Blown down trees reveal secrets of the forest—past and future

by Ed Berg

I have spent the last several weeks looking at blown-over trees in logged forests of the central and southern parts of the Peninsula. The loggers left small live white spruce trees, as well as birch trees of all sizes, to provide seeds for a new generation of forest after the great beetle-kill of the 1990s. The downed birch trees were mostly alive prior to their fall, but the bark beetles had nailed many of the spruce trees after their larger brethren had been logged off.

The idea of leaving seed trees is sound in theory, but in practice it hasn't worked too well. First, as I said, the beetles have subsequently killed many of the spruce, even pole-sized trees down to four to five inches in diameter. Second, there is the general problem of "wind-hardening" or lack thereof. Trees that grow up in a crowded stand are protected from the wind by their neighbors. Trees that are open-grown, however, are constantly exposed to the wind and put out wider and stronger roots for mechanical strength against the wind. When a dense stand is logged, the remaining trees are unprotected and often are blown down. It is a shame to see huge birch trees that could provide millions of seeds going down in our strong winter windstorms, but that is a fact of life on the Kenai.

These wind-thrown trees, however, have provided an opportunity (a "windfall," one might say) for studying the forest fire history of the area. The tipped-up throw mounds expose the mineral soil quite nicely, sometimes lifting the top foot of soil from a patch six to eight feet in diameter.

In the exposed soil we can often find fragments of charcoal from forest fires of long ago. This charcoal can be dated using radiocarbon (Carbon-14) dating, such as archeologists commonly use for charcoal and bones from pre-historic sites.

Using throw mounds to find charcoal is much easier than digging holes. I and my colleagues from the Kenai National Wildlife Refuge—principally Candy Cartwright and Pam Russell—have become quite adept at finding charcoal in these throw mounds.

Using a trowel, we can check out a mound in about five minutes to see if it has charcoal. If we find charcoal, we spend another 15 to 20 minutes collecting enough material (i.e., a teaspoon of charcoal) and taking a GPS reading of the mound location. The charcoal is usually in small fragments—a quarter to half inch-sized flakes—and it takes some patient troweling and sifting to find enough flakes to provide a dateable sample.

We have enough funding to send at least 50 of these samples to Beta Analytic, a commercial laboratory in Florida for radiocarbon dating.

Most of the charcoal we have found appears to be quite old: it is located within an inch or two of the top of the mineral soil layer (which is usually wind-blown silt or loess from the last glacial period), and underneath two to four inches of volcanic ash. Radiocarbon will provide age estimates to plus or minus 50 years or so, and I expect that these ages will show that most of these stands have not burned for many hundreds of years.

The area we have been studying is not small: it covers roughly 80 square miles of logged lands east of the Sterling Highway from Clam Gulch (Falls Creek Road) to Happy Valley (Cottonfield Avenue). We sample about every half mile along the logging roads, looking at anywhere from four or five to 40 or 50 throw mounds at each stopping point, depending on how many stumps are available within a few minutes walking distance of the road.

In a pilot study last year along East Road, southeast of Ninilchik, we found some younger charcoal, on burned wood. This material was located at the base of the organic layer, above the mineral soil and volcanic ash layers. We dated four samples and got dates around 1640, indicating that this stand has not burned for more than 350 years.

This year we have found more deeply buried charcoal (as described above) in the same area, which should provide dates for a much older fire or fires.

Some interesting observations are emerging from this study. First, let me note that, as I have discussed in several past columns, our tree-ring studies have shown

that forests from the Kenai River through Homer to the south side of Kachemak Bay were heavily hit by the bark beetles in the 1870s and 1880s.

Nine of the 11 stands that we have examined in detail in this area show a strong pulse of growth (i.e., wider rings) in the surviving trees after the forests were thinned by the beetles at that time.

Furthermore, we have never found any evidence that these beetle-killed stands burned after the outbreak, even though this widespread regional outbreak was locally as severe as the present outbreak, especially on the Homer bench. The fact that even the youngest charcoal we are finding in the logged areas is 350 years old again confirms the fact that these areas did not burn after the beetle-kill of the 1870s and 1880s.

The second observation bears on the future of the logged areas of the Kenai. We have looked at hundreds of throw-mounds, and in most mounds we can see the remains of old wood under the roots.

These rotten fragments are remnants of old "nurse" logs and stumps on which the present trees germinated and took root. These nurse logs and nurse stumps are usually not burned, indicating that the previous generation of trees came and went without burning. The only burned wood that we have found is from the 1640s fire. In this case, the oldest members of the present generation of trees germinated on burned wood, but over the rest of the study area we don't see this; the present trees germinated on unburned wood.

Ideally, a forest fire consumes much of the organic layer of the forest floor and exposes mineral soil. Spruce, birch and other hardwoods love to germinate on mineral soil, and a good severe mineral-soil exposing fire is the fastest way to get the forest to grow back. Severe burns also provide the best hardwood browse for the moose, in the form of willow, birch and aspen.

In the central and southern Peninsula, however, we rarely get good mineral soil-exposing fires because of the heavy grass cover. Trees do not establish easily in heavy grass. Even if a seed germinates, it has to push its roots through many inches of heavy sod.

Furthermore, the heavy sod insulates the soil and reduces the soil temperature. In short, this means that to survive in a thick grass situation, tree seeds must germinate and establish on nurse logs and stumps. Mother trees advising their seed babies about grass should best say, "Don't even go there!"

The problem with logging in forests with grass (i.e., our native bluejoint grass *Calamagrostis canadensis*) is that removing the logs removes most of the nurse material for new seedlings.

Heavy equipment sometimes scarifies the soil during logging, and we often see seedlings established in Cat tracks and wheel ruts, as well as along roadside edges.

Generally, however, natural regeneration of spruce and hardwoods is very poor in the logged areas that we have visited; there are simply very few places where seeds can effectively germinate and establish; the grass is too thick and most of the potential nurse wood has been removed.

We have been pleased to see good survival of nursery seedlings—both spruce and lodgepole pine—in the areas that have been artificially planted. These seedlings were raised in a nursery for several years and then replanted with a mechanical tree-planter that opens a furrow in the soil. In my opinion, tree planting—mechanically or by hand—is probably the only way to effectively reestablish the forest in the logged areas.

Fire would be best, but it is too expensive and probably too dangerous to try to burn the many thousands of logged acres with prescribed burning, especially with fire severe enough to expose mineral soil.

The unlogged areas will slowly regenerate new forest as they always have in the past, but the beetle-killed trees must first fall down and then become rotten, before they can become seedbeds for new trees. These processes can take can take 20 to 40 years, just to prepare the seedbed, let alone to regrow a new tree.

In our 250-year tree-ring record we can see that past beetle outbreaks were less severe than the 1990s outbreak, and left many more surviving trees. These trees were usually stunted poles that began to grow more rapidly when the canopy was opened up by the death of larger overstory trees. Foresters call these poles "advanced regeneration" and they may recommend that a stand be mechanically thinned to release growth of these poles.

With much of the beetle-killed forest in the southern Peninsula, however, we don't see many pole-sized trees, so this forest will not be replaced by release of advanced regeneration, as it was in the past. Thus, the natural forest will be replaced more slowly than it was in the past, because it will have to regrow from scratch with new seedlings on nurse wood.

The take-home message for landowners on the Kenai who have logged their forests is, I think, pretty straightforward: if you want trees to regrow on your

cutover lands, you had better figure on replanting the trees.

Nature may takes its course, but there is no reason to think that trees will ever naturally regenerate on heavy grass sod, even on a scale of centuries. Without nurse logs or fire, there is simply no place in Calamagrostis turf for a seedling to get a foothold.

Tree planting is not a minor undertaking, but Congress has recently appropriated $500,000 to help Alaska landowners replant trees on parcels of at least seven acres. The Forestry Incentive program can cover up to 65% of the costs of site preparation, seedlings, and plantings.

For information call Al Peterson at the Alaska Division of Forestry in Soldotna at 260-4221.

Additional information on bark beetles can be found on his *Cycles of Nature* Web site at http://chinook.kpc.alaska.edu/~ifeeb/cycles/cycles_index.html.

Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. Peninsula forest history also will be discussed in his one-credit Geology of Kachemak Bay course at Kenai Peninsula College starting Sept. 10. For more information about the course, contact KPC at 262-0300. For more information about the Refuge, visit the headquarters in Soldotna, call (907) 262-7021. Previous Refuge Notebook columns can be viewed on the Web at http://kenai.fws.gov.