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Department of Geosciences and Natural Resource Management

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Nordic Energy Research

Sustainable Energy Systems 2050
NORDIC ENERGY RESEARCH PROGRAMME

Novel and high-productive forest types to support forest adaptation and reach mitigation potentials

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Main challenges in forestry and forest restoration:

Desired forest functions are multiple and changing, and there is an increasing attention on future forest functions such as forest

- **mitigation**
- **habitat for biodiversity**
- **adaptation to climate change**

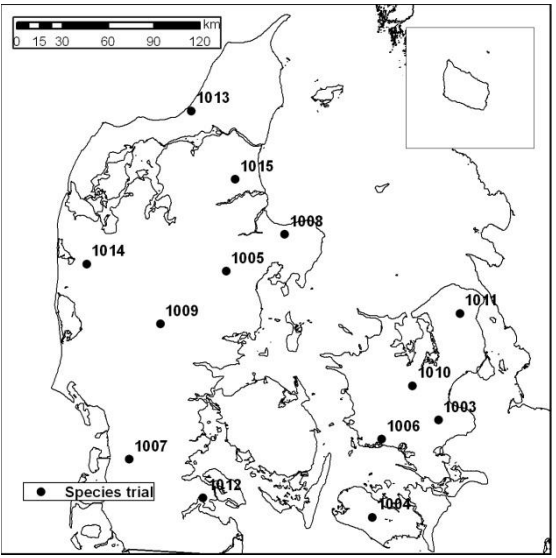
Perhaps the most important challenge:

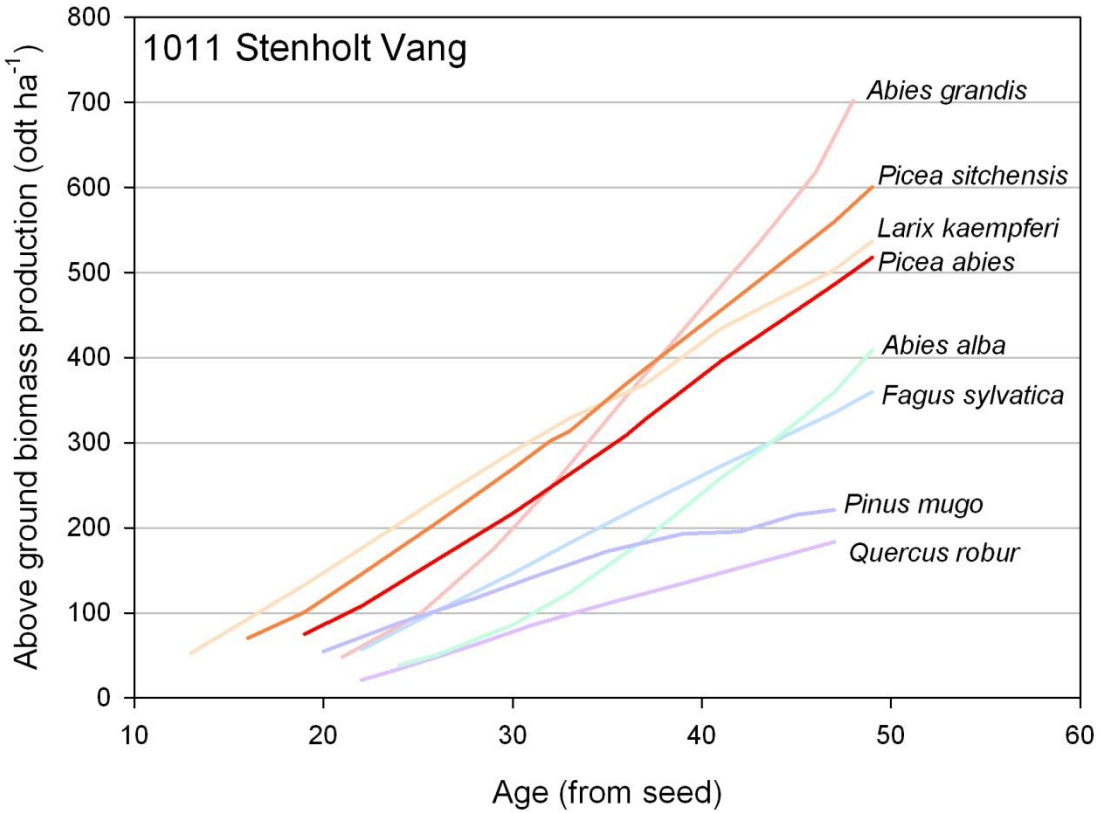
- **establish the whole range of desired tree species and genetic material within species**
- **despite severe challenges in the regeneration phase for many important species**

High productive forest types includes high productive species

- **the most high productive may include both nurse species and main species**

Productivity of tree species in field trials established in Denmark 1964-65





Average production:

Abies grandis **14.6 odt ha^{-1} yr^{-1}**

Picea abies **10.6 odt ha^{-1} yr^{-1}**

Quercus robur **3.9 odt ha^{-1} yr^{-1}**

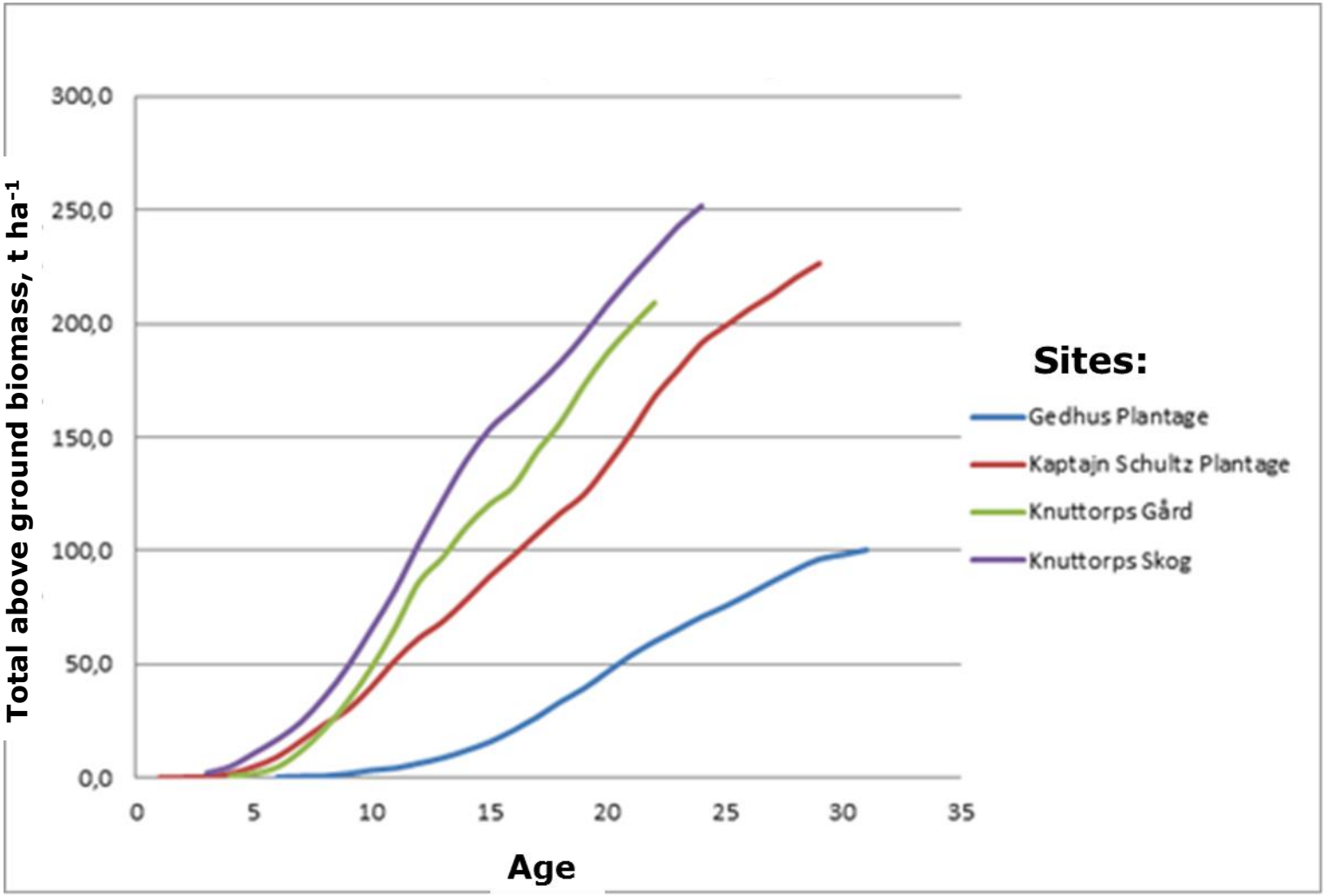
By Thomas Nord-Larsen

… 45 years old grand fir in southern Sweden showing peak production

…130 years Douglas fir with beech understorey in Denmark – some of the first imports of this tree…..

Poplar (OP42; *P. trichocarpa x P. maximowiczii*) - total above ground biomass, t ha^{-1}

Anders Tærø Nielsen



Knutstorp Mark, Skåne:

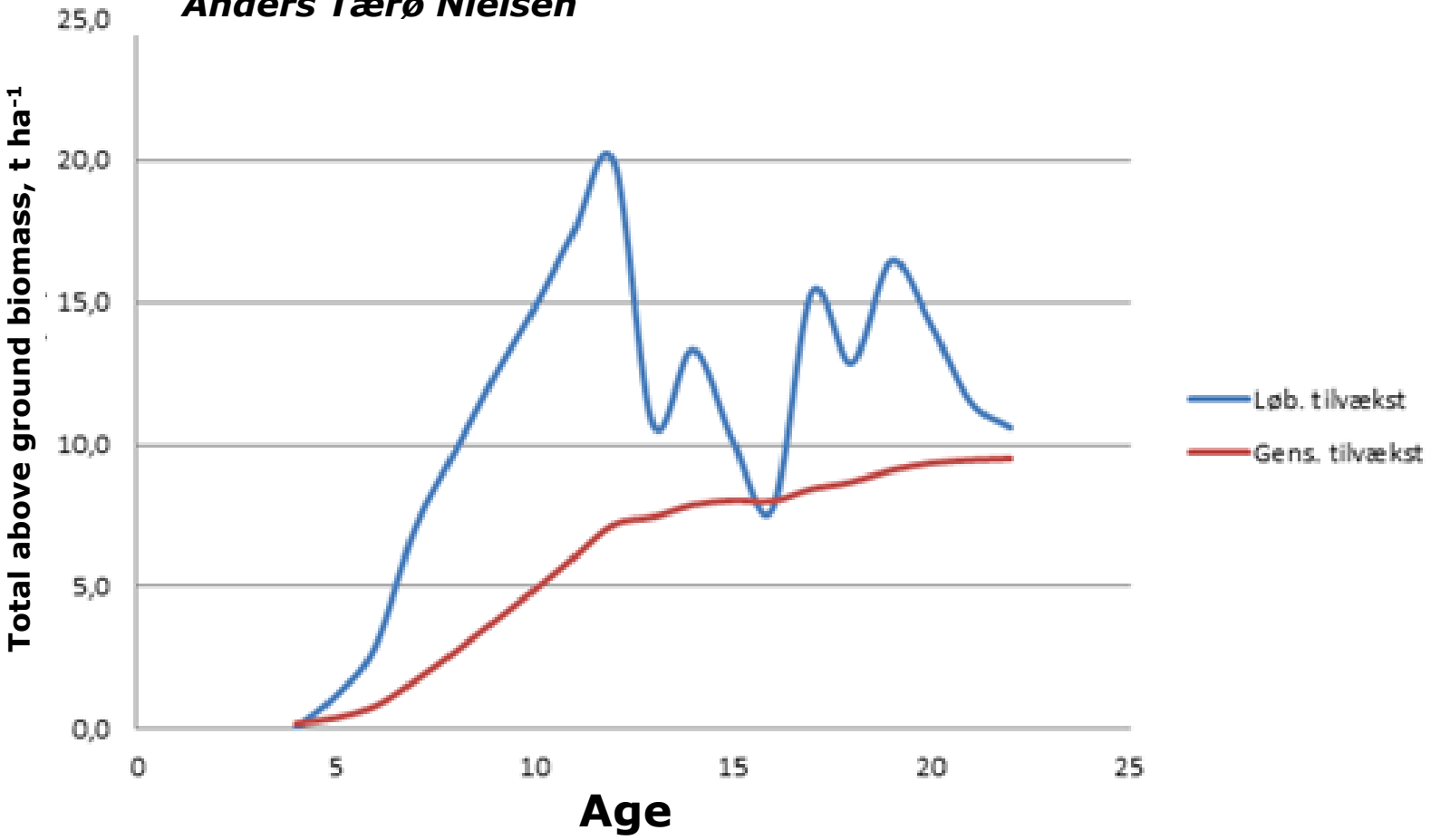
- 24 years old poplar, OP42
- 32 m tall
- Average tree 0.8 m^3
- 56 % moisture (MC)
- Wood density: 355 kg/m^3
- Summer felling to reduce MC?
- Debarking by felling?
- Biorefinery?

- Great forest floor condition for
- other species!

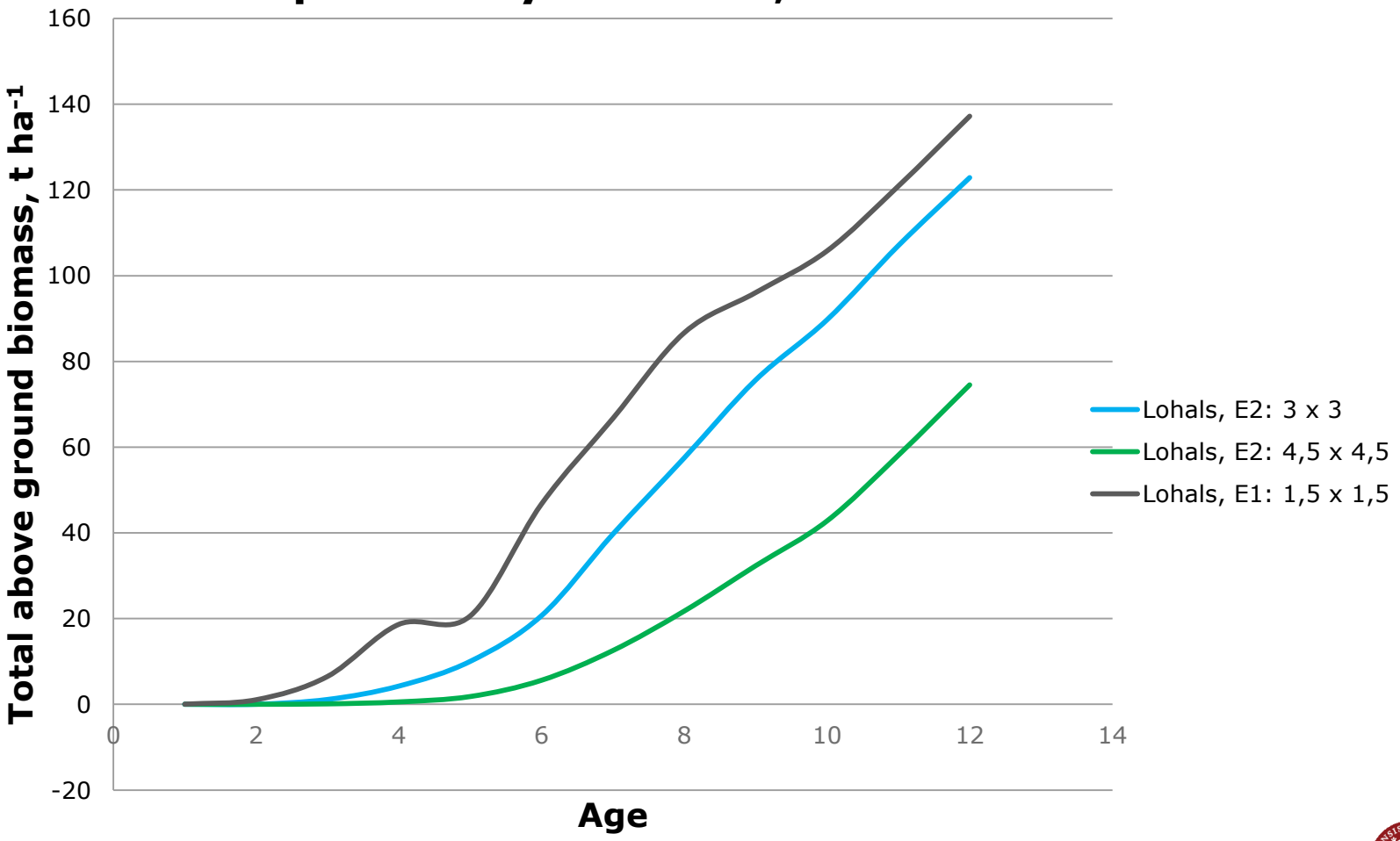
Poplar OP42,

- annual and average increment
- Knutstorp Mark, Skåne (former farmland)

Anders Tærø Nielsen

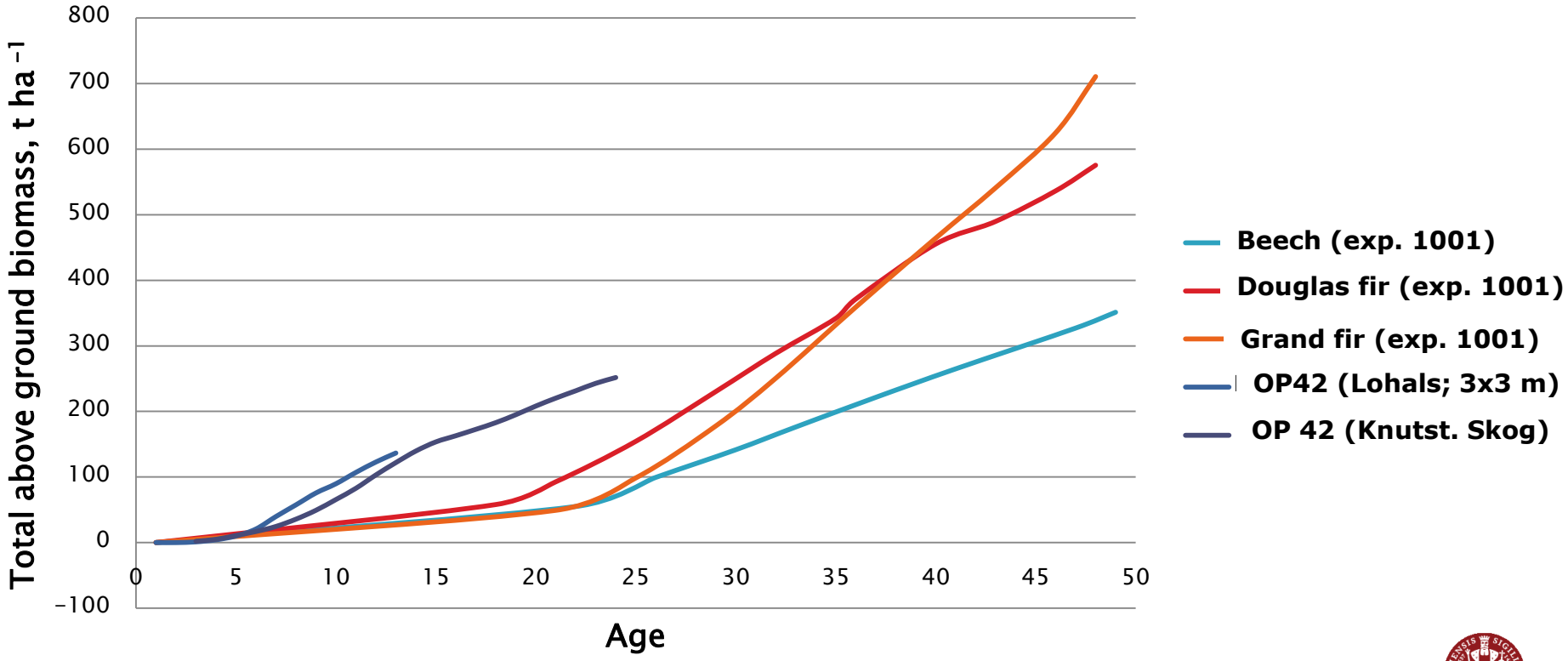


Total above ground production, poplar (OP42) depending on stock density, pilot study at Lohals, Denmark



Poplar as nurse crop?

Productivity of poplar (Lohals (DK) and Knutstorps Skog, Skåne)
- compared to Douglas fir, grand fir and beech on good sites (DK)



The nurse crop is a highly relevant alternative in restoration

- using the principles of shelterwood or continued cover systems
- is high-productive 5-10 years after establishment
- paves the road for inexpensive regeneration or restoration of a wide range of desired species

Here:

11 year old poplar/black alder nursecrop at an afforestation site in Denmark protecting sown beech

Nurse crop method as implemented in practise by HedeDanmark – Sitka spruce with hybrid larch as nurse trees

Age:
15 years

Larch
Height: 11 m
Dbh: 12 cm

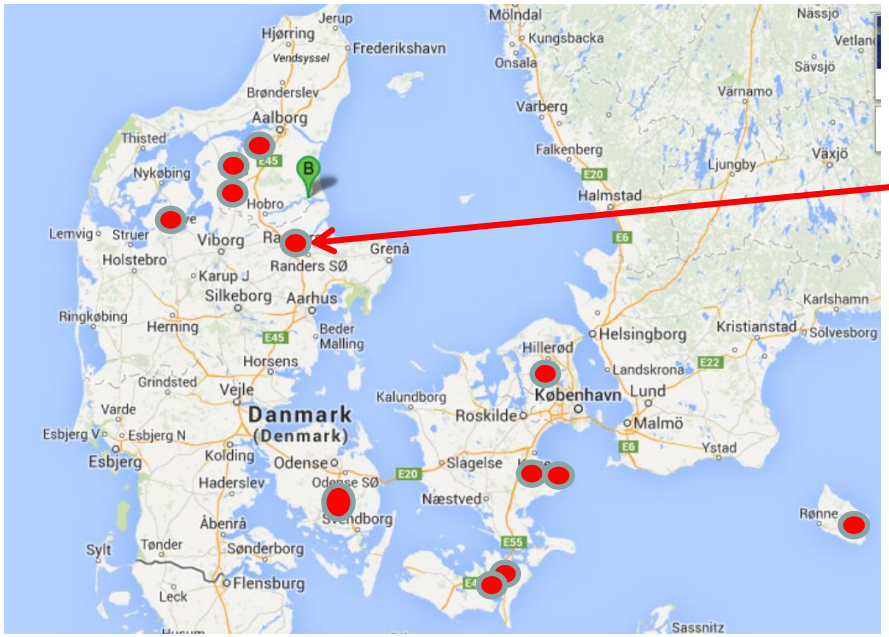
Sitka spruce
Height: 4.5 m
Dbh: 5.5 cm

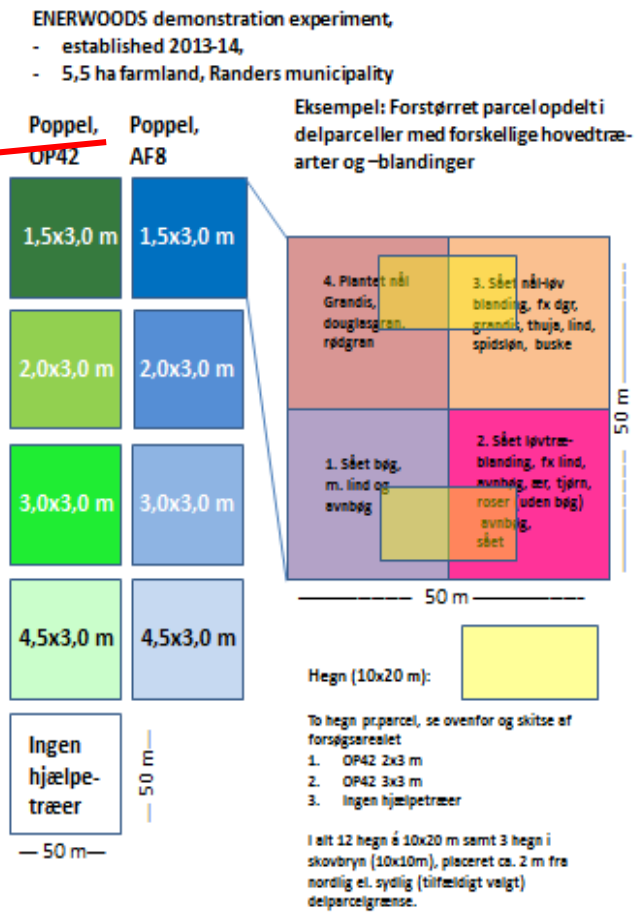
Source: Michael Glud, HedeDanmark

Nurse crop method – beech with hybrid larch as nurse species

Source: Michael Glud, HedeDanmark

ENERWOODS demonstration experiments





+ Skåne, Sweden, (Poplar, Birch)

+ Latvia (poplar, grand fir, Douglas fir, Sitka spruce beech)

+ Finland (poplar, beech, elm (glabra and laevis), Norway maple ….)

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Conclusions

High productive forest types established by the use of nurse trees:

- can support cost effective establishment of the whole range of desired species including high productive late successional species

- they offer an opportunity for forestry to increase forest productivity in the regeneration phase and with short notice; 10-20 years; + 100% or more

- they offer early incomes (stand age 8 – 25 years)

- well-considered design and on-time interventions are needed ensure the establishment and development of the long-term desired species

- they belong to the planted forests with good access for interventions