Entomology

By Bill Carnazzo, November 2008

[Editor's note: References to various now defunct websites in the original article have been removed or replaced with comparable information where available.]

First, a disclaimer. I am not a biologist, entomologist, or other type of scientist. I am a flyfisher with a lot of practical, on-the-job experience and I've read a lot of material over the years about aquatic bugs. Ralph Cutter, Brian Chan, and Rick Haefle have the qualifications to be called scientists. You will find a wealth of information on midges in Brian Chan's book "Fly Fishing Trout Lakes." Rick Haefle has written extensively on entomology and its relationship to fly fishing. You can view all of his many books here. He also writes a monthly column on entomology for American Angler Magazine. Ralph Cutter has also written a number of books, each of which devotes significant text to entomology. [See Cutter's Fish Food, pub. 2005. The website Bill referenced has been taken down – Ed.] Also see the following sites: www.troutnut.com/hatches/favorites.php (wonderful photographs, with links to other site pages covering each of the most common aquatic insects; I will use some of the pictures from this site in this article); and lakes.chebucto.org/ZOOBENTH/BENTHOS/benthos.html . There are many others, but those mentioned are written from the viewpoint of the angler yet have plenty of scientific information for those hungry for that sort of thing.

Aquatic insects are species whose life cycle begins with an egg that has been deposited in the water by an adult. The eggs, once deposited by the adult, are lodged in the bottom rubble or silt in streams and lakes. At the appropriate time, larvae emerge from the eggs, and begin their life of foraging on the stream bottom. At maturity, some of these insects enter a pupal stage to complete their maturity; other species "skip" this step. The next step in the cycle is the emergence of the adult, which begins a short life outside the water. The adults mate, return to the water to deposit eggs, and then die, usually on the surface of the water.

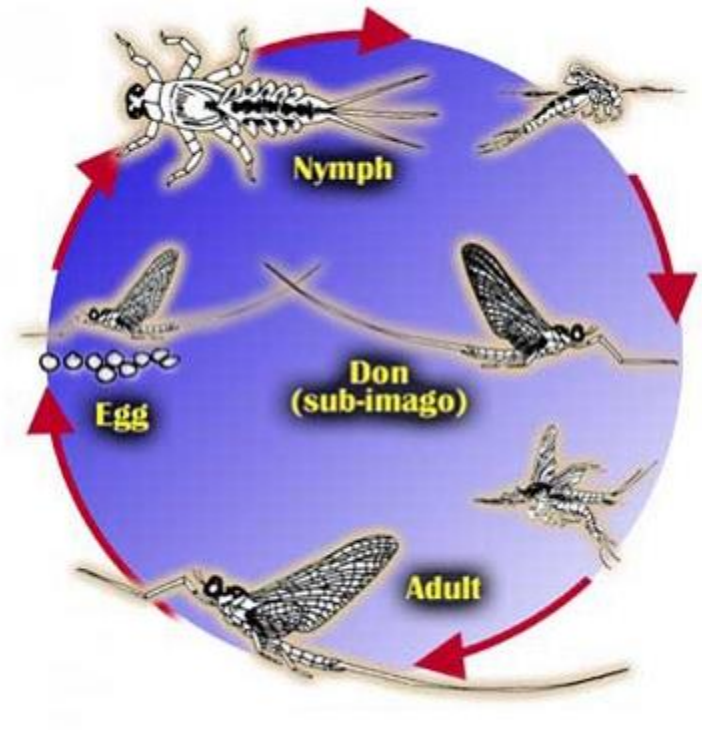
There are four families of aquatic insects that are important to fly fishers: mayflies; caddis flies; stone flies; and "true" flies, sometimes called midges. Within each family, there are many, many species. But for purposes of this article, it is important to recognize in general the four salient bugs. Why does it matter? For the most part, all of the thousands of fly patterns that are featured in magazines and catalogs are designed to imitate one life cycle stage or another of these insects. The concept is that a suggestive or imitative artificial fly that is properly presented to a fish feeding on the corresponding insect will be fooled into grabbing the fly, thereby impaling itself on the hook. This action can occur on the surface of the water, or somewhere in the water column beneath the surface. Let's briefly examine each of these four types of insects. Damselflies, dragonflies, scuds and freshwater shrimp are also important, but are beyond the scope of this article. There is a lot of helpful information for fly fishers on the Internet on each of these insects.

The Mayfly

The mayfly is a graceful, delicate insect with an interesting life cycle that is termed "incomplete" because it skips the pupa stage. The larvae "hatch" from the eggs, and begin a life of roving about the bottom of the stream or lake, foraging for food and growing through various "instars" or stages. The larval stage generally lasts for around a year, but because there are so many species with varying habits, hatches occur virtually year-round, sometimes concurrently and overlapping, and even at varying times of day. The larva (called "nymphs" by fly fishers) have a hard exterior shell called an exoskeleton. When the larva is mature, a gas bubble forms beneath the shell in the thorax area. This gas bubble causes the insect to rise to the surface, where its shell back splits open. The adult insect emerges from the split case and sits on the surface while its wings dry. In fly fisher parlance, this stage is called the "dun," due to the opaque nature of the insect's wings. If a fish doesn't gobble it, the adult flies off to the trees or brush where it molts, losing its initial outer skin. The insect now assumes a gossamer, nearly translucent appearance as it flies toward the stream or lake where, just above the surface, it joins others in a mating dance. Fly fishers call this final mutation the "spinner" stage. Once mating has occurred, the females deposit their eggs by dapping their abdomens on the surface. The eggs descend to the bottom, where they become attached to rocks or debris. The adults die, falling to the surface of the water, where they lie prostrate. The important thing to remember is that opportunistic trout (and other species) feed on these insects at each of the times that they are vulnerable: as larvae on the bottom; during the process of rising to the surface to emerge; during the emergence; during the wing-drying (dun) process; during the egg-laying ritual; and when the expiring spinners fall to the water.

There are four general groups of mayflies for identification purposes: swimmers, crawlers, clingers, and burrowers. Swimmers are slim and cigar shaped; as the name implies they are good swimmers. Most have three tails. Crawlers are broader with stout legs and three tails. Generally the head is narrower than the body. Clingers are flat with a wide head with two tails. They are designed to cling to rocks. Burrowers are generally large, with the largest being over an inch. They have mandibles for digging, and visible gills. For an excellent discussion with good illustrations see Rick Hafele's entomology column in the November-December issue of American Angler.

Here is a simple depiction of the life cycle of the mayfly[1]:



Here are some excellent pictures taken from
http://www.troutnut.com/hatches/favorites.php

This picture shows an adult that has just "moulted" by leaving its exoskeleton behind. Notice the translucence of the wings after moulting-prior to that they will be nearly opaque.

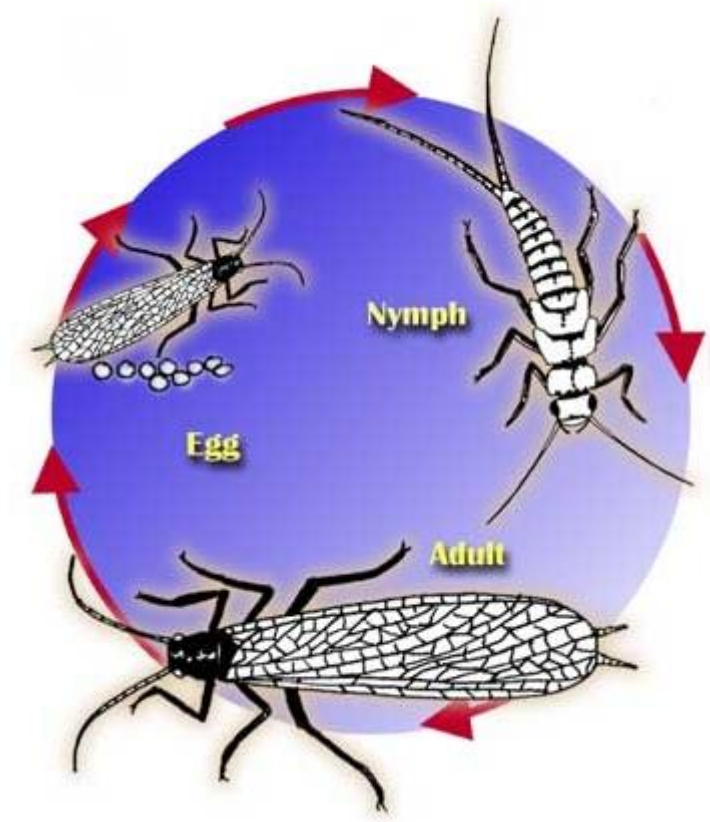
[1] Editor's note: All illustrations of this style throughout the article originated from the website *http://www.kidfish.bc.ca/insects.htm* which is now apparently defunct. Bill was careful to credit this source with each use of these images.

This is a great shot of a mayfly nymph.

This picture shows the emergence process, although the insect was a "stillborn" meaning it did not survive the emergence process for some reason.

Stone Flies
Stone flies also have an incomplete life cycle-i.e., they do not undergo the pupal stage. Their life cycle is similar to that of the mayfly. Hatched from eggs on the bottom, the larvae spend from one to two years maturing. At maturity, they do not rise to the surface as do mayflies. Instead, their emergence begins when they migrate toward shore, and crawl from the water onto streamside vegetation or rocks where their exoskeleton dries out and splits. The adult flies off to trees or brush to dry off. They do not molt, but fly off toward the stream to mate, oviposit, and die. Stone flies are clumsy fliers, often plopping onto the surface noisily, only to become entrapped in the surface film where they are inevitably victimized by hungry predatory fish. Trout feed on them during the larval stage, during migration, during the egg-laying ritual, and of course when they land on the water.

Here is a depiction of the life cycle of the stonefly:
(credit: http://www.kidfish.bc.ca/insects)



Note that, as in the case of the mayfly, the life cycle is "incomplete," meaning that it lacks a pupa stage.

Here are some stonefly pictures, also from
http://www.troutnut.com/hatches/favorites.php

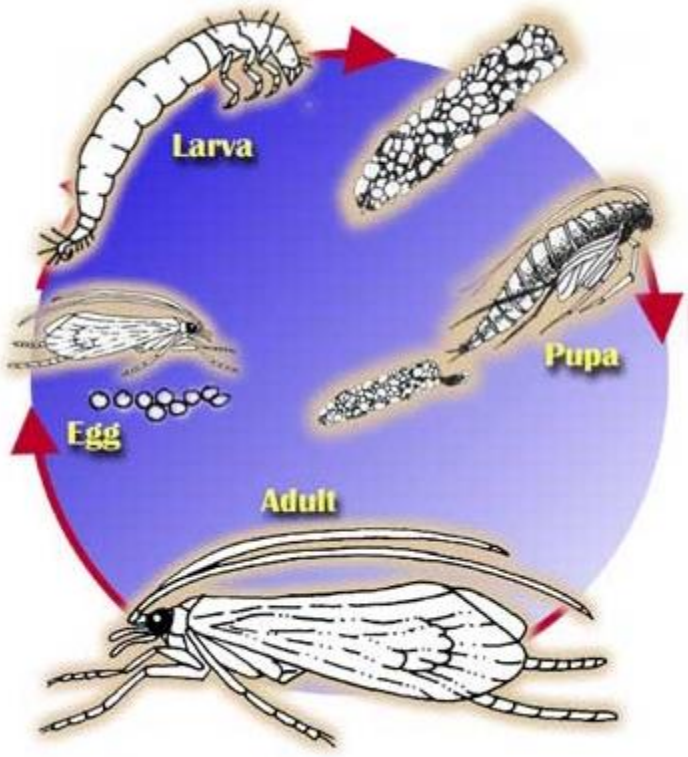
This picture shows stonefly nymphs that have crawled onto a midstream log to hatch. Some have already hatched and their abandoned cases are visible.

Here is an adult stonefly with a reference for estimating length.

Caddis Flies

Caddis flies have a complete life cycle. Their pupa stage is very important to fly fishers. As in the case of mayflies and stone flies, the caddis' life cycle begins with an egg deposited by an adult. When the larva hatches from the egg, it lives on the bottom for up to a year. Some species are free-living; others are confined to a case that may either be portable, or stuck to rocks. Part of the one year period is spent in the pupa stage where the insect undergoes final maturity, similar to a caterpillar. Most caddis species emerge from the pupa case at the bottom, and jet to and through the surface without pausing there. They simply fly out of the water. During a heavy emergence, it can appear as though it is raining. When caddis return to the water, some species will dive to the bottom to deposit their eggs, and then speed to and through the surface again to live awhile longer. Caddis in their adult stage are very quick and agile, and trout have to respond quickly to nab one that is on or near the surface. I will separately discuss the largest of caddis species, the October Caddis, below.

Here again is a depiction of the caddisfly's life cycle:
(credit: http://www.kidfish.bc.ca/insects)



Here the life cycle is "complete" because there is a pupa stage. Two larval types are shown: the cased and the free living forms.

Here are some pictures of caddis taken from http://www.troutnut.com/hatches/favorites.php :

This is a caddis pupa (left). Notice the wing pads and legs. This is a free-living form of caddis larva, often called a "green rock worm."

And here (right) are some cased caddis clinging to the bottom.

This (left) is the adult caddis. Notice the "tent" style wings and the prominent antennae.

The Giant October Caddis - a Very Special Bug

The October Caddis is the genus *Dicosmoecus*, which also bears the common name Giant Orange Sedge. It is a member of the family Limnephilidae, which includes an incredibly large number of case-building caddisfly species with different habits. Caddisflies, like arachnids in the terrestrial world, employ silk for survival. Some species use silk to create a net to filter food from the passing current. Cased larvae, including the October Caddis, use silk build protective homes by binding bits and pieces of rock and vegetation into tough, compact, expandable cases, then use it to seal the case and begin pupation. Anglers who poke around riverbeds surely will have noticed these large rock-and-stick cases.

Although entomologists do not always agree on what materials are used for the case, practical experience in collecting and observing these bugs confirms the commonsense notion that the insect will employ those materials most readily available. Streams lined with conifers will be populated by caddisfly cases built primarily from fir or redwood needles, perhaps mixed with small bits of rock and/or bark. As a result, most October Caddis cases will have a rather shaggy look and a dark-brown coloration. In the late season, before emergence, these cases are large - hook sizes from 2 to 8. In rivers such as the Truckee in places, and the Rubicon in some of its reaches, there are no conifers and very little other vegetation near the banks. In such cases the larvae build their cases of bits of rock and their color reflects that. Thus, many will be grayish brown in color, with bits of shiny mica mixed in with the rocks. Flies tied for this species need to reflect these differences.

The October Caddis can be found in most Western freestone rivers and creeks. I have found specimens in the Truckee, upper Sacramento, McCloud, and Pit Rivers, in portions of Hat Creek, in all forks of the American River and in its tributaries, such as El Dorado Creek, the North Fork of the Middle Fork, and the Rubicon River, in the North and South Forks of the Yuba River, in the upper reaches of the Feather River, in the Mokolumne and Calaveras Rivers, in the upper South San Joaquin River, and in small streams such as Stony Creek.

From the angler's perspective, the October Caddis larva exhibits a number of important behavioral characteristics, including two different forms of "drift," or free travel downstream. The first type of drift is accidental, while the second is an unusual behavioral characteristic that, in its timing, distinguishes the October

Caddis not just from most other cased caddises, but from most other aquatic insects.

During the summer, growing larvae crawl about searching for food. Current sweeps them from rocks and bounces them along until the hapless larvae are eaten by trout or manage to regain rocky footholds. As a larva drifts along, its black head and legs are extended as it gropes for purchase. To the delight of knowing anglers, a portion of the bug's dirty-yellowish abdomen is also extended from its brown case. Properly imitating this tricolored shaggy food item in both appearance and manner of drift is essential to fooling fish.

In addition to having their cases accidentally swept into the feeding lanes of waiting trout, October Caddis larvae also cast themselves adrift deliberately. As Gary LaFontaine puts it in *Caddisflies*, " Amazingly, this is one of those case makers that abandons its case, possibly to build another, and slips into the current. Unlike stonefly nymphs, mayfly nymphs, or free-living caddisfly larvae, which exhibit a higher rate of behavioral drift at night, the drift phenomenon for the uncased larvae happens in the daytime. The peak is connected with water temperature and occurs at approximately 4 P.M." I have indeed observed this happening from middle to late afternoon, as the water temperature climbs. Anglers need to be prepared with imitations and tactics to imitate this behavior, as well.

Pupation begins in September. As they reach their full size, larvae migrate to the underside of rocks and attach themselves there with silk as they seal off the front of their cases. This larval movement also creates feeding opportunities for trout, because the bulky cases are quite vulnerable to the current's force, causing many larvae to bump and tumble their way to oblivion.

When metamorphosis is complete, the orange-bodied, tan-winged adult emerges. Here there is also some divergence of opinion among the bug folks: Some say that the pupa chews out of the case and crawls to the shallows to emerge through the surface film. Others have the pupa rocketing through the surface directly from the river bottom, to fly away as an adult. I have observed the adults hatching both ways. The point is that the emergers are a prime target once trout focus on them. Tactics for this brief stage of the insect's life differ from those aimed at the larval stage and must mimic the action of the pupa rising through the water column. From the angler's perspective, the issue of where they hatch - in the shallows or elsewhere - is relevant only insofar as it relates to where to cast.

In the final, often extremely prolific adult stage of the October Caddis' life cycle, at the peak of the hatch, clouds of adults flutter about the stream, usually in the late afternoon and evening. The females' egg-laying downward dips to the surface are generally ignored by the trout, which confounds anglers. Although theories abound regarding why trout ignore the adults, one plausible explanation is the insect's quirky, erratic, rapid flight makes capture difficult and only marginally productive. In other words, the ready availability of the larvae and pupae may explain the trout's apparent lack of interest in the adults. All of this changes in the late season. The adults' riverine flight becomes sluggish as colder, damp weather advances, and

they begin to land fluttering on the water, only to become enmeshed in the surface tension. Sensing this behavioral change, the trout start taking the struggling orange morsels. Larger trout abandon their deep hidey-holes, often charging to the surface to whack an entrapped victim.

Here are a few pictures to illustrate the stages of this wonderful insect.

This is a beautiful specimen taken from the North Yuba and photographed by my friend Ralph Wood. Note the colors in the case, and the lack of any conifer needles, sticks, or other woody material. The insect was in the pupating process with the front of the case closed off. It was opened up and the nearly mature pupa was taken out of the case. Note the wings along the sides, and the segmented body with dark and light parts. Also note the eyes at the head.

Here are some pupating specimens. Note how they have attached themselves to the bottom of this rock that I had turned over. This picture was taken on the Upper Sacramento in mid-September, 2006. (Bill Carnazzo photo)

Another Upper Sacramento picture (left). Note the differences between the cases-some with sticks, some without. This stage is best imitated by Bill's Stick Caddis, next page: (Bill Carnazzo photo)

Shown here are the black-bead larva in brown and grey. During September, October, and November the black bead is replaced by an orange bead and the yellow collar becomes

orange. This fly has accounted for many, many fish-large fish!

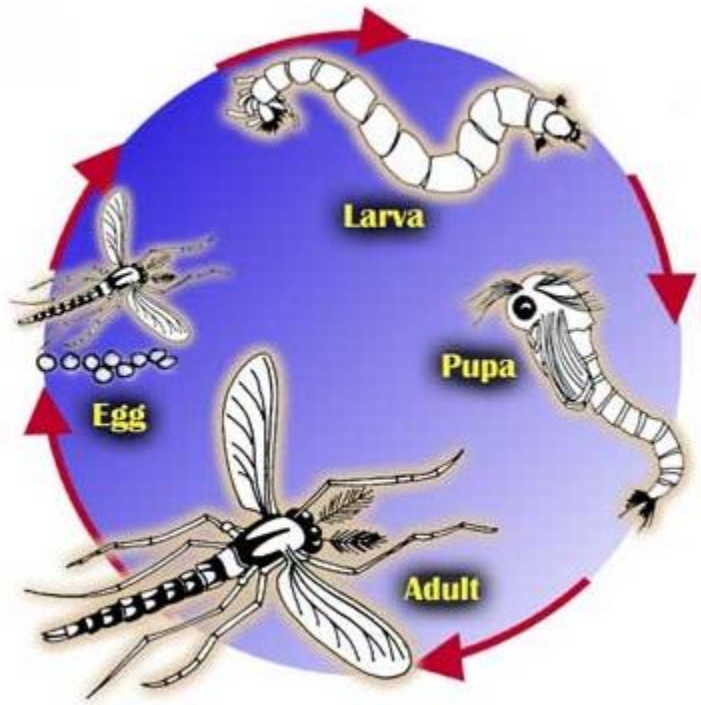
Here (right) is a fly designed to imitate a pupa that has just emerged from the case. Note the orange collar and the two antennae lying across the insect's back. Once the emergence is complete, the antennae will stick straight out to the front. (Bill Carnazzo photo)

Here (left) is the emerger stage, designed to imitate the emergent insect swimming up through the water column on its way to the surface where it will shoot through the film and into the air. Fish smash these flies at or near the end of the drift where the fly begins to move upward. (Bill Carnazzo photo)

This fly (right) is what the adult looks like. It's not a very good image, but the prominent features show up. Notice the antennae, and the way that the wings lay back. Also note the orange color of the body. This stage can be imitated by a large orange Stimulator; however, I prefer something with foam in it, such as the fly shown below.

Bill's foam October caddis adult

Midges or true flies (Chironomids)
Often called gnats, these common insects also have a complete life cycle. They have some quite different characteristics that are both interesting and, to the fly fisherman, quite frustrating at times. There are literally millions of species within this group of insects. Brian Chan's book mentioned above, as well as his many articles, are a good source of information on midges, their life cycle, and how to fish with midge patterns. Here is a depiction of the lifecycle of midges: (credit: http://www.kidfish.bc.ca/insects)



Here are some pictures of midges, taken from
http://www.troutnut.com/hatches/favorites.php :

Midge larvae can vary greatly in size and color. This one is a dirty yellowish color

Here is a midge pupa. Note the gills and other differences from the larva.

The adult midge. Note the resemblance to a mosquito-they are closely related