



**Stream Team Academy
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LIFE CYCLES & NATURAL HISTORY OF AQUATIC INSECTS

Part 5 – The Beetles (Coleoptera)

An Educational Series For Stream Teams To Learn and Collect

By Paul Calvert

Beetles are the largest group of animals, representing one-fifth of all known living organisms and one-fourth of all animals on earth. Although the beetles (Coleoptera) are the largest order of insects, only about 10% of the described species are aquatic. When asked what could be inferred about the work of the Creator from a study of his works, the British scientist J.B.S. Haldane is reported to have replied, that He has “an inordinate fondness for beetles.” The 350,000 described species of beetles, composed of approximately 35,000 aquatic species, contribute greatly to the tremendous diversity in our aquatic systems, both lotic (flowing) and lentic (still). The beetles found in stream systems are typically sensitive to moderately sensitive and are useful water quality indicators.

Beetles are known for their anterior wings that are hard and leathery (the elytra). These wings are not used in flight, but protect all or part of the membranous hindwings that are. Aquatic adaptations have occurred in 14

families of beetles, not including semiaquatic species or those that occur in riparian areas. Of these 14 families, six have both aquatic larvae and adults, five have aquatic larvae and terrestrial adults, and three have the unusual life cycle of terrestrial larvae and aquatic adults.

LIFE CYCLE

Terrestrial adults of aquatic beetles are typically short-lived and emerge synchronously to optimize breeding success. Mating occurs and sometimes is preceded by some form of acoustical signaling similar to other insects like the Hemiptera (true bugs) or the Orthoptera (grasshoppers and crickets) or some form of courtship behavior. Most deposit eggs singly or in small masses in or on submerged vegetation, rocks, or whatever the available substrate is.

Beetles have a complete life cycle or are holometabolous and most are univoltine (one generation per year) but some may be multigenerational. Eggs begin to hatch in one or two weeks. Larvae molt 3 to 8 times before pupating. The pupal phase in all beetles is technically considered terrestrial. The mature larvae either crawl out of the water to pupate on land or remain submerged within a silken cocoon formed around an air bubble. Following pupation, adults emerge in two to three weeks.

HABITAT

Beetles are found in a wide variety of aquatic habitats including both lotic and lentic systems. They can inhabit general habitats like ponds, pools, runs, and riffles in warm, cool, or cold water. Some have adapted and evolved to inhabit very specialized habitats



*The larvae of many beetle species can be difficult to identify.
Photo by Rich Merritt, courtesy of Society for Freshwater Science.*

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Like acid bogs, calcareous fens, brackish water, or marine environments.

Beetle species also vary by where they can be found within a given habitat. They can be found climbing on vegetation, burrowing into the substrate, swimming, or clinging to rocks and logs.

FEEDING

Like their diverse habitat selections, beetles have very diverse feeding methods. Larvae can be herbivores (chewing or piercing plant material), scavengers (eating dead plant and animal material), or predators (chewing, engulfing, or piercing prey). Adult forms may be grazers, detritivores, or predators. Predacious beetle larvae and adults have been reported to consume small vertebrates, especially small fish and tadpoles. One researcher documented an adult predacious diving beetle consuming a small snapping turtle in an aquarium setting.

RESPIRATION

Most larvae respire cutaneously (through their exoskeleton) with additional oxygen transfer through tracheal gills. Adult respiration is as diverse as the order. Some carry oxygen in an air bubble under their elytra and replenish this with periodic trips to the surface. This oxygen is transferred to the tracheae through openings in the abdomen called spiracles. This method is dangerous because traveling to the surface exposes individuals to predation. The form of respiration used by most of the aquatic adults found in streams involves using a plastron or plate composed of hydrofuge (water repellent) hairs for oxygen transfer. These beetles are typically very sensitive to changes in water quality. Pollutants can adhere to the hairs or cause them to be less repellent, reducing the

transfer of oxygen. Finally, a specialized form of respiration, rarely seen in Missouri, uses a slender pointed spine to pierce plant tissue and draw oxygen directly from the tissue.

CONCLUSION

Beetles are tremendously diverse and important to the world around us, including our aquatic resources. They play an important role as indicators of good water quality. Although larvae are sometimes difficult to identify, the adult forms are not and when we see them in our samples, we can breathe a sigh of relief that our stream is in pretty good shape.



Riffle beetle larvae, like the one pictured above, undergo six to eight molts before pupating. Photo by Amy Meier, Missouri Department of Conservation.



Adult riffle beetles use a plastron for respiration, crawling along the bottom rather than swimming in the water column. Photo by Randy Sarver, courtesy of Society for Freshwater Science.

Our next fact sheet will cover the dragonflies and damselflies. Don't forget to send your questions to streamteam@mdc.mo.gov or call 1-800-781-1989.

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.

