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# Climate Change and Forest Genetic Resources; implications for Conservation and Sustainable use

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# Forest Genetic Resources (FRG)

- **The term FRG relates to forest tree and shrub genetic resources**
- **Focus is on the conservation of genetic diversity through the management and sustainable use of forest tree and shrub genetic resources, considering the climate change scenarios**

# Socio-economic importance of forests

- Nearly 4 billion hectares of forest, 30% of land area
- 50 % of the area is managed for wood production
- Only 5 % of the forests are plantations; planted forests contribute 50 % of global wood production
- Wood biomass consumption for fuel; more than 50 % globally, 80 % in developing countries
- 1.6 billion people are relying heavily on forest resources for their livelihoods
- Forest products trade reached US\$327 billion (2004)

**FAO(2007)**

**In addition, forests have**

- **ecological**
- **cultural**
- **aesthetic**
- **emotional**

**values**

**and serve as an important carbon sink**



# Genetic diversity of forest trees

- **A large genetic variation both within and among natural populations of forest tree species, also for adaptive traits**
- **Adaptive traits are often related to climatic variables, different variables in different climatic zones**
- **The geographic range of widespread species occurs in climatic envelopes, assuming that climate exerts a dominant control of the natural distribution**

# Factors influencing genetic diversity

## Life history traits

- The reproductive system
- Continuous or fragmented populations
- Large or small population size
- Gene flow through pollen or seeds

These life history traits are influenced by climate change



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# Two types of effects

- **Ecosystem effect**
- **Population level effect**

# Different expressions of climate change in different zones

- Higher temperatures, more rainfall in the north
- Less rainfall and drought stress in the semi-arid Mediterranean zone, with a high risk of forest fires
- A larger amplitude in climatic factors
- A higher frequency of extreme events
- New insect species and pathogens
  
- The implications of climate change will vary with regions and will be species dependent



# Tropical genetic resources under climate change

- The genetic diversity of tropical forest trees is : depleted by deforestation, forest fragmentation, forest degradation.
- Tropical tree species have adapted genetically to unique ecological niches
- Climate change will in particular affect the sexual systems, the flowering phenology, plant-pollinator and plant-seed dispersal interactions.

# Are genetic adaptation mechanisms sufficient to maintain sufficient genetic diversity for evolution and for utilisation?

In many cases, not, because

- The natural migration ability of forest trees is slower than the forecast scenario change
- Adaptation through natural selection takes too long

**Actions are needed both in forest management and in conservation of forest genetic resources**

**Human interference will be essential for the maintenance of adaptability**

# Conservation of genetic resources

## *in situ* :

- protected areas
- specific gene reserve forests

## *ex situ* :

- conservation orchards, collections or clone banks
- populations in research
- populations in breeding



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# Sustainable use of genetic resources in forest management

- choice of natural regeneration or planting
- choice of species
  - which species, single species, mixtures
- choice of reproductive material
  - local, transferred or from tree breeding
- timing and intensity of thinning
- harvest system

# Measures to be taken

## Regional and species differences in adaptation strategies

### For tropical species:

- Enlarge protected areas
- Increase the size of buffer zones
- Enhance connectivity among conserved landscapes to ensure continuity of evolutionary processes
- Identify species and populations that are doomed to go extinct and establish *ex situ* collections



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# Consequences for forest management

- **Special attention to rare, fragmented species or species occupying extreme habitats**
- **Manage gene reserve forests and protected areas that serve gene conservation objectives according to the conservation objective**
- **A balance between natural and artificial regeneration**
- **Proper choice of forest reproductive material in plantations**

# Consequences for forest management

- **Breeding for adaptation to changing climatic conditions**
- **Establishment of mixed forest types**
- **Establish databases of records of the transfer and use of forest reproductive materials and where they are planted**
- **In general: Diversify adaptation strategies**





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## **At the national policy level**

**Existing guidelines on forest management and general forest policies should be re-evaluated for their validity in the context of climate change**

# Policy recommendations

## (Workshop in Paris, March 2006)

- *Policy-makers should recognize the importance of forest genetic diversity in mitigating the impacts of climate change on the forest sector by expressing a commitment to incorporate the management of this diversity into national forest programmes and other relevant policies, programmes and strategies.*
- *Policy-makers should promote forest management practices that maintain evolutionary processes of forest trees and Support natural regeneration of forests, especially in areas where long-term natural regeneration is self-sustained despite climate change.*

# Policy recommendations

(Workshop in Paris, March 2006)



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- *Policy-makers should take into account the potential for accelerating adaptation of forest trees to climate change through tree breeding and transfer of potentially suitable forest reproductive material by endorsing the development of international guidelines for the transfer of forest reproductive material on the basis of scientific knowledge.*
- *The forest research community should, with the support of policy-makers, carry out more interdisciplinary studies (e.g. tree physiology, forest genetics, pests and diseases, forest management and economics, and modeling) on the impacts of climate change on forests.*

## Hurricane "Gudrun"

A devastating hurricane hit northern Europe, including the southern parts of Sweden between 8 and 9 January 2005. Severe damage struck the forests and parts of the infrastructure, where a conservative estimation gives that at least 40 million cubic meters of timber was destroyed, which equals more than five years of normal harvest



# Important trait in the boreal and temperate forest: the timing of growth start in the spring



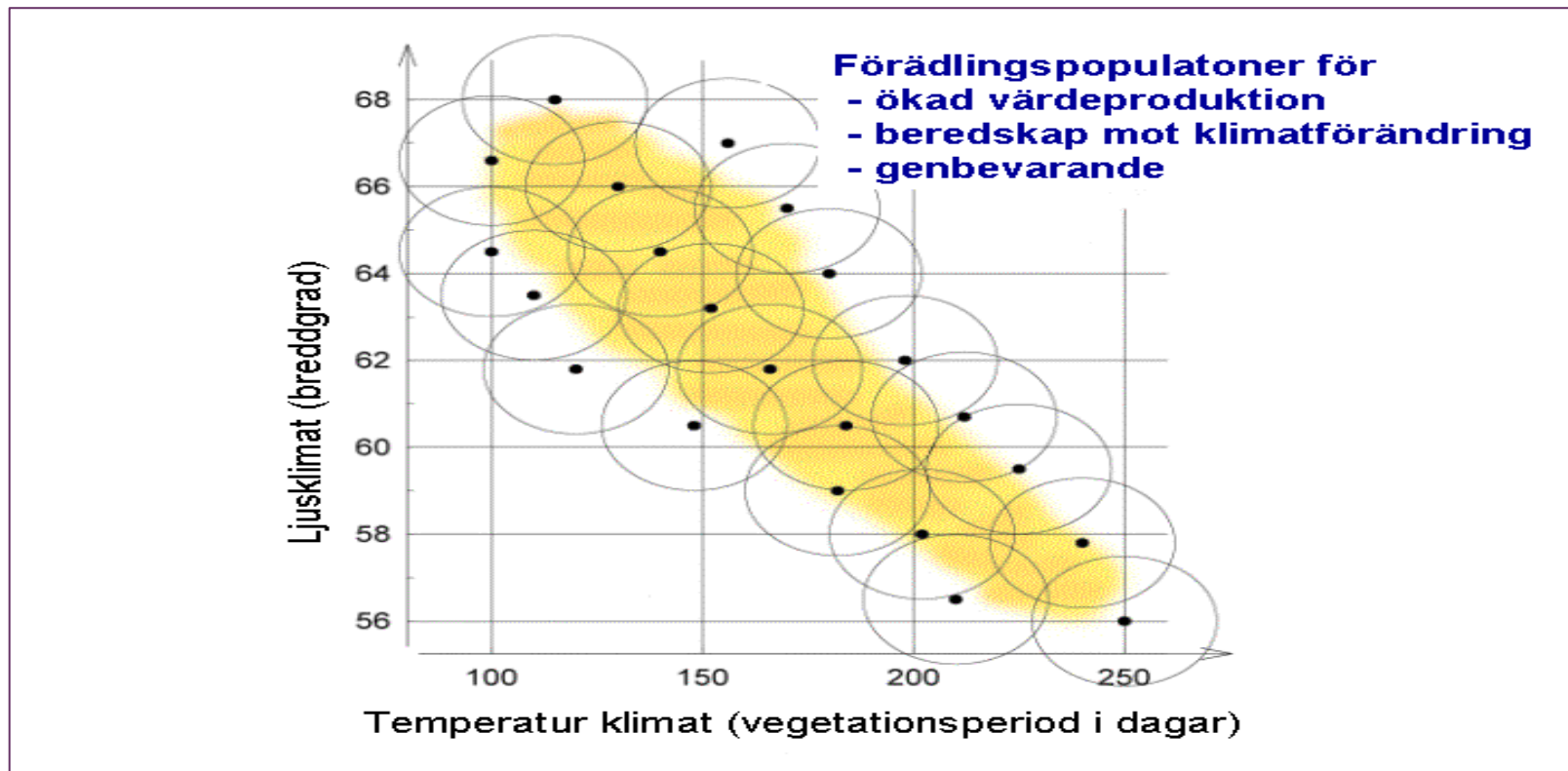
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# Norway spruce breeding populations in Sweden

Synthetic populations with different relationships between latitude and temperature climate



**Thank you !**

