# Alpine and Subalpine Vegetation Monitoring

Mount Rainier, North Cascades, Olympic

I & M RESOURCE BRIEF

## Importance

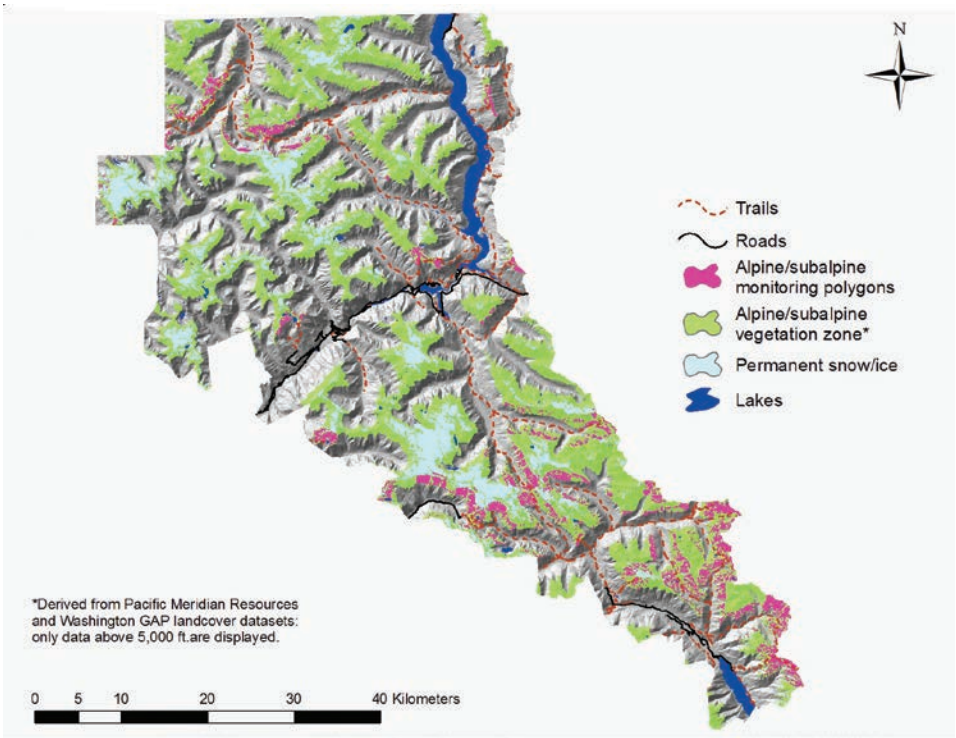
The goal of the alpine and subalpine vegetation monitoring program is to understand the response of vegetation in the alpine treeline ecotone to climate change, within the three mountainous parks of the North Coast and Cascades Network (NCCN). Subalpine and alpine areas are ecologically important zones that provide popular recreational opportunities for visitors to Mount Rainier (MORA), North Cascades (NOCA), and Olympic National Parks (OLYM). The subalpine parkland extends from closed canopy forest (forest line) up to the highest elevation with upright trees (treeline). The alpine zone continues from treeline up to permanent snow and ice on mountain peaks of the Cascades and Olympics. The entire area, from forest line up to permanent snow, is a broad transition zone, often referred to as the alpine treeline. Vegetation composition, structure, and spatial distribution reflect climate's interaction with topography. Because low temperatures are a primary determinant of the distribution of alpine and subalpine areas these areas are particularly sensitive to climate warming. Changing climates may result in significant changes in the distributions of subalpine and alpine meadows of the Pacific Northwest.

## Status and Trends

We used a Generalized Random Tessellation Stratified (GRTS) sample drawn from each park to establish a suite of spatially balanced, random sample sites in accessible areas within the alpine treeline ecotone. Subalpine and alpine vegetation monitoring will begin in the summer of 2012 in NOCA, MORA, and OLYM. The objectives of our monitoring are to determine status and trends in:

1. Composition and structure of alpine and subalpine vegetation communities in MORA, NOCA, and OLYM
2. Composition and structure of legacy alpine plots in MORA
3. Soil temperature and snow cover in vegetation plots
4. Structure and condition of Whitebark pine stands in MORA, NOCA, and OLYM

Pilot surveys of Whitebark pine in MORA and NOCA between 2004 and 2009 revealed disappointing five-year trends in the condition of Whitebark pine stands. In MORA, the proportion of uninfected trees (>2.54 cm diameter at breast height, dbh) decreased from 37% to 22% while infection rates rose from 15% to 26% and mortality increased from 48% to 52%. In NOCA, the




proportion of uninfected trees decreased from 54% to 32% and infection rates increased from 29% to 39% while mortality increased from 17% to 29%. Infection rates in saplings (individuals taller than 50 cm but <2.54 cm dbh) increased in both parks (25% to 43% in MORA and 17% to 21% in NOCA), although live sapling density remained stable. Incidence of mountain pine beetle was fairly low in each park (3% of sites in NOCA and < 1% of sites in MORA).

## Discussion

Climate models project warmer summers and lower snowpacks for the Pacific Northwest. Lower snowpacks may mean earlier snowmelt and longer, drier growing seasons. Altered climate patterns will in turn influence patterns of vegetation cover and phenology (growth patterns and flower timing). In some cases, changes will be dramatic – including more tree growth in the subalpine parkland or more shrubs growing in subalpine and alpine meadows.

Changes in distribution of grasses (which may increase) and forbs (which may decrease) will be more subtle and difficult to notice in the short term. Some species, such as Whitebark pine (*Pinus albicaulis*) will have a more complicated response to climate. Whitebark pine is an importance species in subalpine areas because it is an early successional species, establishing on alpine ridges or after disturbance, often facilitating the establishment of other plant species (see page 28). Today, the survival of this species is threatened by an introduced fungus, white pine blister rust (*Cronartium ribicola*) and native mountain pine beetles (*Dendroctonus ponderosae*). Warmer winters and summers have allowed the mountain pine beetle to survive and spread at higher elevations and in the NCCN we are beginning to see mortality of Whitebark pine from mountain pine beetles. Changes in vegetation distribution and plant phenology (flowering times) will influence recreational opportunities as well as habitat for wildlife.

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**Opposite** Alpine zone detail showing white (American bistort) and blue (lupine) forbs and purple shrubs (heather). NPS/NOCA

**Above** Map of North Cascades National Park illustrating alpine and subalpine zones (green) and sampling polygon locations (purple). NPS/NOCA