



### Stream Team Academy Fact Sheet Series

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Collect this entire educational series for future reference! Contact us at 1-800-781-1989 if you'd like a copy of previous Fact Sheets or a binder for storing them.

*An adult crane fly displaying the functional front wings and reduced hind wings, or halteres.*



# LIFE CYCLES & NATURAL HISTORY OF AQUATIC INSECTS

## Part 8 – The Midges, Mosquitoes, Aquatic Gnats, and Flies (Diptera)

### An Educational Series For Stream Teams To Learn and Collect

By Paul Calvert

**D**iptera is one of the largest and most diverse orders of insects. Volumes have been written about the flies, but we will stick to the basics. There are over 120,000 known species including some we know too well, like the house fly, horse fly, midges, and mosquitoes. Approximately ten percent of Diptera species are aquatic. Adults of this order can be easily distinguished from the other insects where the term “fly” is applied. The “true” flies possess only one pair of functioning wings (the front wings), while almost all other insects possess two or none. The hind wings are not completely absent but are vestigial, reduced in size to paddle-like structures called halteres.

### LIFE CYCLE

**S**warming is the primary mating ritual for flies. Swarms form over swarm markers that include sand, dung, water, or a host (for species that are anautogenous, requiring a blood meal to produce eggs). After mating, females leave the swarm to deposit their eggs. Some species do not swarm. In these species, males provide food as a mating gift and mating occurs while the females are eating.

Egg laying behavior is very diverse. Eggs may be scattered on vegetation above or below the water, laid in gelatinous masses on objects above or below the water, or laid in masses on overhanging vegetation like the Megaloptera. Eggs begin to hatch after just a few days. In some species, egg diapause may occur during dry conditions and the eggs can lay dormant for up to several weeks.

Diptera are holometabolous, undergoing complete metamorphosis. Once hatched, the larvae of most families progress through 3 to 4 instars. Larval stages can be as short as a few weeks or last as long as two years depending on the species, water temperature, and available food. Some Diptera pupae have free appendages. But, the appendages are generally fused together and the abdomen is movable, allowing some “wriggling” at the surface. Examples of this include mosquitoes and midges.

Most species are univoltine (having one generation per year). However, when conditions are favorable, some may complete two generations. Species in colder climates can take up to two years to complete their development. One arctic midge has been reported to have a seven year life cycle.

### HABITAT

**F**ly larvae are found in almost every conceivable aquatic habitat. Mud puddles, ponds, lakes, streams, rivers, and even intertidal zones are the more common habitats. They are also found in moist soil, bracts of pitcher plants, holes in trees, thermal springs, stagnant pools, and even in oil sludge pools. The only aquatic

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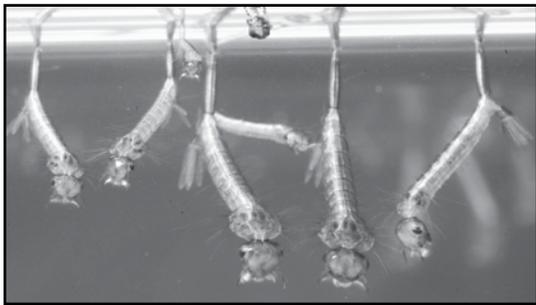
habitat where fly larvae have not been recorded to date is the open ocean.

### FEEDING

Diptera larvae are almost as diverse in their feeding habits as they are in their habitats. Merritt and Cummins (1996) report that the Diptera have representation in every functional feeding group. Some are shredders of coarse particulate detritus, others are specialized for filter feeding or scraping, and others are predacious on everything, from zooplankton to snails.

### RESPIRATION

The Diptera have a variety of very interesting adaptations for acquiring oxygen. The larvae of metapneustic species, including mosquitoes and some midges, must respire while suspended at the water surface. They breathe using respiratory tubes or directly through caudal spiracles and then retreat to the substrate where they burrow or rest on the surface. Metapneustic species are restricted to shallow water habitats or the water column. Some metapneustic larvae, like rattailed maggots, have extensile respiratory tubes attached to the caudal spiracles. This adaptation acts like a snorkel, allowing them to remain submerged in shallow,



*Mosquito larvae are metapneustic and must suspend themselves at the water surface to respire. Photo by Missouri Department of Conservation.*

oxygen-poor water for long periods.

Other free swimming larvae are apneustic, or lack spiracles completely, relying on cutaneous respiration that is sometimes supplemented by gills. A few families have spiracles on the prothoracic and last abdominal segments (amphipneustic) and the crane flies have these spiracles and anal gills, a combination that allows them to breathe in air and water.



*Examples of midge larvae. Note the moveable, segmented abdomen and lack of free appendages. Photo by Missouri Department of Conservation.*

### CONCLUSION

Despite being soft-bodied and generally small, even minute, in size, the Diptera impact many aspects of our lives. They pose significant human health risks throughout the world as vectors of diseases including malaria, yellow fever, typhoid fever, and dysentery. They also contribute to livestock diseases and some, such as the apple maggot and the Hessian fly, even attack agricultural crops. On the other hand, flies are valuable as scavengers, pollinators, parasites of damaging insects, and vectors of diseases that attack noxious weeds. Flies, like the other orders we have discussed, play an important role in the world around us.

Don't forget to send your questions to [streamteam@mdc.mo.gov](mailto:streamteam@mdc.mo.gov) or call 1-800-781-1989.

### Sources:

- Freshwater Macroinvertebrates of Northeastern North America. Barbara L. Peckarsky et al. 1990.
- An introduction to the Aquatic Insects of North America. 3rd Ed. Merritt, R. W. and Cummins K. W. 1996.
- Aquatic Entomology—the Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives. W. Patrick McCafferty. 1998.

