Lessons in a Backpack

United Nations Educational, Scientific and Cultural Organization

GEORGIAN BAY BIOSPHERE RESERVE

Macroinvertebrates

What Wetland Bugs Can Teach Us

Photo Credit: Sue Morrison

Description of Lesson

After learning to identify some of the macroinvertebrates found in wetland habitats, students play Macroinvertebrate Mayhem, a Project Wet game which demonstrates how human activity can negatively impact wetland habitats and cause macroinvertebrate species to decline or disappear.

Students then dipnet at a local wetland perform using macroinvertebrate identification sheets. Students discuss their findings.

Connect with the Georgian Bay Biosphere Reserve

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United Nations Educational, Scientific and Cultural Organization

GEORGIAN BAY BIOSPHERE RESERVE

At a Glance

Grade Level: 4

Learning Environment: Outdoor Classroom (wetland near the school)

Prep Time: 15 minutes

Length of Lesson: 1.5 hours

Key Vocabulary: macroinvertebrates, habitat

Staffing: 1 educator per 5 students

Materials:
Macroinvertebrate Name Tags
Pollution Name Tags
White Board
Marker
4 Pylons
9 Identification Guides
9 Dipnets
1 Carrying Case
9 White Plastic Basins
9 Hand lenses
Guidebook

Kit available from the NNDSB Resource Centre

Groupings: Whole class, and Small groups of 2 or 3

Teaching/Learning Strategies: Discussion, Games, Field Trip.

Lesson Outline

TIME	ACTIVITY	LOCATION	MATERIALS
5 min.	Introduction	Indoor	
30 min.	Macroinvertebrate MAYHEM!	Indoor	Macroinvertebrate Name Tags Pollution Name Tags White Board Marker 4 Pylons
30 min.	Pond Dipnetting	Wetland	9 Identification Guides 9 Dipnets 1 Carrying Case 9 White Plastic Basins 9 Hand lenses Guidebook
10 min.	Conclusion	Indoor	

Curriculum Expectations
Grade 4 Science Curriculum

Understanding Life Systems: Habitats and Communities
Overall Expectations:
1. Analyze the effects of human activities on habitats and communities.

Specific Expectations
1.1 Analyze the positive and negative impacts of human interactions with natural habitats and communities (e.g., human dependence on natural materials), taking different perspectives into account (e.g., the perspectives of a housing developer, a family in need of housing, an ecologist), and evaluate ways of minimizing the negative impacts

1.2 Identify reasons for the depletion or extinction of a plant or animal species (e.g., hunting, disease, invasive species, changes in or destruction of its habitat), evaluate the impacts on the rest of the natural community, and propose possible actions for preventing such depletions or extinctions from happening.

2.1 Follow established safety procedures for working with soils and natural materials (e.g., wear gloves when handling soils to set up a working terrarium).

3.1 Demonstrate an understanding of habitats as areas that provide plants and animals with the necessities of life (e.g., food, water, air, space, and light).

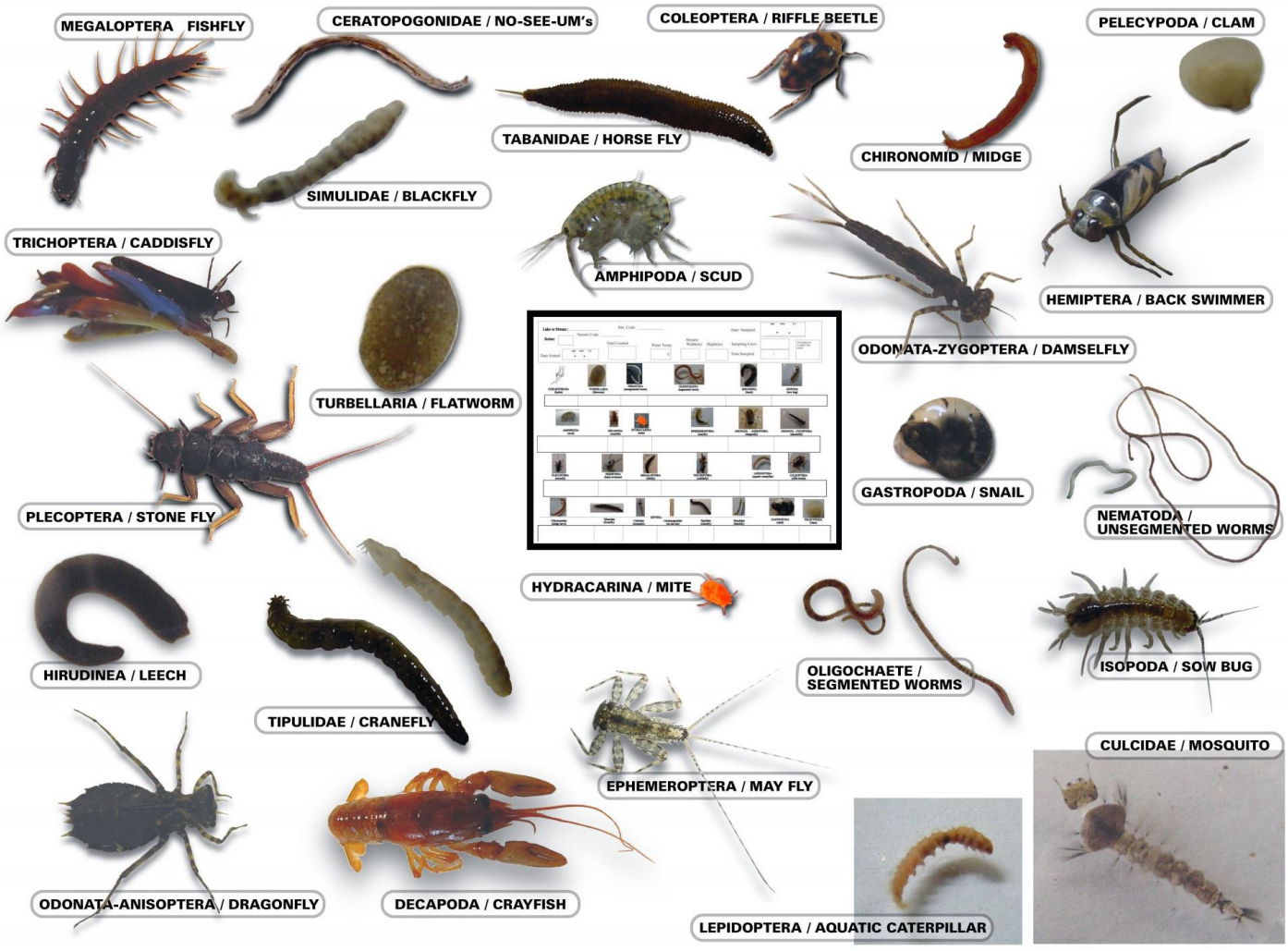
3.3 Identify factors (e.g., availability of water or food, amount of light, type of weather) that affect the ability of plants and animals to survive in a specific habitat).

Background

Wetland habitats are alive with macroinvertebrates. The word “macroinvertebrate” can be broken into two parts: “macro” which means visible to the naked eye (often considered anything larger than 0.5 mm), and “invertebrates” which refers to insects, mollusks and worms – creatures without backbones. Examples of aquatic macroinvertebrates found in wetlands include mayfly nymphs, dragonfly larvae, damselfly larvae, clams, leeches, crayfish, and aquatic worms.

By examining which macroinvertebrates are present in a wetland habitat, we can determine its health. Macroinvertebrates can be used as indicator species – species that are sensitive to changes in water quality and react in predictable ways. Since different species of macroinvertebrates have different levels of tolerance to pollution, the amount of stress that a wetland is under can be measured by taking a sample of the species present.

Common Macroinvertebrates



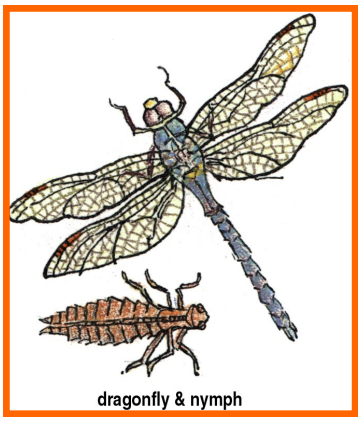
Source: unknown

Teaching and Learning

Part A. Introduction

A habitat is where an animal or plant lives and gets everything it needs to survive: food, water, shelter and space to live.

Within a habitat there are microhabitats, areas where conditions vary from the habitat as a whole. Example: a tree cavity may be warmer and less windy than the surface of the tree.



dragonfly & nymph

Dragonfly nymphs with their hydraulic lower lip that is a third of the length of their body gobble down mosquito larva. In their adult form, dragonflies also are voracious eaters of mosquitoes.

Habitat includes the entire area that contains the components needed by a plant or animal. While thinking of habitat as a plant or animal's home is a good way to explain habitat, it is much bigger than a house. Habitat is the neighborhood where food, water, shelter, and space are found.

Have a discussion about habitat with your students. What is it? Where can we find it? What are different types of habitat? How might habitat be different for different animals?

Part B. Macroinvertebrate Mayhem

This game demonstrates how human activity can negatively impact wetland habitats and cause species to decline or disappear, as shown by the presence of pollution tolerant and intolerant macroinvertebrates.

Begin with a general description of a healthy wetland area, and what to look for in a visual assessment of health (e.g., lots of vegetation, very little bare ground, shade, tall vegetation with deep root systems, native plants rather than alien species). Healthy wetland areas are rich in oxygen; polluted water means there is less oxygen available.

Another way to determine the health of wetland habitats is to collect macroinvertebrates (invertebrates that you can see with the naked eye) to see which species are present (pollution tolerant vs. intolerant). Describe indicator species and why pollution intolerant species are important.

Polluted water = less oxygen

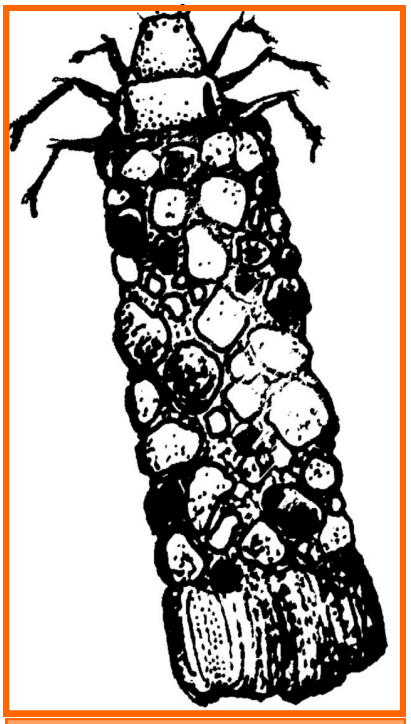
Description of Macroinvertebrates found on the back of laminated pictures:

Pollution Intolerant	Somewhat Pollution Tolerant	Pollution Tolerant
• Mayfly • Stonefly • Caddisfly	• Damselfly Larva • Dragonfly Larva	• Mosquito Larva • Midge Larva

The Game:

In this game of tag, the students become the macroinvertebrates and the teachers become the pollution to tag them.

Pass out the macroinvertebrate tags, one species at a time. Plan to have a lot more pollution intolerant species than pollution tolerant ones, since they change over with time. Explain the special characteristics each has to survive and how the students need to act out these actions during the game.



Caddisfly larvae make their homes from sand or plant material.

Pollution Tolerant Macroinvertebrates:

1) *Mayfly* – Spin in circles when there is pollution in the water, to create bubbles and try to get oxygen. In the game of tag, the students that are mayflies have to stop in the middle of the field and spin around three times.
2) *Stonefly* – in polluted water they push out their abdomens and then suck them back in, like they are panting. In the game of tag, the students that are stoneflies have to stop and do 3 push-ups in the middle of the field. Remind the students to watch out for others while they're running!
3) *Caddisfly* – Have a case around their bodies. In the game of tag, the students that are caddisflies must hop the length of the field.

Facultative and Pollution Tolerant Macroinvertebrates:

4) No special characteristics. Students can run normally, but are still out if they get tagged. Make sure the students all know which macroinvertebrate that they are.

The teacher/assistants are the pollution in the water. Have students suggest types of water pollution (chemicals/pesticide/oil, sedimentation, alien invasion, animal waste, urban runoff), and hand out name cards to the taggers.

Establish boundaries of playing area, with two end "safe-zones." Send the students to one end of the playing field. The object to the game is get to the other end of the field, without being tagged, making sure to do the special characteristics. If the students are tagged they go to a designated area at the side of the field. They can be tagged while spinning or doing push-ups. Remind them to keep their heads up and not to run into each other!

After each round do a population count on the white board of each species. Those that did get tagged turn their name tags over and become the pollution tolerant species listed on the back. Include these new macroinvertebrates in the pollution count for that round. Those students that were tagged can then join the game again. The idea is to have the pollution wipe out all of the intolerant species.

(Adapted from ProjectWet.)

Set-up for population recording on white board:

Species	Pollution Tolerance	Round 1	Round 2	Round 3	Round 4
Mayfly	Intolerant				
Stonefly	Intolerant				
Caddisfly	Intolerant				
Damselfly	Facultative				
Dragonfly	Facultative				
Mosquito Larva	Tolerant				
Midge Larva	Tolerant				

Debrief:

Have students sit down at the end of game and debrief looking at whiteboard. Questions: How many of you were pollution intolerant macroinvertebrates at the beginning of the game? How many at the end of the game? What happened to the pollution intolerant macroinvertebrates? (Pollution made it impossible for them to survive). In a healthy wetland habitat what kinds of macroinvertebrates would you expect to find? (all – pollution intolerant to pollution tolerant. Important to find a diversity of all macroinvertebrates).

Part C. Pond Dipnetting

1. Communicate your expectations of the students. Three R's of Respect – Respect for One Another, Respect for the Equipment, Respect for Living Things. Ask students what each type of respect entail.

Be sure to mention:

- the boundaries of the area
- respect for the lives of the animals that live in this pond community, including handling gently, making sure to keep them in water, putting them back into the wetland at the end of the activity
- rules of conduct including no pushing, shouting, etc.
- which areas of the pond are off limits
- how far students may wade into the water
- the signal that will be used to draw them together (this could be a whistle, a handclap, or an animal noise)

Hand out the following equipment to each group: identification guide, white plastic basin, dipnet, hand lens, small jar. You may also wish to hand out a tally sheet for groups to count the invertebrates they catch.

Demonstrate how to dipnet: Put a couple inches of debris-free water in the basin. This is very important because without water these creatures cannot breathe. Put dipnet right into vegetation or into the mud, stir it around and scoop. Turn the dipnet over so the detritus carefully falls into the water. Sort through the basis either by moving the debris or holding it still and allow creatures to emerge and move. Place creatures into a smaller jar with water for observation.

Compare findings of macroinvertebrates in the groups' basins.

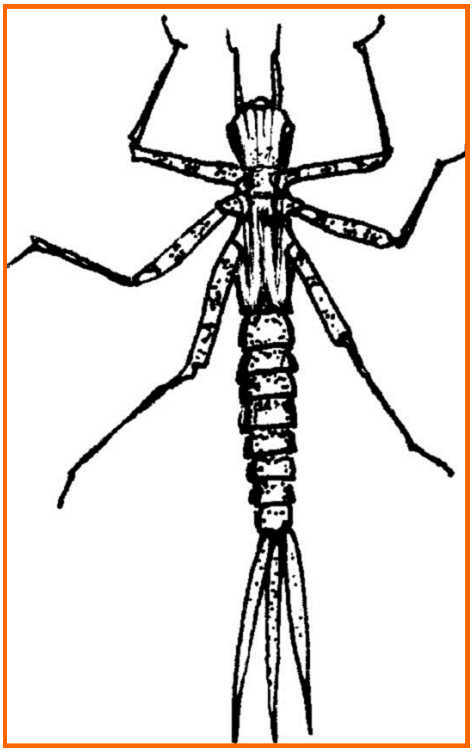
Part D. Conclusion

Ask students:

What do macroinvertebrates tell us about the health of wetlands?

What types of macroinvertebrates did we find today (pollution intolerant, facultative, pollution tolerant)?

What might this indicate about this wetland?



Damselfly larva breathe through three feather-like appendages attached to the abdomen, which it also for steering and propulsion.

Extension Activities

Assessment:

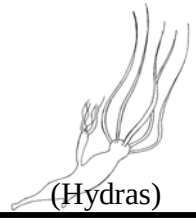
Learning Log
On approximately one page, have students write their reflections to the following questions:
What did I do in class today?
What did I find interesting?
What questions do I have about what I learned?
What was the point of today's lesson?
What connections did I make with previous lessons?

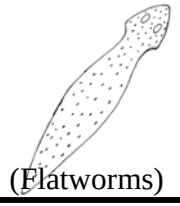
Additional Resources:

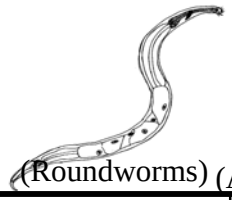
Ducks Unlimited Wetland Conservation Lesson Plans available at:

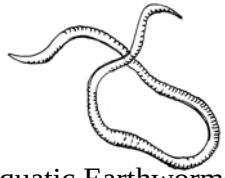
www.greenwing.org/dueducator/lesson_plans.html

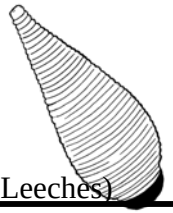
Water Body Name: _____ Date : _____ Group Members: _____

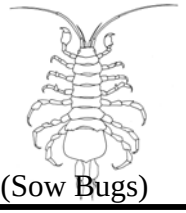

(Hydras)

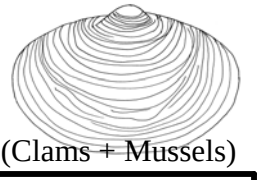

(Flatworms)

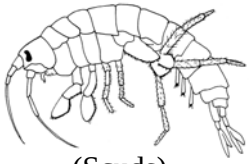

(Roundworms)

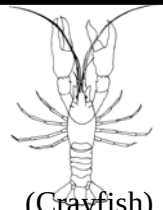

(Aquatic Earthworms)

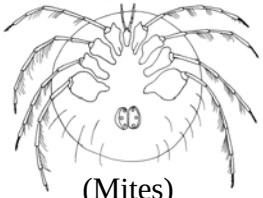

(Leeches)


(Sow Bugs)

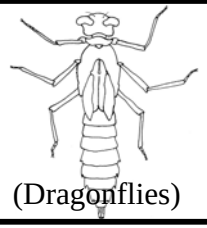

(Clams + Mussels)


(Scuds)

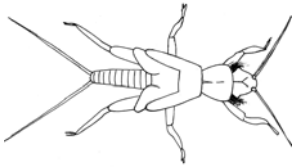

(Crayfish)


(Mites)

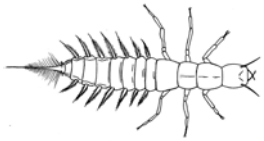

(Mayflies)


(Dragonflies)

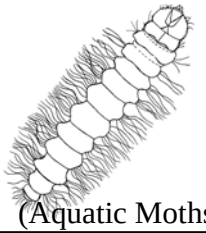

(Damselflies)

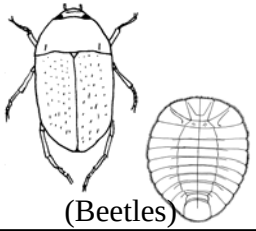

(Stoneflies)

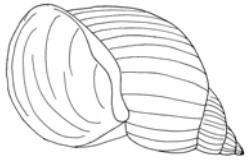

(True Bugs)

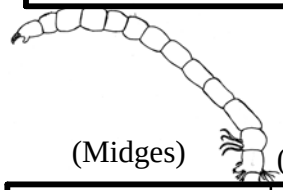

(Fishflies, Alderflies)

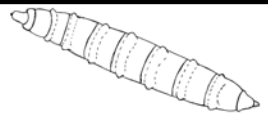

(Caddisflies)

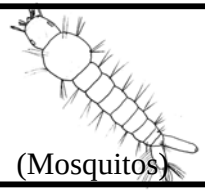

(Aquatic Moths)

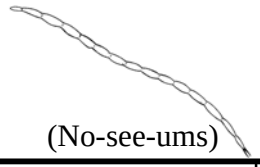

(Beetles)

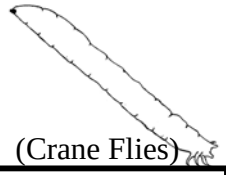

(Snails, limpets)

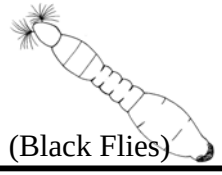

(Midges)


(Horse and Deer Flies)


(Mosquitos)


(No-see-ums)


(Crane Flies)


(Black Flies)

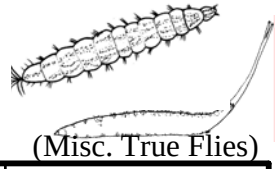

(Misc. True Flies)

Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Backswimmer

Somewhat Pollution Tolerant

Backswimmer

How it gets food:

- Predator

How to identify:

- Front legs are short and stocky for holding onto prey
- Bright, white wings and red, fiery eyes
- Scull around on the surface of the pond, upside down
- Commonly confused with Water Boatman

How it breathes:

- Carries an air bubble from water's surface on body

Somewhat pollution tolerant

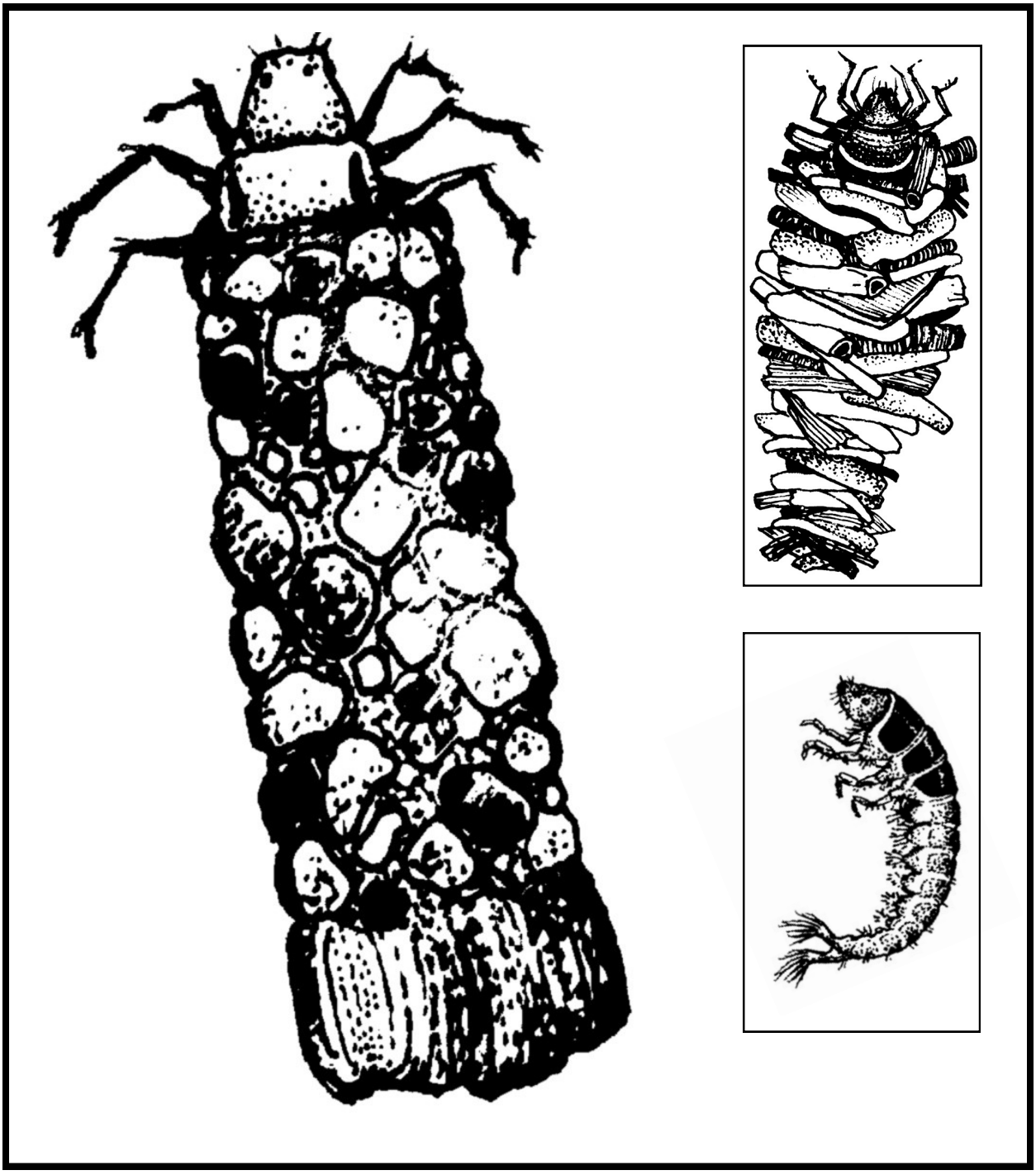


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Caddisfly Larva

Pollution Intolerant

Caddisfly Larva

How it gets food:

- Scavenger

How to identify:

- Soft, grub-like body
- Creates a case to disguise itself from predators
- Makes the case from peddles, reeds, leaves which are held together by silk and saliva

How it breathes:

- Through its body surface

Pollution intolerant

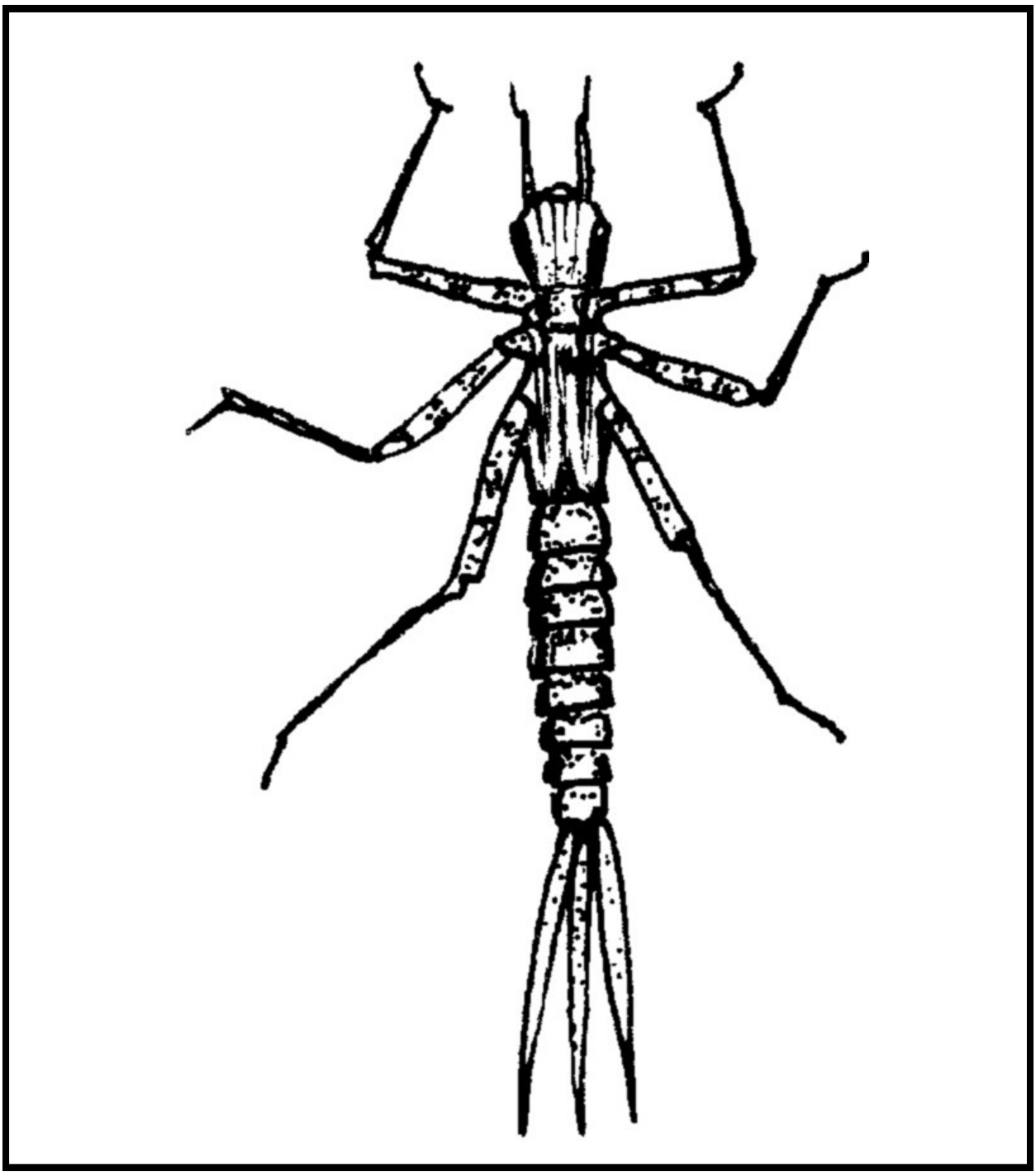


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Damselfly Nymph

Somewhat Pollution Tolerant

Damselfly Nymph

How it gets food:

- Predator

How to identify:

- Three feather-like appendages on the tail - these are the gills, used for both breathing and locomotion
- Four wing pads are visible on the thorax

How it breathes:

- Through the gills on tail

Somewhat pollution tolerant

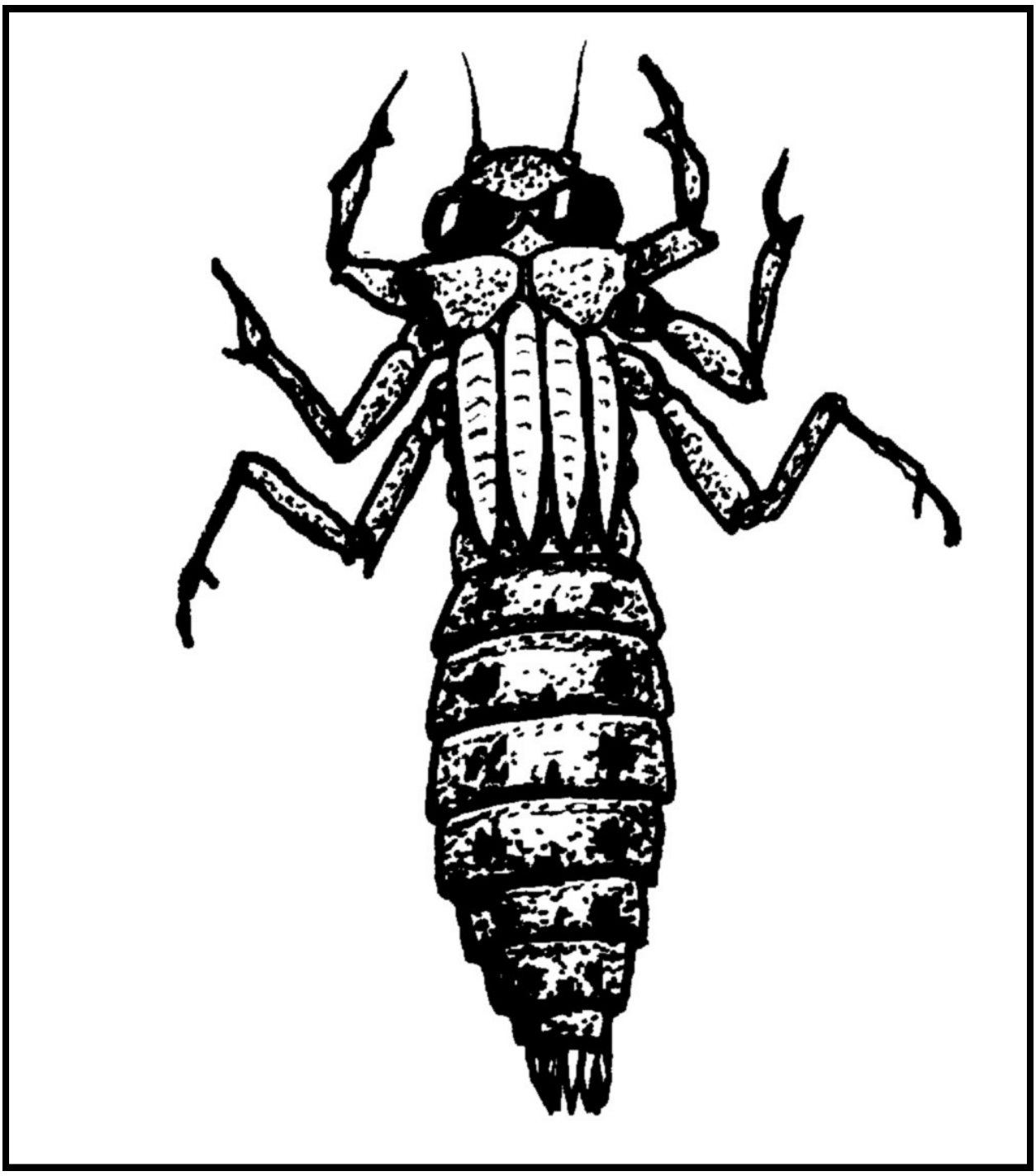


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Dragonfly Nymph

Somewhat Pollution Tolerant

Dragonfly Nymph

How it gets food:

- Predator

How to identify:

- Heavy-bodied
- Folding lower lip extends a third of the length of the body to jut out and catch prey

How it breathes:

- Gills for breathing are located in its rectum
- To propel itself, it shoots out water from its butt

Somewhat pollution intolerant

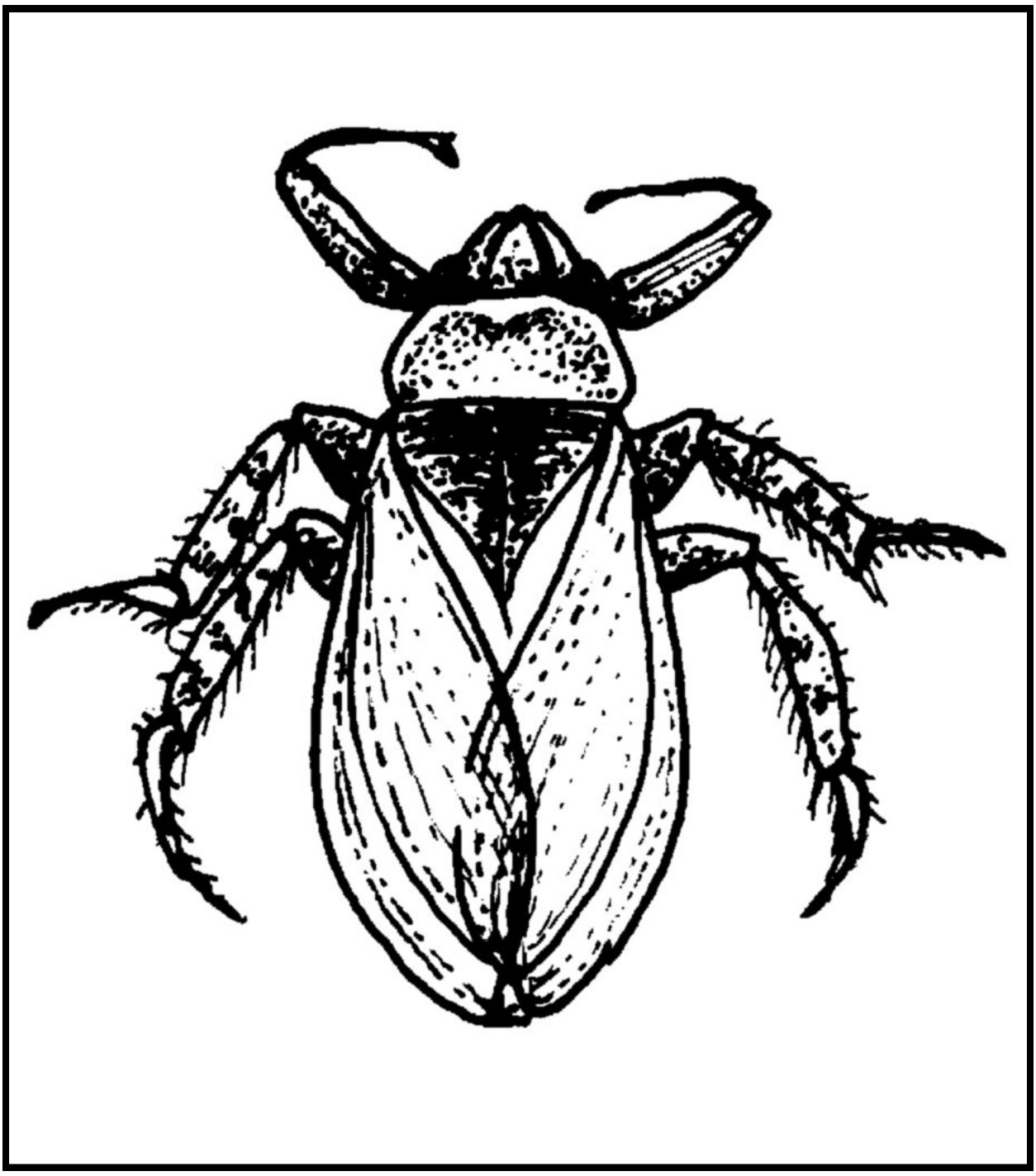


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Giant Water Bug

Somewhat Pollution Tolerant

Giant Water Bug

How it gets food:

- Predator
- Prey are injected with a digestive juice that dissolves them from the inside out. The GWB then sucks up the liquefied innards.

How to identify:

- Our largest water insect (up to 50mm)
- Giant, swollen forearms for catching and holding prey
- Back two sets of legs are used for swimming
- Young GWB look like adults, without the wings.

Somewhat pollution tolerant

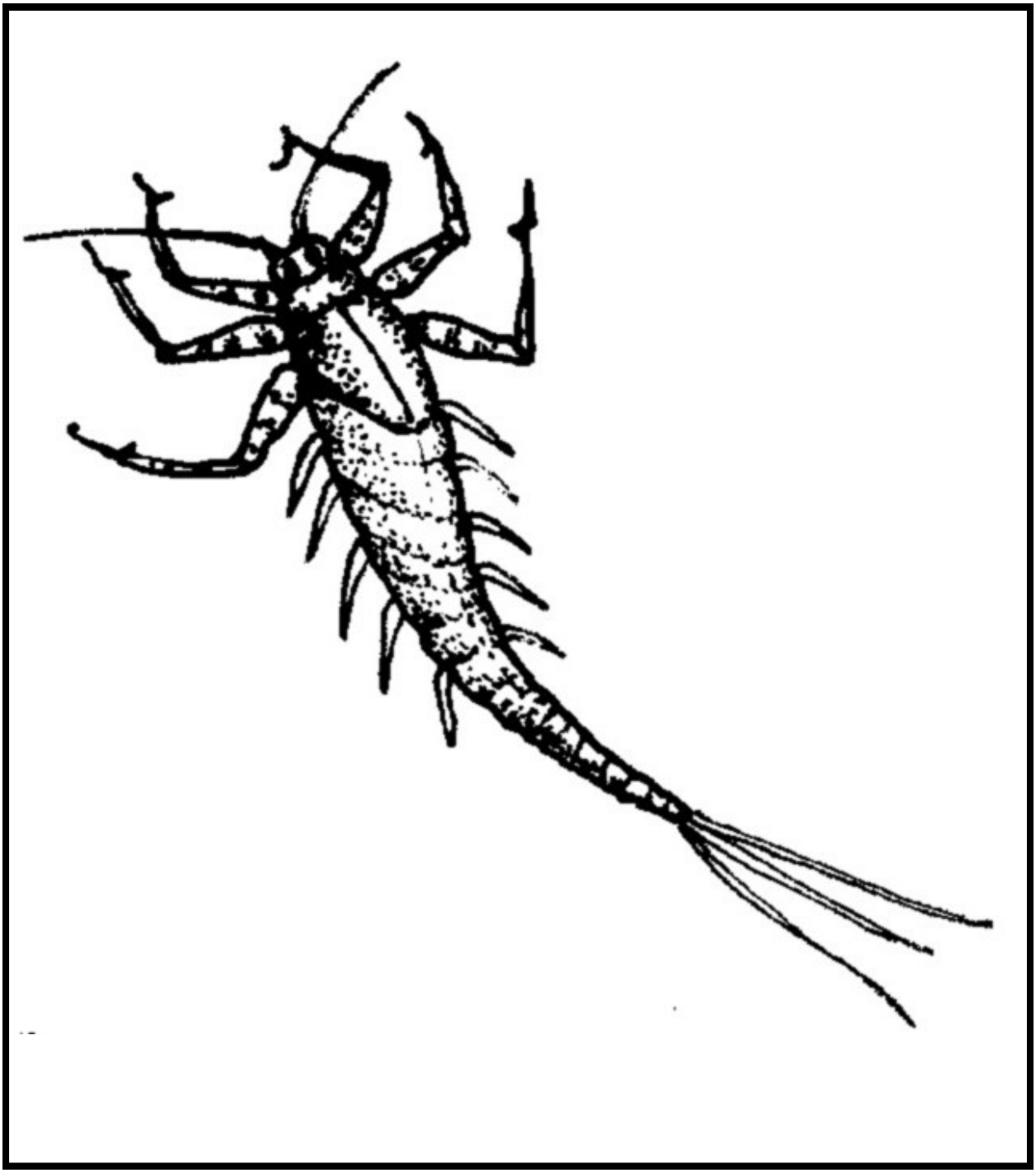


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Mayfly Larva

Pollution Intolerant

Mayfly Larva

How it gets food:

- Herbivore or scavenger

How to identify:

- Easiest way to recognize is by its three-pronged abdomen tip

How it breathes:

- Fuzzy gills line its abdomen

Pollution intolerant

- Only tolerates water with high oxygen content

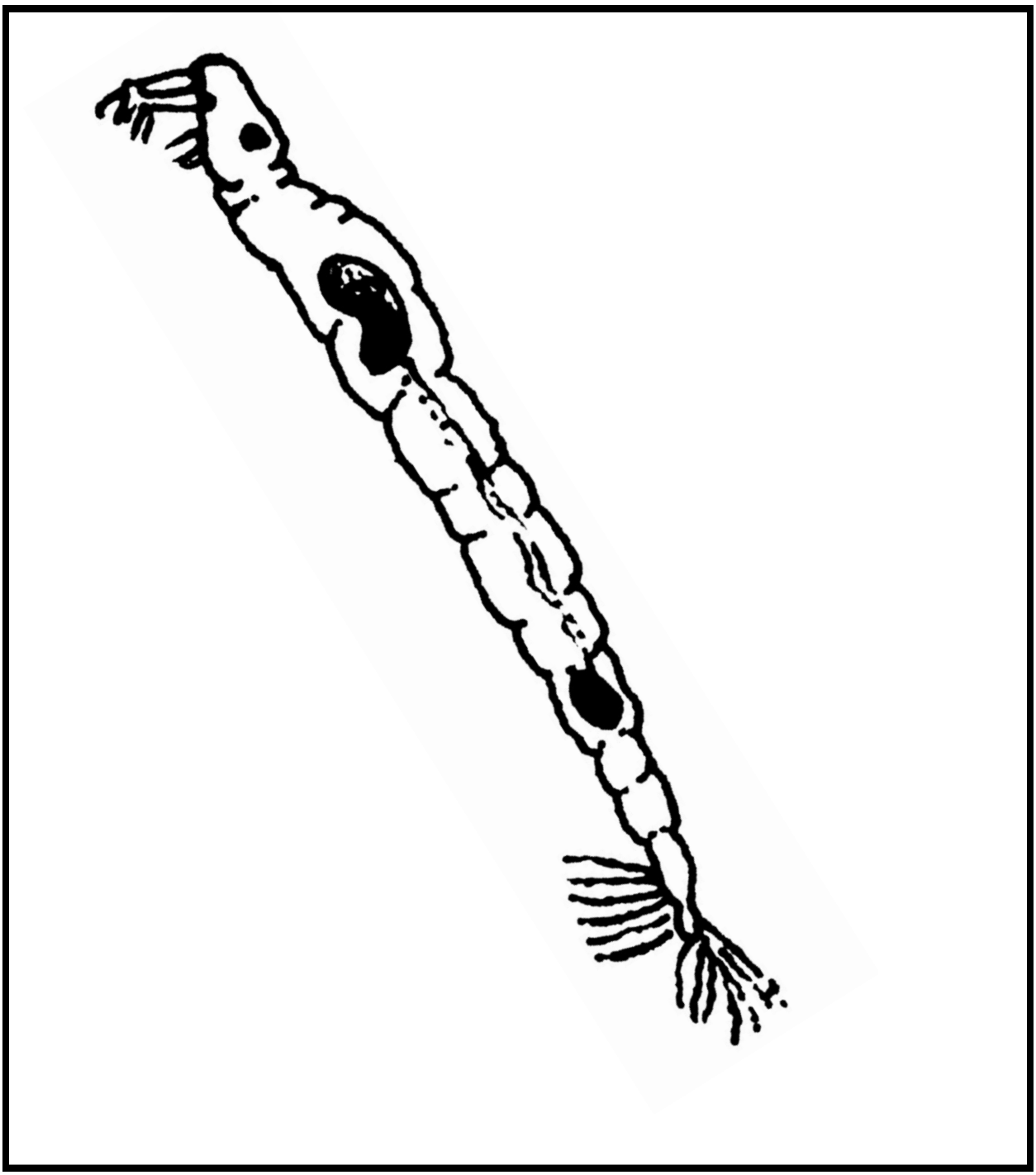


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Midge Larva

Pollution Tolerant

Midge Larva

How it gets food:

- Predator, herbivore, or omnivore

How to identify:

- Small, cylindrical body, sometimes blood-red

How it breathes:

- Through its body surface

Pollution Tolerant

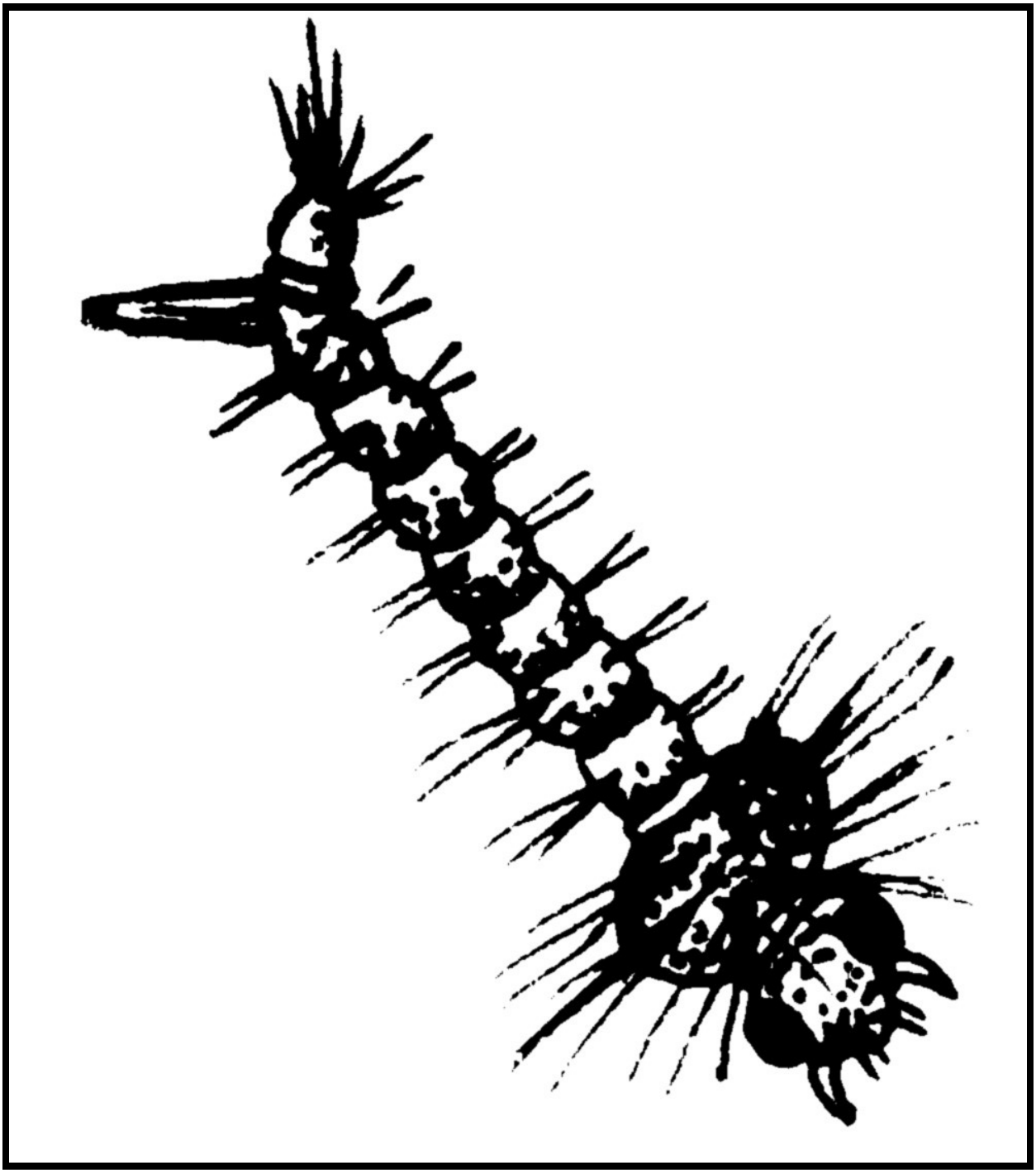


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Mosquito Larva

Pollution Tolerant

Mosquito Larva

How it gets food:

- Feeds on detritus - rotting organic material in the water
- Food source for lots of other aquatic insects

How to identify:

- Often called a "wiggler" because it twists and wiggles just below the surface

How it breathes:

- Hang upside down, breathing in oxygen from its tail

Pollution tolerant:

- Likes stagnant waters

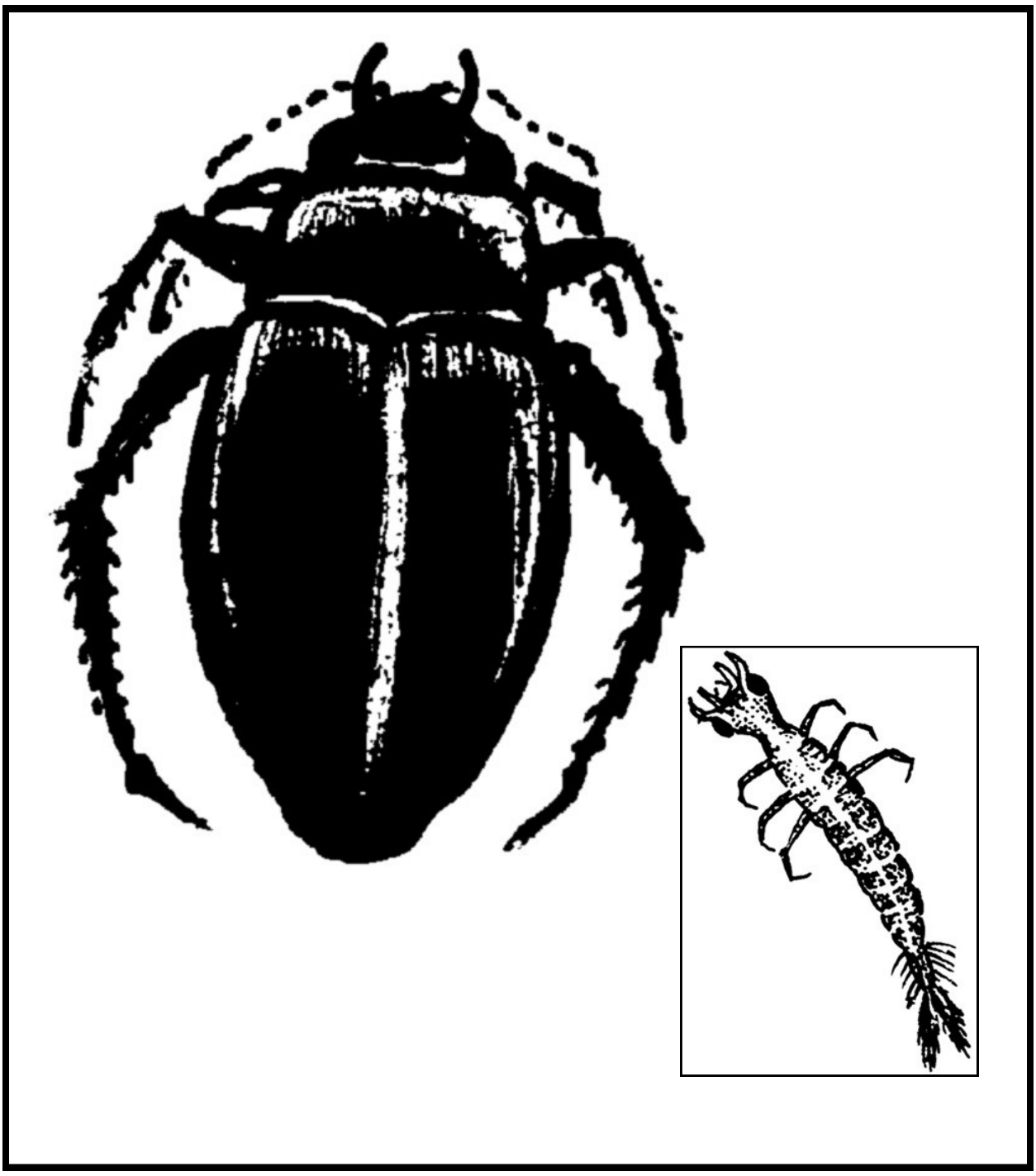


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Predaceous Diving Beetle

Somewhat Pollution Tolerant

Predaceous Diving Beetle

How it gets food:

- Voracious predator

Water Tiger - The Larva Stage

- In the larva stage, they are known as "Water Tigers."
- Swims through water with all six legs
- Kills and eats prey by injecting digestive juices and sucking up the liquefied body.

Predaceous Diving Beetle

- Eats anything it can overpower
- Often have dull-yellow markings on sides

Somewhat pollution tolerant

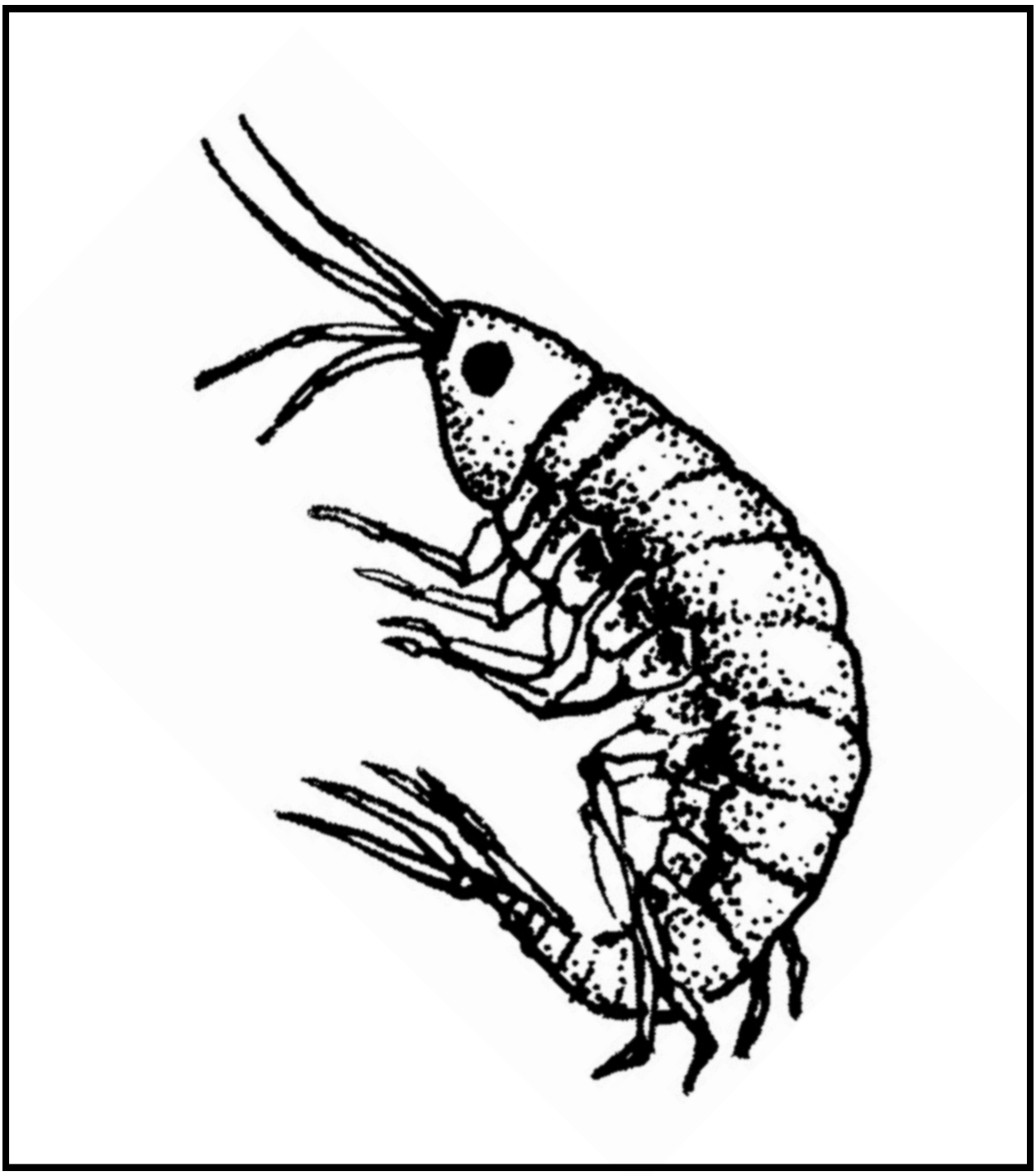


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Sideswimmer

Somewhat Pollution Tolerant

Sideswimmer

How it gets food:

- Scavenger

How to identify

- Fresh water shrimp
- Legs are all different lengths and shapes
- Swims by beating its many legs

How it breathes:

- Gills under the body

Somewhat Pollution Tolerant

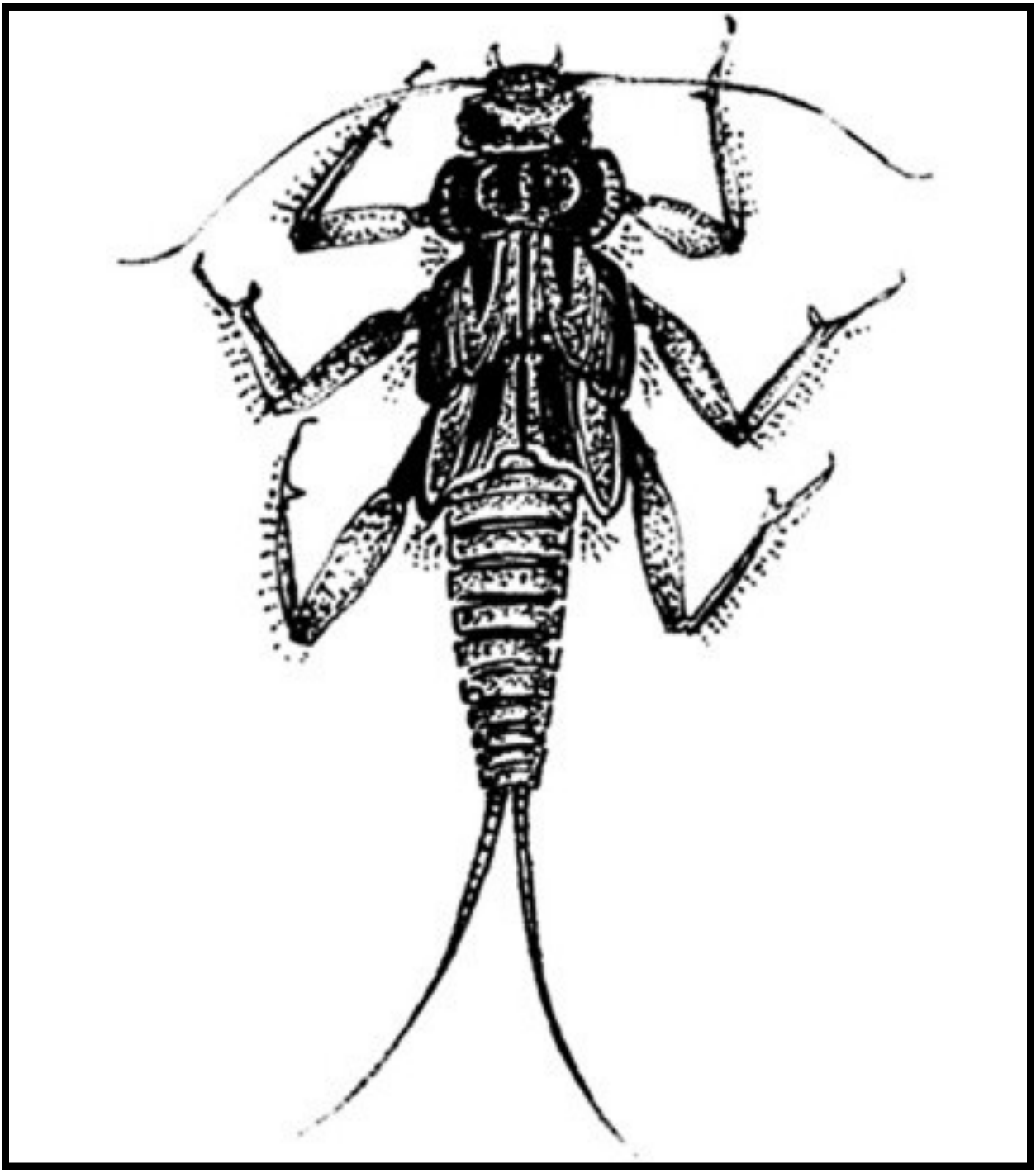


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Stonefly Larva

Pollution Intolerant

Stonefly Larva

How it gets food:

- Predator or herbivore

How to identify:

- Easiest way to recognize it is by its two-pronged abdomen tip

How it breathes:

- Unlike the mayfly, its gills are tucked into its leg pits

Pollution intolerant

- Only likes stream and rivers (clear, fast-flowing water, with lots of oxygen)

Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Water Boatman

Somewhat Pollution Tolerant

Water Boatman

How it gets food:

- Omnivore, herbivore, or scavenger

How to identify:

- Similar looking to a Backswimmer, but it swims the right way up
- To differentiate between Backswimmers and Water Boatman check out the legs:
- Front legs - shaped like garden trowels, for sifting through food
- Middle legs - long and pointy, for holding onto plants
- Back legs - shaped like a boatman's oars, for propelling itself

Somewhat pollution tolerant

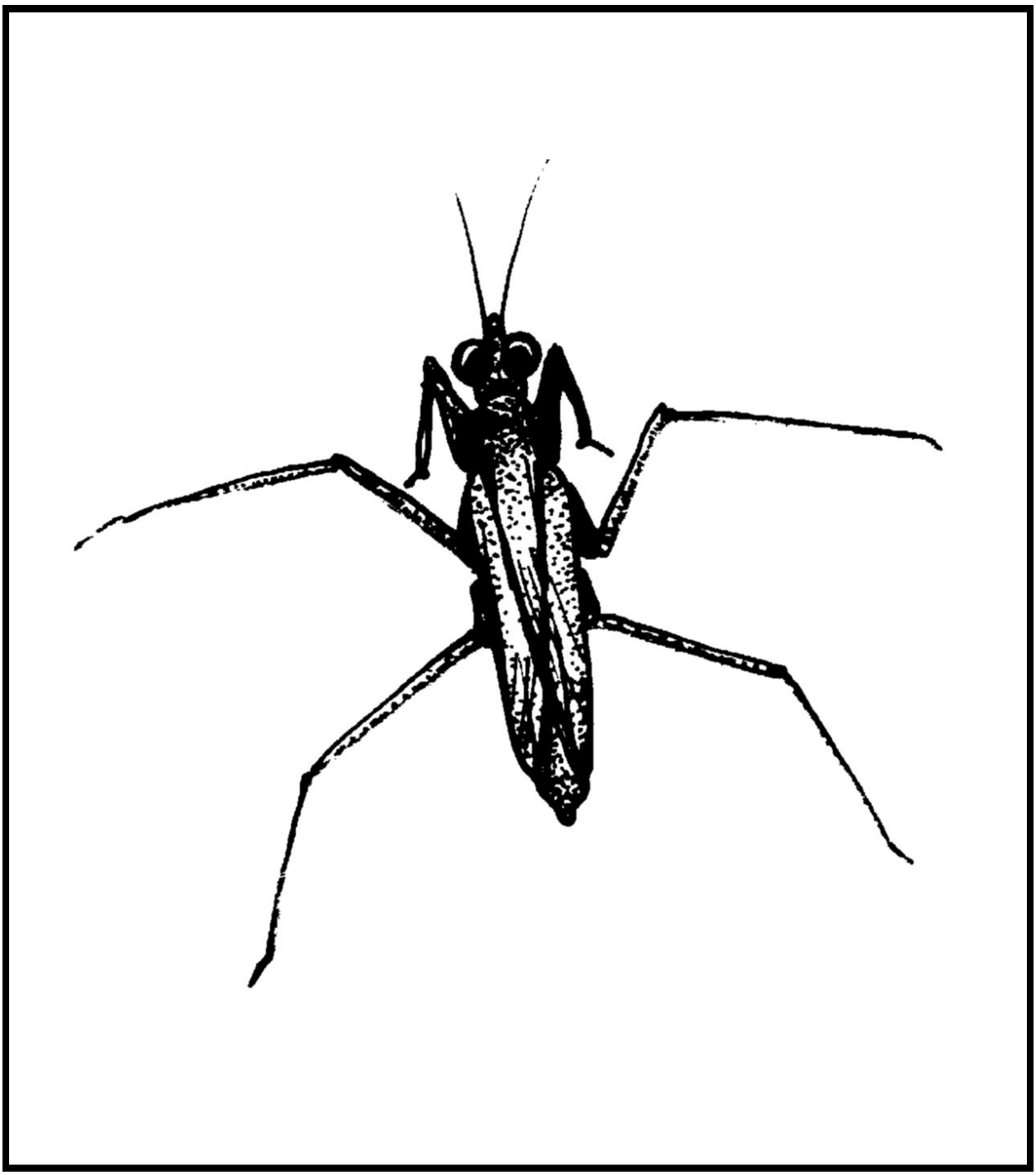


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Water Strider

Somewhat Pollution Tolerant

Water Strider

How it gets food:

- Predator - eats other bugs that have fallen in water and are in the process of drowning

How to identify:

- Four of its six legs are very long and distribute its weight over a large area of the water's surface, allowing it to "skate" along the top of the water

Somewhat pollution tolerant

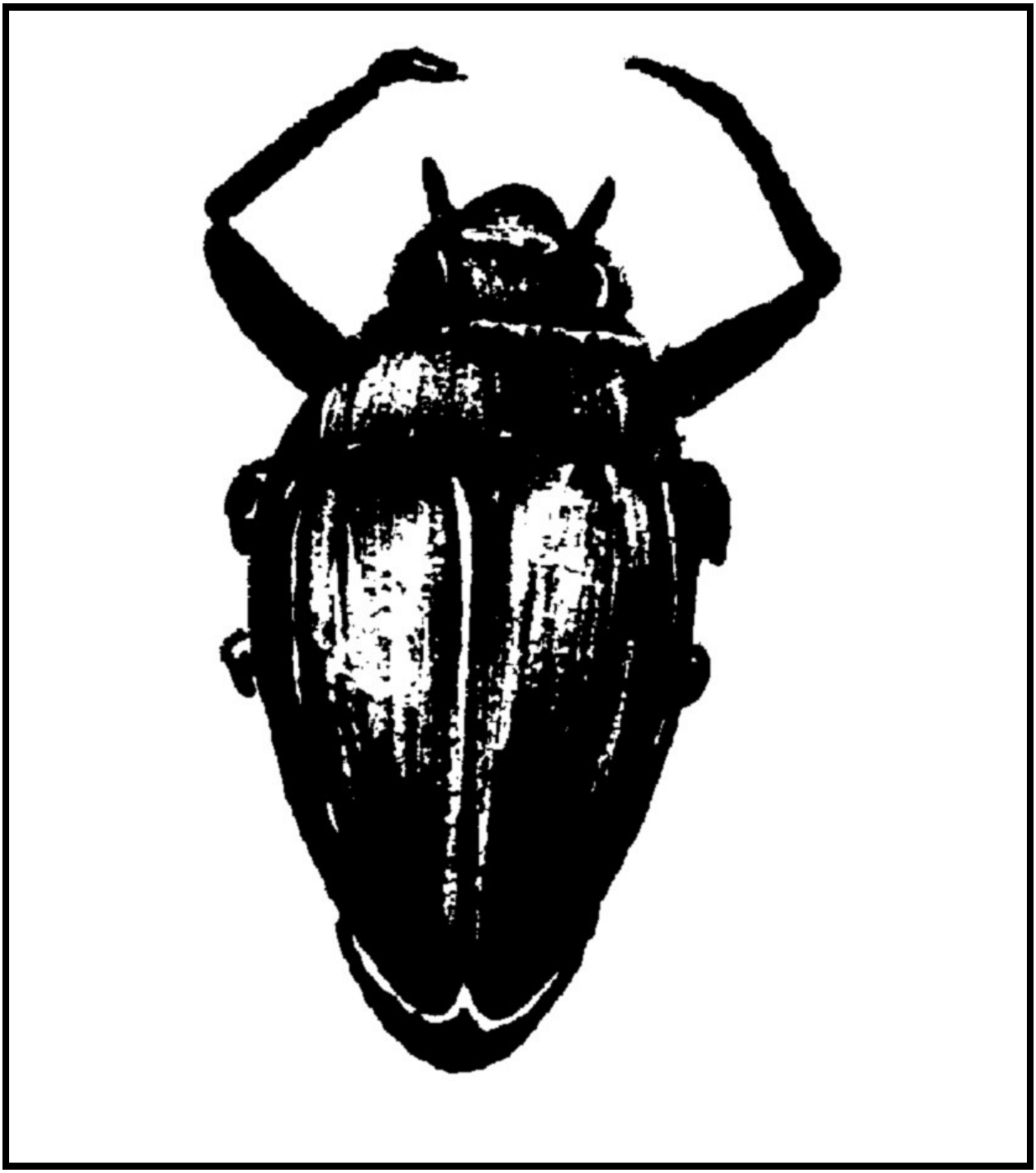


Illustration Credit: University of Wisconsin-Extension and the Wisconsin Department of Natural Resources.

Whirligig Beetle

Somewhat Pollution Tolerant

Whirligig Beetle

How it gets food:

- Predator

How to identify:

- Live mostly on the surface of the water
- Found in groups to avoid being eaten
- Got its name from swimming rapidly in circles on the surface of the water when alarmed
- Each eye is split - one half can see in the air, the other down into the water
- Defense from other predators - taste like rotting-fruit

Somewhat pollution tolerant