

Quercus spp

Description of model and ensemble projections

The current distribution of *Quercus* spp. is modelled to cover the warmer (low altitude) parts of the Swiss Plateau, the low altitude regions of the interior Alps, and the warmest parts of the Ticino. The species is not projected to climb very high in altitude along Jura and Alps. The observed distribution of the genus in colder locations is not simulated well.

Under expected climate change using the A1B scenario, most combinations of statistical and regional climate models predict a rapid spread of *Quercus* on the Plateau, in the Ticino and in the interior Valleys, meaning that these regions will soon represent climate conditions, under which *Quercus* can be expected to grow well. In all regions the genus is projected to expand to higher altitudes, e.g. reaching almost the highest peaks in the Jura and in the southern Ticino. The most massive spread is projected to occur after 2050, meaning that until then no strong expansion is modelled. This is especially visible for the Jura Region. While the simulation under current climate resembles a mixture of the three involved species, the future projections rather conform with the simulations of *Q. robur*, the most frequent among the three most abundant species in Switzerland (*Q. robur*, *Q. petraea* and *Q. pubescens*).

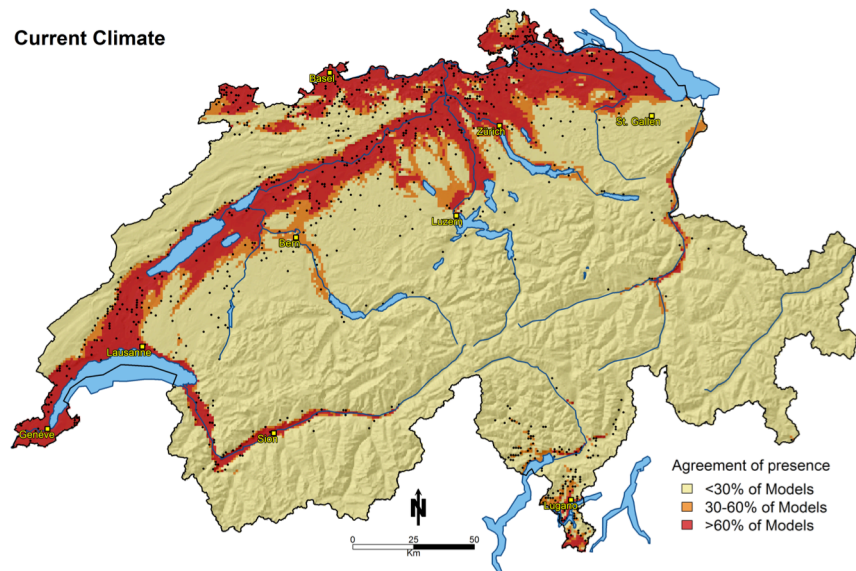


Figure 1. Current distribution (black dots) from the Swiss National Forest inventory (LFI 1) and simulated habitat suitability under current climate as calibrated from LFI forest inventory data of Switzerland.

Synthesis and Conclusions

The model fits the distribution of *Quercus* well in general, although under current climate it does not represent the coldest observations well. Under future climate conditions, the model resembles much the most cold-adapted species (*Q. robur*) and therefore the overall genus model seems to perform well and can be considered a credible model to project the future habitat suitability of Oaks. The ensemble models project a 99% overlap between the current and the future range in Switzerland and a strong expansion of the range (+200%) under future climate conditions.

The genus colonizes dry and warm habitats in general, but especially *Q. robur* can also tolerate temporarily inundated conditions. Many oak forests are of human origin in Switzerland (except the driest *Q. pubescens* forests on rocky outcrops along the Jura, the insolated slopes at low altitudes of the Valais, and of the Ticino. Oaks in general tolerate disturbance by (frequent) cutting (coppicing), which favors oaks over other, less tolerant species such as beech or maple. Yet, on drier and variably dry sites, the species can dominate due to its tolerance to variable drought levels. *Q. robur* is the most cold-tolerant (spring frost), while *Q. pubescens* is the most drought-tolerant among the three most abundant Oak species (Bonfils et al. 2015). All three abundant Oak species inbreed often with each other.

Oaks are very well adapted to the expected climate change and the associated abiotic and partly also biotic effects. The genus is quite drought tolerant, can grow on acidic and alkaline (though a bit less well for *Q. robur*) soils, and it is very tolerant to disturbance. This is partly due to its high genetic variability and partly due to its high capacity to re-sprout after being browsed, coppiced or damaged (Bonfils et al. 2015). The species can be considered a winner of climate change, and will likely spread strongly on the Swiss Plateau, which it has done already earlier during warm phases of the Holocene (Lang 1994).

Range change statistics

	CH	Europe
Current range size [km²]	6'522	–
Future (2080) range size	19'542	–
Range Change 2080/2000 [%]	299%	–
Overlap 2000/2080 [km²]	6'477	–
Overlap/current range [%]	99.3%	–

References

Bonfils P, Rigling A, Brändli U-B, *et al.* (2015) Die Eiche im Klimawandel - Zukunftschancen einer Baumart. In: *Merckblatt für die Praxis*, Nr. 55, p. 12. Eidg. Forschungsanstalt WSL, Birmensdorf.

Lang G (1994) *Quartäre Vegetationsgeschichte Europas: Methoden und Ergebnisse* Fischer, Jena [etc.].

