

## **Protocol: Long term monitoring of the Alpine and Subalpine Vegetation**

**Parks where the Protocol will be implemented: NOCA, MORA, OLYM**

**Justification/Issues being addressed:** Alpine and subalpine communities are emblematic of mountain parks of the Pacific Northwest and subject to emerging threats including global climate change, air borne contaminants and exotic pathogens. The alpine and subalpine vegetation communities are believed to be the first zones that will show the early effects of global climate change. These threats may cause changes in species composition and community structure (Epstein 2004) as well as forest line and tree island extent (Brink 1959, Rochefort 1996, Rochefort 1994, Woodward 1991 Millar 2004, Kimball 2000, Dullinger 2004). Whitebark pine (*Pinus albicaulis*) is a keystone species of high-elevation ecosystems in western North America. Today, the long-term survival of the species is uncertain due to the introduction of a Eurasian fungus (blister rust, *Cronartium ribicola*) to North America in 1910. Changes in alpine and subalpine vegetation will have a direct affect on the animal species that inhabit the alpine and subalpine areas as well as the hydrology in mountainous zones. The subalpine was identified as a high priority vital sign for NCCN to monitor. Areas in the National Parks in the Pacific Northwest will serve as reference sites for which changes in other, more altered, areas can be compared.

### **Specific Monitoring Questions and Objectives to be addressed by the Protocol:**

- 1. Are special patterns, structure and abundance of alpine and subalpine vegetation communities changing?**
- 2. Distribution of forest line/subalpine trees: A. Is location and extent of forest line changing? B. Are the sizes and locations of tree islands changing?**
- 3. Are the whitebark pine communities changing (rates of infection, recruitment, growth and understory composition) in response to infection by white pine blister rust?**
- 4. Are air pollution sensitive species (vascular and non-vascular) exhibiting symptoms of the effects of air pollution?**

### **Basic Approach:**

- 1. Sampling for changes in the composition of subalpine communities will be accomplished through plot based sampling. Permanent plots will be established in the three mountainous parks in the NCCN. Establishment of plots will consider elevational gradients and aspects, to detect changes on physical extents of the subalpine communities. Attributes collected for each site include; species composition, frequency and cover.**
- 2. Changes in tree, forest line and in tree island distribution will be determined by remote sensing. Aerial photos will be used at 10 year intervals to determine tree line and changes in location and extent of tree islands. This is included in the "Landscape Change Protocol". The baseline extent of tree line and tree**

islands will be mapped on aerial photos. Plot level sampling will be used to track the fate of tree seedlings and is included in Objective 1.

3. Changes in species and structural composition in whitebark pine communities as well as incidence, severity, mortality and impacts of blister rust will be collected at MORA and NOCA. Pilot data will be analyzed for power to detect trend and will be used to determine sample size and frequency. Analysis of pilot data has been completed for whitebark pine monitoring.

4. Visual observations of damage on species will be sampled in the locations of subalpine plots. Vascular species which may be included in the sampling include: Subalpine fir ( *Abies lasiocarpa*), huckleberry (*Vaccinium* sp.), bearberry (*Arctostaphylos uva-ursi*),

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**Schedule, Budget, Expected Interim products:**

**Interim products include: baseline information, species lists for each site, cover, species diversity, and baseline information on the current location of forest line and tree islands.**

**Budget.**

1. Forest line change will be based on aerial photographs acquired by parks on a ten-year basis. This budget assumes acquisition of photos, interpretation and ground truthing with Landscape Change protocol funds.

2. Plot level sampling to document changes in alpine and subalpine vegetation communities, whitebark pine communities and the effects of air pollution.

Year 1	ITEM	UNIT	COST	TOTAL
sampling of	1 GS-07 crew	13 pay periods	17,752	17,800

<b>plots</b>	<b>leader</b>			
<b>sampling of plots</b>	<b>3-GS-05 crew</b>	<b>8 payperiods</b>		<b>26,480</b>
<b>Supplies and materials</b>				<b>2,000</b>
<b>Vehicle</b>	<b>1 vehicles</b>	<b>6 months</b>		<b>3,000</b>
<b>TOTAL</b>				<b>49,280</b>

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