

RiverWatch



ILLINOIS RIVERWATCH

Macroinvertebrate Identification Key



Rod R. Blagojevich, Governor
Joel Brunsvold, Director

Introduction

Illinois RiverWatch uses biological monitoring to estimate stream health. As indicators of the quality of a stream's biotic community, the benthic macroinvertebrates collected during the biological survey provide useful information for estimating water quality, habitat conditions and overall stream health. Accurate identification of these organisms is essential to producing reliable information for estimating stream health.

This macroinvertebrate identification key is intended for use by RiverWatch Citizen Scientists as a tool for accurate identification of benthic macroinvertebrates. Organisms featured in the key are specific to Illinois streams. Macroinvertebrates commonly found elsewhere in the Midwest may also be identified using this key, since most organisms listed are common to the region.

Learning the Lingo

Aquatic organisms are identified based on their physical characteristics. Most aquatic organisms share common features that allow them to survive in aquatic habitats. As they evolved, each species also developed unique structures and body shapes well suited for survival in a particular microhabitat. For instance, the adult whirligig beetle is a predator that swims at the water surface. Its eyes are divided so that it has one pair of eyes that can see above the water and one that can see underwater. Some have chewing mouthparts while others have piercing or sucking mouthparts; some have gills while others have siphons or breathing tubes; some have short, flattened bodies while others are slender or curved. These distinctive features are used to separate one group of organisms from another until each can be identified based on its unique physical characteristics.

A firm grasp of the vocabulary used to distinguish these features is essential to identifying benthic macroinvertebrates. Basic terms describe orientation, body divisions, body structures and other aspects of the organism. *Orientation* refers to the direction or location (top, bottom, front, back, etc.) of a particular structure on the body of the organism being identified. *Body divisions* are the parts or sections (head, thorax, abdomen, etc.) of the organism. Common orientation and body division terms are introduced in the following section. *Body structure* terms describe specific parts of the organism, such as legs, claws, wings or gills. *Other descriptive terms* are also used to further describe particular structures of the organism. Terms used in this key are defined in the glossary.

From Top to Bottom and Head to Tail: Some Basic Terms

Several common orientation terms are used to indicate the position of a specific structure. These terms are usually variations on top, bottom, front and back. Figure 1 illustrates where some of these terms are referring to in reference to a generic aquatic insect.

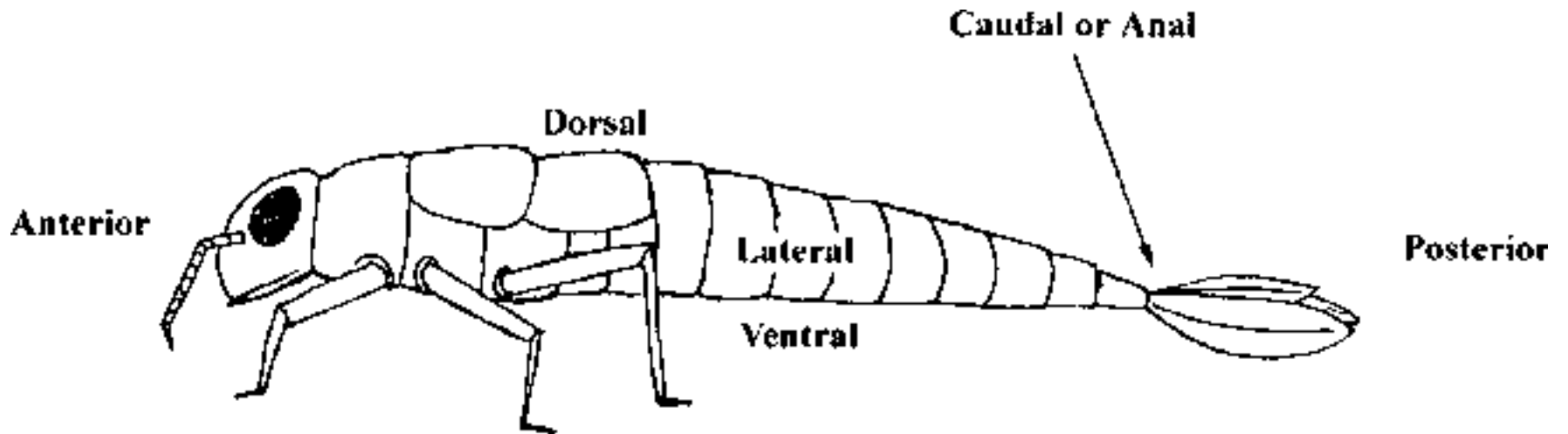


Figure 1: Aquatic Insect Orientations

Most aquatic insect bodies are divided into three regions: the *head*, *thorax* and *abdomen*. The head usually appears as a single segment, although it actually consists of six or seven fused segments. It includes the mouthparts and sensory structures such as the eyes and antennae.

The second region, or thorax, is located immediately behind the head. It consists of three segments: the *prothorax* (first segment), *mesothorax* (second or middle segment), and *metathorax* (third or last segment). Legs or wings are attached to the thorax. The feet of an insect are referred to as *tarsal segments* or *tarsi*.

The third region is called the abdomen. It is located immediately behind the thorax and is often the longest region of the body. The abdomen typically consists of 8 to 11 segments, and may have various hairs, filaments or gills attached. Many insect larvae also have structures attached to the end of the abdomen, such as hooks, prolegs or respiratory structures.

The thorax and abdomen are often difficult to distinguish in some insects (members of the *Diptera* family, for example), and are sometimes referred to together as the *trunk*. The three body divisions are illustrated using a diagram of a generic aquatic insect in Figure 2.

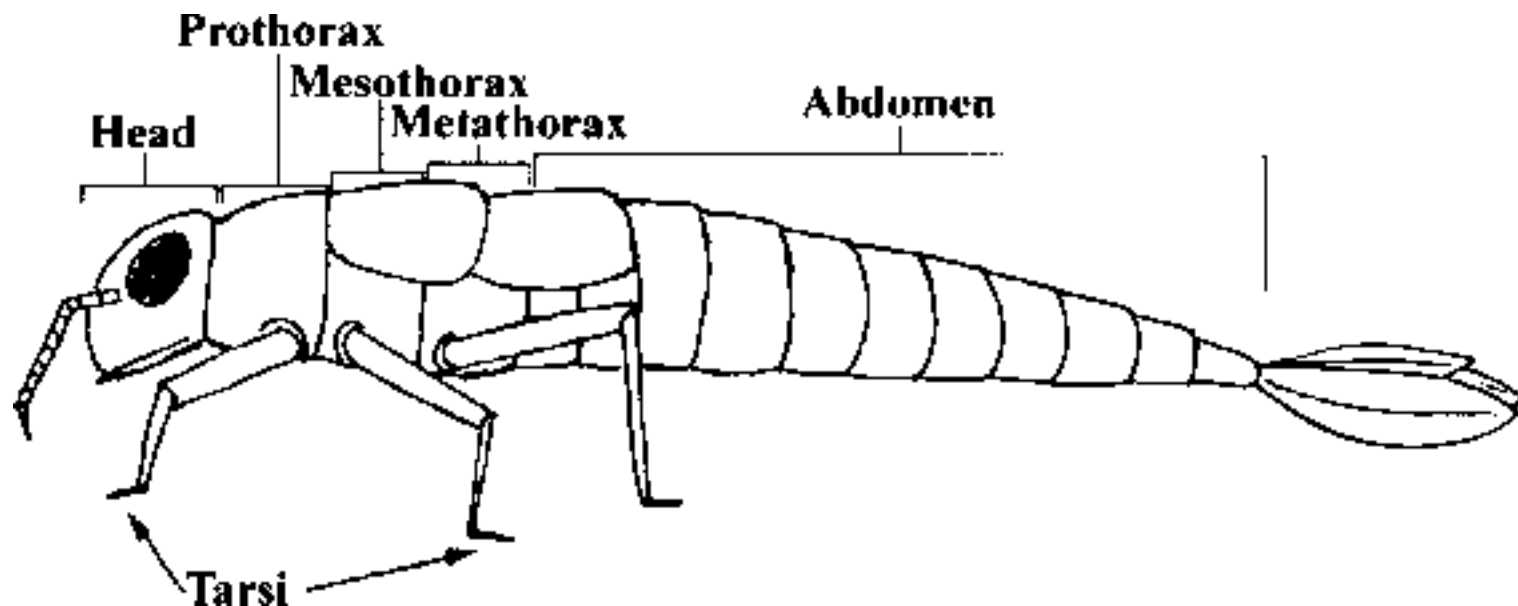


Figure 2: Aquatic Insect Body Divisions

How to Use This Key

This key is designed for those with little or no previous experience identifying benthic macroinvertebrates. Using detailed illustrations and simple descriptions of key structures, aquatic insects can be identified through a simple process of elimination. Each pair of choices, or couplets, represents a branch in the “family tree” of Illinois RiverWatch Stream Quality Indicators.

To use the key, read each choice and select the one which best describes the organism being identified. Once a choice is selected, follow the arrow to the next pair of choices. Continue making choices and following arrows until no further choices or arrows are offered. When this “dead end” is reached, the name of the organism is listed.

All Illinois RiverWatch indicator organisms are listed in the key. Other (non-indicator) organisms commonly found in Illinois streams are also included. These non-indicator organisms are noted where they appear.

This key should be used as the primary tool for identifying benthic macroinvertebrate samples collected for RiverWatch. Once a positive identification is made, it should be cross-checked using RiverWatch field reference cards (*Stream Quality Indicators of Illinois*) or one of the other identification keys recommended in the Illinois RiverWatch Stream Monitoring Manual.

Text adapted in part from *Aquatic Entomology: The Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives* (W. Patrick McCafferty, 1981)

Glossary

ORIENTATION

Anterior — forward; refers to the head end of the body or that part of a structure located nearest the head of the body

Basal — origin; refers to the origin of a structure, generally closest to the point of attachment to the body

Distal — end; refers to that part of a structure furthestmost from its point of attachment to the body

Dorsal — top, upper or back; refers to the upper or top part of the body or structure

Lateral — side; refers to the site of the body or structure

Medial — middle; refers to the longitudinal midline of the body

Posterior — rear; refers to the tail end of the body or that part of a structure located nearest the tail of the body

Ventral — lower, bottom or front; refers to the lower or bottom part of the body or structure

BODY DIVISIONS

Abdomen — the third major body region of an insect, typically divided into 8 to 11 individual segments

Head — the first major body region of an insect, including mouthparts and sensory structures such as the eyes and antennae.

Mesothorax — the second or middle segment of the thorax

Metathorax — the third, most posterior segment of the thorax

Prothorax — the first, most anterior segment of the thorax

Thorax — the second (middle) major body region of an insect, often divided into three parts or segments

BODY STRUCTURES

Antennae — a variously shaped appendage of the head, occurring in pairs, commonly located between the eyes

Beak — hard, cone-shaped mouthparts

Cephalothorax — a single body region consisting of a head and thorax that are little differentiated from each other

Compound eyes — multifaceted eyes, usually situated laterally on the head of some aquatic insects (dragonflies, damselflies,

Mouthparts — any of several various structures which form the mouth of an insect; typical structures include the labrum, labium, mandibles, maxilla

Exoskeleton — external, rigid body wall of arthropods

Eyespots — single eye or eye-like structure found on the head (beetles, etc.)

Filaments — slender, finger- or thread-like appendage such as antennae or gills

Gills — structures used for absorption of oxygen from the water

Labium — lower lip or most posterior whole mouthpart of the insect head

Labrum — upper lip or most anterior, unpaired mouthpart of the insect head

Lobe — a rounded projection

Operculum — a covering of a chamber (ex.: the disc-like structure covering the opening of the shell in an operculate snail)

Plate-like gills — broad, flattened gills

Prolegs — a fleshy, unsegmented, leglike or lobelike structure; usually occurring in pairs and located on the thorax of some fly larva and on the abdomen of various other insect larva

Protuberance — a projection or bulge; a rounded projection

Simple eyes — non-faceted eyes, usually smaller than compound eyes

Spiracle — an external opening along the body wall of insects used for air intake

Tubules — long, filamentous, tube-shaped structures

Wingpad — a developing wing or sheath of a developing wing

OTHER DESCRIPTIVE TERMS

Apex — tip or point of a structure

Caudal (or Anal) — a structure that is located on the very end, or near the anus of an organism

Elongated — long and thin; extended and lengthened

Membranous — consisting of or resembling a thin, pliable skin-like tissue serving to line or connect various body structures

Operculate — functioning as a covering for other structures (ex.: the triangular, rectangular or oval shaped gill coverings on the abdominal segments of various mayfly larvae)

Segmented — divided into sections, often of similar size, and joined in a linear fashion (ex.: leeches, aquatic worms and the abdominal regions of many aquatic insects)

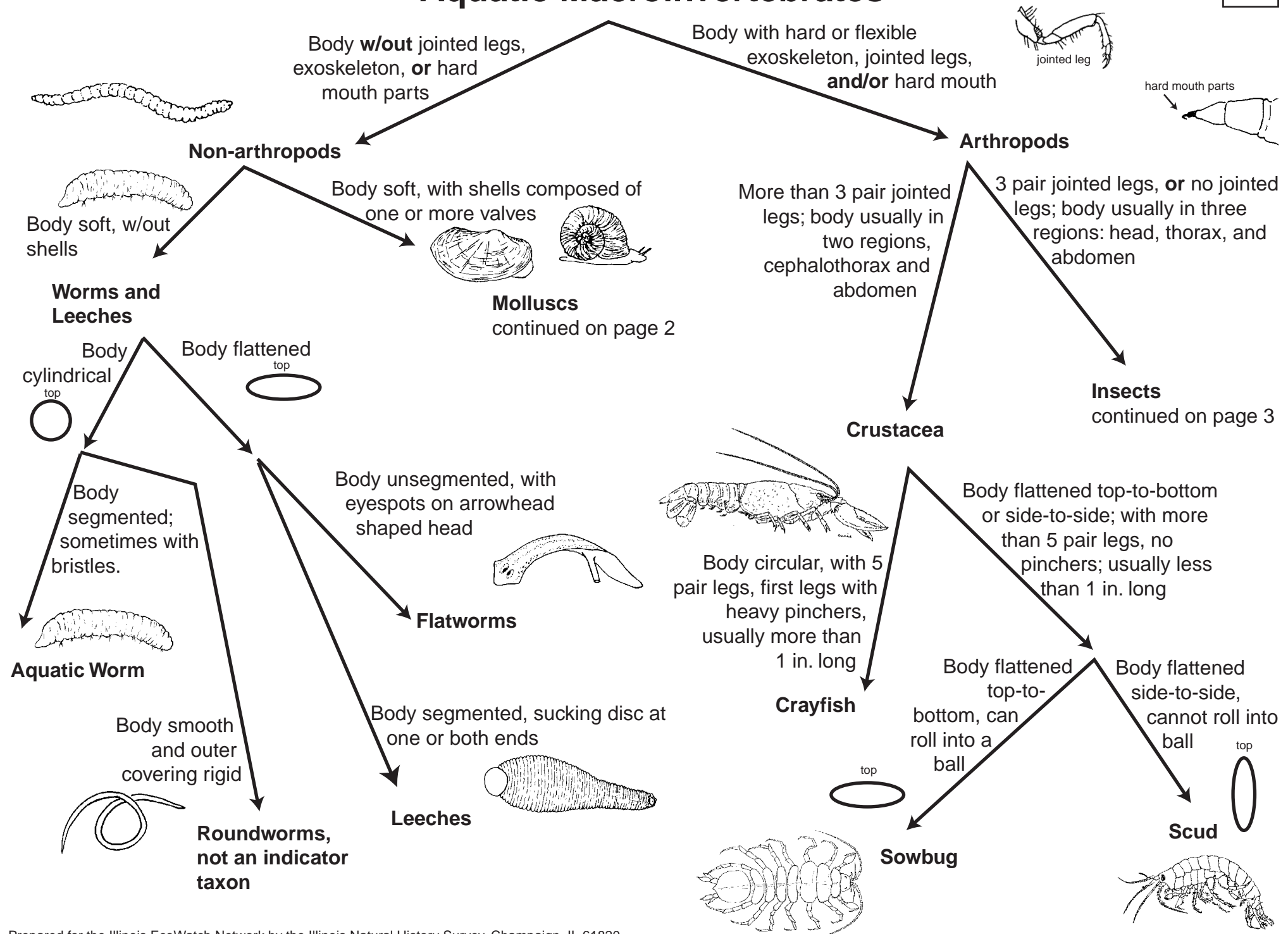
Terminal — forming or located at the end of a structure

Definitions adapted in part from *Aquatic Entomology: The Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives* (W. Patrick McCafferty, 1981)

Key prepared by Dr. R. Edward DeWalt and Carolyn Peet Nixon of the Illinois Natural History Survey, 607 E. Peabody Drive, Champaign, Illinois 61820.

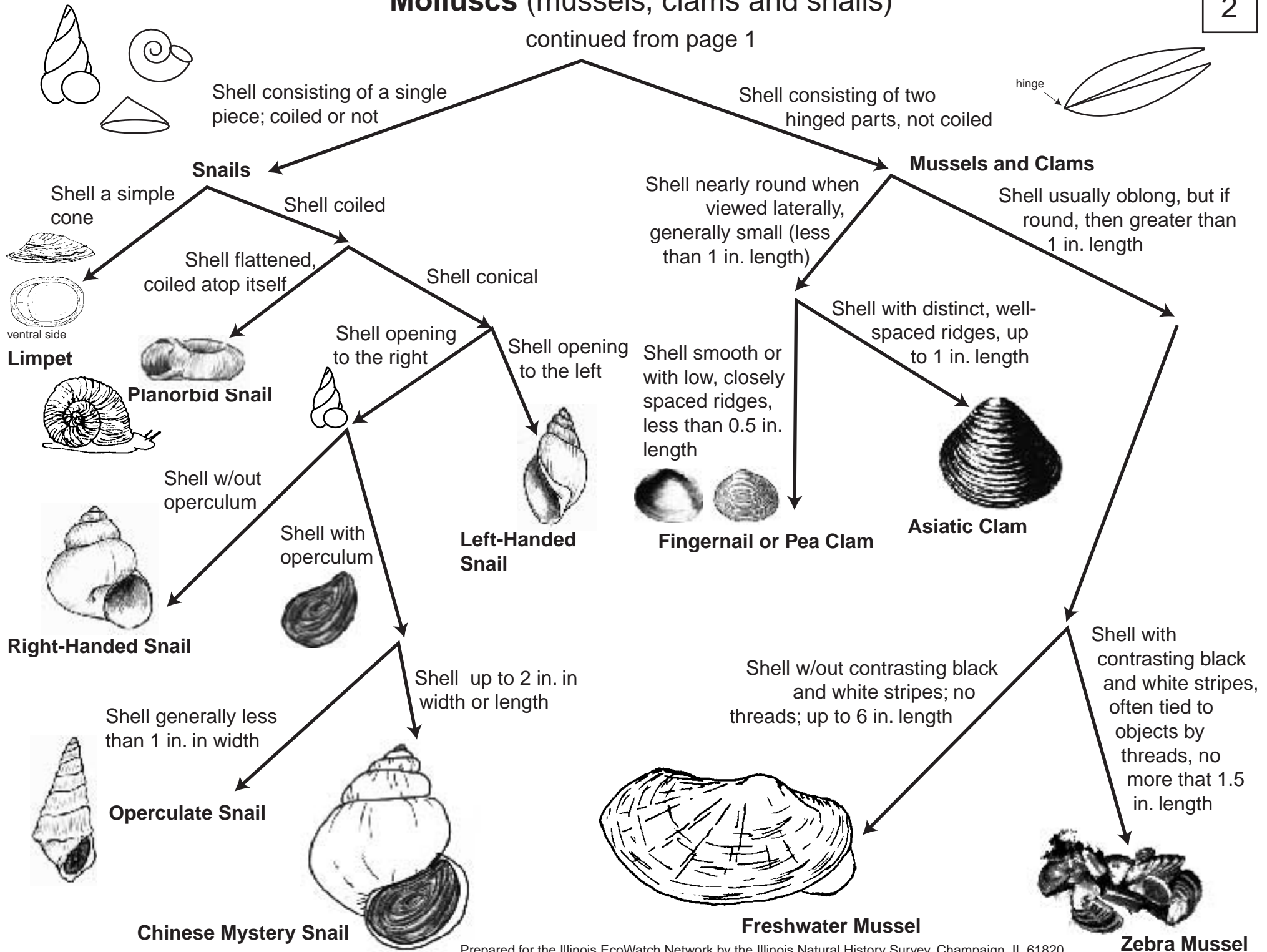
Drawings in the key by C. Nixon or from *The Mayflies of Illinois* (B.D. Burks, Illinois Natural History Survey); *The Caddis Flies, or Trichoptera, of Illinois* (Herbert H. Ross, Illinois Natural History Survey); *The Taxonomy and Bionomics of the Aquatic Hemiptera of Illinois* (David Robert Lauck, unpublished Masters Thesis from the University of Illinois); or *Freshwater Sphaeriacean Clams (Mollusca: Pelecypoda) of North America* (J.B. Burch, US EPA)

Aquatic Macroinvertebrates



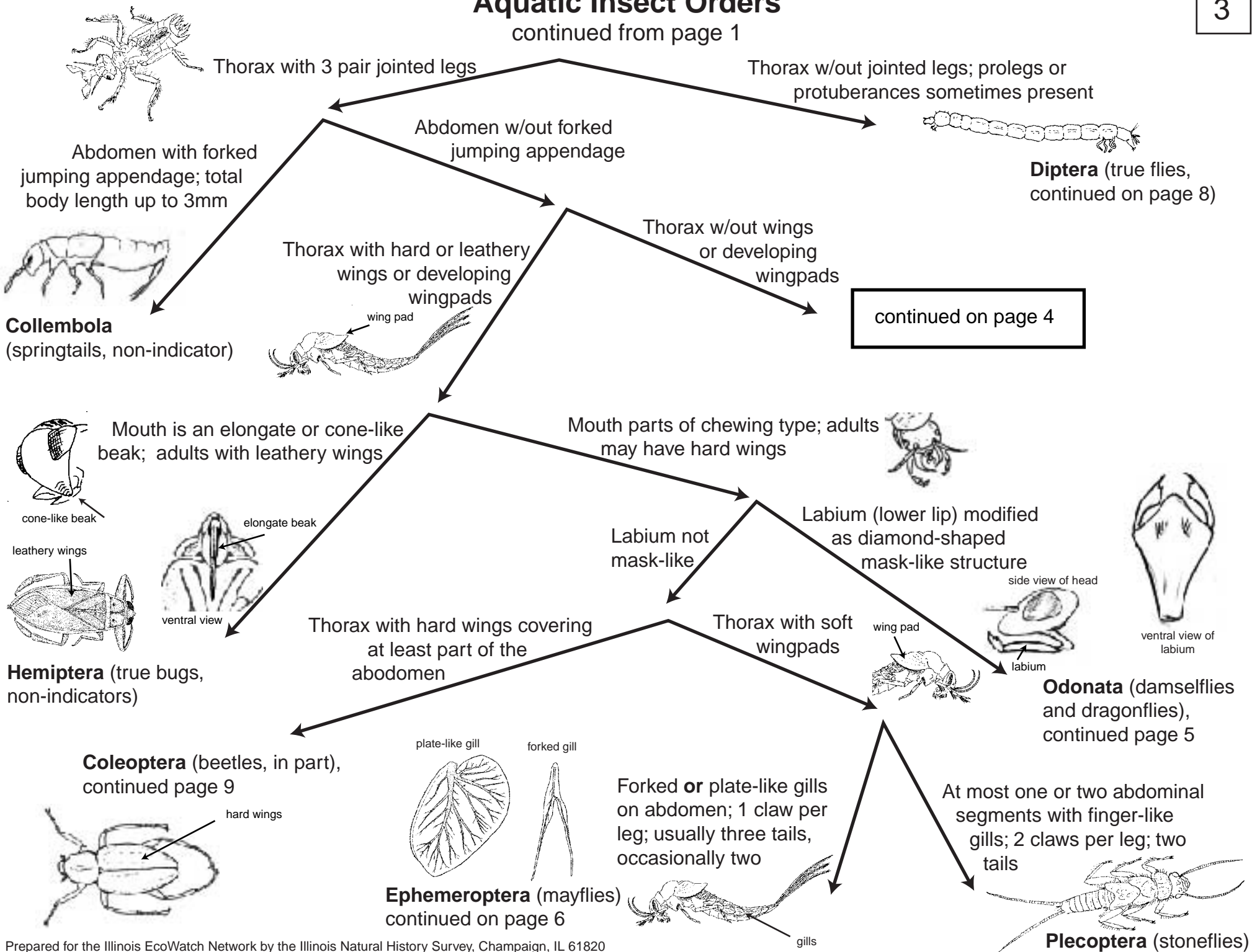
Molluscs (mussels, clams and snails)

continued from page 1



Aquatic Insect Orders

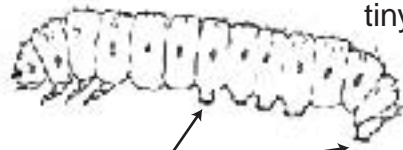
continued from page 1



Aquatic Insect Orders, continued

continued from page 3

Abdomen with pairs of short, fleshy, prolegs with ring of tiny hooks at tip



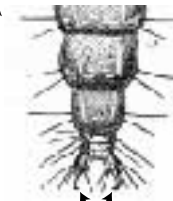
prolegs with hooks

Lepidoptera (aquatic moths, non-indicators)

Abdomen lacks short, fleshy, structures with ring of hooks

Abdomen ends variously but never in 1 pair of prolegs having a single hook each (if pair of prolegs are present, then 2 hooks)

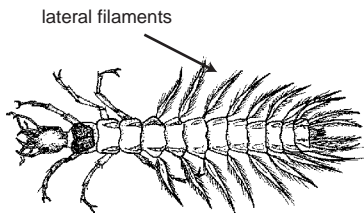
Abdomen ends in 1 pair of short or long prolegs (sometimes fused together) that have a single hook each.



Trichoptera (caddisflies), continued page 7

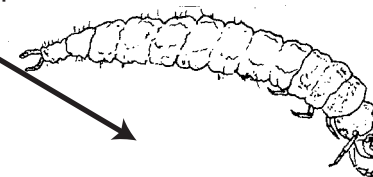
prolegs with hooks

Abdomen has well-developed lateral filaments



lateral filaments

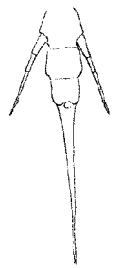
Abdomen lacks well-developed lateral filaments



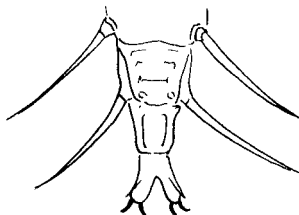
Coleoptera (beetles, in part), continued page 9

End of abdomen with single, unforked filament **or** 1 pair prolegs, each with 2 hooks

If filaments at end of abdomen, then paired or forked, **or** if proleg, then single proleg with 4 hooks

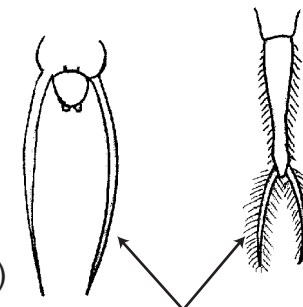


single filament

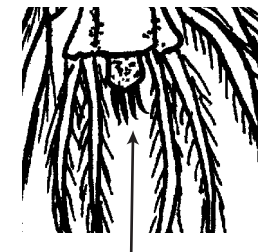


paired prolegs

Megaloptera hellgrammites and alderflies), continued page 5



paired filaments

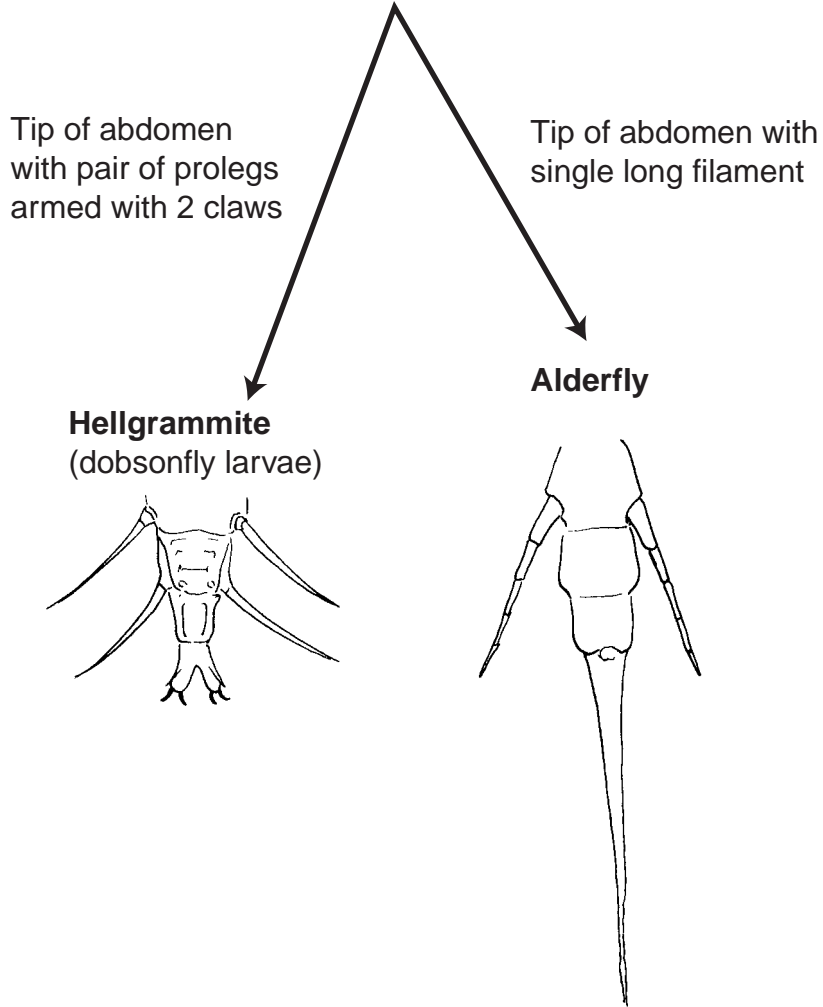


proleg with hooks

Coleoptera (beetles, in part) continued page 9

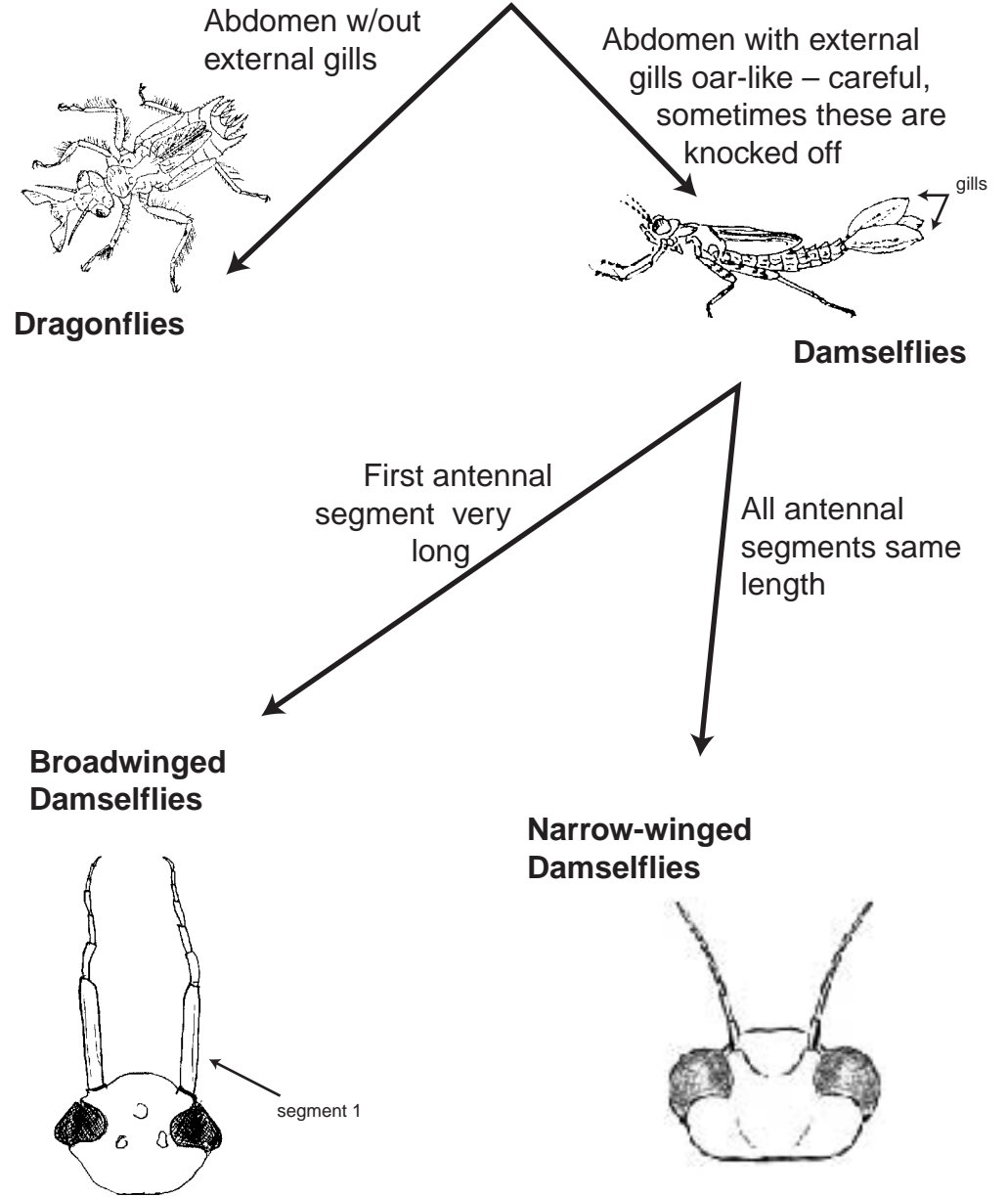
Megaloptera (dobson flies and alderflies)

continued from page 4



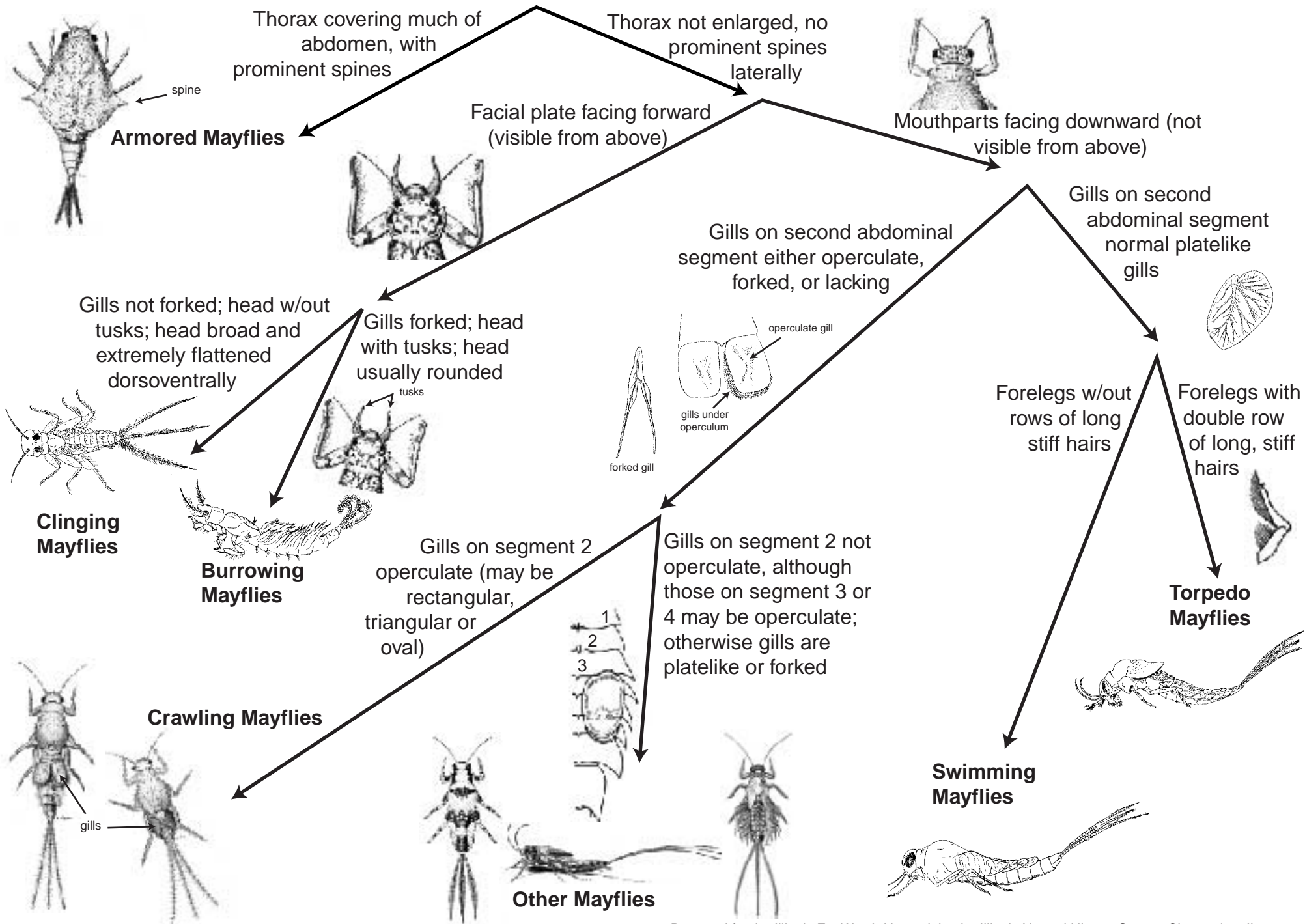
Odonata (dragonflies and damselflies)

continued from page 3



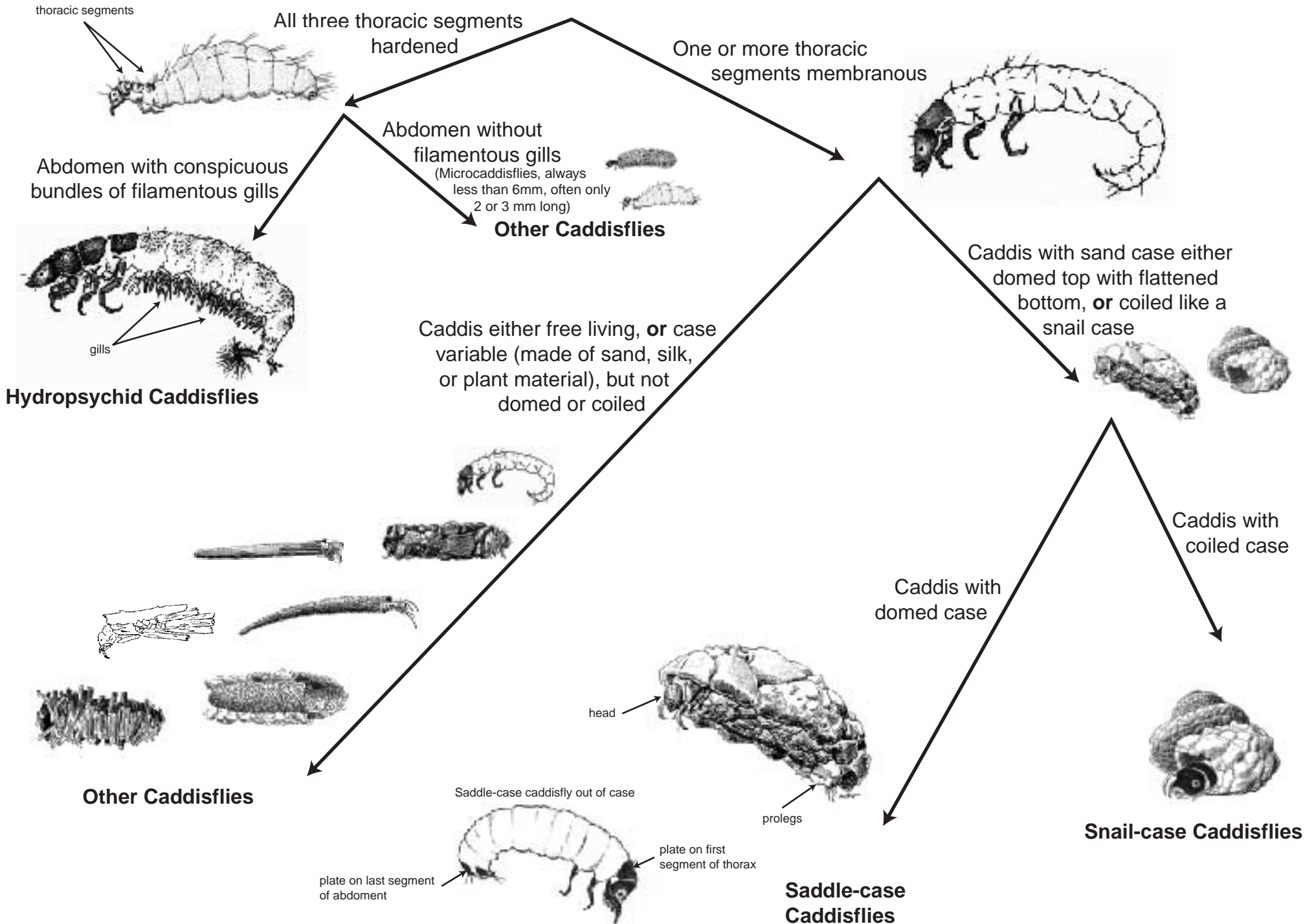
Ephemeroptera (mayflies)

continued from page 3



Trichoptera (caddisflies)

continued from page 4



Diptera (true flies)

continued from page 3

If branched gill, then less than 1/4 length; if case, not slipper-shaped

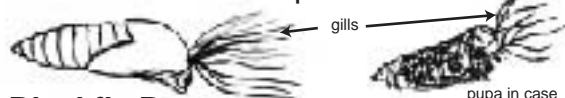


Body with developing wingpads

Body w/out developing wingpads

Fly Pupae, non-indicators

Pair of highly branched gills on thorax about 1/2 length of body; slipper-shaped case



Blackfly Pupae

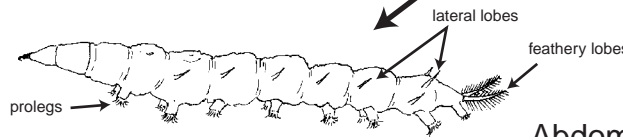
Head fully formed and distinct from thorax



Head inconspicuous, sometimes with only hard mouthparts and slender rods; often retracted into body



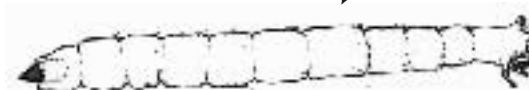
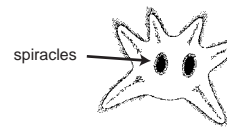
Several abdominal segments with prolegs; abdominal tip with feathery pointed lobes; lateral lobes on other abdominal segments



Snipe Fly

Abdomen variable, but not with the **combination** of abdominal prolegs, feathery lobe at tip and lateral abdominal lobes

Abdominal tip with disc containing dark spiracles surrounded by 2-8 lobes (most commonly 6)

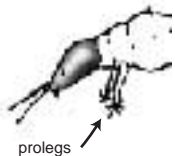


Crane Fly

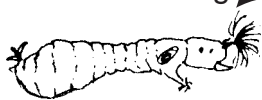
Abdominal tip w/out disc, spiracles, and lobes

Other Fly

First thoracic segment with fleshy prolegs with hooks



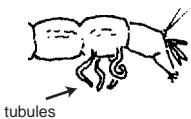
Lower third of abdomen swollen; head usually with fans for feeding



Black Fly

Lower third of abdomen not swollen

Last abdominal segments with tubules; body blood red in life



Bloodworm

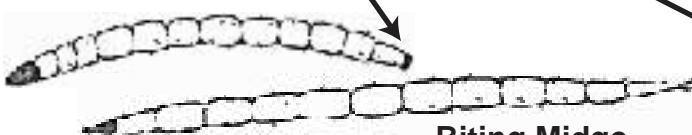
Last abdominal segments w/out tubules; body color varies



Midge

First thoracic segment w/out fleshy prolegs

Body very slender; lacking abdominal prolegs or lateral filaments



Biting Midge

Body not slender, possibly thorax or abdominal segments swollen; may have abdominal prolegs; lateral filaments possible

Other Fly

Coleoptera (beetles)

continued from page 3

