Characterisation of woody necromass in beech forests with different anthropic accessibility: the case of La Rioja (Spain)

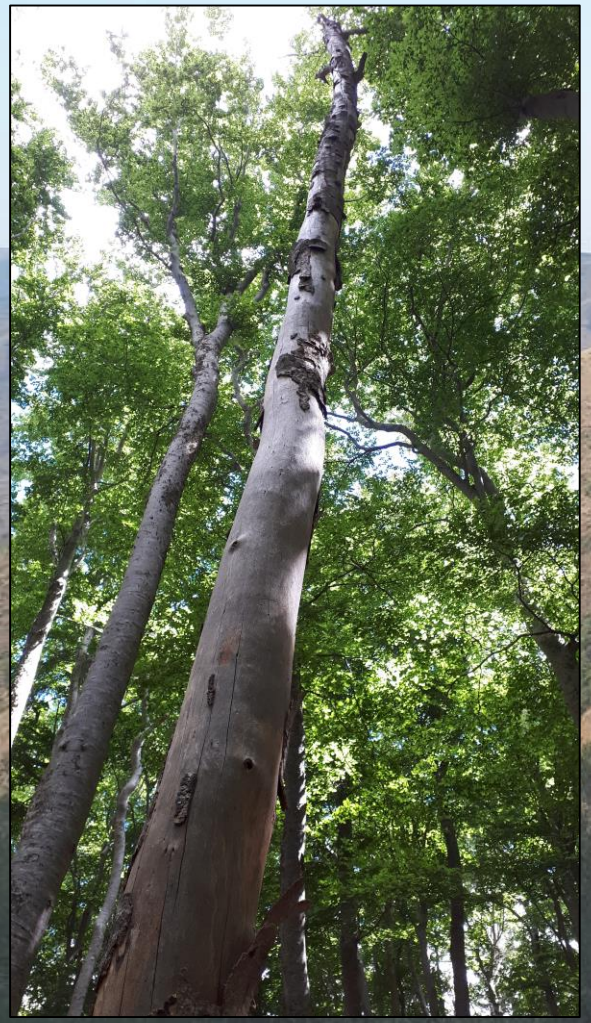
Ilaria COLLEPARDI[1]*, Emanuele ZIACO[2], César PÉREZ CRUZADO[3], Angela LO MONACO[1]

[1] Department of Agriculture and Forest Sciences (DAFNE), University of Tuscia, Via S. Camillo de Lellis, 01100, Viterbo, Italy; ilaria.collepardi@hotmail.it; lomonaco@unitus.it
[2] Department of Natural Resources & Environmental Science, University of Nevada, 1664 N. Virginia Street, Reno, NV 89557, USA; emanueleziaco@hotmail.com;
[3] Higher Polytechnic School of Engineering, University of Santiago de Compostela, Benigno Ledo s/n E-27002, Lugo, Spain; cesar.cruzado@usc.es
* Correspondence: ilaria.collepardi@hotmail.it

STUDY OBJECTIVES:

- Analyze the dendrometric parameters of the study areas;
- Quantify and qualify the deadwood (snags, logs and dead stumps) within the study areas;
- Investigate the existence of a quantitative gradient of deadwood starting from the access road to the forest;
- Estimate the amount of carbon stored in live trees and deadwood (snags, logs and dead stumps).

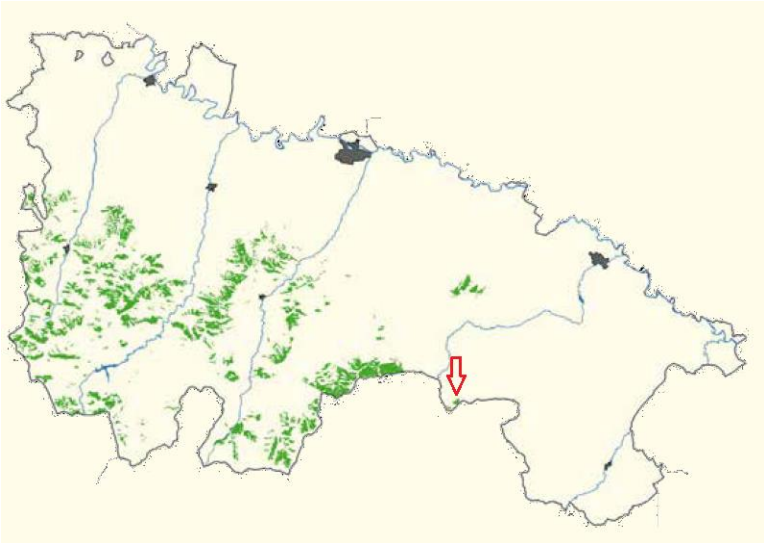
CLASSIFICATION OF DEADWOOD:



Snags (standing dead trees)

Logs (deadwood on the ground)

Dead stumps



La Rioja

- Area of 5.045 km² (it is the second smallest Spanish autonomous community);
- 315.675 inhabitants; density of 62,57 inhabitants/km²;
- Climatic condition heterogeneus, but in general characterized by cold and humid winter season and dry and hot summer season. Spring and autumn are characterized by mild temperatures and abundant rains. Yearly temperature generally varies from -2° C (January) to 26° C (August). The average annual rainfall is 400 mm.
- 62% of the territory for forest use, of which:

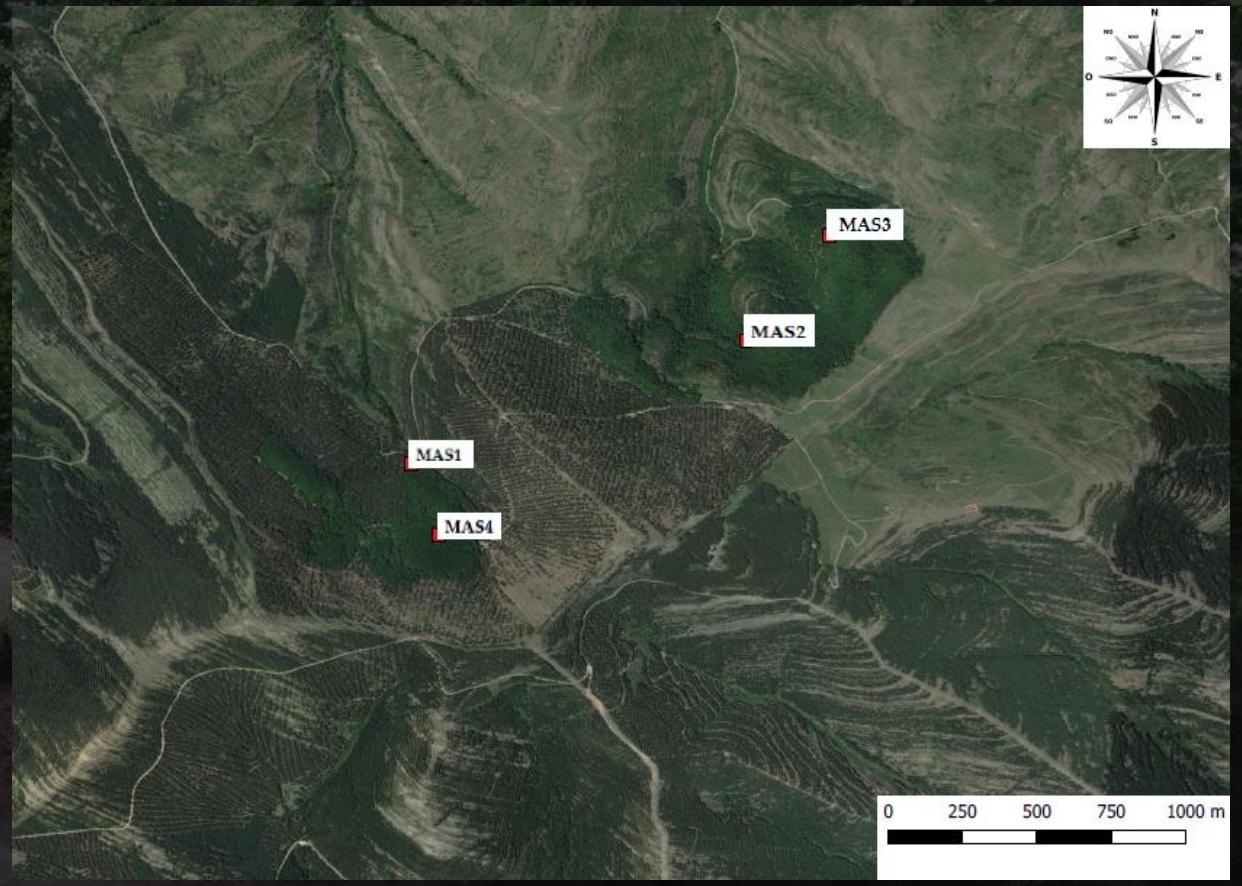
  -> 66% publicly owned;

  -> 57% is wooded area, of which:

  -> 15% are beech forests (approx. 25,500 ha).

Macro Areas of Study

- The study areas are about 10 km away from the historic center of Enciso, a municipality of La Rioja with a population of about 170 inhabitants.
- The surveys were conducted in four macro areas of study (MAS) within two beech forests served by forest roads.
- MAS are positioned on slopes at altitudes between 1340 and 1515 m a.s.l.;
- The studied beech forests are not subjected to any management plan, but there may have been legal concessions in past years.



DATA COLLECTION

1) Dendrometric information of the four MAS;
2) Quantitative information of the deadwood within the MAS;
3) Qualitative description of the deadwood within the MAS.

In each MAS three circular plots with a radius of 20 m were placed at a gradual distance from the access road: the first from 20 to 60 meters (E), the second from 60 to 100 meters (M) and the third from 100 to 140 meters (Difficult - D). In each plot, to obtain the quantitative and qualitative information of the logs, two linear transects 50 m long and 1 m wide were performed, perpendicular to each other and with the center falling in the same center of the plot.

E: 20 – 60 m **M: 60 – 100 m** **D: 100 – 140 m**

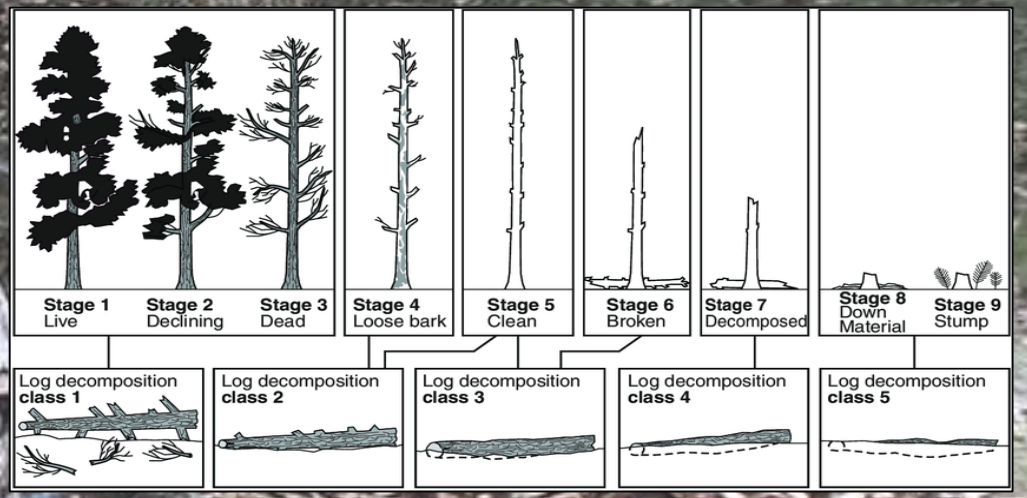
e.g. MAS1

FEGA

Parameters detected in each plot:

- **Live trees**: DBH, Height (H);
- **Snags**: DBH, Height (H), Diameter at ½ height, Decay Class (DC);
- **Dead stumps**: Species (S), Diameter (D), Height (H), Decay Class (DC);
- **Logs (D ≥ 2.5 cm)**: Diameter (D), Decay Class (DC).

To define the DC of deadwood the visual classification system from Hunter (below) and from Morelli have been used. Both methods allow a subdivision into 5 decomposition classes.



Processing of dendrometric data

For each of the 12 plot was calculated:

- Tree density
- Basal area of living trees
- Average diameter of living trees
- Average height of living trees
- Volume per hectare of living trees
- Volume per hectare of snags, logs and dead stumps

Stored carbon analysis

Carbon concentration: 49% of the dry mass.

Basic density:

- For *Fagus sylvatica* it is equal to 0.57 t / m^3;
- For deadwood it varies according to the Decay Class.

Statistic analysis

- Descriptive statistics
- ANOVA Test
- Tukey Test

Results of dendrometric analysis

For each MAS, density (trees/ha), basal area (m^2/ha), average diameter (cm), average height (m) and average volume (m^3/ha) were reported.

The p-value shows the results of the ANOVA.

Parameter	MAS1	MAS2	MAS3	MAS4	p-value
Density (trees/ha)	916	406	451	496	<0,05
Basal area (m^2/ha)	33.8	34.7	35.2	39.6	<0,05
Average diameter (cm)	21.7	33	31.5	31.8	<0,05
Average height (m)	16.7	19.8	19.5	19.6	<0,05
Average volume (m^3/ha)	402	506	504	566	<0,05

Table 1. Results of the dendrometric analysis for each MAS

Results of the qualitative and quantitative analysis of the deadwood

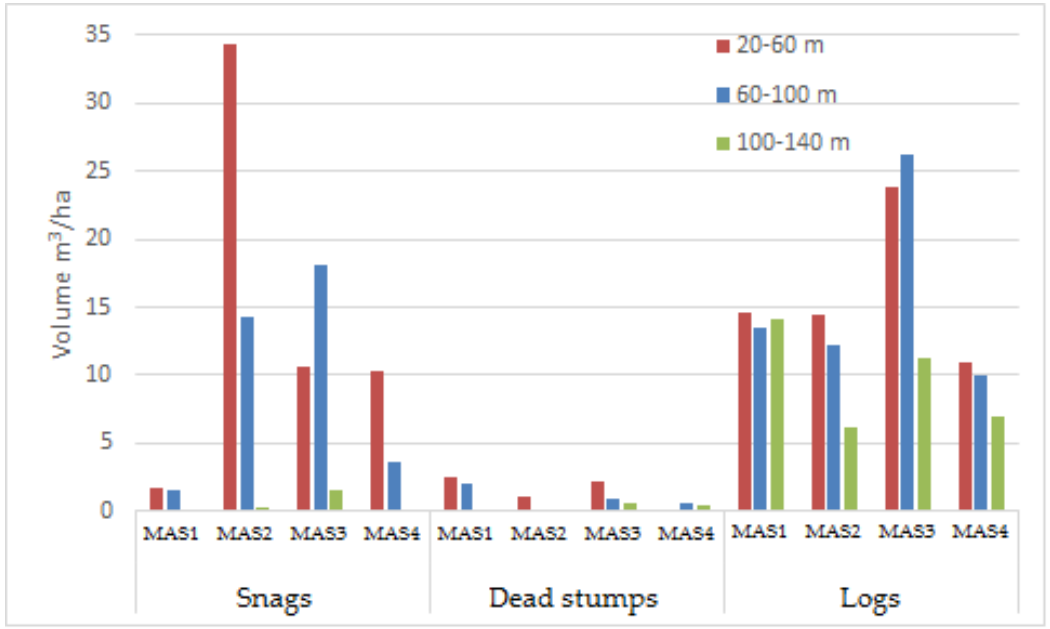


Figure 1. Volumes of snags, dead stumps and logs divided by MAS and accessibility classes

Normally the D plots have the lowest deadwood volume and the largest deadwood volume normally falls in the E plots. So it turns out that the average volumes of snags, logs, dead stumps and deadwood in general decreased at decreasing accessibility.

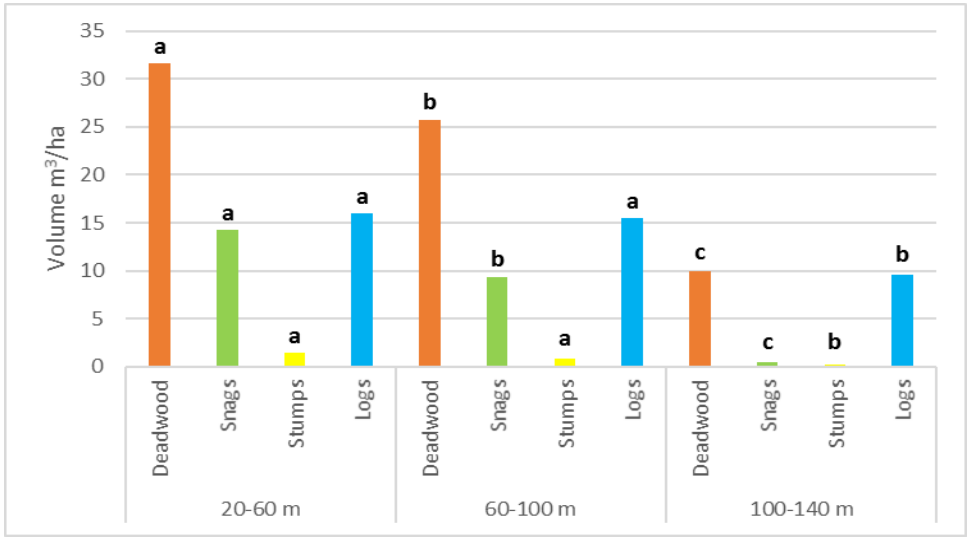


Figure 2. Volumes of deadwood categories for each accessibility class. Different letters indicate significant statistical difference by Tukey test in total deadwood and each deadwood category

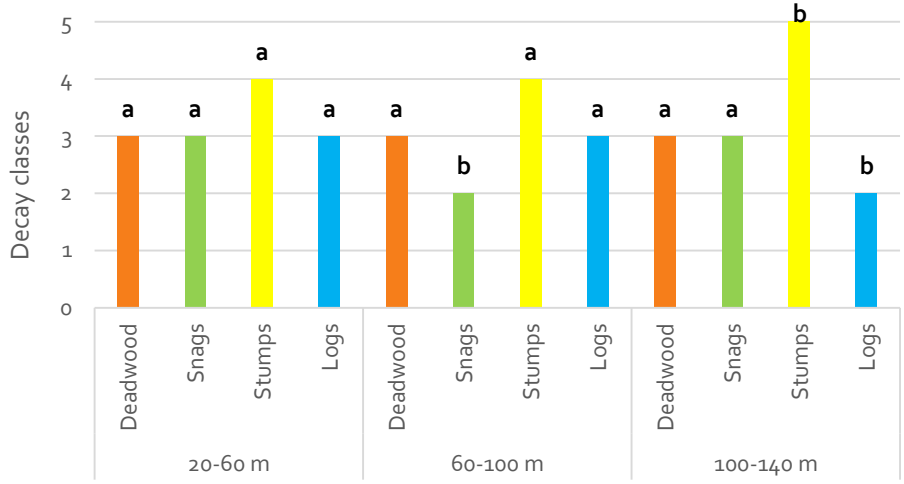


Figure 3. Decay classes of the categories of deadwood for each accessibility class. Different letters indicate significant statistical difference by Tukey test in total deadwood and each deadwood category

Carbon Storage

- Live trees show an average total volume of 289.2 t/ha in the first accessibility class, 273.8 t/ha in the second accessibility class, 282.3 t/ha in the third accessibility class, and store respectively 141.7 t of C/ha, 134.2 t of C/ha and 138.3 t of C/ha.

- Total deadwood shows a total average volume of 14.2 t/ha in the first accessibility class, 11.6 t/ha in the second accessibility class, 4.5 t/ha in the third accessibility class, and store respectively 6.9 t of C/ha, 5.7 t of C/ha and 2.2 t of C/ha.

1. Snags show an average total volume of 6.4 t/ha in the first accessibility class, 4.8 t/ ha in the second accessibility class, 0.2 t/ha in the third accessibility class, and store respectively 3.2 t of C/ha, 2.4 t of C/ha and 0.1 t of C/ha.
2. Dead stumps show an average total volume of 0.6 t/ha in the first accessibility class, 0.4 t/ha in the second accessibility class, 0.1 t/ha in the third accessibility class, and stock respectively 0.3 t of C/ha, 0.2 t of C/ha and 0.032 t of C/ha.
3. Logs show a total average volume of 7.2 t/ha in the first accessibility class, 6.9 t/ha in the second accessibility class, 4.9 t/ha in the third accessibility class, and store respectively 3.5 t of C/ha, 3.4 t of C/ha and 2.4 t of C/ha.

Discussions

- The volume of the deadwood decreased with the lower accessibility. This trend is opposite to the knowledge in literature, in fact the accessibility to the forest is considered a factor that facilitates the collection of deadwood by man, and generally, a decrease in the amount of deadwood is expected approaching the access road. Other factors may affect accessibility as ground slope and its direction relative to the road. The size and decay class of deadwood can also influence the propensity to collect. The human use of deadwood as fuel is normally more related to the fallen tree than to snags or dead stumps as well as to the lower decay class.
- The volume of deadwood found was compared with the data of the National Forest Inventory of La Rioja. The inventory shows that in the beech forests of La Rioja there are 12.27 m^3/ha of deadwood. According to the third and fourth Spanish National Forest Inventories the average volume of deadwood in the Spanish forests was 8 and 10.5 m^3/ha. Therefore the volumes recorded in this research far exceed the national average volume estimated from the inventories, in fact almost 22.5 m^3/ha of deadwood have been estimated, but it was distributed differently according to the class of accessibility. This situation could be due to several causes, among these, the combination of slope, cattle grazing, frequent rain and snow phenomena may have favored the rolling and the accumulation of deadwood from mountain to valley, then towards the roads; and the deadwood might have been collected by man in the access classes furthest from the road, because less visible.
- The values of carbon stored in deadwood within the sampling areas far exceed those estimated by Gasparini and Di Cosmo and by Vallauri et al. for the Italian beech forests, that is 3.1 t/ha and 5 t/ha respectively. The stored carbon values depend on the volume of deadwood, therefore these also decrease as the distance from the access road to the forest increases. These high carbon accumulation is one of the positive consequences resulting from the presence of high quantities of deadwood in the forests.

Conclusions

In conclusion, both the quantity and the quality of the deadwood in the investigated areas were determined. The deadwood, and therefore the amount of stored carbon, were higher than those reported in the Spanish and Italian national forest inventories. Specifically, they were also higher than the average reported for Riojan beech forests, and then the averages reported in other Italian and European studies in the literature. All decomposition classes except the first were found and this suggests minimal anthropogenic pressure on the deadwood within the studied beech forests. The lack of anthropic disturbance in fact leads to the natural decomposition of this important ecosystem component. In any case it is desirable a compliance with the regulations in force, so that, in the absence of specific authorization, the deadwood is not removed but left to decompose naturally.

THANK YOU FOR WATCHING!