

Montane Forest Ecotype



Figure 18. Montane Forest Ecotype

Montana's montane forests occur along the western third of the state, from the rugged peaks of the Purcell Mountains in northwestern Montana to the Beartooth Range near Yellowstone National Park. From the foothills to the summits, vast coniferous forests of larch, fir, hemlock, pine, and spruce trees characterize these areas. Such mountain forests also serve to protect the headwaters of Montana's rivers. Most of this ecotype is in public ownership through the U.S. Forest Service (USFS). Collaboration with the USFS will be critical to the conservation of these areas.

Landscape Characteristics

The montane forest ecotype includes 24,498,117 acres and represents 26 percent of Montana. This ecotype is mostly situated on mountain slopes, although a small portion is located in the valleys of extreme northwest Montana. Slopes are generally moderate to steep, often exceeding 45 degrees. All mountain ranges in Montana have at least some montane forest, as do the following major valley locations: lower Clark Fork, upper Flathead, Seeley/Swan, Kootenai, Bull River/Lake Creek, and Stillwater north of Whitefish. All are included in this ecotype.

The elevation range is the same as for the entire state (the highest and lowest elevation points in Montana are in this ecotype). The lowest elevation, 1,800 feet, occurs where the Kootenai River flows into Idaho. The highest elevation is 12,799 feet atop Granite Peak in the Beartooth Mountains. Both base elevations and mountaintop elevations are lowest in the northwest section of the ecotype and increase toward the south. Base elevations of almost 2,000 feet in the Libby, Troy, and Thompson Falls area increase to about 3,000 feet in the

Flathead/Mission Valleys and to more than 3,000 feet in the Missoula/Bitterroot Valleys. The highest base elevations west of the divide are generally about 4,500 feet along the east front and south as far as the upper Jefferson Valley. As the divide is approached from here, base elevations exceed 6,000 feet in the Big Hole and Centennial valleys. Generally, base elevations inside and outside of the mountain front as well as around the Little Belt, Big Snowy, Judith, and Crazy mountains are around 4,000 to 4,500 feet. Base elevations around the Highwood, Bears Paw, and Little Rocky mountains are about 3,000 to 3,500 feet.

Although summit elevations of mountains in the north are lower than those in the south (i.e., major mountain ranges in the north top out at 9,000 to 10,000 feet versus 10,500 to 12,800 feet in the south), base to summit relief is similar. High mountain ranges in all areas are 6,000 to 7,000 feet from base to summit and moderate mountain ranges 4,000 to 5,000 feet. Distances between mountain ranges are shorter in the north particularly, and west of the divide generally, than those in the southwest.

Since the end of the Precambrian time period (570 million years ago), there have been two major mountain building episodes in the region now occupied by the Northern Rockies. The first was a compression stage, resulting in folding and overthrusting of rock strata. Following this was a tension stage, where the region was pulled apart, causing rock segments to separate and tip at various angles. This stage is currently active.

During the Precambrian time period, sediments were deposited over a wide area in a sea extending from the Three Forks area north into Canada. These sediments form the belt series rocks found in the mountains of most of northwestern Montana. Most of the mountains in the southwest are composed of combinations of metamorphic, igneous, and Paleozoic/Mesozoic (deposited after 570 million years ago) rocks. Individual mountain ranges often have a core or central area of metamorphic or intrusive igneous rock partially surrounded by uplifted layers of sedimentary rock. Some mountain areas such as the Gallatin Range, the mountains around Wolf Creek, and the Bears Paw Mountains consist of extrusive igneous (lava flows) rock. Two very large areas of intrusive igneous rock (granite) occur between Helena and Twin Bridges and south from Hamilton toward Anaconda.

The topography of most of the higher mountain ranges was influenced by glaciation. Mountain glaciers created features including glacial troughs (U-shaped valleys), cirques, tarns (lakes in cirques), and sharp horns and walls. The mountains in the northwest corner were overridden by the cordilleran ice sheet, which tended to smooth off their tops. The northern end of the Mission Range is an example of this, whereas the southern end of this range is a prime example of mountain glaciation. Except for the Crazies and the Little Belts, the isolated mountain groups of central Montana did not experience mountain glaciation but may have been partially overridden by the Laurentide ice sheet.

Most of the mountain region has had anywhere from 10 to 45 centimeters of volcanic ash deposited on it. The heaviest deposits were in the extreme northwest. These deposits occurred during the time of the formation of the Cascade Mountains.

Soils

Most of the montane forest ecotype is overlain by soils that are classified as cool or cold (32 to 47 degrees F)—cool in the summer, cold in the winter, and moist most of the time. Such soils generally form under forest cover and have an organic duff layer (partially decomposed leaves, etc.) underlain by either a white leached layer or a brown clay layer. If the parent material is limestone, a calcareous layer may be present. Except for the limestone-derived soils, soils in this region are usually acidic.

Climate

Most of the climate discussion is based on information in Caprio and Nielsen (1992). The climate of the montane forest ecotype is ruled first by macroclimatic influences and then by elevation influences. The general climate of northwest mountain areas is maritime, whereas that of the mountains farther east and south is more continental, although mountain areas in general tend to be more maritime than their adjacent lowlands. Elevation affects both temperature and precipitation. A general rule of thumb is that temperature decreases about 6 degrees F for every 1,000-foot rise in elevation. This is a general rule and might not hold true in specific areas. Because of orographic effects, precipitation increases with increased elevation, so that in any specific area the higher elevations are wetter. However, due to macroclimatic differences, a given elevation in one part of the state will not receive the same amount of precipitation as another. The pattern of yearly distribution will also be different.

Mean yearly temperatures range from 39 to 40 degrees F at lower elevations in most of the mountains to about 30 degrees F at the highest elevations. The Beartooth Mountains and Plateau constitute a large and very high landmass with average annual temperatures as low as 20 degrees F. Throughout most of the mountain mass, January maximum daily temperatures are in the 22- to 25-degree F range. However, at the high elevations of mountains in southwestern and central Montana and Glacier National Park, these temperatures range from 8 to 19 degrees F. Some of the areas of northwestern Montana are warmer, with January maximum daily temperatures ranging from 28 to 30 degrees F. A similar pattern holds true for mean January nighttime minimums, except that the relative greater warmth of the northwestern mountains is more extreme. The mountains of almost the entire northwest corner exhibit January minimum temperatures in the 10- to 11-degree F range no matter what elevation. The mountains of the rest of Montana have January mean minimum temperatures ranging from 4 to 6 degrees F at lower elevations and 0 to minus 11 degrees F at the highest

elevations. The mean July daily temperatures at low elevations generally range from 58 to 60 degrees F, whereas at high elevations they range from 51 to 54 degrees F. The coldest places are the Beartooth Plateau and the mountains of Glacier National Park. Those mountains bordering or surrounded by the plains have the lowest mean annual extreme minimum temperatures. The two coldest mountain ranges in this regard, the Beartooths and Crazy's, experience annual minimum temperatures in the minus 41- to minus 45-degree F range. At the other extreme, the mountains of the northwest corner do not generally get colder than minus 27 degrees F at any elevation. Annual maximums range from 85 to 92 degrees F throughout most of the mountains. The frost-free season at most of the higher elevations ranges from 10 to 50 days annually. Lower elevations have frost-free seasons ranging from 50 to 90 days annually.

The montane forest ecotype is the wettest in the state. Closed canopy forests generally do not occur at less than 20 inches annual precipitation in western Montana. Within the ecotype the northwest is the wettest. A given precipitation level is reached at a much lower elevation in the northwest than in the south and east; in other words, it takes a lot more elevation to produce the same amount of precipitation in the southwest, south-central, and central mountains than it does in the northwest. In the southwest, only a few very small and scattered areas receive more than 60 inches of precipitation annually. These occur at elevations greater than 11,000 feet in the Beartooth, Crazy, and Madison mountains. In the northwest, such areas are relatively large and occur in most mountain areas higher than 7,000 feet. Higher parts of Glacier National Park, the Cabinet Mountains, the Mission Range, and the Swan Range are estimated to receive more than 120 inches annually.

Average annual precipitation for the ecotype as a whole is estimated to be around 37 inches. Some relatively small areas of the ecotype are in the 12- to 16-inch zone. While 52 percent of the area in the ecotype receives 20 to 40 inches, the remainder receives 40 to 60 inches (20 percent), 16 to 20 inches (15 percent), 60 to 100 inches (9 percent), 12 to 16 inches (3 percent), and 100 or more inches (1 percent). Yearly precipitation in the mountain areas has more precipitation in winter than summer, as opposed to adjacent lowlands. This effect is most extreme in the northwest corner, where the relatively higher winter precipitation extends even into low elevations. The lowest percentage of growing season precipitation in the state, 22 to 27 percent, occurs in a wide area around the Cabinet Mountains and in small areas in Glacier National Park and the Mission Range. Summer precipitation in the high southwestern mountains generally ranges from 32 to 35 percent of the total annual precipitation.

Snowfall ranges from 81 to 300 inches annually in most mountain areas depending on elevation, although parts of the Mission Range, the Swan Range, and Glacier National Park may get 1,000 inches in an average year. In most mountain areas, the ground will be covered with at least 1 inch of snow from 120

to 260 days in an average year. A large part of the Glacier National Park may have snow on the ground for more than 300 days.

Anthropogenic Uses

The montane forest ecotype is diverse both in land management and its uses by humans. Whether it is for natural resources or recreational activities, these areas have multiple opportunities for explorers and entrepreneurs. Primary activities include hiking, mountaineering, hunting, biking, snowmobiling, animal watching, and skiing. The primary industries in this ecotype are construction and the timber industry. The breakdown of landowner stewardship for the montane forest ecotype is as follows:

U.S. Federal Agencies:	17,405,054 acres, or 71.8% of total area, which include:
BLM:	648,466 acres, or 2.7% of total area
USFS:	15,586,235 acres, or 64.3% of total area
USFWS:	19,707 acres, or less than 0.1% of total area
NPS:	1,125,565 acres, or 4.6% of total area
State Agencies:	765,594 acres, or 3.2% of total area
Tribal Lands:	825,579 acres, or 3.4% of total area
Private:	5,231,777 acres, or 21.6% of total area
City and County:	6,795 acres, or less than 0.1 of total area

Vegetation

Vegetation community composition in the forested mountain areas of Montana is not affected by soil conditions except under a few conditions (Pfister et al. 1977). Forest vegetation patterns are influenced primarily by climate, topography, and species migration patterns. The factors mentioned above result in a great variation in forest species composition across the ecotype. Because of this, the vegetation of this ecotype will be described in general areas based on climate characteristics.

The area north of Missoula and west of the Continental Divide has the greatest variety of tree species. The macroclimate of the northwest forest is more maritime, generally resulting in an area less subject to cold arctic outbreaks in the winter, which receives more total precipitation and a higher proportion of precipitation in the winter. The climatic conditions create an area where potentially 100 percent of the land could be forested. Most valleys are forested, and except for the nonforested Flathead Basin, these are included in the montane forest ecotype. Climate, plus a greater proximity to the Pacific, results in a greater abundance of Pacific and intermountain flora and a greater variety of plant species than the remainder of Montana. Grand fir (*Abies grandis*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), mountain hemlock (*Tsuga mertensiana*), and western white pine (*Pinus monticola*) are trees essentially confined to the northwest forested area. Western hemlock and

white pine are limited primarily to the extreme northwest corner. Alpine larch (*Larix lyallii*) extends a very short distance into the northernmost part of the east-of-divide area, and western larch penetrates much of the west-central region (Arno 1979). As in other parts of Montana, individual tree species are adapted to certain elevation zones. The order of adaptation from lowest to highest elevation for trees in the northwest area has been determined by (Pfister et al. 1977). In those areas warm and dry enough that there is a lower timberline adjacent to grassland, ponderosa pine (*Pinus ponderosa*) dominates at the lowest forest elevations. The upper timberline at about 8,000 feet is formed by alpine larch, whitebark pine, and subalpine fir. Grand fir, western red cedar, both hemlocks, and alpine larch have very narrow zones of distribution. The other conifer species may occupy elevation zones thousands of feet wide and therefore occur together with numerous other species. Generally the tree species are considered climax dominants only in the lower part of their range and are seral in the upper parts; however, in the northwest area, western larch, lodgepole pine, and spruce are considered seral wherever they occur (Pfister et al. 1977).

Some of the understory species common in the northwest area of the montane forest ecotype are either absent or rare in other parts of the ecotype. These include devil's club (*Oplopanax horridum*), queencup beadlily (*Disporum hookeri*), trefoil foamflower (*Tiarella trifoliata*), and wild sarsaparilla (*Aralia nudicaulis*). Heartleaf arnica (*Arnica cordifolia*), common juniper (*Juniperus communis*), and elk sedge (*Carex geyeri*) are rare in the northwest area but are widespread in other areas of the ecotype (Arno 1979). Understory species ubiquitous and relatively common in the northwest and throughout the montane forest ecotype include bluebunch wheatgrass, Idaho fescue, rough fescue, snowberry (*Symphoricarpus albus*), spirea (*Spirea betulifolia*), pinegrass (*Calamagrostis rubescens*), ninebark (*Physocarpus malvaceus*), twinflower (*Linnaea borealis*), huckleberry (*Vaccinium* spp.), and kinnikinnick (*Arctostaphylos uva-ursi*).

In the west-central area of the montane forest ecotype, the climate is drier, colder, and less maritime than the northwest, but is less continental than parts of the ecotype to the east and south. Western larch is common (although not necessarily widespread) in west-central and northwest areas but not throughout the ecotype. Western red cedar, grand fir, and alpine larch penetrate slightly into this area. The elevation ordering of tree species is similar to the northwest area except that grand fir, western red cedar, white pine, and hemlock are missing in most areas. Understory species shared with the northwest area but uncommon or missing to the east and south include smooth woodrush (*Luzula hitchcockii*), menziesia (*Menziesia ferruginia*), and beargrass (*Xerophyllum tenax*). In areas east of the Continental Divide, the ecotype is reduced to relatively isolated mountain islands surrounded by grassland or shrub grassland. Compared to the northwest and west-central areas, the overall climate in the east is colder, drier, and windier. This results in conditions unsuitable for several of the tree species found to the north and west. Although ponderosa pine is present in the plains

forests to the east (plains forest ecotype), it is generally absent throughout all but a small portion of this area of the montane forest ecotype. Apparently, the growing seasons coupled with high elevations limit the distribution of ponderosa pine. The most extensive areas of ponderosa pine just east of the divide are around Helena (Arno 1979). Douglas fir, lodgepole pine, and subalpine fir dominate forests throughout this area. Lodgepole pine is an extremely common seral species dominating much of the upper Douglas fir zone and the spruce fir zone. Only a very restricted area close to Yellowstone National Park is apparently climax lodgepole pine. Areas near the timberline commonly support subalpine fir and whitebark pine except on limestone substrates where whitebark pine is generally missing and often replaced by limber pine (*Pinus flexilis*). Alpine larch penetrates a small proportion of this area as well. Extensive amounts of the south-central area of the ecotype support spruce-dominated forests.