



Seeking provenances/species that will be better adapted to future climate

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Palle Madsen¹, Khosro Sagheb-Talebi², Ole K. Hansen¹ and Jørgen Bo Larsen¹

- 1) Department of Geosciences and Natural Resource Management, Univ. of Copenhagen, Denmark
- 2) Research Institute of Forests and Rangelands (RIFR), Iran





A new collaborative project on the Caspian forests of Iran: A gene pool for the adaptation of European forests?

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Presentation includes....

1. Brief introduction to the Caspian/Hyrcanian forests in Iran
2. The background and idea of the project – including an introduction to the Caspian/Hyrcanian forests in Iran
3. Project aims, hyphothese and plans
4. Links to sustainability, adaptation and restoration?

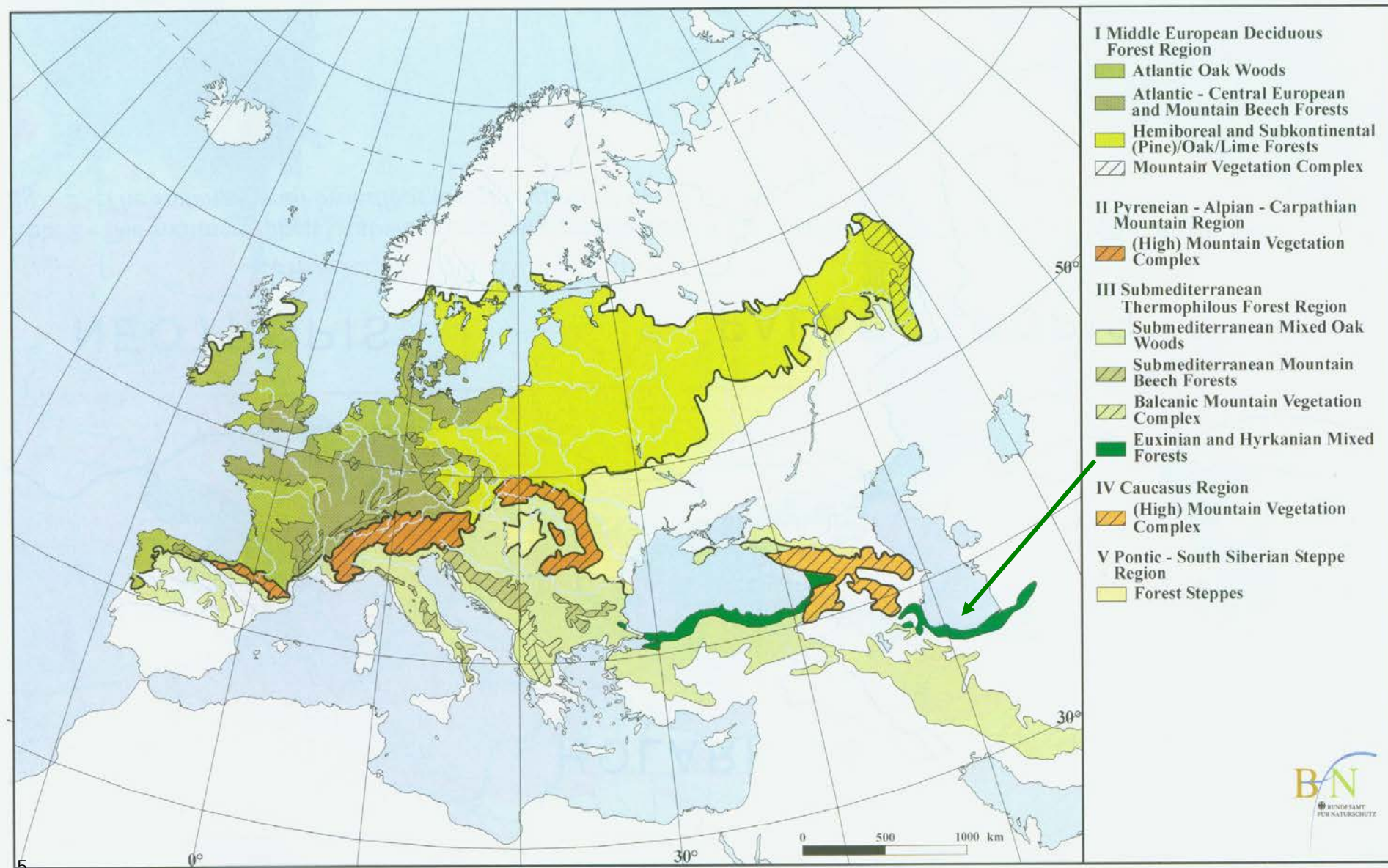


The idea and background of the project: Episode 1.

Tehran - 2004. IUFRO 7th Beech symposium and field Tour



The summer green broad-leaved forests of West-Eurasia



The Caspian/Hyrcanian forests in Iran

110 x 800 km stretching over the northern slopes of Alborz mountains and southern shores of the Caspian Sea:

- from sea level up to 2800 m.a.s.l
- total area of 1.8 million ha (15% of Iranian forests)
- 1.8 mill. ha of rich deciduous forest
- dates back to Tertiary (>1.8 mill. Years)
- 1-200,000 ha considered virgin forest

Annual precipitation:

2000 mm in west, 600 mm in east

Mean temperature:

15 °C in west and 18 °C in east

Relative humidity:

85% in west and 75% in east





Caspian forest, Iran 2004
Chestnut leaved oak (*Q. castanaifolia*)

#Height 45 m, DBH > 2 m


#Age > 600 years



... an often unattended REFUGIAL area

- 80 tree and shrub species
- Caspian Forest and Europe share many species
- or the species are very closely related

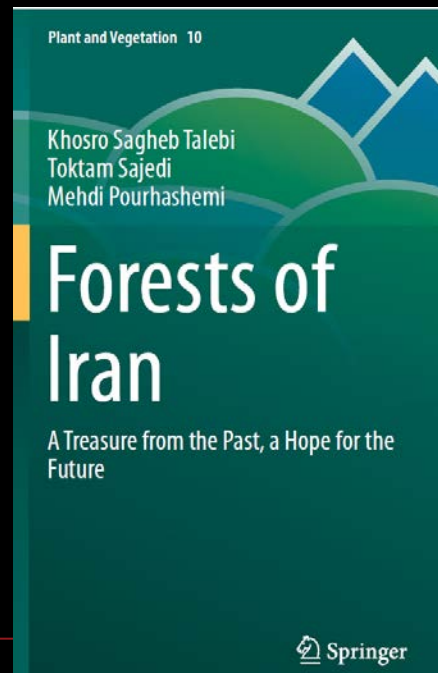
Velvet or Persian maple
- *Acer velutinum*

- 
- A photograph of three men standing in a forest next to a large tree trunk. The man on the left is wearing a light green shirt and olive green trousers. The man in the middle is wearing a dark jacket over a light blue shirt and dark trousers. The man on the right is wearing a dark patterned polo shirt, brown trousers, and black rubber boots. The tree trunk is large and has a white cross marked on it. The forest floor is covered in moss and fallen leaves.
- ash - *Fraxinus excelsior*
 - beech - *Fagus orientalis*
 - alder - *Alnus subcordata*
 - elm - *Ulmus glabra*
 - field maple - *Acer campestre*
 - hornbeam - *Carpinus betulus*
 - wild cherry - *Prunus avium*
 - hazel - *Corylus avellana*
 - wild service tree - *Sorbus torminalis*
 - lime - *Tilia platyphyllos*
 - yew - *Taxus bacata*
 - velvet or Persian maple - *Acer velutinum*
 - box - *Buxus hyrcana*



Relict Arcto-Tertiary species

Zelkova carpinifolia



Parrotia persica



Changes in tree genera and large herbivores during the Quaternary interglacials – impact of ice ages in Great Britain

(Bradshaw & Mitchell, 1999. *The palaeoecological approach to ...*)

Pleistocene 1,808,000 - 11,550 BP
Holocene: 11,550 BP - present time
Eemian: 131,000 - 114,000 BP

R. Bradshaw, F.J.G. Mitchell/Forest Ecology and Management 120 (1999) 3–12

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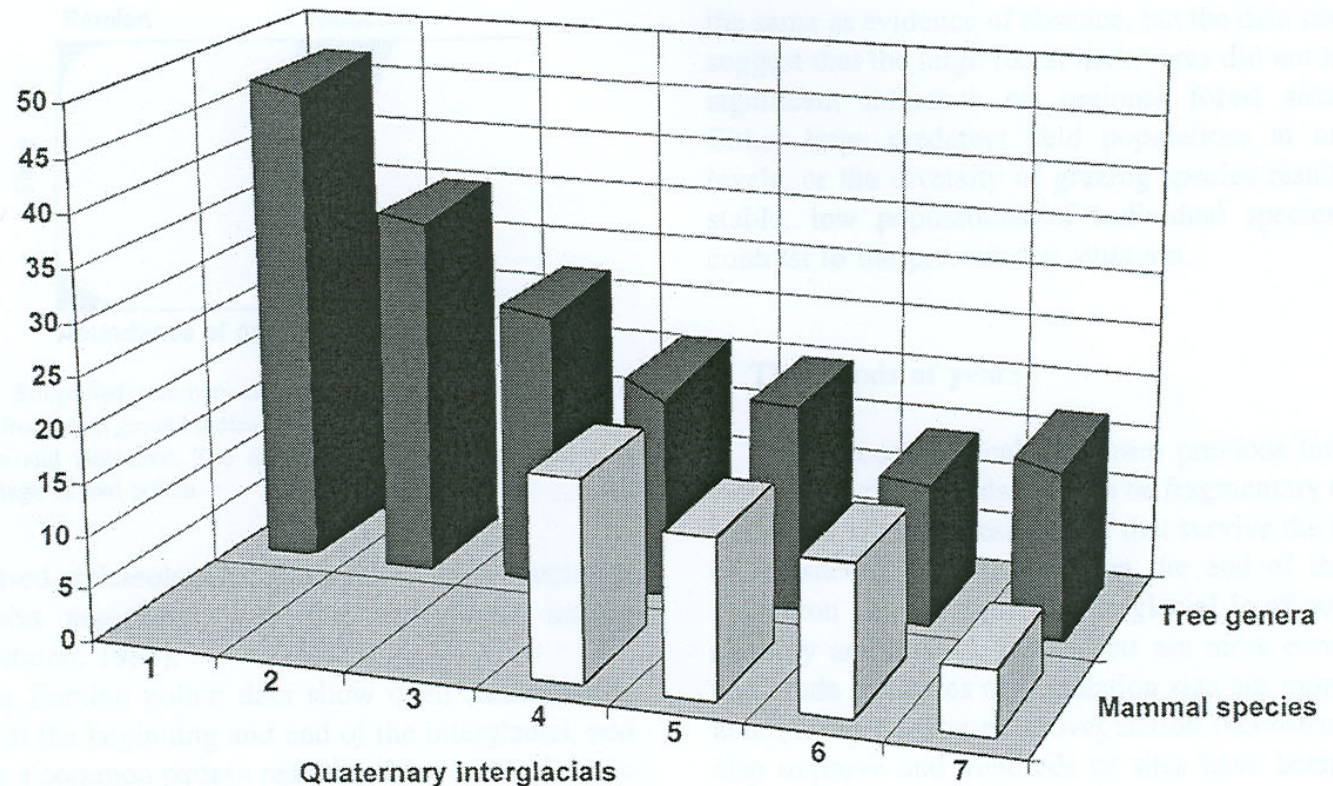


Fig. 1. The number of tree genera (black columns) and large forest herbivores (white columns) recorded as fossils during some Quaternary inter-glacials: 1. Reuverian, 2. Tiglian, 3. Waalian, 4. Cromerian, 5. Holsteinian, 6. Eemian, 7. Holocene. The time-scale is non-linear.

Number of native forest tree species

- is unusually low in the Nordic and Baltic regions



- and more tree species are needed to support
- adaptation for the future
 - spreading the risk relative to upcoming stressors



The idea and further background of the project: Episode 2.

The *Abies alba* case – silver fir

Silver fir provenances trials in Denmark

- Established 1935-36
- 7 field trials
- Two of them inventoried by age 44 (Larsen, J.B. 1981 – Forst. Cbl. 100, 275-28)
- The rest of the trial did not succeed due to poor establishment results/techniques



The *Abies alba* case

- superior performance of the Calabrian provenance in long term field trials in Denmark – why ???

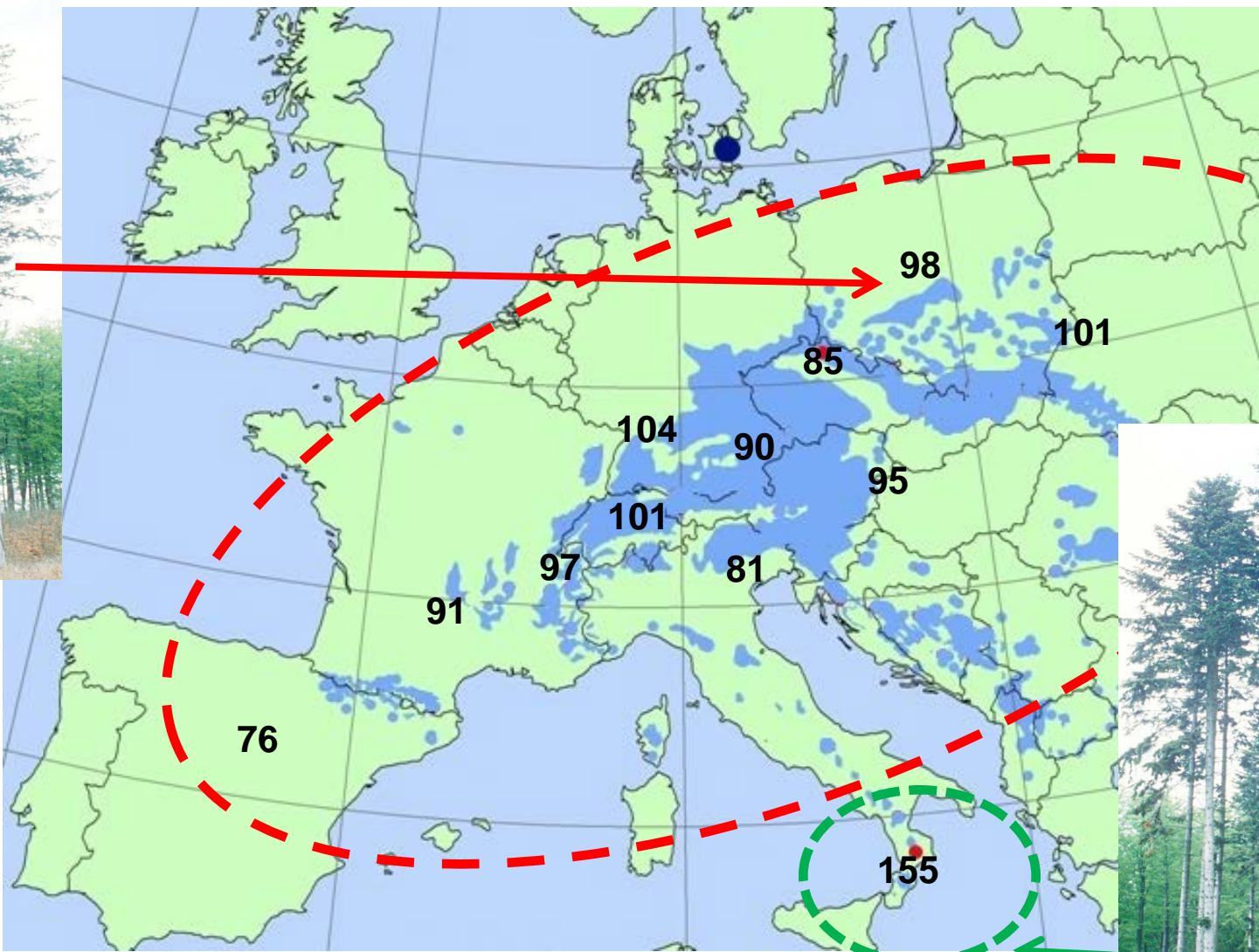


Calabrian:
Mt. Gariglione
20.4 m³/ha*year

Central
European:
12.9 m³/ha*year

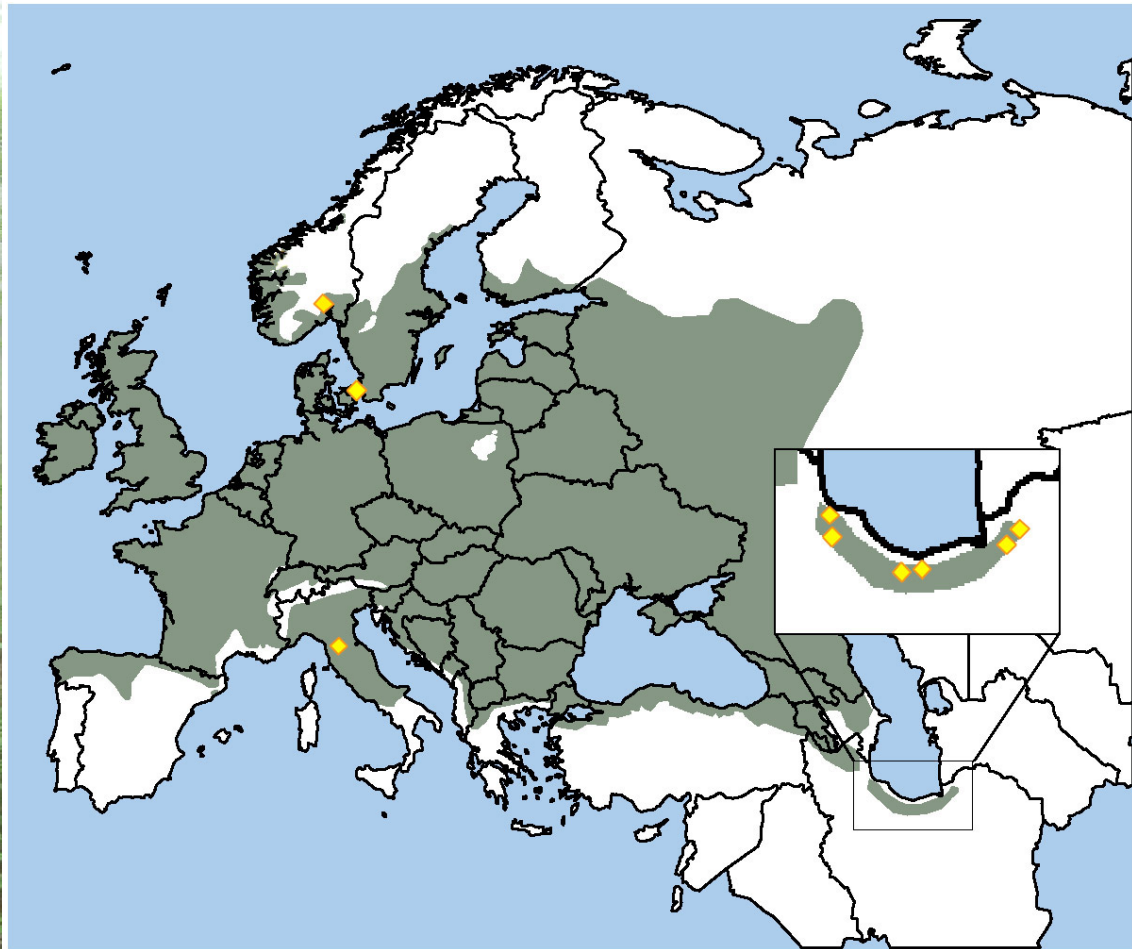


Results of silver fir provenance trials from 1935-36 in Denmark



Growth rate: 100 = mean of all provenances

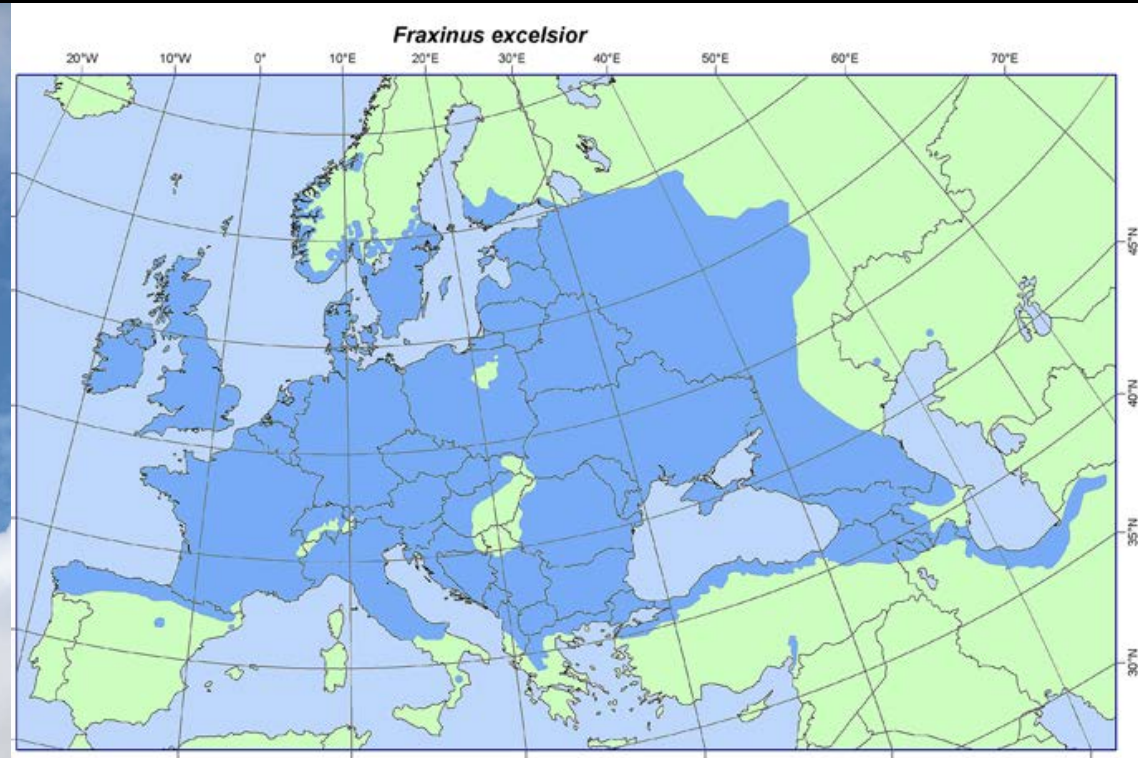
An initial study on ash: - comparing *Fraxinus excelsior* between regions



Erichsen et al. *in prep*



Fraxinus excelsior



Why are we in Denmark so interested in Non-native species and provenances?

- the Danish and north-western European landscape history is one of centuries of unsustainable forest and landscape management starting more than 1,000 years ago

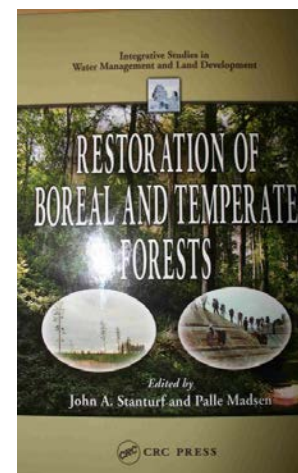
An ecological disaster created large areas of heath land by

- deforestation
- shifting cultivation
- excess grazing

Sometimes burns to improve grazing got out of control and created severe sand drift threatening houses and villages



A peasant herding his sheep in the completely degraded Danish landscape 150 years ago (F. Vermehren, 1855)



... only non-native tree species could be established in the degraded landscape, primarily:

- mountain pine (*Pinus mugo*)
- Norway spruce (*Picea abies*)
- Scots pine (*Pinus sylvestris*)

... here are some of the last remnants of the 1st generation mountain pine plantations that made it possible to restore forest conditions in degraded landscape 150 years ago

- such examples still exist in the coastal dune-areas along the Danish west coast

A man in a green jacket and dark trousers stands in a dense forest of tall, thin trees. The forest floor is covered with green ferns and fallen branches. The background is a misty, dense forest.

History has shown that large scale restoration efforts can lead to improved forest environmental conditions (microclimate and soil)

- our ancestors – the people who initiated the restoration programme 150 years ago - would probably not believe how soil fertility and growing conditions have improved - if they had the opportunity to watch the result today

High-productive mixed Norway spruce and Douglas fir
- novel forest ecosystem with non-native tree species.....

Project aims, hyphothese and plans

Overall goals

- Explore new opportunities to develop and improve our forests robustness including the physiological and evolutionary adaptability of the tree species
- New knowledge about whether and to what extend the Caspian forests refugial populations possesses an important genetic potential for other forests and their ability to adapt to future challenges such as climate change and new diseases and pests
- Contribute to the understanding of forest evolutionary processes as a function of selection pressure (ice ages/human influence) and isolation (refugial conditions)

Hypothesis

For tree species found in both Europe and the Caspian forests the Caspian provenances possesses a larger genetic diversity and consequently better adaptability in terms of

- physiological adaptability
- evolutionary adaptability



What we will do

1) Establish provenances trials in both DK and Iran – min. 6 species

- identification of seed sources and sites
- up to 9 Caspian provenances per species; western, central and eastern regions – three elevations from each region
- up to 3 Danish/European provenances per species
- harvest of seed and produce seedlings for planting
- establishment of species trials in forest experimental stations in the Caspian region
- establishment of trials – in DK on afforestation sites
- - two main trials app. 13 ha each; plot sizes for each provenance >0.2 ha

2) Common garden studies in nursery stage with the seedlings from (1)

3) DNA – characterization of species in Iran - interplay with (1 + 2)

4) Enhancing botanical gardens/arboretums - exchange of seed material

5) Exchanging knowledge and technology related to forest research, management and silviculture



Experiments will be established at farmland under nurse trees of poplar



One of the two Danish sites as it looked early April 2017 – one week after poplar planting....

Similar site established how it looked in the 11th season



Links to sustainability, adaptation and restoration?

Non-native 130 years old Douglas fir mixed with native beech (*Fagus sylvatica*) on restored land in Denmark

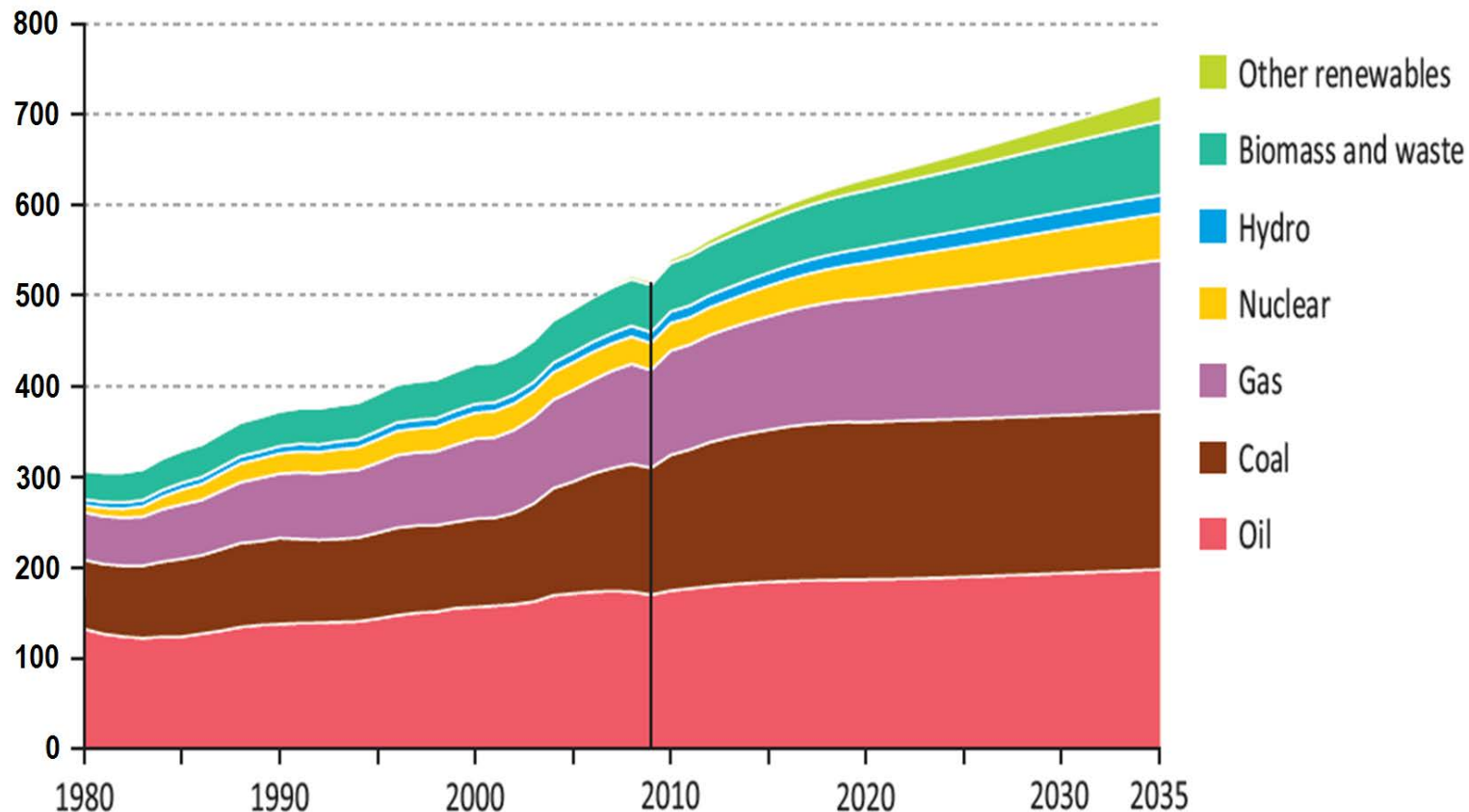
What genetic material to establish where and to serve what objective?

Choice of site-adapted

- species
- provenance
- clones

To support the adaptability and restoration of forests we need to keep in mind the importance of healthy and productive forests to support a sustainable development of society – not only sustainable management of the forest itself - as ...

- we are still moving in the wrong direction at increasing speed with respect to the use of fossil energy
- sustainably managed forests and restoration is at present the most powerful tool among the sources of renewables to combat climate change



Source: International Energy Agency, 2011.
World Energy Outlook 2011.

Thanks for your attention

Questions and comments welcomed!

