

Branch age and diameter to detect woodland management: new developments

Kirsti Hänninen¹, Welmoed A. Out², Jannie H. Larsen² & Caroline Vermeeren¹

Woodland management (pollarding/coppicing): can we prove that it was practised in the past?

Age/diameter data of branches are used to study woodland management in archaeological assemblages of waterlogged (uncarbonised) wood. As predicted by an earlier model, the age/diameter data of branches of 2-6 cm of clearly unmanaged, modern-day trees of willow, ash and alder indeed differ from those of clearly managed trees (Figs. 1, 2 and 3, Out et al. 2013). Branches of managed trees grow faster than branches of unmanaged trees. But is it still possible to distinguish between unmanaged and managed trees when looking beyond the straightforward examples? **New questions** are:



fig. 1. Managed trees: pollarded willows.

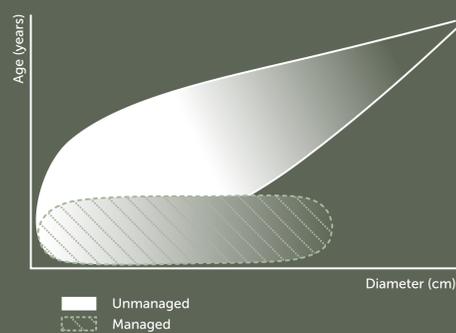
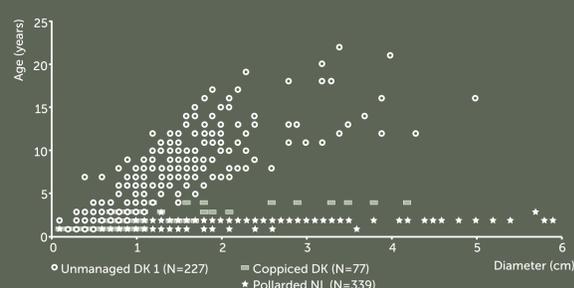


fig. 2. Model for the age and diameter of (uncarbonised) branches of managed and unmanaged trees.

fig. 3 Age/diameter data of unmanaged and managed willow (modern-day trees), confirming the potential of the method. Note the plateau in the data of branches of managed trees.



New questions are:

- How does the growth of straight, vertical branches of unmanaged trees in willow and hazel (*natural spurts*, fig. 4) relate to the growth of branches of managed trees (managed spurts)?
- What happens in managed trees with a long management cycle?



fig. 4 An unmanaged hazel shrub growing along a forest edge, showing straight, vertical branches (*natural spurts*) that look similar to branches of managed trees.

Methodology

- Analysis of the age and diameter of primarily branch wood of modern-day trees and shrubs.
- Studied taxa are willow (*Salix*), ash (*Fraxinus*), alder (*Alnus*) and hazel (*Corylus*).
- The data include multiple measurements per branch (every meter).

New results on modern-day trees: confirmation and confusion

The earlier results are confirmed by newly collected data, also for branches with a diameter > 6 cm (fig. 5).

Error type 1: Risk of incorrect detection of management The age/diameter data of *natural spurts* (straight, vertical branches of unmanaged trees) plot between the data of managed and unmanaged trees (fig. 5). Natural spurts occur in unmanaged shrubs and fallen trees of e.g. willow and hazel. Moreover, unmanaged alder seedlings, growing under good conditions, grow as fast as branches of managed alders.

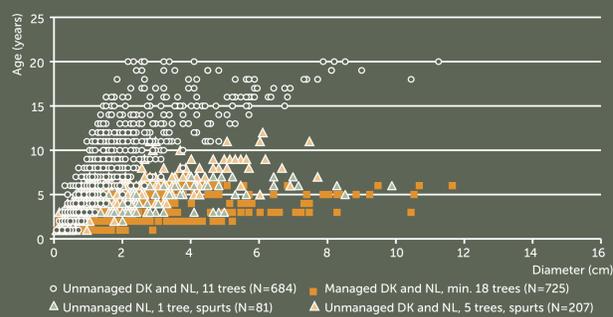


fig. 5. Age/diameter data of unmanaged and managed willow, including vertical, straight branches of unmanaged trees (*natural spurts*). Note the overlap between unmanaged and managed trees up to 3 cm.

Error type 2: Risk of overlooking management When branches of managed trees are not removed for a longer period, the age/diameter data of these branches also plot between the earlier data of unmanaged and managed trees (fig. 6). Management may sometimes still be recognisable because of the presence of a plateau, but not when the branches of managed trees get very old (e.g. 50 yrs).

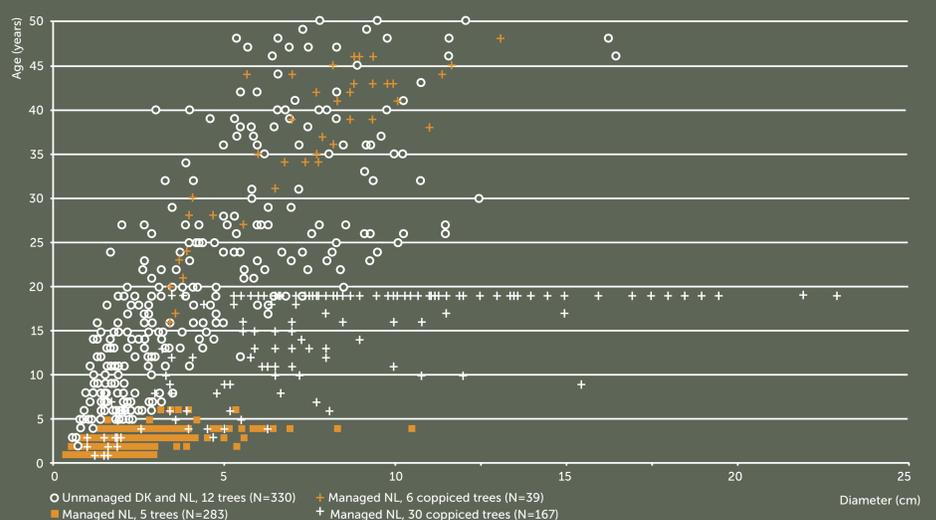


fig. 6. Age/diameter data of unmanaged and managed ash. Note the overlap between unmanaged and managed trees up to 4 cm.

Conclusions

The modern-day age/diameter data confirm that **distinction is possible between managed and unmanaged wood** for willow, ash and hazel. It is more problematic for alder.

The occurrence of **natural spurts** and **old branches of managed trees** result in the presence of a **third data cloud in the model**, in between the age/diameter data of unmanaged and managed trees. This results in overlap between the groups for branches < 4cm.

The occurrence of **natural spurts may sometimes result in incorrect identification of management** in archaeological assemblages. **Branches of managed trees**, incl. branches that are max. 20-30 years old, **may still be recognised by a plateau** in the age/diameter scatterplot (figs. 3 and 6). **To detect long-term management in archaeological studies we recommend:** multiple samples, large sample sizes ($N \geq 100$), analysis per taxon and context, and a focus on branches ≥ 4 cm.

Please see the handout for extra information

Branch age and diameter to detect woodland management: new developments

Kirsti Hänninen¹, Welmoed A. Out², Jannie H. Larsen² & Caroline Vermeeren¹

Woodland management (pollarding/coppicing): can we prove that it was practised in the past?

Woodland management (the intentional and long-term cutting of branches to improve the quantity and quality of wood), such as coppicing and pollarding, is often discussed in North-Western European archaeology (e.g. Christensen 1997; Rasmussen 1990; Klooß 2014, **figs. 1 and 2**). But while there is evidence from written sources and paintings for historical periods, it is less clear whether woodland management was also practiced in Prehistory.

One way to recognise woodland management is by **the analysis of the age and diameter of branch wood** (Morgan 1988; Out et al. 2013). As predicted by the earlier developed model (**fig. 3**), this method **allows differentiation between branches of 2-6 cm of clear examples of unmanaged and managed trees of modern-day willow, ash and alder trees (fig. 4)**. Branches of managed trees grow faster than branches of unmanaged trees, presumably because of better access to light, while other environmental conditions and competition also play a role. **But is it still possible to differentiate between unmanaged and managed trees when looking beyond the straightforward examples?**

New questions concern:

- Is the model also valid for branches of hazel (*Corylus avellana*)?
- How does the growth of straight, vertical branches of unmanaged trees (*natural spurts*, **fig. 5**) relate to the growth of branches of managed trees (*managed spurts*)? This is important since management is often presumed when archaeological contexts yield many long, straight branches.
- What happens in managed trees with a long management cycle, i.e. 20-50 yrs?

Methodology

- Age/diameter analysis of primarily branch wood of modern-day trees and shrubs, unmanaged and managed, in the Netherlands and Denmark.
- Studied taxa: **alder** (*Alnus glutinosa*), **ash** (*Fraxinus excelsior*), **willow** (*Salix* sp.) and **hazel** (*Corylus avellana*).
- **Unmanaged trees showing very straight, vertical branches** that were expected to show spurts of growth (natural spurts).
- **Managed trees with a long management cycle** of which the branches had not been removed for a relatively long time (up to 50 yrs).
- The diameter and the age were established every meter from all branches and side-branches ≥ 1 m long.

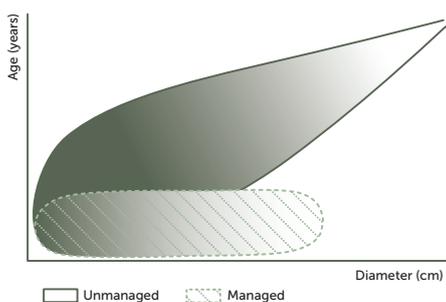


fig. 3. Model for the age and diameter of (uncarbonised) branches of managed and unmanaged trees.

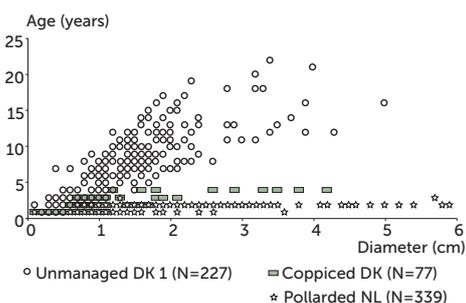


fig. 4. Age/diameter data of unmanaged and managed willow (modern-day trees), confirming the potential of the method. Note the plateau in the data of branches of managed trees (Out et al. 2013).



fig. 1. Managed trees: pollarded willows.



fig. 2. Iron age track way Vlaardingen (© VLAK Vlaardings Archeologisch Kantoor).

New results on modern-day trees: confirmation and confusion

Confirmation New data confirm the model also for hazel (**fig. 6**). It is possible to distinguish clear examples of managed and unmanaged hazel trees by age/diameter analysis, also in archaeological assemblages (**fig. 7**). For willow, ash and alder, newly collected data of ca. 40 new trees confirm the earlier results (**fig. 8**), for branches not only ≤ 6 cm but also up to at least 23 cm.

Error type 1: Risk of incorrect detection of management: Natural spurts, i.e. straight, vertical branches of unmanaged trees, occur (besides normal branches) in unmanaged shrubs and fallen trees of e.g. willow and hazel. **The age/diameter data of natural spurts plot between the data of managed and unmanaged trees (figs. 8 and 9)**. Also unmanaged alder seedlings growing under good conditions grow as fast as branches of managed alders.

Error type 2: Risk of overlooking management: When the **branches of managed trees are not removed for a longer period**, the age/diameter data of these branches also **plot between the earlier data of unmanaged and managed trees, or even as unmanaged trees (Fig. 10)**. Nevertheless, **management may still be recognisable by a plateau in the scatterplot, depending on branch age.**



fig. 5. An unmanaged hazel shrub growing along a forest edge, showing straight branches (natural spurts) that look similar to branches of managed trees.

Conclusions

- The model is valid for branches of willow, ash and hazel up to 23 cm. It is more problematic for alder.
- The occurrence of **natural spurts** and **old branches of managed trees** results in the presence of a **third data cloud in the model**, in between the age/diameter data of unmanaged and managed trees. This results in overlap between branches of unmanaged and managed trees for branches < 4cm.
- The occurrence of **natural spurts may result in confusion with branches of managed trees** in archaeological assemblages.
- Nevertheless, **branches of managed trees**, including branches that are max. 20-30 years old, **may still be recognised by a plateau** in the age/diameter scatterplot (figs. 3 and 6).
- **To detect long-term management in archaeological contexts we recommend:** multiple samples, large sample sizes (N_≥100), analysis per taxon and context, and a focus on branches ≥ 4 cm.

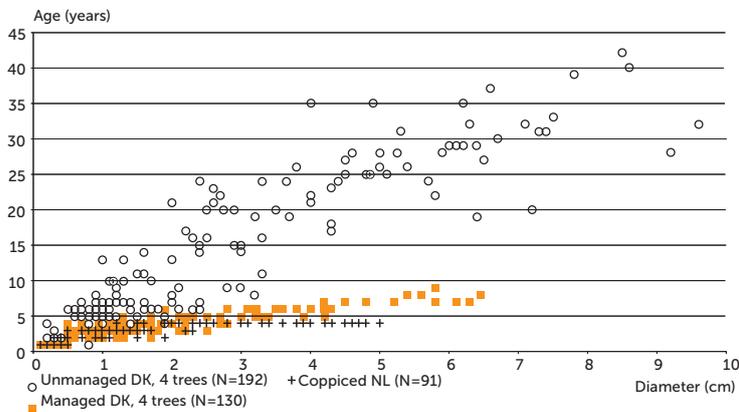


fig. 6. Age/diameter data of unmanaged and managed hazel.

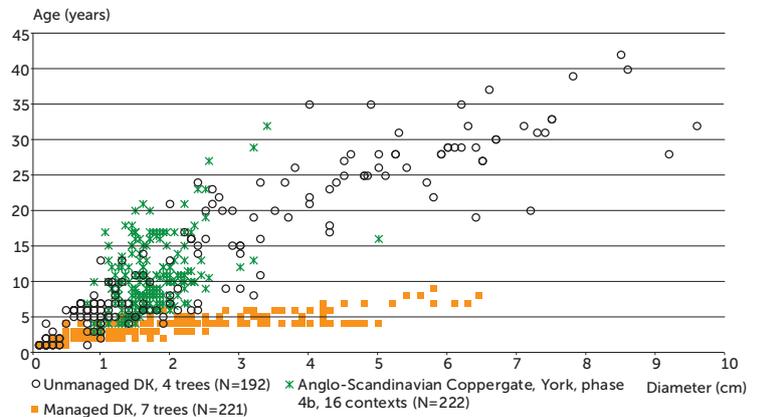


fig. 7. Archaeological hazel data from Anglo-Scandinavian York plotted on the data of modern-day hazel trees. Unpublished data A. Hall.

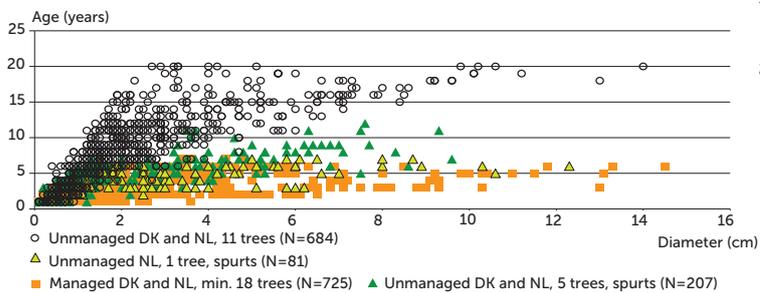


fig. 8. Age/diameter data of unmanaged and managed willow, including vertical, straight branches of unmanaged trees (natural spurts). Note the overlap between unmanaged and managed trees up to 3 cm.

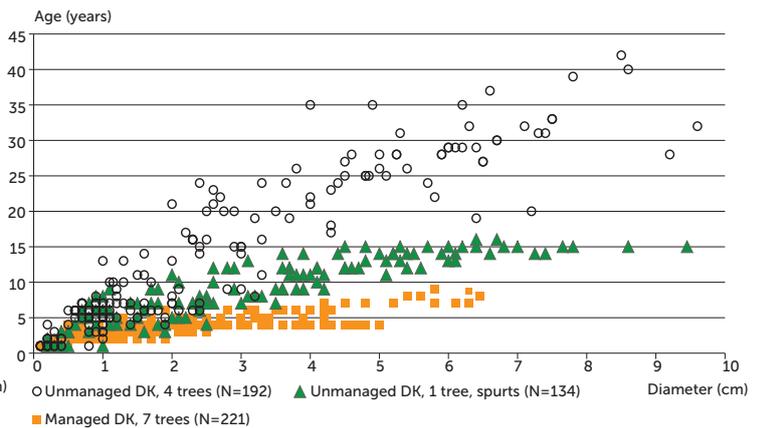


fig. 9. Unmanaged and managed hazel, including fast-growing branches of unmanaged trees (natural spurts).

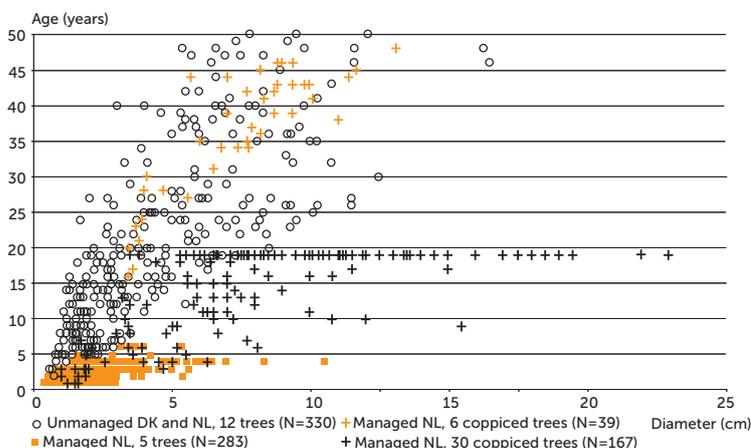


fig.10. Unmanaged and managed ash.

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