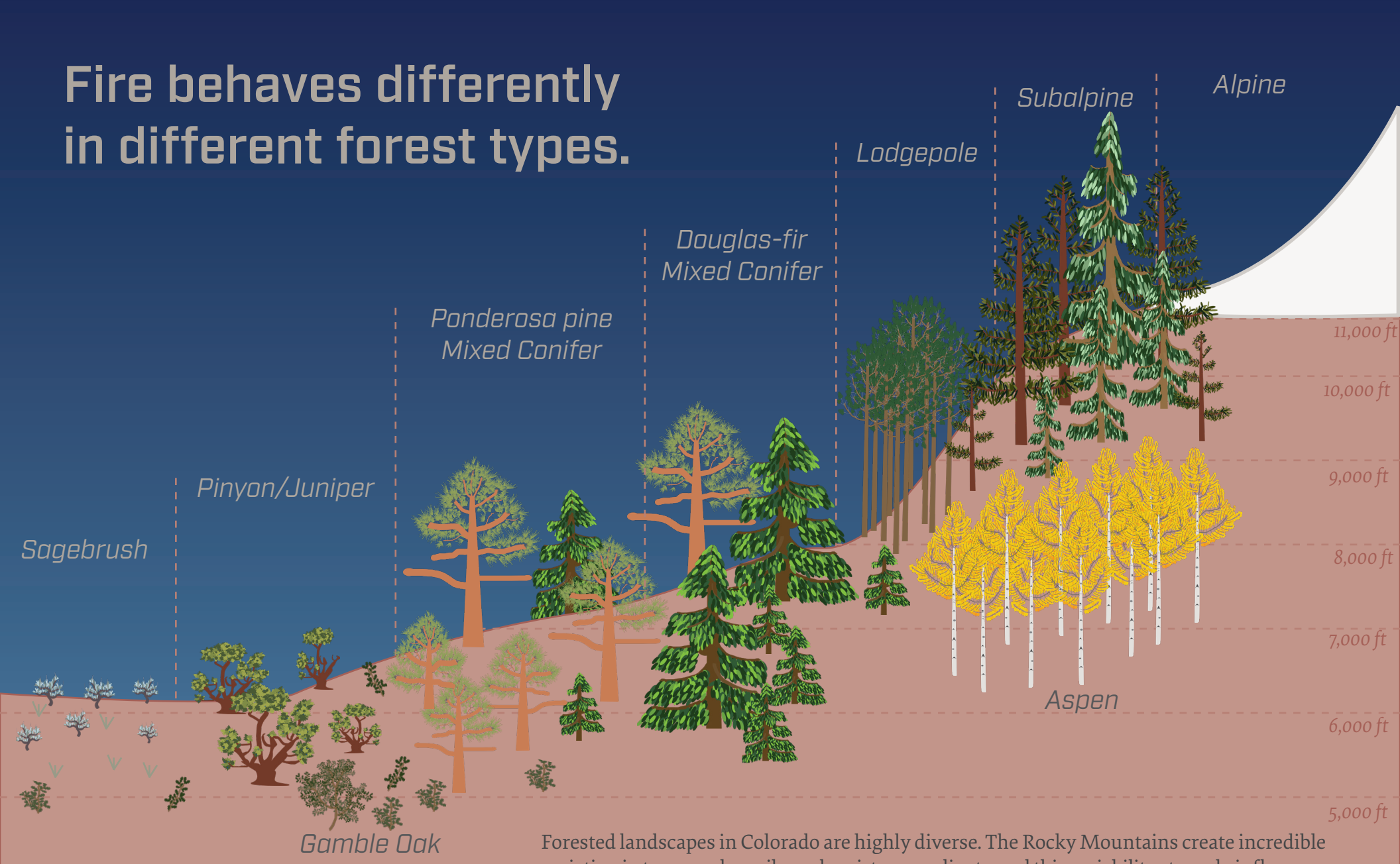
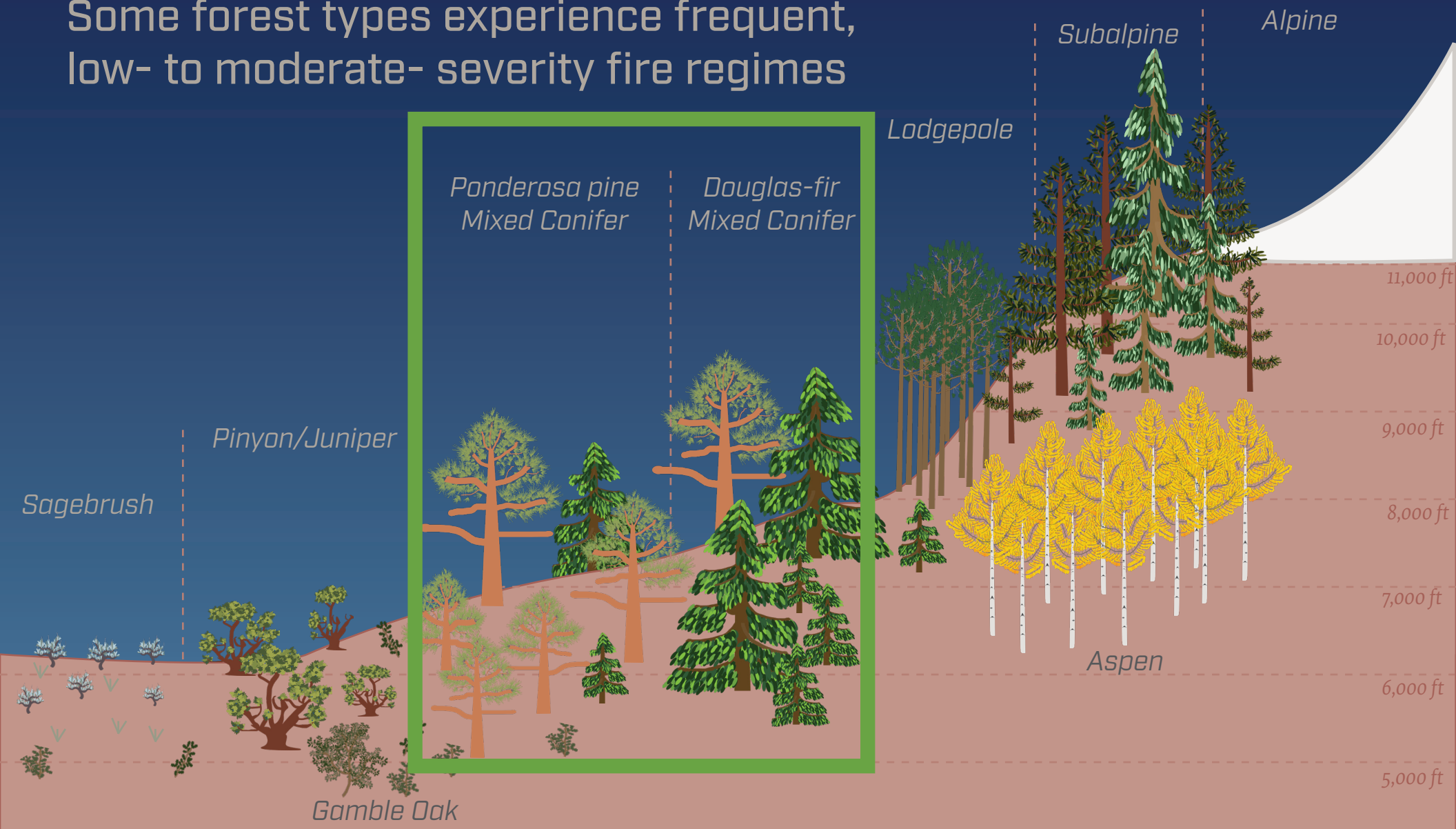
Fire behaves differently in different forest types.



COLORADO FOREST RESTORATION INSTITUTE
COLORADO STATE UNIVERSITY

Forested landscapes in Colorado are highly diverse. The Rocky Mountains create incredible variation in topography, soils, and moisture gradients, and this variability strongly influences the enormous diversity of understory and forest vegetation that grows in different places. Even with all this diversity, Colorado's forests can be divided into several major forest types distributed across elevation gradients, as illustrated above. Fire is a necessary component of all these vegetation types and is an important force in shaping the forests we see today. Fire provides crucial ecosystem services to these forests, such as nutrient cycling, clearing out dead or diseased trees or accumulated fuel, and creating opportunities for new trees to grow. Each of these forest types responds differently to fire; read on for more details.

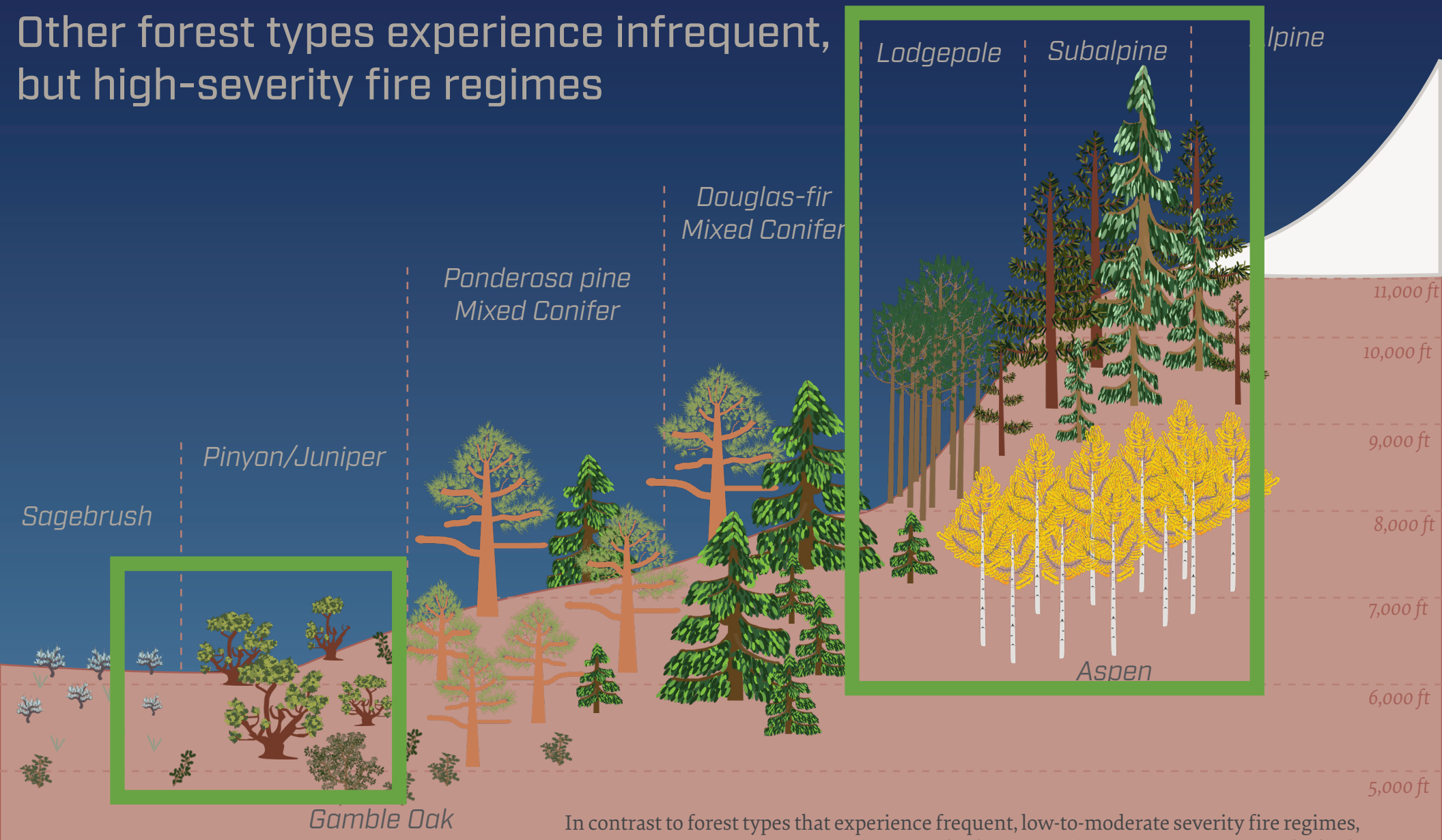
Some forest types experience frequent, low- to moderate- severity fire regimes



All vegetation types that interact with fire have a **fire regime**. A fire regime is the general pattern in which a fire occurs within a particular forest type, and is made up of several factors, including **fire frequency** and **fire severity**. **Fire frequency** is how often a fire returns to a particular forest patch (also called the **fire return interval**). **Fire severity** is the ecological impact that a fire has on a given landscape.

Some forest types, such as ponderosa pine mixed conifer, have a fire regime that historically experienced frequent (i.e., 7-50 yr fire return interval), low-to-moderate severity fires (i.e., fires that don't kill most trees, but may result in small patches of dead trees), that varied in size.

Other forest types experience infrequent, but high-severity fire regimes

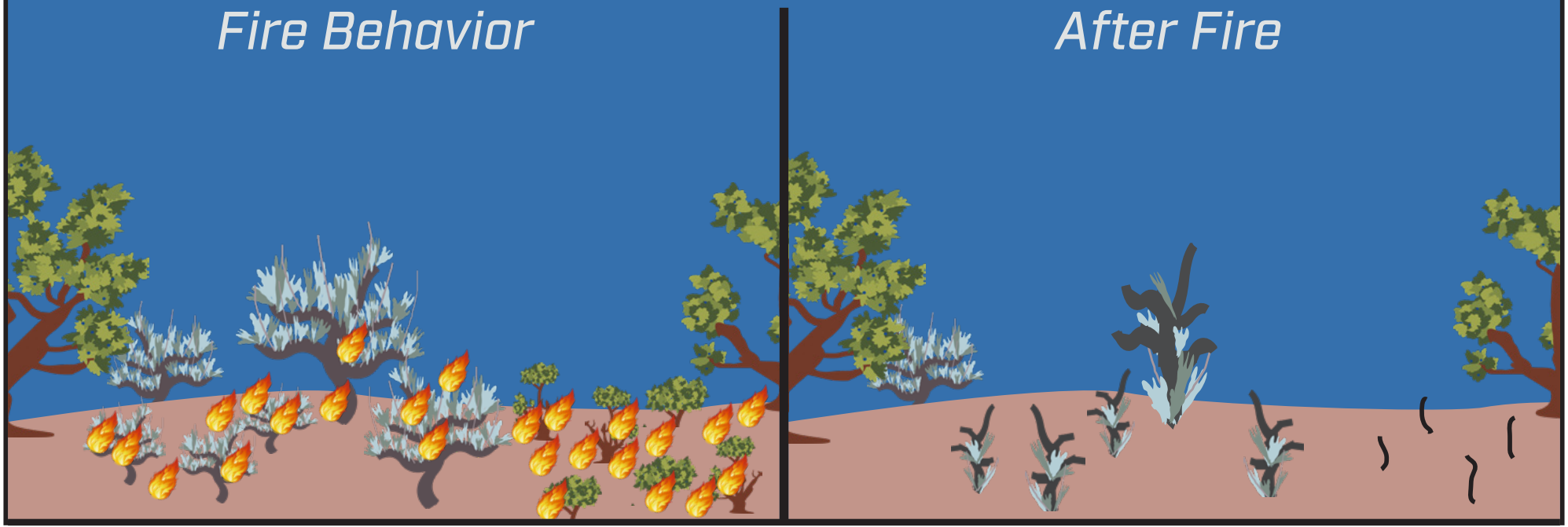


In contrast to forest types that experience frequent, low-to-moderate severity fire regimes, some forest types experience infrequent, high-severity fire regimes. For example, high elevation subalpine forests receive and retain a large amount of snow. Due to the presence of this moisture, fuels (e.g., live trees and other plants, dead trees, fallen limbs, etc.) in subalpine forests do not dry out as readily as in lower-elevation ponderosa pine mixed conifer forests, which receive less snow overall than subalpine forests. The conditions under which higher elevation subalpine forests burn occur less frequently, so the fire effects are more severe.

Sagebrush (3,000-11,000 ft)

Fire Return Interval: 10-300 years (variable)
Fire Severity: High-severity
Species: Various sagebrush species, rabbitbrush, rubber rabbitbrush

While sagebrush is not considered a forest type, it is very common in Colorado. Sagebrush is also a fire-dependent vegetation type that can be adjacent to forests due to Colorado's complex topography. While sagebrush can sprout back after a fire, fire regimes in sagebrush are highly variable. At lower elevations, sagebrush communities burn more frequently (~10–100 years), whereas at higher elevations sagebrush communities burn every ~30–300 years. When sagebrush communities burn, the fire severity can be moderate- to high-severity depending on seasonality and continuity of vegetation. Fire is particularly crucial to control the encroachment of trees such as pinyon and juniper.



Pinyon/Juniper Woodlands (5,000-9,000 ft)

Fire Return Interval: 200-400 years (infrequent)
Fire Severity: Moderate- to high-severity
Species: Pinyon pine, juniper species

Pinyon juniper woodlands have highly variable fire regimes, in part because this forest type is often located between shrublands/grasslands and ponderosa pine dominated forests. However, pinyon and juniper species are typically not fire-resistant. Fire suppression over the last century has allowed pinyon/juniper forests to encroach onto some grasslands/shrublands where fire would historically have controlled their expansion. In some areas, cheatgrass (a highly fire-dependent species) invasion into pinyon juniper forests has created larger and more continuous fuel beds, resulting in larger and more frequent fires.

Historical Woodlands

Cheatgrass Invasion

Ponderosa Pine Mixed Conifer (6,300-9,500 ft)

Fire Return Interval: 7-50 years (frequent)
Fire Severity: Low- to moderate severity, with some smaller patches of stand-replacing fire (where most or all trees die)

Species: Ponderosa pine, Douglas-fir, aspen, juniper, white fir, gamble oak

Ponderosa pine mixed conifer forests are fire dependent. Historically, fire burned across the forest floor, controlling tree regeneration, hardening mature trees, and leaving open spaces between trees. Human management activities (grazing, logging, fire suppression) have resulted in unnaturally dense forests. During extreme weather, high winds can easily spread fire between tree crowns, resulting in very large high-severity wildfires where most trees are killed. This is not always the case but is a trend that has occurred more frequently in this forest type in the last few decades.

Historical Fire Regime

Recent Fire Regime Trend

Douglas-fir Mixed Conifer (6,000-9,500 ft)

Fire Return Interval: 20 to >100 years (semi-frequent)
Fire Severity: Moderate-severity with patches of stand-replacing fire
Species: Douglas-fir, ponderosa pine, lodgepole, aspen, white fir, occasional spruce, limber pine, gamble oak

Douglas-fir mixed conifer forests contain a diversity of tree species, many of which are not as fire tolerant as species in ponderosa pine mixed conifer forests. These forests also tend to be cooler and wetter than lower elevation ponderosa pine forests, and as a result do not burn as frequently. These forests are naturally denser than lower elevation forests, and when fire burns in these areas, patches of stand-replacing fire can be common.

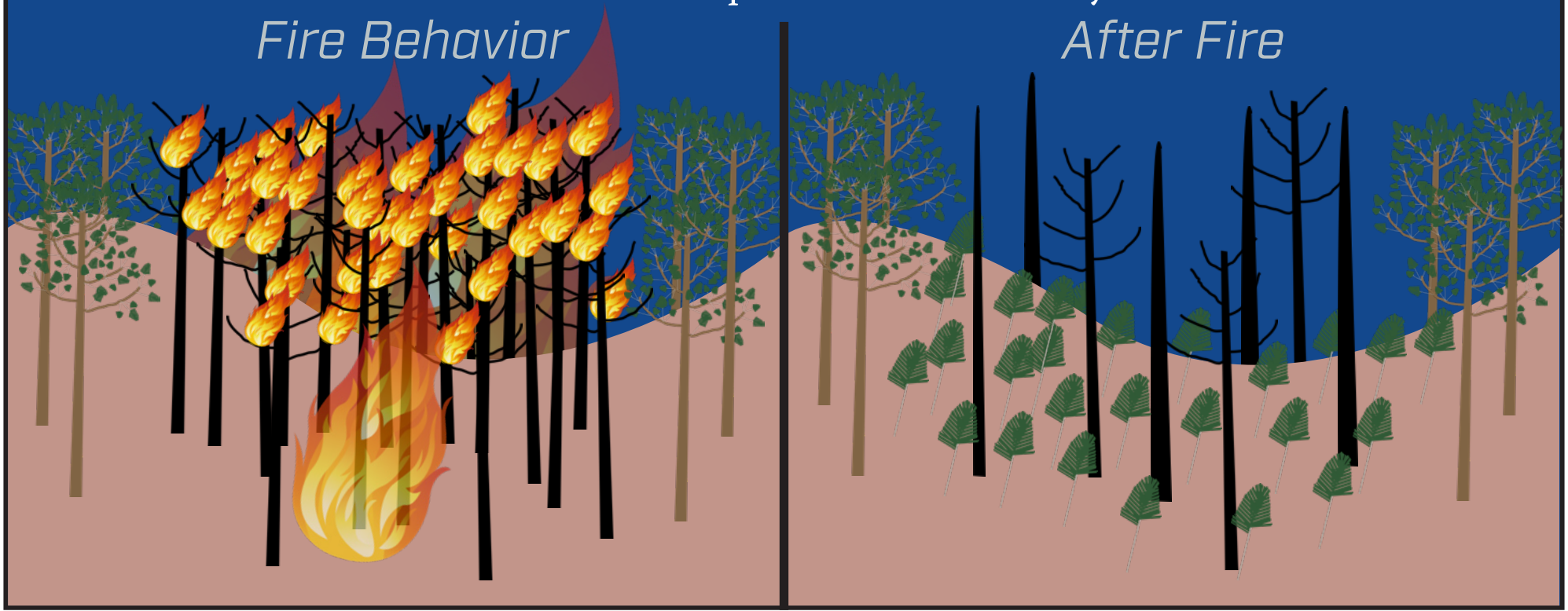
Historical Fire Regime

Recent Fire Regime Trend

Lodgepole Pine (8,000-10,000 ft)

Fire Return Interval: 75-300 years (infrequent)
Fire Severity: Stand-replacing fire
Species: Lodgepole pine dominated, occasionally Douglas-fir, ponderosa pine, aspen, white fir, Englemann spruce, blue spruce, limber pine, gamble oak

Lodgepole pine forests naturally grow densely, so fire spreads easily from tree crown to tree crown, resulting in patches where most trees are killed. Lodgepole pine also can have serotinous cones, which open and release seeds when heated by fire. These seeds then readily regenerate the new forest. More research is needed to understand forest recovery following the combination of drought, climate change, mountain pine beetle mortality, and recent wildfires; serotinous cones may not have been viable because of mountain pine beetle mortality.



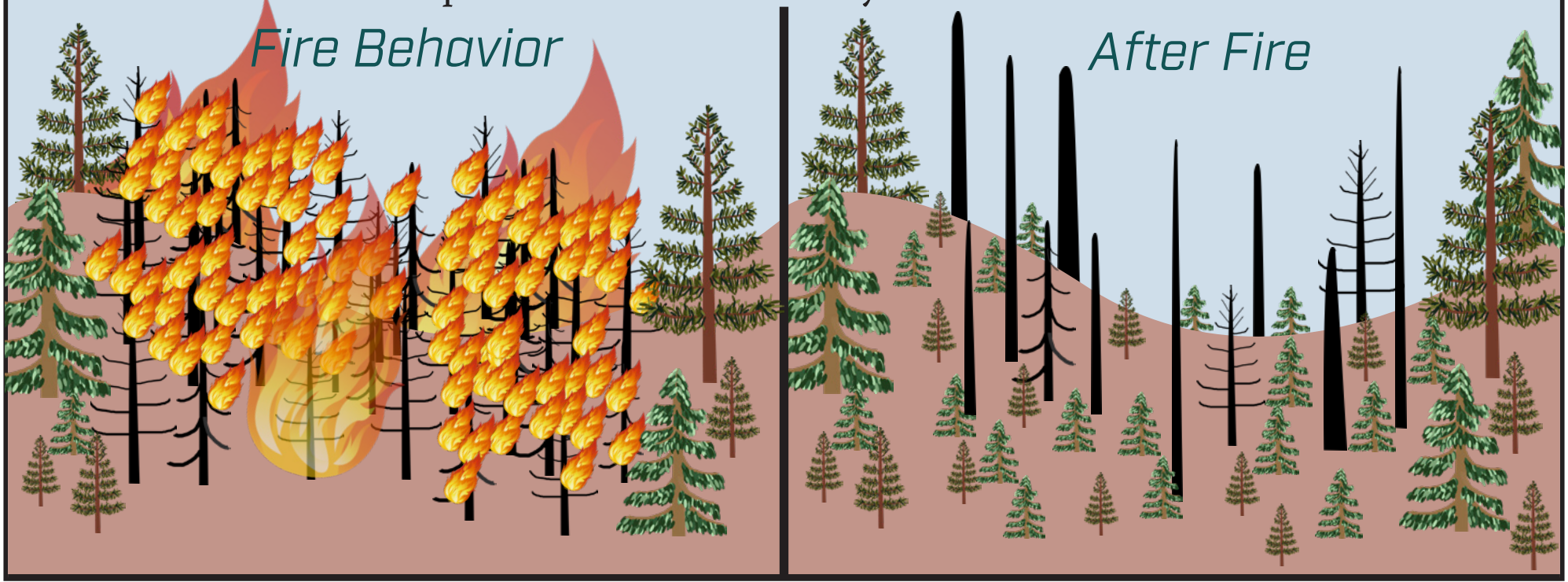
Subalpine (9,000-11,000 ft)

Fire Return Interval: 100-600 years (infrequent)

Fire Severity: Stand-replacing fire

Species: Co-dominated by subalpine fir and Englemann spruce; occasionally lodgepole pine, limber pine, bristlecone pine, blue spruce, aspen

Subalpine forests receive the most snow of all of Colorado's forest types and are the wettest and densest forests in Colorado. When extended dry conditions occur in these forests, dead trees and other fuels that have accumulated over long periods of time dry out, creating conditions ripe for fire. Drought conditions drive fires in subalpine forests, so fires are infrequent, stand-replacing, and are often synchronous events across the region. Further research is needed to understand how the combination of drought, climate change, spruce beetle outbreaks, and wildfire will influence post-fire forest recovery.



Sprouting Species - Gambel Oak & Aspen

Fire Return Interval: highly variable
Fire Severity: Stand-replacing fire
Species: Gambel oak, aspen

COLORADO FOREST RESTORATION INSTITUTE
COLORADO STATE UNIVERSITY
Have questions or want more info?
Visit our website: cfri.colostate.edu

Deciduous sprouting species such as Gambel oak and aspen are readily killed by fire, but these species recover quickly following fire via sprouting. Disturbances such as fire, grazing, avalanches, insect outbreaks, or cutting trigger a sprouting response in these species. In many cases, fire will create conditions where Gambel oak and aspen can expand their pre-fire area because of their ability to sprout, which takes fewer plant resources than germinating from seed.

Fire Behavior

After Fire