Why doesn't it grow here?

by Ed Berg

As a forest detective, I often spend my time investigating why specific things happen on the landscape, such as a spruce bark beetle outbreak, a particular fire, the drying of a wetland, or the presence of a plant in an atypical habitat, such as treeline-specialist mountain hemlocks on the Kenai lowland. These are interesting puzzles, and they at least generate lively discussions, if not definitive answers.

I find it equally instructive to look at things that haven't happened, at least not yet, or things that are missing or rare or changing. For plants, the basic ecological question is, why is this particular plant growing right here, in this particular spot? What is it about the plant's properties, the soil, moisture, light, seed sources, and competitors that allow this plant to grow here? And conversely, for plants that aren't growing here, we can ask how these same factors might prevent or limit the plants.

For many temperate and tropical plants, our cold climate sets a pretty tough hurdle. Many southern plants are simply not frost tolerant; their cells don't dehydrate in the winter, and ice crystals tear up the cell membranes and kill them. As our winters continue to warm, however, more plants with marginal frost-tolerance are able to survive here. Gardeners in Homer, for example, have gotten away with planting various USDA Plant Hardiness Zone 4 shrubs in recent years, instead of conservatively sticking with tougher Zone 2 or 3 plants, according to Homer News chief gardener Rosemary Fitzpatrick. An unusually cold winter can still toast Zone 4 shrubs (such as azaleas and rhododendrons) but this is increasingly unlikely with our warmer winters.

In case you haven't noticed the warmer winters, consider that both Homer and Kenai average December temperatures have increased by 4°F and January temperatures by 6°F, ever since the North Pacific sea surface temperatures warmed in 1977. Summer temperatures are warmer too, but only by about 2°F.

Occasional low summer temperatures on the Kenai keep plants like corn, tomatoes, and peppers from reproducing, even though these plants can grow to maturity here. Mitch Michaud of the National Resources Conservation Service (NRCS) tells me that corn needs to have the summer minimum above 50°F to produce ears, and tomatoes and peppers need 55°F. Summer weather in the 40°s will derail fruit production in these plants.

Another life-cycle bottleneck for plants is seed germination and seedling establishment. The thick sod of native bluejoint grass (Calamagrostis) keeps the soil cold and makes it difficult for even native tree species like spruce and birch to germinate and establish. Cold soil however is a local condition, and there are warm sites such as south-facing slopes, so soil temperature is probably not as definitive a barrier as climate for a plant species to live somewhere in this area.

Intense browsing by moose would certainly stop many shrub and tree species from setting up shop on the Kenai. Just about any kind of non-native shrub or tree that you might ever want to plant in your yard will most likely be browsed by the moose before the first winter is over. Moose are probably new on the Kenai in the last 130 years, at least in large numbers, so this would explain how 18 species of their favorite food—willows—have been able to establish before the moose got to them. It's safe to assume that no new shrub or tree species have established since the moose began to prosper, probably as a result extensive fires on the Tustumena Benchlands starting in the 1870s.

On the Kenai it appears that many creatures—both plant and animal—simply haven't gotten here yet, at least on their own hook. Some of this retardation is due to our almost island-like peninsula structure, which probably restricts animals more than plants. Lodgepole pine for example grows in the Yukon at several degrees latitude higher than the Kenai; it certainly grows well here if properly tended. Since the end of the last major glacial period, lodgepole pine has moved steadily northward from southern British Columbia, averaging 10 miles/century—a rate that would require another 50 centuries to bring it to the Kenai.

Aspen appears to be moving south on the Kenai but has barely made it to Kachemak Bay. Aspen seeds are tiny (nearly invisible in their wind-blown cotton) and are only viable for a few weeks at best; they require wet mineral soil to germinate, such as created by severe mineral soil exposing fires. This is not a

recipe for an aggressive colonist. Aspen is well established north of Tustumena Lake, but it is very rare south of the Caribou Hills. Prevailing winds are from the southwest in the spring when aspen cotton is dispersing, so the seeds have to disperse against the wind to get to Kachemak Bay.

Once established, aspen propagates with a remarkable vengeance with clonal root sprouts (suckers). In Utah a single clone (named "Pando," for "I spread" in Latin) covers 107 acres with 47,000 individual stems, and weighs 6 million kilograms. Clones like this probably established after the last glacial period 8-10,000 years ago, and may be among the largest and oldest living organisms. Each clone starts from a single tiny seed and is one genetic individual.

Birch is more of a puzzle. Birch seeds disperse effectively in early winter over the snow and germinate during the next spring or summer. This is a much more effective system than aspen's same-season, short-lived seed mode. Nevertheless, birch is extremely patchy in some areas of the Kenai, such as the south side of Kachemak Bay. In a study that we did in Seldovia Bay, we saw no birch or aspen, nor any sign of moose or snowshoe hares, for that matter. Alders however were abundant. Like aspen, birch likes to germinate on mineral soil, and fire is the fastest way to get mineral soil exposure. The south side of Kachemak Bay has probably never burned in the 2200 years that it has had spruce forest, so the rarity of birch (and aspen) may simply be due to the chronic lack of a good fire-generated mineral soil seedbed.

The acidic soils of the Kenai prevent plants from settling here that like a sweeter soil. Gardeners know well that it is necessary to generously lime the garden in order to get most domestic plants to thrive or even grow at all on the Kenai. This acidity is due to the ultimate volcanic origin of our soils, either directly from volcanic ash or from glacial till and windblown loess that is derived from greywacke sandstone in the mountains, which is itself mostly derived from volcanic basalt. There is very little limestone in the Kenai mountains, which could have neutralized our soils. Most Kenai plants are probably rooted in the loess cap that blankets our hills and valleys, and typically has an acidic pH in the low 5s; most agricultural plants like a higher, less acidic pH around 6.5, according to soil scientist Doug VanPatten, recently retired from the NRCS in Homer.

When I first came to Alaska from Wisconsin in the 1970s, I was appalled to see what passed for a "hay" crop up here. In Wisconsin we got three cuttings of fine alfalfa hay per season, whereas on the Kenai we get one cutting of mixed grasses and horsetails. I was told that alfalfa didn't overwinter well here. Mitch Michaud points out, however, that alfalfa grows well in the Interior, where the soils are not so acidic and the summers are warmer. It could take many truckloads of lime to make a good alfalfa field on the Kenai, so cost-wise hay farmers are probably right to stick with the grass.

In addition to acidic soils, the needle litter of spruce forests produces a soil that is toxic to many plants. There are very few plant species that grow on the floor of a spruce forest. From the point of view of species diversity, a mature spruce forest is like a desert.

In theory, the opening up of the Kenai's beetle-killed spruce forest could provide habitat for new plant species that can't tolerate spruce-contaminated soils. Most of this new habitat, however, is being rapidly taken over by Calamagrostis grass, which creates a tight sod and cold soil, that is as inhospitable to new plants as spruce soil, and is its own brand of botanical desert.

I have recently completed an extensive fire history study of the central and southern Kenai, and have found that fire has been a relatively minor player in the upland spruce forests south of Tustumena Lake, at least over the last 2500 years for which we can find adequate charcoal in the soil for radiocarbon dating. The average time-since-fire is about 600 years, and west and north of the Caribou Hills we found stands that haven't burned for 800 to 1500 years. Spruce bark beetles on the other hand infest these stands every 50 years on average, at least to the extent that surviving trees show detectable growth pulses due to reduced competition.

The lack of fire in our southern Kenai forests means that mineral soil doesn't get exposed very often in the uplands and that nurse wood (rotten logs or stumps) is the primary germination site for baby plants. Spruce germinates readily on nurse wood, birch much less so, and aspen probably not at all. The stilted roots typical of spruce trees on the southern Kenai show that these trees germinated "up in the air" on nurse wood, in a fire-free environment.

When you go north of the Kasilof River into the lake and black spruce muskeg country, fire has been much more abundant, and spruce tree roots spread out from the base of the trunks, indicating that the trees germinated in mineral soil, not on nurse wood. The

fire-return-interval in the lowland black spruce forests is about 90 years, and is about 300 years in the surrounding upland mixed white spruce, birch and aspen forests. The diversity of plants is greater in this mosaic of forest ages and vegetation types than in the southern Kenai monospecific white/Lutz spruce forests and the Calamagrostis grasslands. Wildlife as well is much more diverse and abundant north of the Kasilof River. Fire may be the curse of homeowners, but it's a great benefactor of the plants and the animals on a landscape scale.

To sum up, a cold climate, acidic soils, island-like geography, and extensive spruce forests with little fire have kept a lot of plants off the Kenai in the past. Now that the climate is warming, we can expect more fires in drier forests, sparked by more human sources of ignition. This will allow new plant species to colonize and thrive on the Kenai, as well as new animals. We may not want some of these newcomers. Things like Russian thistle and purple loosestrife are downright nasty, even if they look nice in gardens. Concern about invasive plants is rising in Alaska, and now is the time to think carefully about what plants we don't want and to be a bit more careful about what might escape from our gardens. There are lots of mistaken introductions in the Lower-48 that we would do well not to repeat in our warmer Alaska.

Ed Berg has been the ecologist at the Kenai National Wildlife Refuge since 1993. Ed will be teaching his "Geology of Kachemak Bay" course at the Kenai Peninsula College in April in Soldotna (Tuesday eves) and Homer (Thursday eves). Call 260-2812 for more info. Previous Refuge Notebook columns can be viewed on the Web at http://www.fws.gov/refuge/kenai/.