Spruce Bark Beetles in the past

by Ed Berg

When I first began my job as the ecologist at the Refuge in 1993, the spruce bark beetle outbreak was just shifting into high gear. I could see the beetles in the trees around my house out East End Road from Homer, and the Forest Service's 1993 aerial surveys reported red-needle (fresh beetle-kill) forest at 367,000 acres for the Kenai Peninsula. It was getting serious.

As an ecologist, my first question was: has this happened before? Is this a recurring disturbance like fire and windthrow, or is it a singular attack like the chestnut blight of the 1920-30's or the Dutch elm disease of 1950-70's? These two European imports changed the face forests and city streets throughout the East Coast and the Midwest.

So, was this now happening in Alaska? An invasion from the Outside, attacking our grand old spruce trees?

I reviewed local historical records and found little about past bark beetle activity. The earliest report on the Kenai was in 1950, around the edges of the 1947 burn near Skilak Lake. The Forest Service annual surveys picked up a lot of beetle-kill in the early 1970's from Pt. Possession to Sterling. (These surveys always showed local pockets of recent beetle-kill somewhere on the Peninsula in every survey. This is typical background low-level infestation, and it is normal for a variety of forest insect pests and diseases. Like bacteria and colds, these ailments are always present, but at low levels.)

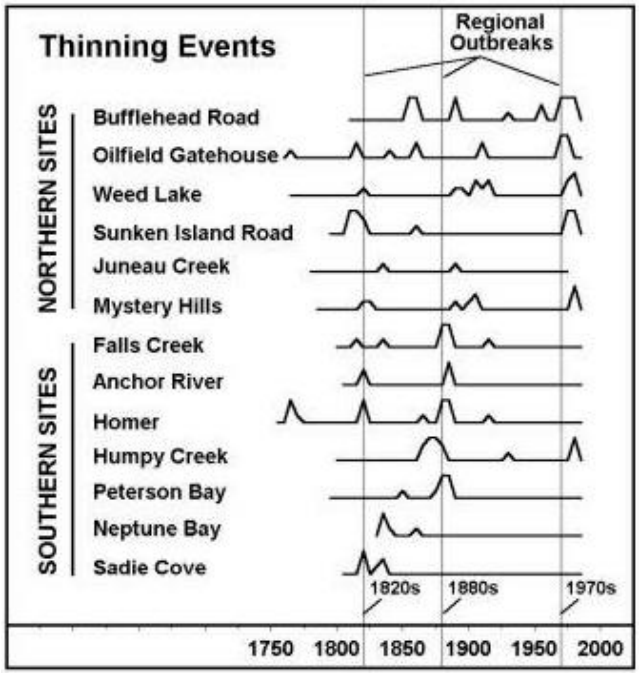
But what about major outbreaks? Had these occurred before? There simply was no historical record, but in a young state like Alaska, that doesn't mean much. In Norway they have been actively fighting the engraver beetle Ips typographicus for three hundred years with trap trees and thinning treatments. In a country like Norway you can go to the library to do ecological research, but here we have to go to the woods and start from scratch.

I found studies from Colorado where tree-rings showed evidence of massive bark beetle outbreaks in the 1940's and 1850's. The basic idea was that beetles kill the larger trees, and then the smaller (suppressed) trees are "released" from competition. They grow faster and put on wider rings.

Detecting growth releases in tree-rings requires very precise microscopic measurements of these tree-rings. I had done a bit of this work, called "dendrochronology," as a graduate student and knew more-or-less what kind of equipment was needed. I was able to hire a recent Ph.D. Chris Fastie who was well-trained in dendrochronology and was familiar with Alaskan conditions. To measure the tree-rings we bought a sliding bench micrometer and a good binocular microscope.

The sliding bench micrometer is adapted from an industrial milling machine and has a very sensitive electronic pickup, which allows easy measurement of tree ring-widths to an accuracy of 0.01mm. (The period at the end of this sentence measures 0.48mm, for example.) The measurements are recorded in a computer at the push of a button. Once set up, I can easily

measure 200 rings (years) in 20-30 minutes, and the data are stored in a computer file, ready for statistical analysis.



The accompanying map and graph summarize our bark beetle history studies to date. You can see the big outbreak of the 1970's along the Swanson River area (northern) sites, where a lot of dead beetle-kill trees are still standing (with death dates of 1970-71). The survivors released well in this area, although some of them have succumbed in the 1990's outbreak.

In the southern sites, the big release was in the 1880's, although on the south side of Kachemak Bay it appeared as early as the 1820's. Many (but not all) sites up and down the Peninsula showed at least a low-level release in the 1820's.

The release at Humpy Creek in the 1980's was due to a blowdown. In 1981 Jim Peterson of AK Division of Forestry reported a 300 acre blowdown in this area (at Mallard Bay, to be precise). Ed Holsten from the Forest Service watched minor red-needle activity percolating in this area during mid-1980's. Red needles began to spread rapidly in 1988 as summers warmed, and Mallard Bay became the "epicenter" for the outbreak on the south side of Kachemak Bay.

Some of the isolated releases on the graph may be due to blowdowns, but like Humpy Creek-Mallard Bay, they may well have been followed by beetles, because bark beetles love downed trees. (Beetle production from a downed tree is many times greater than from a standing tree. This is why a freshly downed tree can be used as a trap tree - it is the favorite bark beetle habitat and it pulls them in like a magnet.)

The regional thinning on the graph (1820's, 1880's, 1970's) represent thinning (not blowdowns) of the forests covering thousands of acres. Nevertheless, most of the release events on the graph are small in comparison to the present bark beetle outbreak, with only 5-10% of the trees releasing in a stand in a given five-year period. This is low-level outbreaking, even on a regional scale.

Only one area - the north (Homer) side of Kachemak Bay in the 1880's - shows evidence of the kind of profound thinning that is occurring today in the southern Kenai forests. In 1994 we studied a recent clear-cut on the west side of Homer that showed a very exaggerated 1884 growth release in virtually every tree. We cut more than 500 slabs from a 4.5 acre tract, assisted by Stan Eller's biology classes from Homer High School. This was a very mature forest in the 1880's when the beetles hit it hard, and the survivors were highly suppressed understory poles averaging 3.5" in diameter. These were the same kind of skinny 2x4-sized poles that are still green in the otherwise dead forests in the same area today.

We had one particular bit of serendipitous good luck with the Homer site. Chris found a 1904 forestry survey of the Kenai Peninsula by William A. Langille, who in Alaska was the right-hand man of Gifford Pinchot under Teddy Roosevelt. Pinchot was in the process of creating what became (in 1905) the US Forest Service, and Langille became the supervisor of the new Alexander Archipelago Forest Reserve (today's Tongass NF) from 1905 to 1911.

In his 1904 report Langille puzzled about the standing dead forests between Homer and Anchor Point, with 40-100% mortality of the larger trees, and the thriving understory of smaller trees which were not "thrifty" (i.e., they had too many branches for clear saw lumber, indicating an open canopy with little competition). This 1904 understory is precisely what we sampled ninety years later as large 2' diameter trees, each with a pole-sized core of tight rings in the center. The fact that Langille reported the trees as "standing" indicates that this was not a blowdown, and he was unsure why they had died.

Langille visited this forest some 20 years after the large trees had died. The bark had probably fallen off, and Langille (who was not a college-trained forester) most likely would not have known how to recognize

beetle scars on old trees.

To a researcher with a trained eye, however, the beetle scars were probably fairly evident. Chris Fastie, for example, found an old leaner snag tree a few miles north of the Homer site with the maternal beetle gallery scars still quite visible. (These scars are about 3" long, parallel to the trunk.) Cross-dating the tree-rings yielded a death date of 1884 for this tree, which is the exact same year that most of our Homer trees began their dramatic release. We often say that this 1884 beetle-killed tree is as close to the "smoking gun" of direct evidence as we have gotten in our investigations of bark beetle history.

The upshot of these studies is that we have indeed had regional bark beetle outbreaks in the past, but not on the massive scale of the 1990's outbreak. In the past the forest recovered, either through released growth of suppressed survivors ("advanced regeneration") or through seedlings, often on nurse logs and stumps. The new factor today is the warmer climate. In my next article I will show how recent warmer summers have turned up the volume on beetle activity, probably through drought-stressing the trees.

Ed Berg has been an ecologist at the Kenai National Wildlife Refuge since 1993.