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The Ecological Importance of Coarse Woody Material

Following forest harvesting or catastrophic weather, woodlands may seem unsightly with fallen treetops, uprooted stumps, brush piles, and other woody material scattered across the landscape. It could lead some to question whether these areas are capable of revegetating, supporting wildlife, or helping to protect air and water quality. Further, such conditions could become a source of dispute between different interest groups such as abutting property owners, outdoor recreationists, and land managers. Although people may be unaware of its role, coarse woody material (CWM) is an important component of healthy forests, whether created by animal (beaver dams), weather (fallen branches and uprooted stems), or human activity (brush piles or logging residue).

Coarse Woody Material Research

Research on coarse woody material in the Eastern United States began in the early 20th century due to concerns associated with enhanced wildfire risk. The scope of work was primarily focused on abiotic factors (e.g.: slope, moisture, soil type, and temperature) and their impact on the rate of decay for conifer and deciduous tree species, decay fungus, and disposal methods. Later research expanded to include interactions of CWM with wildlife, forest regeneration, hydrologic (water cycle) functions, and forest carbon. CWM research has expanded to include nutrient cycling and wildfire mitigation in both the southeastern and western United States. European research is currently focusing on restoring fungal species assemblages and saproxylic[1] insect populations that have been in decline due to intensive forest management systems.

Trees toppled by winds create coarse woody material piles, and new vistas!

[1] *Invertebrates dependent upon decaying or dead wood for a portion of their lifespan. Some examples include bark-feeders, wood-borers, fungus-feeders, and wood-nesting bees.*

Tree Decline and Woody Material Creation

Trees provide a multitude of ecosystem services, such as cooling forest streams, wildlife refuges, and once harvested, forest products. However, one use is frequently overlooked – as a source of food for other organisms. Trees are routinely colonized by a variety of organisms during and after their lifetime.

Each organism has a specific role in influencing woody decomposition rates. For instance, tree cavities permit water and oxygen into the tree's interior, which allows fungi to begin decaying wood. In turn, ant colonies become established in the decaying wood, which then provide a food source to birds and mammals. To resist fungal decay and to make themselves less palatable to insects, trees synthesize defensive compounds. Trees also produce specialized cell structures, such as lignin, which help to both support their immense structure and resist decay.

As trees die and fall to the ground, they take on a new purpose. Decomposing trees serve as a refuge for a host of fauna including invertebrates, amphibians, birds, and mammals. Woody material can also form a physical barrier to minimize browsing, allowing desired vegetation to establish. Fungal and bacterial decomposition of woody material also aids nutrient cycling with the soil. As it decays further, woody material behaves like a sponge, retaining moisture, serving as host for bryophytes (mosses), and is ultimately incorporated into the soil profile as humus.

Decaying logs persist for decades and frequently aid in the establishment of new tree seedlings.

Woody Material Decay

Woody material is temporal. In some cases, it may last just a few years (e.g., gray birch and aspen). Other species, like eastern red cedar, can persist on the forest floor for decades. Ground contact and dispersal of woody material into smaller pieces increase decay rates. In contrast, piling woody material decreases decay rates as elevated material tends to desiccate, surface harden, and become less susceptible to rot and decomposition.

Research has shown that small diameter oak and pine (2"-5") material decay in less than 20 years, while larger diameter woody material is persistent and may take 75 years to decay in unmanaged forests. On average, forestland in Connecticut has about five dry tons of coarse woody material per acre.

Wildlife Impacts

For decades, the importance of woody material has been recognized as a component of increased structural heterogeneity and diversity in forested ecosystems. Foresters, wildlife biologists, and other resource managers have incorporated woody material into management and restoration plans for a variety of vertebrate species, ranging from reptiles to birds and mammals and even fish.

New England cottontail populations have been in severe decline throughout the region. To increase their survival rates, artificial brush piles have been constructed with logging residue to provide supplemental cover during harsh weather. Increased amounts of residual woody material (i.e., CWM) following a harvest also benefits amphibians by providing shade that limits desiccation during dry periods. Others, including Audubon Connecticut, have endorsed leaving coarse woody material in harvest areas and increased retention of intact tree-tops to provide cover, drumming and perch sites, and habitat for insects consumed by birds.

Amphibians, like this Eastern Newt utilize coarse woody material for protection.

Wildfire Concerns

On September 21, 1938, a Category 3 hurricane swept through New York and New England causing significant and widespread damage to forests throughout the region. Wildfire danger was elevated for several years following the storm due to the increased amount of woody material on the forest floor. The Civilian Conservation Corps worked diligently to salvage the downed lumber and create fire ponds that can still be seen throughout the state. The greatest risk for wildfire is typically restricted to the

A forest in Connecticut showing damage following the 1938 Hurricane.

period between late winter and early spring when trees are extracting water out of the soil and solar radiation is drying out the leaf litter, but prior to full leaf out. Aside from that short window, wildfire risk in Connecticut is minimal, as our region typically receives 47" of rainfall per year.

Wildfires are much less widespread today than a century ago. Prior to the enactment of wildfire legislation and concerted efforts to combat wildfire in the early 1900s, the wildfire return interval (number of years between wildfires on a given parcel of land) averaged less than 30 years. Enforcement of liability for escaped fires combined with vigorous fire suppression efforts have increased the return interval to now over 1000 years. In our area, land managers and scientists have been attempting to reintroduce fire to the landscape in an effort to aid nutrient cycling, maintain early successional habitat, reintroduce fire-dependent species in decline (such as pitch pine and oak), and to deter the growth of undesirable (non-native) species.

Improving buffers surrounding riparian areas decrease scouring and improve water quality.

Forest Regeneration

Browse damage by white-tailed deer is widely recognized as being problematic not only to native tree seedlings, but also detrimental to many native wildflower species. To foster healthy, diverse forests for the future generations by reducing browse damage, forester often leave piles of slash as a physical barrier to deer movement. We are also investigating a novel option of using 10-foot tall windrows of slash around an area to form a temporary physical barrier that deters herbivory.

Water Quality

Human activity near aquatic environments could lead to increased soil runoff rates. Local ordinances restrict certain activities around riparian areas and vernal pools by mandating "Best Management Practices" that protect water quality. In forested settings, coarse woody material serves as a buffer, similar to silt fences or haybales surrounding construction sites. They trap leaf litter, and redirect water flow, which aids in lowering stream velocities and decreases streambank scouring. Recently, woody material has been used to construct wood jams on tributaries of the Connecticut River to improve habitat for brook trout.

Forest Carbon

Trees and woody plants convert carbon dioxide into oxygen through photosynthesis that sequesters and stores carbon from the atmosphere. Research since the 1970s has investigated whether coarse woody material should be removed from the landscape or left onsite to decompose. In some regions, woody material (tree tops and limbs) is removed during harvest operations and processed for residential and commercial heating. Intensive silvicultural operations in northern European forests that leave little CWM after harvests have raised concerns regarding the decline of wood decaying insects and fungi. However, that does not to appear to be an issue in Connecticut, as net tree volume growth exceeds removal by over a 2:1 ratio.

Concluding Thought

Coarse woody material is a critical and important part of the forested ecosystems. Land managers continue to seek balanced approaches when determining appropriate levels and arrangements of woody material retention and extraction, and although it may seem unsightly, CWM is both purposeful and beneficial for long-term ecosystem health.

Incorporating CWM into land management provides a multitude of benefits.