

From vegetation cover to the reaction of single plant species: What can GLORIA already tell us about the effects of climate warming on alpine vegetation?



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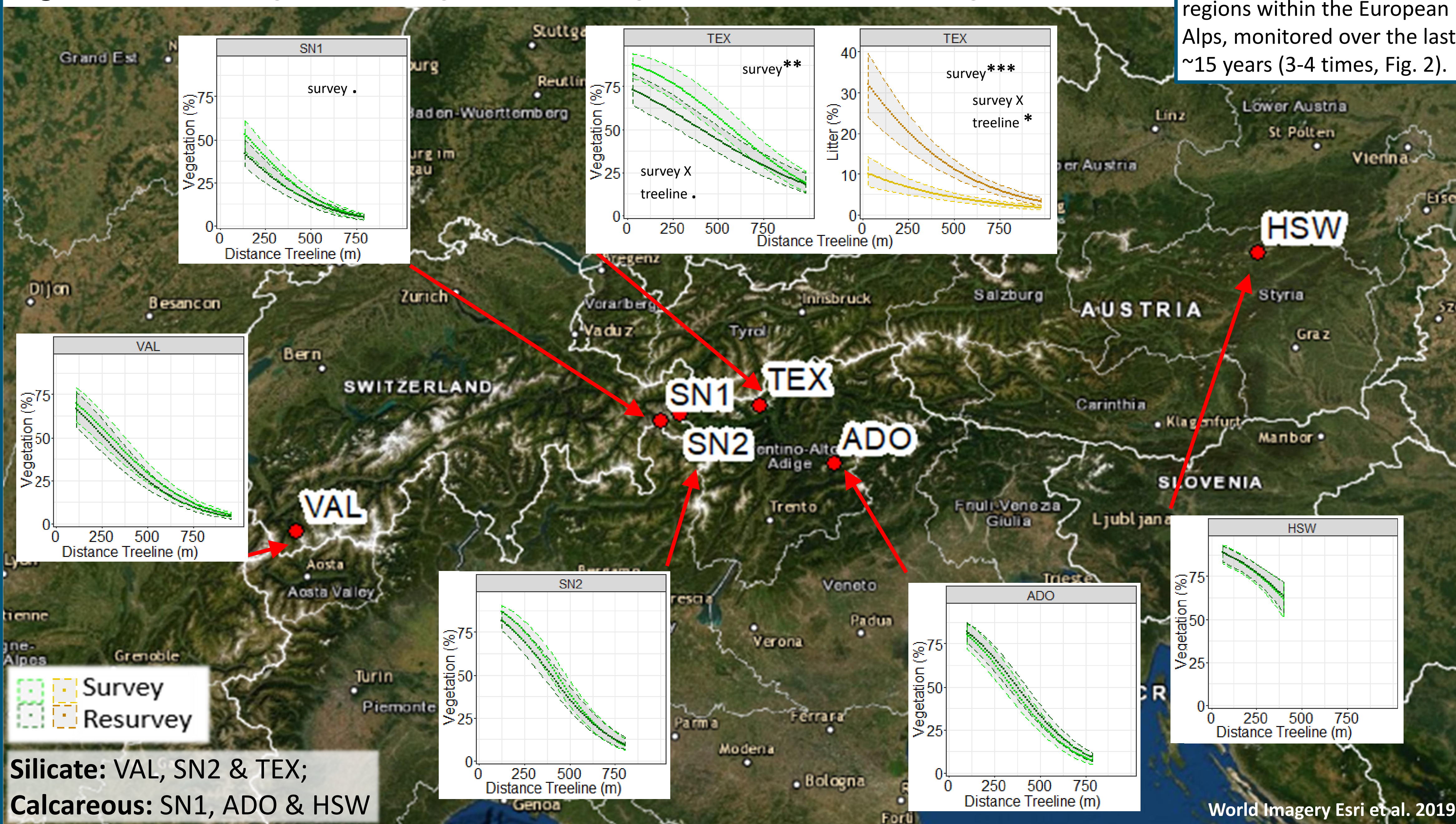


Long-term research projects such as **GLORIA** (Fig. 1) are crucial to understand ongoing biodiversity changes and verify predictive models. Alpine plant diversity is highly sensitive to global change:

- Increase of species numbers & thermophilization of summit flora (Europe: Steinbauer et al. 2018: Nat. 556; Andes: Carilla et al. 2018: Ecol. Evol. 8)
- Threat for cold adapted species through competitive displacement or physiological problems (Lamprecht et al. 2018: New Phytol. 220)
- An increase of vegetation cover and competition in dense communities is expected

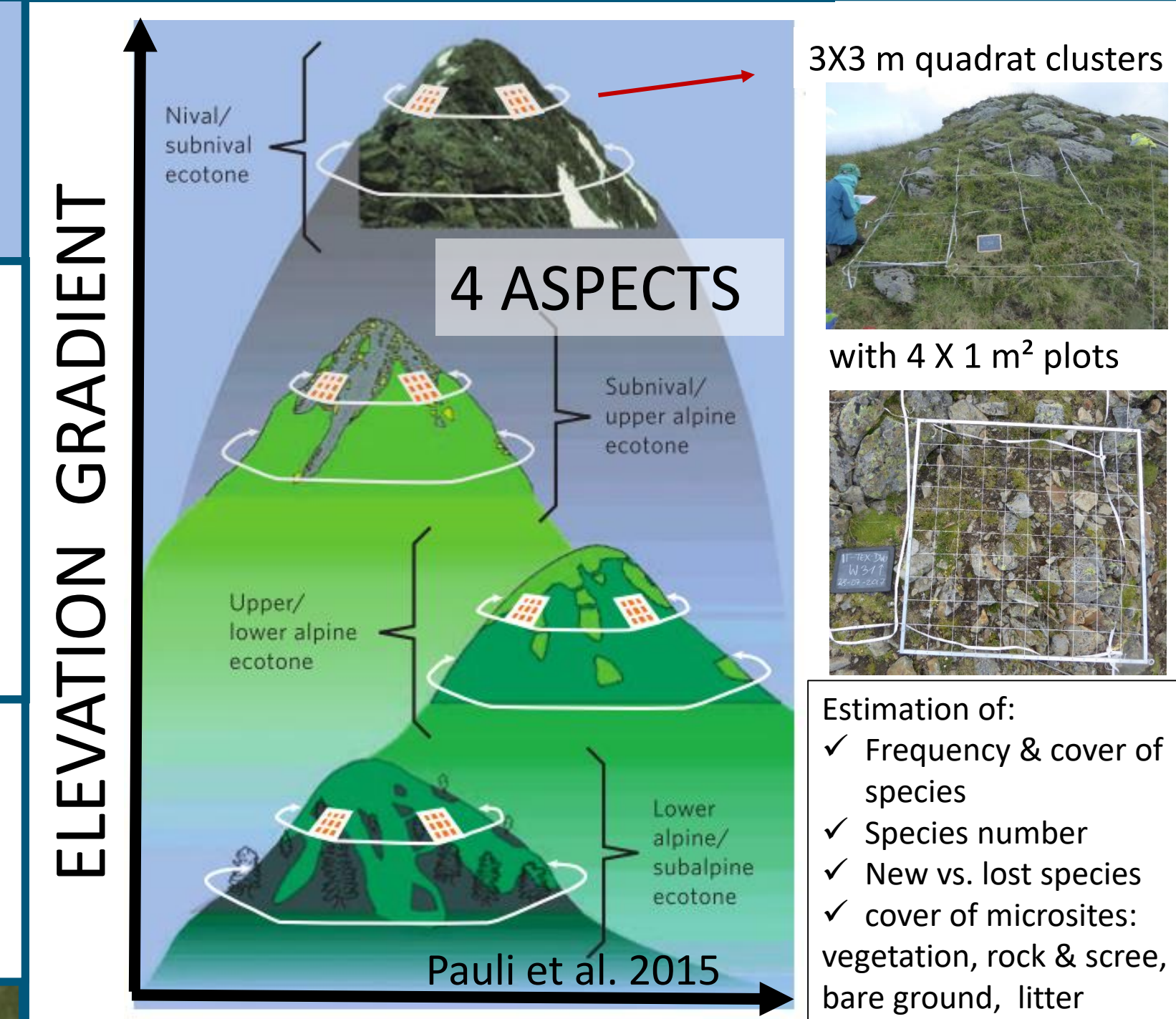
Vegetation cover along the elevation gradient and changes over time in six different regions (Fig. 2):

STUDY AREAS: 6 target regions within the European Alps, monitored over the last ~15 years (3-4 times, Fig. 2).



Silicate: VAL, SN2 & TEX;
Calcareous: SN1, ADO & HSW

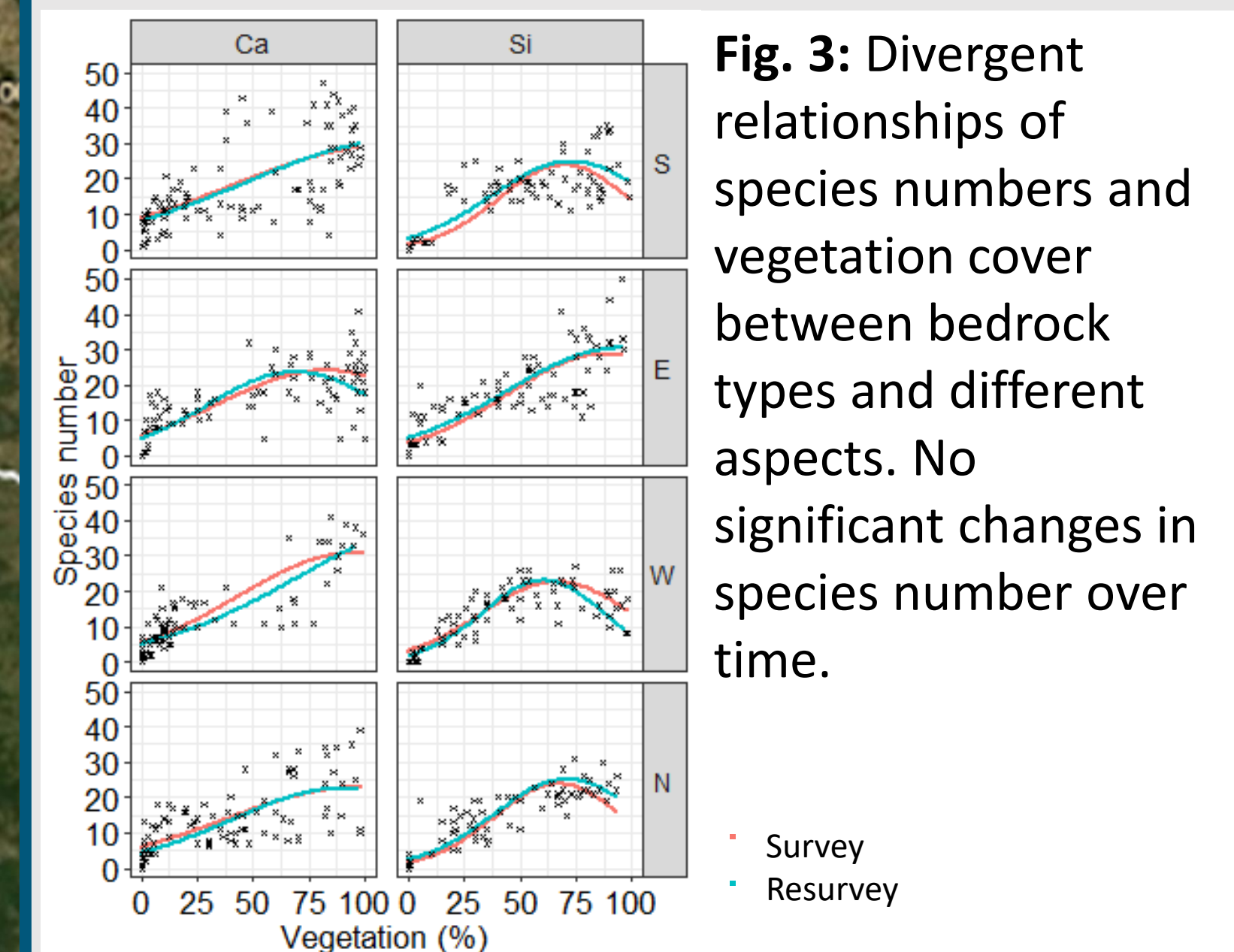
Fig. 2: Vegetation showed a strong decrease along the elevation gradient whereas differences between the surveys were small. Only in TEX a significant decrease of vegetation especially at lower altitudes was detected. This decrease was coupled with a significant increase in litter. Plots: Predicted cover values of southern aspects $\pm 95\%$ confidence intervals (bootstrapped) from a betaregression model in R: $vegetation\ cover \sim survey * region * distance\ to\ treeline + aspect * survey$.



TIME GRADIENT ~ 15 years

Fig. 1: GLORIA-multi summit approach: Investigation of the upper 10 m and the 1 m² plots at summits along an elevation gradient, considering 4 aspects.

Silicate vs. calcareous bedrock



Plots: Predicted species number (coloured line) according to a GLM (quasipoisson) in R: $Species\ number \sim vegetation * bedrock * survey * aspect + vegetation^2 * bedrock * survey * aspect$. Black crosses represent datapoints.

OUTLOOK To identify species under threat of extinction vs. migrating species from lower altitudes, further analyses along transects reaching from the summits down to the treeline will be realized soon.