

The RobustAlps project: a silvopastoral system in *Alnus viridis*-encroached alpine pastures

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Abstract
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Abstract

Green alder (*Alnus viridis*) is a pioneer shrub species that has expanded over former pastures in Central Europe due to land abandonment, leading to negative agri-environmental impacts, such as an increase in nitrate leaching and soil acidification. Robust livestock breeds, such as Highland cattle, could be used to control *A. viridis* expansion and create an agro-silvopastoral system aiming at restoring alpine grassland services. The objectives of this study were to investigate the impact of *A. viridis* encroachment on plant community composition and diversity and to map the spatial distribution of Highland cattle in *A. viridis*-encroached pastures with the strategic placement of attractive points.

During the summer of 2019, three different Highland cattle herds were placed in three sites along an *A. viridis* encroachment gradient in Switzerland (Site Bovonne and Champlong) and Italy (Site Val Vogna). A total of 58 botanical surveys were carried out before grazing to assess plant community composition, pastoral value and ecological indicator values associated with *A. viridis* cover. The spatial distribution of cattle in shrub-encroached paddocks was studied at the beginning, middle, and end of the grazing period by monitoring 6 to 8 cows equipped with GPS collars in each herd. During the summer of 2020, molasse-based blocks were placed in highly encroached parts of three paddocks (two in Bovonne and one in Vogna) to attract the herds. Botanical surveys were carried out before and after grazing around both molasse-based blocks and control areas to assess the role of attractive point in increasing *A. viridis* grazing.

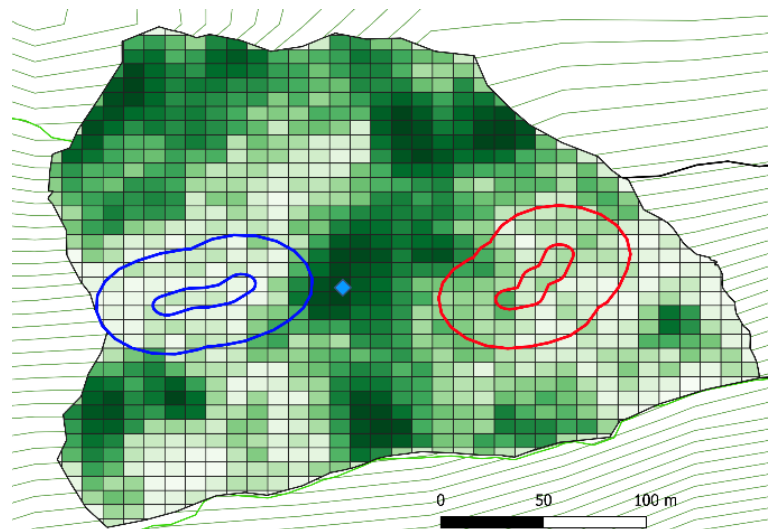
Plant species associated with higher pastoral values of the vegetation were found in areas with lower *A. viridis* cover, while highly encroached areas were dominated by a few nitrophilus and shade tolerant broad-leaved species and by ferns. In contrast to many other breeds, Highland cattle were capable of grazing on *A. viridis* encroached area, as well as on the steepest slopes and further away from water sources, as they were not significantly influenced by these harsh conditions. Moreover, cattle even preferred *A. viridis* patches and steep slopes in Champlong, during certain grazing periods, which shows that cattle are able to move to areas with the most unfavourable conditions and can stay there for relatively long periods (approximately two weeks). Vegetation cover around attractive points strongly decreased after grazing (by about 50%) compared to control areas, which resulted in increased bare

soil. Simultaneously, leaves of *A. viridis* were also more consumed and branches more damaged by cattle around attractive points.

Altogether, our findings demonstrate the ability of Highland cattle to graze in harsh environmental conditions and to exploit *A. viridis*-encroached pastures. Furthermore, the presence of attractive points was shown as extremely efficient in attracting cattle toward patches highly colonized by *A. viridis* (Figure 1), where they successfully grazed and damaged *A. viridis*. Such results highlight the important role of Highland cattle and attractive point in initiating a succession from vegetation with low pastoral value (ferns, nitrophilus species) toward the re-establishment of grassland species with higher forage value. Overall, our results suggest that highland cattle have a high potential to reduce *A. viridis* encroachment in the long-term and partially restore shrub-encroached alpine grasslands.

Figure 1: Maps of the green alder-encroached paddock of Bovonne in 2019 without attractive points (a) and in 2020 when the effects of attractive points have been tested (b). Blue losange represents the water tank for cattle. Grid cells are 10 x 10 m and green color represents the exploitation by cattle (i.e. from GPS points) from low exploitation in light green to high exploitation in dark green. Red shapes (buffer of 10 m and 50 m) represent the area around attractive points while blue shapes (buffer of 10 m and 50 m) represent the control area. The maps highlight the similar exploitation by cattle of both areas in 2019, prior to the use of attractive points (a), and the higher exploitation of the area around attractive points in 2020, especially in the 10 m buffer (b).

(a) Exploitation by cattle in 2019 before the use of attractive points



(b) Exploitation by cattle in 2020 with the use of attractive points

