Carbon Pools in R

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Theory behind the statistical function

The quantile function calculates quantiles based on a specified probability distribution. The formula for calculating the quantiles is based on the definition of quantiles and the probability distribution.

The formula for the quantile at probability p (where p is a value between 0 and 1) is defined as:

Where:

* is the quantile at probability .
* is the -th order statistic, which is the data point just below the -th percentile.
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* is the fractional part of the index (i.e., the decimal portion).

The quantile function in R uses linear interpolation to calculate quantiles. It estimates the quantiles by finding the order statistics and based on the specified , and then performs the linear interpolation using the formula above to estimate the quantile value.

In simpler terms, the quantile function finds the two data points that bound the specified quantile, calculates a weighted average of those points, and returns the estimated quantile value. This allows you to divide your data into segments based on the specified probabilities (e.g., quartiles at ).

Table 1. Tables of deadwood decay classes per tree genus or tree functional type aggregated.

| Species | Decay Class 1 | Decay Class 2 | Decay Class 3 | Decay Class 4 | Decay Class 5 |
| --- | --- | --- | --- | --- | --- |
| Abies | 343 | 305 | 247 | 174 | 149 |
| Alnus | 422 | 359 | 286 | 197 | 120 |
| Deciduous | 523 | 442 | 345 | 241 | 152 |
| Carpinus | 428 | 392 | 336 | 211 | 140 |
| Conifer | 374 | 334 | 271 | 198 | 160 |
| Fagus | 520 | 379 | 261 | 229 | 220 |
| Fraxinus | 452 | 403 | 392 | 227 | 151 |
| Picea | 381 | 340 | 270 | 190 | 157 |
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| Quercus | 614 | 518 | 397 | 300 | 195 |

Tables of deadwood decay classes per tree genus or tree functional type aggregated. All the values are expressed as dry biomass per volume . The Decay Classes are a function of time, from the most recent wood decay stage to the oldest from .

* Add a new table with new values. Add also the linear regression function.

## Including Plots

You can also embed plots, for example, tables of deadwood stocks.

Add here the table with the plot carbon values.

**Deadwood simulation**

The deadwood pools calculation, together with the synthesis of the deadwood sampling methods with the iLand simulation, has surely been the most challenging procedure, passing through several steps and supervision by experts in the field, together with the best available references (Doroteja 2023; other ).

Comm 1

Comm 2

Comm 3

Comm 4

First step:

We selected the available metadata on the deadwood samplings per plot (Hoffmeister 1,2,3, bottoms-up). The sampling methods are extensively described in (the Jenik plot guidebook), and the table about necromass contains the site and plot ID that, combined, create a unique key ID, tree species, type of lying deadwood, deadwood volume, and decay stage.

Deadwood decay stage basic wood density conversion from 5 decay classes as in doroteja et al., (2023) to 4 classes as in Jenik dataset (Hofmeister et al., 2015 ) for the available tree genus. This conversion is based on the adjusted values for a generalization in Europe of <https://doi.org/10.1016/j.foreco.2023.121431>. To derive the function for the decay stages we used the statistical function to calculate quartiles from quantile distributed functions of deadwood decay stages based on 5 categories. Theory behind the statistical function

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After I created the decay classes based on experimental data in , we needed to merge consistently our metadata with the plot tree table including all single tree measures and parameters in every plot and deadwood structure sampling of the plots. Here we assigned at every tree species we have along the 98 plots a corresponding Genus or forest functional type.

Look at the species proportion per plot to assign a classification to those piece of wood not classified. Here I decided to assign it at the plot dominant species

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Tree species not into the table coming from the laboratory analysis (https://doi.org/10.1016/j.foreco.2023.121431) on the deadwood deacy stages of every analyzed species are categorized as deciduous or coniferous unless the Genus was shared as in Alnus, Quercus, Pinus, Abies and Fraxinus see line 215 tree species conversion <https://github.com/baldomarco/Bottoms-Up/tree/main/STSM/Carbon> .

Input into iLand project file

The main iLand project file input derived from the fieldwork data are:

*youngRefractoryC*: carbon content of yrC (woody) aboveground carbon pool (kg/ha) we have real values logging residuals, branches, logs.

*swdC***:** initial carbon content in (standing) snags (kg/ha) we have standing dead wood and stumps or snags, also this value it is x4

*swdCount:* number of snags we have and I put also the stumps per ha. In the case of BDV plot exp from CZ data BottomsUp needs to be x4 because normalized per ha we have 1/4ha plots

*otherC:* initial carbon content in the pools for other wood (i.e. branches and coarse roots). (kg/ha.). This content is split up into the five parts. swdC x otherC fraction for the otherC pool. need to add 30 (branches) or 60% (branches + course roots) more

The main outputs we need for the Bayesian analysis related to deadwood and also used indirectly for the deadwood pools bdv prediction column and for initialization of deadwood pools due the discrepancy between the fieldwork deadwood pools values and the model ones:

SNAG\_sim: The kg/ha carbon values into the plot snag pool

AG\_DW\_C: The aboveground fraction of the deadwood carbon (snags+stumps+branches+logs)

total\_DW\_C\_sim: The whole deadwood carbon amount (AG\_DW\_C + course roots)

An example of the plot L6\_06 calculation:

swdC = SNAG\_sim = 277869.714

*otherC* = SNAG\_sim\*0.6 = 166721

*youngRefractoryC* = total\_DW\_C\_sim (781915.3618) - SNAG\_sim – *otherC* = 337323.8

Deadwood decay stage basic wood density conversion from 5 decay classes as in doroteja et al., (2023) to 4 classes as in Jenik dataset (Hofmeister et al., ) for the available tree genus. This conversion is based on the adjusted values for a generalization in Europe of <https://doi.org/10.1016/j.foreco.2023.121431>. To derive the function for the decay stages we used the statistical function to calculate quartiles from quantile distributed functions of deadwood decay stages based on 5 categories. Theory behind the statistical function

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Literature review:

<https://www.sciencedirect.com/science/article/pii/S0378112715003655>

Certainly, here are some studies that discuss deadwood density and volume in mixed forests:

1. **"Dead Wood Basic Density, and the Concentration of Carbon and Nitrogen for Main Tree Species in Managed Hemiboreal Forests"**  
   This study examines the basic density of deadwood across various tree species in hemiboreal forests. The findings indicate significant differences in wood density among species, with values ranging from approximately 300 to 600 kg/m³.

<https://www.seefor.eu/vol-15-no-2-de-meo-et-al-deadwood-diversity-of-boreal-and-sub-boreal-old-growth-forests-in-southern-finland.html>

1. **"Deadwood Diversity of Boreal and Sub-boreal Old-growth Forests in Southern Finland"**  
   This research investigates deadwood diversity in old-growth forests, reporting an average deadwood volume of approximately 85 ± 28 m³/ha. The study highlights the importance of deadwood in maintaining biodiversity and ecosystem health.

<https://www.mdpi.com/1999-4907/14/1/45>

1. **"A Modelling System for Dead Wood Assessment in the Forests of Lithuania"**  
   This paper presents a system for assessing deadwood, discussing the relationship between wood density and decay stages. It emphasizes the necessity of understanding wood density variations to accurately convert deadwood volume to biomass and carbon content.

<https://www.mdpi.com/1999-4907/14/1/45>

These studies provide insights into deadwood density and volume, which can inform your calculations and assumptions regarding deadwood biomass and volume conversions.

Cite for sure in the calculations:

Bitunjac, D., Sever, M. Z. O., Sever, K., Merganičová, K., & Marjanović, H. (2023). Dead wood volume-to-carbon conversion factors by decay class for ten tree species in Croatia and eight tree genera globally. *Forest ecology and management*, *549*, 121431. <https://doi.org/10.1016/j.foreco.2023.121431>

Shvidenko, A., Mukhortova, L., Kapitsa, E., Kraxner, F., See, L., Pyzhev, A., ... & Schepaschenko, D. (2022). A Modelling System for Dead Wood Assessment in the Forests of Northern Eurasia. *Forests*, *14*(1), 45. <https://doi.org/10.3390/f14010045>