Common gardens may reveal uncommon choice

by Elizabeth Bella

Spruce bark beetle followed by fire illustrates vegetation change in the Caribou Hills (credit: Kenai Refuge).

This unprecedented warm spell has us all thinking about climate, and the dramatic effects abnormal temperatures have on our seasonal expectations. Favorite winter activities have been curtailed by the warm, wet weather hunched over the region. On the plus side, heating bills are lower, runners are taking advantage of the balmy air and snow-free patches, and anyone who's driven to Anchorage lately appreciates the clear, dry roads.

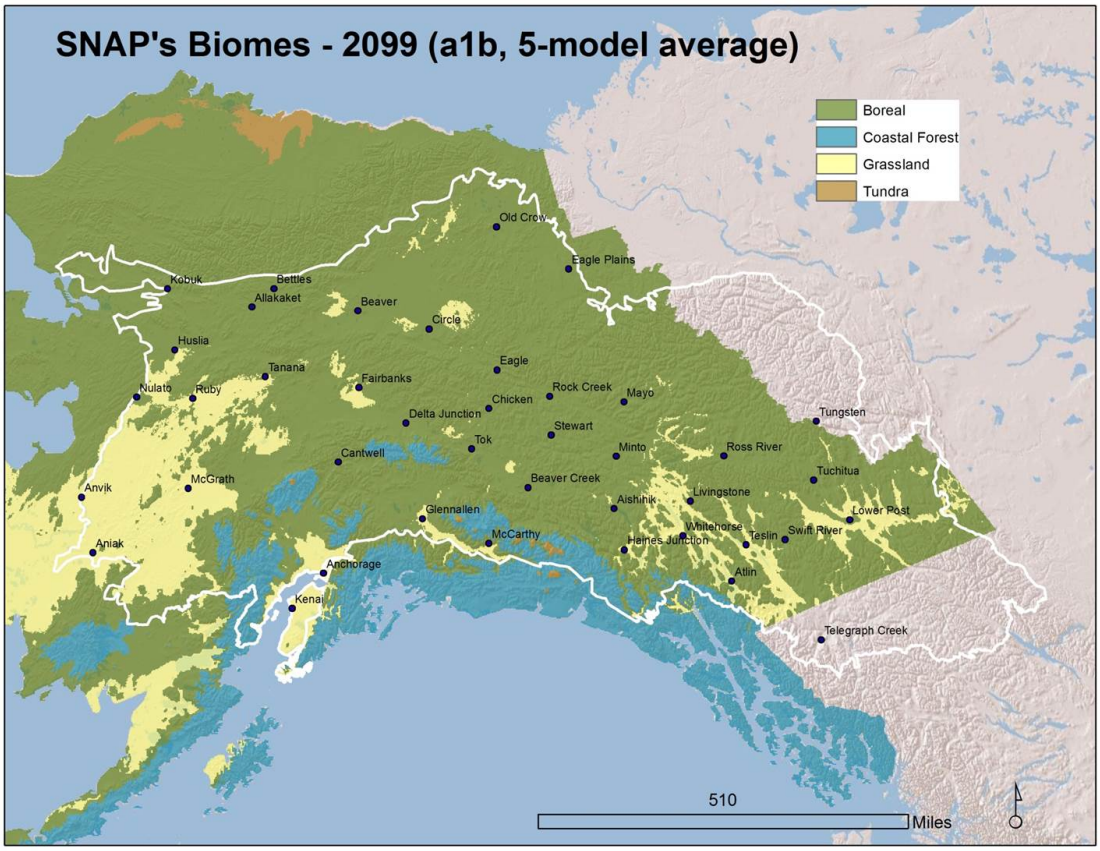
Climate change is expected to have profound effect on regional and local ecosystems. Climate models are one way to visualize what future landscapes will look like. Climate-biomes, or cliomes, are large-scale assemblages of species and vegetation communities that we expect to occur based on prevailing climate conditions. Models illustrate that most regions across the state will have at least one big cliome shift in the coming century.

Several different climate models applied to Alaska show similar results – the future western Kenai Peninsula climate may be similar to that of the prairies of Saskatchewan. Bark beetle outbreaks, rising temperatures, and changing precipitation patterns may cause fire frequency or intensity increases, nudging the landscape towards grasslands. On the eastern Kenai, a future coastal forest climate prevails, which may resemble the coastal rainforests of southern BC and Pacific Northwest rather than current Sitka spruce- mountain hemlock forests.

Adaptive capacity refers to the ability of a species, habitat, or ecosystem to accommodate or cope with climate change impacts with minimal disruption. The Kenai Peninsula has relatively high biological diversity, located between the coastal and boreal forest cliomes, but the distribution of tree species is curious. Glaciation and other major geographic features may have kept species from filling in their current potential range, such as mountain hemlock's absence from most of the south peninsula. Trees, as slow-growing, sedentary organisms, may have low adaptive capacity.

Climate and forest growth research in Canada suggests that many tree species are already lagging up to 80 miles in latitude outside their ideal climate range. Certain populations of trees, at higher elevations or at edges of their optimal climate range, may be more susceptible to climate change due to genetic isolation. Actual lag time depends on non-climate factors including seed dispersal ability, photoperiod requirements, or soil type compatibility. In the interior, seed dispersal capability is limiting tree species' ability to move northward, causing a serious lag at the front end of northward migration and subsequent decline at the southern range edge.

Adaptive management decisions may include planting or transporting species to cope with the lag. Assisted migration is one adaptive practice, involving the deliberate movement of species from their current climate niche to their projected climate niche. Understanding what species will grow, survive, and reproduce in new climates is essential to smart adaptive choices. To directly study tree growth, we aim to install a series of common garden sites at varying latitudes on the western Kenai. Also known as a transplant experiment, common gardens include a variety of species and genetic varieties (genotypes) planted under uniform conditions. We want to know if local genotypes will persist – and if locals aren't going to make it, we want to know what our best options are.



A five-model climate scenario depicts the western Kenai as having a grassland climate by the year 2099 (credit: SNAP, http://www.snap.uaf.edu/).

We plan to include various genotypes of local species including Sitka spruce, white spruce, and quaking aspen. Resident species may have particular genotypes that grow and survive better in changing climates. For example, white spruce that is stunted and slow-growing at high elevations in British Columbia may outstrip local white spruce growth rates when they are planted together, or may be able to resist new types of insects or disease that resident genotypes succumb to.

We will also plant forest species from nearby cliomes, such as Douglas-fir, Engelmann spruce, Pacific silver fir, western redcedar, yellow-cedar (suitable for moister forests of the projected future eastern Kenai), and ponderosa pine, Siberian and western larch, western hemlock, western white pine, and lodgepole pine (for drier cliomes like the western Kenai). Yellow-cedar is already in decline in Southeast Alaska, attributed to warmer winters, an example of a lagging species. Other species have already been planted up here, including lodgepole pine and various larch species. Lodgepole pine is not native to the Kenai Peninsula, but is found just over in the Yukon Territory and near Haines, as well as throughout Southeast Alaska (the closely related shore pine).

The future landscape story is just starting to unfold as we work to understand the intersection of shifting cliomes and adaptive management choices. The idea of bison grazing in grassland patches between resilient pine forests, or elk frolicking in south coastal rainforest, may be far-fetched now – but maybe not in a century. We may be heading towards a decline in diversity due to range lags, so options for creating a novel landscape of the future are intriguing, especially considering our summer-like temperatures this January!

Dr. Elizabeth Bella is an ecologist at Kenai National Wildlife Refuge. You can find more information about the Refuge at http://kenai.fws.gov or http://www.facebook.com/kenainationalwildliferefuge. Biology news highlights can be found here: http://www.fws.gov/refuge/Kenai/what_we_do/science/biology-news.html.