterous). None fly well and this has prevented

them from crossing even small geographical barriers. *Thus, like the mayflies, stoneflies are useful tools in studies of historical biogeography.*

Temperate species that overwinter as nymphs often do not stop growing even in water temperatures close to 0°C. It seems that it is warm water temperatures rather than cold ones that punctuate stonefly life cycles. The ability to spend the summer in diapause enables some species to live in *temporary streams*.

### **Habitat and Ecological preference**

Plecopteran nymphs are restricted to cool, clean streams with high dissolved oxygen content. Some species, however, may be found along the wave-swept shores of large oligotrophic lakes. When subjected to low dissolved oxygen concentration, the nymphs of many species exhibit a characteristic “push-up” behaviour that increases the rate of movement past the gills. The gills are variously placed among species on the neck, thorax and abdomen. However, some species have no gills and respiration in these is assumed to be across the cuticle surface.

**The high water quality requirements of the nymphs bars all but a very few species from habitats subject to low oxygen levels, siltation, high temperatures and organic enrichment, and this has led to their effective use as biological indicators of environmental degradation.**

Field surveys clearly show that the nymphs of many species are associated with particular sections of a stream bed or lake shore. The specific microhabitat occupied depends on a variety of environmental factors such as the nature of the substratum (particle size and configuration), current regime, presence of other organisms, and local variations in water chemistry and temperature. Habitat preference often changes as the nymphs develop and with season. Prior to emergence, final instar nymphs tend to migrate towards the bank where they crawl out of the water to shed their skins.

Most stoneflies are classified as clingers or sprawlers, as they are closely associated with the substrate or leaf litter. A few species have been reported from the hyporheic zone.

### **Feeding**

Generally, stonefly nymphs are either shredders or predators. Some groups that are predaceous as late instars have been reported to be herbivorous or detritivorous in early instars, while late instars of large detritivores may consume some prey. Predators are engulfers, that is, they swallow their prey whole or bite off and swallow parts of prey. They are active search or pursuit predators, using their long filamentous antennae to locate prey using tactile, wave disturbance, and chemical cues. Many species are opportunistic feeders, consuming prey in proportion to their relative abundance. Other species are selective for prey species or sizes. In some families adults feed, and in others they do not.

## References

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