Impacts of a dioecious shrub on soil processes

Vigdís Freyja Helmutsdóttir[1], Kristín Svavarsdóttir[2] & Þóra Ellen Þórhallsdóttir[1]

[1] Institute of Life and Environmental Sciences, University of Iceland

[2] Soil Conservation Service of Iceland

Introduction

We examined ways in which woolly willow (*Salix lanata,* Icelandic: *loðvíðir*) may act as an ecosystem engineer, a species capable of changing its biotic or abiotic environment, modulating habitats and resource availability for other species, often in a facilitating way[1]. Isolated shrubs may alter microclimate conditions[2], and their fungal symbionts modify soil environments[3]. Here we report on the impact of woolly willow on belowground processes.

Experimental design

Two contrasting field sites in SE Iceland were chosen, each with 30 individual willows and control points:

- Moss-rich heathland on Skaftafellsheiði (380 m a.s.l.)
- Early successional outwash plain, Skeiðarársandur (80 m a.s.l.)

A standardised approach (Tea Bag index[4]) was used to measure decay rates (*k*) and stabilisation of organic soil material (*S*) along a gradient from willows during the 2019 and 2020 growing seasons (Figure 1).

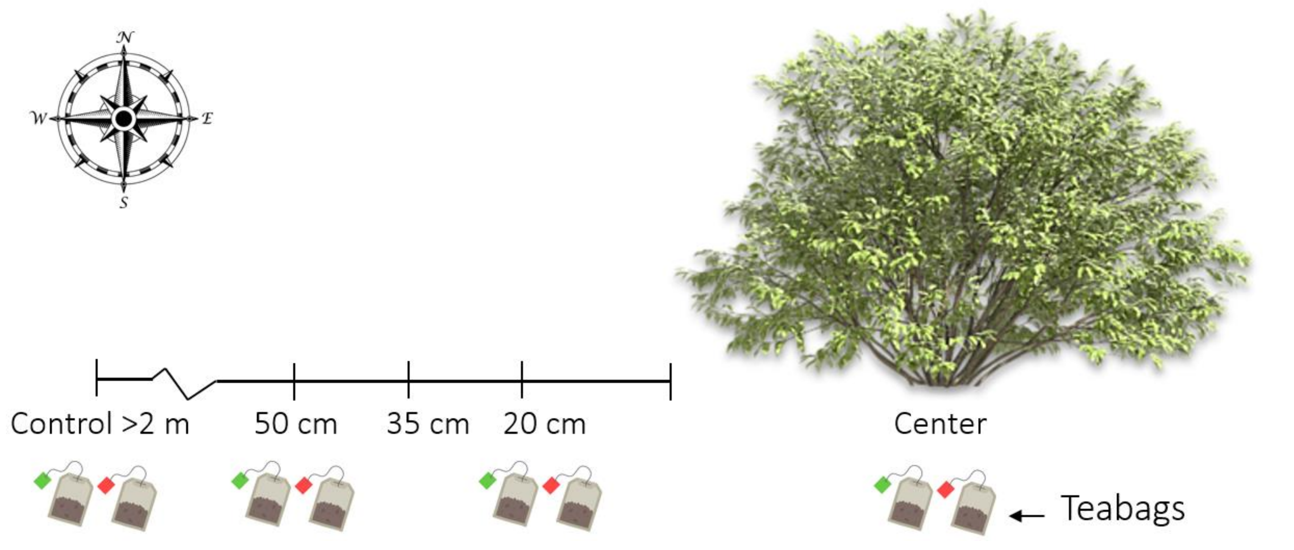

Figure 1. Teabags were buried at the centre of each willow, at 20 and 50 cm from their perimeter and at control points >2 m away from any visible shrub.

Results and discussion

There are trends for lower *k* and *S* with increasing distances from willow bushes, with some significant drops when leaving the influence of the rhizosphere (Figures 2 & 3). As willows on the heath are larger than on the plain, that occurs around 50 and 20 cm, respectively.

The observation that both decay and stabilisation rates are higher under willows may be explained by the fact that plants stimulate the activity of soil microbes through labile root exudates. At the same time, symbiotic mycorrhizal fungi can alter the release of carbon to the microbial community, and enhance carbon stabilisation through soil aggregation[3].

Unexpectedly, even though female woolly willows are on average smaller than males, they show higher decomposition and stabilisation factors (Figures 4 & 5). This could suggest increased microbial activity around females or different microsite preferences between the sexes.

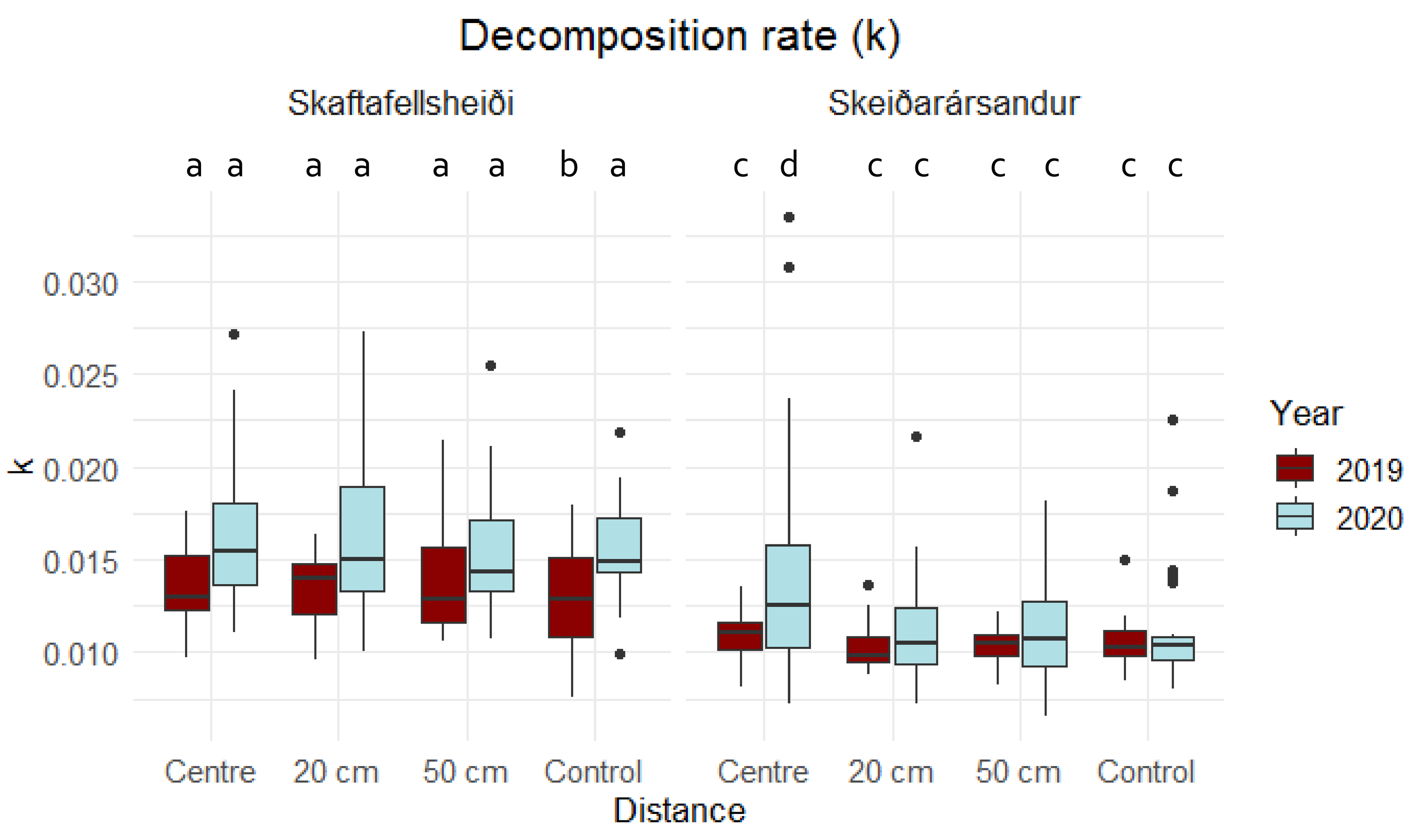

Figure 2. *Decomposition rate (k) for all sites, years and treatments. Different letters indicate significant difference (p<0.05).*

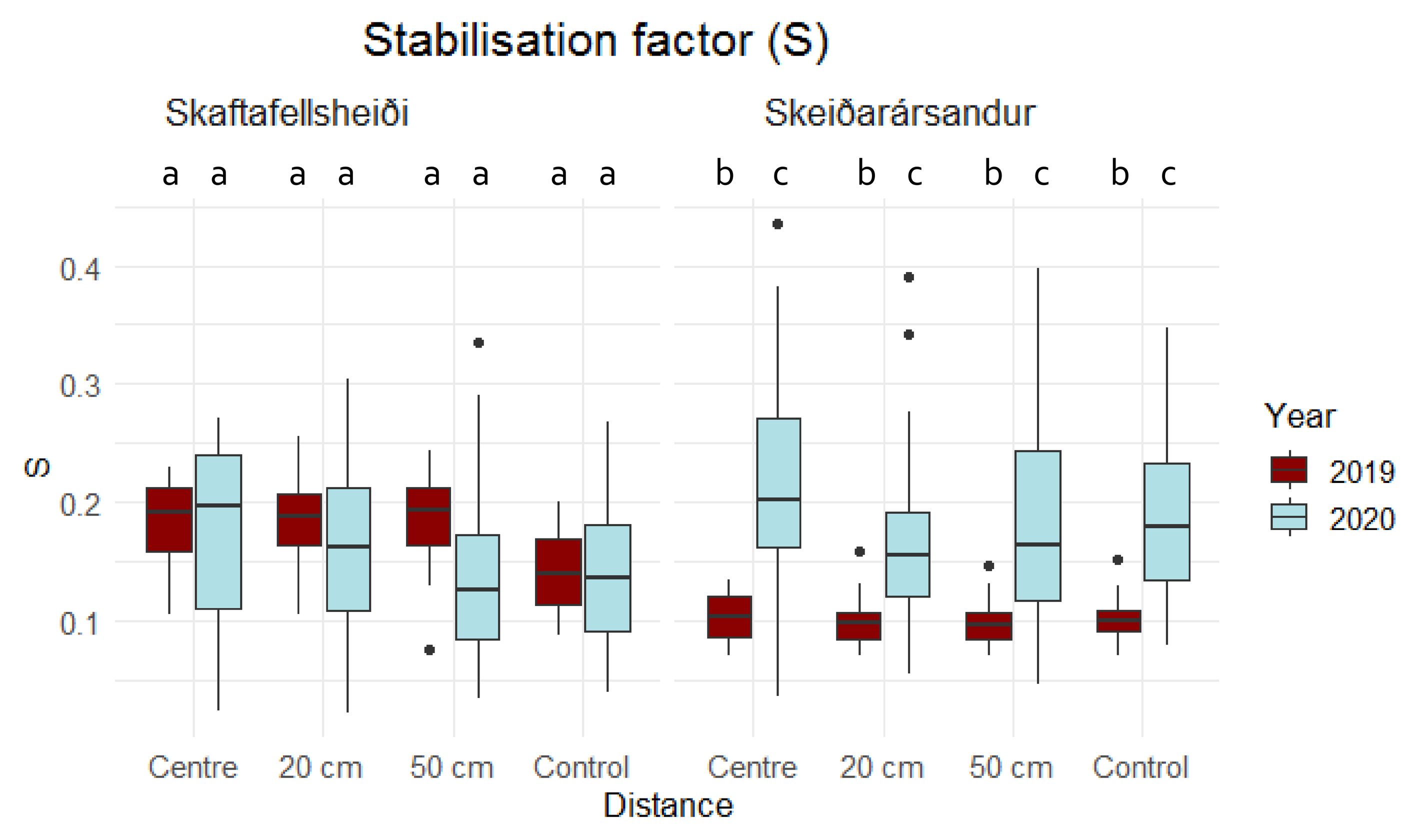

Figure 3. *Stabilisation factor (S) for all sites, years and treatments. Different letters indicate significant difference (p<0.05).*

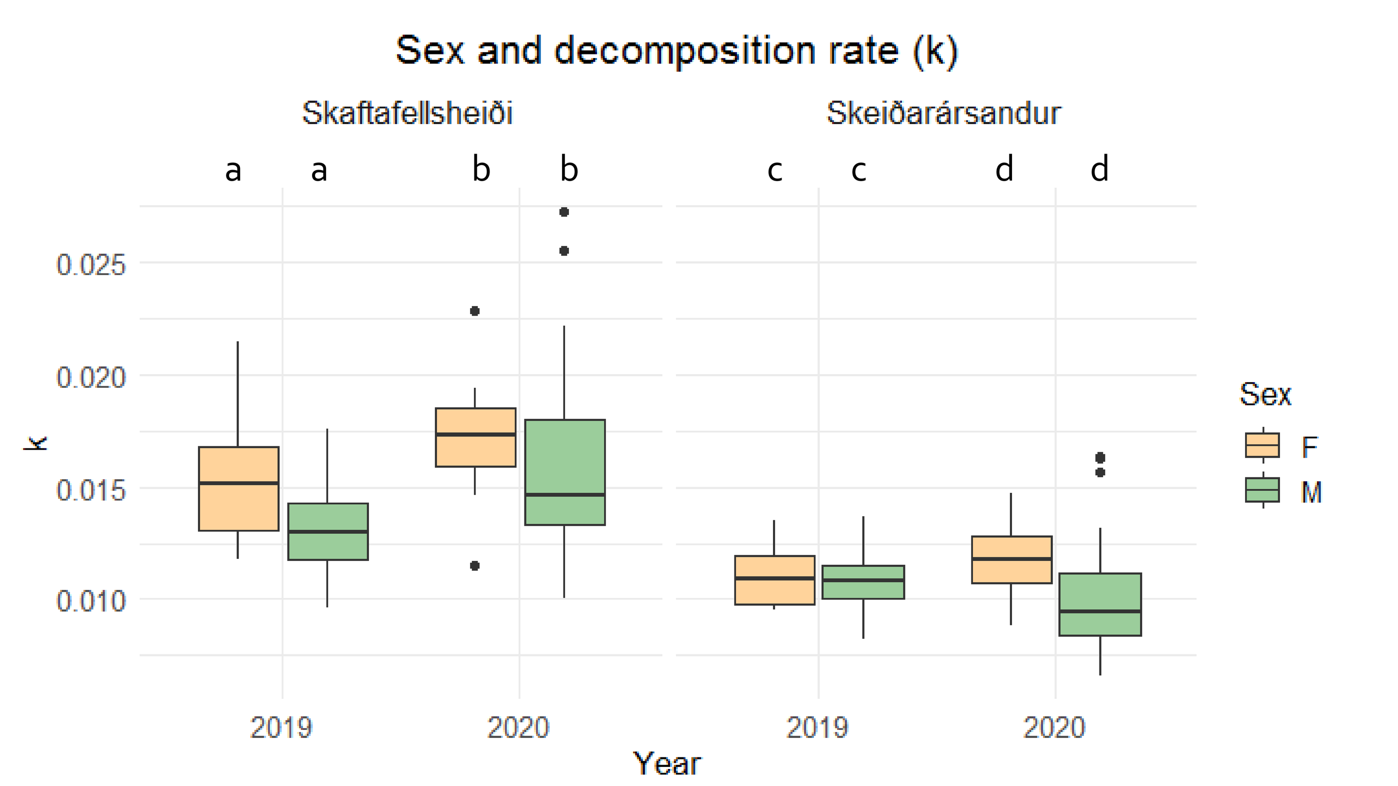

Figure 4. *Decomposition rate (k) shown for the sexes. Different letters indicate significant difference (p<0.05).*

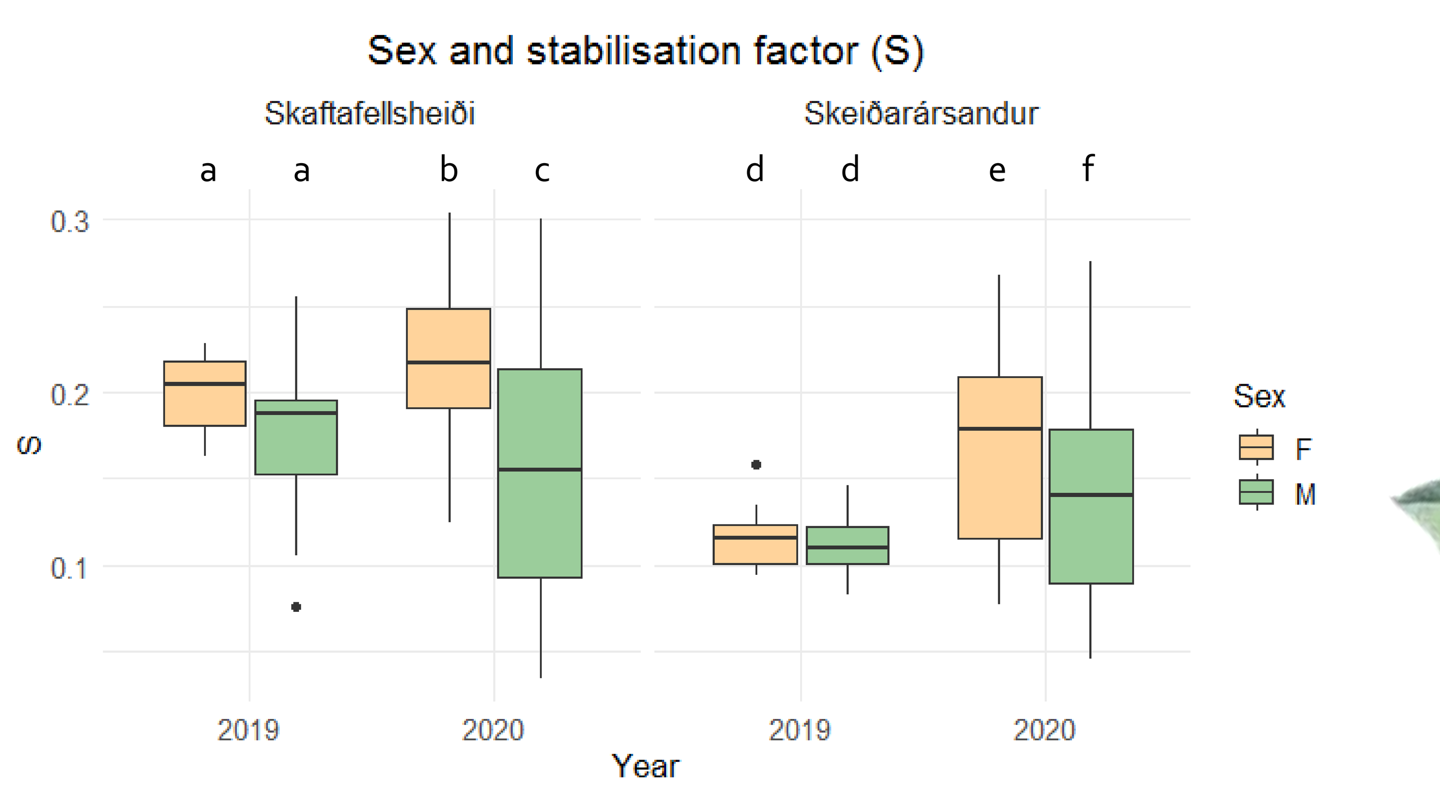

Figure 5. *Stabilisation factor (S) shown for the sexes. Different letters indicate significant difference (p<0.05).*

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