Chapter IX —Aquatic Coleoptera

(Beetles)

- Insects of Inland Waters: Orders Having Aquatic Adults
- (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

Of the more than one million described species of insect, at least one-third are beetles, making the Coleoptera the most diverse order of living organisms. The order Coleoptera (beetles) is the largest order of insects. It belongs to the infraclass Neoptera, division Endopterygota. Members of this order have an anterior pair of wings (the *elytra*) that are hard and leathery and not used in flight; the membranous hindwings, which are used for flight, are concealed under the elytra when the animals are at rest. Only 10% of the 350,000 described species of beetles are aquatic.

Aquatic species occur in two major suborders, the Adephaga and the Polyphaga. Both larvae and adults of six beetle families are aquatic, Dytiscidae (predaceous diving beetles), Elmidae (riffle beetles), Gyrinidae (whirligig beetles), Haliplidae (crawling water beetles), Hydrophilidae (water scavenger beetles), and Noteridae (burrowing water beetles). Five families, Chrysomelidae (leaf beetles), Limnichidae (marsh-loving beetles), Psephenidae (water pennies), Ptilodactylidae (toe-winged beetles), and Scirtidae (marsh beetles) have aquatic larvae and terrestrial adults, as do most of the other orders of aquatic insects; adult limnichids, however, readily submerge when disturbed. Three families have species that are terrestrial as larvae and aquatic as adults, Curculionidae (weevils), Dryopidae (long-toed water beetles), and Hydraenidae (moss beetles), a highly unusual combination among insects.

Many other beetle families have species that are riparian, semiaquatic, coastal, or marine. Because beetles exhibit such diverse adaptations, generalisations about life history patterns and feeding are difficult at the ordinal or even subordinal level.

Life History

Beetles are holometabolous. Eggs of aquatic coleopterans hatch in one or two weeks, with diapause occurring rarely. Larvae undergo from 3 to 8 molts. The pupal phase of all coleopterans is technically terrestrial, making this life stage of beetles the only one that has not successfully invaded the aquatic habitat. A few species have diapausing prepupae, but most complete transformation to adults in two to three weeks. Terrestrial adults of aquatic beetles are typically short-lived and sometimes nonfeeding, like those of the other orders of aquatic insects.

Unlike the Hemiptera, the larvae of Coleoptera are morphologically and behaviourally different from the adults, and their diversity is high. In temperate regions, beetles from most major groups commonly exhibit univoltine life cycles. However, multivoltinism is, as might be expected, more common in the more stable tropics.

A particularly interesting suite of aquatic and semiaquatic habitats inhabited by beetles occurs at the edge of the sea. In general, insects have not made major inroads into salt water, but a considerable number of beetles are able to tolerate such environmental conditions by either physiological tolerance or behavioural adaptation.

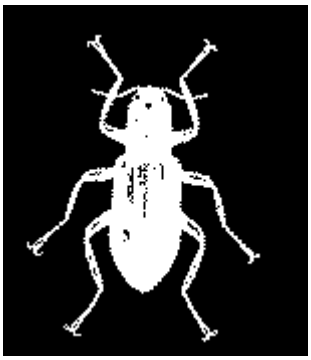
The Coleoptera are divided into four suborders. The first two are very small relict groups, of which the Myxophaga are more or less aquatic, mainly in running water. The Adephaga or carnivorous beetles are a large suborder containing six aquatic families. In the very primitive Amphizoidae, nearly all the Dytiscidae, and the Noteridae, the larvae are metapneustic, breathing by means of a single pair of abdominal spiracles. In the primitive Hydrobiidae, the Haliplidae, one genus of Dytiscidae, and the Gyrinidae, the larvae have tracheal gills.

- The Haliplidae (crawling water beetles) are very small beetles living mainly in ponds and the littoral region of lakes. The commoner species in Europe appear to be related to the trophic characteristics of the lakes that they inhabit, with Haliplus flavicollus and H. fulvus in oligotrophic and H. heydeni and H. ruficollis in the most eutrophic.
- The Dytiscidae (predaceous diving beetles) with about 4000 species presumably are rivalled only by the Chironomidae as the largest family of freshwater animals.
- The Gyrinidae live submerged as larvae but as whirligig beetles stay on the surface of the water during most of their adult life though they can dive.

Habitat

Beetles are found in a very wide range of aquatic habitats. Aquatic beetles are classified as clingers, climbers, sprawlers, swimmers, divers, and burrowers.

The Gyrinidae, or whirligig beetles, occur on the surface of ponds in aggregations of up to thousands of individuals. Unlike the mating swarms of mayflies and hemipterans, these aggregations serve primarily to confuse predators. Whirligig beetles have other interesting defensive adaptations. For example, the Johnston's organ at the base of the antennae enables them to echolocate using surface wave signals; their compound eyes are divided into two pairs, one above and one below the water surface, enabling them to detect both aerial and aquatic predators; and they produce noxious chemicals that are highly effective at deterring predatory fish.



Family Elmidae **(Riffle Beetle)**

- Both adults and larvae are commonly encountered. Adults are considered better indicators of water quality because they have been subjected to water quality conditions over a longer period.

Family Psephenidae (Water Penny)

- Only the larvae of water pennies are aquatic, although adults may be seen on rocks or reedy vegetation along the shorelines.

Family Gyrinidae **(Whirligig Beetle)**

- Whirligig beetles are common inhabitants and normally are found on the surface in quiet pools.

Table IX-1: Families of Coleoptera that contain aquatic or semiaquatic species (Williams & Feltmate, 1992)

Family	Distribution & Habitat
Suborder - **Archostemata** (none)	
Suborder - **Myxophaga**	
Superfamily Sphaerioidea	
Sphaeriidae	(minute bog beetles)- edges of freshwater bodies, in roots, mud & gravel
Hydroscaphidae	(skiff beetles)- stream margins, often in algae; hot springs
Suborder - **Adephaga**	
Superfamily Caraboidea	
Carabidae	(ground beetles)- a few species found at the edges of streams, ponds, swamps; rock crevices on seashores
Haliplidae	(crawling water beetles)- aquatic vegetation at the edges of ponds, lakes & slow streams
Hygrobiidae	standing, often stagnant, muddy water
Amphizoidae	(trout stream beetles)- fast streams, often on logs
Noteridae	(burrowing water beetles) shallow margins of standing or slow streams, often in mud or on plants
Dytiscidae	(predaceous diving beetles)- ponds & lakes, esp. near vegetation; slower sections of running waters
Gyrinidae	(whirligig beetles)- ponds & lakes, especially near vegetation; slower sections of streams & rivers
Suborder - **Polyphaga**	
Superfamily Hydrophiloidea	
Hydraenidae	(moss beetles)- stream margins, ponds near emergent vegetation; hygropetric (wet rock surface) habitats; marine rockpools & intertidal
Hydrochidae	(water scavenger beetles)- on plants in ponds or slow streams
Spercheidae	(water scavenger beetles)- stagnant ponds on underside of surface film
Georyssidae	(minute mud-loving beetles)- margins of freshwater bodies in sand or mud
Hydrophilidae	(water scavenger beetles)- ponds & lakes, esp. near vegetation; slower sections of streams & rivers
Superfamily Histeroidea	
Histeridae	(hister beetles)- some in ponds, also in damp soil & dung
Superfamily Staphylinoidea	
Staphylinidae	(rove beetles)- some species on the shorelines of fresh and saltwater bodies; marine crevices & intertidal (sand & rocky areas)
Superfamily Scaraboidea	
	some groups appear to need very moist environments, e.g. Lucanidae, Passalidae & Rutelinae (Scarabeidae)
Superfamily Dascilloidea	
Helodidae (Scirtidae)	(marsh beetles)- lentic & slow lotic waters, esp. near emergent vegetation; tree holes; springs
Superfamily Dryopoidea	
Limnichidae	(marsh-loving beetles)- in mud on the margins of streams and ponds
Psephenidae	(water pennies)- fast streams, wave-swept shores of large lakes

Family	Distribution & Habitat
Ptilodactylidae	(toed-winged beetles)- fast & slow water regions of streams; stream margins in leaf litter
Heteroceridae	(mud-loving beetles)- tunnels in stiff mud of some stream & pond margins
Elmidae	(riffle beetles)- fast & slower sections of streams, wave-swept shores of large lakes; some species on shoreline
Dryopidae	(long-toed water beetles)- shallow regions of ponds & lakes esp. in emergent vegetation; swift streams
Superfamily Cantharoidea	
Melyridae	(flower beetles)- semiaquatic on marine beaches & intertidal zone
Superfamily Cucujoidea	
Salpingidae	(narrow-waisted bark beetles)- marine, on rocks
Superfamily Tenebrionoidea	
Tenebrionidae	(darkling beetles)- some species in moist sand on beaches at the high tide mark
Anthicidae	(ant-like flower beetles)- some species live in the stream-side burrows of staphylinids; salt marshes
Superfamily Chrysomeloidea	
Chrysomelidae	(leaf beetles)- ponds & lakes on submerged but esp. floating leaves of rooted macrophytes
Superfamily Curculionoidea	
Curculionidae	(weevils)- some species of Erirrhininae (e.g. *Bagous*) live on submerged aquatic plants

Feeding

Like their habitats, the feeding habits of aquatic beetles are very diverse. Larvae can be herbivores (chewers or piercers), scavengers (gathering collectors), or voracious predators (engulfers or piercers). Dytiscid larvae (predaceous diving beetles), well known for their piercing mandibles, inject proteolytic enzymes into their prey or your hand, resulting in either subsequent ingestion of internal tissues or excruciating pain. Larval dytiscids prey even on small vertebrates (fish and tadpoles). Adult beetles also exhibit a wide range of feeding habits. Some species have been reported to scrape blue-green algae from substrates. Others are detritivores or predators. One adult dytiscid was observed consuming a small snapping turtle in an aquarium; however, the extent of these beetles' predation on vertebrates is not well known.

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