

## Publication

## Shrub encroachment by green alder on subalpine pastures: Changes in mineral soil organic carbon characteristics

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Shrub encroachment by green alder ( *Alnus viridis* ) has been an ongoing process in European mountain areas after land abandonment. The invasion of this N<sub>2</sub>-fixing and highly productive plant on former subalpine pastures and meadows changes the properties and interactions in the plant-soil system. In the national carbon inventory, it is assumed that green alder woodlands contain the same amount of SOC (69 t C ha<sup>-1</sup>) as productive forests due to the lack of data. To explore the rarely studied change of the soil organic carbon (SOC) pools during the shrub establishment, the study used a chronosequence approach by testing pastures in a pre-encroached status and green alder stands with an age of 15, 25, 40 and 90 years, respectively. Besides the estimation of the SOC stock, the soil samples, taken in four different depth layers, were physically fractionated to characterize the quality of the SOC. While pasture grassland contained a median SOC stock (0–30 cm) of 100 t C ha<sup>-1</sup>, the SOC stocks decreased to 81 t C ha<sup>-1</sup> for 40 years old shrub stands. The 90 years old green alder bushes showed the significantly highest C stock in the mineral soil with 174 t C ha<sup>-1</sup>. Green alder encroachment led to an increase of the particulate organic material (POM) in the mineral soil resulting in a high concentration of unprotected carbon. By contrast, a stabilization of the SOC with the mineral soil phase was not visible during green alder establishment. The study concludes that green alder encroachment causes a significant increase of fresh and unprotected carbon in the soil system compared to subalpine pastures, resulting in a significantly higher total SOC stock (+74 t C ha<sup>-1</sup>) after 90 years and a doubling of the potential to leach dissolved organic carbon. At landscape level, the ingrowth and establishment of green alder on abandoned subalpine pastures can therefore influence the terrestrial and aquatic systems. Secondly, the SOC stocks of shrub forests are insufficiently represented in the current National Inventory Report.

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