

their second and third sets of legs. Crayfish breathe with feather-like gills on the underside of their bodies. They are somewhat tolerant to a wide range of environmental conditions, but are susceptible to metals and pesticides.

Benthic macroinvertebrates found in Iowa

The Iowa Department of Natural Resources Watershed Monitoring and Assessment Section, in cooperation with the University of Iowa Hygienic Laboratory, has collected benthic macroinvertebrate samples in Iowa streams and rivers since 1994. Table 1 lists all of the families of benthic macroinvertebrates found in samples from 1994-2008. For additional information about benthic macroinvertebrates found in Iowa visit the University of Iowa Hygienic Laboratory's "Iowa's Aquatic Macroinvertebrates" website: www.uhl.uiowa.edu/services/limnology/macroinvertebrates/index.xml. To learn more about biological monitoring of streams in Iowa, go to the DNR's Biological Stream Monitoring site at www.igsb.uiowa.edu/wqm/publications/TOCbiologicalMonitoring.htm. If you would like to learn how to sample benthic macroinvertebrates, consider attending an IOWATER workshop. Go to www.iowater.net for the IOWATER workshop schedule.

References

Bouchard, R. W., 2004. *Guide to aquatic macroinvertebrates of the Upper Midwest*. Water Resources Center, University of Minnesota, St. Paul, MN.
 Hilsenhoff, W. L., 1982. *Using a biotic index to evaluate water quality in streams*. Technical Bulletin Number 132, Department of Natural Resources, Madison, WI.
 Voshell, J.R. Jr., 2002. *A Guide to Common Freshwater Invertebrates of North America*. McDonald and Woodward Publishing Company, Blacksburg, Virginia.
 Wiggins, Glenn, 1996. *Larvae of the North American Caddisfly Genera (Trichoptera) 2nd ed.* Toronto: University of Toronto Press.

Photo Credits

Caddisfly larvae and crane fly larva courtesy of the University of Iowa Hygienic Laboratory.
 Caddisfly net and crane fly adult courtesy of the North American Benthological Society.
 Leech and crayfish courtesy of the Missouri Department of Conservation.

Acknowledgements

The Iowa DNR would like to acknowledge the University of Iowa Hygienic Laboratory for the data collection and identification of benthic macroinvertebrates as part of Iowa's statewide biological monitoring program.

Funding

Water monitoring activities of the Iowa Department of Natural Resources are funded by Iowa Infrastructure – Environment First Fund appropriations, as well as grants provided by the U.S. Environmental Protection Agency from Sections 106 and 319 of the Clean Water Act and the Regional Environmental Monitoring and Assessment Program.

Iowa Watershed Monitoring and Assessment Program Web Site – www.igsb.uiowa.edu/wqm/



Prepared by
 Iowa Department of Natural Resources, Geological and Water Survey
 109 Trowbridge Hall, Iowa City, IA 52242-1319

IOWA'S WATER

Ambient Monitoring Program

What in the world are *Benthic Macroinvertebrates*?

Benthic macroinvertebrates are aquatic bottom-dwelling (benthic) animals that can be seen with the naked eye (macro), but lack backbones (invertebrates). Based on statewide sampling results from the Iowa Department of Natural Resources' stream biological assessment program, the most common benthic macroinvertebrates in Iowa include insects, clams, crustaceans, leeches, snails, and worms (Figures 1 & 2).

Where and when are benthic macroinvertebrates found?

These animals are widespread. They can be found in large rivers, small creeks, small ponds, wetlands, and lakes and can live on all bottom types, such as sand or rocks. Most benthic macroinvertebrates are present throughout the year; however, they are most easily found in the summer months. During the colder months, many species burrow deep in the sediment or remain inactive on rock surfaces.

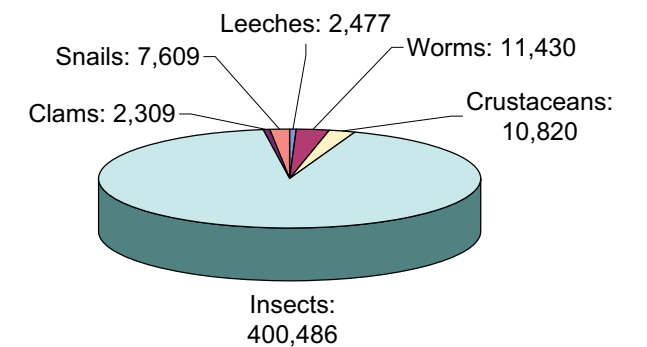


Figure 1. Total benthic macroinvertebrates found in Iowa's streams from 1994-2008.

A benthic macroinvertebrate's life (stage)

Many aquatic insects undergo metamorphosis, which is the transition between life stages: egg to larva to pupa, and finally to adult. They remain in the water for most of their lives in the egg, larva, and pupa stage. Some aquatic insects stay in the water into their adult stage (e.g., aquatic beetles); however, most adults take on a winged terrestrial form. The majority of these insects live only a brief time as adults, usually a few hours to a few weeks or months, while they locate mates and reproduce.

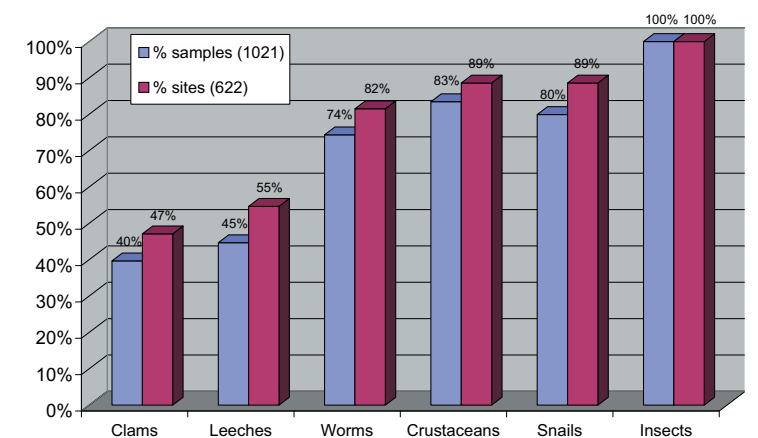


Figure 2. Percent occurrence of benthic macroinvertebrates found in Iowa's streams from 1994-2008.

Table 1. Families of benthic macroinvertebrates found in Iowa's streams from 1994-2008.

Class	Families					
Clams: Bivalvia 4 different orders 10 total taxa	Corbiculidae Pisidiidae Sphaeriidae	Unionidae				
Leeches: Clitellata 3 different orders 24 total taxa	Erpobdellidae Glossiphoniidae Haemopidae					
Crayfish/others: Crustacea 3 different orders 15 total taxa	Asellidae Cambaridae Crangonyctidae	Gammaridae Talitridae				
Snails: Gastropoda 3 different orders 18 total taxa	Ancylidae Hydrobiidae Lymnaeidae	Physidae Planorbidae Pleuroceridae	Succineidae Valvatidae			
Insects: Insecta 10 orders 505 total taxa	Aeshnidae Brachycentridae Ceratopogonidae Corduliidae Culicidae Dytiscidae Ephydriidae Haliplidae Heteroceridae Hydroptilidae Leptohipidae Limnephilidae Muscidae Notonectidae Phoridae Potamanthidae Ptilodactylidae Sciomyzidae Staphylinidae Tipulidae	Athericidae Caenidae Chaoboridae Corixidae Curculionidae Elmidae Gerridae Hebriidae Hydrochidae Isonychidae Leptophlebiidae Macroveliidae Naucoridae Oligoneuriidae Phryganeidae Psephenidae Ptychopteridae Scirtidae Stratiomyidae Uenoidae	Baetidae Calopterygidae Chironomidae Corydalidae Dixidae Empididae Glossosomatidae Helicopsychidae Hydrometridae Lampyridae Lestidae Mesoveliidae Nemouridae Perlidae Pleidae Psychodidae Pyralidae Sialidae Syrphidae Veliidae	Baetiscidae Capniidae Chrysomelidae Cosmopterigidae Dolichopodidae Ephemerellidae Gomphidae Helodidae Hydrophilidae Lepidostomatidae Leuctridae Metretopodidae Nepidae Perlodidae Polycentropodidae Psychomyiidae Rhyacophilidae Simuliidae Tabanidae	Belostomatidae Carabidae Coenagrionidae Crambidae Dryopidae Ephemeridae Gyrinidae Heptageniidae Hydropsychidae Leptoceridae Libellulidae Miridae Noteridae Philopotamidae Polymitarcyidae Pteronarcyidae Saldidae Sisyridae Taeniopterygidae	
Worms: Oligochaeta 1 order 4 total taxa	Lumbricidae Naididae Tubificidae					

Why are benthic macroinvertebrates important?

As an integral part of the aquatic food web, benthic macroinvertebrates convert energy stored in organic matter into a food source that fish and other vertebrates can utilize. They eat leaves, algae, and bacteria and, in turn, are eaten by fish, amphibians, birds, and other vertebrates. In death, benthic macroinvertebrates release nutrients that are reused by aquatic plants and animals, repeating the cycle.

Why use benthic macroinvertebrates to monitor water quality?

Benthic macroinvertebrates serve as useful biological indicators in water. As water quality and habitat conditions change, the benthic macroinvertebrate community also changes. Unlike fish and other vertebrates, benthic macroinvertebrates are less mobile and are unable or unlikely to escape the effects of sediment and other pollutants that diminish water quality. Benthic macroinvertebrates represent a diverse group of aquatic animals. The large number of individual taxa have a wide range of responses to stressors such as toxic pollutants, sedimentation, and habitat disturbance. Therefore, the number and kinds of taxa collected and identified are relatively good indicators of stream health. Having an abundance of different types of taxa, or high biodiversity, is important.

A few benthic macroinvertebrates in depth



larvae

Net Spinning Caddisfly – Trichoptera, or caddisflies, comprises an order of insects that is completely aquatic until reaching the adult stage, living in all kinds of waterbodies. Caddisflies can produce silk threads which they use to make cases from wood, plant material, sand, or small rocks for protection, camouflage, and sometimes to collect food. Due to their sensitivity to pollution and habitat disturbance they are widely used as an environmental indicator. Adult caddisflies are winged, terrestrial insects.



silk net

One family of Trichoptera, Hydropsychidae, is the net spinning caddisfly. The larvae spin a fine silk net which they attach to a hard surface. In flowing water these nets catch food such as algae, detritus, and smaller invertebrates. Densities of Hydropsychidae can be very high in areas with abundant food sources, causing larvae to become territorial and defend their nets. They warn others of their presence by rubbing a sharp, pointed structure on their front legs against their head. When overtaken they will abandon their net and must spin a new one or take over an existing one. Hydropsychidae are tolerant to moderate levels of nutrient enrichment (organic pollution).



larva



adult

Crane Fly – Tipulidae, or crane flies, is a family belonging to the Order Diptera (true flies). As larvae, crane flies can be found in streams, lakes, and wetlands often under leaf packs, snags, rocks, and in algal mats. A crane fly resembles a caterpillar with its head retracted into its body. As an adult it resembles a large mosquito that does not bite.

The larvae are important contributors to the aquatic environment by shredding leaves, making them more accessible to other invertebrates. All Diptera are generally tolerant to pollution and habitat disturbance, however the Tipulidae is one of the more sensitive Dipteran families.



Leech – Hirudinea, or leeches, is a segmented worm found in lakes, wetlands, and streams. Most people think of leeches as bloodsuckers that feed on warm-blooded animals, like humans, but most are predators of other invertebrates or scavengers of dead plants and animals. While many are plainly colored some are brightly colored, striped, or have marbled coloration. Leeches obtain oxygen through their skin and are not very sensitive to pollution or habitat disturbance.



Crayfish – Cambaridae, or crayfish, is a freshwater crustacean found in streams, lakes, ponds, and wetlands. Crayfish usually hide under rocks and logs or burrow into the substrate. The front legs (first set) on a crayfish are enlarged claws used for defense and in territorial disputes. They are scavengers feeding on living and dead animals and plants which they shred using