

Key concepts

Local adaptation

The genetic differentiation between populations results from spatial variation in the pattern of natural selection. Local adaptation might be expressed by variations in growth, survival, phenology and other fitness related tree characteristics.

Forest reproductive material (FRM)

Reproductive material of forest tree species including (i) seed unit (cones, infructescences, fruits and seeds, (ii) parts of plants (stem, leaf and root cuttings, explants or embryos and any parts of a plant intended for the production of planting stock), (iii) planting stock (plants raised from seed units, parts of plants or from plants from natural regeneration).

Provenance

A tree population or group of individual trees growing at a particular place of origin.

Provenance test

A common garden experiment, established at one or more locations, where the genetic variation of different provenances is evaluated in terms of tree growth, mortality, phenology, stem form, etc.

Regions of Provenance

An integral part of European and National FRM legislation and defined as an area with sufficiently uniform ecological conditions in which forest stands or seed sources show similar phenotypic or genetic characters. In reality, the delineation of the Regions of Provenance differs from country to country and might be based on a number of criteria, including ecological units, vegetation zones or even administrative boundaries.

“Local is best”

Traditionally, localized forest seeds have been advocated for reforestation on the assumption that such materials are best adapted to the local environmental conditions. A large number of scientific studies however found that local seedlings are often outperformed by non-local provenances and global climate change creates new environmental characteristics to which local seed sources will be maladapted.

Legislative frameworks

The COUNCIL DIRECTIVE 1999/105/EC is the legal framework for the production and marketing of forest reproductive material (FRM) within the European Union (EU) and provides the basis for all national regulations.



Photo: Vasyly Mahyych

SUSTREE Project

SUSTREE: “*Conservation and sustainable utilization of forest tree diversity in climate change*”

SUSTREE is a transnational project promoting climate change adaptation and genetic diversity of forest ecosystems in Central Europe. Funded by Interreg, SUSTREE comprises of eight partner institutions from six countries (Austria, Germany, Czech-Republic, Hungary, Poland, Slovakia) of Central Europe sharing their expertise, to enable management of the forest genetic resources.

Within this cooperation project:

- We develop transnational delineation models or decision support tools for forest seed transfer and genetic conservation based on species distribution models and available intra-specific climate–response function.
- These models are being connected to national registers of forest reproductive material in order to support nursery and forest managers for selecting the appropriate seed and planting material for future forest regeneration.
- Pilot applications in state forest enterprises will document the usability of the introduced tools for forest and natural resource managers as well as for policymakers and public bodies responsible for restoration and forest reforestation schemes.



Fig. 7: Countries cooperating in the SUSTREE project

References

OECD Guidelines on the Production of Forest Reproductive Materials , OECD, 2013. Available at: <http://t1p.de/a31t>

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Summary report of the Commission Expert Group on Legislation on seeds and plant propagating material. Section Forest Reproductive Material , Arcachon (FR), 26-27 APRIL 2017. Available at: <http://t1p.de/rfsw>

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<http://www.interreg-central.eu/Content.Node/SUSTREE.html>
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SUSTREE Policy Brief

“*Conservation and sustainable utilization of forest tree diversity in climate change*”

KEY MESSAGES

1

Forest trees exhibit manifold local adaptations to the climate of their habitat guaranteeing optimal growth and survival under stable environmental conditions.

2

Climate change disrupts the link between climate and local adaptations thereby challenging the “local is best” paradigm.

3

Regions of Provenance, defined within European and National legislations, differ among countries and do not reflect climate conditions nor support adaptive management in climate change.

4

Legislations governing reforestation and seed transfer should be based on range-wide local adaptation of trees to assist management of genetic resources under climate change.

Background

Genetic variation within tree species can be utilised to enhance resilience of forests to climate change and to save the multifunctional role of forest ecosystems.

Annually, approximately 900 million seedlings of the major tree species are planted in Central Europe. This offers an opportunity to implement adaptive management by matching adapted forest seeds and seedlings with suitable planting locations under expected future climate conditions.

European and national legislations define Regions of Provenance to guide the provision of forest seeds and seedlings. These Regions of Provenance are not comparable among countries and certain legislations restrict the transfer of forest seeds and seedlings across borders. Moreover, climate change will substantially alter growing conditions within and beyond these regions, invalidating the delineations in the future.

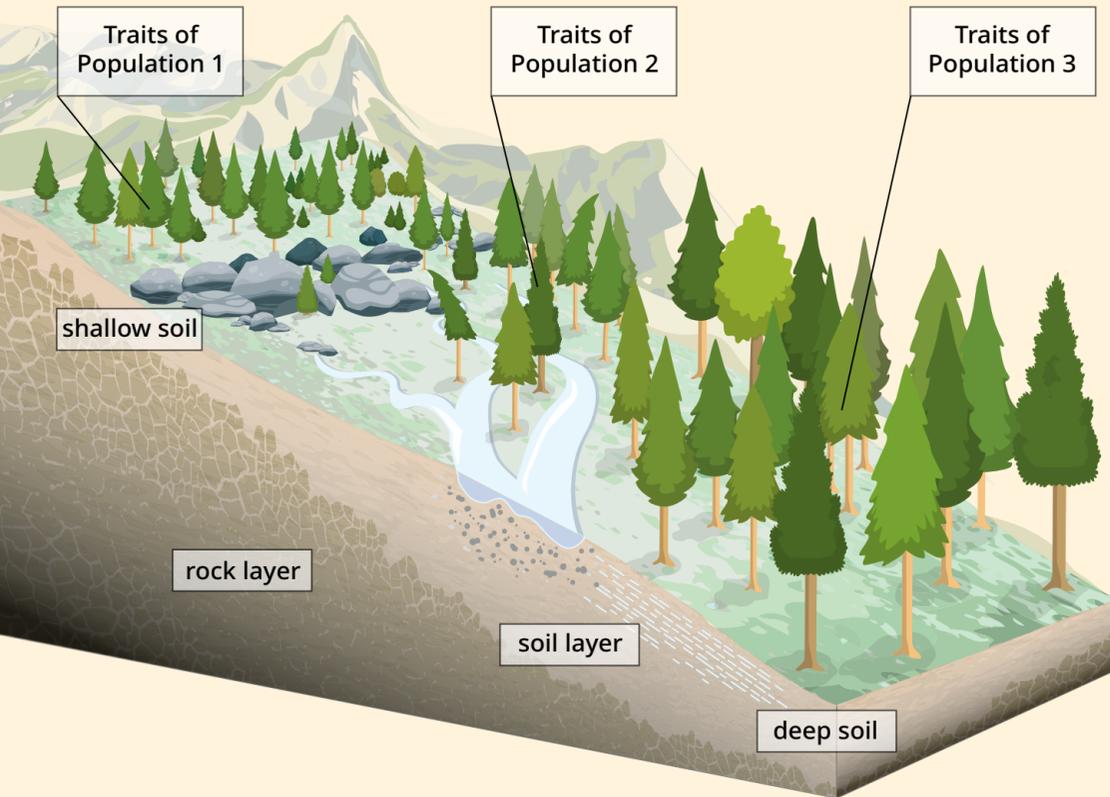


Fig. 1: Different population of a conifer based on an altitudinal gradient and soil

Regions of provenance in climate change?

We tested for similarities and differences in the climate regime of the current Regions of Provenance across Central Europe. Existing Regions of Provenance were statistically assigned to climatically similar groups for current and future climate (Fig. 3).

Regions across borders were found to have similar climate demonstrating that (i) climate was generally not considered while delineating such Regions of Provenance and (ii) individual countries used different approaches for delineating the respective Regions. Moreover, the climate within groups of Regions of Provenances will be strongly impacted by climate change.

Existing Regions of Provenance explain only between 8 and 31 % of the variation of climate in Central European forests, while country borders and altitude explain up to 52 % for single climate variables (Fig. 4).

Considering expected changes of climate in the future, demonstrates that neither Regions of Provenance nor country borders

can explain the temperature variation in European forests (Fig. 4). Thus, the role of national borders and Regions of Provenance to guide seed transfer should be strongly scrutinized.

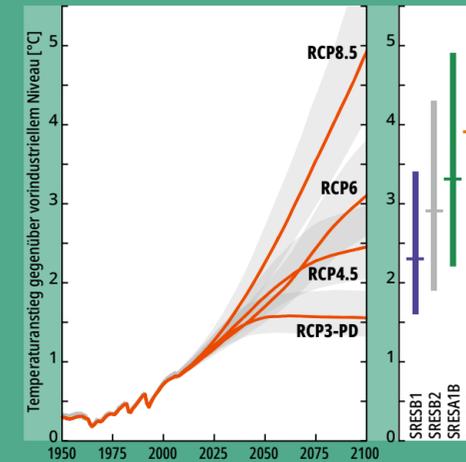


Fig. 2: Observed and simulated global average temperatures near the surface for the period 1950–2100, shown as deviations from the mean temperature of 1980–1999, for four representative concentration pathways (RCPs). Source: Rogelj et al. (2012)

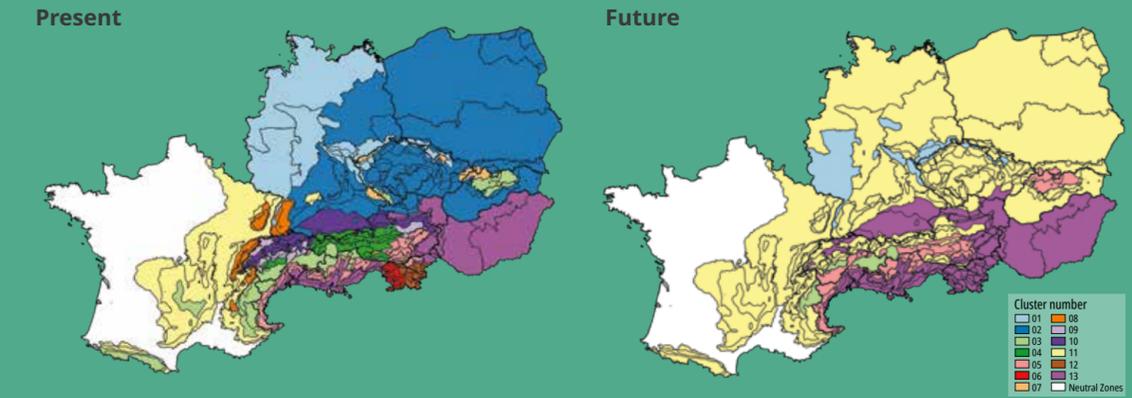


Fig. 3: Climatic similarity among Regions of Provenance for Norway spruce (*Picea abies*) under present climate (left) and the expected shift and expansion of south-western and pannonic climate regimes throughout the Regions of Provenance.

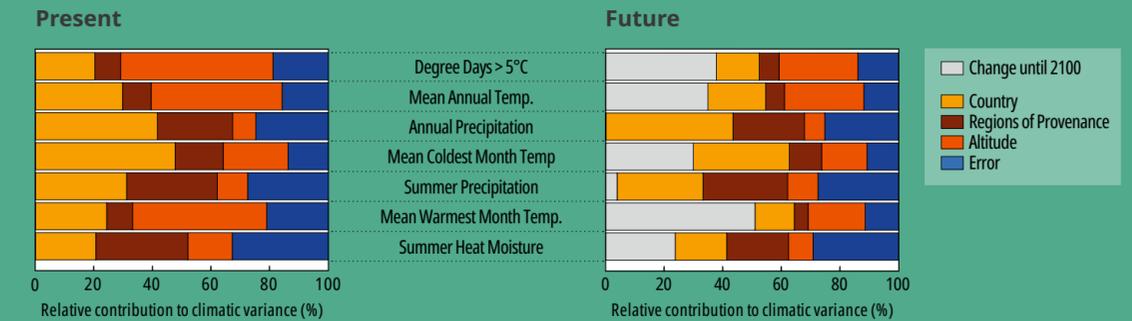


Fig. 4: How well do Regions of Provenance, Country borders and Altitude reflect the variation of climate parameters to which tree populations are locally adapted.

Seed transfer and European legislation

Regions of Provenance and the criteria on which they are based, for instance ecological units, vegetation zones or genetic similarities, vary between countries. This is supported by a survey among forest seed legislation experts conducted within the SUSTREE project (Fig. 5).

Besides guiding the production and marketing of forest reproductive material (FRM) within the European Community as stated in Council directive 1999/105/EC, the Regions of Provenance are also used for

recommending provenances, regulating reforestation subsidies and for breeding activities depending on country level regulations (Fig. 6).

Such national regulations might indirectly hinder adaptive management under climate change by restricting transfer of FRM between Regions of Provenance and between countries. For example, the transfer of forest seeds and seedlings across borders to Poland, Slovakia and Czech Republic is constrained.

Basis for defining provenance delineation

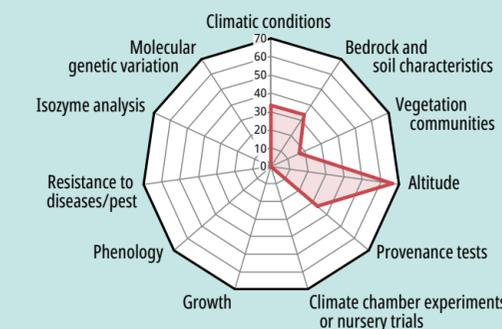


Fig. 5: Characteristics for defining Regions of Provenance

Delineation criteria

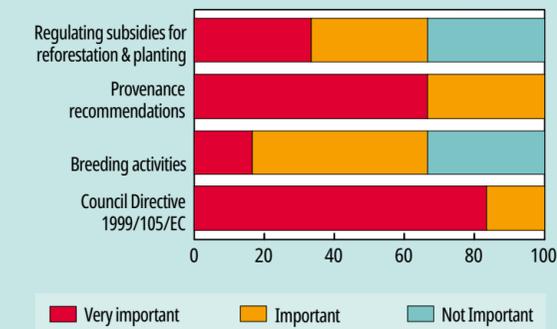


Fig. 6: Functions of the Regions of Provenances