Vegetation Patterns of the Uinta Mountains, UT

Vegetation, in one or another of its various forms, covers a large percentage of the Earth's land surface. Over 270,000 different species of plants have been identified (Christopherson, 2000). The patterns formed by this vegetation are fascinating to study. Several factors determine how these patterns are shaped and change over time. These factors include: temperature, precipitation, amount of sunlight, potential evapotranspiration, soil type, available nutrients and many others (Christopherson, 2000).

An area of particular interest in studying vegetation patterns is the Uinta Mountains. The Uinta Mountains are located in Northeast Utah between the Colorado, Utah, and Wyoming borders. A rare east-west trending range within the Rocky Mountain System, the Uintas stretch approximately 150 miles east to west and 50 miles north to south (Stevens, 1969). The range exists between the Green River Basin (~6,600 ft. above sea level) to the north and the Uinta Basin (~5,500 ft. above sea level) to the south (Stevens, 1969). Within the range, at least ten peaks reach over 13,000 feet and many more reach 12,000 feet, the highest of these being King's Peak (13,528 feet above sea level) (Stevens, 1969). Covering these mountains are several different life zones, many species of trees, shrubs, flowers and grasses, and some interesting biogeographical patterns. This paper will not only discuss the climate, geology, and the resulting vegetation of the Uintas, but it will also discuss some of the exceptions to the vegetation patterns seen and the causes for those abnormalities.

Climate, Geology, and Vegetation of the Uintas

Climate plays a major role in determining the vegetation distribution of the Uintas. The regional climate for the Uinta Mountains is influenced by several factors. It is affected most notable by westerly flowing polar air brought by the prevailing winds in the winter months and by interior, moist air from the Gulf of Mexico during the summer months (Stevens, 1969; Mitchell, 1976; Schlenker, 1995). In the winter, frontal storms cause orographic lifting and an increase in precipitation, while in the summer, convectional storms are the source of precipitation dropping moisture brought northward from the Pacific (Gifford et al., 1967; Schlenker, 1995). According to Mitchell (1976)

(Figure 1) the Uintas sit directly south of a regional winter air mass boundary and is the

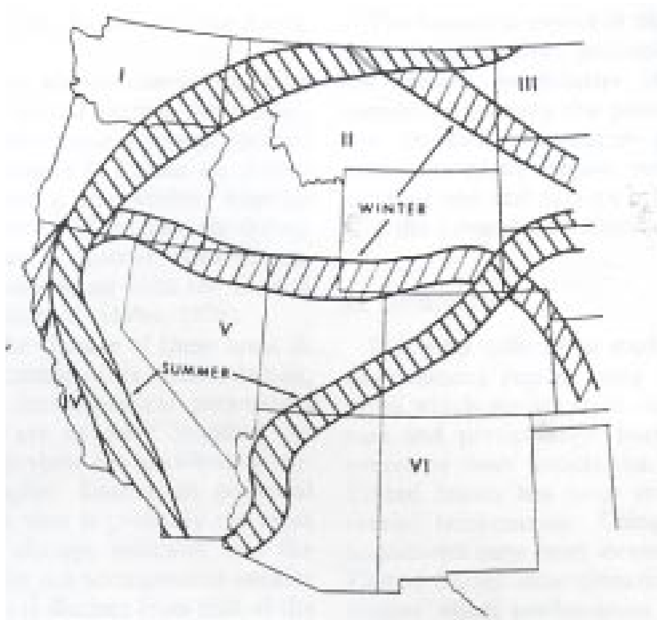

Figure 1. Regional Summer and Winter Air Mass Boundaries (Mitchell, 1976).

cause of much of the precipitation in the area. The Uinta Mountains see frontal storm activity due to the convergence of cooler air masses from the north and warmer air masses from the south (Schlenker, 1995).

As defined in class, coniferous forests have an excess of precipitation throughout most of the year, cold winters, and cool summers (Ehleringer, 2000). This typifies much of the climate in the Uinta Mountains. Average annual precipitation in the Uintas is approximately 20 inches, although this varies greatly throughout the range (Figure 2)

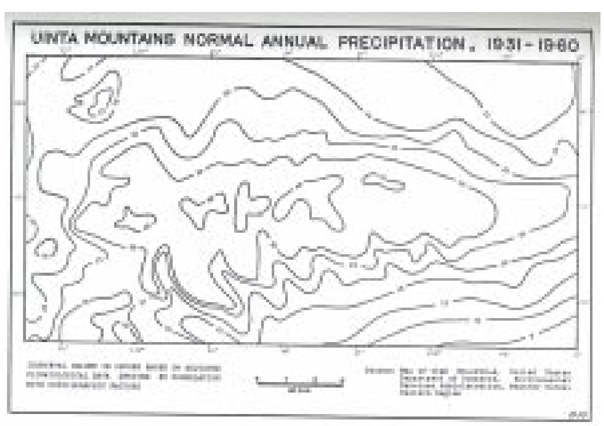

Figure 2. Mean Precipitation of the Uinta Mountains, 1931-1960 (Stevens, 1969).

(Svihla, 1932; Stevens, 1969). Precipitation amounts peak in late winter and early spring and in general decrease from west to east across the range (Schlenker, 1995; Reid, 1993). Snowfall is quite heavy in the Uintas and can happen at almost anytime throughout the year (Stevens, 1969). Temperature in the Uintas ranges from approximately 65° F in July to about 15° F in January (Stevens, 1969). The growing season in the Uintas extends from early June to the beginning of September (Murdock, 1951).

The geology and the glacial history also play a large role in the vegetation distribution of the Uintas. The Uinta Mountains are an anticline faulted range that formed during the Cretaceous-early Tertiary mountain building episode, as did the Colorado and Wyoming Rockies (Chronic, 1990). The bedrock of the Uinta Mountains consists primarily of late Precambrian to Tertiary beds of quartzite, metaquartzite, sandstone and shale with a thickness of approximately 12,000 feet (Marsell, 1969; Briggs and MacMahon, 1982). The peaks of the Uintas consist of loose quartzite material, instead of solid masses like most other ranges in the west (Hayward, 1952). This rock is relatively resistant to erosion and has greatly slowed the process of soil formation in the range (Hayward, 1952). The soils of the Uinta Mountains tend to be sandy considering its bedrock, especially in the King's Peak area (Briggs and MacMahon, 1982). Most soil in the Uintas has been created by glacial activity or is currently being made by the active erosion of quartzite boulders. There are no igneous rocks and very little evidence of volcanic activity in the Uintas (Hayward, 1952; Schlenker, 1995).

The surficial geology of the Uintas is dominated by glacial remnants. The peaks of the Uintas show evidence of extensive glaciation in the form of cirques and aretes, while the lower areas provide classic U-shaped valleys and moraines (Stevens, 1969). The glaciation of the Uintas took place during the Pleistocene Epoch (Marsell, 1969; Schlenker, 1995) and covered the greater portion of the Uintas west of longitude 109° 40' West (Atwood, 1907). Several glacial stages are said to have occurred in the Uinta Mountains, the most recent being the Blacks Fork and the Smiths Fork episodes (Schlenker, 1995). These episodes have been correlated with the Bull Lake and Pinedale glacial episodes of the Rocky Mountain model, estimated to have occurred between 155,000 BP - 130,000 BP (Pierce et al., 1976) and 30,000 BP - 12,000 BP (Madole, 1986) respectively (Schlenker, 1995). These episodes are equivalent to isotope stages six and two (Shackleton and Opdyke, 1973). Glacial lakes dot the surface of the Uintas mountains having been carved out by glaciers. Today there are no active glaciers found in the Uintas, but active snow banks can be found on the north side of more than 30 peaks (Cronquist et al., 1972; Stevens, 1969).

Edward H. Graham (1937) designates five different life zones within the Uinta range (Figure 3). The life zones from lowest to highest in elevation are: the shrub-

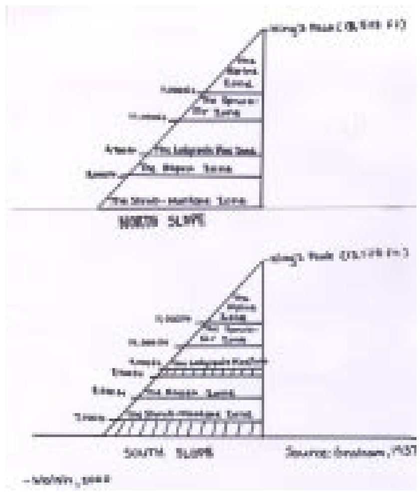

Figure 3. Life Zones of the Uinta Mountains

montane zone, the aspen zone, the lodgepole pine zone, the spruce-fir zone, and the alpine zone. The shrub-montane zone exists between 7,000 and 8,000 feet on the southern slope and on the northern slope is found as a continuous expanse below the lodgepole pine and aspen zones. Common flora within this zone includes sagebrush (*Artemisia tridentata*), Gambel oak (*Quercus gambelii*), mountain mahogany (*Cercocarpus montanus*), and to a lesser extent, ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*) and blue spruce (*Picea pungens*). The aspen (*Populus tremuloides*) zone is located at approximately 8,000-8,700 feet, although it is not continuous, as it often times gives way to the shrub-montane zone. The lodgepole-pine zone, dominated by lodgepole pine (*Pinus contorta*) exists between 9,000 and 10,000 feet, although lodgepoles can be found mixed in with the spruce-fir zone and the aspen zone. From 10,000 to 11,000 feet is the spruce-fir zone. Common trees found in this zone are the Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and Douglas fir (*Psuedotsuga mensesii*). Most glacial lakes and open meadows occur within this zone bringing with them an array of wet and dry meadow plant species. The last zone, the alpine zone, begins at about 11,000 feet and extends upward. Although willows (*Salix bebbiana* var. *perrostrata*) and birch (*Betula glandulosa*) can be found in this zone, the vegetation comprises of mostly grasses, lichens, mosses and sedges (Cronquist et al., 1972).

Abnormalities in the Vegetation Patterns

Many factors affect and shape the vegetation patterns of the Uintas. Fire plays a very large role in reshaping the vegetation patterns seen. Both aspen and lodgepole pine are trees that invade recently burned areas (Cronquist et al., 1972). Although Graham (1937) designates life zones for both aspen and lodgepole pine and recognizes them as part of the primeval vegetation of the area, it is obvious from the extent of the two species and their location within the spruce-fir life zone that they are both preclimax species (Bradley et al., 1992; Cronquist et al., 1972).

Several other species are affected by fire in the Uintas. Engelmann spruce is easily killed by fire and is unlikely to survive more than one or two light fires (Bradley et al., 1992). Due to its thin bark, moderate-to-high stand density, and low and dense branching habit, subalpine fir is very intolerant of fire, in fact it is the least fire-resistant conifer in Utah (Bradley et al., 1992). Douglas fir is relatively resistant to fire and its mature trees develop a thick, corky layer of bark that protects against cool to moderately severe fires (Flint, 1925). Fire is a natural and important part of the ecosystem in the Uinta Mountains and does a lot to change the vegetation patterns created there.

As discussed earlier, geology and climate are two key components in determining the vegetation patterns of the Uintas. These factors again come into play when discussing some of the other exceptions to the vegetation patterns of the Uintas. As stated by Svihla (1932), both the shallowness of the soils and the steepness of the slopes in the range largely affect run-off amounts and soil moisture availability . These factors then in turn create small variations in the vegetation seen. For example, in the shrub-montane zone, big sagebrush is most common, but where soils are rocky and poor, black sagebrush (artemisia arbuscula var. nova) is present instead (Cronquist et al., 1972). Also, Douglas fir and blue spruce exist on steep protected slopes, while ponderosa pine grows where slopes are more exposed (Cronquist et al., 1972). Many more similar examples of vegetation variation due to change in geology and climate exist within this range.

One of the most interesting exceptions to the vegetation patterns of the Uintas is the zone inversion that exists. Described by Cottam (1930) and Graham (1937), in two different areas within the Uintas do we see species from several life zones represented within a single other life zone. Cottam (1930) describes this in Beaver Creek Canyon at about 7,200 feet within the shrub-montane zone. Within this life zone where Gambel oak and big sagebrush are common, species from the aspen and lodgepole pines zones can be found, along with species from the spruce-fir zone and the alpine tundra zone (Cronquist et al., 1972). Another example given by Graham (1937) describes this "zone jumbling" near Moon Lake (8200 feet) within the aspen-lodgepole pine zone. Here representatives from the shrub-montane zone and the spruce-fir zone can be found (Cronquist et al., 1972). Graham hypothesizes at the causes of these zone inversions, giving cold air drainage as an explanation of the zones extended downward and edaphic differences as a possible cause of zones extending upward (Cronquist et al., 1972).

Conclusion

Different patterns of vegetation can be seen all over the Earth's surface. It is in studying those patterns that we learn the most about their causes and how they change. Perhaps more important than studying the patterns is studying the exceptions to the patterns. By looking at the vegetation patterns of the Uinta Mountains and the exceptions that exist, it is easier to have a more complete understanding of what controls and regulates the complex environment we see.

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