TECHNISCHE UNIVERSITÄT DRESDEN

Wildlife Ecology and Management & Molecular Physiology of Woody Plants

Adaptedness versus adaptability:

Forest genetic management as a tool to mitigate climate change effect on forests

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What makes forests different?

Trees are **long-living organisms.**

Age of some forest trees:

Quercus spec.: 750 years

Tilia spec.: 600 years

Fagus sylvatica: 400 years

This means they have to be able to undergo very different environmental situation, e.g. the „minor glacial“ (16th/17th century)

What makes forests different?

Trees are **immobile.**

This makes them widely dependent on their local environment.

In contrast, long-living animals normally are highly mobile, i.e. they can avoid extreme environments (and, in the case of mammals, they create an „inner environment" with biochemically and physiologically very constant conditions)

What makes forests different?

- **Traits of <u>interest are usually first apparent after decades of vegetation cycles.</u>**

The tree‘s dilemma

- Trees are not mobile they can not escape from harmfull stress factors
- They are exposed to differing environmental factors over a long period and in differing intensity (seasons, air polution…)
- They can react on the environmental differences in a physiological/anatomical comparably narrow frame (phenotypic plasticity)

Natural and anthropogenic conditions

Environmental (stress) factors:

Temperature
Water
Light
Pests and diseases
Browsing

- adapted to the environment by processes of selection
- adapted to the environment by physiological, anatomical and morphological plasticity

How can trees survive – what‘s the „strategy“?

Adaptedness and adaptability

- of individuals (phenotypic plasitcity, resilence)
- of populations (genetic structures)

Adabtability – adaptedness
population genetics

- Various environmental factors: genetic variability within the population $\longrightarrow$ selection of the best adapted genotypes

- Genetic variability: expressed in high number of different genotypes, alleles , genes etc.

- Example: compared to other organisms trees show a high degree of heterocygosity:

  trees: more than 20%

  humans: around 6%

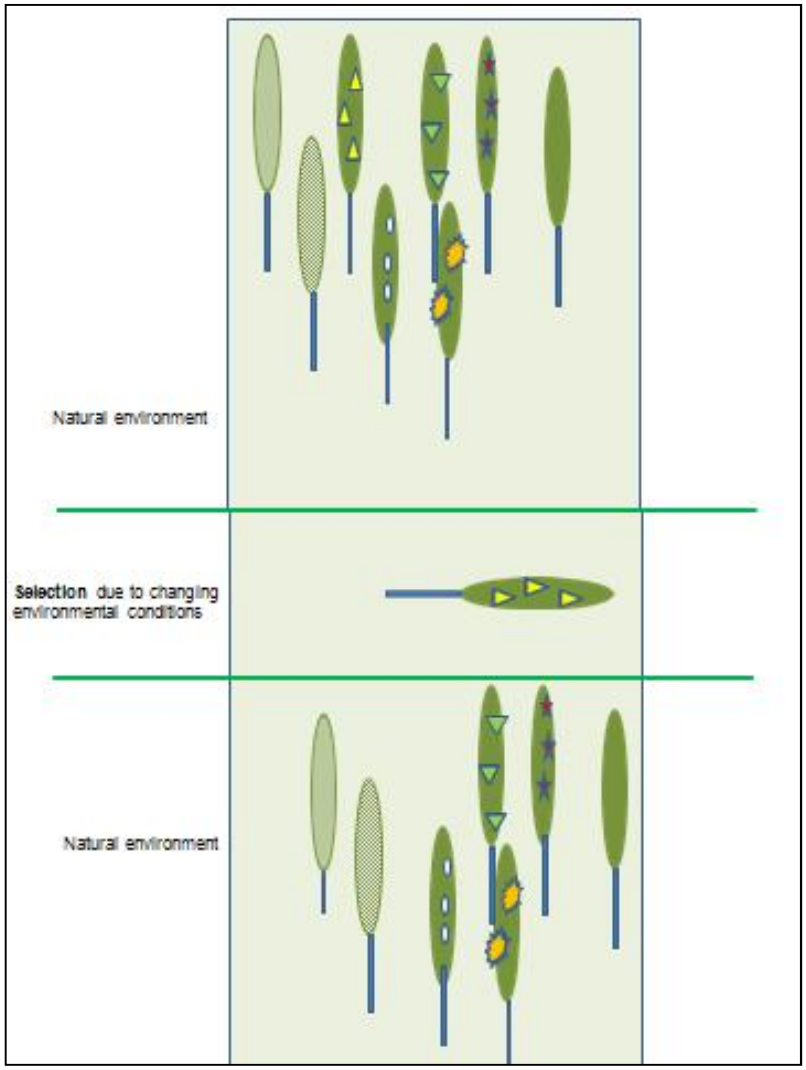
Traits of interest

- Growth (e.g. for energy purposes, urban trees)
- Wood quality
- Early and constant flowering (for regeneration purposes)
- Resistance/resilence/tolerance to pest and diseases (depends on the species)
- **Resistance/resilence/tolerance to abiotic stress (e.g. drought, early frost, late frost, winter frost, flooding…)**

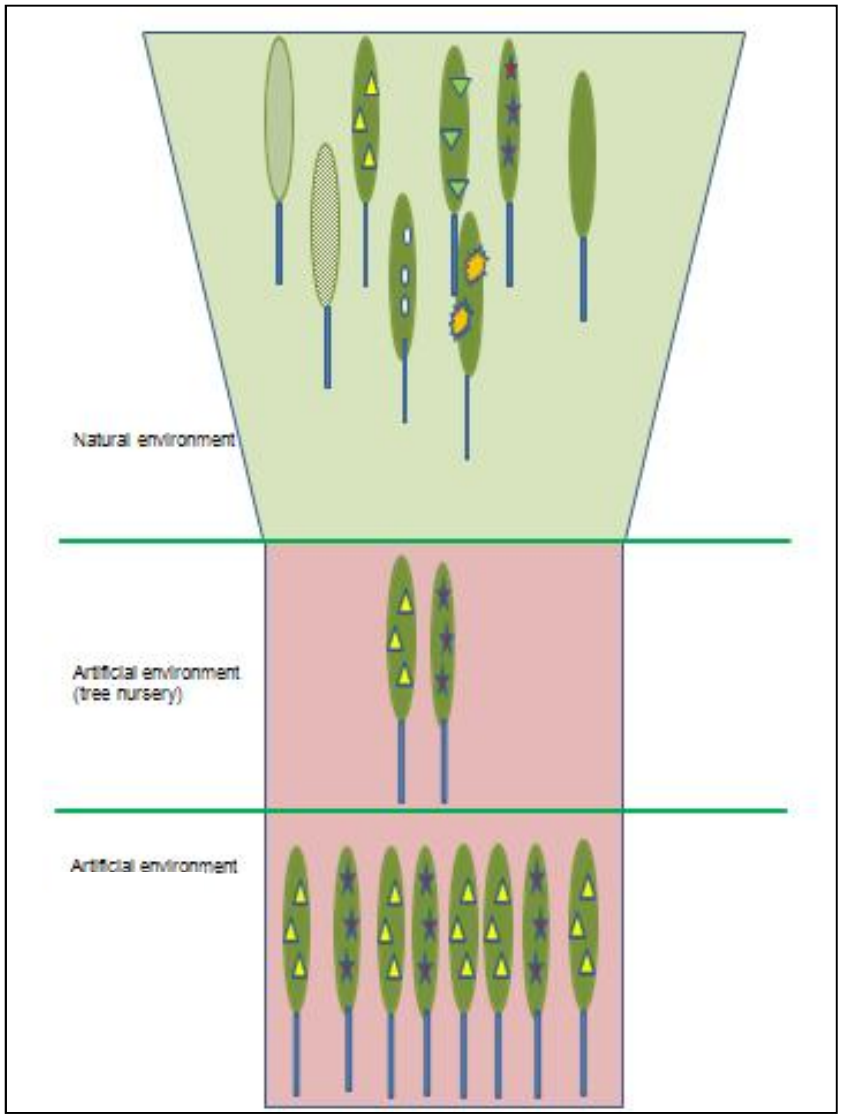
Adaptability *vs.* adaptedness

- Adaptedness refers to the recent situation: An individual or a population is adapted if it is able to survive and to reproduce under a given environmental situation
- Adaptability refers to situations in the future: Populations or individuals are adaptable, if they can survive and reproduce under different situations in the future (characterized to be uncertain)

Adabtability – adaptedness selection



Adabtability – adaptedness
artificial environments as genetic bottlenecks



Managed forests
Habitus, growth performance, resistance to specific environmental factors, homogeneity, potential site conditions, low cost of propagation, production, establishment, management

Low genetic variability, few different genotypes

Goals of future forest genetic management

- **maintain the potential of certain genotypes (management for a sustainable yield)**
- **maintain adaptedness to recent environmental situations (classical provenance based forestry)**
- **maintain adaptability to future environmental situations (increase number of genetic variants to mitigate unknown future effects of climate change)**

Allelic frequencies of the *EST-A$_1$*-allele in parents and offspring of flooded and non-flooded pedunculate oaks