Mountain hemlocks—ghosts of the past or harbingers of the future?

by Ed Berg

Mountain hemlock is normally a dweller of the high mountain slopes, perched up above the highest white spruce. As you drive through the mountains to Anchorage, you can see the dark green hemlock band at the top of forested slopes, and at Turnagain Pass you come right up into this zone. The hemlock trees, often bent and gnarly at treeline, have deeply grooved bark that is quite distinctive, once you have an eye for it, even at 65 mph.

Mountain hemlocks are the oldest dateable trees (with countable rings) on the Kenai Peninsula. We have cored live hemlocks that were born in the 1500s at treeline above Upper Fuller Lake, for example. There are cottonwoods on the Kenai that are probably older, but the old ones are always rotten inside and you can't count the rings. George Pollard showed me a grove of giant cottonwoods on the northeast corner of Tustumena Lake; the largest one was six feet in diameter, but it was hollow and I crawled inside and could stand up. Hemlocks however are tough, and the bark beetles don't touch them. Mountain hemlock wood is strong, and its close relative western hemlock is an important lumber and pulp tree in the Pacific Northwest.

Here is the puzzle about mountain hemlock. Although mountain hemlock has evolved to live in one of the most extreme habitats on the Peninsula (alpine treeline), it also grows quite well out on the western Kenai lowland, along with white/Lutz spruce, birch, aspen, and cottonwood. We find thriving patches of mountain hemlock scattered around the western Peninsula in well-drained sites, a long way from the mountains. For example, on the north side of the Swanson River oilfield there is a nice stand of hemlock, with trees dating to the 1600s. (I'm told that the geologists who drilled the Discovery Well at this site in 1957 punched into an oil-producing conglomerate at 10,000 feet, which they named the Hemlock Conglomerate in recognition of the unusual forest around the well.)

There are several more stands of hemlock north of the oilfield, around Scaup Lake, with trees dating to the 1500s. These stands are fairly visible from the air and on aerial photos as continuous dark green patches. Ted Bailey recently told me about a nice patch of hemlocks a mile down the Funny River Horse Trail, and there are some hemlocks along Echo Lake Road.

Given that mountain hemlocks can grow well on the western Kenai, far from their alpine treeline home, we can ask why aren't there more of them out on the lowland? Indeed, if hemlocks are the oldest conifers and they have not been thinned like spruce by the repeated bark beetle attacks, why isn't mountain hemlock the dominant forest type, at least on well-drained sites? Two possible hypotheses come to mind in such situations. The first hypothesis is that our present hemlocks are "ghosts of hemlocks past," i.e., relict survivors of once widespread forests during the cooler times of the Little Ice Age (1300s-1850s). In this case we would say that the hemlocks are slowly being out-competed by white/Lutz spruce which are better suited to warmer sites (and a warmer climate).

The second hypothesis is that the scattered hemlock "islands" on the western Kenai are simply products of random long-distance dispersal of seeds, probably by some of the strong northeast winds blowing down out of the mountains in the fall when the cones open up and release the seeds. Once a hemlock seed germinates and establishes, it can grow up and begin producing seeds in about 20 years. On this hypothesis, the trees in a particular patch should be closely related, being all descendents of the original wind-blown "colonist." The stand should show a high degree of inbreeding, similar to the inbred descendents of shipwreck survivors on a desert island.

The first hypothesis—hemlocks as relict survivors of a once-widespread forest—has different genetic implications. In all conifers the male contribution to mating—the pollen—is wind-borne; the pollen parent (i.e., the father) of a given seed may be located hundreds of yards or even miles from the cone-bearing parent (the mother). This means that there is little inbreeding in any particular group of trees. Even if the forest has been reduced to isolated patches, say by logging or climate change, the genetic composition of the

surviving trees doesn't change with aging, anymore than it does in humans.

It is not difficult in principle to assay the genetic composition of trees; this is done routinely in genetics labs, using either proteins (allozymes) or DNA. I did a study like this on scrub oak trees in South Carolina for my PhD thesis, and there are now some high school biology labs in Alaska that could carry out the basics of such a study.

On the Kenai Refuge we have tried a more direct approach to testing these two hypotheses, looking at pollen in lake sediment cores. In 1997 we assisted Scott Anderson from Northern Arizona University in pulling a 9 meter (30 foot) core of sediments from a lake we call Paradox Lake between Camp Island Lake and the Swanson River Road. Scott has analyzed the pollen (and charcoal, for fire history) in this core and has a detailed record of the revegetation of the Kenai lowland following the retreat of the last glaciation (13,100 years ago, at this location). In this core Scott found that alder arrived 11,000 years ago, and that both black and white spruce arrived 8400 years ago. The key point, however, is that he never saw any hemlock pollen at all in the core. We would have felt better about this study if he had picked up at least a few hemlock pollen grains in the core, just to show that the pollen preserved well and could be distinguished from the many other species of pollen in the sediment.

Last summer we took another shot at this question. Scott Anderson returned with colleagues Darrell Kaufman, Al Werner and their students to take cores in several lakes to look at climate change effects recorded in the sediments since deglaciation. Cores were taken in Tustumena Lake, as well as in a small pond in the Swanson River oilfield that is surrounded by hemlocks. They called this pond "Discovery Pond," because it is near the 1957 Discovery Well and because it offers promise of more discoveries. The living hemlocks in this area are well in excess of 400 years old, by tree-ring count, so hemlock pollen should be abundant in at least the upper 400 years of sediment. A radiocarbon date on the lowest hemlock pollen in the core should tell us when hemlock arrived at this site.

We know from pollen studies by Tom Ager of the US Geological Survey that mountain hemlock arrived on the Kenai at the Tern Lake junction at least 2500 years ago, and in Girdwood by 3000 years ago. In a core from Hidden Lake, Tom observed traces of hemlock pollen appearing 6000 years ago, but he suspects that this pollen was blown in from Prince William Sound, and that hemlock forest didn't arrive until much later. Tom did not find any hemlock pollen in peat and lake sediment cores at K-Beach Road, Clam Gulch, and Homer. He did find traces of mountain hemlock pollen at the head of Kachemak Bay at Circle Lake (mile 18, East End Road), which began appearing about 1000 years ago. Today there are a few western hemlocks in the China Poot–Peterson Bay areas of Kachemak Bay, and occasional mountain hemlocks at higher elevations in the mountains.

All of these pollen observations (or lack thereof) considered together are shifting the weight of evidence toward the second hypothesis—that the scattered hemlock patches on the western Kenai are simply products of random chance events of long-distance seed dispersal. When the wind gods roll the dice up in the mountains, who knows where the dice will fall? As to why mountain hemlocks are not the dominant forest type on the western Kenai, my best guess is that the trees simply haven't gotten here yet; they are still in the process of dispersing.

In a future column I will explore the possibility of planting mountain hemlock on the western Kenai as an alternative to planting bug-prone species like white spruce, lodgepole pine, and Siberian larch. Mountain hemlock has a proven hardiness and versatility that we should not ignore. Perhaps we should speed up the rolling of the dice.

Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. Further information on mountain hemlock (and most other tree species) can be found on the Fire Effects Information System http://www.fs.fed.us/database/feis/, sponsored by the US Forest Service. 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.