

Major groups of Alaskan aquatic insects

There are many hundreds of species of aquatic insects in Alaska, but many are so similar to each other that they can be distinguished only under a microscope. Since this book is designed as an introduction to aquatic insects of Alaska, we won't catalog every species here. We'll describe the seven major orders of Alaskan aquatic insects, and within each order we'll profile the major families (a division that's two steps above the species level).

After looking through this section, you should be able to examine an aquatic insect and figure out what order it belongs in. With more careful examination, you may also be able to identify which family it is part of. If you decide to dive further into identification (for example, if you want to try to identify your aquatic insect's species), look at the end of this book for suggested references that provide more detail.

Classifying insects

An insect is a type of animal that lacks a backbone and has jointed legs. Taxonomists (scientists who study and determine the classification of living things) have placed insects in a special category of animals known as arthropods, a word of Greek origin meaning "jointed foot or leg."

Among the many groups of arthropods found on Earth, insects are literally in a class of their own. Unlike other arthropods such as crabs, centipedes, and spiders, insects have six legs, three body parts (head, thorax, and abdomen), and wings. These traits have earned insects a place in their own class, the class Insecta. The class Insecta is divided into orders. Orders are divided into families, families into genera, and genera into species. All the species within the class Insecta are, by definition, insects.

*The Four-spotted Skimmer dragonfly – genus *Libellula* and species *quadrifasciata* – is one of many species in the Skimmer family (*Libellulidae*), which is one of many families in the order *Odonata* (dragonflies and damselflies). The Black Meadowhawk dragonfly (*Sympetrum danae*) shares enough characteristics with the Four-spotted Skimmer to be in the Skimmer family, too. The American Emerald dragonfly (*Cordulia shurtleffii*), however, is different enough from the Four-spotted Skimmer and the Black Meadowhawk that taxonomists have placed it in a different family of dragonflies (the Emeralds, or *Corduliidae*).*

*Think all this Greek and Latin is confusing? In fact, scientific names often hold interesting information and clues. For example, the family name for Emerald dragonflies, *Corduliidae*, comes from the Greek *kordyla*, which means "club." This gives you a heads-up that some adult dragonflies in the Emerald family have bulbous abdomens.*



Four-spotted Skimmer



Black Meadowhawk



American Emerald

The Major Orders of Aquatic Insects



Caddisflies Order Trichoptera (page 29)



Dragonflies and Damselflies
Order Odonata (page 47)



Flies Order Diptera (page 55)



Mayflies Order Ephemeroptera (page 75)



Stoneflies Order Plecoptera (page 87)



Water Beetles Order Coleoptera (page 98)



Water Bugs Order Hemiptera (page 110)

Caddisflies — Order Trichoptera

Architects, net-spinners, and others

If you've ever stared at the bottom of a pond and suddenly realized that something you thought was a tiny clump of bark bits or spruce needles was actually crawling, you've probably seen a caddisfly. This order of insects is best known for constructing elaborate cases, using materials ranging from twigs to sand grains to carefully-cut pieces of leaves. But caddisflies of some families don't build cases at all. Some caddisflies build fixed shelters, from which they deploy silken nets to capture food. Most caddisflies feed on dead or living plant materials; some are predators.

Adult caddisflies have a fluttering, moth-like flight; in fact, some types are easily mistaken for moths because they tend to fly at night. Caddisfly larvae have six prominent legs and long, soft abdomens that end with two fleshy legs, called *prolegs*, that each bear a claw.

In case-maker caddisflies the vulnerable abdomen is safely concealed inside a rigid case. These cases are constructed piece by piece using silk that the caddisfly larva exudes from its mouth. Different types of case-building caddisflies specialize in different case materials and case shapes, and cases can be cleverly adapted for a variety of habitats. Characteristics of the larvae that are important for distinguishing families include the presence of gills and their shape, the presence of rigid plates (called *sclerites*) on the thorax, and the case shape and materials.

Caddisflies undergo complete metamorphosis, so they have a pupal stage before they become adults. In case-building species, the pupae usually remain inside the case. In free-living species, the larva may construct a cocoon, attached to a rock or other underwater anchor, in which to transform into an adult. Once the transformation is complete, the adult wriggles to the surface, sheds its pupal skin, and flies away.

Caddisfly larvae can be found in still waters and fast-moving streams alike. Many types are sensitive to water pollution, so they can be good indicators of stream health. Alaska is home to at least 134 species of caddisflies.



Because they have a fluttering, moth-like flight, and because some types tend to fly at night, caddisflies can sometimes be mistaken for moths at first glance. But unlike moths, which have feather-like branched antennae, caddisflies have filament-like, unbranched antennae.



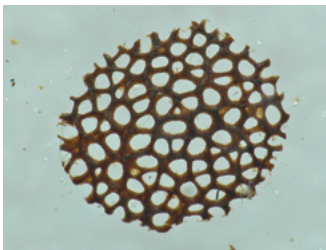
Caddisflies' family name, Trichoptera, means "hairy-winged," referring to the adults' fuzzy wings.



Caddisfly larvae have six prominent legs and long, soft abdomens. The abdomen is usually concealed in those species that construct portable cases or fixed retreats.



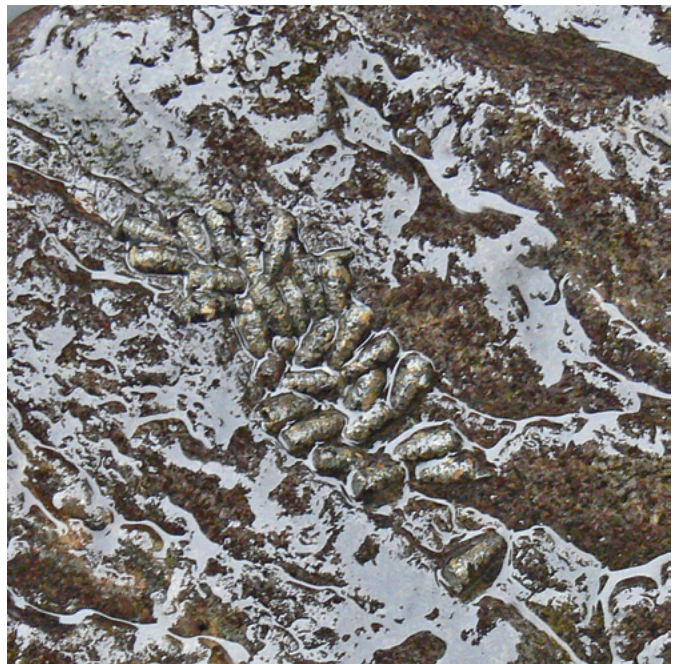
Just before pupating, a free-living caddisfly larva (such as this Green Rock Worm) spins a silken cocoon in which to transform into an adult.



Some case-building caddisflies construct silken nets at each end of the case just before transforming into the pupa. These sieve-like structures allow water to flow into the case while keeping would-be predators out.



Caddisflies in the Green Rock Worm family do not build cases. This free-living lifestyle is well suited to their predatory ways, which require quick mobility and maneuverability.



Case-building caddisflies pupate within their cases, which may be firmly attached to the undersides of submerged rocks or to branches.

Caddisfly case materials

Sand and Stones



Vegetation



Silk



Apataniid Case Makers

Apataniidae

Apataniid Case Makers are very similar to Northern Case Maker Caddisflies (see page 42), a family they once belonged to. Larvae live in cool streams and cold lakes. In streams, they can be found at high elevations and living on rocks in turbulent flows or in a thin film of water on rock faces near waterfalls. The larvae feed on algae that is scraped from the surface of rocks.

Larval identification notes

- ▶ Heads of some larvae flat, or even slightly concave, and surrounded on three sides by a semicircular ridge
- ▶ Cases made of small rock fragments or sand; most are cylindrical, tapered and curved
- ▶ Some larvae add moss, algae, and leaf and twig fragments to the cases as camouflage



Apataniid Case Maker larva



Apataniid Case Maker larva and case (photo by California Dept. of Fish & Game, Aquatic Bioassessment Laboratory)

Interesting facts

- ▶ One species from Alaska is reportedly parthenogenic, meaning females can produce offspring without the help of males.
- ▶ The prefix “mano” in *Manophylax* (see story below) is Greek for “rare,” indicating that members of this genus are exceedingly localized or infrequently encountered.
- ▶ Functional Feeding Group: scrapers



Nugget Falls with Juneau’s Mendenhall Glacier in the background (photo by John Hudson)

Stories from the field

In 2002 a new species of Apataniid Case Maker Caddisfly was discovered at Nugget Falls near Mendenhall Glacier in Juneau. Despite searches in similar habitats all over Juneau, that species, *Manophylax alascensis*, has been found only at this single location. These grazers of microscopic algae live in a rather unique habitat—a thin film of flowing water on vertical bedrock faces along the margins of this powerful waterfall. During rainy periods, some larvae venture outside the areas kept wet by the falling water and spray. When the sun returns, the water dries out from under them forcing the larvae to make a slow and steady retreat back to moist habitat. We have visited this site to watch the tiny larvae climb the rock faces as they feed.

Comb-lipped Case Makers

Calamoceratidae

Most species in this family occur in the tropics or subtropics. The five species found in North America live in cool streams where plant detritus and dead wood, their primary foods, accumulate in pools and other slow-flowing areas. The larvae are often covered in silt and can be found attached to roots or twigs at the stream edge, just below the water surface. As larvae grow, they change the materials they use to build their cases, from sand and small pieces of detritus to sand and wood fragments and eventually to hollowed twigs and plant stems. A single species, *Heteroplectron californicum*, is known from Alaska.

Larval identification notes

- ▶ Head and top of first segment of thorax dark brown and shiny
- ▶ Row of 16 stout hairs across upper lip



Comb-lipped Case Maker larva (photo by California Dept. of Fish & Game, Aquatic Bioassessment Laboratory)

Interesting facts

- ▶ Mature larvae frequently live inside a single hollowed-out twig or plant stem that is lined with silk and open at both ends to allow water to flow over the gills.
- ▶ Some larvae use empty cases of stone made by other caddisflies, adding small pieces of wood to the front ends (photo below).
- ▶ Mature larvae often tunnel into large pieces of bark, branches, and submerged logs, eventually pupating inside their burrows.
- ▶ Functional Feeding Group: shredders



Comb-lipped Case Maker larva (photo by California Dept. of Fish & Game, Aquatic Bioassessment Laboratory)

Common Net-spinners

Hydropsychidae

Common Net-spinner Caddisflies spin intricate, rectangular mesh nets that strain their food—algae, fine organic particles, and small aquatic invertebrates—from the current. A typical net is attached to a rock or log and forms a pouch against the surface. The open end faces upstream and the net is bowed by the current so that its shape resembles a bowl cut in half and glued to a wall. Often it is coated with algae, strands of which may wave in the current. The larvae periodically emerge from their retreat to feed on whatever the net has caught. They can be found living in a variety of flowing waters, from intermittent streams to large, fast-flowing rivers.

Interesting facts

- ▶ Larvae do not build portable cases but may construct camouflaged retreats of gravel, sand, or plant debris at the base of the net.
- ▶ In a sample tray the larvae can rapidly move backwards with great agility using their abdomens, which are tipped with two claws (a).
- ▶ Young larvae do not construct nets at all, and some species do not construct nets during the winter.
- ▶ When larvae become dislodged from their retreats, they may attempt to enter the retreats of other net-spinning caddisflies. This usually causes a fight, which the owner of the net usually wins.
- ▶ The larvae are often found in streams flowing out of lakes.
- ▶ Functional Feeding Group: collector-filterers, predators



Common Net-spinner larva

Larval identification notes

- ▶ Rigid plates on top of all three thoracic segments
- ▶ Conspicuous branched gills next to the middle and hind legs and along the underside of the abdomen
- ▶ Often a tuft of long hairs near the tip of each proleg (a)

Fingernet Caddisflies

Philopotamidae

Fingernet Caddisflies do not build portable cases but rather live and feed inside elongate, fingerlike silk nets. The nets are up to 60 mm long by 5 mm wide, and have the finest mesh among all the net-spinning caddisfly families. Large numbers of these nets are often found together. The nets, which are usually attached to the underside of rocks in streams, are anchored at the opening, leaving the rest to flap about in the water current. The larvae feed on fine small particles of organic matter and diatoms caught in the net.

Interesting facts

- ▶ The nets of mature larvae may have tens of millions of openings and be made from more than 1 km of silk.
- ▶ A hole at the end of the net bag provides an escape exit, helps to maintain flow through the net as it becomes clogged, and allows feces to pass out.
- ▶ The specialized lip is used to gently scrape food particles from the inside of the net.
- ▶ Functional Feeding Group: collector-filterers

Larval identification notes

- ▶ Unique to this family: a broad (nearly as wide as the head) T-shaped and membranous upper lip (labrum); in other families the upper lip is narrower than the head, dark colored, and rigid
- ▶ Only first thoracic segment has rigid plate on top; abdomen conspicuously white



Fingernet Caddisfly larva

Giant Case Makers

Phryganeidae

Giant Case Maker larvae construct large cylindrical cases from pieces of leaves and bark they cut to size and sew together, either into stacked rings or as a continuous spiral. The cases are often much longer than the larvae themselves. Compared to other case-maker caddisflies, they are more slender and agile, characteristics considered primitive among caddisflies.



Giant Case Maker larva (photo by Tom Murray)



Giant Case Maker larva (photo by Tom Murray)

Larval identification notes

- ▶ Mature larvae conspicuously larger than those of other families
- ▶ Top of the head and first segment of the thorax usually marked with dark bands or patches on a yellow background
- ▶ Top of the second and third thoracic segments mostly soft tissue (they lack large hard plates)

Interesting facts

- ▶ Adults of *Phryganea cinerea* have been found living at great depths (100 m) in large lakes.
- ▶ The omnivorous larvae feed on dead and living plant matter as well as a variety of aquatic invertebrates.
- ▶ A larva removed from its case will quickly set to work constructing a new case with any suitable material available.
- ▶ Functional Feeding Groups: shredders, predators

Green Rock Worms

Rhyacophilidae

The name Green Rock Worms describes these stream-dwelling caddisfly larvae quite well. Many are green—some brilliant green—and while they are certainly not worms, these free-living predatory caddisflies might be mistaken for worms as they crawl among rocks in search of prey. As free-living larvae, they do not live in cases or fixed retreats, but they do build loose assemblages of small stones (often between two rocks) held together with silk. Within these protective structures, the larvae spin cocoons where they transform into adults. Openings in the structure allow water to bring oxygen in and carry wastes out.

Interesting facts

- ▶ One study noted that larvae left behind threads of silk wherever they went.
- ▶ The larvae use an ambush strategy when hunting mobile prey like mayflies, and a searching strategy when hunting sedentary prey like Black Flies.
- ▶ The free-living habits of Green Rock Worms make them more vulnerable to fish predation than other caddisflies. Not surprisingly, fly fishers have designed flies to mimic these caddisflies.
- ▶ Functional Feeding Group: predators



Green Rock Worm larva

Larval identification notes

- ▶ First segment of thorax and last segment of abdomen topped with a single rigid plate
- ▶ Well-developed anal prolegs each end in a sharp claw
- ▶ Most lack gills on the abdomen
- ▶ When present, abdominal gills are branched
- ▶ Deep constrictions between thoracic and abdominal segments give larvae a muscular appearance



Green Rock Worm larva

Hoodcase Makers

Molannidae

Hoodcase Makers are distinguished by their flattened and tapered cases, which extend out on either side and above the head, forming a “hood” that obscures the larva from above. Larvae live on sand and mud substrates in lakes, cold springs, and slow-flowing parts of streams and rivers. The case is often built of sand and small rock fragments, making the larvae difficult to see unless they are moving. They may also incorporate detritus and wood fragments into their cases though some cases are made entirely of detritus. The omnivorous larvae feed on small invertebrates as well as diatoms, algae, and the tissues of larger plants.

Interesting facts

- ▶ Larvae bury themselves into the substrate before pupation.
- ▶ One species, *Molannodes tinctus*, is found only in Alaska and the Yukon Territory.
- ▶ Functional Feeding Group: collectors-gatherers, predators

Larval identification notes

- ▶ Case shape is distinctive of this family



Hoodcase Maker larva (top view)



Hoodcase Maker larva (side view)

Humpleless Case Makers

Brachycentridae

Humpleless Case Makers lack the humps that case maker caddisflies normally possess on the top and/or sides of the first segment of the abdomen. But it's their small size and interesting cases that help set them apart from other caddisfly families. Some build four-sided tapering cases from thin pieces of plant material arranged like the logs of a cabin. Other species build cases that are round in cross-section, either entirely from silk or from the circular windings of ribbon-shaped plant materials (see photo below). They inhabit running waters, from small streams to rivers; some species are commonly found on moss-covered rocks. Their diet consists of diatoms, algae, fine organic matter, and insects.

Interesting facts

- ▶ Using silk, larvae in the genus *Brachycentrus* anchor their cases—facing upstream—to rocks or plants. They use hairs on their exceptionally long middle and hind legs to snare food particles that drift by on the current.
- ▶ Certain Chironomid larvae enter Brachycentrid pupal cases to pupate. This will result in the death of their “host.”
- ▶ Functional Feeding Groups: collectors-filterers, collectors-gatherers, shredders

Larval identification notes

- ▶ No humps on the top or sides of the first abdominal segment



Humpleless Case Maker larva
(photo by Tom Murray)

Humpleless Case Maker larva

Lepidostomatid Case Makers

Lepidostomatidae

Lepidostomatid Case Maker larvae typically live in cool springs and streams, but they can also be found in lakes and even temporary streams. They are usually found in the slow moving parts of streams where dead plant matter, their main food source, accumulates. Most species construct a four-sided case from rectangular pieces of bark and leaves; some build spiral-shaped cases of plant material or tubes made of sand grains.

The larvae of Lepidostomatid Case Makers look similar to Northern Case Maker larvae, but they lack a hump on top of the first abdominal segment. With the help of magnification, one can also distinguish the two families by the location of the antennae. In Lepidostomatids the antenna is right next to the eye, while in Northern Case Makers it is halfway between the eye and the front of the head.



Lepidostomatid Case Maker larva (photo by California Dept. of Fish & Game, Aquatic Bioassessment Laboratory)

Larval identification notes

- ▶ Similar to Northern Case Maker larvae, but lack hump on first abdominal segment, and antenna is right next to eye

Interesting facts

- ▶ Some larvae are scavengers on salmon carcasses.
- ▶ Functional Feeding Group: shredders



Lepidostomatid Case Maker larva (photo by Tom Murray)

Longhorned Case Makers

Leptoceridae

Longhorned Case Makers are inhabitants of lakes, ponds, and the slow parts of streams. Most live on the bottom, and some species prefer the shallows. Their cases can be quite variable. Some are made of sand, with wide openings tapering sharply and surrounded by wide flanges. Others are straight tubes of rock fragments, mollusk shells, or plant material with twigs or conifer needles attached to the sides. Some are entirely of silk. Some, made entirely of plant materials, are spiral-shaped. Other plant-material cases consist of stacked twigs and stems, resembling tiny, hastily-constructed log cabins. Depending on the species, the diet may include detritus, living plant tissue, and/or invertebrates.

Interesting facts

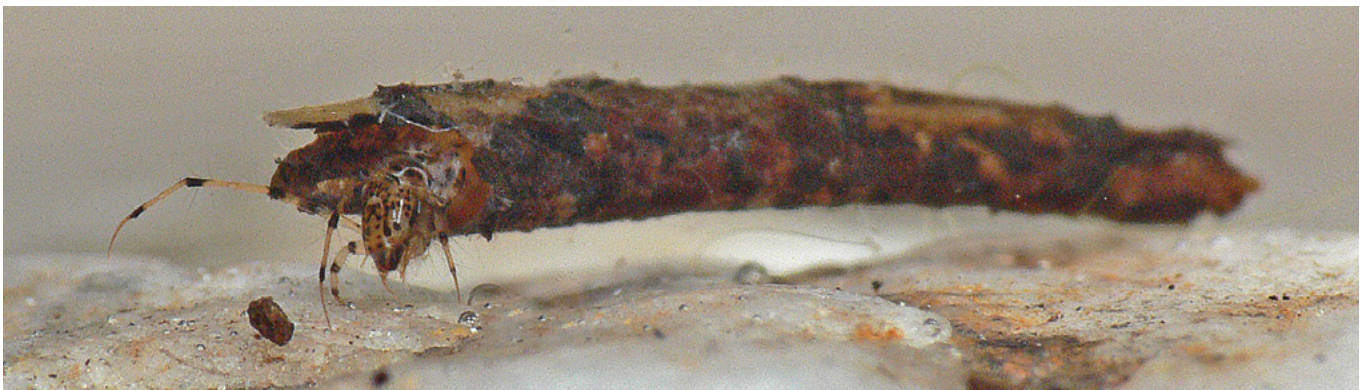
- ▶ Some species in the genus *Ceraclea* burrow into freshwater sponges and eat them.
- ▶ Some lake-dwelling members of the family get around using their long hind legs to swim.
- ▶ Functional Feeding Group: shredders, collectors-gatherers, predators

Larval identification notes

- ▶ Antennae at least six times as long as wide
- ▶ Hind legs are much longer than the middle and front legs



Longhorned Case Maker larva



Longhorned Case Maker larva

Northern Case Makers

Limnephilidae

The Northern Case Maker family contains the greatest number of species (over 70) of any caddisfly family in Alaska. These caddisflies occur throughout the state in nearly every kind of freshwater habitat. Some may even venture out of the water and into adjacent moist habitats. Most consume plant materials by shredding leaves and other debris or by scraping diatoms and fine pieces of detritus from the surface of rocks and wood. Some feed upon salmon carcasses.

The larval cases are diverse in form and materials. They can be round, three-sided, or flat. Some are made of leaves carefully cut and “sewn” together into purse-like retreats (see photo below left). Some are made with pieces of twigs, bark, and leaves arranged lengthwise or stacked transversely. Cases of sand or small rock fragments can be thick or slender, curved or straight, and may have conifer needles attached to the outside. *Dicosmoecus* larvae build their cases so stout and strong that hungry dippers must thrash them against rocks to force the larvae out.



Northern Case Maker larva

Larval identification notes

- ▶ Although many genera in this family have distinct cases, the characteristics used to distinguish Northern Case Makers from other families are too numerous to mention here and difficult to see without a microscope.

Interesting facts

- ▶ Functional Feeding Groups: shredders, collectors-gatherers



Northern Case Maker larva

Purse-case Makers

Hydroptilidae

Commonly called micro-caddisflies, the Purse-case Makers are small indeed. The largest species known from Alaska can reach 6 mm in length (smaller than a hemlock needle), but most others are only 2 to 3 mm long. Many have laterally-compressed abdomens that fit nicely inside two-piece, purse-shaped cases. These cases are often covered with concentric rings of filamentous algae or coated with a layer of sand. Other members of this family construct a silk case shaped like a bottle with the base cut off; the larva's head and legs protrude from the "bottleneck."

The herbivorous larvae feed on the liquid contents of filamentous algal cells, or graze on diatoms. They live in lakes, ponds and cold springs, fast-flowing streams, and the calm sections of large rivers.

Interesting facts

- ▶ Fragments of rockweed (*Fucus*), an intertidal seaweed found throughout North Pacific waters, were found in the guts of larvae from Finland.
- ▶ Functional Feeding Groups: piercers-herbivores, collectors-gatherers, scrapers, shredders

Larval identification notes

- ▶ Smaller than larvae of most other families
- ▶ Rigid plates on top of all thoracic segments
- ▶ Abdomen rather wide relative to head and thorax; without gills
- ▶ Most have conspicuous constrictions between the abdominal segments



Purse-case Maker larva



Purse-case Maker case

Stone-cased Caddisflies

Uenoidae

Stone-cased Caddisflies live in running waters. Some can be found on rock faces covered with a thin film of water; others prefer turbulent streams. These caddisflies construct cases of small rock fragments. There are two types: straight tubes with larger stones attached to the sides (photo below) or sharply curved and tapered cases. Larvae graze on diatoms and fine organic matter on the surfaces of rocks and pupate on the underside of rocks, often in dense aggregations.

Interesting facts

- ▶ Some species feed on the tops of rocks during the day and retreat to the underside during the night.
- ▶ Species within the genus *Neophylax* reduce competition with one another by living in different sections of the stream between the headwaters and the mouth.
- ▶ Functional Feeding Groups: scrapers

Larval identification notes

- ▶ Front edge of plate on top of middle thoracic segment is notched (a)



Stone-cased Caddisfly case (photo by California Dept. of Fish & Game, Aquatic Bioassessment Laboratory)



Stone-cased Caddisfly larva (photo by California Dept. of Fish & Game, Aquatic Bioassessment Laboratory)

Tortoise-case Makers

Glossosomatidae

In Tortoise-case Makers the case, an oblong dome of rock fragments, completely covers the larva, like a tortoise shell. Under the dome, a band of rocks separates two equal-sized holes, one at each end. The larva can spin around to poke its head from either its front or back “door” when feeding. Gaps between the rocks allow water to pass through. While many caddisflies are able to “add on” to their cases to accommodate their growth, Tortoise-case larvae are forced to upgrade as they outgrow their homes. After moving into a new case, built off the end of the old one, the larva casts away the old case.

Tortoise-case Maker caddisflies can be very abundant. They live in cool, fast-flowing streams where they scrape algae and detritus from rocks for food. High densities of small larvae can give the surface of rocks a gritty texture.

Interesting facts

- ▶ Most caddisflies that build portable cases use their anal claws to hold on to the case; Tortoise-case Makers extend their claws out of the case as an extra set of “legs” for holding on to surfaces.
- ▶ Prior to pupation, the larva removes the rock band under the case and then firmly anchors the rim to a rock with silk (lower photo).
- ▶ At one time in their evolutionary history, Tortoise-case Makers probably lived case-free and constructed their rock domes just to protect themselves as pupae. Over time, larval behavior evolved to build the pupal retreat earlier.
- ▶ Functional Feeding Groups: scrapers



Tortoise-case Maker cases

Larval identification notes

- ▶ The design of the case is unique among caddisfly families
- ▶ No gills on the abdomen
- ▶ Only first thoracic segment is covered by rigid plates
- ▶ All three sets of legs are the same length



Tortoise-case Maker larva

Tube-making Caddisflies

Polycentropodidae

Tube-making Caddisflies live in fixed retreats made of silk. They use their larval retreats to filter zooplankton and insects from slow currents or to conceal themselves from potential prey. Filter-net retreats are shaped like trumpets that end in long tapering tubes, or like bags held open in the current.

Tube-making larvae that ambush prey from their retreats hide within cylindrical or depressed open-ended tubes equipped with silken trip-wires. Like web-weaving spiders, these ambush predators detect their prey by feeling vibrations along the silk strands.

Interesting facts

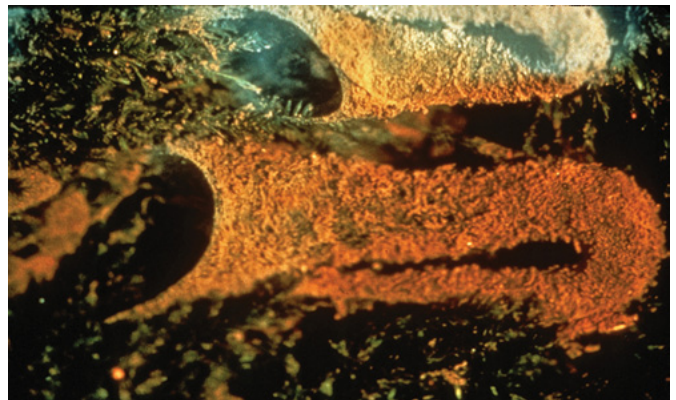
- ▶ Tube-making Caddisflies can be very abundant on submerged plants and branches, especially at lake outlets where countless zooplankton are helplessly swept into their waiting nets.
- ▶ With undulations of the body, a dense row of hairs along each side of the abdomen helps keep oxygen-rich water moving through the retreat.
- ▶ Functional Feeding Groups: collectors-filterers, shredders, predators

Larval identification notes

- ▶ Pointed projection at the base of each front leg
- ▶ Only the first thoracic segment covered with sclerites
- ▶ Abdomen without gills
- ▶ Prolegs are long and each bears a large, strongly bent claw



Tube-making Caddisfly larva



Tube-making Caddisfly filter-net retreats (photo by Rich Merritt)