Draft

Land Above the Trees: Alpine Ecology
A Guide for Leading Wildflower Hikes in the Hart's Pass Area

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Preface

As a forest service botanist on the Methow Valley Ranger District, I guide wildflower hikes in the Hart's Pass area every year in July. I have taken the information learned during the alpine ecology class, personal experience, and from additional reading and created an interpretive talk and field notes for myself and other botanists to use while guiding our half-day wildflower hikes. This experience has been extremely beneficial in expanding my knowledge of alpine plants and habitats and in organizing a well thought-out discussion and notes on topics of interest for co-workers and myself to use to share the fascinating alpine plant world with others. I have written this as if I were speaking to a group of people in my natural and informal manner and I have organized it in such a way that best meets the needs of how I conduct my wildflower walks. I am hoping that others guiding these walks can use the information I've gathered here and transform it into their own individual style and needs.

Because only a two-page paper has been requested, I am submitting only the introductory talk that initiates the wildflower walk, which is four pages in length. I did not want to send unwanted lengthy pages of notes that further expand on the class topics rather than summarize it. However, I will be happy to submit the notes on the additional topics explored on our wildflower walks if necessary to receive academic credit or if it is of interest.

Introductory Interpretive Talk

The following is an introductory interpretive talk, approximately ten minutes in length, to be spoken at the beginning of the Hart's Pass wildflower walk at the trailhead. I lead these wildflower walks most often on the Pacific Crest Trail going north to Windy Pass because it is a flat, easy trail for all people and the trail goes through a variety of habitats and plant communities. However, this talk and information could be easily adapted to other trails in the area.

The Alpine Zone

Looking at the slopes surrounding us, we have a picture-perfect view of an alpine area. We can see that it consists of a mixed mosaic of habitats - rocky ridges, talus slopes, and lushly vegetated slopes interspersed with small clumps of trees. The school-book definition of the alpine zone refers to a region that occurs above tree-line. In reality, the alpine zone includes small, dwarfed trees. The tree-line, or tree limit, is the highest elevation that trees will grow. In this area on the eastern side of the North Cascade Mountains the tree limit typically occurs at around 7,000 feet. Hart's Pass is 6,200 feet. It is often not a distinct line, but a blending of boundaries with the lower subalpine zone which occurs here between approximately 6,000 to 7,000 feet. In the subalpine zone trees are taller and grow sporadically but more abundantly. At the lower limit of the subalpine zone you can often see the forest line that forms the upper limit of where the continuous montane forests grow.

Above tree line, often called timberline, the growing season is usually less than 30 days and daytime temperatures do not usually get above 50° F during the growing season (July and August). Tree seedlings need daytime temperatures above 50° F and a long enough growing season to get established. The short, cold growing season is the biggest factor in determining tree line. At tree limit, trees have only enough energy to maintain the minimal requirements for existence with little energy left for growth. In this zone, trees are typically not more than 13 feet tall. These small trees are either protected under the snow in the winter, or those exposed to the strong, cold winds are shaped into stunted, contorted krummholz trees. Krummholz is a German word meaning "crooked wood" or "elfin timber" describing the wind blown appearance of these shapely trees. Although small in stature, these trees may be up to several hundred years old. As we hike we'll take a look at these trees closer up.

Trees at these upper limits usually do not produce cones or reproduce by seeds. Seeds may blow up from lower altitudes and become established in suitable sights, or trees may reproduce asexually. Sexual reproduction is typically when a plant produces flowers or cones that form seeds. Asexual reproduction is done without the production of sexual flower parts or seeds. A vegetative form of asexual reproduction that you can see happening with these clumps of subalpine fir on the slopes is called layering. The lower branches of these trees spread downward to accommodate heavy snow loads. When they come into contact with the soil surface they take root and a new stem grows upward. So, these clumps of trees we see are not made up of separate individuals, but are actually genetically a single individual.

Habitat Types

There are several different types of habitats that occur within the alpine zone based largely on the amount of rock and soil breakdown from the original bedrock material. Looking up at the ridgetops, we can see large masses of exposed bedrock. This rock is eroded by many forces including repeated glaciation, wind, and frost wedging. Frost wedging occurs as water gets into cracks in the rock and the freezing and thawing action of the water slowly breaks apart the rock. Larger rocks are broken down into talus and scree. Talus is large, boulder size rock and scree is smaller, fist size rock. This material is further broken down into fellfields, which are a mix of rock and gravely soils. Meadows and snowbed areas have the deepest and oldest soils. Each of these habitats support a unique type of plant community that are specially adapted to grow specifically in the particular conditions of that habitat. We'll take a closer look at each of these habitats and plant communities as we walk through them on our hike and discuss them in greater detail.

Plant Adaptations to Alpine Conditions

The environmental conditions up here at this high elevation are harsh. The winters are long and intensely cold. The snow falls early and melts late. The summer growing season is short, cool, and often with extreme temperature fluctuations. Daytime temperatures can easily reach 90° or more, especially down low among the rocks where plants are growing, and then drop at night to below freezing. It is not uncommon to have snowfall up here even in July and August. The winds, which are often intense and constant up here all year long, are a significant factor determining which plants grow and how they grow in the alpine zone. There is twice the amount of ultraviolet radiation and 25% more light in the alpine elevations than at sea level. For a plant to capture enough sunlight for photosynthesis and energy to grow and reproduce during a short period of time, and at the same time protect itself against severe cold and water loss from high temperatures and wind is a delicate balance that alpine plants need to maintain in order to survive. Alpine plant species have developed several adaptations to survive these challenges of the harsh environmental conditions.

The most noticeable thing about many alpine species is their small, dwarf size. The main advantages to being small up here are that the plants stay out of the intense, desiccating winds and cold temperatures. You'll notice if you sit or lie down that it's less windy and warmer near the ground. Wind can quickly suck the moisture out of a plant. Also, it takes less energy being smaller; it takes more energy to produce more plant tissue. The bigger a plant, the more energy expended on producing plant tissue.

The main reason for the different types of growth forms of alpine plants seems to be to maximize as much leaf surface area in order to capture as much sunlight as possible, while at the same time minimizing exposure to the cold and wind. Different species have evolved different strategies to accomplish this. Some alpine species are called cushion plants. They form little rounded mounds of leaves so that the wind flows over them. The mound is also capable of retaining heat and moisture. It can be several degrees warmer inside the mound than the outside air temperature. Other species are mat forming, like this phlox we see blooming all over right now. It spreads out to maximize its exposure to the sun while closely hugging the ground for protection. Rosettes, which are a circular set of leaves, also grow appressed to the ground and maximize heat radiation with their radial symmetry. Grasses and some sandworts, on the other hand, grow upright but their stems are so thin and flexible they can withstand the wind.

You'll notice that many alpine plants are very hairy. Those hairs help diffuse the intense sunlight and at the same time help prevent the loss of plant moisture and heat. Plants have pores on their surface called stomata, like the pores of our skin. The hairs protect water and heat from escaping through the pores. Thick, waxy succulent leaves are another adaptation to help prevent water loss. It's interesting that alpine plants have many of the same characteristics of desert plants. Although very different habitats, the plants growing in these different habitats have to cope with similar harsh conditions and finding ways to prevent water loss is a main concern.

The red coloration of some alpine species is a red pigment in the stems and leaves called anthocyanin. This red pigment is more effective than green chlorophyll at using sunlight to warm plant tissues. Other species, like spring beauty, have hollow stems that retain heat. Some plants can actually give off enough heat to melt the snow surrounding them. As we hike, we'll look more closely at these characteristics in the different plants we see.

Alpine plants often develop extensive root systems. Moss campion, a little cushion plant, takes twenty-five years for its above the ground parts to grow seven inches in diameter, while its long taproot can grow up to five feet long within the same period of time.

Almost all alpine species are perennials. It takes a tremendous amount of energy for an annual plant to germinate, grow, produce a flower, and mature a seed all in one short season. It takes less energy for a perennial to grow and use stored energy from previous year's growth. Also, if the growing season is too short in a given year or the conditions are not right, an annual plant may die without ever having the chance to produce the seeds of new plants for its continued existence. For a perennial plant, if the season is too short, or if it's too cold to flower, or the insect pollinator is not around to pollinate the flowers the plant is still capable of surviving on to the next season when it will have another chance if conditions are more favorable.

In an area where the seasons are short, it is advantageous to be able to grow, flower, and produce seed as quickly as possible and to be able to do it in cold, less than optimum conditions. Alpine species are adept at this. They are able to begin growing earlier in the season and in colder conditions than lower elevation species. Flower buds often form the year before blooming and are protected underground and by a blanket of snow all winter until blooming time. Alpine buttercup begins flower bud tissue differentiation four years before it actually blooms.

Plant Identification

To begin to learn to identify plants and wildflowers it's helpful to know a little bit about how plants are organized into related groups. Plants are grouped into families based on similar characteristics. Within those families plants are further divided into groups of genera and then individual species. A scientific name is a combination of the genus and the species name. For example, *Phlox diffusa*. *Phlox* is the genus, which there are several different species of. *Diffusa* is the individual species. I will be using both common names and scientific names (Latin names) today. Don't let the Latin name scare you. The names can describe characters about the plant that help us to remember it better. Also, there can be many different common names for one plant species or two different plants can have the same common name. Common names can be very confusing. Scientific names can be very helpful to insure that we're talking about the same plant. So as we look at different plants today, I'll point out some of their family characteristics and tell you what family they're in, which will help you to know what plants are related to each other and help you to identify and get to know them better.

I ask that you, please, stay on the trail while we're walking as much as possible and step on rocks rather than plants if you go off-trail. Alpine habitats are extremely fragile. Plants grow slowly up here and if they are damaged they take along time to regrow. Also, please, don't pick the flowers. It's taken a lot of energy to produce that flower and we want to give it a chance to produce seed to insure continued survival. I'll pick just a very few flowers for everybody to share seeing special characteristics.

This is a very informal hike. Please, ask all the questions you think of and share information you may know with the group. We all have a lot to share and learn from each other.

Topics of Interest to be Discussed at Appropriate Places along the Walk

1) Habitat types in greater detail.
   Bedrock, talus and scree slopes, fellfields, meadows and snowbeds.
2) Unique community types.
   Heather, rock, and snowbed communities.
3) Reproduction strategies of alpine species and pollinators.
4) Alpine trees and succession.
5) Geology of the North Cascade Mountains specific to the Hart's Pass area.
6) Lichens.
7) Historic information on the Hart's Pass road and mining.
8) Individual species information - identification, ecology, cultural uses, etc.
9) Additional species to add to the Watchable Wildflowers of Hart's Pass Species List.

Notes on Topics of Interest

Habitat Types

Geology and Glaciation

The area has undergone alpine glaciation and ice-sheet glaciation.

The Hart's Pass area shows evidence that the most recent glaciation of the northern Cascades was not alpine glaciaiton confined to valleys, but ice-sheet glaciation. The passes are broad and gently rounded saddles, rather than the ragged topography caused by alpine cirque glaciation. The Cordilleran Ice Sheet beveled off ridge crests, excavated u-shaped troughs across divides, and created a variety of depositional landforms. Even though ice sheet glaciation was most recent, the u-shaped valleys heading in steep-walled cirques indicate that alpine glaciation was the primary sculptor of the landscape.

Alpine glaciers excavated cirques and modified former stream valleys into deep u-shaped troughs.

Ice flowed up the Pasayten Valley and entered the Methow drainages over Harts Pass and Robinson Pass, which means that the source of at least some Methow Valley ice was the Cordilleran Ice Sheet.

Glacial striations and erratics near the summit of Slate Peak and on the summit of Tamarack Peak indicate that the entire northern Cascade Crest ridge was covered under an ice sheet. The passes are where the ice sheets were thickest.

The ice sheet probably arrived in the Methow region by 16,000 yrs B.P. and had largely diminished by 13,500 B.P. Alpine glaciers from the Cascades reached their maximum positions around 18,000-19,000 B.P.

The area has been glaciated several times. Occurring in late Pleistocene or Holocene time.

Drift and associated landforms associated with alpine glaciation are missing because they have been eroded away by the more recent ice sheet.

Harts Pass Formation is predominantly marine arkose with subordinate amounts of fossiliferous black shale.

Historic Information on the Hart's Pass Road and Mining

Gold and silver were discovered in Allen Basin (northwest of Hart's Pass) in 1893. To get supplies into the area and the gold and silver out, the first road was carved out by 1900. In 1903 it was widened to 36 inches and truck axles were shortened to match the narrow roadbed. The road was rebuilt in 1935 by the F.S. to its present width and pretty much the original route. The road to Slate Peak is the highest road in Washington.

Two old mining towns - Barron and Chancellor. At its peak Chancellor had over a thousand people and was the site of the main power house for the surrounding mines.

Deadhorse Point was allegedly named after horses in a pack string panicked, ran down the trail, and lost their footing and fell down the steep slope.

Since the early 1900's as many as 30,000 sheep a year grazed the alpine areas. They were herded all the way up from the Columbian basin along the Pasayten Driveway, the livestock trail that follows Rattlesnake Creek.

In 1941 the guard station at Hart's Pass was used as an outpost of the Air Warning Service to watch for enemy aircraft/Japanese invasion. It was staffed thru the winter. During the Cold War Ground Observer Corps volunteers staffed it to watch for the same.

References

Waitt, Richard Brown. 1972. Geomorphology and Glacial Geology of the Methow Drainage Basin, Eastern North Cascade Range, Washington. Dissertation submitted to University of Washington. 153 p.