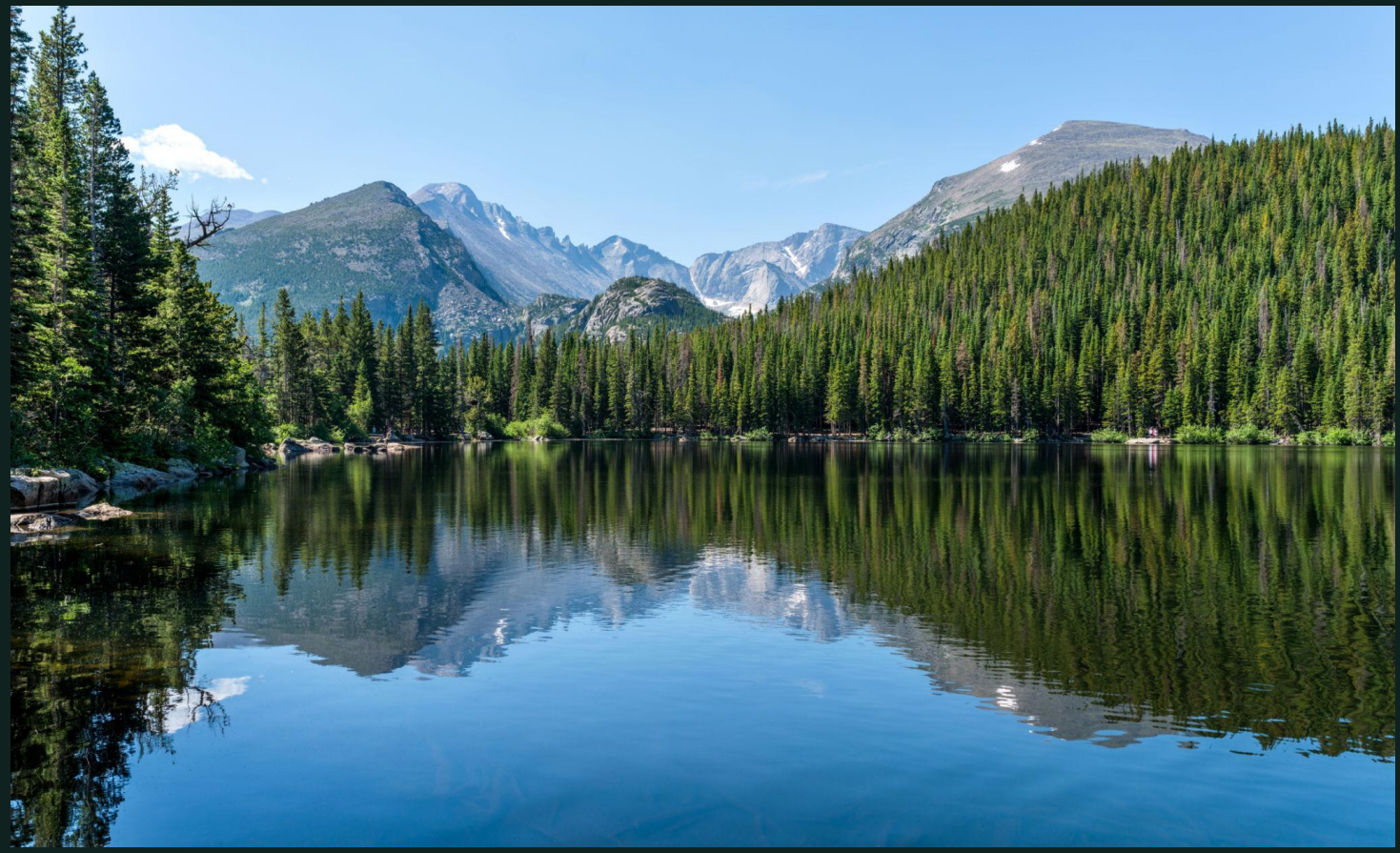
Silviculture in the Southern Rocky Mountains

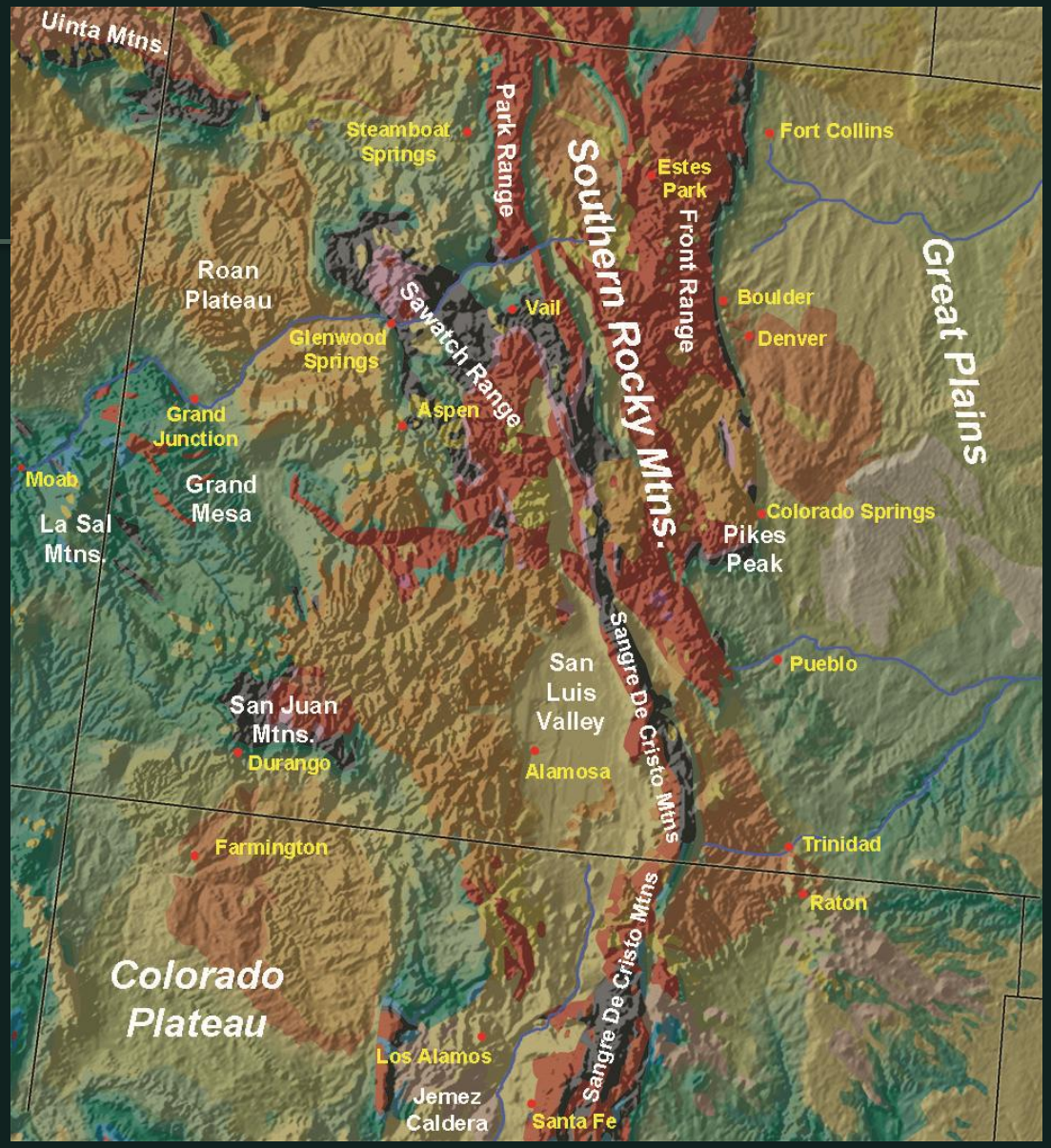


By Nolan Clark

Where are the Southern Rockies?

- Colorado and northern New Mexico; portions extend into southern Wyoming

- Major ranges:
  - Front Range
  - Sawatch
  - San Juan
  - Sangre de Cristo



Public Land

- United States Forest Service (USFS)
- Bureau of Land Management (BLM)
- State Forests



Historical Factors

- **Before 1985**
  - Indigenous tribes used the forest for fuel, shelter, and food
- **1850s – 1900**
  - mining, railroad construction and settlement created massive demand for lumber
- **1900 – 1945**
  - National Forests increased oversight over resources
- **1945 – 1980s**
  - mechanized logging expanded clearcutting
- **1990s – Present**
  - management prioritizes multiple use
  - restoration, wildlife risk mitigation, wildlife habitat, and recreation

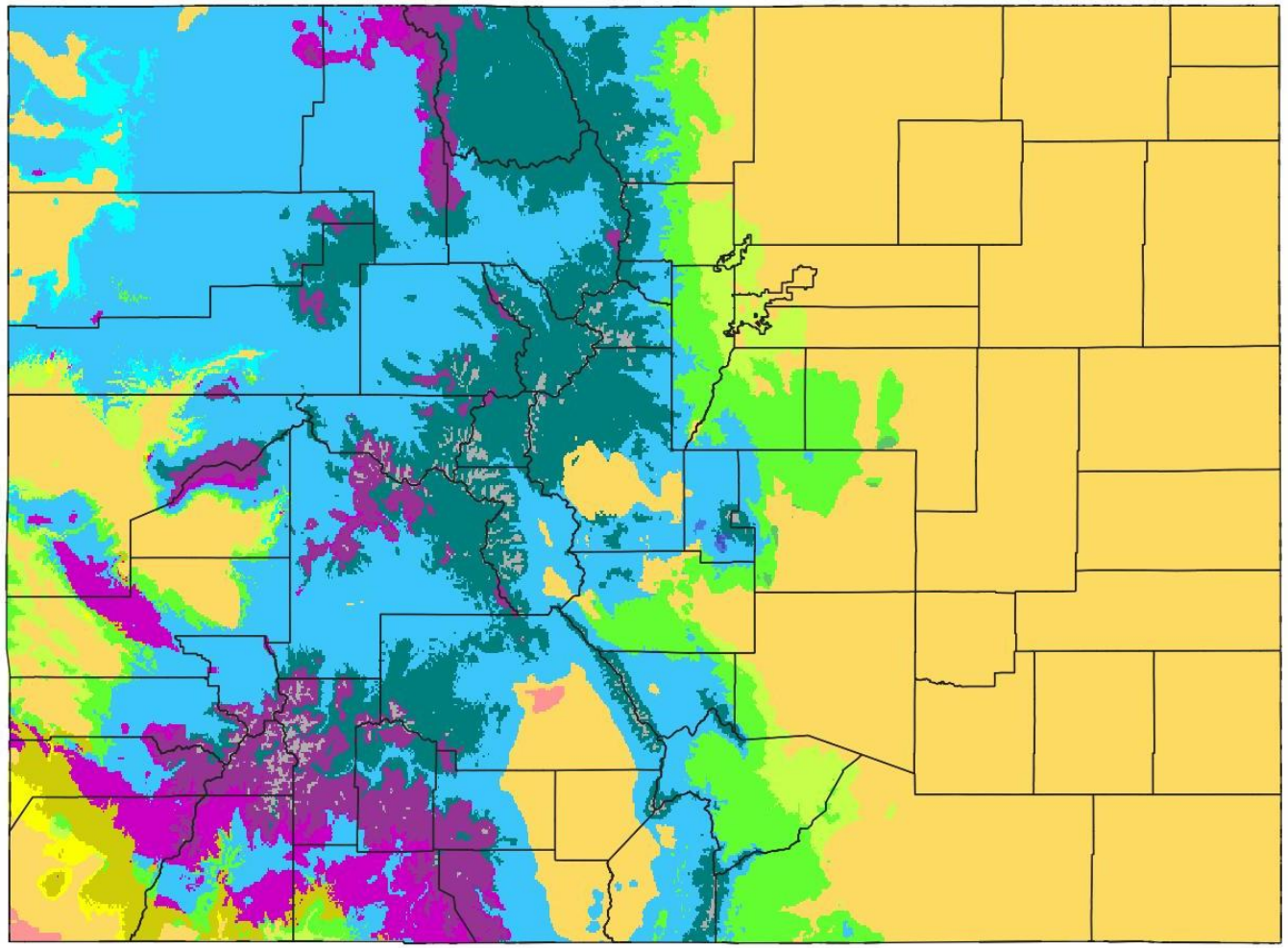


Koppen Climate Types

- Cold semi-arid or steppe (Bsk)
- Warm-summer humid continental (Dfb)
- Subartic or cool-summer continental (Dfc)
- Cold desert (BWk)
- Alpine Tundra (ET)
- Dry-summer continental (Dsb)



Köppen Climate Types of Colorado



- BWk (Cold desert)
- BSk (Cold semi-arid)
- Csa (Hot-summer mediterranean)
- Csb (Warm-summer mediterranean)
- Cwa (Humid subtropical)
- Cwb (Subtropical highland)
- Cfa (Humid subtropical)
- Cfb (Oceanic)
- Dsa (Hot-summer mediterranean continental)
- Dsb (Warm-summer mediterranean continental)
- Dsc (Dry-summer subarctic)
- Dwb (Warm-summer humid continental)
- Dwc (Dry-winter subarctic)
- Dfa (Hot-summer humid continental)
- Dfb (Warm-summer humid continental)
- Dfc (Subarctic)
- ET (Tundra)

Cold semi-arid or steppe

- Low precipitation, warm summers, cold winters
- Locations
  - San Luis Valley
  - North Park
  - South Park
- Species
  - Colorado pinyon pine
  - Rocky Mountain and Utah juniper
  - Ponderosa pine
- Elevation range: 5,000 – 9,000 ft



Warm-summer humid continental

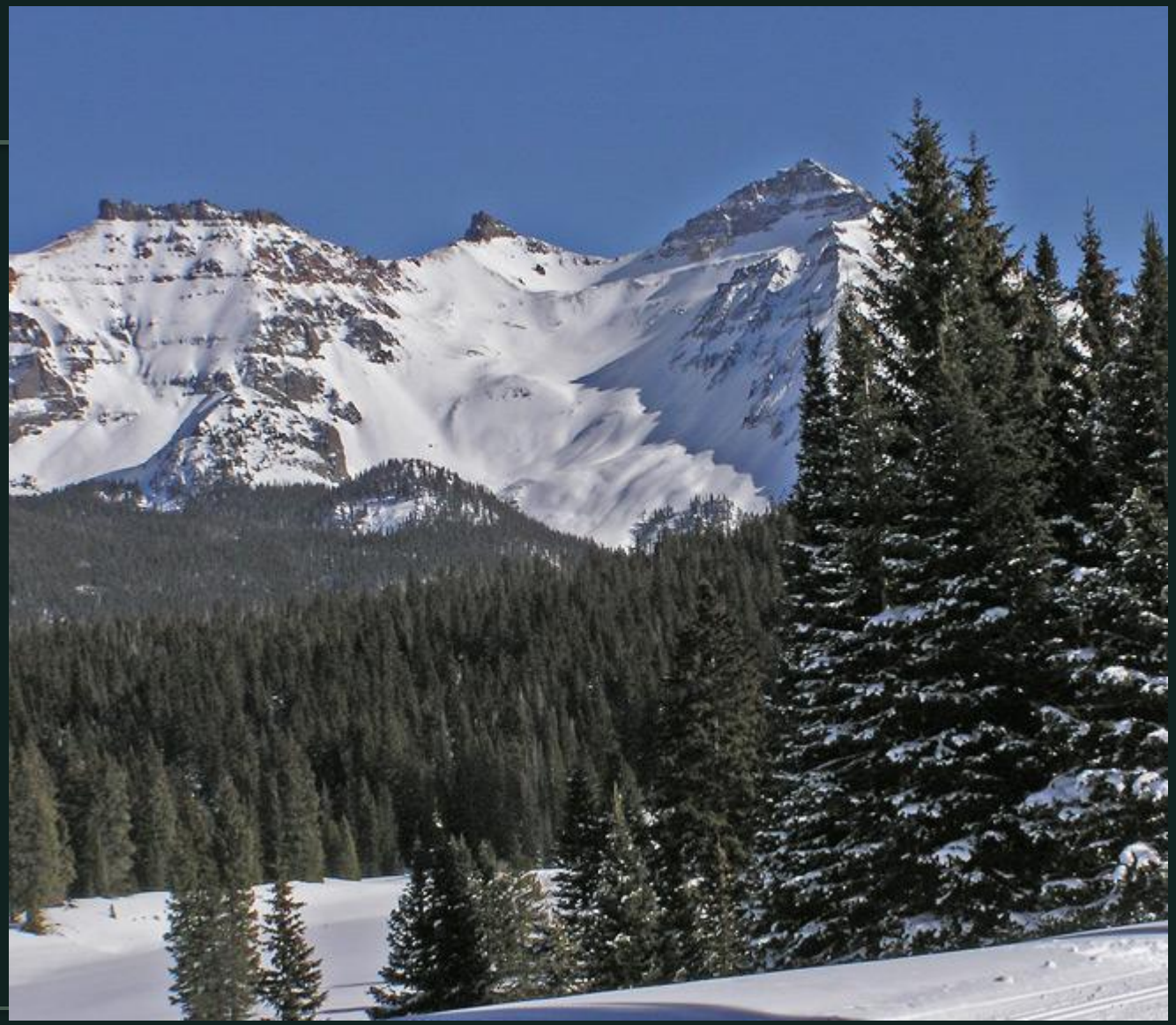
- Cold winters, moderately warm summers, year-round precipitation

- Locations
  - Low and middle montane areas of central and southern Colorado
- Species
  - Ponderosa pine
  - Douglas-fir
  - lodgepole pine
  - quaking aspen
- Elevation Range: 6,000 – 9,500 ft



Subarctic

- Long, cold winters, short cool summers, substantial snowfall
- Locations
  - Park Range
  - Front Range at high elevations
  - Sawatch Range
  - San Juan Mountains
- Species
  - Lodgepole pine
  - Engelman spruce
  - subalpine fir
  - quaking aspen
- Elevation range: 8,000 – 11,500 ft



Cold desert

- Very low precipitation, sparce vegetation

- Location
  - Portions of the San Luis Valley
- Species
  - scattered pinyon and juniper

- Elevation range: 4,500 – 7,500 ft



Alpine tundra

- Freezing temperatures for most of the year, above tree line, short growing seasons, high winds
- Located at high elevations of the :
  - Front Range
  - Sawatch Range
  - Jan Juan Mountains
  - Sangre de Cristo Mountains
- No established forests, occasional krummholz
- Elevation range: 11,000 – 12,000 ft



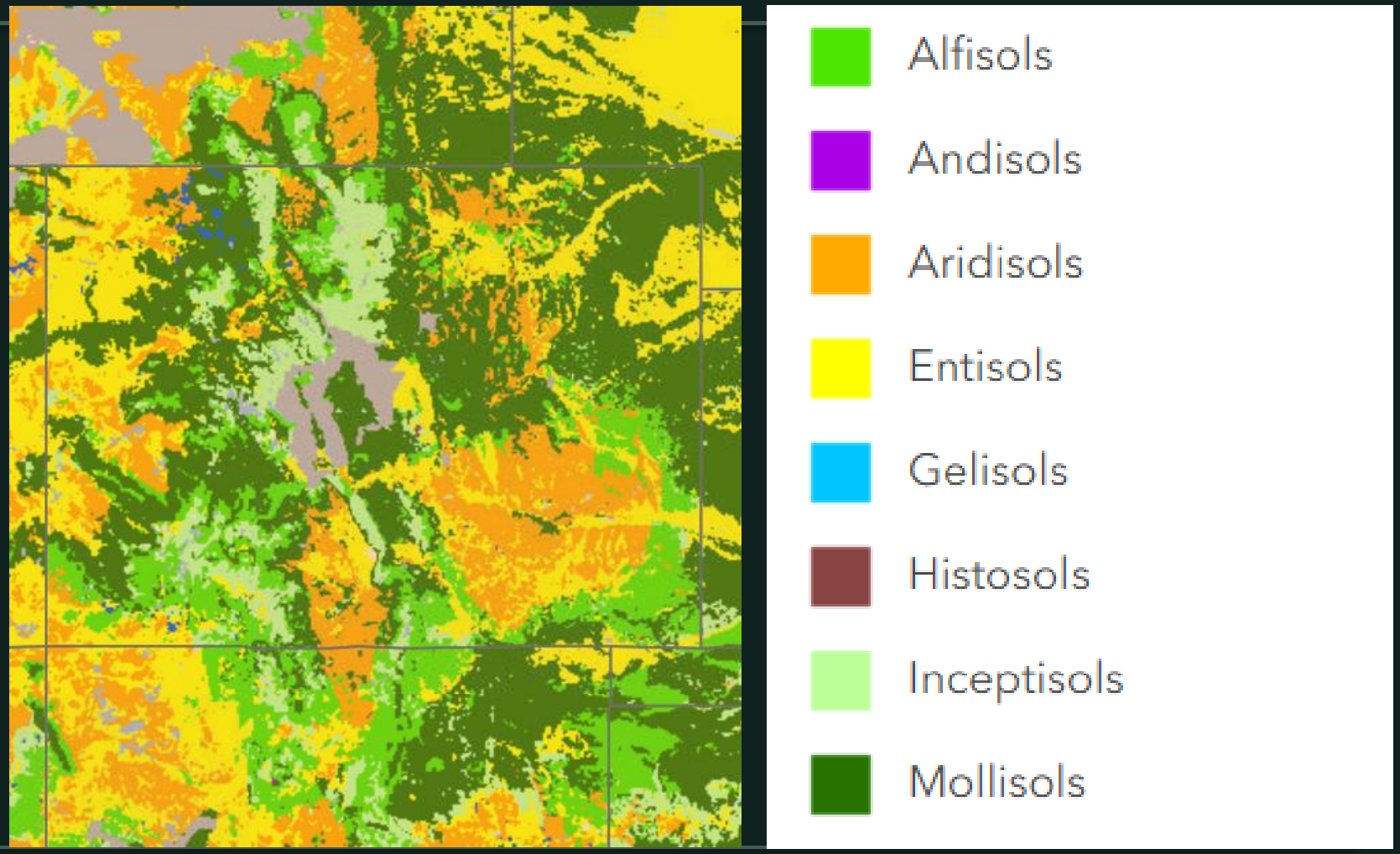
Dry-summer continental

- Cold winters, warm summers, dry summers
- Location
  - small portions of southern Colorado
- Species
  - Ponderosa pine
  - Douglas-fir
  - quaking aspen
- Elevation range: 6,500 – 10,000 ft



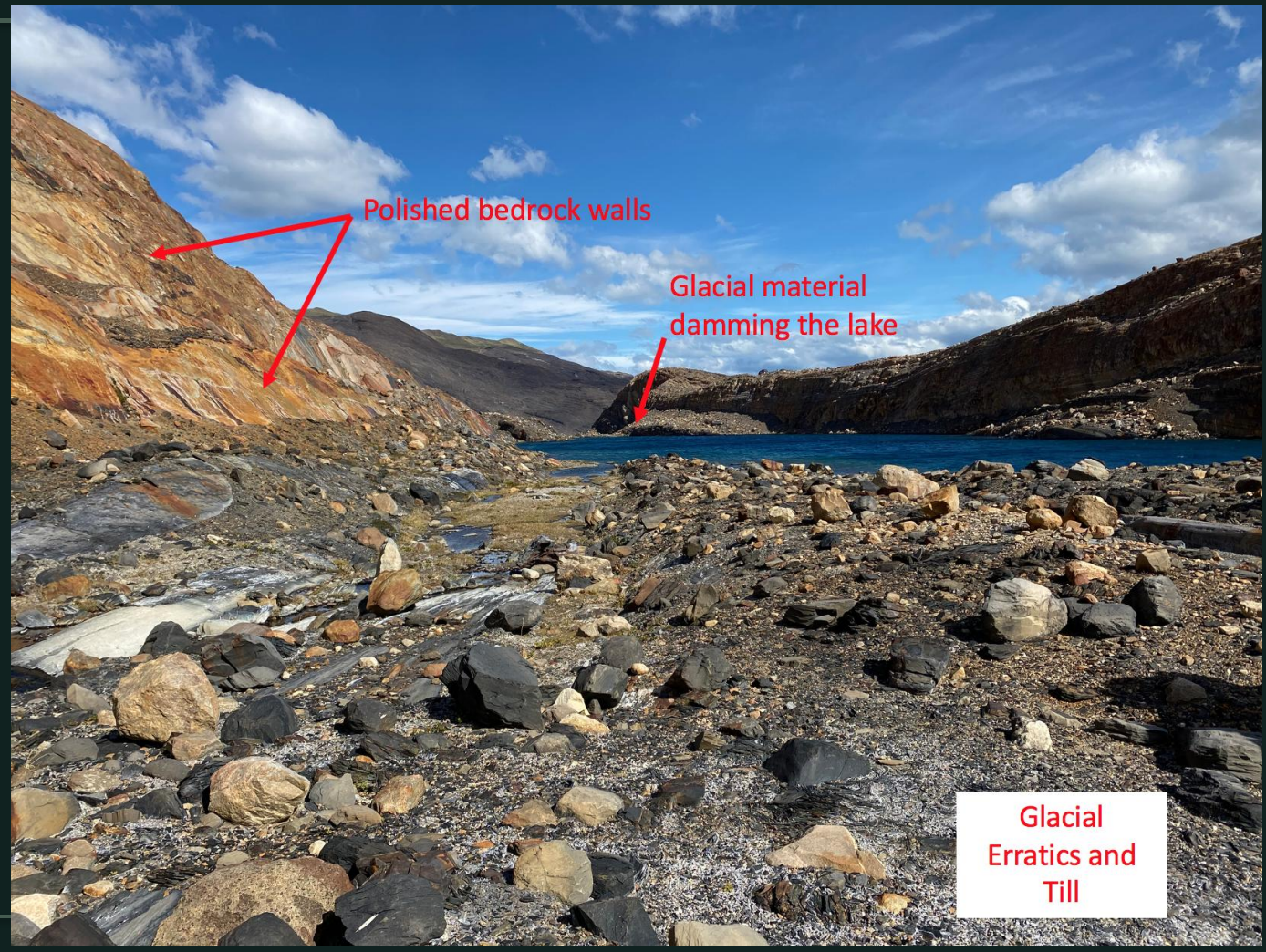
Prominent Soil Orders

- Alfisol
- Inceptisol
- Entisol
- Mollisol

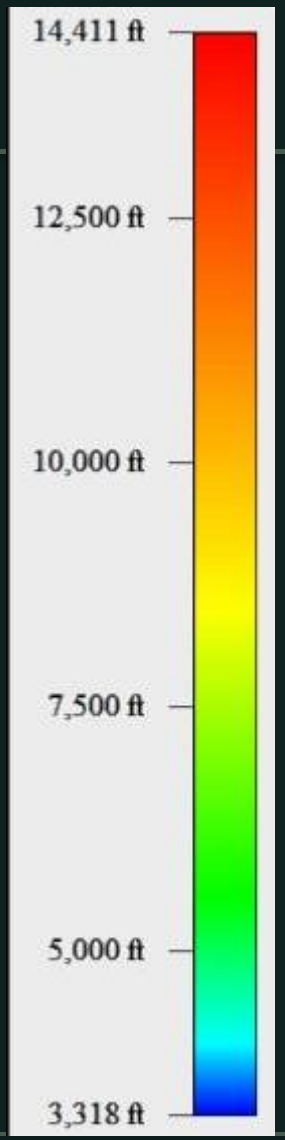


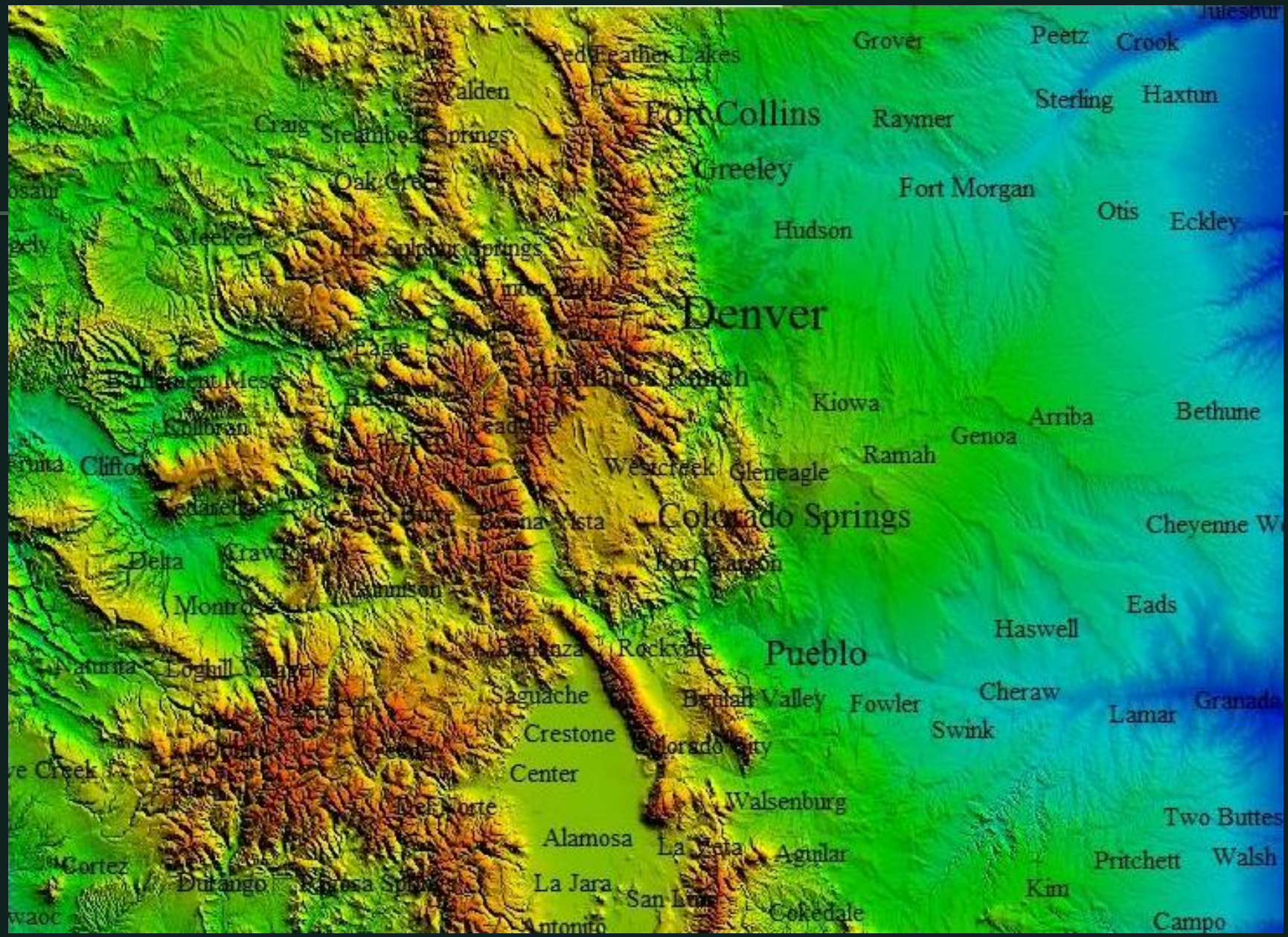
Soil Formation and Regional Geology

- Front Range
  - granite and metamorphic parent material
- San Juan Mountains
  - volcanic parent material
- Flat Tops
  - volcanic caprock
  - sedimentary formations in the surrounding landscape
- Glacial valleys
  - glacial till and outwash



SITE FACTORS



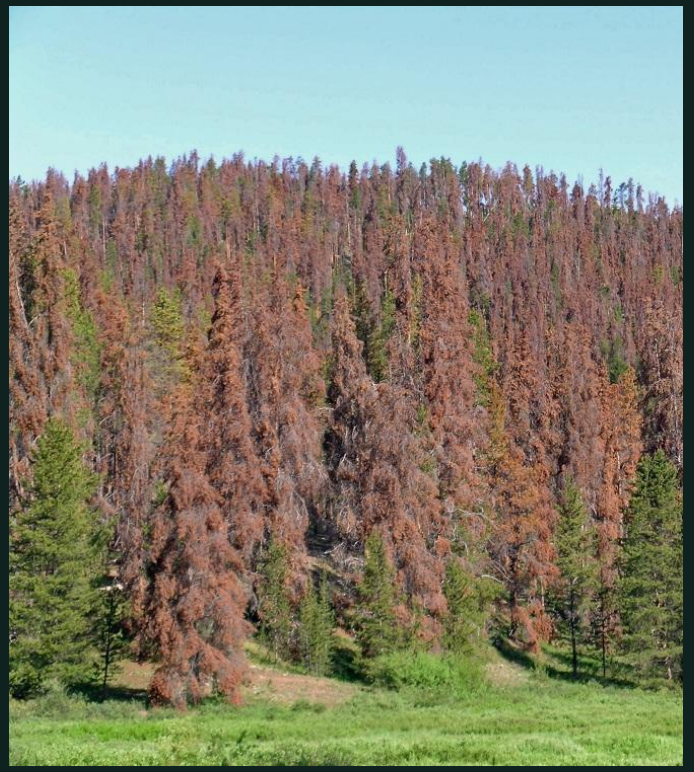


Disturbance Regimes

- Fire



- Insects and Disease



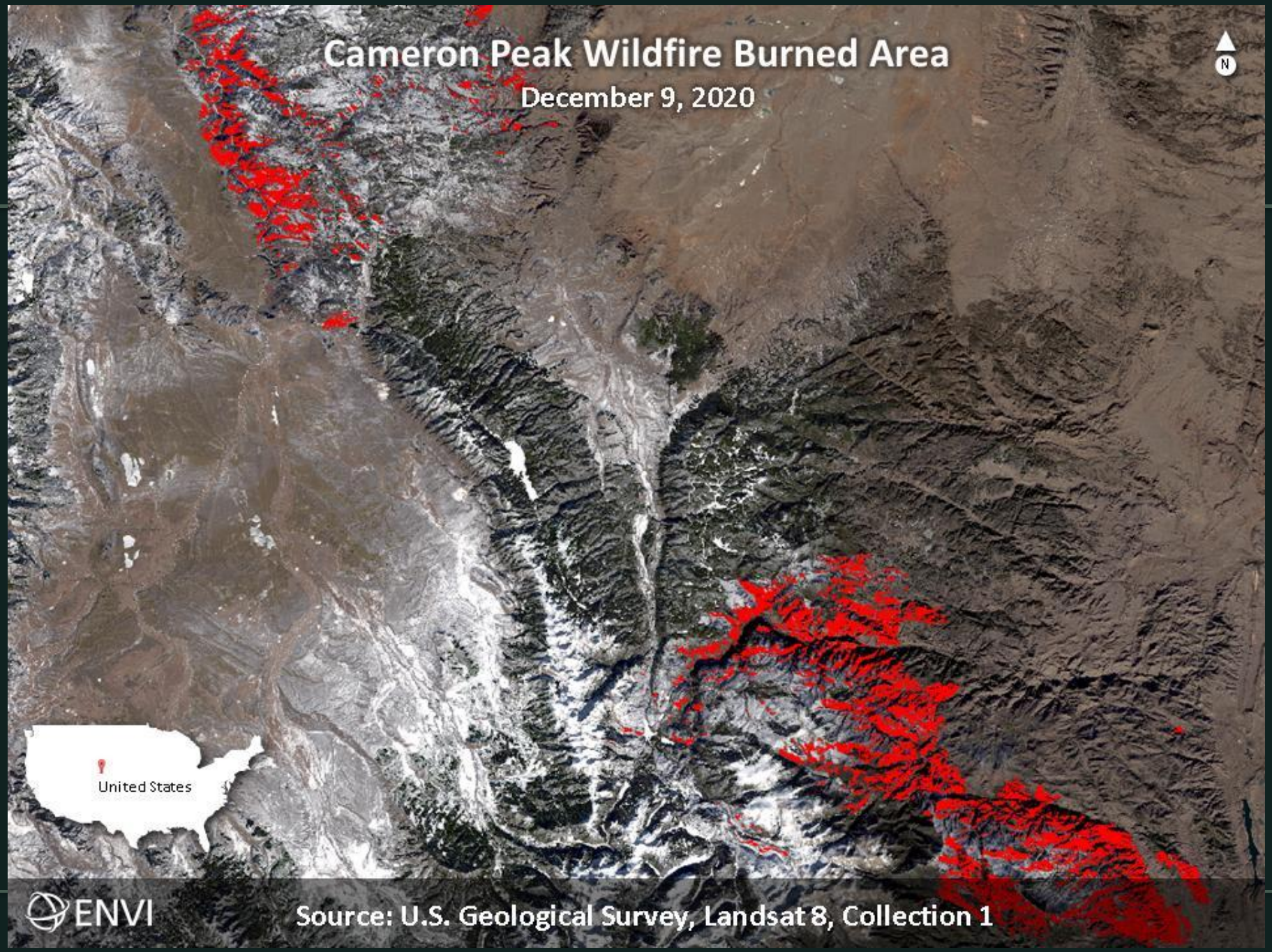
- Windthrow and Avalanches



Fire

- Approximately 2.24 million acres (905,000 ha) burned between 1990 and 2019
- Fires are increasing in severity
  - Williams Fork, East Troublesome, Cameron Peak, Mullen, Calwood
  - 604,550 acres burned combined
  - 55% burned at high severity
- High severity can destroy seed source prevent natural regeneration




Cameron Peak Wildfire Burned Area
December 9, 2020
N
United States
ENVI
Source: U.S. Geological Survey, Landsat 8, Collection 1

Insects and Disease

- **Insects**
  - Mountain pine beetle (*Dendroctonus ponderosae)*
    - 3.4 million acres affected between 1996 and 2013
  - Western spruce budworm (*Choristoneura occidentalis*)
    - 217,000 acres affected in 2024
  - Spruce beetle (*Dendroctonus rufipennis*)
    - 11,000 acres affected in 2024

- **Disease**
  - Dwarf mistletoe (*Arceuthobium spp*.)
    - over 50% of lodgepole pine infected in Colorado
    - seeds are discharged at over 60 mph
    - “Witches’ brooms”
    - reduction in diameter, height, and seed production
    - most Rocky Mountain conifers are susceptible



Wildlife

- Key Species
  - Rocky Mountain elk
  - mule deer
  - black bear
  - moose
  - bighorn sheep
- Habitats
  - montane forests
  - subalpine forests
  - alpine tundra
  - riparian areas

- Management
  - Aspen provides early-successional habitat for elk and mule deer
  - migration corridors







Lodgepole pine (*Pinus Contorta*)

- Cool montane to cold subalpine
  - 8,000 – 10,000 ft
- Dimensions
  - 50 – 100 ft tall
  - 8 – 20 in DBH
- Shade tolerance
  - very intolerant
- Regeneration Strategy
  - wind dispersed seed
  - fire adapted with serotinous cones
- Pests
  - Mountain pine beetle
  - lodgepole pine dwarf mistletoe



Ponderosa pine (*Pinus ponderosa*)

- Dry lower montane
  - 6,000 – 9,500 ft
- Dimensions
  - 60 – 120 ft tall
  - 18 – 36 in DBH
- Shade Tolerance
  - intolerant
- Regeneration Strategy
  - wind dispersed seed
  - establishes in canopy openings
  - mineral soil is preferred

- Pests
  - Mountain pine beetle
  - southwestern dwarf mistletoe



Douglas-fir (*Pseudotsuga menziesii*)

- Cool, moist montane
  - 6,500 – 9,500 ft
- Dimensions
  - 60 – 120 ft tall
  - 12 – 30 in DBH
- Shade Tolerance
  - intermediate
- Regeneration Strategy
  - wind-dispersed seed
  - establishes under partial canopy
  - dry soils
- Pests
  - Western spruce budworm
  - dwarf mistletoe



Engelmann spruce (*Picea engelmannii*)

- Cold moist subalpine
  - 9,000 – 11,500 ft
- Dimensions
  - 60 – 100 ft tall
  - 12 – 30 in DBH
- Shade Tolerance
  - tolerant
- Regeneration Strategy
  - wind-dispersed seed
  - can establish under dense canopy
  - can utilize nurse logs

- Pests
  - Spruce beetle
  - Spruce broom rust



Subalpine fir (*Abies lasiocarpa*)

- Cold moist subalpine
  - 9,000 – 11,000 ft
- Dimensions
  - 40 – 100 ft tall
  - 8 – 24 in DBH
- Shade Tolerance
  - tolerant
- Regeneration Strategy
  - wind-dispersed seed
  - can establish under dense canopy
  - moist mineral soil preferred
- Pests
  - Western balsam bark beetle
  - Armillaria root rot



Quaking aspen (*Populus tremuloides*)

- Cold montane to subalpine
  - 7,000 – 11,000 ft
- Dimensions
  - 40 – 80 ft tall
  - 8 – 20 in DBH
- Shade Tolerance
  - very intolerant
- Regeneration Strategy
  - root suckers and wind-dispersed seed
  - primarily establishes after disturbance
- Pests
  - Defoliators
  - Cytospora canker
  - sooty-bark canker



Regeneration and Management

- **Lodgepole pine**
  - clearcutting
  - precommercial thinning
- **Ponderosa pine**
  - shelterwood
  - thinning from below
  - prescribed fire
  - understory removal
- **Douglas-fir**
  - shelterwood and group selection
  - commercial thinning, crop tree release
  - scarification
- **Engelmann spruce**
  - shelterwood and group selection
  - spruce beetle prevention
- **Subalpine fir**
  - shelterwood and group selection
  - density control
  - minimization of soil distrubance
- **Quaking aspen**
  - clearcutting to stimulate root suckering
  - protection from browse
  - occasional thinning

ECONOMIC VALUE







ECONIMIC VALUE

Commercially Valuable Species

- **Lodgepole pine**
  - poles and posts
  - dimensional lumber
  - studs

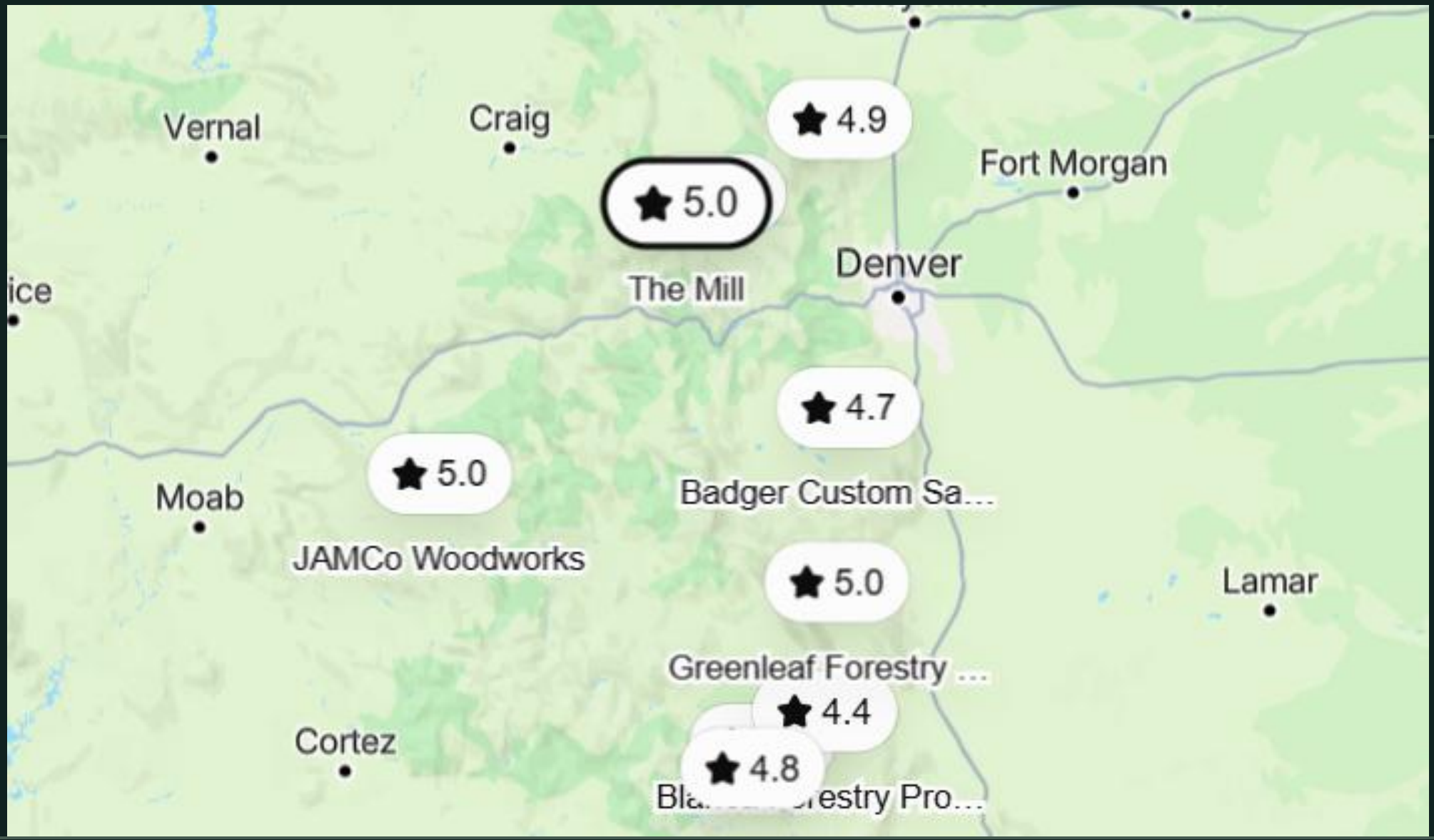


- **Engelmann spruce**
  - dimensional lumber
  - specialty wood products
  - studs



- **Quaking aspen**
  - firewood
  - dimensional lumber
  - specialty wood products





Sourced from ChatGPT

Conclusion

- With a lack of a prominent timber market, management objectives have shifted

- Management activities are aimed at reducing wildfire risk, promoting recreation, managing for wildlife, and ensuring forest health

- While natural disturbances like wildfire, bark beetles, and disease create challenges, they also provide opportunity for restoration.

Thank you!

