The forest detective at work

by Ed Berg

I often tell school kids that I am a "forest detective" at the Kenai National Wildlife Refuge. Officially my job is labeled "ecologist," but basically I am paid to figure out what's going on in the woods. Much of the time I study large-scale questions like, "Have we had large spruce bark beetle outbreaks in the past?" or "How is climate warming affecting the Peninsula wetlands?" But I also look at small-scale phenomena like, "What's that red stuff growing on birch trees?" or "Why did the Labrador tea and lowbush cranberry turn brown this spring?"

When most people walk through the woods, they enjoy seeing the plants and the wildlife. Their senses are tuned to the sights and sounds and smells of nature, and they are enjoying the fresh air and just being outside. The forest detective enjoys these things, too, but my mind is constantly puzzling about what I am seeing: what is the history of this forest? When did it last burn? What will this forest look like in 50 or 100 years? Why is this kind of plant growing here? What insect has been eating this leaf? What is the name of this lichen, moss, bug, etc., etc.?

The list is endless, but so is the entertainment of contemplating these questions. The more I find out in the woods, the more interesting the questions that I can ask. For example, I have recently noticed a red coloration on birch bark that looks like old paint. I sampled this material and examined it under a microscope, and found it to be filaments of algae. I took several digital pictures of the filaments, at 400- and 1000-power, which showed the cell contents to be tiny orange balls that looked salmon roe.

Next, I did an Internet search and found a website with pictures of a similar algae. I sent an e-mail with my digital photographs to the website author, professor A. J. Silverside at the University of Paisley in Scotland, who confirmed my identification of the algae as *Trentepohlia*. *Trentepohlia* typically lives inside of lichens, providing sugars from photosynthesis to feed the fungus part of the lichen. The red filaments that I observed are free-living *Trentepohlia*, that presumably escaped from their fungal host in lichens.

Now, here is the question which this exercise has generated: Is *Trentepohlia* increasing? This spring I returned to a site near Wasilla where I first noticed the red coloration a year ago on several birch trees along a path. Having now acquired a "search image" for this coloration, I found it on 20-30% of the birch trees in this forest. I have also begun to notice it on birch trees around the Refuge headquarters. Is this a real increase, or just my growing awareness of this organism? If it is a real increase, what is its significance? As far as I have found out so far, *Trentepohlia* is harmless, but an increase might be related to changes in air quality or climate, for example. For starters, I have marked and photographed some trees near the Refuge headquarters so that I can check next year to see if coloration is expanding. Solving these mysteries often takes time; if not this year, then perhaps next year.

A good detective is always looking for clues. But often the most interesting clues concern what is not present. These absences are more like "holes" in a suspect's story that an acute detective will spot, as opposed to obvious things like the missing murder weapon. The forest detective, for example, may notice the absence of rotten moss-covered logs on the forest floor in an otherwise normal-looking forest. This absence indicates that the forest is of recent origin, typically as a post-fire forest where most of the old forest was burned up. Near tree-line, the absence of dead wood indicates that the forest has moved higher up, with a rising tree-line.

The absence of dead wood in forested muskeg indicates that the muskeg has recently been colonized by new trees, probably in response to a falling water table. In both the tree line and muskeg situations the absence of dead trees (either standing or down) shows that the expansion of the forest is both recent, and that it has not been reversed, as by a cold period in the tree-line case, or a return of a high water table in the drying muskeg. The absence of dead wood thus shows both the change and trend of the change in these two situations. This is a lot of information from something "missing," which a casual observer might not notice.

The massive spruce bark beetle outbreak of the 1990s has been the subject one of my longest pieces of detective work. When I first started working on the beetle outbreak in 1993, we had no historical in-

formation about bark beetle activity prior to 1950 on the Kenai. The earliest record from Alaska was a 1920s outbreak in the Copper River area, associated with logging slash from timber production for the Anaconda mine. Over the last 10 years we have looked at 23 forest stands in the Kenai-Cook Inlet area, and 4 stands in the Yukon for comparison. By precisely measuring thousands of tree-rings we have detected growth pulses in living trees, which occurred after the stands were thinned by previous beetle outbreaks. From the growth pulses we have dated these outbreaks to the 1810-20s, 1870-80s, 1910s, and 1970s on the Kenai, and 1930-40s in the Yukon.

In this case the evidence of past bark beetle "crimes" is indirect, because the old beetle-killed trees have usually long since rotted away. (In the dry climate of the Yukon, however, we found standing beetle-scarred snags that whose tree-rings indicated that they died the period of 1934-42). Given the indirect nature of the evidence, we had to evaluate other possible causes of growth pulses, besides thinning by bark beetles. Fire is one possibility, so we were careful to select stands that showed no evidence of burning within the life of the oldest trees. Similarly, we avoided stands that could have been thinned by logging or firewood cutting, which would have been revealed by cut stumps. The only viable alternative cause of growth pulses, we decided, might be thinning by blowdown from windstorms. In a windstorm the largest trees are preferentially killed, just as they are in a spruce bark beetle attack.

Sleuthing the historical files at the Refuge office we found a remarkable 1904 report by a forester William Langille, which described the standing dead forest between Homer and Anchor Point. The bark had probably fallen off the trees, as 20-30 years had passed since they were killed, but the fact that Langille reported the trees as standing showed that they had not been killed by blowdown.

We next studied regional weather patterns and found that although there are occasional local blowdowns of several hundred acres, the Kenai does not have regional windstorms, such as the hurricanes of the East Coast. Our forests, however, do show regional patterns of thinning, where at least half of the Peninsula is simultaneously affected, most dramatically with the southern Peninsula in the 1870-80s, and the northern Peninsula in the 1970s.

By the process of elimination, we deduced that forest thinning by bark beetles is the only plausible explanation for the periodic growth pulses that we see in the Peninsula tree-rings over the last several centuries. By way of truly direct evidence of bark beetles for these growth pulses, in 1994 Chris Fastie found an old bark beetle-scarred snag near Homer whose tree-rings indicated a death date of 1884, precisely the year that the major growth pulse began on the Homer bench. This is as close to the "smoking gun" as we have ever been able to get in this particular piece of detective work.

My current detective project concerns the drying of the landscape of the Kenai Peninsula. This is a subtle phenomenon, not as obvious as fire or bark beetles, but the changes may be every bit as dramatic over the next hundred years and beyond, as ponds and small lakes dry up, and the muskegs become forested. The evidence for this drying process is all around us, once you have developed a "search image" for the signs. Stay tuned: we'll check out this "crime scene" in a Refuge Notebook next month.

Mark your calendars for August 2, 2003, when Kenai NWR and Alaska Maritime NWR host a Centennial Celebration of the National Wildlife Refuge System. The event is free to the public at the Alaska Fairgrounds in Ninilchik and lasts from 10 a.m. to 8 p.m. Attractions include speakers, movies, displays, and kid's activities sharing Alaska's refuges and wildlife. Live music and delicious food will also be provided.

Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. Previous Refuge Notebook columns can be viewed on the Web at http://kenai.fws.gov.