SILVA21

Extension Notes

2023 | Volume 2

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TAKE HOME MESSAGE

- A harmonized three-class system was developed to describe the state of decomposition of both downed and standing woody debris and could be used to facilitate comparison with future studies.
- Using this classification, a meta-analysis was performed and showed projected warming is likely to accelerate wood decomposition and decrease residence time in the decay stages.
- Shorter residence time will change deadwood dynamics and decrease deadwood habitat saproxylic diversity
- While coarse woody debris has been recognized as a resource for bioenergy, the window of time to harvest dead trees targeted as feedback will shrink with further warmings, particularly for hardwood in warm regions

BROAD-SCALE WOOD DEGRADATION DYNAMICS IN THE FACE OF CLIMATE CHANGE

In the context of global change, a better understanding of the dynamics of wood degradation, and how they relate to tree attributes and climatic conditions, is necessary to improve broad-scale assessments of the contributions of deadwood to various ecological processes and ultimately for the development of adaptive post-disturbance management strategies.

A harmonized classification system for visual criteria of deadwood of both standing dead and downed wood debris

A harmonized three-class system was created to describe the state of decomposition of both downed and standing woody debris (Figure 1) for the use of a meta-analysis. This classification could be used to facilitate comparison with future studies.

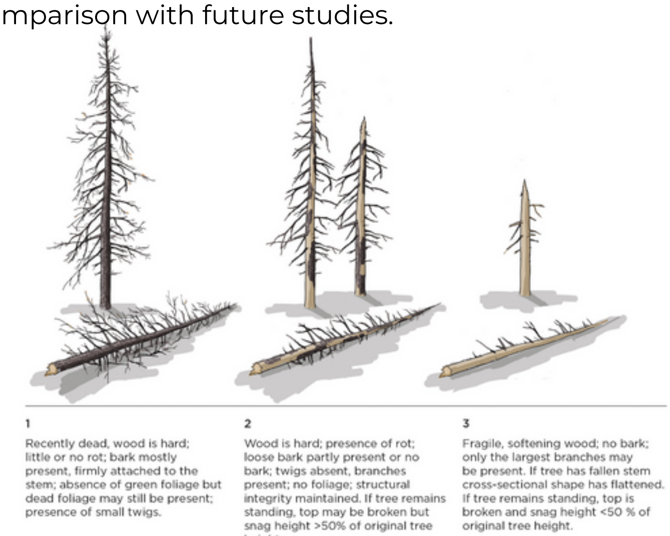

Figure 1: A new decay classification to allow for the inclusion of both standing dead trees and downed woody debris.

Both climatic conditions and tree-level variables are important indicators of time since death (TSD) of woody debris

Using climatic conditions and tree-level variables obtained using a meta-analysis, linear regression models showed that TSD was best explained using interactions between decay class and the following four variables:

- **Maximum summer temperature;** higher temperatures decreased TSD
- **Total annual precipitation**; greater precipitation increased TSD
- **Wood density;** greater wood density increased TSD
- **Tree phylogeny**; TSD was 4.4 years higher in softwoods compared to hardwoods

The above four variables accounted for 84% of the variance between observations, which were classified into three main clusters using a PCA-analysis. A decay-class transition rate model was included to account for mean residence time of 75% of the trees being 'out of the system' and classified beyond DC #3 (Figure 2).

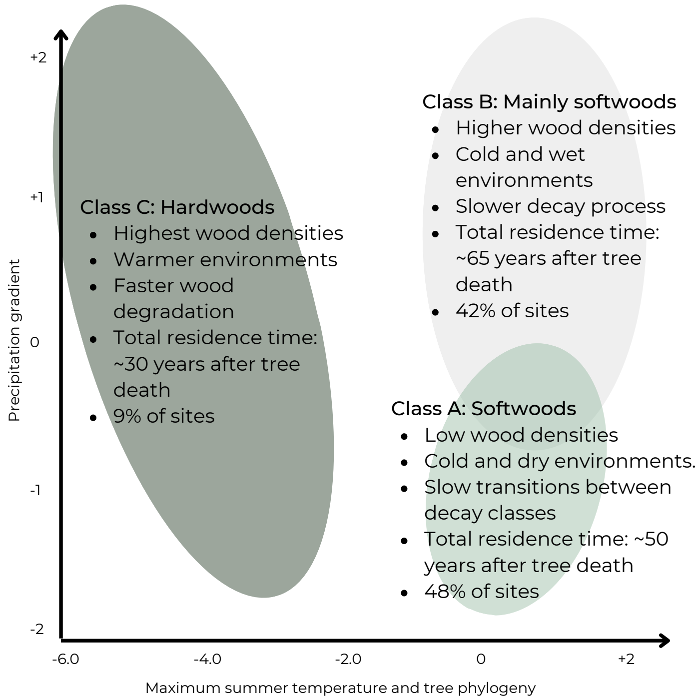

Figure 2: A graphical interpretation of the main three clusters identified from a mixed reduced k-means biplot of samples included in the meta-analysis considering site maximum temperature (°C), site total annual precipitation (cm), wood density and tree phylogeny. Total residence time accounts for 75% of trees within a site.

Projected warming is likely to accelerate wood decomposition and decrease residence time in the decay stages

Using baseline climate data across Europe, mean TSD of deadwood in the first decay class was, on average, ~10 years. Lower values were observed around the Mediterranean and higher values in the Alps, Scotland and southwestern coast of Norway (Figure 3). Future climate projections show that mean TSD could decrease from 10 years to 6 and 4 years by 2100, according to SSP2-4.5 and SSP5-8.5 scenarios, respectively (Figure 3).

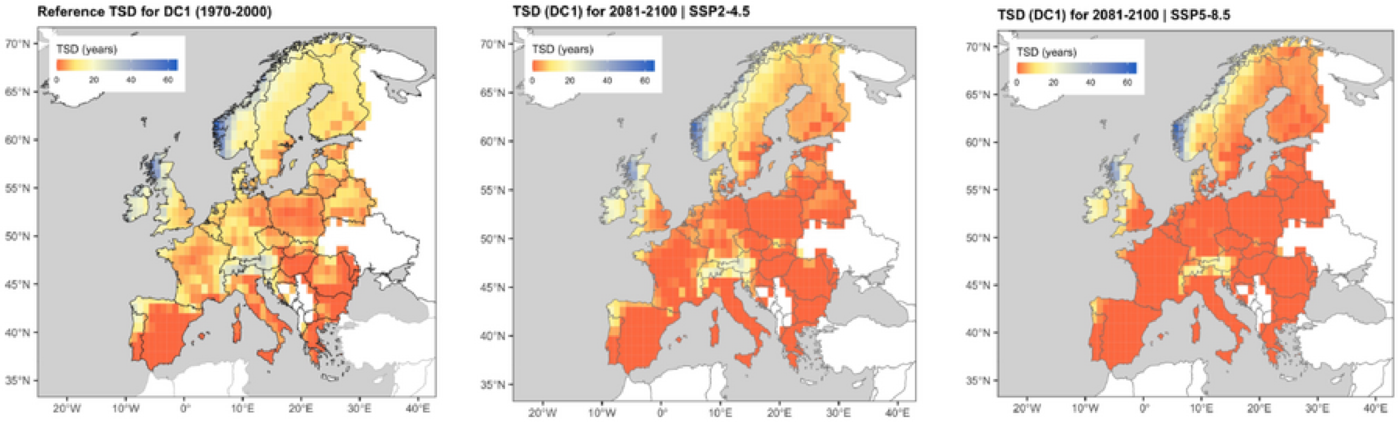

Figure 3: Modeled time since death (in years) of deadwood in decay class 1 across Europe. Far left panel shows reference TSD using baseline climate date for 1970-2000 with middle and far right panels referring to TSD for the 2081-2100 period according to SSP2-4.5 and SSP5-8.5 climate scenarios, respectively.

A shorter residence time will change deadwood dynamics, thereby impacting diversity and salvage logging practices

Saproxylic biodiversity may be altered due a reduced availability of deadwood of different decomposition stages over time, reducing the amount of available of habitat. This is likely to worsen with rising temperatures.

Shorter residence times of deadwood suggests a **reduced "shelf life" of dead trees** that are used as value-added products. This is especially true for hardwoods in warmer regions where salvage harvesting needs to occur in a shorter period after a disturbance.

Climate change and faster decaying wood is likely to affect the **carbon footprint, sequestration rate, timing and quantity emissions** related to the decomposition of dead trees.

METHODOLOGY: A literature review was performed for articles documenting time since death (TSD) and coarse woody debris (CWD). Based on five criteria, studies were compiled into a meta-analysis and the impact of 1) tree-level variables and 2) site-level climatic variables on TSD was tested. An integrated decay-class system was constructed to describe decomposition of both downed and standing woody debris and used to compile and classify TSD from all studies. A mixed-effect meta-regression was used to test the influence of variables on TSD and a cluster analysis was used to summarize woody debris dynamics. A stage-based matrix was used to describe each cluster's deadwood stages distribution over time. Lastly, projected changes in mean TSD were calculated using two future climate scenarios.

Summary based on article by:

Chagnon, C., Moreau, G., Bombardier-Cauffopé, C., Barrette, J., Havreljuk, F., Achim, A. 2022. GCB - Bioenergy. 14(8): 941-958. https://doi.org/10.1111/gcbb.12951

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