Life Cycles & Natural History of Aquatic Insects

Part 1 – Introduction

An Educational Series For Stream Teams To Learn and Collect

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The world around us is full of natural and living wonders and, as you study them, new revelations occur almost daily. Many Stream Teams become fascinated with the invertebrates in our streams, wanting more and more information on how they live, interact with each other, and function within the world around them. This new series of fact sheets will provide you more information to help you better understand aquatic macroinvertebrates and make good sound decisions concerning your adopted stream. We will look at the general life cycle (including adult forms), habitat, feeding, and respiration of seven Insect Orders:

1. Ephemeroptera
2. Plecoptera
3. Trichoptera
4. Coleoptera
5. Odonata
6. Megaloptera
7. Diptera

Stoneflies (Order Plecoptera) experience incomplete metamorphosis with larval development taking three months to one year. Larvae utilize oxygen dissolved in the water for external respiration via membranes and/or gills.

Life Cycles

Not all life cycle stages of aquatic insects are aquatic. In fact, most only have aquatic larvae or nymphs and adults are terrestrial. However, there are some that have both aquatic and terrestrial adults, and there is even one Order containing Families that have terrestrial larvae and aquatic adults. Needless to say, there are many different roads to travel to become classified as an aquatic insect.

There are two types of life cycles or metamorphoses in aquatic insects. The first is ***hemimetabolous***, or incomplete metamorphosis. Orders that undergo incomplete metamorphosis include Ephemeroptera, Plecoptera, and Odonata. These Orders go from egg to larva (nymph) to adult with no pupal stage and the nymphs look very similar to the adults. The Orders Trichoptera, Coleoptera, Megaloptera, and Diptera are ***holometabolous***, that is, they go through a complete metamorphosis that includes a pupal stage. They go from egg to larva to pupa to adult and the larvae look very different than the adults.

Habitat

Aquatic insects are found in every conceivable aquatic habitat, from mud puddles to hot springs and tidal pools to streams, even the open ocean. Although all of these habitats are really fascinating, let's concentrate on where we can find them in the streams of Missouri. There are primarily five types of aquatic insect habitats in stream systems: riffles,

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pools, substrate (benthic sediment), vascular plants, and woody debris.

Feeding

Aquatic insects can be herbivorous (plant eaters), detritivorous (scavengers or detritus eaters), carnivorous (predacious on other animals), or omnivorous (feed on anything). Although many experts try to place them into these categories and then into particular feeding groups or guilds, this may be carrying classifications too far. Many insects change throughout their life cycles from one guild to another.

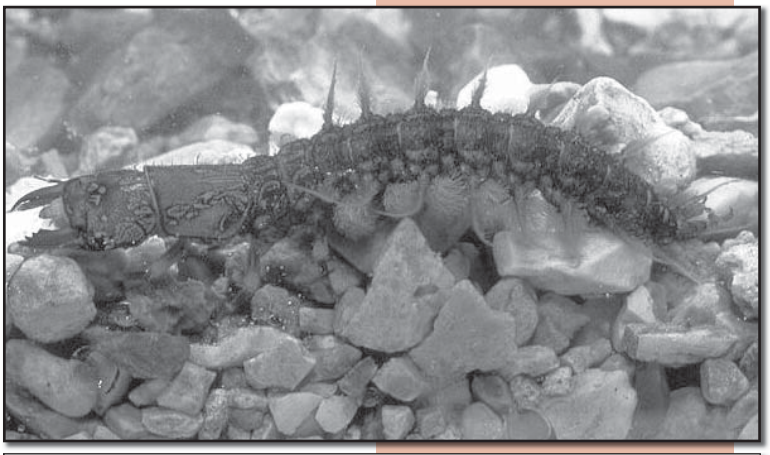
Respiration

Respiration is a fascinating and essential function for all living organisms. This is no exception in the insect world. Having originated from terrestrial ancestors, all insects obtained their oxygen from the air through tubes known as tracheae. The tracheae take oxygen through openings in the cuticle (protective covering) known as spiracles, and carry it directly to the body tissue.

Once insects invaded the aquatic world, they needed a way to resupply their oxygen. The efficient tracheal system of tubing for transport of gases was retained to use as an adult, but adaptations were needed to obtain oxygen in a new environment. Aquatic insects either resurface and refresh their air supply or pull dissolved oxygen directly from the water around them. Insects that have adapted to aquatic systems that aren't moving or still (lentic) like ponds, lakes, and wetlands, typically pull their oxygen from the atmosphere. Those in moving systems (lotic) like streams and rivers, typically pull their oxygen from the dissolved oxygen in the water around them.

These fact sheets will concentrate on those found in streams and rivers. These insects typically have what are known as closed tracheal systems. This means there are no openings (spiracles) present in the cuticle and some areas of the cuticle are thinner. Under these thin areas there are rich networks of tracheae for the gas exchange to occur by diffusion. In other cases the cuticle is modified into thin extensions called tracheal gills. These gills may be of various forms. Tracheae may be present or absent and they can be located on different parts of the body, but their function is the same. Although it is still being debated how important tracheal gills are in the actual gas exchange, it is not debated that they are important for ventilation. Movement of gills ventilates the cuticle with water containing dissolved oxygen, allowing for gas exchange to occur. This movement can come in many forms: abdominal contractions, gill beating, swimming, positioning one's body in the stream flow, or a combination of any of these activities.

Now with some general information under our belts, we will delve into more specifics for each of the Orders mentioned earlier. Our first Insect Order to be covered in the next fact sheet will be the mayflies, Order Ephemeroptera. More will follow. Don't hesitate to send questions to streamteam@mdc.mo.gov or call 1-800-781-1989.



Dobsonflies (also called Hellgrammites) go through 10–12 instars (stages between molts) during incomplete metamorphosis before crawling out onto shore to pupate. They have spiracles which help them respire when they leave the water.

Sources:

Freshwater Macroinvertebrates of Northeastern North America. Barbara L Peckarsky et al. 1990.

Aquatic Entomology–the Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives. W. Patrick McCafferty. 1998.