The influence of snow cover duration on alpine plant phenology

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Background
Climate change affects snow cover duration in alpine ecosystems. Snow insulates soil and vegetation during winter months and allows soil processes to continue. Too early snowmelt may put plants at risk of lethal freezing events in spring. The development of many alpine plant species is photoperiodically controlled, thus, these plants will not profit from earlier snowmelt. Delayed snowmelt shortens the growing season of alpine plants. Less time for flowering and seed formation may reduce the reproductive fitness. In a snow manipulation experiment at 2500 m a.s.l., we examine the influence of variable snowmelt dates on alpine plant phenology.

Objectives
1) Testing the feasibility of manual snow cover manipulation at high elevation
2) Identify phenology strategies in alpine plant species

Results & Discussion

Snow manipulation
Snow reduction led to significantly earlier snowmelt (P<0.01). On average, these plots were snow free 7 days before the control, matching recent results of Klein et al. (2016) who found a decline in snow cover duration by 5.8 days per decade since 1970.

Plant phenology
The selected alpine plant species adopt different strategies for their phenological shift between vegetative and flowering stages (Figure 2). The dominant sedge Carex curvula as well as herb Geum montanum flowered shortly after snowmelt. The grass Helictotrichon versicolor and the herb Potentilla aurea showed a distinct temperature sum threshold at which they start flowering (ca. 6000 degree hours >1°C, corresponding to ca. 21 bright days). The grass Poa alpina seems to be at least partly controlled by photoperiod, confirming results of Keller & Körner (2003). Leontodon helveticus did not show a clear response and its strategy might depend on the timing of snowmelt, possibly by releasing several flowering cohorts which are not all controlled by the same mechanism.

Methods & References
Snow manipulation was manually achieved in Apr/Jun 2016. Snow depth was de- or increased (down to 0.5m or up to 2.2-2.5m) to advance or delay snowmelt. Snowmelt dates were identified by a clear soil temperature increase, measured by temperature loggers (middle of each 2m x 2.5m plot) in 3-4 cm soil depth. Plant phenology was assessed six times during the growing season. For each plot, each species was allocated to its phenology stage, based on the majority of the individuals. Phenological shift between vegetative and flowering stage is assessed here (logit functions of sum of degree hours > 1°C after snowmelt).

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