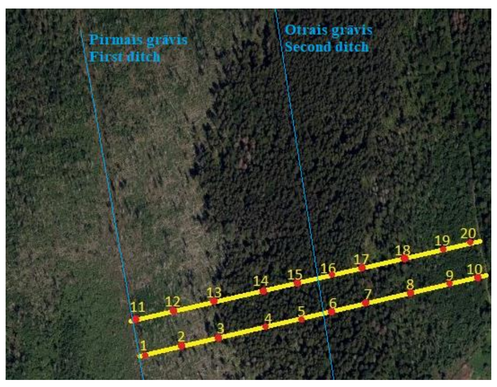
Forests and water: effect on carbon storage

Kārlis Bičkovskis, Guntars Šņepsts, Jānis Liepiņš, Andis Lazdiņš, Jānis Donis, Āris Jansons
Latvian State Forest Research Institute "Silava"
karlis.bickovskis@silava.lv aris.Jansons@silava.lv

The increase of groundwater level (rewetting) is gaining popularity as a biodiversity enhancement measure across Europe. In Latvia large areas of wet forests on mineral and peat forests exists (10% and 11% of the total forest area, respectively), thus the additional benefit to biodiversity of such measure can be justified only in very specific cases. Aim of our study was to characterize the effect of rewetting on forest carbon stock and its potential in relation to the occurrence of stem rot.

Material and Methods

Transects of sample plots (500m^2) were established perpendicular to a clogged ditch, where water flow was stopped by a beaver dam and not renewed due to nature protection goals and a functioning ditch. The site was characterized by deep organic soil.



The occurrence of decayed trees in birch stands with and without drainage systems (i.e. wet and drained) was determined by increment cores, sampling altogether 10542 trees across Latvia.

Results

The results show a significant ($p<0.05$) negative relationship between the distance from the functioning ditch and the accumulated carbon in living trees up to ~160 meters, and a positive relationship with the distance from the stopped ditch. Similar relationships were found in soil analysis – carbon storage in this component of the forest ecosystem was higher closer to the functioning ditch. In contrast, a higher amount of carbon in deadwood was present closer to the stopped ditch; however, it was insufficient to compensate for lost carbon in tree biomass and lower soil carbon storage.

The proportion of birches with stem rot increased significantly with age. The effect of growing conditions was significant, but notable only in older stands, where the proportion of affected trees was notably higher in wet forests than in drained or forests with normal moisture regime.

Conclusions

1. Discontinuation of the drainage system results in the collapse of the stand.

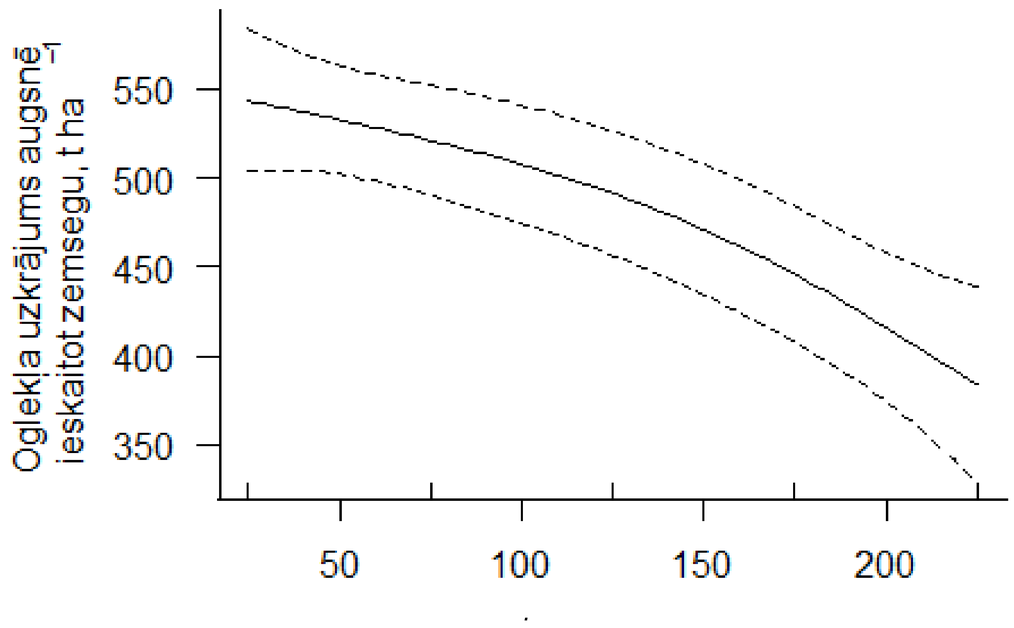
2. Decay of formed deadwood releases carbon in the atmosphere.

3. Stand decay coincides with carbon losses from soil and ground cover.

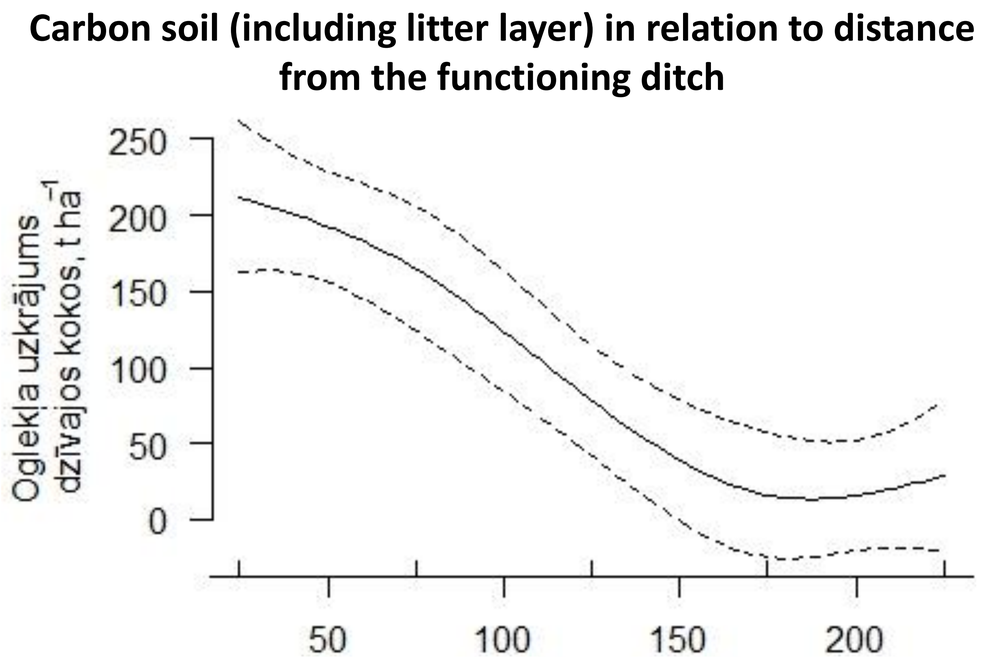
4. Maintenance of drainage systems is essential to ensure the positive effect of forests on climate change mitigation. Targeted biodiversity protection shall consider this aspect.

5. Elevated groundwater level leads to the increased share of birch with stem rot, especially in older stands, having a negative effect on carbon storage in biomass (in managed forests – also on storage in harvested wood products).

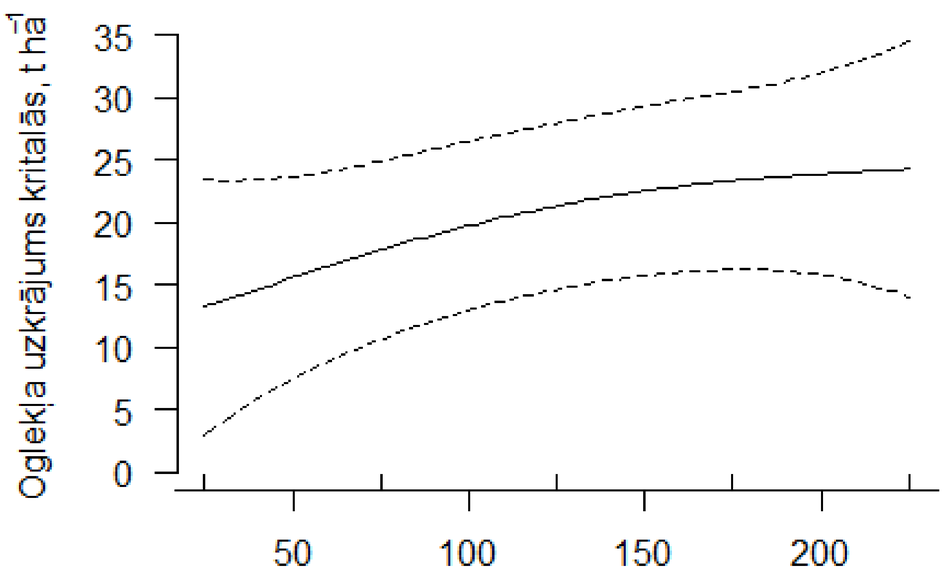
Cross-section discs of birch with stem rot



Carbon soil (including litter layer) in relation to distance from the functioning ditch



Carbon in tree biomass in relation to distance from the functioning ditch



Carbon deadwood in relation to distance from the functioning ditch

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