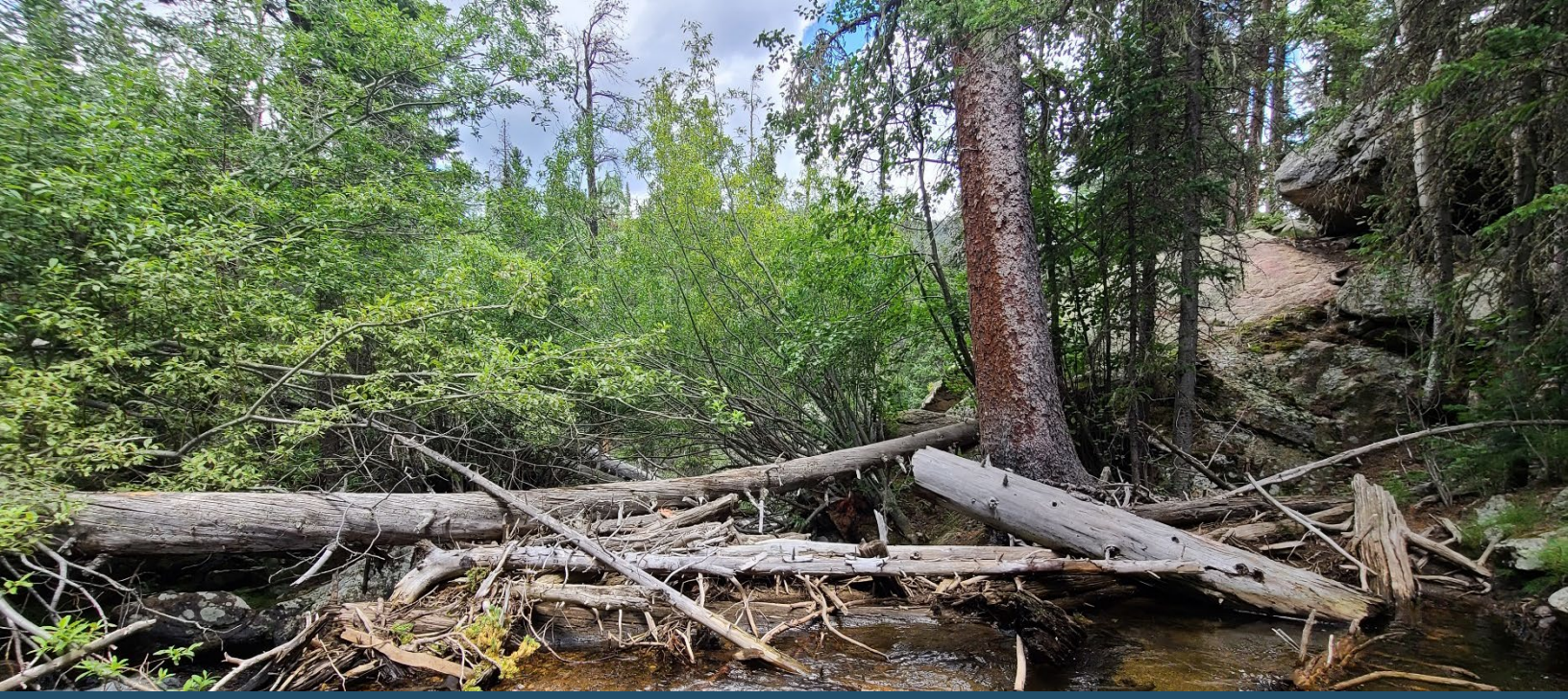
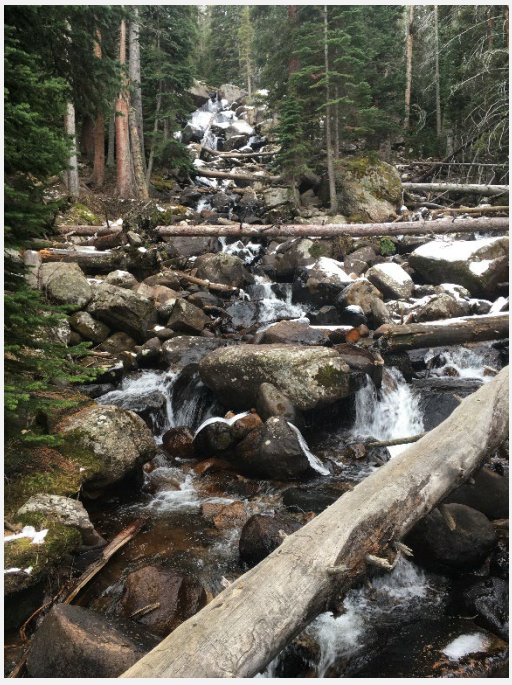


THE ROLE OF LARGE WOOD IN COLORADO STREAMS



When you think of a stream in the Colorado Rocky Mountains what do you imagine? Perhaps you envision pools full of trout or hear the sound of water tumbling over boulders. Perhaps you see vegetated stream banks shaded by forests of pine and aspen. But do you picture wood in the stream? You should. Wood is critical to the pools of trout and the vegetated streambanks, and when the pine, spruce, fir, and aspen that shade the corridor today pass the end of their lives, they will end up as wood in the stream.

Large wood deposited in stream channels plays an important role in enhancing a stream corridor's physical and ecological heterogeneity. Historically, however, wood has been removed from many stream channels, where it was believed to be a nuisance. Recently, the reintroduction of large wood back into our stream corridors has become an important focus of river scientists.

Large wood is defined as: downed, dead wood in stream corridors (rivers, floodplains) that is greater than 3 feet (1 meter) in length, and greater than 4 inches (0.1 m) in diameter. Large wood concentrated into aggregations of pieces are called "jams."

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Wood is Good: The Benefits of Large Wood in Stream Corridors

Physical and Ecological Complexity

Large wood, especially when concentrated into aggregations (i.e., “jams”) can influence how water and sediment move within and through stream corridors. By forming islands and bars, splitting flows and scouring pools, and by “pushing” water deeper into the channel bed and banks (where it is cooled), wood improves aquatic habitat and water quality. Wood can also act to stabilize stream banks, or force lateral movement of the stream channel – both of which can be desirable natural processes.

The physical complexity that large wood establishes benefits many organisms. Fish, such as trout and salmon, rely on deep pools for food, habitat, and safety. Vegetation can also establish itself on new ground, now protected from flows by the newly formed bars and islands.

Wood deposited out of channels or on adjacent floodplains can influence overbank flows and sediment deposition, particularly during floods. By acting as a natural barrier in the landscape large wood can slow the energy of floodwaters thereby reducing flood damages downstream. Wood on the floodplain can also cause deposition and scour of sediment which leads to landscape and habitat heterogeneity.

On floodplains, wood offers habitat to various terrestrial organisms which in turn provide food sources for larger organisms including rodents, birds, and larger mammals that feed off these animals. The nutrients and shelter that wood provides as it decays help to re-establish vegetation more quickly after large floods. Large wood on floodplains is also a small, but not insignificant source of carbon storage on land.

Why is Complexity Important?

Generally, rivers that are “messy” and more complex are considered healthier, more resilient, and more capable of reducing potential hazards. For example, streams with multiple channels may distribute flood waters more broadly, slowing flood waters and reducing downstream flood hazards. Messy streams are often more connected with their floodplains, also potentially reducing the extent of burning during wildfires. Large wood can naturally influence both the physical and ecological complexity within stream channels and floodplains, lending to its importance in river management and restoration.

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Large Wood Dynamics: How does Large Wood Travel in Stream Corridors?

Recruitment

Large wood can enter stream corridors in various ways:

- Individual or mass tree death events (beetle kill, windstorms, etc.) and eventual falls from adjacent banks or hillslopes
- Erosion into forested channel banks that recruits living trees
- Debris flows, avalanches, landslides, and other natural events that bring trees down into valley bottoms

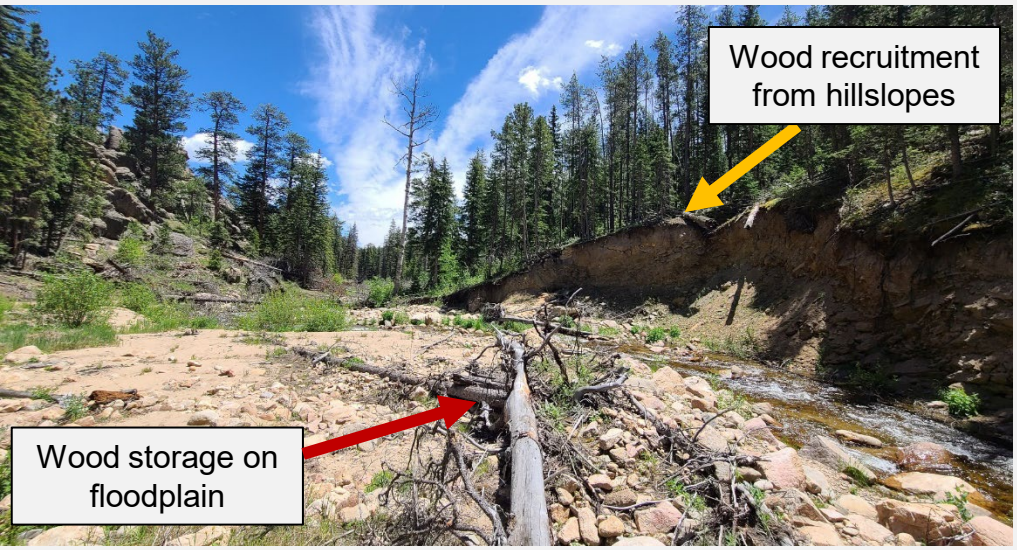
Transport

Once on the floodplain or in the stream channel, large wood will persist until stream flows are capable of floating and transporting the individual pieces downstream.

Check out this timelapse video of a large wood jam during high flows on the Cache La Poudre River, CO.

Storage

As a stream flow loses the capacity to transport the large wood, it is deposited in channels or on floodplains either individually or in jams. There it may influence both river function and form. Large wood can persist for years, decades, and even centuries, depending on how fast it decays. Decay rate is correlated with the frequency of wetting and drying cycles and other physical characteristics.



Ultimately, sustaining quantities of wood in stream corridors that can influence stream process, form, and function requires a **source** of wood, as well as the **persistence** of wood once deposited in the corridor. Various factors, including climate, watershed size, human influence, and frequency of disturbances (wildfire, beetle kill, avalanches, etc.) can impact this dynamic arrangement.

Starving Streams: Humans and Wood Removal

Many streams today are relatively lacking in wood due to human influences:

"The beneficial effects of wood in river corridors have largely been overlooked because of the widespread lack of abundant wood in forested river corridors. This reflects centuries of active wood removal from rivers, as well as diminished wood recruitment associated with changing land cover, reduced wood retention as river corridors have become more physically simple and homogeneous, and perceptions of wood in rivers as wasted or unsightly."

-Wohl et al. (2019)

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Large Wood in Colorado Front Range Streams

Large wood dynamics change throughout the different zones of a watershed. Colorado Front Range watersheds can be loosely divided into four such zones: 1) **Glacial Valleys**, 2) **Canyons**, 3) **Alluvial Fans**, and 4) **Plains**.

Glacial Valleys

Glacial valleys are typically unconfined (wide) and located at higher elevations. Because of the valley width, when a stream is not adjacent to a forested hillslope or floodplain, the stream may not have substantial amounts of wood as wood recruitment is limited. Streamflow in glacial valleys tends to be smaller and may not be capable of large-scale wood transport even during high flows. Where there is a supply of wood to the stream corridor, this wood may be stored in both the channel and the floodplain. Additionally, sub-alpine trees are generally smaller and will result in less overall wood volume in the channel and floodplain than trees in downstream zones.

Canyons

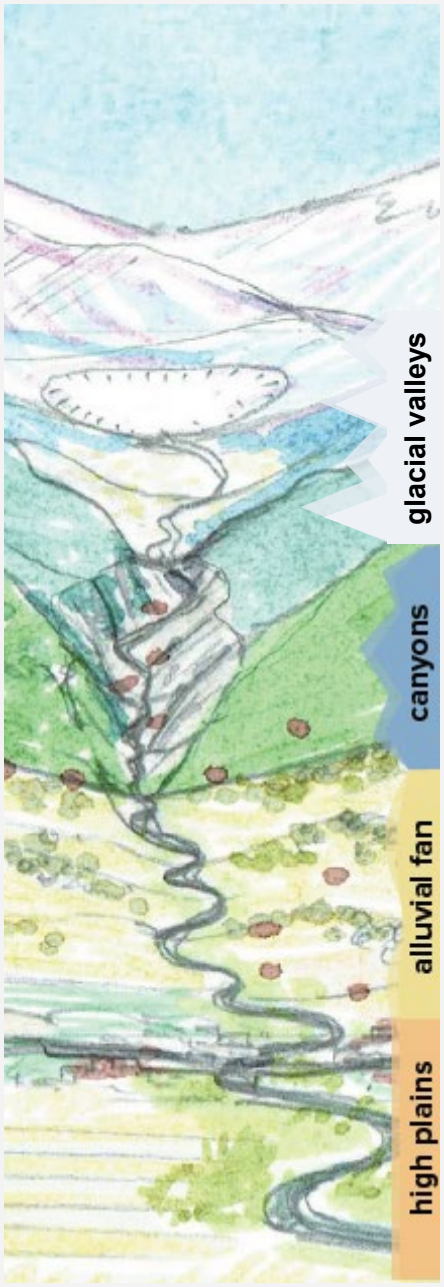
The Canyon zone is characterized by steep, confined (narrow) stream corridors. The connectedness between the forested hillslopes and stream can result in a considerable wood source; furthermore, the narrow stream corridors also have a high transport capacity meaning wood can be moved in from upstream areas. This wood is then stored in the channel and in wider floodplain pockets where the capacity for the stream to transport the wood is lower. However, this wood can be transported into downstream areas during very high flows.

Alluvial Fans

This zone is the transition between the Canyon and High Plains zones. The valleys are moderately confined, and streams may wander across the valley. Wood can be sourced from forested hillslopes adjacent to the corridor, from forested floodplains when the channel erodes its banks, or from upstream canyon areas. This zone is characterized by large wood storage in wider and more complex areas where there are bars, islands, and floodplains. Wood may also be transported downstream during large flows.

Plains

This zone is characterized by relatively unconfined valleys and corridors, unless degraded by human activities. Although wider valleys can typically store more material than confined valleys, large wood in the grasslands of the Plains may be less abundant than in forested mountain regions, unless flows can deliver wood from upstream regions or unless mature floodplain forests remain adjacent to the channel. However, large wood may still be present and historically have been influential in these systems, particularly where cottonwood or forest stands exist within the stream corridor and the channel is free to migrate across its floodplain.



Human Influence

Another important influence on large wood dynamics is the degree of human activity. Urbanization or encroachment into stream corridors typically results in channelization and disconnection between a stream's channel and floodplain. This disconnections means that there are fewer locations for wood storage and fewer opportunities for wood recruitment. The removal of standing trees and existing large wood is also common as humans move into stream corridors. These human actions are especially prevalent in the Alluvial Fan and Plains zones and in these degraded systems, large wood may no longer act as a driver of stream form and function.

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