Geology is Destiny
by Rick Haasle

Aquatic insects are not randomly distributed: most species have definite habitat requirements. Understanding which insects live where will help you to pick the right flies.

It's winter again, and many of us are more likely to tie flies, read fishing books or magazines, or build a rod than go fishing. For those of us with an interest in insects, this is also a good time to contemplate bugs. As Isaac Walton wrote, "...rivers and the inhabitants of the watery element were made for wise men to contemplate, and fools to pass by without consideration...." I don't want to be a fool, so I thought it would be a good time to contemplate some of the ways streams and insects interact.

If there is one thing humans are good at it's dividing things into parts. Making something simpler and easier to understand is the main reason for dividing it into smaller parts. Streams and rivers have not escaped this human habit, and a variety of schemes have been thought up for dividing streams into smaller, simpler parts. Problems occur when the parts seen as something unique or separate from the whole, but that idea leads us into the realm of philosophy, which I'll leave for other writers.

One of the simplest ways to divide a stream into parts is from upstream to downstream. The top of a river system is composed of small headwater streams that start off as intermittent springs or seeps and gradually increase in size to small, permanently flowing streams. Such headwater areas are typically characterized by cool water, large rocky substrates, steep gradients, and fast water. Trout frequently inhabit these small, steep streams, but their number and size are often limited.

Farther downstream, in what might be called the middle reaches, the stream grows as tributaries join it. Gradients are less severe and water velocities generally slower. In these areas, fast riffle sections alternate with slow pools. The substrate varies from coarse gravel and rock in the riffles to sand and silt in the pools. Depending on the altitude and latitude of the river system, the middle reaches may maintain cool water or may begin to warm considerably. Where the water remains cool, trout populations are often excellent.

The lower reaches of a river system are represented by wide, open stream channels with low gradients and slow current speeds. Although riffles may still occur, they are less frequent and shorter in length relative to the pool sections. The substrate is often composed of small gravel and sand, and is less stable than in other areas of the river system. Water temperatures are often warm in these lower reaches, making them unsuitable for trout.

"Warm" is often defined as when the average monthly temperature exceeds 20 degrees centigrade, or about 72 degrees Fahrenheit, at some point during the year. But where these lower sections of streams have been artificially cooled by releases of cold water from dams, very impressive trout populations have developed.

How do aquatic insects respond to these different sections of a river? First, let's consider some very general trends. Some interesting information has been published about the distribution of mayflies, dragonflies, stoneflies, and caddisflies in cool streams, warm streams, and still waters. The accompanying table (compiled from Ecology, by G. B. Wiggins and R. J. Mackay, 1978) shows the number of genera of each group of insects in each type of water. It indicates why mayflies, stoneflies, and caddisflies are important for anglers to imitate when fishing cool trout streams, though, surprisingly, more genera of mayflies are listed as inhabitants of warm streams. It also shows that caddisflies have a good diversity of genera in all water types.

This is good information to keep in mind when you travel. If, for instance, you're visiting a relatively warm trout stream (or the warmer lower reaches of a cold stream), you can expect to find many mayflies, damselflies, and dragonflies. If, however, you're fishing in a pond you've never seen before, it's safe to assume that a stonefly pattern won't be very useful.

Many orders of insects are represented in both moving and still
waters, but very few orders are distributed evenly. Seventy-one percent of mayfly families are restricted to moving water; in other words, none of the species belonging to these families lives in still water. All alderflies and hellgrammites live only in moving water. But only 18 percent of Odonata families are restricted to moving water, which means that you're very likely to find damselflies or dragonflies in still water. Beetles and midges come closest to even distributions: no matter what type of water you fish, chances are good that it contains some aquatic beetles and Diptera.

Two of the most important factors that determine which types of insects live where are current velocity and substrate type. All insects in streams and rivers have evolved to cope with current. Heptageniidae mayflies have flattened bodies that the current can flow over; Baetis mayflies have streamlined bodies that offer little resistance to flowing water. Some insects are adapted to living in very fast water, and even in the full force of the current. Nearly all stoneflies have claws that allow them to hang on to rocks. Caddis of the Rhyacophila genus use anal hooks to hold on to the substrate. Other caddisflies attach their cases to rocks, and some dangle from rocks with strands of material much like silk or spider web.

Many insects that live in fast water have found ways to avoid the current. Small aquatic beetles and many midges live in crevices between rocks. Some dragonflies burrow to avoid fast currents. Other insects have evolved to live in slower currents, and avoid fast water entirely.

Learning which types of insects live where can help you to choose fly patterns when you visit strange water. If you're looking at a fast little stream with a hard, rocky bottom, you probably shouldn't try a dragon- or damselfly nymph or an imitation of a big, burrowing mayfly. A pattern that represents a stonefly nymph, a free-living caddis larva, or a clinging mayfly nymph might be just the ticket.

There is one more interesting and unusual method many aquatic insects use to avoid fast water: crawling down several inches to several feet below the surface of the substrate. This is not considered burrowing behavior, because the insects do not dig their way down. Rather, they simply crawl down through the cracks and crevices between rocks and boulders. This area below the surface of the substrate and between the spaces in the rocks has even been given its own name: the hyporheic zone. Sampling in the hyporheic zone, by taking core samples of the substrate, has found that in streams with a deep bed of gravel or rock up to 80 percent of the mayflies, stoneflies, caddisflies, and Diptera living in the stream are below the substrate's surface.

It is now believed that most species of aquatic insects in streams spend at
least some part of their life cycle or some part of the year below the substrate's surface. The hyporheic zone thus appears to serve as a significant refuge for aquatic insects by offering shelter from extreme conditions such as flood or drought. It also forms a reservoir of insects that can quickly recolonize the surface of the streambed if it is depleted by adverse conditions.

So what do these zones of a river and the adaptations of insects mean to a fly fisher? First, they give you another way of thinking about the streams you fish. Are they cold headwater streams or warm valley streams? While this may seem obvious, knowing that insect types change as you move from cool upper river spots to warmer downstream areas will help you to remember to switch to different patterns. You might enjoy taking a day sometime and driving up near the headwaters of one of your favorite streams. Get out and take a few minutes to collect some insects, noting their types, sizes, and levels of maturity. Then drive downstream until the stream begins to change from a small, closed-in stream to a more open, middle-size river, and collect another sample, noting the same information. Finally, drive down to the lower reaches, where the river becomes slower and warmer, and take one more sample. Try to take all your samples from riffle habitat if it can be found, even though the riffles in different reaches will likely have a different size and type of substrate. This should give you some good insight into how the river and its life changes from top to bottom.

Second, knowing how your rivers change from top to bottom can also help you to keep track of their health. If you start to see more warmwater insects in areas that were once populated with species that need cool water, you have a good indication that stream conditions are declining. Irrigation withdrawals and loss of riparian vegetation are two common causes that increase water temperatures and change the populations of aquatic insects.

Finally, understanding more about how a stream changes along its course creates a better appreciation of our own nature. Like a river, each one of us begins small and with an overabundance of energy, then gradually grows to a peak of productivity, only to slow down and finally wash away.

Sometimes there's just no avoiding philosophy.

Rick Hafle, our entomology columnist, lives in Oregon. He's a full-time scientist and one of those rare chefs whose livelihood and avocation coincide. His work is studying insects, and he goes fly fishing when he's not working. Rick is the co-author, with Scott Roeleker, of An Angler's Guide to Aquatic Insects and Their Imitations, a revised edition of which has just been published by Johnson Books, Boulder, Colorado.

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