

Aquatic Insects and the Fires of 1988

Did the fires affect species diversity?

by **George Roemhild**

In 1890, Dr. William Forbes collected the first aquatic insects that we know were collected in Yellowstone National Park. A lot of people have continued his lead, and we now have a bibliography of more than 130 papers describing and listing the insects of this area. Altogether, we have records of about 800 terrestrial and 400 aquatic insects. This sounds like a lot of bugs, but it is certainly only a small percentage of the actual number of species living and breathing in America's oldest park.

The insects that seem to get the most attention are those that have some ecological, economic, or esthetic importance. For instance, we know that there are 23 species of mosquitoes in the park,

and this is probably very close to the total number. The name of one, *Aedes excrucians*, gives us a clue as to why they have been given priority attention. For the same general reasons, we know that there are 36 species of horse flies in the park.

In a more pleasant vein, however, we also have an extensive, and, I expect, quite complete list of the butterflies of Yellowstone; almost 250 species of these bright and pleasing insects live in the park.

The group of insects that holds my attention are those born of water. Aquatic insects are important to all of us for several reasons. A most important use of this group is as indicators of

water quality. Insect species are partitioned into their respective ecological niches because their needs are best fulfilled in those particular circumstances. If the environment is changed, by pollution, for instance, the species in that niche will change because their needs are no longer satisfied under the changed conditions.

Another reason these insects matter to us is because of their intimate relationship with fishes. They are our sportfishes' favorite food, and fishermen have utilized that relationship to build a whole industry based on presenting a fish with an imitation insect hiding a hook.

A third reason for caring about and

studying aquatic insects is the same reason we study geysers or grizzly bears—we need to understand our co-dwellers on this planet. Canada came to this conclusion about ten years ago, and has since conducted a biological survey to document what is around them. It is my understanding, and my hope, that the United States will undertake a similar project in the near future.

I first collected aquatic insects in Yellowstone National Park in 1979, with lesser efforts in 1980 and 1981. All the major streams were sampled: Yellowstone, Madison, Firehole, Gallatin, Snake, Lewis, Gardner, and Lamar Rivers, and Specimen, Bacon Rind, Grayling, Campanula, Lava, Slough, Pebble, Soda Butte, Elk, Cascade, Aster, Otter, Obsidian, Thumb, Tower, Dunraven, Elk Antler, Weasel, Arnica, and other creeks. Ponds, lakes, and pools were also sampled. All specimens from these collecting efforts are in the Montana State University Collections.

From that time until 1992, I identified bottom samples for the U.S. Fish and Wildlife Service project in the park. These samples were mostly from small backcountry streams, in which these fisheries researchers were interested. As a result of my involvement in this project, in 1991, it was decided to collect and build up a representative collection of insects for the Yellowstone Park Museum Collection.

Essentially all the same spots were sampled in 1991 and 1992 as were sampled in my earlier survey. These samples, about 1,000 of them, are in the Museum Collection at Mammoth Hot Springs. More sampling is being done during 1993.

About the end of 1992, we decided that some useful information might be revealed if a comparison were made between the species of insects found in the earlier survey and those collected more recently, after the extensive and infamous fires of 1988. The major question: had the fire changed everything, or was the aquatic environment relatively unaffected?

My hunch was that there would be little change, since the samples I had taken for Fish and Wildlife Service personnel had shown few obvious changes,

and I had found that those samples taken after the fires contained large amounts of charcoal; this was actually activated charcoal that had been red-hot when it hit the water. I think that it had acted as an effective absorbent of noxious gases and chemicals created by the fire, with the result that the aquatic insects appeared as abundant and diverse as before the fires.

To test my idea, it was decided to compare the species taken in earlier samples to those present in the postfire samples. Three groups were selected for this comparison: stoneflies, mayflies, and caddisflies. These groups were chosen because they are ubiquitous, easily collected, and easily identified, and each group has a large number of species.

Having a large number of species was important to our study because we intended to use a technique that fisheries managers use to estimate the total population of fish in a given body of water even though only a small percentage of the fish are captured for the study.

It works like this. A number of fish are caught, marked (usually a fin is clipped), and released back into the water. A few days later, a second sample of fish is caught from the same water. Some will be marked, and some won't. If the second sample represents a truly random sample of the fish population in

that body of water, then the total number of fish in the body of water can be calculated by means of this formula, where N stands for the total fish population:

$$N = \frac{\text{Number of fish caught and marked X number caught in second sample}}{\text{Number of marked fish in second sample}}$$

The reason we need groups of insects with large numbers of species is because we modified the above formula, substituting a whole species of insect for an individual fish. For the purposes of this exercise, a species is one unit in a population of stoneflies, mayflies, or caddisflies. If a species was taken in both the early and the postfire sampling periods, then it was considered a recapture. This allows a comparison of species and, in addition, an estimate of the total number of species of these groups in the park. As far as I know, a recapture formula has not been used like this before, but the results appear plausible.

What are the changes that the 1988 fires imposed on the aquatic environment? First, as the data in the table suggest, there don't seem to be large changes in the number or diversity of the insect populations over the park as a whole.

Second, we can expect local changes

Table 1. Numbers of species of three common aquatic insect orders collected in Yellowstone National Park before and after the 1988 fires.

	Number of species collected 1979-1991	Number of species collected in 1991-1992	Number of species common to both collection periods	Total of species collected in both periods	Theoretical total number species
Stoneflies (<i>Plecoptera</i>)	47	58	40	65	68
Mayflies (<i>Ephemeroptera</i>)	28	32	21	40	43
Caddisflies (<i>Trichoptera</i>)	74	69	38	104	142
Totals	149	159	99	209	253

Other Aquatic Invertebrates in the Park

Our surveys turned up large numbers of other species besides stoneflies, mayflies, and caddisflies. These come from several orders besides the insects.



Amphipoda. This group includes the scuds and side swimmers (known as shrimp to some fishermen). Two species were identified, mainly in aquatic vegetation.

Gastropoda. We suspect the park has six species of these aquatic snails, and we have identified four of those.



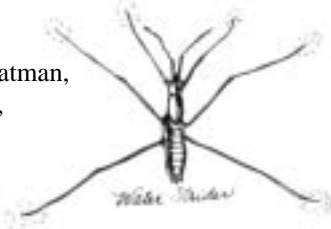
Pelecypoda. There are probably about six species of fingernail clams in the park, and two species of Margaretiferidae mussels.



Insecta. As mentioned in the text, there are about 400 species of aquatic insects known. The table on page 3 lists the totals for the stoneflies, mayflies, and caddisflies, but many others are found in the park.



The Hemiptera, which include water boatman, backswimmers, water striders, shore bugs, creeping bugs, and others, are represented by about 25 species.

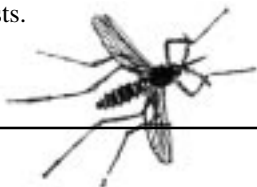


The Odonata, or dragonflies and damselflies, are represented by about 45 species.

The Coleoptera, or beetles, have not been widely collected in aquatic environments, and about 20 species are known in the park.



The Diptera, or true flies, are represented by more species than are all other aquatic insects combined. We have more than 200 named dipterans, mostly mosquitoes, crane flies, horse flies, ephyrids, black flies, and others. But an extremely large group of dipterans, the Chironomidae (or midges) remains uncollected and unidentified. One authority on midges has stated that "natural lakes, ponds, and streams have at least 50 and often more than 100 species." The midges are also numerous as individuals as well as species; pond bottoms may support as many as 50,000 per square meter. Given Yellowstone's diverse aquatic habitats, we can easily visualize 500 or more species as resident in the park. Only a few people in the United States are versed in "Chironomidae-ese" well enough to identify species. Thus we have generously left a big piece of research for future entomologists.



to occur because we have an enormous shift in the types of food resources available to insects in specific locations.

For example, some insects are "grazers" that feed on algae, diatoms, and other green plants. These foods occur in streams or ponds that are open to sunlight that allows the plants to photosynthesize and grow. Another group of insects feed on dead plant matter in the stream, because there is no sunlight reaching the water to grow green plants, a situation typical of shaded streams. Obviously, we have fewer shaded streams now than before the fire. We should, therefore, lose some of the leaf- and log-feeders, and have an increase in the grazer-herbivore group.

Come to think of it, that's about what will happen in the terrestrial environment.

George Roemhild, Professor Emeritus of Entomology at Montana State University, is well known both to entomologists and to fishermen for his long career and many publications relating to aquatic invertebrate population dynamics, community succession in ponds, mountain lake limnology, and other subjects. Among his many publications is the volume Aquatic Insects of Montana.