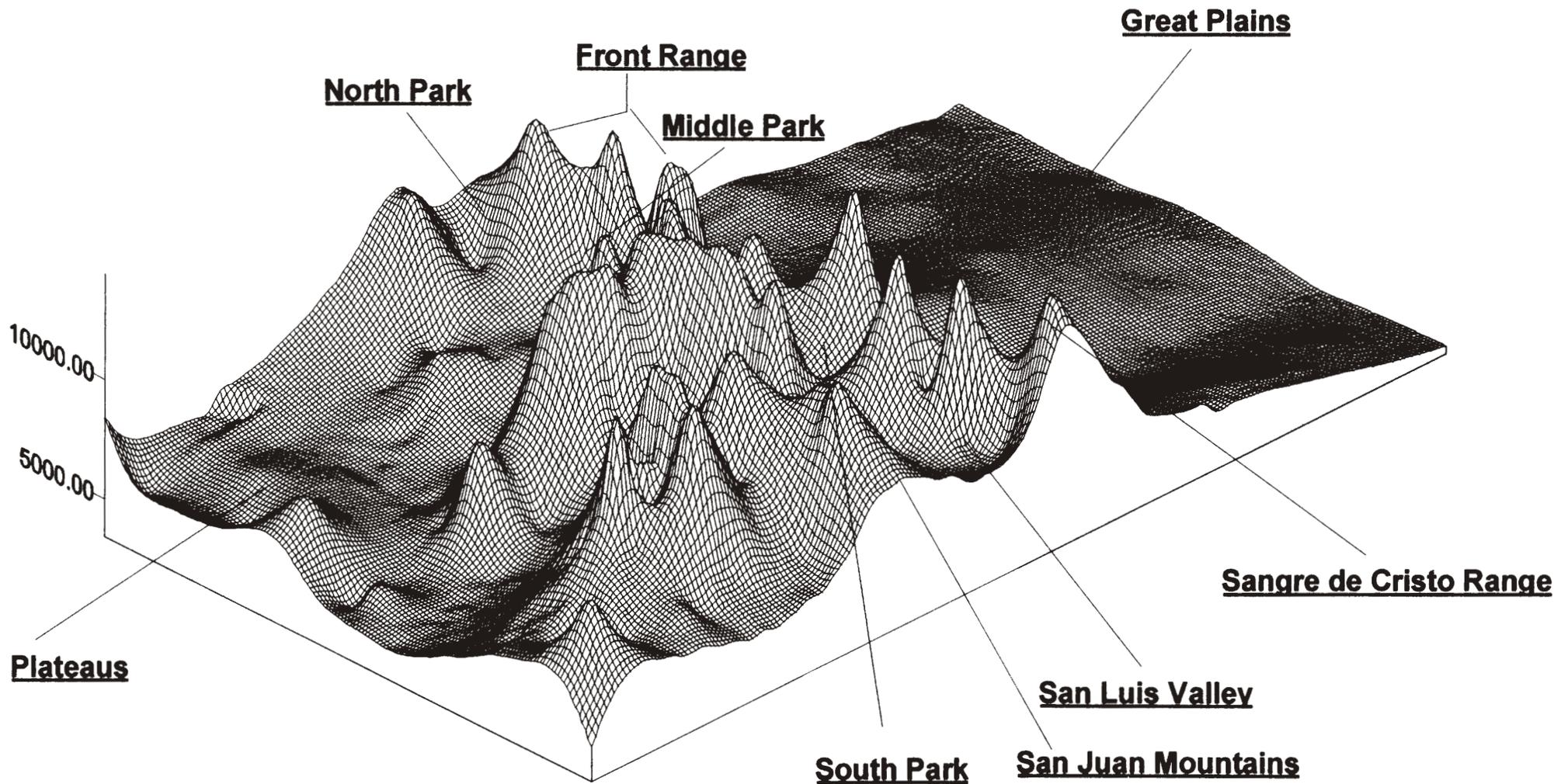
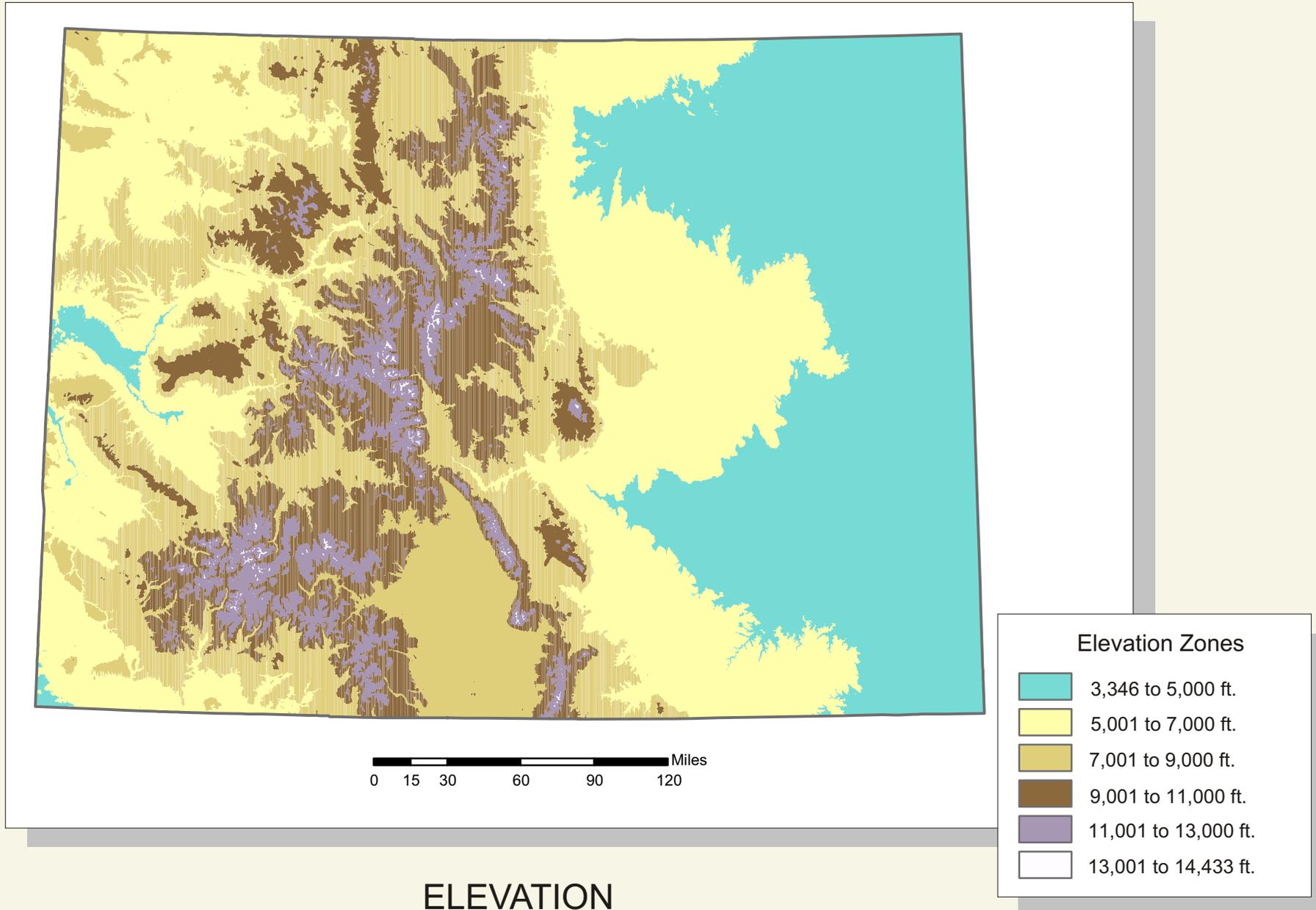
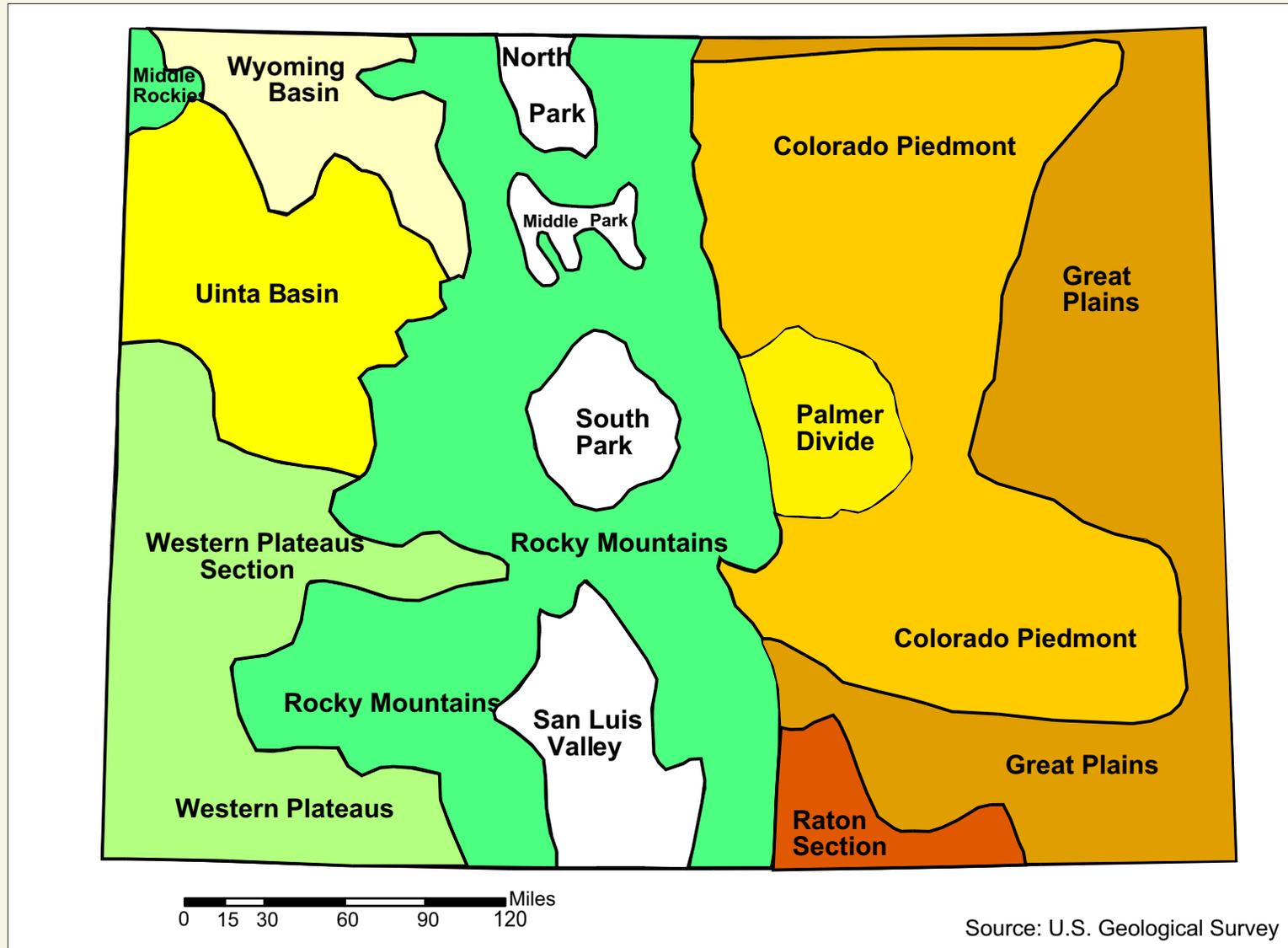


COLORADO TOPOGRAPHY







LANDFORM REGIONS

TOPOGRAPHY-LANDFORM REGIONS-ELEVATION

Cartographers have always been challenged to depict the Earth's varied surface features on a flat sheet of paper. While representing areas of plains would seem comparatively easy, it is when one considers the numerous hills, valleys, gorges, plateaus, and mountains that constitute Earth's topography, and especially Colorado, that the problem comes a bit more into focus.

The three maps titled Colorado Topography, Landform Regions, and Elevation represent three ways to depict the surface features of Colorado.

READING THE MAPS

The simplest depiction of the physical geography of the state is to label the major landform features and group them into regions. Notice that eight distinct terms are used to classify the nature of Colorado's surface: mountain, plain, valley, park, plateau, basin, piedmont, and divide. One region, the Raton Section, is not given a descriptive label, in part owing to the highly varied nature of the land surface there.

By using these landform labels and keying them to particular colors, it is possible to show that significant portions of Colorado share certain types of surface features. For example, the southwestern corner of the state, all the area in light green, is primarily a region of plateau landforms. These are flat surfaces, often elevated, which have experienced considerable erosion from water and wind [PH 17, PH 32, PO 55]. Obviously, valleys exist within this plateau region, but they are not labeled on this map. The reason is that a regional map cannot show all the details of the "real world," but it must generalize. This means that it is only possible to show for each landform region that feature which is most common in that location.

The dominant landform of central Colorado is shown in dark green and labeled Rocky Mountains [PH 24, PH 25, PH 27, PH 28]. Here again the information must be generalized so that only the most common features are represented, in this case the mountains and several large parks or valleys, shown in white [PH 23, PH 30, A 29]. Other landforms exist within this region of mountains and parks or valleys, including limited areas of plains and plateaus. However, the latter are the exception and not the rule and thus cannot be shown on this generalized map of landform regions.

A second way to depict surface features is with a map showing elevation. A series of lines, called contour lines or isolines, are used to give an indication of differences in elevation from place to place. At first it may appear quite complicated and even confusing. But notice that each line connects or runs through points of equal elevation. For example, the line at the right of the map (extreme eastern Colorado) is labeled 4000, which means that at any point along this line the elevation is 4000 feet above sea level. Move your view to the west and the next line is labeled 5000. As indicated (Contour Interval = 1000) each isoline is either 1000 feet higher or 1000 feet lower than the line next to it.

Where lines are far apart, as in eastern or northwestern Colorado, one must travel a considerable distance across the state's surface to experience either an increase or decrease of elevation of 1000 feet [PH 12, PH 14, A 24]. In contrast, in the mountainous central portion of the state the lines are bunched closely together. This means that by traveling only a short distance it is possible to climb or descend a 1000 feet in elevation, or more [PH 21, PH 24, PH 28]. Here the appropriate terms are "climb" or "descend" because the topography consists of mountains and valleys and local relief (differences in elevation) can be very great even within a small area. Notice that the locations with closely bunched lines correspond with the regions of dark green on the previous map, that is, the Rocky Mountains. Also located within the mountain landform region are several parks and a large valley. Find these and examine the nature of the contour lines in these places.

Understanding this map and being able to "see" the high and low spots in the topography requires practice. It may be necessary to find a line with an elevation label and count carefully from that point in order to know the precise elevation of other lines. Even then it may not be clear at first if the elevation is increasing or decreasing. What may help is to look at the next map -- Colorado Topography.

Here the cartographer has used a technique that appears to spread a "net" over the peaks and valleys, the plateaus and plains of the state. The map is still on a flat sheet of paper but now the surface appears to be three-dimensional. It also helps that some of the surface features are named, e.g., Great Plains, Sangre de Cristo Range, etc.

Looking at the three maps side-by-side, it should be easier to "see" the differences in elevation and surface features. Notice that elevation changes so gradually in the landform regions labeled Great Plains and Colorado Piedmont that the map of topography shows little variation in this region. By contrast, in the mountainous regions the isolines are close together and the map of topography shows mountains and valleys in close proximity.

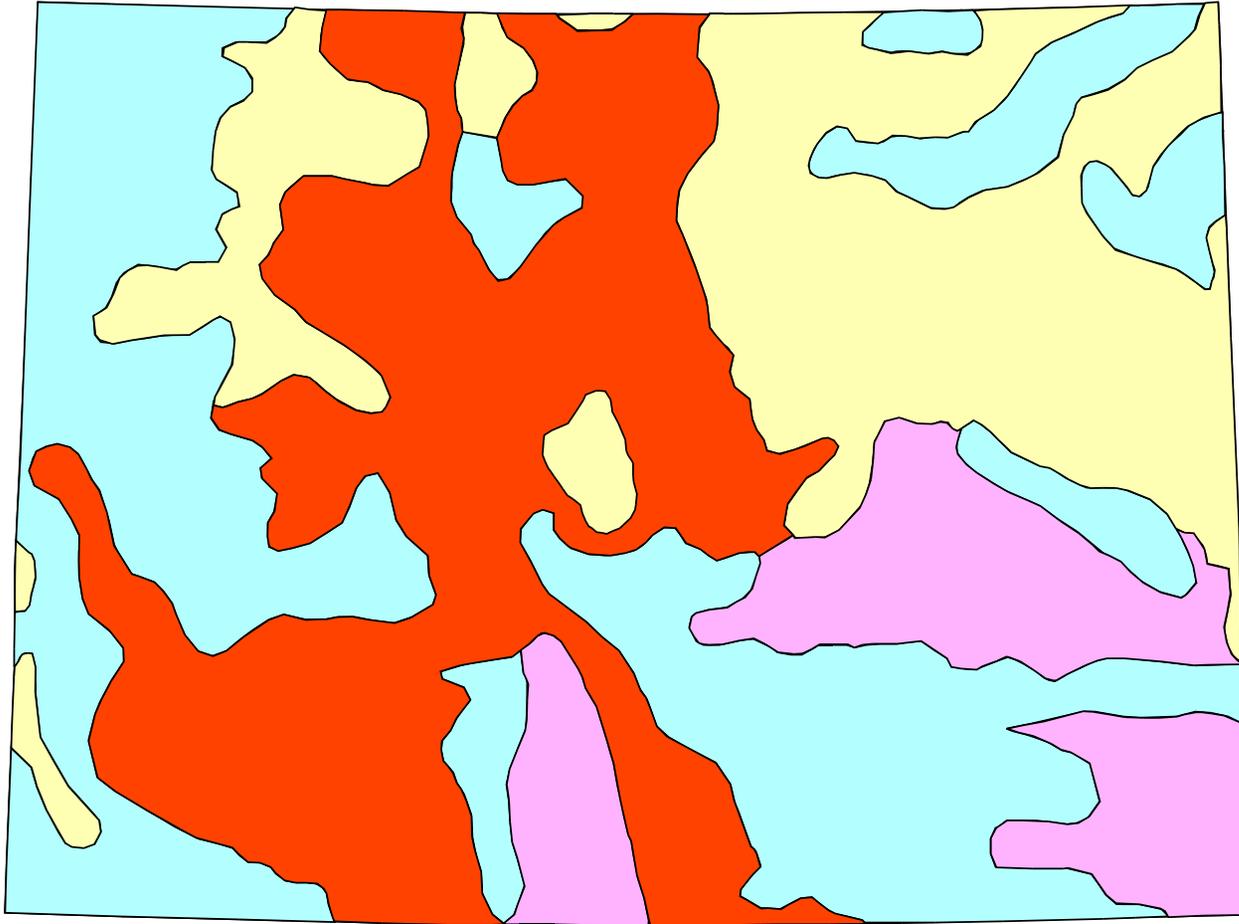
Most people are more attracted to the topography map than to the other two and feel that it gives them a better understanding of what Colorado is really like. Why, then, include the elevation map at all? First of all, the topography map is much more difficult to draw. Very few people can construct such a map by hand, and then it would require a great amount of time. This particular map was drawn by CAD (Computer Assisted Drafting), but not everyone has the software program needed to create this map. And even this program requires that the elevations of many locations be fed into the computer before the drawing can occur. But there are two other problems with this map that are important to understand. In order for peaks and valleys to be clearly seen it is necessary to exaggerate the actual differences in elevations. So what is depicted on this map is not exactly what one would see if traveling through these regions. Also, in a mountainous region like Colorado this form of topography map hides some places behind the higher elevations. Notice in this map that you cannot see much of the eastern slope of the Front Range and only a tiny bit of the Palmer Divide (visible between two of the peaks). These are important regions of Colorado and should not be omitted on any map. However, if the topography map was rotated so the viewer would seem to be looking westward from some part of the Piedmont (which is something the computer mapping program can do!), then much of western Colorado would be blocked from view by the high mountains of the Front Range.

QUESTIONS TO THINK ABOUT

What is the best method to show the Earth's very "unsmooth" surface on a flat, smooth piece of paper? There is probably not a single most correct answer to this question. It depends upon the cartographer's purpose and what the map reader is supposed to learn.

However, the nature of the Earth's surface, and of Colorado's, is very important. Many things are strongly influenced by the nature of the local topography. For example, would you rather go skiing on the surface of the Great Plains, the Western Plateaus, or the Rocky Mountains? Would it be easier to build a road or a railroad through the Great Plains, the Western Plateaus, or the Rocky Mountains? How many other ways can you think of that Colorado's topography or the nature of its land surface affect the way we occupy and use this portion of the planet? It may be useful to compare these maps of topography to others showing Population, Transportation, Climate, Farming, etc.

By living, working, and playing upon the land surface of Colorado, humans also impact this physical environment. As you travel about, is it possible to identify ways in which landforms, elevation, or topography are being changed? If so, do you believe these changes are direct and intentional, or indirect and unintentional? Would it be possible to map such changes?



Source: National Atlas of the United States of America

SOILS

-  **Alfisols**
-  **Aridisols**
-  **Entisols**
-  **Mollisols**

SOILS

Soil is generally considered to be that uppermost layer of the Earth's surface occupied by living organisms, that is plants and animals. On a worldwide basis the average soil depth is only about 6 inches, but varies greatly from place to place. The soil found at any specific place on the Earth's surface is the result of basically five factors. These include 1) parent material; 2) climate; 3) topography; 4) soil biology; and, 5) time.

Parent material is the source of the tiny rock fragments that make up the soil. Through a process called weathering, parent material is broken into smaller and smaller particles. These may either come from the underlying bedrock or may be materials transported from other places by wind, water or ice.

Temperature and moisture are the most important climatic factors in soil formation. Generally, the warmer and wetter a climate is the more rapidly parent material is broken down into soil. Conversely, in cooler and drier locations soils evolve more slowly.

Topography is also an important factor in soil formation. As a general rule of thumb, soils develop to greater depths on flat land than on hillsides or mountain slopes. On sloping topography erosion can carry away soil from the land surface faster than weathering converts parent material into new soil. On level or gentle surfaces, such as valley bottoms or plateaus, soils tend to accumulate.

Soils consist mainly of mineral matter (small fragments of parent material), air, and water, plus a very small portion of organic matter. But the organic material, made up of living and dead plants and animals, is of extreme importance to soil fertility. Decomposed and decomposing organic matter is called humus and it plays an important but complicated part in maintaining soil fertility. Often on cultivated land, the natural humus content is supplemented by applications of manure.

The final factor in soil formation is the period of time the various processes have acted upon parent material and interacted. For example, it is common practice to refer to soils as immature or mature, depending upon the length of time they have been in the process of formation. Finally, since soil formation is such a slow process soils are generally considered a nonrenewable resource; when they are damaged or destroyed it is not feasible to await development of a new soil.

Soil Classification

The most common soil classification system is based on a soil's properties. This produces 10 or 11 Soil Orders and many sub-orders. As one would expect in a place of such varied elevations, topography, and climate, Colorado exhibits a complex pattern of soils. The generalized distribution of the four most extensive soil orders is illustrated on the accompanying map.

Alfisols

Alfisols are mature soils that develop under a variety of environmental conditions. The name is derived from two abbreviations, "Al" for aluminum, and "f" for Fe, the symbol for iron, common elements in this soil order. In Colorado they are found mostly in upland areas of uneven terrain and colder climates where their usefulness is frequently limited by shallow depth, varied topography, and short growing seasons. Even a quick glance at the map suggests that Alfisols can be associated with the Rocky Mountains and some of the more rugged portions of the western Colorado plateau country.

Aridisols

These are the soils of dryer lands and generally associated with desert and semidesert climates, thus the prefix "arid." As the map reveals, Aridisols are concentrated in southern and southeastern Colorado. The south central region of Aridisols is in the San Luis Valley, one of the driest locations in the state. The remaining two areas are in locations of limited precipitation and high average temperatures, a combination of environmental factors that keep soil moisture low. In their natural state Aridisols are generally unproductive due to this lack of moisture. Where irrigated, however, these soils can be quite productive, as in the San Luis Valley where they support a variety of crops including vegetables and small grains. [A 29], [A 34]

Entisols

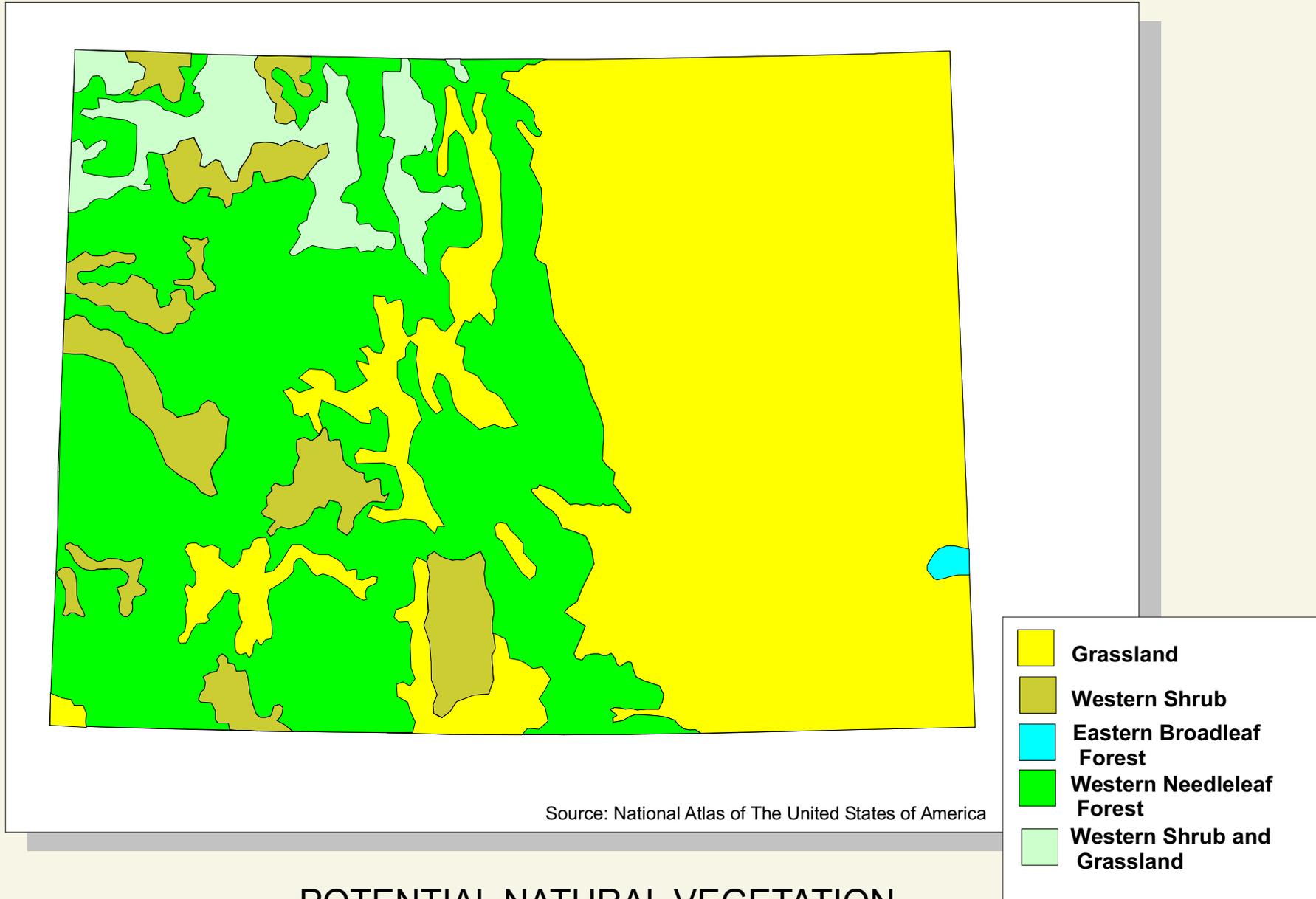
Entisols are immature or underdeveloped soils owing to their recent origin (the "Ent" prefix is merely the last three letters of recent). They may also be associated with dryer climates.

The most extensive deposits of Entisols in Colorado occur in river valley as a result of alluvial (water deposited) material. Note that several of these soil regions have an elongated shape. Most notable are the South Platte and Arkansas in eastern Colorado, the Colorado River and its tributaries in the west, and the Rio Grande along the western margin of the San Luis Valley. Smaller regions of Entisols occur in mountain valleys such as North Park and remnant basins of now seasonal streams. Where irrigated this soil order tends to be very productive. [A 26] [A 32]

Mollisols

Mollisols are found in regions where neither arid nor humid conditions characterize the climate, but where environmental conditions support the growth of grasses. These are soils that generally have a rich humus content owing to the decay of extensive grass roots systems. On a world wide basis Mollisols are probably the most productive of all soil orders because of their high organic content and relative ease of cultivation.

Large areas of northeast Colorado are in this soil order, with a smaller region in the northwest. Where irrigation water is adequate these soils are highly productive. But even where plant growth is dependent upon natural precipitation more drought resistant crops such as wheat, barley, and sunflowers are grown. [PH 14] [A 37] [A 23]



POTENTIAL NATURAL VEGETATION

POTENTIAL VEGETATION

Vegetation is the mosaic or pattern of plant communities evident upon the landscape. Mapping vegetation is, however, a difficult task. On the one hand the variety and distribution of plant communities found in Colorado's complex range of environments cannot be comprehensively portrayed at the map scale used in this atlas. The second problem and perhaps the greater one is the impact of human actions upon vegetation. Some plant communities have been largely, if not completely, eradicated. At the same time, exotic plant species are intentionally introduced (new crops), as well as unintentionally (unwanted species we collectively term "weeds").

In response to this latter problem, the concept of potential natural vegetation is applied to the mapping of plant communities. Potential natural vegetation is defined as the vegetation that would currently exist assuming the following: the effects of earlier human impacts on plants are acknowledged; human influence is removed from the scene; plant communities establish their distributions on the basis of natural competition (succession) under conditions of constant climate. Stated most simply, potential natural vegetation would be "plants growing where they grow best without interference from humans."

The distribution of vegetation is of interest to geographers, and should be to everyone, for three reasons: it is the most visual component of the landscape; it is usually an indicator of other environmental conditions, e.g., precipitation, temperatures, air movement, soils; it usually has a significant impact on human activities.

Five major plant associations are found in the Colorado; the vegetation typical to each is listed below.

Grassland [PH 14] [I 28] [PO 58] [A 37] [PO 65]

- fescue-mountain muhly prairie
- gramma-buffalo grass
- sandsage-bluestem prairie

Broadleaf Forest

- northern floodplain forest

Western Forest [PH 25] [PH22]

- western spruce-fir forest
- pine-douglas fir forest
- spruce-fir-douglas fir forest
- southwestern spruce-fir forest
- juniper-pinyon woodland

Shrub and Grassland [PH 23] [PH 17] [A 29]

- mountain mahogany-oak scrub
- great basin sagebrush
- saltbush-greasewood
- sagebrush steppe

Western Shrub [PH 13]

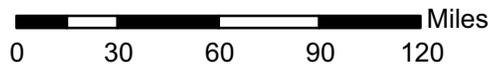
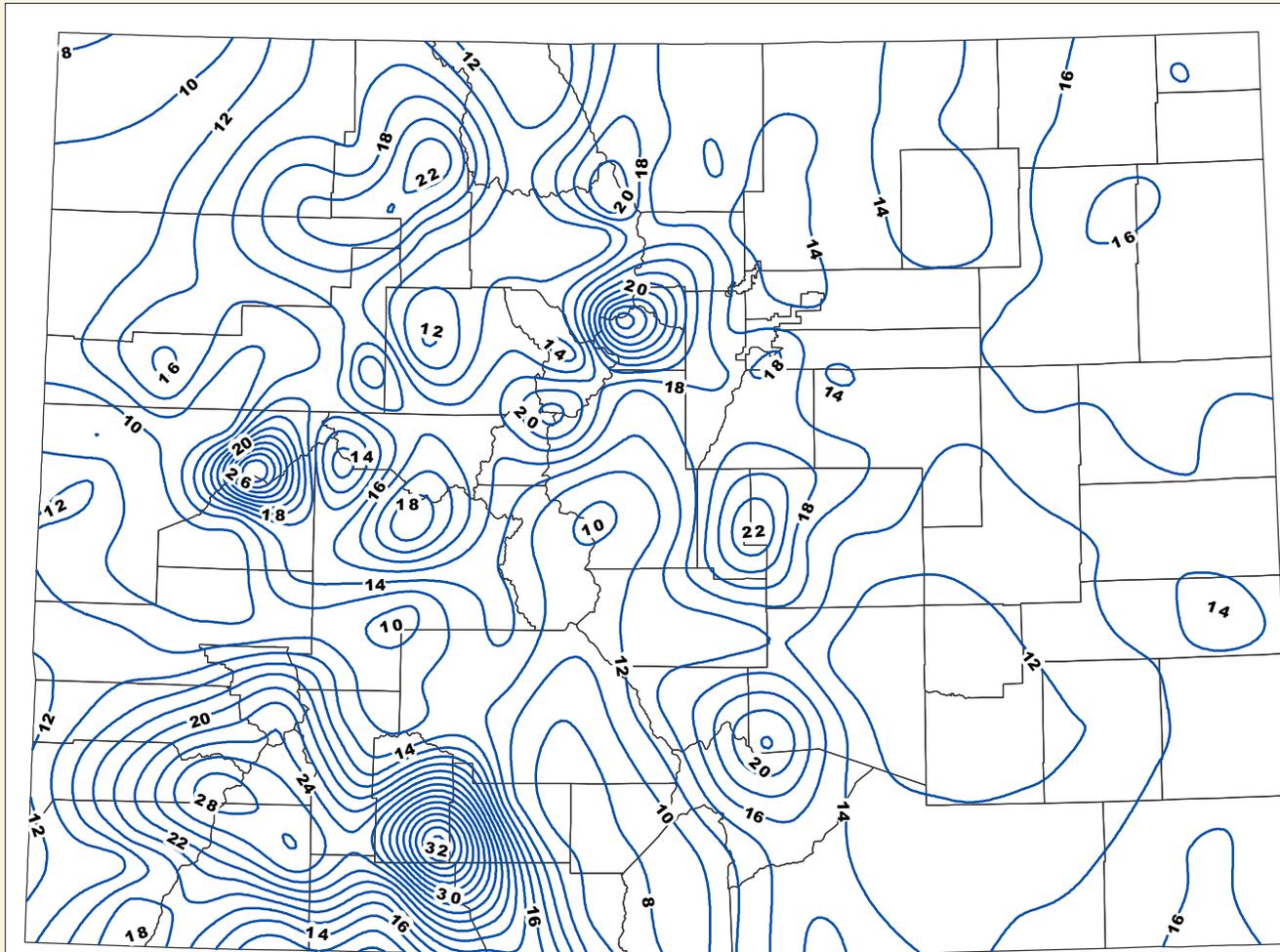
- Mountain mahogany-oak scrub
- great basin sagebrush
- saltbush-greasewood

QUESTIONS TO THINK ABOUT

In terms of the variety of vegetation, how can eastern Colorado be so different from the rest of the state? Remember, the map depicts "potential natural vegetation," so that differences in plant communities is primarily owing to natural environmental conditions, not current human activity. Are there any other maps of natural conditions in which eastern Colorado appears to be quite uniform and at the same time quite different from the remainder of the state? Are the patterns on the maps of vegetation and elevation at all similar?

Do you live in eastern Colorado, or have you traveled along the South Platte or Arkansas River valleys? Is that region of the state all grass, as the map suggests? Can you find trees there? The answer is Yes!, there are trees in this natural grassland. But where did they come from and how do you think they got there?

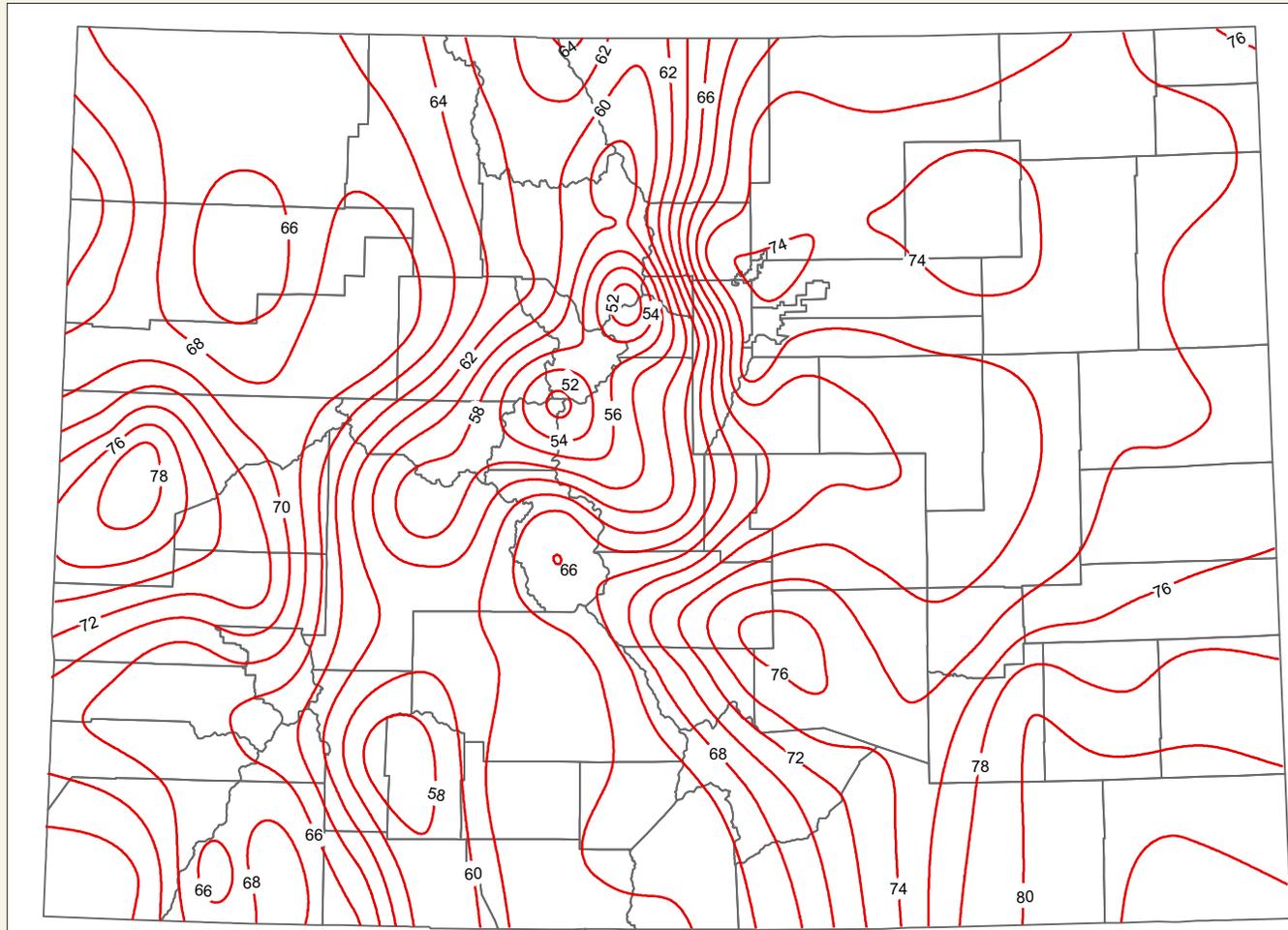
How different would a map of "actual" vegetation be from this map of potential natural vegetation? Plot your school or home location on the map of potential natural vegetation. Take a brief field trip outside to observe, record, and identify the different plants you encounter, especially those occurring repeatedly (do not ignore lawns, gardens, and crops!). Do your observations fit what the map indicates is the vegetation type in your location? How can you explain differences? Remember the caution given in the first paragraph of this section about the difficulties of mapping vegetation.



Source: Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-1990, Colorado

Interval = 2 Inches

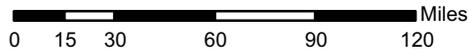
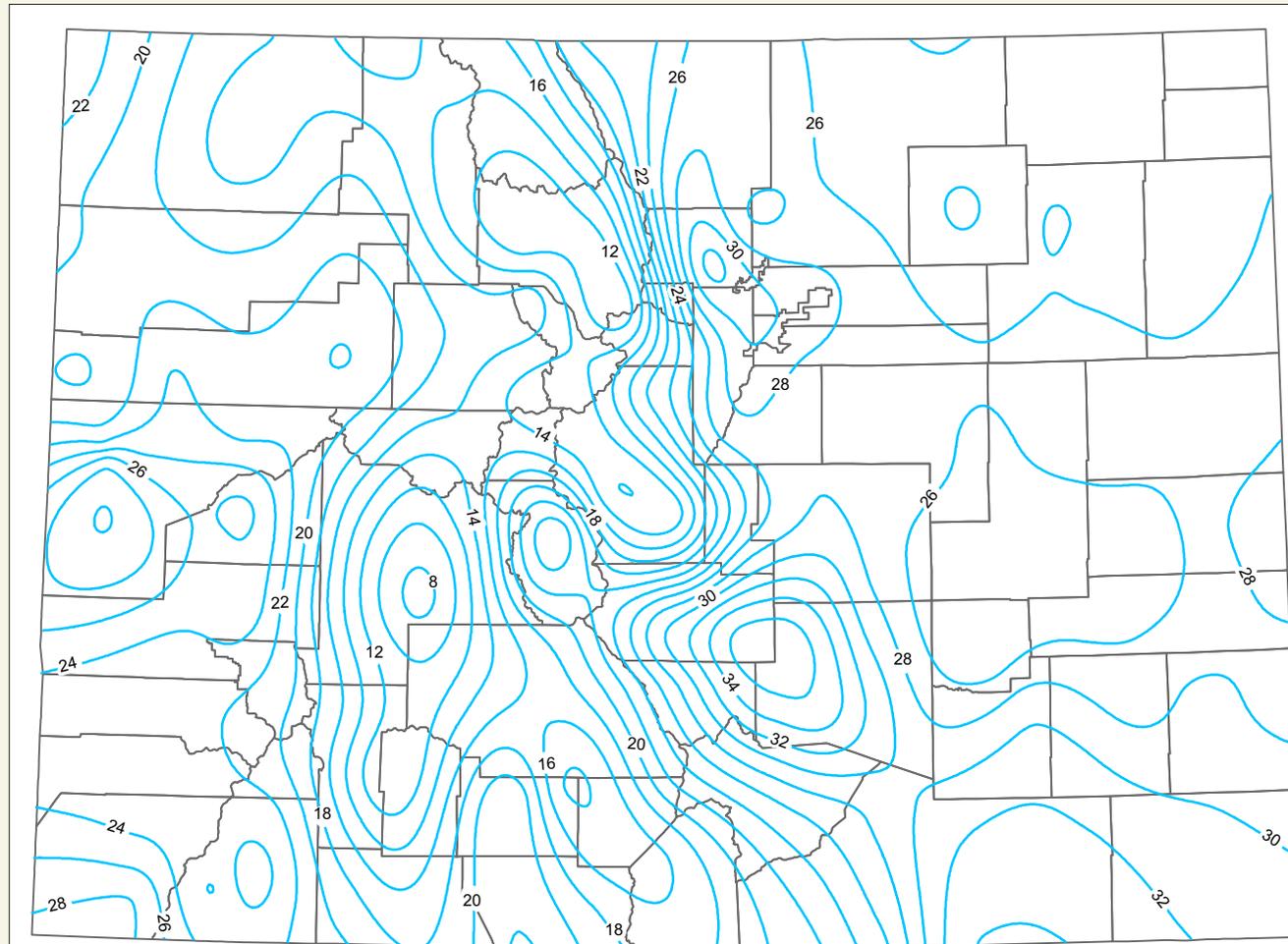
Average Annual Precipitation



Source: Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-90, COLORADO

Interval = 2 Degrees F.

Average July Temperature



Source: Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-90, COLORADO

Interval = 2 Degrees F.

Average January Temperature



Pawnee Buttes

Eastern Colorado is a region of plains, broad river valleys, and rolling uplands. The origin of these landforms is essentially depositional, primarily water and wind-borne materials originating in regions to the west and northwest. Occasionally, the gentle topography is broken by erosional remnants such as the Pawnee Buttes where a more resistant layer protects somewhat the underlying soft materials from the forces of erosion. These buttes provide a layered geologic history of this portion of eastern Colorado.



Wyoming Basin

The flat to rolling topography of the Wyoming Basin extends into northwestern Colorado. This elevated basin is dry, with a typical vegetative covering of bunch grasses and sagebrush. Sheep are more numerous than cattle in this environment. Large deposits of oil, coal, and oil shale underlie much of this region.



Plains Vegetation

Though historically referred to as a desert, the plains of eastern Colorado actually lie in a zone of steppe, an environment of low-growing grasses and other drought-resistant or xerophytic vegetation. The yucca plant is known by a variety of names, including Spanish bayonet for its pointed, blade-like leaves, or soapweed, since pioneers made a form of soap from its roots and found its leaves handy for scouring cooking utensils. Unfortunately, extensive areas of yucca indicate overgrazing.



Tornado Watch

Owing to a variety of factors -- continental location, proximity to the Rocky Mountains, elevation, latitude -- the weather in eastern Colorado is subject to frequent and sometimes radical change. An early summer storm cell is cause for concern. Such a system may produce violent thunder showers, damaging hail, or even a tornado. Annually, eastern Colorado produces a substantial number of reported funnel clouds and/or tornados, though these are fewer and smaller than the occurrences in Texas, Kansas, or Oklahoma.



South Platte River

For most of the year, the South Platte River makes its way between low, Cottonwood-covered banks as it crosses the plains of eastern Colorado. Only during late spring and early summer runoff is there a notable increase in volume and occasional flooding. Hydrologists speculate that prior to modern settlement, the South Platte in eastern Colorado ceased flowing most years during late summer and fall. Seasonal fluctuations are now reduced owing to storage and diversion of water from Colorado's western slope; downstream states such as Nebraska are by law assured a continuous flow.



Colorado River

Near the point where it leaves the state, the Colorado River flows between flat-topped formations of red sandstone. This river, once called the Grand River, has the greatest volume of any river in the state and its water is used by residents as far away as Arizona, southern California, and Mexico. Over-use is a significant environmental problem.



Hail

Each summer, thunderstorms develop over eastern Colorado with thunderheads (cumulonimbus clouds) that may reach 60,000 feet in elevation. These hail stones destroyed crops, punctured roofs, and damaged vehicles. They were produced when strong vertical air currents in the towering storm carried ice particles up and down, repeatedly adding layers of ice until the stones could no longer remain suspended in the atmosphere.



Horsetooth Reservoir

Beds of horizontal sediments were lifted and tilted by the intrusion of igneous materials into what are now the Front Range mountains. Erosion has removed softer strata leaving elongated valleys between ridges (hogbacks) of harder sediments. Horsetooth Reservoir is impounded within one of these erosional valleys.



Raton Mesa

The horizontal flow of molten rock created this elevated mesa (table) near Colorado's southern border. Within the Raton Section are many other evidences of volcanic activity, including small necks or plugs and cinder cones.



Spanish Peaks

These two large mountains were created as masses of volcanic magma intruded or pushed upward into the overlying sediments. Erosion has stripped away much of the softer sedimentary material revealing the harder volcanic rock as well as numerous wall-like dikes radiating outward from each peak, much like the spokes of a wagon wheel.



Wolf Creek Pass

This location in the San Juan Mountains of southwestern Colorado is one of the wettest places in the state. The mountains intercept moisture bearing winds, force them to rise, and the result is precipitation, often in the form of snow. In a single winter season, nearby Wolf Creek Pass has received as much as 400 inches of snow.



South Park

Located within the mountains of Colorado are several large flat-floored basins commonly referred to as "parks." South Park, measuring approximately twenty-four by forty-eight miles, appears to be a grassy and virtually treeless plain. However, the basin's average elevation is 8,800 feet. The headwaters of the South Platte River arise in this basin.



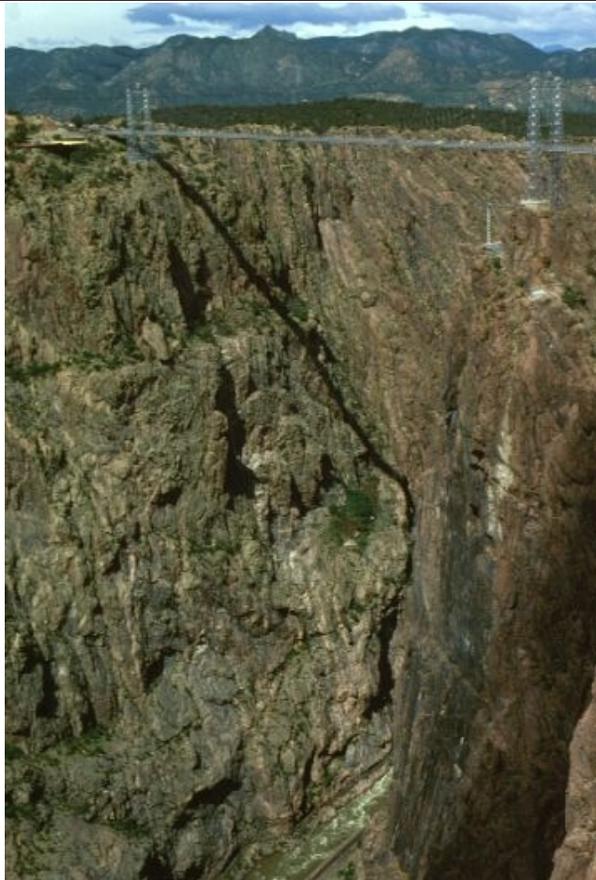
Blanca Peak

Part of the Sangre de Cristo range, Blanca Peak (14,345 feet) takes its name from the light colored granite that forms the summit. As the fourth highest mountain in Colorado, Blanca Peak is also covered with snow much of the year. The entire range was created as a portion of the Earth's crust was heaved upward along a zone of faults or fractures.



Rocky Mountain National Park

Higher elevations of the Front Range receive abundant snow most years. Note the U-shaped valley carved by ice. Many glacial landforms exist in the Park, including moraines, horns, tarns, and even small ice fields.



Royal Gorge

The Royal Gorge Bridge spans a 1,200-foot-deep canyon carved by the Arkansas River. As the river erodes downward the surrounding land surface has been uplifted, accelerating the work of the river. The suspension bridge is the world's highest, hanging 1,053 feet above the river, yet its function is as tourist attraction, not transportation link. Owing to the narrowness of the gorge, the single railroad track that runs beside the river is in places suspended from the rock wall.



San Juan Mountains

These mountains are heavily eroded remnants of huge volcanoes that spewed molten rock and ash over present-day southwestern Colorado. Despite the action of water, wind, and ice, more than a dozen peaks in the San Juans exceed 14,000 feet. Vulcanism produced valuable deposits of gold and silver, the basis of several "rushes" and resulting boom towns.



Sawatch Range

Located in south central Colorado, the Sawatch Range contains the state's highest elevation (Mt. Elbert, 14,433 feet) and many of its "Fourteeners," peaks that exceed 14,000 feet. Because of their height, snow remains upon many of the peaks most, if not the entire year.



Grand Mesa

Western Colorado is dominated by plateaus and mesas. The Grand Mesa's surface is composed of thick layers of lava, called basalt. This material once accumulated in valleys where it cooled and hardened. Erosion removed the softer materials surrounding the lava and left the mesa standing high above the intervening landscape.



Great Sand Dunes

Prevailing southwesterly winds moving across the desert floor of Colorado's largest intermontane basin, the San Luis Valley, pick up fine soil particles. As the winds reach the Sange de Cristo mountains they lose velocity and deposit their load near the western foot of that range. The result is Great Sand Dunes National Monument, approximately forty square miles of dunes some of which rise over 700 feet above the valley floor.



Black Canyon

With nearly vertical walls, some more than 2,000 feet tall, the Black Canyon of the Gunnison River is among the most spectacular landscapes in Colorado. Initially, the river cut downward through softer volcanic materials. Once its course was established the river has continued to erode the very hard Precambrian materials through which it now flows. At places, the river nearly disappears beneath jumbles of boulders, making this a challenging run for kayakers.



Colorado National Monument

Spires of reddish Wingate sandstone, some more than 300 feet tall, characterize the Colorado National Monument. Thin layers of harder caprock, light brown in color, protect the underlying and more easily eroded sandstone. In the distance the Colorado River flows through the Grand Valley near western Colorado's largest city, Grand Junction. Notice rock climbers atop this spire.



Dinosaur National Monument

The old and largely sedimentary materials of the Uinta Mountains contain numerous fossils, including those of large dinosaurs. After paleontologists began excavating the fossils, an area extending from northwestern Colorado into eastern Utah was designated a National Monument. Not only did this help protect the fossil beds against unauthorized digging, it also stimulated tourism. In fact, the nearby small town of Artesia, Colorado, changed its name to Dinosaur, Colorado.