# How will beetle-killed forest look in 40 years

*by Ed Berg*

My crew and I have just returned from a trip of 40 years into the future. Our time machine was a Cessna 185 which dropped us off at Barabara Lake on the far northern end of the Kenai Peninsula, five miles south of Turnagain Arm. I and refuge biotechs Candy Godin, Doug Fisher, and Pam Russell came to study a forest which was heavily hit by spruce bark beetles in 1958-59. We wanted to see how well this forest has regrown after 40 years. Will the present beetle-killed stands of the Kenai Peninsula look like this forest 40 years from now?

The 1950 aerial photos show this area as a closed canopy mixed white spruce and birch forest—classic Kenai Peninsula old growth forest. The post-beetle 1975 aerial photos show much less live spruce. Viewing the 1975 photos stereoscopically (in three-dimensions) we could see dead spruce trees sticking up everywhere like little toothpicks. In the 1996 photos the toothpicks were all gone, and more birch was present. When we hiked through this area we saw that the photos had not lied. In three days we couldn't find a single standing dead spruce tree from the 1958-59 beetle-kill; every tree of that vintage was down on the ground. Many down trunks were moss-covered and quite rotten; others had fallen more recently and still had 20-30% of the bark on the trunk, and the old beetle scars were quite visible. This forest definitely answers the often-asked question: how many years will it take for all the beetle-killed trees to fall down? Answer: 40 years.

We took more than 100 increment core samples from the largest spruce trees, and counted stems of all woody plants along a 300 x 4 meter transect. The wide tree-rings in the increment cores showed that the trees had grown rapidly since the 1960's. These trees were the "little guys" that survived the beetle attack and were released from competition by the death of their larger neighbors.

We could also see earlier periods of wider rings in many of the trees, suggesting beetle thinnings in the 19$^{th}$ century. This pattern of periodic thinning and release is typical of the 18 stands that we have previously examined in detail around the Kenai Peninsula and Cook Inlet. We often see releases every 75 to 100 years in the same stand.

Viewed from the air this forest has an open texture, because the big trees are fairly widely spaced. This openness gives the forest a park-like appearance, if one can ignore the dense devil's club understory. You don't walk or run through this park, because you are constantly climbing over rotten logs hidden in the grass, while fending off the devil's club with leather-gloved hands. Nevertheless with all the live trees the forest has a lush moist feel to it, and we thoroughly enjoyed working in it. I have never seen so many red current bushes, and had to take frequent berry-picking pauses as part of the vegetation sampling protocol.

When the devil's club berries are ripe in the fall this forest should be Valhalla for black bears. We didn't see any bears, although one visited our camp while we were gone. It clawed my tent rainfly, and bit through an aluminum lid on a pot, but didn't go after our plastic food barrel or get into our tents.

Our 300 meter transect showed good amounts of winter browse for moose and hares (especially birch, red current and highbush cranberry), but the shrubs were lightly browsed compared to shrubs in the central Peninsula. The area could probably support many more moose, but predators such as bears and wolves may be keeping the moose population in check.

I am pleased to report that this forest is reproducing itself quite nicely. We found young white spruce of all sizes flourishing in the understory, often growing on rotten stumps and logs ("nurse logs"), which we describe as "germinating up in the air." This is the typical mode of seedling recruitment in an old growth forest, and it contrasts with recruitment after a fire where the seeds germinate on exposed mineral soil. We could see that the parent trees had also been recruited up in the air. Virtually every large spruce had a forked base, not uncommonly with a hole between the root knees. (If you don't mind sticking your hand in these holes, you can often pull out some old rotten wood from the nurse log, even after several hundred years have passed since the tree germinated.)

The key to the success of this forest after the 1958-59 beetle outbreak was the survival of a cohort of smaller trees (which were as much as 150-200 years

old). These trees grew faster and account for most of the present timber volume in the stand. More importantly, they are the seed parents for the crop of new seedlings and saplings which will create the next generation of trees.

Many of the present beetle-killed stands on the Kenai Peninsula look the way this stand looked 40 years ago; they have a good crop of smaller surviving trees which will regenerate the future forest. There are stands, however, which have very few surviving trees (big or little), and are pretty much wall-to-wall dead mature spruce with very little hardwood. Ideally, these stands should be burned, or harvested and replanted. With no seed parents, these dead stands will be taken over by dense bluejoint grass (*Calamagrostis*). This grass forms a thick sod and lowers the soil temperature, which makes it difficult for seeds to germinate and take root.

On a Peninsula-wide scale we have studied how forests have regrown after the beetle outbreaks of the 1810's-1820's, 1870's, 1910's, and 1970's. The forests have always grown back, some faster than others, and generally not on the scale of one human's memory. With our present warmer climate we can expect more chronic low-level beetle infestation, and it will occur in smaller trees. With the spruce not living as long, we should see a greater proportion of hardwoods like birch, aspen, and alder in the forests, because these species are not bothered by the beetles. More hardwoods should reduce fire risk, and will certainly be to the liking of moose and hares, and everything that eats moose and hares. For many of us the present beetle outbreak has been a trauma, but it is all part of the natural process, and life will go on. The future of our forests looks bright indeed, if we step back and take the longer view.

*Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. For more information about the Refuge, visit the headquarters on Ski Hill Road in Soldotna, call 262-7021 or see the website at http://www.fws.gov/refuge/kenai/.*