Climate warming brings alders and spruce bark beetles to mountains across Cook Inlet

by Ed Berg

Kenai Refuge employees examine recent spruce bark beetle damage to a tree along the lower Tlikakila River near Lake Clark. USFWS/Amy Miller.

I have just returned from two weeks of fieldwork in big country across Cook Inlet. This is like a visit to the Kenai fifty years ago. Virtually all travel is by small aircraft and boat. The local bush pilots are among the best in the world, but bad weather and steep topography have left a history of crash sites that sometimes aren't located until 10 or 20 years after the planes went down.

The rugged mountains near the coast are a textbook example of recent glacial geology and climate change. The glaciers are melting back as the climate warms, leaving fresh unvegetated rocky moraines in their wake. Away from the coast, however, the mountains are more rounded and covered with long talus slopes that suggest a much older topography that escaped the last glacial cycle, perhaps owing to their location in the rainshadow of the coastal mountains.

The warmer summers have brought an aggressive alder invasion up the mountain slopes in recent decades. Photos from 1912 show treeless valleys north of Lake Clark that are now thickly blanketed with alders. National Park Service pilot Lee Fink has observed this "alder rise" during his 15-20 years of flying in these mountains. A new tree-ring based reconstruction of summer temperatures since 1769 by Will Driscoll of Wooster College shows a general warming of the growing season since the 1940s and an accelerating warming of 5°F since the 1970s, which is probably responsible for the new alder growth.

Another barometer of climate change in this area is the recent spruce bark beetle outbreak, which has heavily hammered the coastal forests, as well as some interior sites including the upper Tlikakila River, southwest of Lake Clark Pass. Coastal forests around Tyonek experienced a substantial beetle outbreak in the 1970s, and the late 1990s showed heavy beetle kill down the west side of Cook Inlet from Anchorage to Tuxedni Bay.

Dendrochronologist Rosemary Sheriff, University of Hawaii takes an increment core sample from a tree to look for evidence of past spruce bark beetle outbreaks. USFWS/Amy Miller.

When massive insect outbreaks occur, land managers often want to know if such outbreaks have occurred in the past and what they can expect in the future. There is no cure for spruce bark beetle outbreaks, but knowledge of past outbreaks and forest recovery can provide a framework for management decisions concerning timber harvest, fire suppression and wildlife habitat.

On the Kenai and in the Yukon we have successfully used tree-ring analysis to study bark beetle outbreak patterns over the last 250 years. At the invitation of the National Park Service (NPS), my assistant Matt Bowser and I joined Amy Miller, a NPS ecologist, and Rosemary Sherriff, a dendrochronologist from the University of Hawaii-Hilo in a study of bark beetle disturbance history in Lake Clark National Park and Preserve.

To study past bark beetle outbreaks, we look at tree-rings for growth pulses caused by thinning of the forest by beetle kill. This method depends on the fact that spruce bark beetles kill the larger trees and spare the smaller pole-sized trees. When the smaller trees are released from competition, they grow faster for 60 to 80 years until the canopy re-closes and competition again slows their growth.

To assess growth releases quantitatively in a forest stand, we take samples from about 100 trees, using a threaded steel tube that we screw into the center of a tree. The resulting pencil-sized core sample is glued on a wooden block and polished with a belt sander. We then measure the width of each tree-ring quite precisely (to 0.01 millimeter) with an electronic micrometer connected to a computer. These measurements generate thousands of numbers that we analyze statistically to see if there are consistent patterns of growth releases, that indicate regional thinning of the forests by bark beetles.

In this study we sampled seven forest stands in Lake Clark National Park and Preserve, and two stands at Pedro Bay, on Iliamna Lake. Sites in the Park included Two Lakes, Telaquana Lake, Lachbuna Lake, the lower Tlikakila River and Currant Creek, both near the shore of Lake Clark, and Chinitna Bay on the coast of Cook Inlet. In 2000 I had sampled a stand at Polly Creek, approximately 35 miles north of Chinitna Bay on the coast, which will be included in the present study.

In contrast to conditions on the Kenai, the interior stands (Two Lakes, Telaquana, Lachbuna, and sites on Lake Clark) showed little or no current spruce bark beetle presence, but many live trees exhibited infestation by some kind of engraver beetle (Ips sp.). Engraver beetles are common on the Kenai and are less potent cousins of the spruce bark beetle (Dendroctonus). They are often revealed by little piles of sawdust and pitch on top of a freshly downed spruce trunk. Ips typically live in the upper, sunnier part of the tree, and usually doesn't kill the tree. In the stands we observed, however, Ips were present all the way down to the ground and had apparently killed a small percentage of the trees. More study is needed to see if this is a more aggressive species of Ips than the Ips peturbatus we have on the Kenai.

Generally, in the stands we visited the trees have grown very slowly in recent decades (as shown by narrow, closely spaced rings), which indicates that they are stressed, and hence susceptible to disease and insect attack. The slow tree growth is probably due to a combination of drought stress due to warmer summers and normal maturing and crowding of the trees. In any case, slow growth does not bode well for the future of these forests. In all likelihood the trend of warm summers will continue as part of global warming, and the forests not yet hit by spruce bark beetles will be attacked in the next few years.

At Pedro Bay on Iliamna Lake we found thousands of acres of dead spruce trees - a situation all too reminiscent of the Kenai. Forest Service aerial surveys show that this outbreak began in 1990 and peaked in 1996, and has since declined because most of the mature trees have been killed, as on the Kenai. We could still pull solid wood cores from the dead trees, and we saw few of the redbelt sapwood rot fungus conks that are so visible on dead spruce on the Kenai. The forests we sampled had an abundance of trees of every age, and it was heartening to see that the younger trees had survived and are thriving.

The presence of young trees in all the stands we examined contrasted strongly with many southern Kenai stands, which have only mature (and now dead) trees and no live "children" waiting in the understory to be released. These "old-age" Kenai stands were heavily thinned by bark beetles in the 1870s and experienced very little subsequent seedling recruitment. They are now converting to savanna-like grasslands dotted with birch and alder, and will need fire or tree planting if continuous forest is to be regenerated.

We saw no obvious stand-wide patterns of growth releases in our tree cores, suggesting that if bark beetles have been present in these stands in the past, the attacks would have been at low intensity. On the southern Kenai we often see strong visible growth releases in the rings dating to the 1870-80s and 1970s, but we have needed statistical analysis to find more subtle growth releases in the 1760s, 1810-20s, and 1910-20s, for example. Statistical analysis will definitely be necessary to detect any past outbreaks in our new cores, and it is entirely possible that spruce bark beetles have

not seriously impacted the interior stands in the past.

The Polly Creek stand on the west side of Cook Inlet that I examined in 2000 showed a strong release in the 1870-80s. The motivation for visiting this stand was an 1899 report from ships of the Harriman Alaska Expedition, which described the dead forests around Iliamna volcano and in Kachemak Bay. It is likely that spruce bark beetles killed the trees in the mid-1870s, and standing snags were still visible in 1899. In 1904 forester William Langille described generally impoverished forests on the Kenai, and specifically described the standing dead forest between Homer and Anchor Point, with young limby, open-grown trees growing up among the snags.

The next stage of this study will be to mount all of the cores and measure the tree-rings, which will be done in Rosemary Sherriff's laboratory at the University of Hawaii. This will provide the numerical data with which we can make a careful comparison of the spruce bark beetle outbreak patterns in the Lake Clark area with those of the Kenai Peninsula, and also of the Kluane area of the Yukon.

It took many helping hands to bring this study together and we would like to thank everyone very much. The National Park Service's Inventory and Monitoring Program, Southwest Alaska Network, provided financial and logistical support. Pilots Leon Alsworth and Lee Fink from Lake Clark National Park and Preserve, Rick Johnston from the Kenai National Wildlife Refuge, and Glen Alsworth of Lake Clark Air skillfully shuttled us around the countryside. National Park Service ranger Shay Hurd took us by skiff to two sites on Lake Clark, and volunteer ranger Jerry Mills skiffed us twice across Telaquana Lake. In Pedro Bay, Lisa Jacko helped us select sites on Pedro Bay Native Corporation land; Norman Jacko took us by skiff to Don Shepherd's homestead on Lonesome Bay, and Verna Kolyaha kindly transported our huge pile of gear around town.

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://www.fws.gov/refuge/kenai/.