This chapter includes general information on environmental adaptations, feeding habits, and other more detailed information on the most common aquatic insect families found in Texas.

Introduction
Freshwater macroinvertebrates are animals without backbones that live in or near the bottom of freshwater ponds, lakes, streams, and rivers for some or all of their life cycle. Freshwater macroinvertebrates inhabit all types of freshwater ecosystems. They are very important indicators of the health of streams and rivers reflecting water quality and habitat conditions.

Historically, water chemistry and physical parameters, such as DO, were used to determine the quality of a stream. However, these types of indicators provide only a “snapshot” of water quality in a stream, not a comprehensive view of conditions over time. Biological communities and in-stream habitat give better overall pictures of conditions in a stream by showing changes in physical and chemical parameters.

Freshwater insects shape a large part of the freshwater macroinvertebrate community, accounting for up to 90 percent of the bottom organisms in a stream. Non-insect benthic macroinvertebrates include crayfish, clams, snails, worms, and leeches.

Of the two million known insects, 80,000 species depend on the freshwater environment for all or part of their life cycle; approximately 5,000 freshwater species have been described in North America. In general, the majority of freshwater insects live in the aquatic environment during the immature stages of their lives and emerge as terrestrial adults. A few live their entire lives in water—for example, aquatic Hemipterans (true bugs) and aquatic Coleopterans (beetles).

Adaptations to the Aquatic Environment
Freshwater macroinvertebrates are generally grouped by two characteristics: how they feed and how they move within the aquatic environment. In addition, macroinvertebrates are also categorized by their tolerance to pollution.

General Environmental Adaptations
Freshwater macroinvertebrates, in order to adapt to the aquatic environment, have to be able to move or maintain their position in the water. The water penny (Coleoptera–Psephenidae) is an example of a clinger. It has a flattened body structure that allows it to remain close to a rock surface and avoid being swept away by the current. Water pennies are usually found in riffles, where water velocity and turbulence are high.

Burrowers and sprawlers are adapted to inhabit sediments comprised mainly of sand and silt. Burrowing mayflies (Ephemeroptera–Ephemeridae) have large, spade-shaped leg parts and tusk-like mouth parts to assist in digging. Sprawlers have adaptations for staying on top of the substrate, such as long legs. Climbers, as the name implies, are adapted for climbing plants or debris.

Table 6-1 summarizes the general environmental adaptations of aquatic insects. In some instances, more than one adaptation is listed for a certain family. This means that not every genus in this family has the same environmental adaptations.

Functional Feeding Groups
Freshwater macroinvertebrates are divided into various groups based on feeding habits, called functional feeding groups. The classification of a functional feeding group is based on food preference and how an organism eats. Table 6-2 summarizes general functional feeding groups. For example, predators feed by either eating prey whole or by piercing into their prey. Collectors feed on small bits of organic matter by either gathering deposits from the substrate or by filtering particles out of flowing water. In some instances there is more than one functional feeding group listed for a certain family. This means that not all genera in this family have the same food preferences.

Pollution Tolerance
Aquatic organisms are also put into categories based on their tolerance to pollution. Tolerance values range from 0 to 10 with 0 being least tolerant and 10 most tolerant. Like functional feeding
groups and general adaptations, tolerance values apply to the family level and may vary depending on the genus. Tolerance values are assigned to organisms that are used as pollution indicators. In some instances there is more than one tolerance value listed for a certain family. See Chapter 3 for more information on the use of freshwater macroinvertebrates as indicators of pollution.

See the “Organisms Used as Indicators of Pollution” section in Chapter 3 for more information on the use of freshwater macroinvertebrates as indicators of pollution.

### Table 6-1

**General Environmental Adaptations of Freshwater Macroinvertebrates**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
| Skaters (sk) | • Adapted for movement on the water’s surface  
• Scavenge on organisms caught in the surface film |
| Planktonic (pl) | • Inhabit open water (limnetic zone) of lakes, ponds, bogs (lentic)  
• May float and swim in open water or float at the surface to get oxygen or food; can dive when alarmed |
| Divers (dv)  | • Can swim by rowing with the hind legs in lentic habitats and lotic pools  
• Some come to surface to get oxygen; dive and swim when alarmed  
• Some cling to or crawl on submerged objects |
| Swimmers (sw) | • Adapted for fish-like swimming in lotic and lentic habitats  
• Cling to submerged objects—rocks (lotic riffles) and vegetation (lentic)—following short bursts of swimming |
| Clingers (cn) | • Construct shelters, have long tarsal claws and flattened bodies for attaching to surfaces in lotic riffles and wave-swept rocky littoral zones |
| Sprawlers (sp) | • Live on the surface of floating aquatic plants or fine sediments  
• Usually have modifications for staying on top of substrate and keeping respiratory surfaces free of silt |
| Climbers (cb) | • Live on overhanging branches, logs, roots, or aquatic macrophytes |
| Burrowers (bu) | • Inhabit fine sediments of streams (pools) and lakes |

*adapted from Merritt and Cummins 1995*

### Table 6-2

**Functional Feeding Group Classification of Freshwater Macroinvertebrates**

<table>
<thead>
<tr>
<th>Functional Feeding Groups</th>
<th>Food Preference</th>
<th>Feeding Habits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shredders (SHR)</td>
<td>Live aquatic plants, or dead and dying plants, such as leaves and wood, where fungus, bacteria, and algae (periphyton) are closely attached to the substrate</td>
<td>Chew, bore, or gouge plant material</td>
</tr>
<tr>
<td>Collector-gatherers (CG)</td>
<td>Small bits of decomposed organic matter, also known as fine particulate organic matter (FPOM)</td>
<td>Gather deposits from the bottom</td>
</tr>
<tr>
<td>Collector-filterers (CF)</td>
<td>Small bits of decomposed organic matter</td>
<td>Filter matter out of the water</td>
</tr>
<tr>
<td>Scrapers (SCR)</td>
<td>Periphyton—algae, diatoms, bacteria, and fungi attached to rocks and plants—also known as coarse particulate organic matter (CPOM)</td>
<td>Scrape food from rock, plant, and other hard surfaces</td>
</tr>
<tr>
<td>Piercers (PI)</td>
<td>Live aquatic plants</td>
<td>Pierce into the plants and suck fluids out</td>
</tr>
<tr>
<td>Predators (P)</td>
<td>Live animals</td>
<td>Engulf whole animals, or pierce into the animals and suck fluids out</td>
</tr>
</tbody>
</table>

*adapted from Merritt and Cummins 1995*
General Freshwater Macroinvertebrate Key

The general freshwater macroinvertebrate key that follows is made up of the most common freshwater orders. The main purpose of the key is to familiarize the reader with the different orders and their key characteristics.

The first part is a general insect key, which can be used to find the order in which an insect belongs. The second part lists the common families of each order and gives the key characteristics of that family.


Definitions of Scientific Terms

Aquatic organisms are identified by physical characteristics. The following is a list of definitions which will help explain the scientific terms used in identifying benthic macroinvertebrates.

Basic Terms

Basic terms are used to describe:

Orientation or location. Used to refer to the location of a body structure; front, back, top, or bottom.

General body divisions. Head, thorax, or abdomen.

Body structure. Gills, antenna, legs, claws, wings, or mouth parts. There may be additional terms used to further describe body structures. For example, mayflies are identified by the presence of gills. Specific families of mayflies are identified by the shape and location of their gills.

Orientation

anal. Refers to last abdominal segment, posterior end.

anterior. Near or toward the head.

basal. Base or point of attachment.

caudal. Posterior part of body or tail.

distal. Refers to a part farthest from the body.

dorsal. Refers to back or uppermost side.

lateral. Refers to sides (left or right).

posterior. Hind or rear end.

terminal. Forms located at the end of a structure.

ventral. Underside

General Body Divisions

abdomen. The posterior section of the body behind the thorax.

head. Bears the eyes, antennae, and mouth parts.

thorax. Body region behind the head that has the legs and wings, divided into three segments, (1) prothorax, (2) mesothorax, and (3) metathorax.

Body Structure

antennae. Long sensory appendage found on the head of insects and crustaceans. The singular is antenna.

anus. Posterior opening of the digestive system.

carapace. Hard dorsal covering in shellfish.

cerci. Pair of dorsal appendages at the posterior end of the abdomen. The singular is cercus.

chelate. Claw-like.

coxa. The segment of the leg at the point of attachment to the body.

compressed. Flattened from side to side or top to bottom.

epiproct. A short projection located just above the anus on the 10th segment in dragonflies–Odonata.

exoskeleton. A supporting structure found outside of the body; for example, the shell of a crayfish.

femur. Long leg segment, located between the trochanter and tibia.

lamellate. Thin, flat membrane.

labium. Lower lip or posterior mouth part.

labrum. Upper lip or anterior mouth part.

mandibles. Pair of hard (sclerotized) unsegmented jaws. Located between the labrum (upper lip) and maxillae (secondary jaw).

maxillae. Secondary jaws that are paired and segmented and used to aid in chewing and holding food. Located between the mandibles and labium (lower lip).

prementum. Part of labium (lip). When the labium is not in use, it lies against the ventral side of the head and thorax. The prementum—either broad, thin, or spoon shaped—conceals or partially conceals the lower face.

notum. Hard plate-like areas (sclerites) on the dorsal surface of a thoracic segment; each segment of the thorax has a notum, prothorax-pronotum, metathorax-metanotum and mesothorax-mesonotum. The plural is nota.

ocelli. Simple eye. The singular is ocellus.

paraprocts. A pair of projections located to the left and right of the anus (dragonflies–Odonata).

proleg. A fleshy leg on the abdomen of some insect larvae.

raptorial legs. Front legs modified for grabbing and holding prey.

sclerite. Hard plate-like areas, often bordered by sutures or a membranous area.
sclerotized. Hardened.
scutellum. A triangular sclerite between the pronotum and the wings
setae. Thin bristle-like projections.
sutures. Line-like grooves in the body wall.
spiracle. External opening for respiratory system.
sternum. A hard plate (sclerite) on the ventral or lower region of the thorax.
tarsus. The final leg segment next to the tibia, generally bears the claws.
tibia. Leg segment between the femur and tarsus.
trochanter. Small leg segment between the base segment (coxa) and the middle leg segment (femur).
wing pads. Developing external wings.
Key to Common Freshwater Macroinvertebrates (cont.)
Aquatic Insect Orders

**Diptera True Fly**
Thorax lacks jointed legs; may have prolegs
Head distinct and well developed
Prolegs are often present at the thorax, end of abdomen or both; obvious hairs and/or processes at the end of the abdomen

**Mayflies Ephemeroptera**
Head is indistinct, entirely or partly lacking
Abdomen ends 2 to 3 tails (caudal cerci)
Feet (tarsi) with 1 claw; abdomen ends in 2 to 3 tails (caudal cerci); wing pads and lateral gills present; many abdominal segments may have lateral gills

**Hemiptera True Bugs**
Mouth is beak shaped which projects beneath the head; adult has leathery wings
Thorax with hard wings creating plate-like covering

**Coleoptera Aquatic Beetle Adults**
Wings or wing pads present
Abdomen ends in 1, 2, or no tails (caudal cerci)
Feet (tarsi) with 2 claws; abdomen ends in a 2 cerci; abdominal gills usually absent; if present filaments found on the first few abdominal segments

**Stoneflies Plecoptera**
Mouth is not beak shaped; mouth parts are for chewing or grasping prey
Abdomen ends in 1, 2, or no tails (caudal cerci)
External wings or wing pads absent
Go to next page
Key to Common Freshwater Macroinvertebrates (cont.)
Aquatic Insect Orders (cont.)

External wings or wing pads absent

Pairs of short, fleshy prolegs on the underside of the abdomen that end in a series of tiny hooks are present

Aquatic Caterpillar
Lepidoptera

Mouth is not beak shaped; mouth parts are for chewing or grasping prey

Extendable lower lip (labium) present; may look like a large mask or lie flat under the head. At rest, the labium covers the mouth parts.

Damsel Fly & Dragonfly
Odonata

Abdomen never ends in pair of prolegs with a single hook; if terminal hooks are present there will be 4

Thoracic segments often with developed hard exoskeleton, or fleshy; abdomen ends in a pair of anal prolegs (size varies) usually with a single hook at the end

Caddisfly Larvae
Trichoptera

Abdomen has well defined lateral filaments

Abdomen from usually does not end in a single, unforked, long filament and never with a pair of hooked prolegs; structures at the end of the abdomen vary

Coleoptera
Aquatic Beetle Larvae

Abdomen ends in a single, unforked long filament or in a pair of prolegs, each with 2 hooks

Megaloptera
Dobsonfly & Alderfly Larvae

Abdomen lacks well-developed lateral filaments

Coleoptera
Aquatic Beetle Larvae
Common Texas Freshwater Macroinvertebrates

Freshwater Insects

Dobsonflies and Alderflies—Order Megaloptera

Dobsonflies—Family Corydalidae

▼ Larvae live under rocks in riffle areas and fast-moving water of streams (lotic)
▼ Intolerant of pollution and low oxygen
▼ Aggressive stream predators
▼ Common genus and species found in Texas—Corydalus cornutus and Chauliodes
▼ General feeding group(s)—predator
▼ General habitat(s)—clinger and climber
▼ Pollution tolerance—generally sensitive to moderately tolerant

Key characteristics:
▼ large mandibles
▼ a pair of hooked anal prolegs
▼ 8 pairs of lateral filaments
▼ no terminal filament

Figure 6-1

Alderflies—Family Sialidae

▼ Similar to the dobsonfly larvae but smaller; predators
▼ Live mostly in deposited sediments of streams (lotic), permanent ponds and lakes (lentic)
▼ Common genus found in Texas—Sialis
▼ General feeding group(s)—predator
▼ General habitat(s)—burrower, clinger
▼ Pollution tolerance—generally sensitive

Key characteristics:
▼ long, single tail filament (separates alderfly larvae from all other aquatic insects)
▼ 7 pairs of lateral filaments
▼ no hooked anal prolegs

Mayflies—Order Ephemeroptera

▼ Widespread and abundant in most regions; occur in a wide variety of habitats
▼ All larvae are aquatic; majority live in streams, a few live in ponds, and lakes
▼ Majority of life cycle is spent in the water
▼ Adults have no functional mouth parts and live less than 24 hours as an adult
▼ Important food source for fish in streams
▼ Wide range of DO requirements
▼ Very important in the biological monitoring of streams
▼ Most crawl on substrate, but many are good and fast swimmers
▼ Swim by moving abdomen and caudal filaments up and down
▼ Can adapt to less oxygen-rich environments and can increase water circulation by moving gills
▼ Most are herbivores (feed on plant material) or detritivores (feed on organic matter, leaf litter)

Pollution indicator role: Mayflies display a wide range of pollution tolerance, but are generally associated with good water quality. Mayflies are one of three key indicator organisms used in biological assessments. Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are used to calculate the EPT Index.

General characteristics:
▼ filamentous antennae
▼ 1 tarsal claw
▼ presence of lateral or ventrolateral gills on most of the first 7 segments
▼ majority have 3 caudal filaments (2 cerci and 1 median filament); only a few have 2 caudal filaments
▼ closely resemble stonefly larvae, which have only 2 cerci, lack gills on middle abdominal segments, and have 2 tarsal claws
▼ wing pads are present

Figure 6-2
Family Baetidae

- Small but active swimmers
- Widespread; occur in variety of streams, permanent and temporary ponds, and littoral zones of lakes
- Common genera found in Texas—Baetis, Bae- todes, Callibaetis, Centroptilum, Cloeon, Camelobaetidius, Fallceon, Paracloeodes, Pseudocloeon
- General feeding group(s)—collector-gatherer, scraper
- General habitat(s)—swimmer
- Pollution tolerance—generally sensitive to moderately tolerant

Key characteristics:
- torpedo shaped body
- lamellate abdominal gills
- long antennae (twice the length of the head)
- median caudal filament often shorter than the cerci

Family Caenidae

- Widespread and common in a variety of lentic and lotic habitats, in streams (all sizes), swamps, spring seeps, marshes, lakes, and ponds
- Often partially covered with silt because they frequent the sediment
- More tolerant of low DO levels than any other mayfly family
- Adults live only a few hours and mate shortly after emerging
- Common genera found in Texas—Caenis, Brachycercus
- General feeding group(s)—collector-gatherer, filter-collector
- General habitat(s)—sprawler
- Pollution tolerance—generally sensitive to moderately tolerant

Key characteristics:
- small in size
- easy to recognize by nearly square operculate gills
- gills have fringed margins

Family Ephemerellidae

- Common in United States
- Most species inhabit clean streams; often abundant in leaf litter, eddies, or near bank areas
- Some species can be found along wave-swept lake shores and organically enriched streams
Most larvae are herbivores or detritivores; a few are omnivores and feed on small invertebrates.

Common genus found in Texas—*Eurylophella*

General feeding group(s)—collector-gatherer, scraper

General habitat(s)—clinger, sprawler, swimmer

Pollution tolerance—generally sensitive

**Key characteristics:**
- gills absent on abdominal segment 2
- lamellate or operculate gills on segments 3 to 7 or 4 to 7

---

**Family Heptageniidae**

Widespread and abundant in lotic habitats (streams); also found in wave-swept shorelines of lakes.

Inhabit rocks, wood, debris, and other materials where they can cling.

Common genera found in Texas—*Stenacron*, *Stenonema*

General feeding group(s)—scraper, collector-gatherer

General habitat(s)—clinger

Pollution tolerance—generally sensitive to moderately tolerant

**Key characteristics:**
- body flattened top to bottom (dorsoventrally)
- eyes and antennae located dorsally (further back on head)
- may lack median caudal filament
- oval gills in a single plate, usually with tufts near the base

---

**Family Ephemeridae**

Burrow into sand or eddies in riffle areas of small to medium-sized streams; inhabit silt bottoms of medium to large streams, as well as sand or silt bottoms of clean lakes.

Primarily filter feeders; circulate water through their burrows; also graze on algae and detritus from bottom.

Common genus found in Texas—*Hexagenia*

General feeding group(s)—collector-gatherer, scraper

General habitat(s)—burrower

Pollution tolerance—moderately tolerant

**Key characteristics:**
- large body size
- filamentous gills extending upward over the back
- tusks curving upward and outward from the mouth

---

**Family Isonychiidae**

Large in size and excellent swimmers.

Feed on algae and diatoms; use long hairs on forelegs to filter food out of water.

Found in riffles or sandy bottoms of streams.

Common genus and species found in Texas—*Isonychia sicca* (used to be in the family *Oligoneuriidae*).

General feeding group(s)—filter-collector

General habitat(s)—swimmer, clinger

Pollution tolerance—generally sensitive

**Key characteristics:**
- front legs have two rows of setae (long hairs)
- torpedo-shaped body
- rounded gills
- lower part of abdomen curves upward when not swimming
- outer caudal filaments fringed on both sides
**Family Leptophlebiidae**
- Found in many stream habitats including cobble substrates, debris dams, and leaf packs
- Common genera found in Texas—*Leptophlebia, Choroterpes, Farrodes texanus, Paraleptophlebia, Thraulodes, Traverella*
- General feeding group(s)—collector-gatherer, scraper, filter-collector, shredder
- General habitat(s)—swimmer, clinger
- Pollution tolerance—sensitive

**Key characteristics:**
- Abdominal gills on segments 2 to 7 either forked with fringed margins

**Caddisflies—Order Trichoptera**
- All but a few are aquatic
- Most are found in streams and rivers, with a few inhabiting ponds and lakes
- Very important part of the stream community, sometimes dominating the insect community of a stream
- Important in biological monitoring of streams
- Important food source for fish
- Three major groups: (1) free-living (predators), (2) case-building (scrapers/shredders), and (3) net-spinning (algae, detritus, macroinvertebrates)
- Undergo complete metamorphosis (larvae, pupae, and adult), which allows them to spin silk used to build nets and cases
- Case materials are either organic (leaf, sticks, pine needles, or bark) or mineral (sand, fine gravel)

**Pollution indicator role:** Caddisflies display a wide range of pollution tolerance but are generally associated with good water quality. One of three key indicator organisms used in biological assessments: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are used to calculate the EPT Index.

**General characteristics:**
- 3 pairs of thoracic legs (near head)
- single tarsal claw
- abdominal gills
- head subdivided into 3 parts by Y-shaped lines
- short anal prolegs (no joint) at the end of the abdomen, with pointed anal claws
- no wing pads

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**Family Tricorythidae**
- Larvae are widespread
- Inhabit detritus, silt, and gravel in streams of all sizes
- Some species are resistant to low DO levels
- Common genera found in Texas—*Leptohyphes, Tricorythodes*
- General feeding group(s)—collector-gatherer
- General habitat(s)—clinger, sprawler
- Pollution tolerance—generally sensitive to moderately tolerant

**Key characteristics:**
- triangular or oval operculate gills on abdominal segment 2
**Case-Building Caddisflies**

**Family Helicopsychidae**

- Use sand grains to build small snail-like cases; very distinctive and the larvae never abandon the case.
- Mainly lotic, but can be found along lake margins and sometimes in deep water; tolerate warm temperatures, found in thermal springs.
- Widespread; inhabit rocks or wood.
- Feed by scraping periphyton off of substrate.
- Common genus found in Texas—Helicopsyche.
- General feeding group(s)—scraper.
- General habitat(s)—clingers.
- Pollution tolerance—sensitive.

**Key characteristics:**
- Never leave snail-like case; hard to remove.

**Family Leptoceridae**

- Larvae construct a wide variety of cases; some genera build long cases built with vegetation, vegetation and sand, or pure silk, and have fringes of long setae on the legs for swimming; other genera build shorter, stouter cases of plant or mineral materials and are unable to swim.
- Found in a variety of permanent habitats: lotic (slow water) and lentic (littoral zone and far from shore).
- Common genera found in Texas—Setodes, Trienaodes, Nectopsyche, Oecetis.
- General feeding group(s)—shredder, collector-gatherer, predator.
- General habitat(s)—climber, sprawler, clinger, swimmer.
- Pollution tolerance—generally sensitive.

**Key characteristics:**
- Long antennae (much longer than other caddisflies).
- Long metathoracic legs.

**Case-Building Microcaddisflies**

**Family Hydroptilidae**

- Found in lotic (erosional) and lentic (littoral) environments.
- Purse-shaped case made out of fine sand grains.
- Common genera found in Texas—Hydroptila, Leucotrichia, Mayatrichia, Ochrotrichia, Oxyethira, Stactobiella.
General feeding group(s)—scraper, collector-gatherer, piercer
General habitat(s)—clinger, climber
Pollution tolerance—sensitive to moderately tolerant

Key characteristics:
lack branched ventral gills
very small larvae
completely sclerotized thoracic nota

Family Polycentropodidae
Majority found in streams, but also inhabit littoral areas of lakes and temporary ponds
A few species are herbivores and build trumpet-shaped capture nets; most species are predators with tubular-shaped retreats
Tubular retreats aid in respiration; larvae circulate water through them by moving their body; important in habitats that are occasionally oxygen deficient
Common genera found in Texas—Cernotina, Neureclipsis, Nyctiophylax, Phylocentropus, Polycentropus, Polplectropus
General feeding group(s)—filter-collector, predator
General habitat(s)—clinger
Pollution tolerance—sensitive to moderately tolerant

Key characteristics:
unmodified tarsi (legs)
presence of dark or light spots (muscle scars) on head

Net Spinning Caddisflies
Family Hydropsychidae
Important caddisfly family; frequently represent a large portion of the stream macroinvertebrate community in streams of all sizes, temperatures, and currents
Most are omnivores, feeding on algae, crustaceans, and insects captured in their nets
Widespread, abundant; tolerance to organic pollution varies by species; very important in the biological monitoring of streams
Build net retreats on rocks, logs, and other substrate
Common genera found in Texas—Cheumatopsyche, Dipllectrona, Hydropsyche, Smicridea, Macronema, Macrostemum, Potamyia
General feeding group(s)—filter-collector
General habitat(s)—clinger
Pollution tolerance—sensitive to moderately tolerant

Key characteristics:
larvae are very large
numerous, branched filamentous gills on ventral side of abdomen

Damselflies and Dragonflies—Order Odonata
All larvae aquatic
Tolerate some pollution
Often top predators in the invertebrate community
Prey on other insects and small minnow-size fish
Adults also predators; highly beneficial insects
Two-thirds live in ponds and lakes, and one-third in streams; mosquitoes make up a large part of the diet for adult and nymph stages
Pollution tolerance—moderately tolerant although variable (some species less tolerant than others), generally indicators of water with lower DO levels

General characteristics:
easily distinguished from all other aquatic insects
large body size
elongate, hinged lower lip (labium) modified for seizing prey
wing pads

**Dragonflies—Suborder Anisoptera**

**General characteristics:**
- abdomen relatively broad and terminates in three triangular-shaped cerci
- some move by rapidly expelling water through rectal chamber (burrowers)
- most are burrowers and clingers
- lower lip (labium) forms spoon-shaped mask fitting over the lower part of the head and mouth parts; others have a flat labium

**Figure 6-18**

**Family Aeshnidae**
- Climb actively in vegetation of shallow waters; cling to and move around on vegetation to stalk prey
- Voracious predators; feed on invertebrates and small vertebrates (minnows)

**Figure 6-19**

**Family Gomphidae**
- Nymphs inhabit streams and riffles and often burrow into silt or sand in slower-moving water; some may inhabit small permanent ponds and littoral areas of lakes
- Common genera found in Texas—*Dromogomphus, Erpetogomphus, Gomphus, Hagenius, Ophiogomphus, Phylogomphoides, Progomphus*
- General feeding group(s)—predator
- General habitat(s)—burrower
- Pollution tolerance—sensitive to moderately tolerant

**Key characteristics:**
- nymphs have large body size
- flat prementum
- antennae slender, bristle like, with 6 to 7 segments
- body cylindrical with long tapered abdomen
- head slightly flattened
- abdomen has lateral spines on segments 8 and 9, (and/or sometimes on segments 5 to 7)
**Family Libellulidae**

- Sprawl on bottom, but some crawl on debris and vegetation
- Inhabit slow-moving waters of streams and vegetated zones of ponds and lakes
- Common genera found in Texas—Brechmorhoga, Erythemis, Erythrodiplax, Libellula, Orthemis, Perithemis
- General feeding group(s)—predator
- General habitat(s)—sprawler
- Pollution tolerance—tolerant

**Key characteristics:**
- prementum spoon shaped (fits over face like a mask)
- large body; narrower than Macromiidae
- frontal horn on head *absent* (between antennae)
- looks hairy

**Family Corduliidae**

- Found with debris in currents of medium to large streams or lake margins exposed to wave action
- Sedentary, often covered with silt
- Common genus found in Texas—Macromia
- General feeding group(s)—predator
- General habitat(s)—sprawler
- Pollution tolerance—sensitive

**Key characteristics:**
- prementum spoon shaped
- frontal horn on head

---

**Damselflies—Suborder Zygoptera**

Key characteristics:
- abdomen long and thin, ending in 3 long vertically oriented external gills (caudal lamellae: flattened leaf-like structures at posterior end)
- swim by moving abdomen from side to side
- most cling to plants and other objects
- lower lip (labium) longer and narrower than the dragonfly’s
**Family Calopterygidae**

- All species are lotic, living in running water habitats (in streams of all sizes); found among bank vegetation and accumulating debris
- Common genera found in Texas—*Calopteryx, Hetaerina*
- General feeding group(s)—predator, scraper
- General habitat(s)—climber
- Pollution tolerance—moderately tolerant to tolerant

**Key characteristics:**

- large body
- very long first antennal segment

**Family Coenagrionidae**

- Mainly found in lentic (standing-water) habitats; in permanent ponds, marshes, swamps and littoral (shallow-water) areas of lakes; sometimes in stream vegetation in areas of little or no current
- A few species inhabit riffle areas of streams and along stream banks
- Climb on vegetation where they stalk prey; feed on small invertebrates
- Common genera found in Texas—*Argia, Chromagrion, Enallagma, Ischnura*
- General feeding group(s)—predator
- General habitat(s)—climber
- Pollution tolerance—moderately tolerant

**Key characteristics:**

- small size
- antenna segments equal
- base of prementum *not* greatly narrowed

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**Stoneflies—Order Plecoptera**

- Intolerant to pollution
- Important food source for fish and invertebrate predators
- Important in biological monitoring of streams
- All but a few live in streams
- Need oxygen-rich environment due to the lack of extensive gills
- Some nymphs are plant feeders, others are predators
- Most are adapted to cool temperatures of clear mountain streams, but a few species are found in Texas
- Found under rocks, in debris, and in thick mats of algae
- Common families and genera found in Texas—*Capniidae, Allocapnia, Leuctridae, Zealeuctra, Perlidae, Perlesta, Perlinella, Perlodidae, Isoperla, Taeniopterygidae, Taeniopteryx*
- General feeding group(s)—predator, shredder, collector-gatherer, scraper
- General habitat(s)—clinger, sprawler

**Pollution indicator role:** Stoneflies are associated with good water quality and a good supply of oxygen, and are generally considered sensitive to pollution. One of three key indicator organisms used in biological assessments: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are used to calculate the *EPT Index*.  

**General characteristics:**

- long antennae
- 2 claws on each tarsus
- gills, if present, on head, thorax, or basal segments of the abdomen
**Black Flies—Family Simuliidae**

- Common and widespread
- Inhabit a wide variety of lotic (running water) habitats
- Often abundant on rocks, submerged wood, or vegetation in fast- to slow-moving currents
- Adults are small in size; female adults have a painful bite and are considered serious pests in some parts of the country; blood meal is needed to mature eggs
- Common genera found in Texas—*Cnephia, Prosimulium, Simulium*
- General feeding group(s)—filter-collector
- General habitat(s)—clinger
- Pollution tolerance—moderately tolerant to tolerant, usually found in swift-moving streams, but can also indicate elevated nutrients (nitrogen and/or phosphorus) in the water

**Key characteristics:**
- uniquely shaped: swollen abdomen that is attached to rocks and other debris by a caudal (posterior end) sucker
- relatively large head
- single ventral proleg on the thorax

**Craneflies—Family Tipulidae**

- Adults have a large mosquito-like body with long legs; sometimes referred to as mosquito hawks
- Aquatic larvae are widespread and abundant
- Adult craneflies do not bite; they are harmless
- Larvae live in water or moist soil
- Most aquatic species found in lotic (running-water) habitats; a few found in shallow, lentic (standing-water) habitats
- Feeding habits vary; all feeding groups are included—omnivores, herbivores, carnivores, and detritivores; most feed on plants and plant debris, some are predators
- Common genera found in Texas—*Antocha, Erioptera, Helius, Hexatoma, Limnophila, Lipsothrix, Psuedolimnophila, Tipula*
General feeding group(s)—shredder, collector-gatherer
General habitat(s)—burrower
Pollution tolerance—moderately tolerant, indicating moderately clean water; rare in polluted water

Key characteristics:
- head capsule has a partial hard covering and is retracted into the thorax
- size is large, 10 to 25 mm long
- easily recognized by lobes on the posterior end, which stretch out to form a terminal disk that has 2 conspicuous eye-like spiracles
- spiracles are characteristic of a species
- caudal spiracles (external opening for breathing system) are used to get oxygen from the surface; in well-oxygenated streams most oxygen is obtained through the cuticle (outer covering)
- Body is worm-like and thick skinned
- Colors range from brownish-green to somewhat transparent white

Deerflies or Horseflies—Family Tabanidae
- Most larvae develop in semiaquatic habitats that may be closely associated with aquatic habitats; some species are entirely aquatic
- Aquatic larvae are found in stream riffles, shallow stream margins, and shallow vegetated habitats
- Larvae are predators feeding on other aquatic macroinvertebrates
- Most adult females feed on the blood of humans, livestock, and other animals; bites are painful
- Common genera found in Texas—Chlorotabanus, Chrysops, Tabanus
- General feeding group(s)—predator, collector-gatherer
- General habitat(s)—sprawler, burrower
- Pollution tolerance—moderately tolerant

Key characteristics:
- distinct prolegs absent
- girdle of six or more pseudopods (false feet) on most abdominal segments
- 10 to 25 mm long

Midges—Family Chironomidae
- The largest family of aquatic insects; 30,000 species
- Inhabit all types of temporary and permanent aquatic habitats
- Larvae are dominant in the profundal (bottom) and sublittoral (area between littoral and profundal) zones
- Larvae are extremely important part of aquatic food chain; eaten by other insects and fish
- Many species are free living (predators); most species build cases made of bottom (substrate) material cemented together with saliva
- Herbivores and detritivores feed on fine bottom particles; some are filter feeders that build cases to collect food
- Tolerant species are usually red and called bloodworms; they contain a hemoglobin-like pigment that holds oxygen
- Bloodworms are often abundant in sewage lagoons or organically polluted areas of lakes and streams
- Adults do not feed, and live no more than two weeks; seen in swarms over water and by light at night
- Look like small pale mosquitoes, but do not bite
- Common genera found in Texas—61 common genera; difficult to identify to genus and species; most identify to the family level only
- General feeding group(s)—collector-gatherer, filter-collector, predator
- General habitat(s)—burrower
- Pollution tolerance—tolerant, indicators of poor water quality; extremely tolerant of low oxygen

Key characteristics:
- pairs of anterior and posterior prolegs
- sizes vary from 2 to 30 mm long
- narrow bodies
Rat-tail Maggots—Family Syrphidae

- Inhabit shallow lentic (standing-water) habitats, margins of lotic (running-water) habitats, and sewage lagoons; common in areas with large amounts of decomposing organic matter and sludge.
- Very tolerant of pollution, low DO, and poor water quality; use breathing tube to get oxygen from the air.
- Feed on detritus and microorganisms.
- General feeding group(s)—collector-gatherer.
- General habitat(s)—burrower.
- Pollution tolerance—tolerant, indicator of poor water quality and low DO.

Key characteristics:

- Large body.
- Broad and blunt shape.
- A very long segmented extendible breathing tube (siphon); can be extended 3 to 4 times the body length.
- Ventral (underside) prolegs.

Mosquitoes—Family Culicidae

- Common and widespread.
- Serve as transporters of serious diseases: yellow fever, encephalitis, and malaria.
- All larvae are aquatic pupae are generally aquatic.
- Occur in a variety of places, such as pools, ponds, lakes, swamps, or any object or container holding water; not found in areas with current or wave action.
- Larvae feed on organic debris and microorganisms.
- Only a few larvae genera are predators, mostly on other mosquitoes.
- Male adults feed on nectar from plants; females, on blood from mammals, birds, reptiles, or amphibians.
- Depending on the species females may live several weeks or months.
- Larvae breathe at the surface.
- Common genera found in Texas—Culex, Anopheles.
- General feeding group(s)—filter-collector, collector-gatherer.
- General habitat(s)—swimmer, planktonic.
- Pollution tolerance—tolerant; indicator of poor water quality and low DO.

Key characteristics:

- Culex mosquito has a breathing tube at the posterior end; seen hanging from the water surface.
- Anopheles mosquito lacks a breathing tube and spends most of the time floating at the surface.
- Have a flip-flop swimming motion; very active swimmers.
- Pupae have a large head and thorax.
- 3 to 15 mm long.

True Bugs—Order Hemiptera

- Adults and immature stages are aquatic.
- Modified mouth parts form a beak with piercing sucking mouth parts.
- Anterior (front) portion of first wing hard and leathery; posterior (back) portion membranous.
- Some aquatic adults can fly, but not well.

Backswimmers—Family Notonectidae

- Most species breed in littoral areas of lakes and permanent ponds; some breed in stream pools.
- Resemble water boatman (Corixidae).
- Swim ventral (bottom) side up, but orient themselves dorsal (back) side up when not in the water.
**Giant Water Bugs—Family Belostomatidae**

- Large size
- Powerful predators; capture and kill anything they can handle, including fish, frogs, tadpoles, and other insects; important invertebrate predator
- Inhabit permanent lentic (standing water) habitats: margins of ponds, lakes, and marshes, especially weedy areas
- Can fly and are attracted by lights
- Also known as toe biters, can inflict a painful bite
- Lay large masses of eggs on vegetation above the water surface or carry eggs on the backs of males
- Common genera found in Texas—*Abedus, Belostoma, Lethocerus*
- General feeding group(s)—predator
- General habitat(s)—climber, swimmer
- Pollution tolerance—tolerant

**Key characteristics:**
- Large body, oval and flattened
- Raptorial front legs for grasping prey
- A pair of short, strap-like posterior respiratory appendages (retractable)
- Obvious beak-like mouth

**Creeping Waterbugs—Family Naucoridae**

- Common in the southern U.S.; rarely as far north as Canada
- Usually associated with lotic habitats, living in streams, spring ponds, or impoundments
- Fully developed wings, but rarely fly
- Live in well-oxygenated water
- Feed on a variety of aquatic organisms
- Common genera found in Texas—*Ambrysus, Cryphocricos, Limnocoris, Pelocoris*
- General feeding group(s)—predator
- General habitat(s)—clingers, swimmer

**Key characteristics:**
- Dorsoventrally (top to bottom) flattened
- Rounded appearance when viewed from above
- Front femur thickened
- Margins of head, eyes, and pronotum continuous

**Water Boatmen—Family Corixidae**

- Abundant; common insects in ponds
- Some occur in streams or brackish pools along seashore above high tide line
- Erratic but fast swimmers
- Spend most of time clinging to submerged vegetation
- Do not bite
- Feed on algae and other minute organisms
- Common genera found in Texas—*Trichocorixa*
- General feeding group(s)—predator, piercer
- General habitat(s)—swimmer
Key characteristics:
▼ body elongate and oval shaped
▼ back legs elongate and serve as oars
▼ front legs short, single-segmented tarsi, and scoop shaped
▼ dorsal surface of body is flattened

**Figure 6-36**

**Water Striders—Family Gerridae**
▼ Semiaquatic; live on surface of water
▼ Seen moving on the water surface, often in large groups
▼ Feed on small insects that fall on water surface or aquatic insects living just beneath the surface
▼ Found in a variety of aquatic habitats; areas with little wave action or current are preferred
▼ Lotic species inhabit streams of all sizes
▼ Lentic species inhabit swamps, marshes, permanent and temporary ponds, shoreline areas, and the ocean
▼ Lotic species can be found in lentic areas and vice versa
▼ Most species are commonly associated with emergent vegetation
▼ Common genera found in Texas—*Rheumatobates*, *Trephobates*
▼ General feeding group(s)—predator
▼ General habitat(s)—skater

**Key characteristics:**
▼ body long and slender
▼ front legs short
▼ middle and back legs are long and slender
▼ joint of the back legs extends beyond the tip of a short abdomen

**Figure 6-38**

**Water Scorpions—Family Nepidae**
▼ Common in ponds
▼ Predators; feed on other insects
▼ Poor swimmers; usually cling to vegetation or other objects in the water
▼ Breed in permanent lentic (standing water) habitats, especially shallow areas with a lot of vegetation
▼ Can bite if handled carelessly
▼ Resemble terrestrial walking sticks
▼ General feeding group(s)—predator
▼ General habitat(s)—climber
▼ Pollution tolerance—moderately tolerant

**Key characteristics:**
▼ long, slender body (*Ranatra*); long oval shape (*Nepa*); narrow and short (*Curicta*)
▼ long, slender legs
▼ raptorial front legs (used to hold prey)
▼ pair of long, slender abdominal appendages that form a nonretractable breathing tube
▼ mouth beak-shaped

**Figure 6-37**

**Broad-Shouldered or Short-legged Water Striders—Family Veliidae**
▼ Abundant in a wide variety of aquatic habitats: streams near riffles or under cut banks, swamps, ponds, marshes, or margins of lakes
▼ Common genera found in Texas—*Microvelia*, *Rhagovelia*
▼ General feeding group(s)—predator
▼ General habitat(s)—skater

**Key characteristics:**
▼ smaller, and with shorter legs, than Gerridae
▼ joints of the back legs do not extend beyond the abdomen
Beetles—Order Coleoptera

- Largest insect order, with 3 percent having an aquatic stage; represent a significant portion of the aquatic insect community
- 1,100 aquatic species with 18 families in North America
- Both larvae and adults may be aquatic in some species
- Adults range in size from 1 to 40 mm long
- No piercing and sucking mouth parts; chewing mouth parts are present
- Entire forewing is hardened and shell-like in adults
- Larvae have no distinguishing characteristics; vary greatly in size and general morphology

Predaceous Diving Beetles—Family Dytiscidae

- Larvae and adults both aquatic and predators
- Largest family of water beetle
- Adults range in size from 2 to 40 mm long
- Most species are lentic in all types of temporary and permanent habitats but prefer shallow vegetated areas of swamps, marshes, bogs, and ponds
- Most abundant in areas that lack insectivorous fish
- Adults can fly
- Common genera found in Texas—*Agabus, Bidessonatus, Brachytois, Hydaticus, Hydroborus, Hydrotois, Liodessus, Oreodytes*
- General feeding group(s)—predator
- General habitat(s)—diver, swimmer
- Pollution tolerance—moderately tolerant

Key characteristics:
- body distinctive, oval to cylindrical
- small size
- brown or black color
- long legs with 2 long tarsal claws
- larvae are generally long and slender

Riffle Beetles—Family Elmidae

- Larvae and adults are aquatic herbivore-detritivores, feeding on algae, decaying wood, and detritus
- Pupae are terrestrial; adults will fly to a suitable habitat, but rarely fly again
- Live in oxygen-rich water
- Found on stones, logs, and other debris in the swiftest-moving water of a stream or on a waveswept shore
- Widespread and abundant
- Adults less than 4.5 mm long
- Common genera found in Texas—*Ancyronyx, Dubiraphia, Macrelmis, Heterelmis, Hexacylloepus, Macronychus, Microclylloepus, Narpus, Neoelmis, Stenelmis* (tolerant)
- General feeding group(s)—collector-gatherer, scraper
- General habitat(s)—clingers
- Pollution tolerance—mostly sensitive, with a few species more moderately tolerant; indicators of good water quality

Key characteristics:
- body distinctive, oval to cylindrical
- small size
- brown or black color
- long legs with 2 long tarsal claws
- larvae are generally long and slender
Larvae are voracious predators, feeding on a variety of aquatic animals.

- Common genera found in Texas—*Berosus, Enochrus, Helocharis, Helophorus, Hydrochus, Lacobius*
- General feeding group(s)—collector-gatherer
- General habitat(s)—diver, swimmer
- Pollution tolerance—moderately tolerant

### Key characteristics:
- Size range: 1 to 40 mm long
- Black; some are yellow or brown
- Short, clubbed antennae, usually concealed beneath head
- Maxillary palp (feeler-like structure) larger than antennae
- Hind legs flattened, usually with fringe-like hair
- Similar to predaceous diving beetle (Dytiscidae)

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**Water Pennies—Family Psephenidae**

- Larvae and adults feed on plants
- Adults live in vegetation along shore and are terrestrial
- Larvae are found on the underside of rocks in fast-moving water, but may be found on wave-swept shores
- Common genera found in Texas—*Eubrianax, Psephenus*
- General feeding group(s)—scraper
- General habitat(s)—clingers
- Pollution tolerance—mostly sensitive, with a few species more moderately tolerant; indicators of good water quality

### Key characteristics:
- Flat, round body
- Brownish color
- Legs underneath

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**Whirligig Beetles—Family Gyrinidae**

- Seen swimming or resting on the water surface in groups of a few or several hundred, especially in protected areas (out of wind and current)
- Widespread and abundant
- Often swim under the surface
- Most species are lentic with a few lotic species; adults are found in depositional areas, while larvae live among aquatic macrophytes
- Common genera found in Texas—*Dineutus, Gyretes, Gyrinus*
- General feeding group(s)—predator (engulfer), surface-film (nueston) scavenger
- General habitat(s)—swimmers, divers
- Pollution tolerance—moderately tolerant

### Key characteristics (adult):
- 2 pairs of eyes; 1 for looking up, the other for looking down
- Greatly flattened legs

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**Water Scavenger Beetles—Family Hydrophilidae**

- Common in vegetated areas of quiet, shallow pools and ponds
- A few are good swimmers, but most are crawlers
- Feed on decaying vegetation, but also on living plant material, especially algae

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- Larvae are voracious predators, feeding on a variety of aquatic animals
- Common genera found in Texas—*Berosus, Enochrus, Helocharis, Helophorus, Hydrochus, Lacobius*
- General feeding group(s)—collector-gatherer
- General habitat(s)—diver, swimmer
- Pollution tolerance—moderately tolerant

### Key characteristics:
- Size range: 1 to 40 mm long
- Black; some are yellow or brown
- Short, clubbed antennae, usually concealed beneath head
- Maxillary palp (feeler-like structure) larger than antennae
- Hind legs flattened, usually with fringe-like hair
- Similar to predaceous diving beetle (Dytiscidae)
elongate, oval body (similar to predaceous diving beetle), 3.5 to 14 mm long
larvae distinctive; fringed lateral projections on all abdominal segments and posterior

Other Freshwater Invertebrates
The following section contains information on the most common non-insect freshwater invertebrates found in Texas.

Unsegmented Worms—Phylum Platyhelminthes

Flat Worms—Class Turbellaria
- Flattened or cylindrical unsegmented worms
- Gray, brown, or black in color
- Most common and familiar are the planaria
- Common taxa—order Tricladida (planarians), family Planariidae, genus Dugesia
- Predators or scavengers

Aquatic Caterpillars—Order Lepidoptera

Family Pyralidae
- Largely terrestrial with a few associated with aquatic habitats
- Feed on plants
- Some species become so abundant they affect the surrounding aquatic plant community
- Inhabit a wide variety of permanent aquatic habitats
- Easy to distinguish from other aquatic insect larvae
- Difficult to tell aquatic and terrestrial apart; only those that build cases out of aquatic vegetation and those with numerous filamentous gills covering their body can be recognized as aquatic
- Common genera found in Texas—Crambus, Parapangx, Petrophila
- General feeding group(s)—shredder, scraper
- General habitat(s)—climber, swimmer, cling
- Pollution tolerance—moderately tolerant

Key characteristics:
- 3 pairs of thoracic legs
- pairs of prolegs ringed with hooks on abdominal segments 3-7

Segmented Worms—Phylum Annelida

Bristle Worms—Class Oligochaeta
- Common in soft mud bottoms; widespread
- May live in tubes, within mats of filamentous algae, or on aquatic vegetation
- Feed on organic material obtained by ingesting large quantities of sediment as they move, extracting organic material in the digestive tract and discarding the rest through the anus
- Important in cleaning up dead and decaying vegetation
- Common bristle worms are Dero, which is found on the underside of duckweed, and Tubifex, found in the deepest parts of lakes and in stagnant waters
- Tubifex worms can live without oxygen for certain periods of time and are often abundant; the bright red color of Tubifex worms (blood worms) comes from an oxygen-bearing pigment; often associated with very polluted waters
- Pollution tolerance—tolerant, high numbers considered indicator of very poor water quality

Key characteristics:
- cylindrical and segmented
- bundles of bristle (setae) on sides of each segment after the first
- size range: 1 mm to 122 cm long
- distinct head region
Carnivores and scavengers; some filter algae and detritus
Live in a variety of habitats
Mostly aquatic gill breathers

**General characteristics:**
- usually at least 5 pairs of leg-like appendages
- 2 pairs of antennae; 1 pair may be small
- a pair of appendages on each segment of the cephalothorax (fused head and thorax)
- may have appendages on the abdominal segment
- 2 distinct body regions: cephalothorax and abdomen
- cephalothorax covered by hard covering (carapace)

**Southeastern River Shrimp, Southern or Eastern Prawns, and Grass Shrimp—Order Decapoda**
- Southeastern river shrimp, *Macrobrachium*: 9 to 240 mm long.
- Southern and eastern prawns and grass shrimp, *Palaemonetes*: 25 to 55 mm long
- Edwards Aquifer has a blind shrimp; San Marcos River has very large prawns
- Commonly found in ponds and lakes, especially around vegetation; also found in ditches

**General characteristics:**
- first 2 pairs of legs are chelate (claw-like)
- second chelate leg larger than first
- no spine above the eye
- body laterally compressed

**Leeches—Class Hirudinea**
- Found mostly in freshwater
- Use an inchworm-type motion and creep along the substrate
- When not moving, all leeches use at least one sucker to hang on to vegetation, rocks, or other substrate
- Leeches are predators (snails, insect larvae, crustaceans, and worms) or scavengers; a few are the bloodsucking type (also feed on vertebrates)
- Pollution tolerance—tolerant; high numbers considered indicator of very poor water quality

**Key characteristics:**
- dorsoventrally flattened (top to bottom)
- anterior and posterior suckers

**Crustaceans—Class Crustacea**
- All have hard exoskeleton
- Appendages are modified for a variety of functions: walking, swimming, feeding, respiration, grooming, sensory reception, reproduction, and defense
- Move by swimming, walking and crawling, and can move backwards quickly when disturbed
- Omnivorous predators and scavengers that also eat vegetation
- Food for fish, wading birds, frogs, turtles, raccoons
- Some crayfish burrow in wet areas without ever going into water, while others are found in
muddy ponds and ditches or slow-moving areas of streams and rivers

- Burrows vary in size and depth (8-10 ft, depending on water level); excavated soil is piled outside the hole, forming a chimney-shaped structure
- Common genera found in Texas—*Cambarellus, Procambarus*

**Pollution indicator role:** Moderately tolerant, rarely found in polluted water.

**Key characteristics:**
- Entire head and thorax (cephalothorax) covered by a carapace
- 5 pairs of leg-like appendages on the cephalothorax
- First pair of legs has large claws (chelate)
- Decapod (10 legs)

![Figure 6-50](image)

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**Aquatic Sowbugs—Order Isopoda**

**Family Asellidae**

- Primarily marine and terrestrial; about 50 species are aquatic
- Crawl slowly over bottom or vegetation; found in vegetation, under logs and rocks in shallow-water areas
- Majority are scavengers, feeding on dead and injured organisms
- Resemble terrestrial sowbug, but legs are longer and more extended
- Blind species found in caves, wells, and springs (Edwards Aquifer); white or cream colored
- A few species can tolerate polluted water with low oxygen
- Little importance as food source for fish
- Common genera found in Texas—*Asellus, Lirceus*
- Pollution tolerance—moderately tolerant to tolerant, generally an indicator of poorer water quality

**Key characteristics:**
- Lack a carapace
- Dorsoventrally flattened (top to bottom)
- 7 pairs of leg-like appendages (cephalothoracic)

![Figure 6-51](image)

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**Sideswimmers or Scuds—Order Amphipoda**

**Family Gammaridae and Hyalellidae**

- Mostly marine; about 50 species live in freshwater
- Omnivorous scavengers feeding on plant and animal material
- Prey of fish, birds, insects, and amphibians
- Move actively at night by swimming or crawling on side by flexing and extending entire body
- Common and widespread; large numbers live in clear unpolluted waters
- Found in lakes, streams, ponds, springs, and subterranean waters
- Blind species can be found in caves and underground springs (Edwards Aquifer)
- Common genera found in Texas—*Gammarus* (sensitive), *Hyalella* (tolerant)
- General feeding group(s)—gatherer, shredder
- General habitat(s)—swimmer
- Pollution tolerance—wide range, generally moderately tolerant to sensitive; rarely found in severely polluted water

**Key characteristics:**
- Laterally (side to side) flattened body
- No carapace
- 7 pairs of leg-like appendages (cephalothoracic: head and thorax)
Microscopic Crustaceans—Order Cladocera

- Very important food for fish
- Found in a variety of habitats; most common in lakes and littoral areas
- More tolerant of low oxygen than water fleas
- Common genera—*Cyclops* (single eye and 2 egg sacs) and *Diaptomus* (long antennae and single egg sac)
- Collect with a plankton net

**Key characteristics:**
- Cylindrical shape
- Greatly narrowed abdomen
- 2 caudal branches (rami) with setae
- Antennae hang down, giving a droopy appearance
- Less than 2 mm long, visible but need microscope to view
- Carry 1 to 2 egg sacs, posterior end

Molluscs—Phylum Mollusca

Snails and Limpets—Class Gastropoda

- Found in every freshwater environment, from the smallest ponds and ditches to the largest lakes and rivers
- The genus *Physa* (pouch snail) is very pollution tolerant, while most gastropods need high oxygen concentrations
- Creep along any substrate (rocks, plants, man-made debris), generally in water up to 2 meters deep
- Feed on microscopic algae on submerged substrate, filamentous algae, aquatic plants, and dead organic matter

**Key characteristics:**
- Most snails have shells that are coiled, which are spiral or discoidal (disk-like)
- Limpets have low, cone-shaped shells
- Spiral shells are either dextral (curving to the right) or sinistral (curving to the left)
Clams—Class Pelecypoda

- Known as bivalves because of the two-sided shell
- Found in all types of freshwater environments, but are most common in the muddy bottoms of rivers; smaller clams, like fingernail clams and the introduced Asian clam (Corbicula), live in streams and lakes
- Feed on microscopic plankton and organic debris (filter feeders)
- Spend all the time on the bottom; move with a pseudopod (false foot)

Key characteristic:
- 2-sided shell

Water Mites—Class Arachnida

Order Acarina (mites and ticks), Suborder Hydracarina

- Found in all types of freshwater habitats; most common and abundant in ponds and littoral areas of lakes; especially in areas with a lot of rooted aquatic vegetation
- Preyed on by a variety of aquatic invertebrates

Key characteristics:
- Look like tiny spiders, but body is fused into a single mass
- No segmentation; look like little ball with legs
- 6 pairs of spider-like legs
- Variety of bright colors: red, blue, yellow, tan, brown, or combinations of colors