



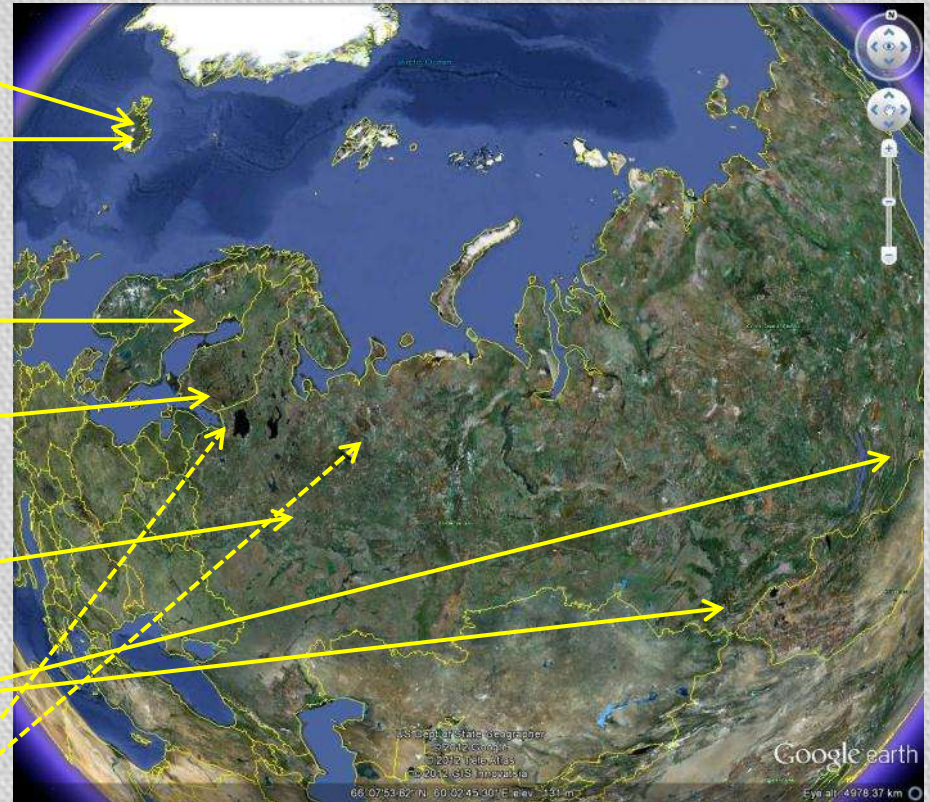
SPRING AND AUTUMN FROST DAMAGE TO LARCH PROVENANCES CONNECTED TO WEATHER EVENTS

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Provenance trial at Höfði planted 1999

- 17 provenances
 - 1 Icelandic seed orchard
 - Vaglir
 - 6 Icelandic provenances
 - Guttormslundur, Lýsishóll, Framhólar,
 - Ljósárkinn, Atlavík, Víðivellir
 - 1 Swedish seed orchard
 - Östteg
 - 3 Finnish seed orchards
 - Imatra, Ihala, Lassinmaa
 - 1 Southerly Russian provenance
 - Kostroma
 - 3 Southern Siberian provenances
 - Altai 1 and 2, Ostscoe in Buryatia
 - 2 provenances of dubious origin
 - Vendenga, Leningrad



Measurements 2011

- Height
- Diameter (DBH)
 - Volume calculated
- Year that damage took place
 - Journals and other references
 - Counted down the stem
- Number of vertical shoots directly after damage
- Current number of terminal leaders
- Daily mean, maximum and minimum temperatures for Hallormsstaður (Icelandic Meteorological Office)



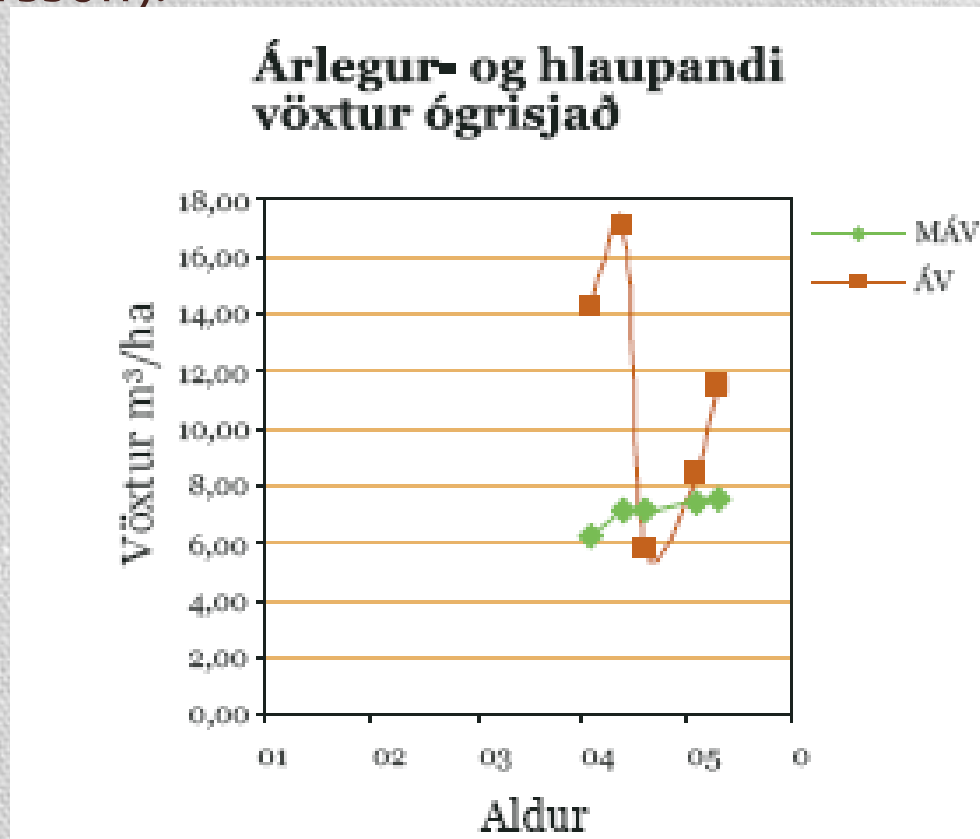
Recorded damage 2000-2011

- Widespread spring damage to needles was noted
 - 2003
 - 2005
 - 2011
- Widespread autumn die-back to terminal leaders was noted
 - 2005
 - 2007



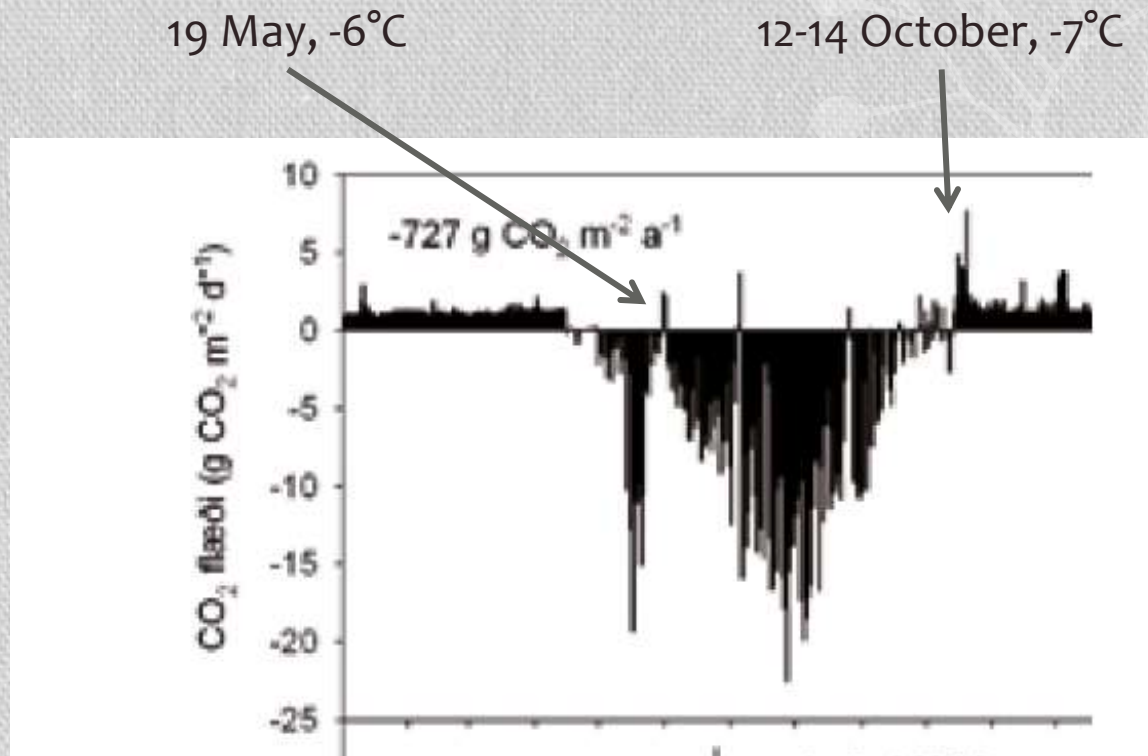
Example of the effect of spring frost 2003

- In a 35 year old *Larix sukaczewii* stand, Current annual volume increment dropped from 17 m³/ha in 2002 to to 6 m³/ha in 2003 (Lárus Heiðarsson).

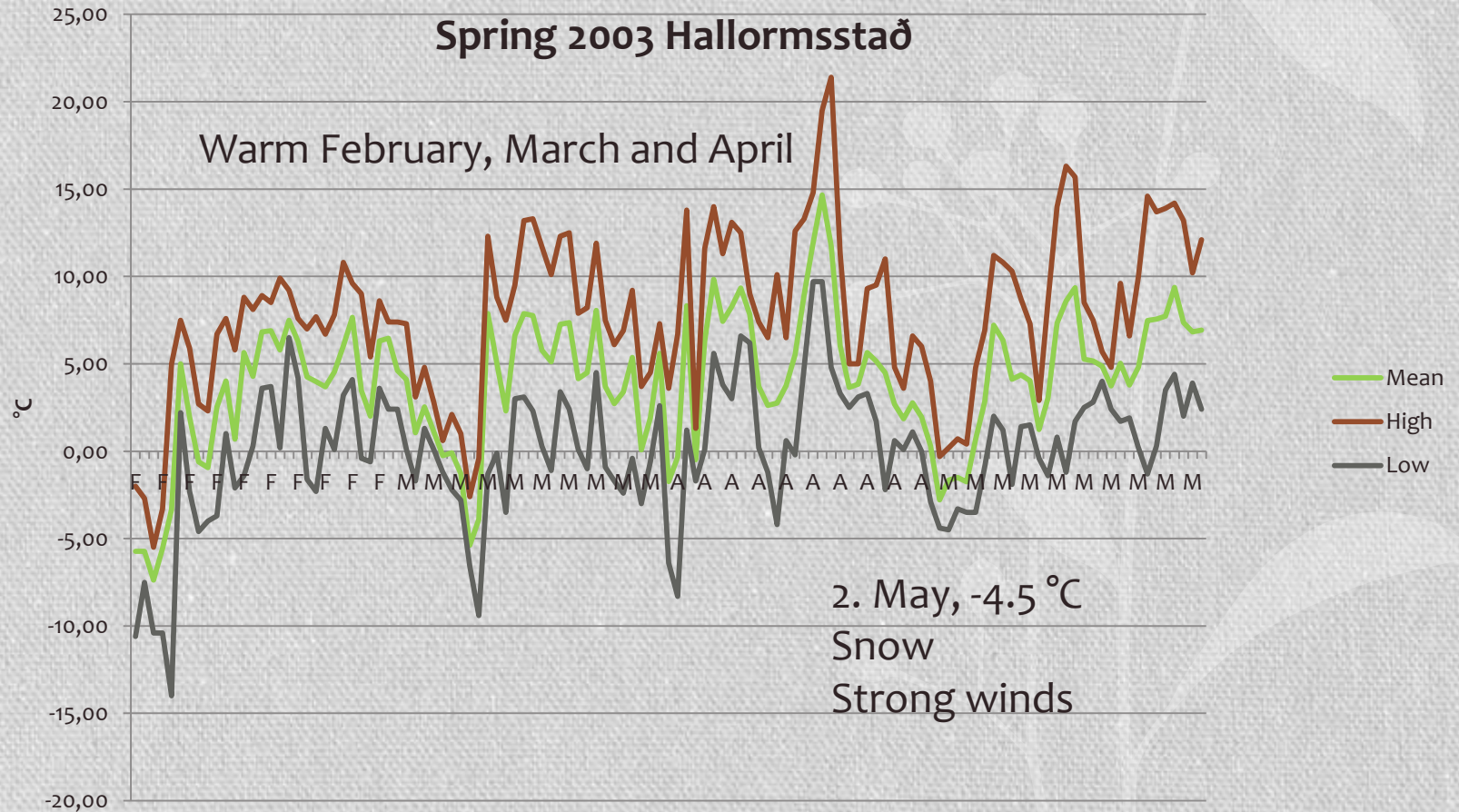


Example of the effect of spring frost 2005

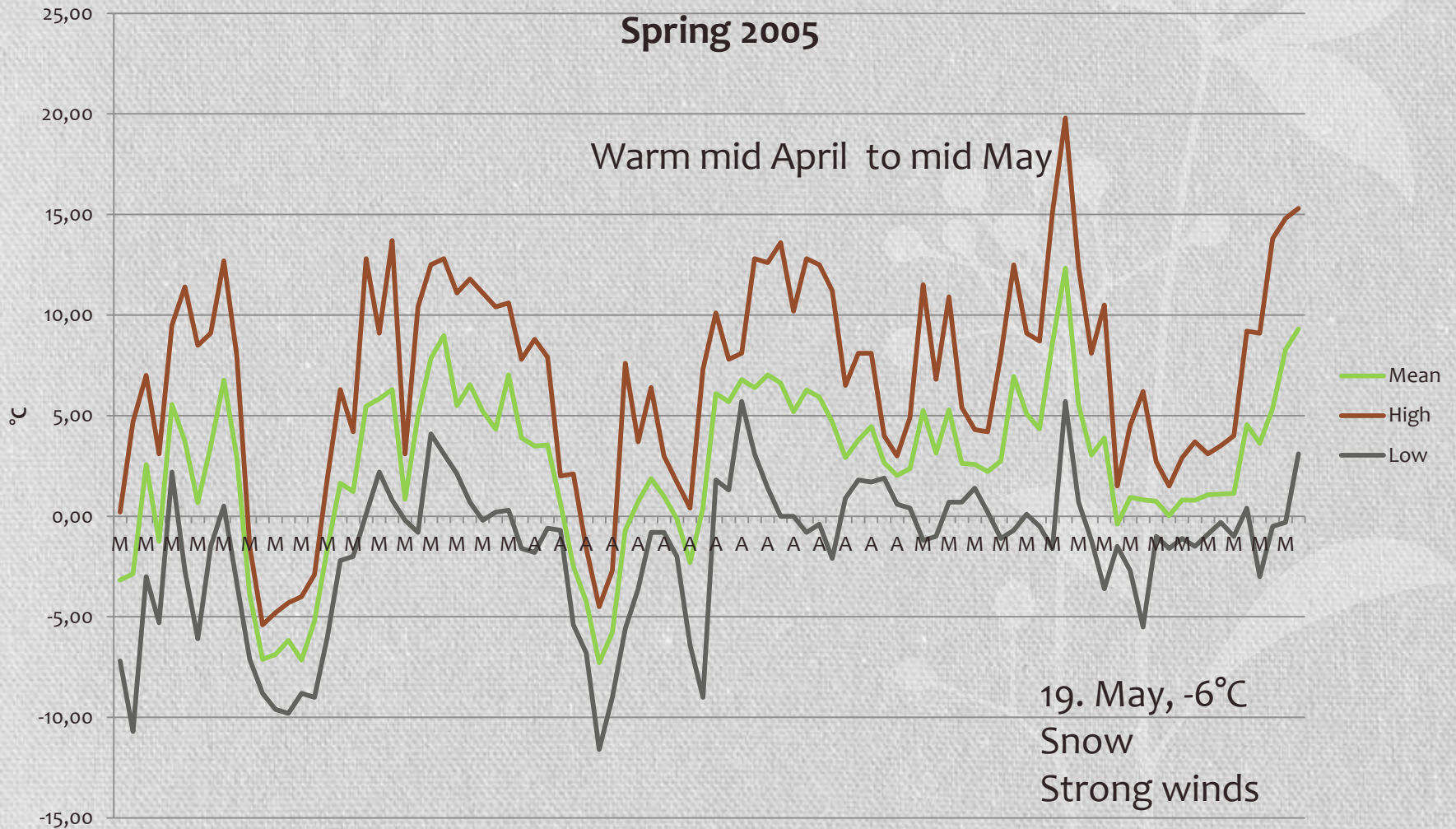
- Carbon sequestration dropped and did not recover for several weeks (Brynhildur Bjarnadóttir 2007).
- The effect of the autumn frost event can also be seen



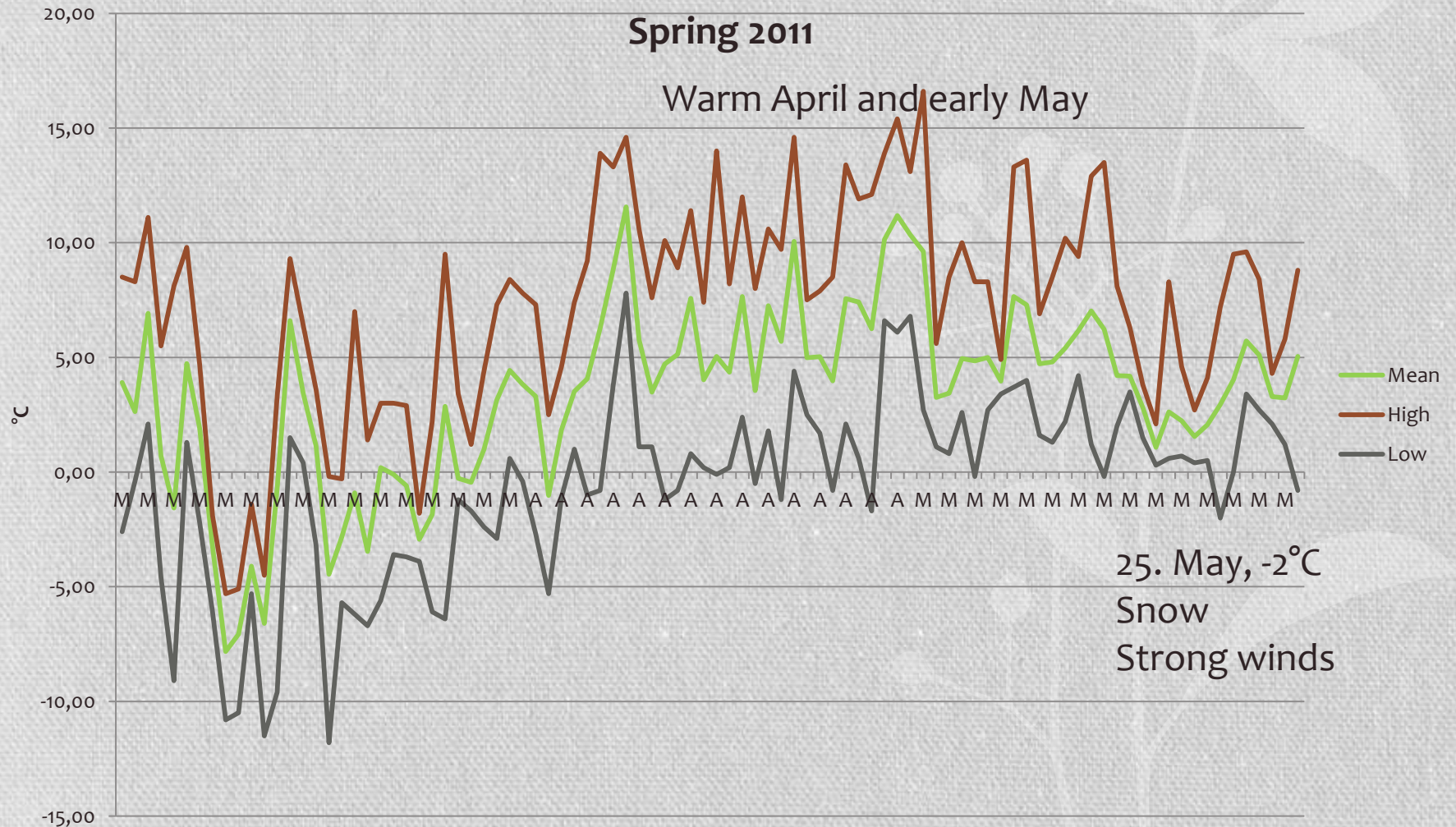
Needle damage in spring 2003



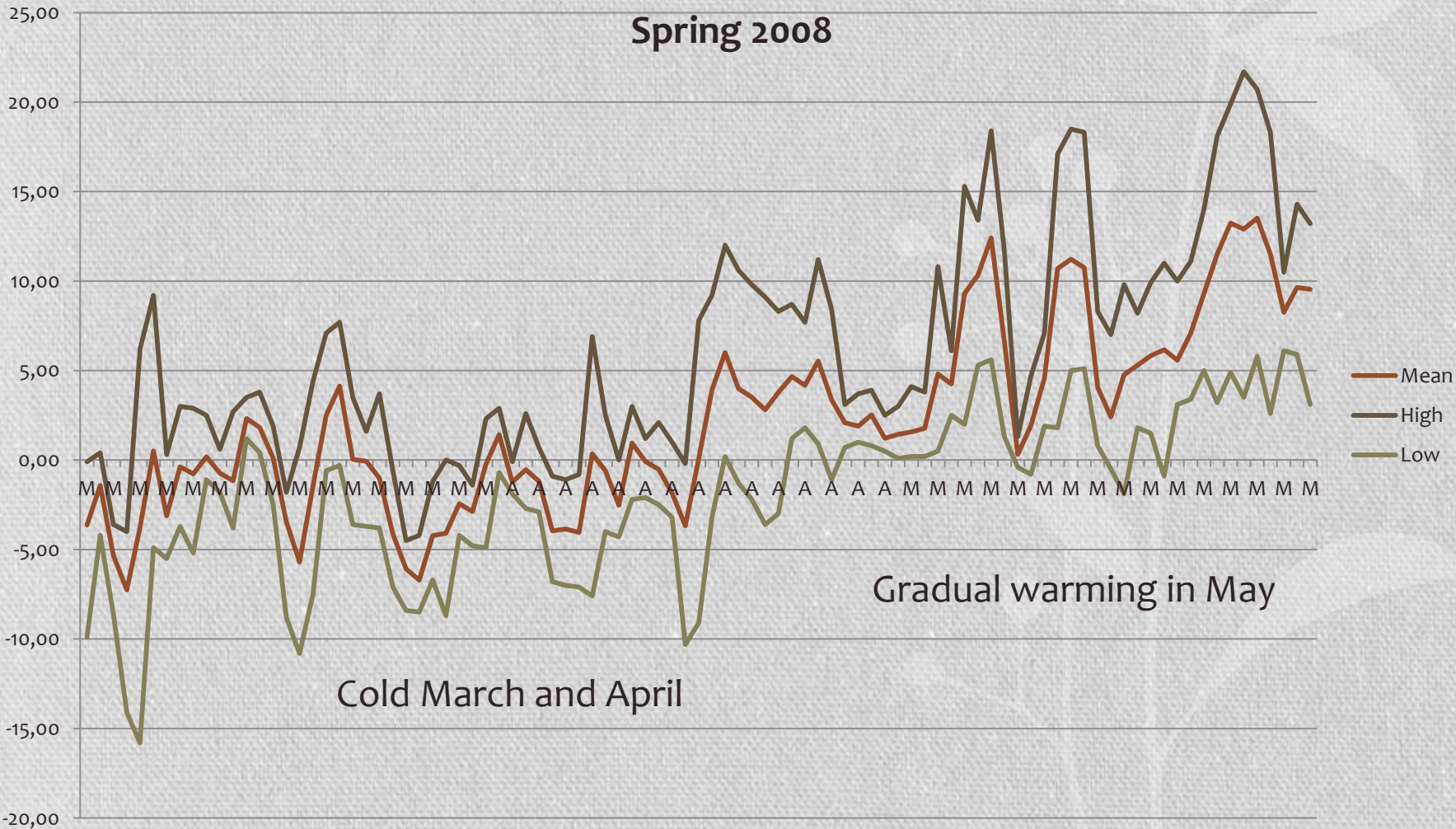
Needle damage in spring 2005



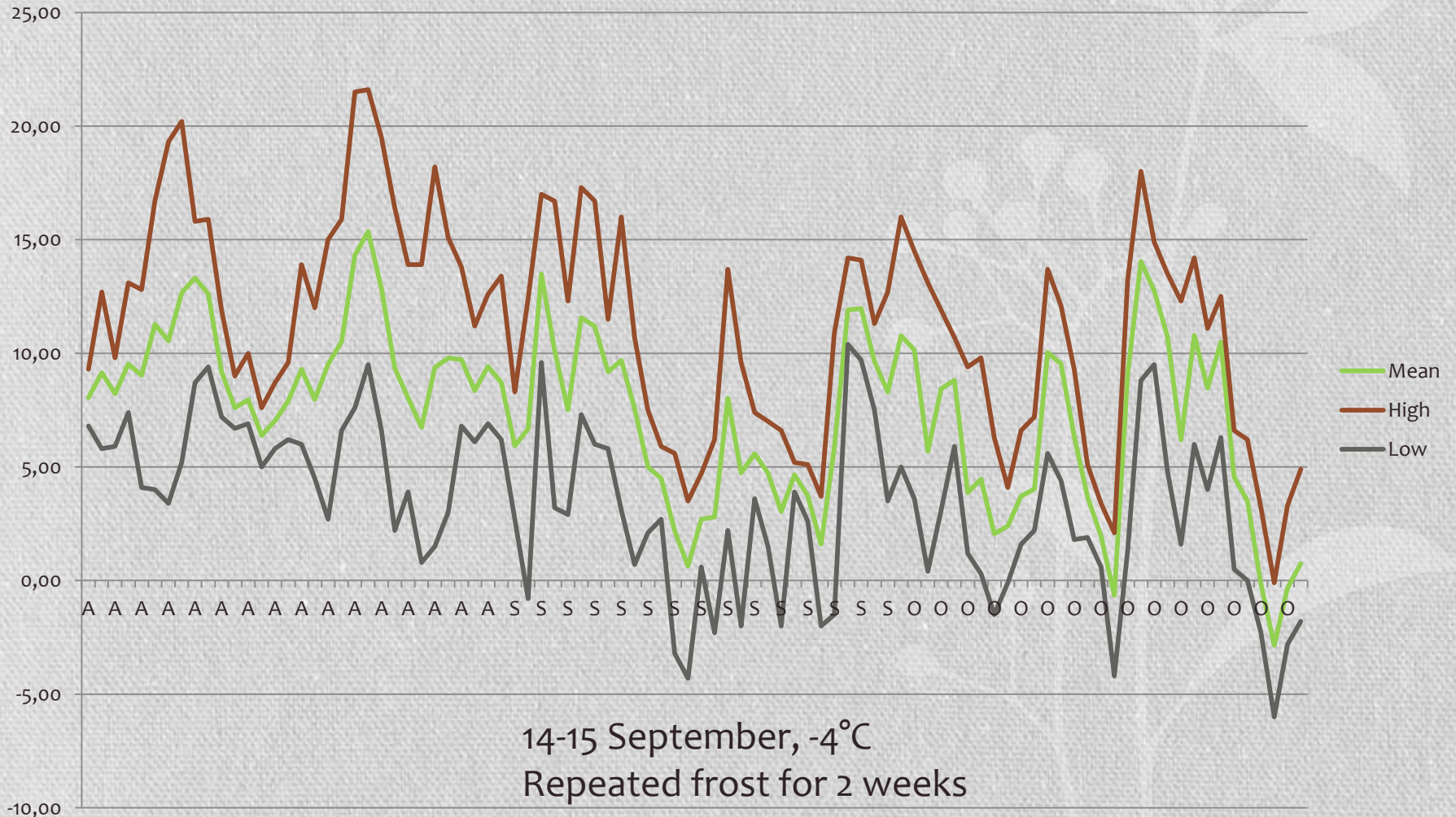
Needle damage in spring 2011



A spring that Siberian larch is adapted to

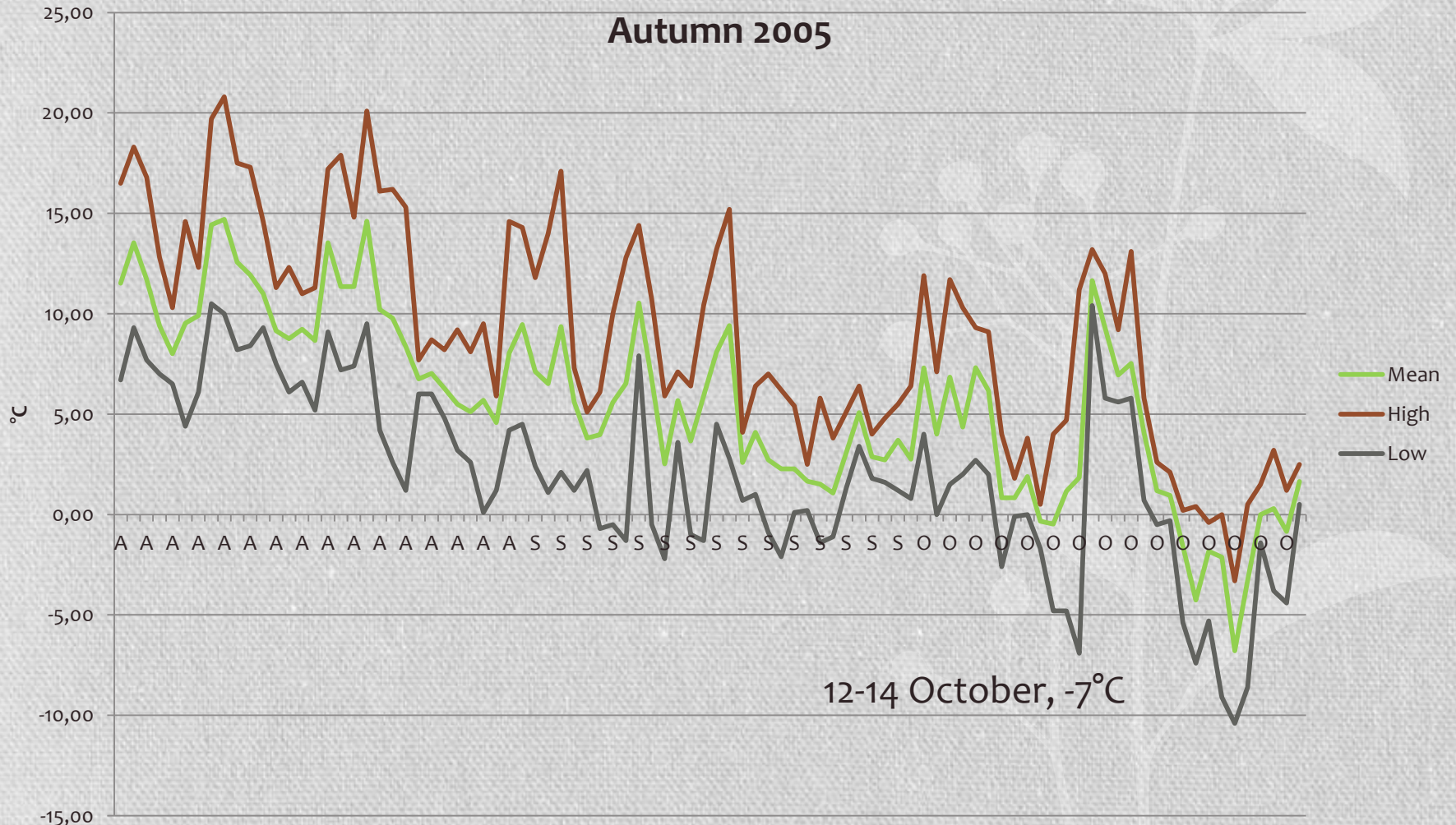


Shoot die-back autumn 2007



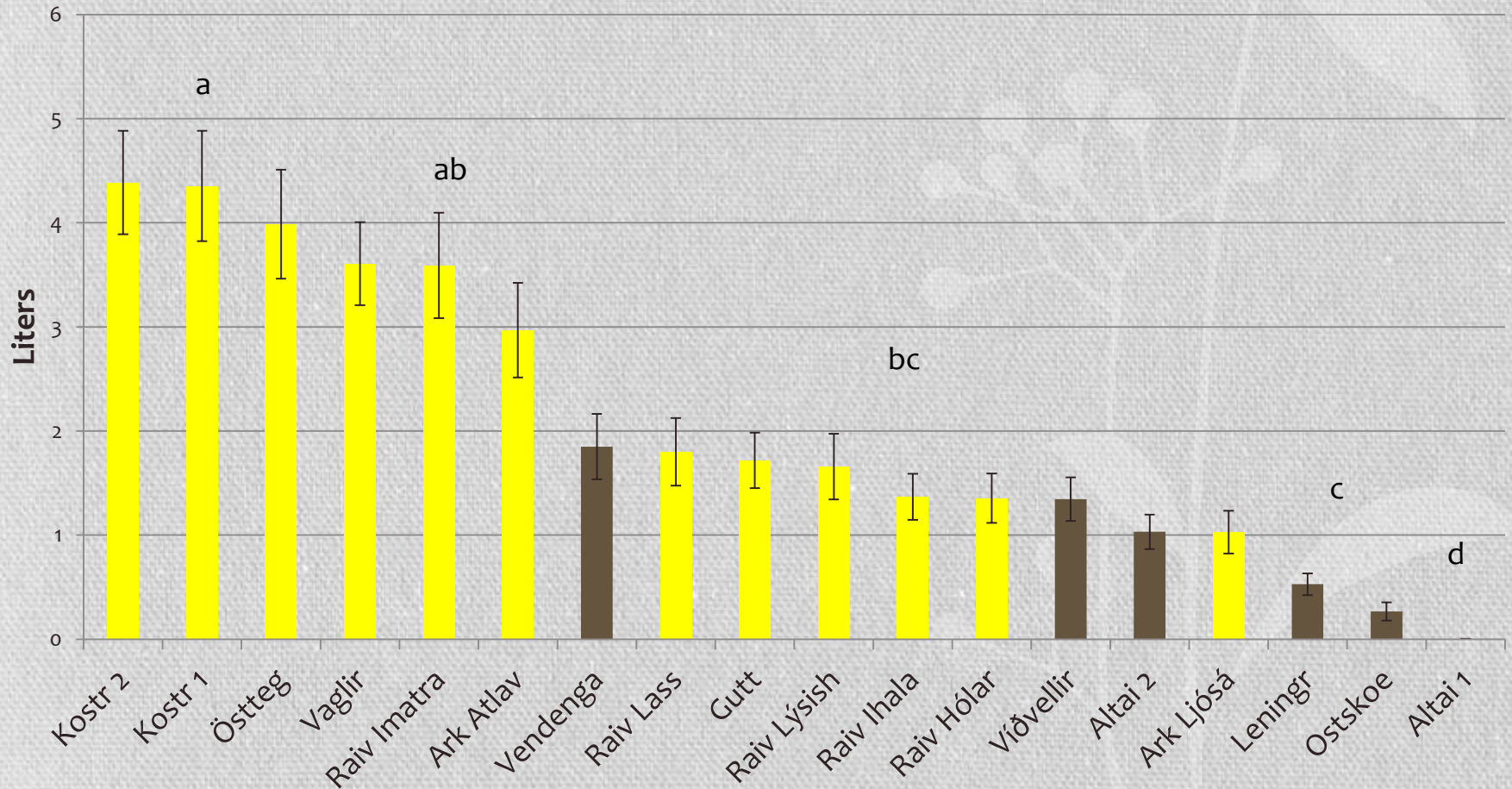
Shoot die-back autumn 2005

Connected to spring damage the same year?

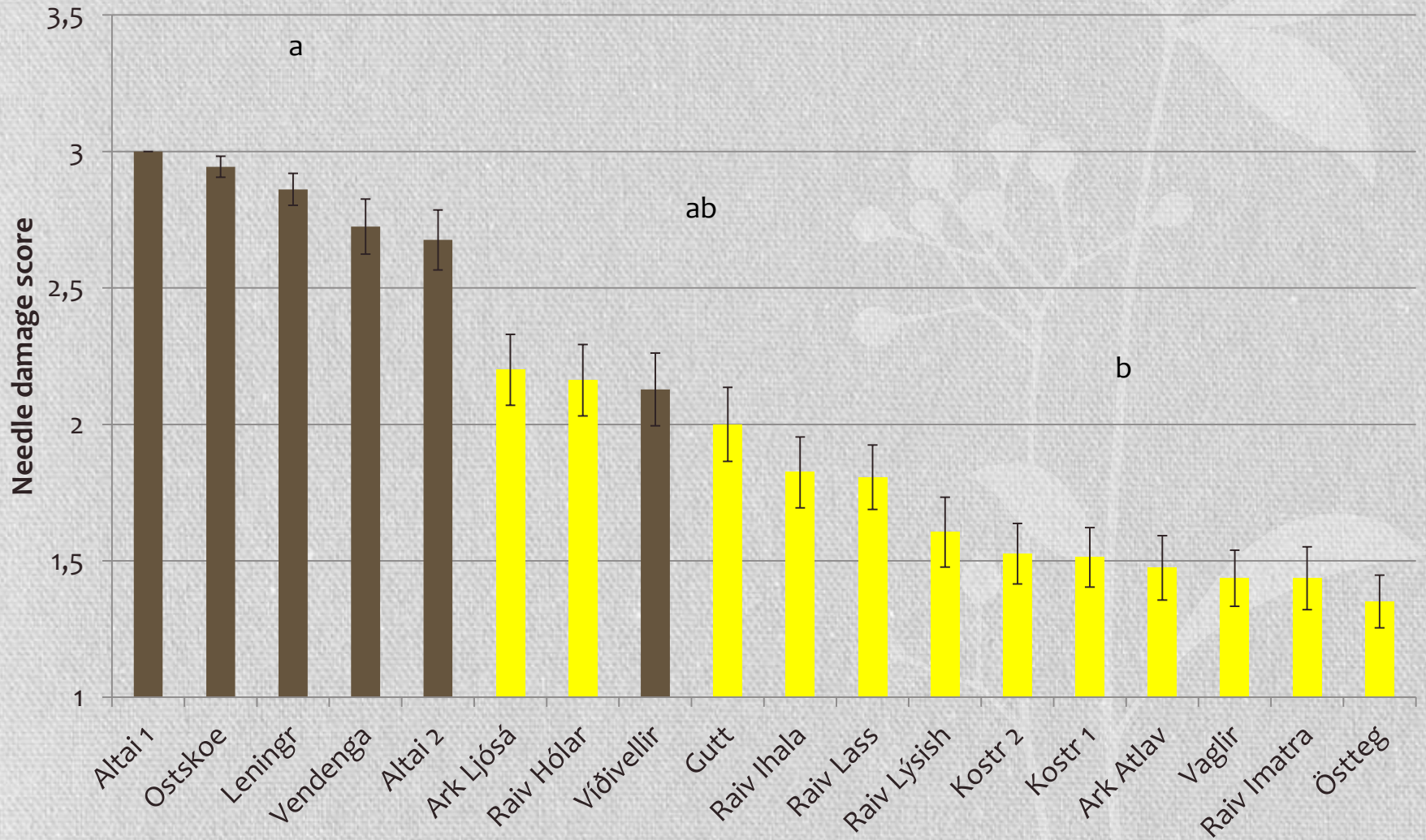


Results, Volume growth at age 12

Volume / tree

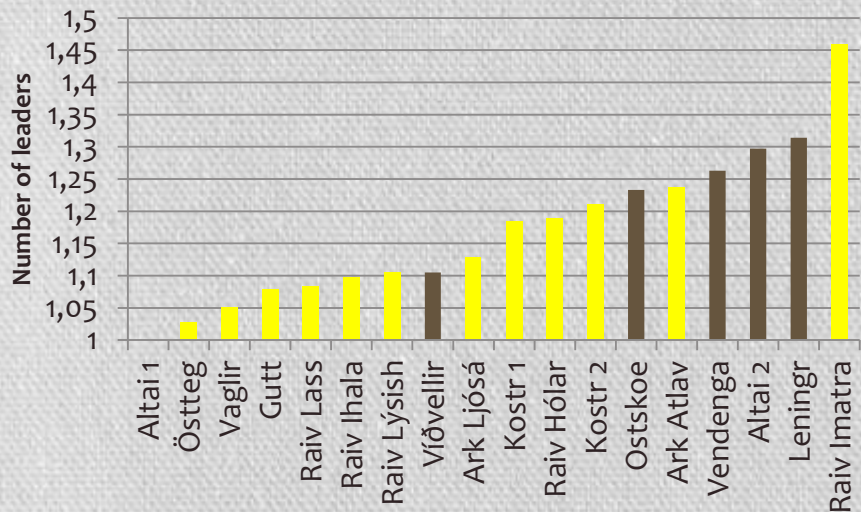


Needle damage 2011

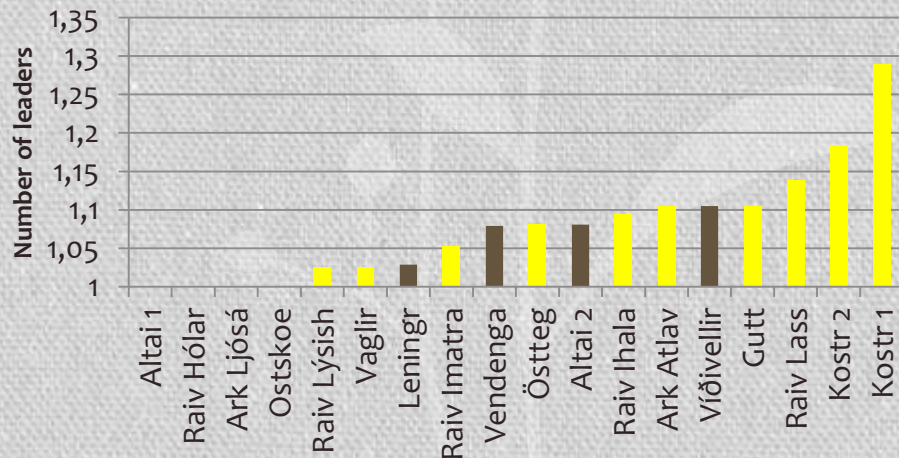


Multiple leader formation after spring damage is negligible

2003 ns.



2005 ns.





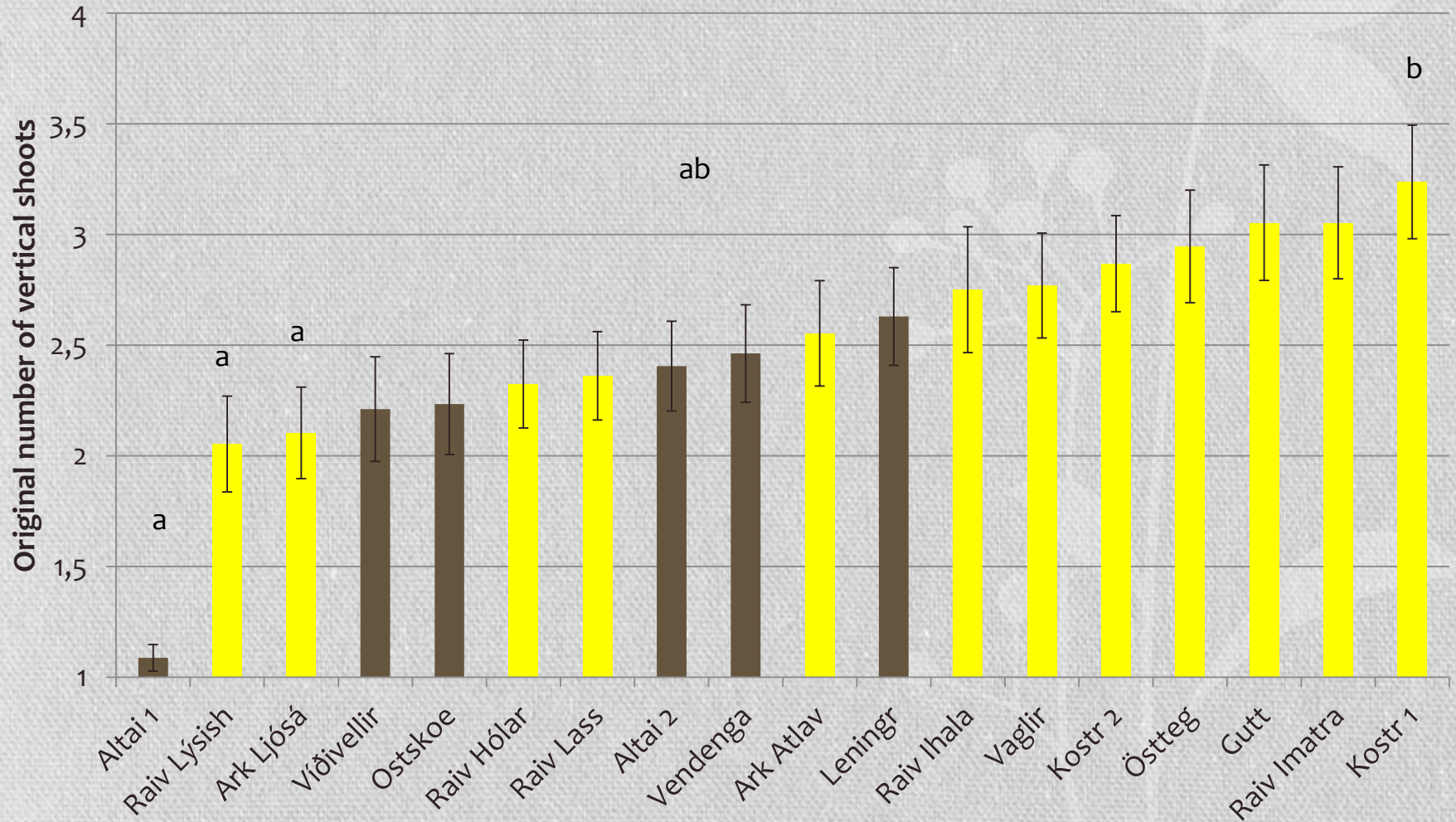
4 cm
The response of some
provenances is to set bud



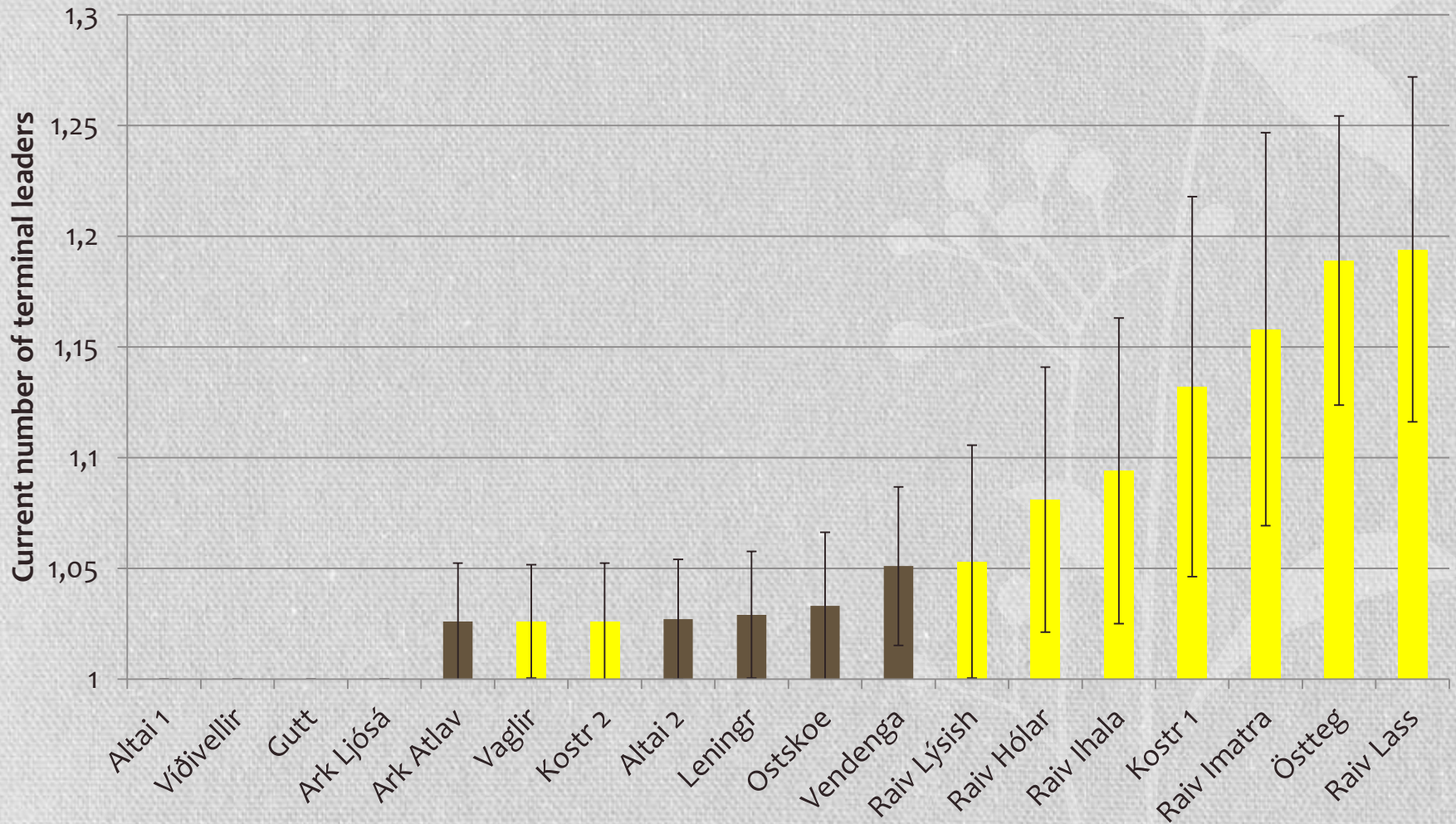
Terminal leaders from 2011
21. March 2012

16 cm
Others continue growing

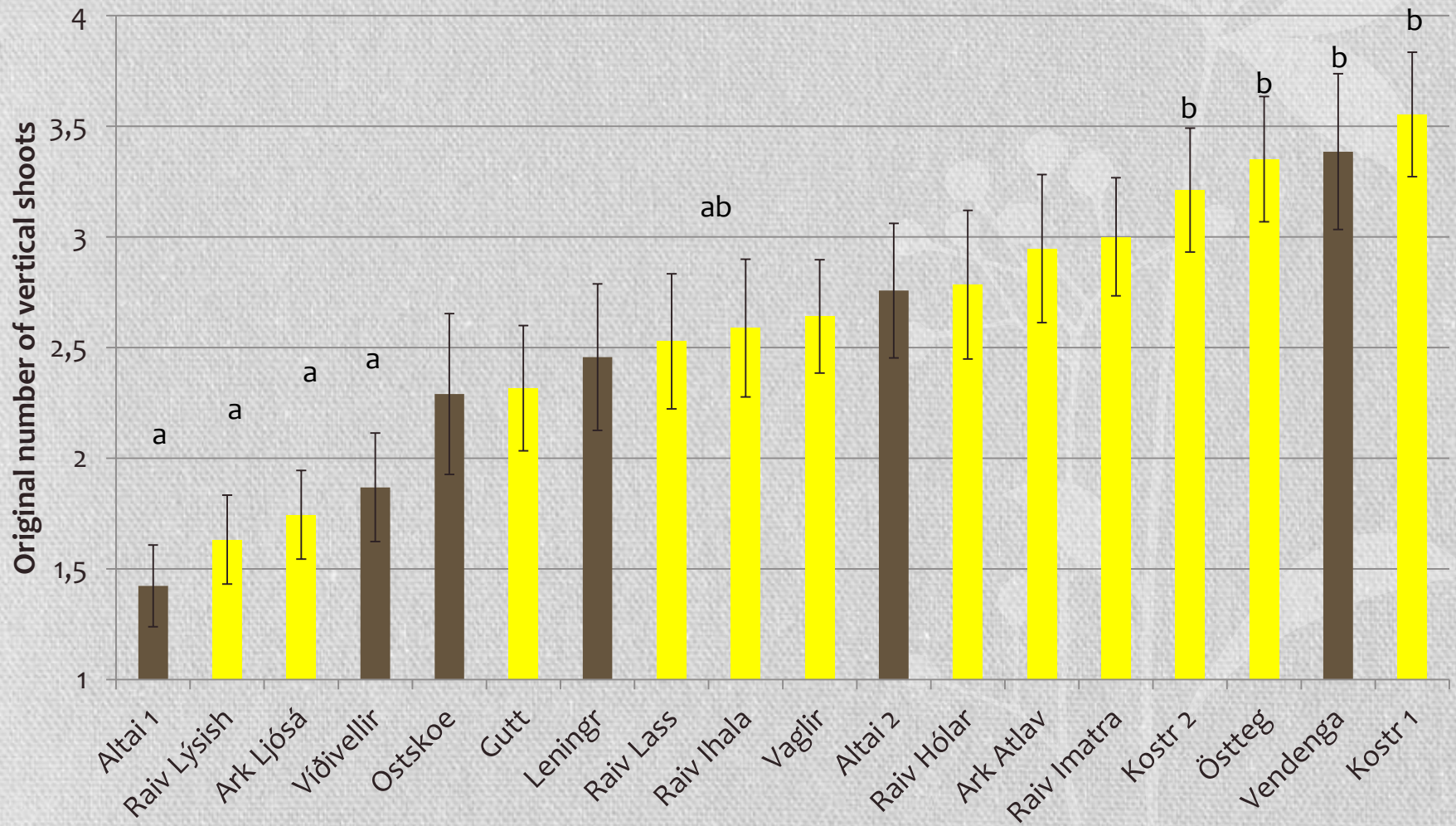
Autumn damage 2005, original number of vertical shoots



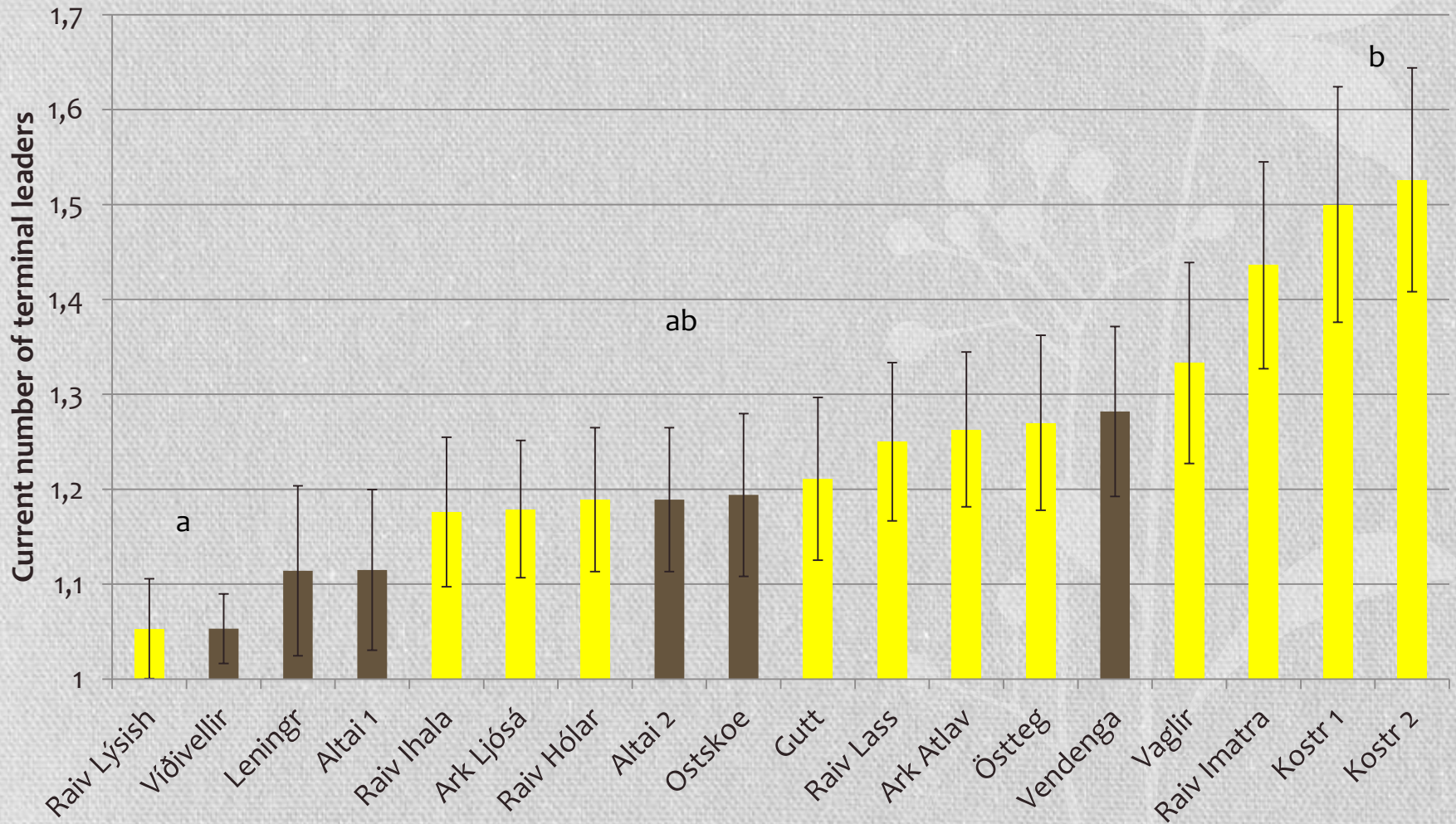
Autumn damage 2005, current number of terminal leaders, n.s.



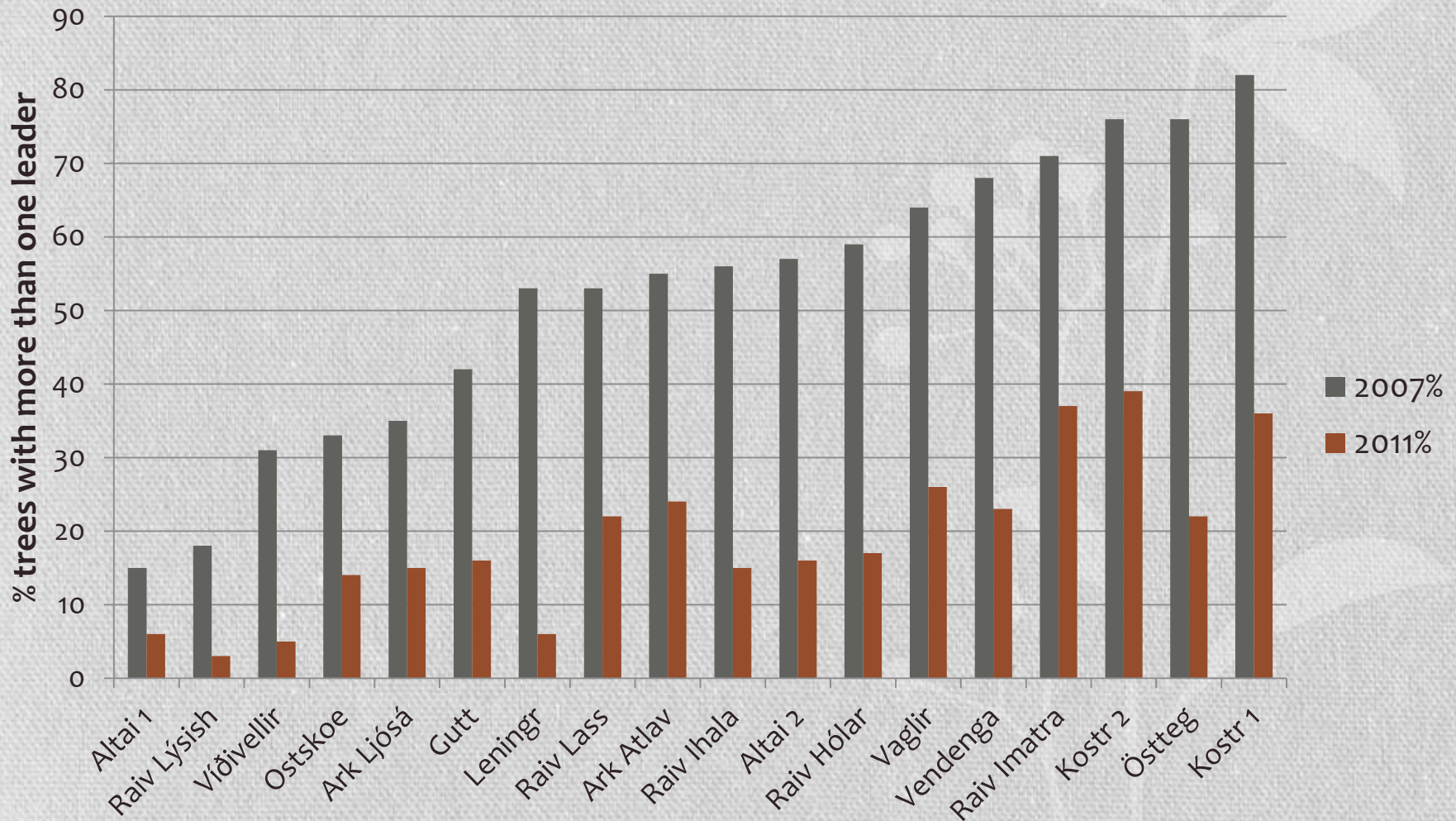
Autumn damage 2007, original number of vertical shoots



Autumn damage 2007, current number of terminal leaders, n.s.

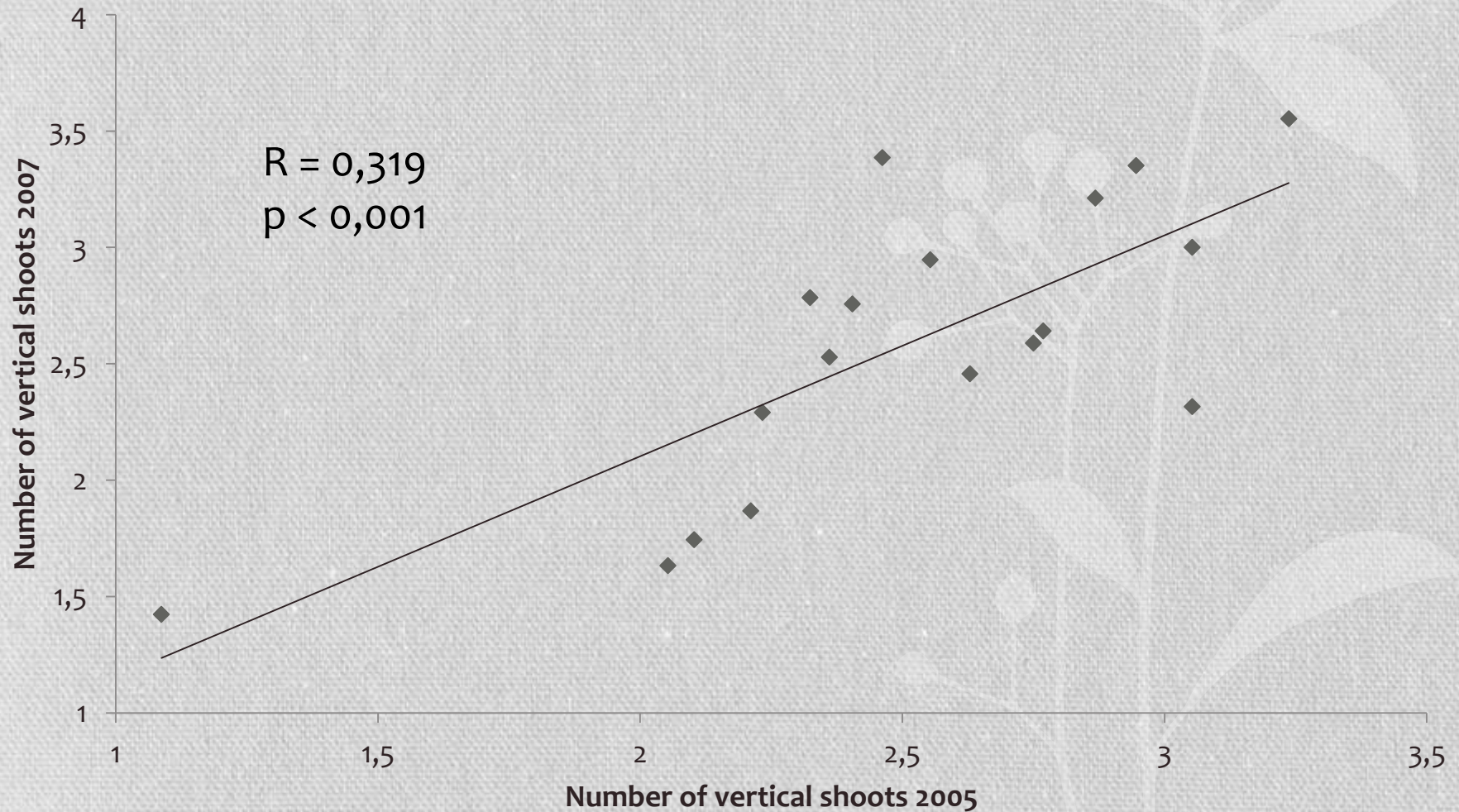


Consequences of 2007 autumn damage shown in a different way



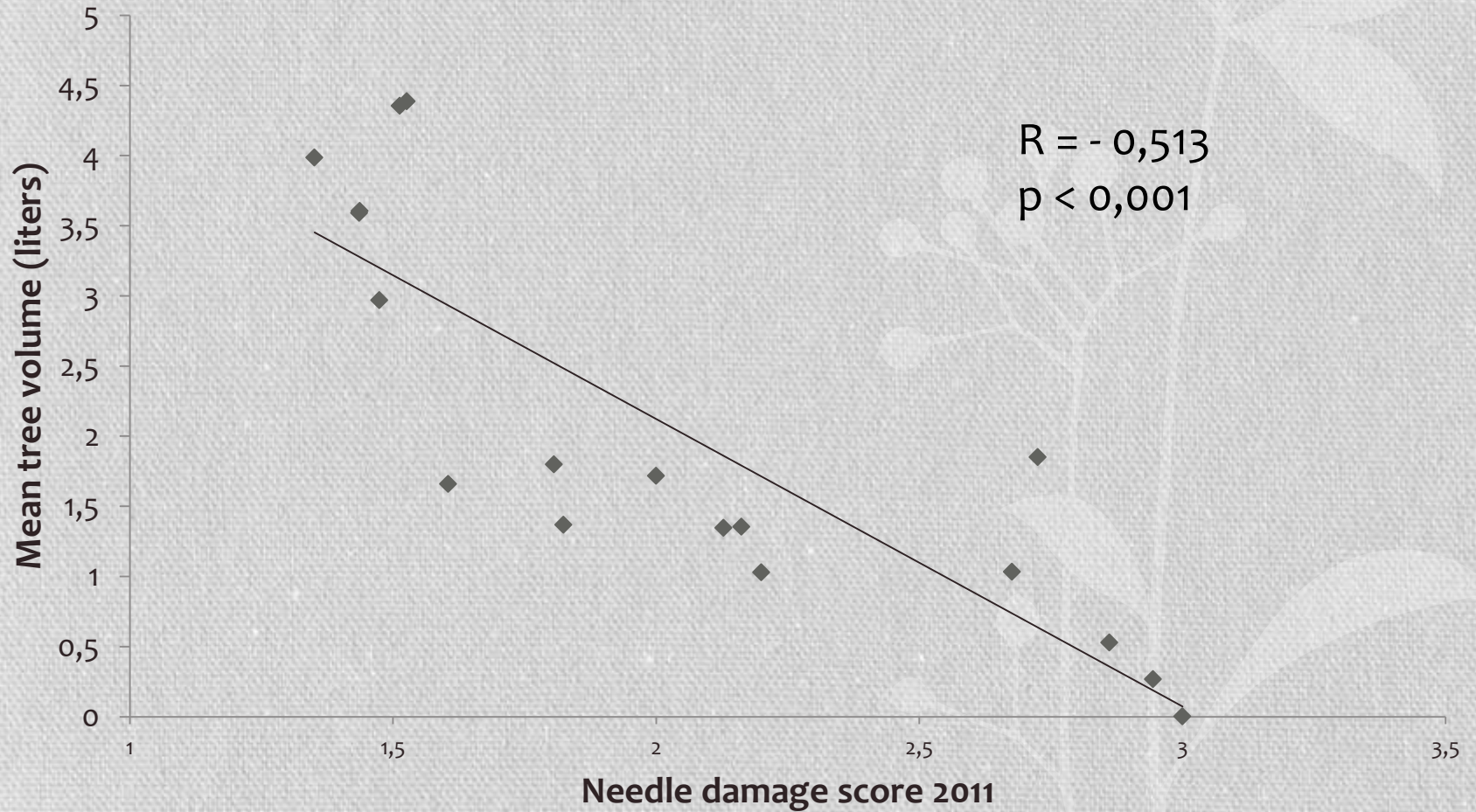
Correlation in autumn damage 2005 and 2007

Spearman rank correlation



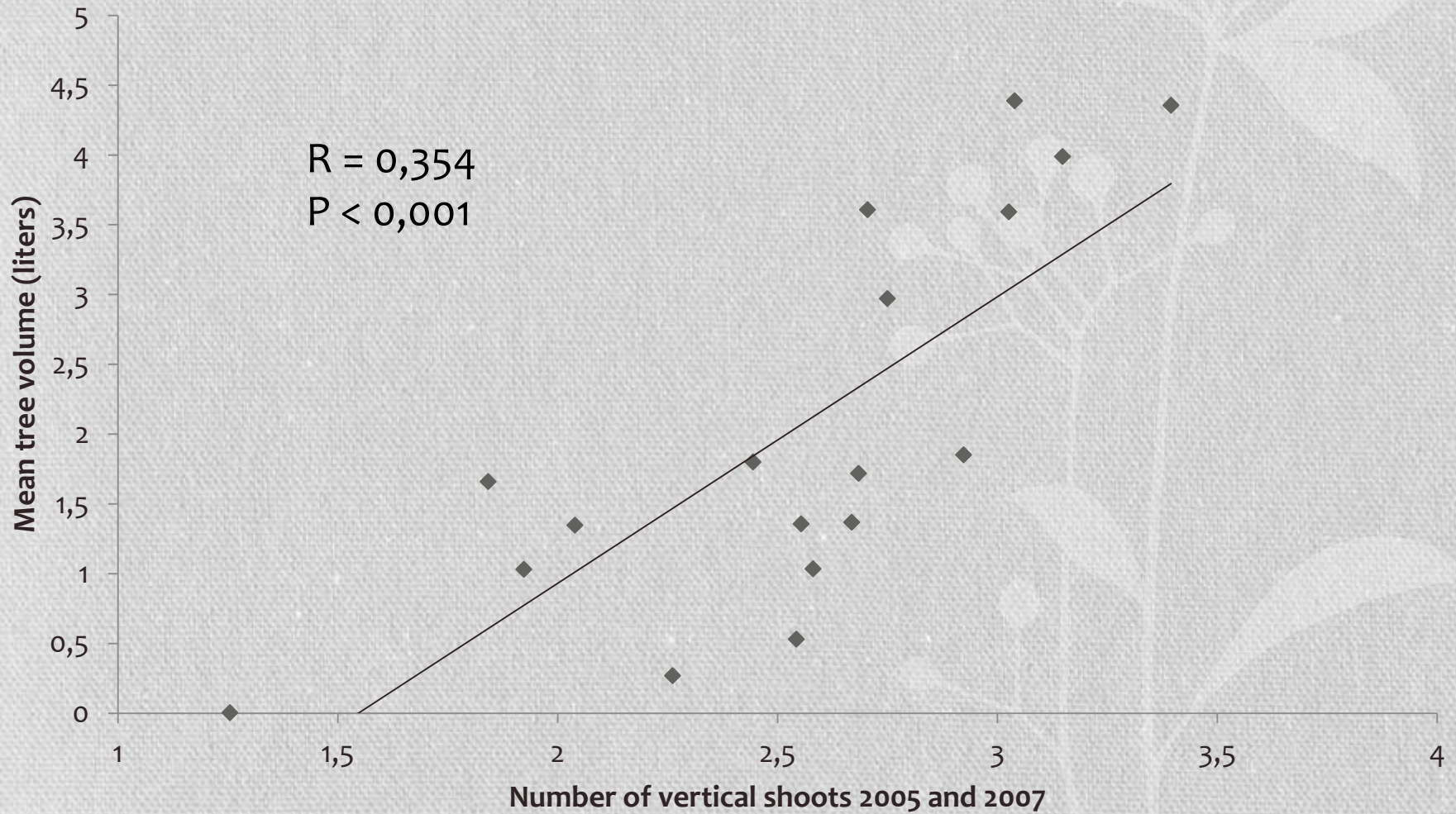
Negative correlation between spring needle damage and volume growth

Spearman rank correlation



Positive correlation between volume and autumn damage

Spearman rank correlation



Provenance:
Altai 1



Provenance:
Altai 2



Provenance:
„Leningrad“



Provenance:
Guttormslundur
(ex Urals)



Provenance:
Vaglir
Icelandic seed orchard



Provenance:
Östteg
Swedish seed orchard



Provenance:
Kostroma



Conclusions

- Spring and autumn damage were equally common during the first decade of the 21st century.
- Spring damage results in growth loss, not form defects .
- Autumn damage results in form defects, not much growth loss.
- Increased volume is achieved by growth later in autumn, not an early start in spring.
- Most trees formed a single dominant leader within 4 years of autumn die-back, almost all within 6 years.
- The final consequences of autumn damage for most trees was a slight crook and one or more former co-dominant stems.

Conclusions

- The provenances that sustained the greatest spring needle damage grew significantly less than others. They are mostly Siberian and no longer used in Icelandic forestry.
- The provenances that sustained the greatest autumn damage are nevertheless usable, with the exception of Kostroma perhaps.
- The results do not support a change in emphasis regarding which provenances to use in interior North and East Iceland.
- It is not yet time to switch to European larch, but perhaps we should start thinking about planting Russian larch at higher elevations.

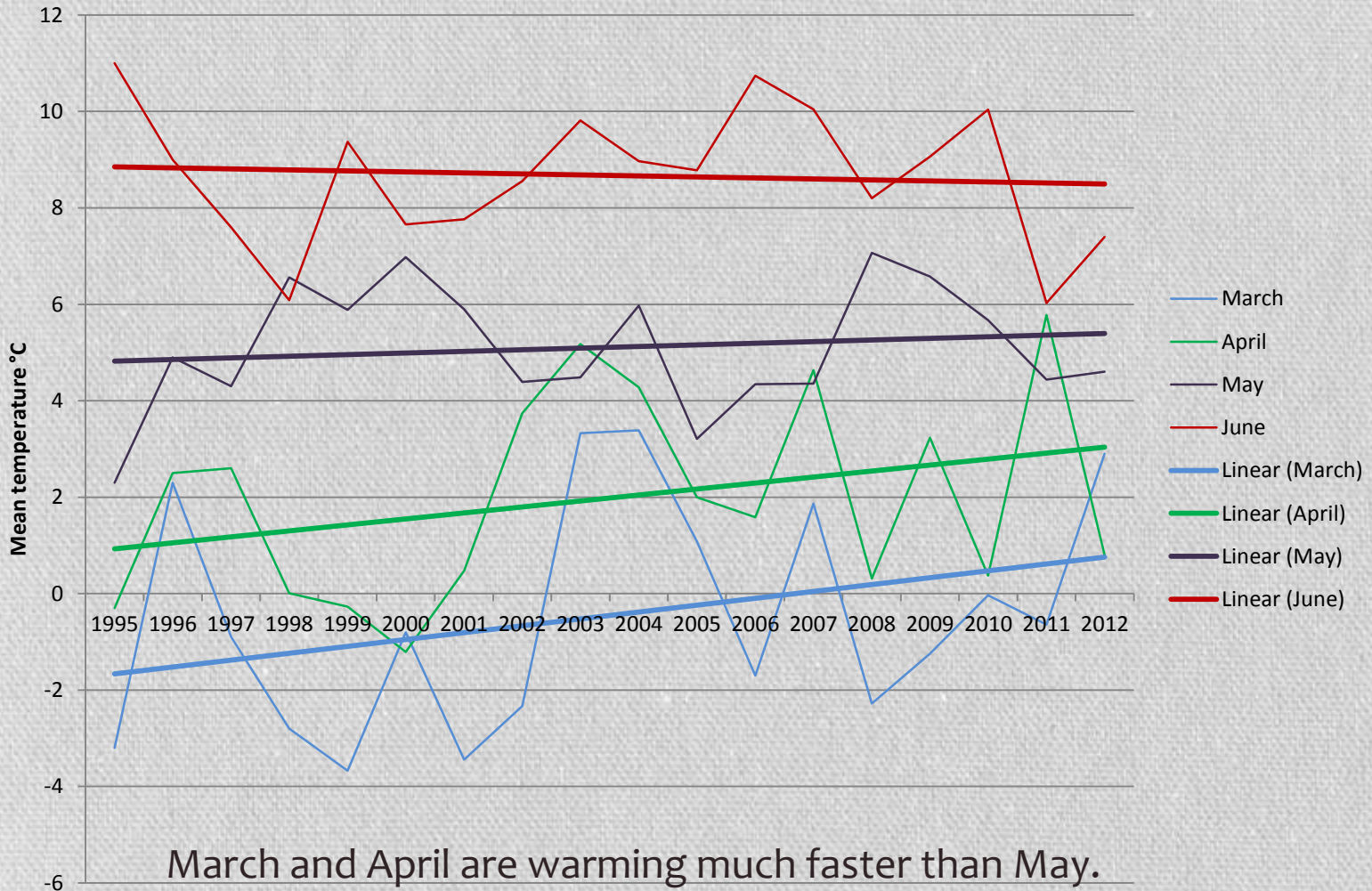
Extra conclusion

- Conifer canker (*Phacidium coniferarum*)
 - Most common following cold weather in early summer
 - It is active now after cold Junes in both 2011 and 2012
 - Most seriously affects Siberian provenances, especially
 - Ulan Udensk
 - Tuva
 - Otskoe, Buryatia (as we will see tomorrow)
 - Some Altai provenances
 - *Larix occidentalis* is also affected
 - *Larix sukaczewii* shows little damage
 - *Larix decidua* is not affected.



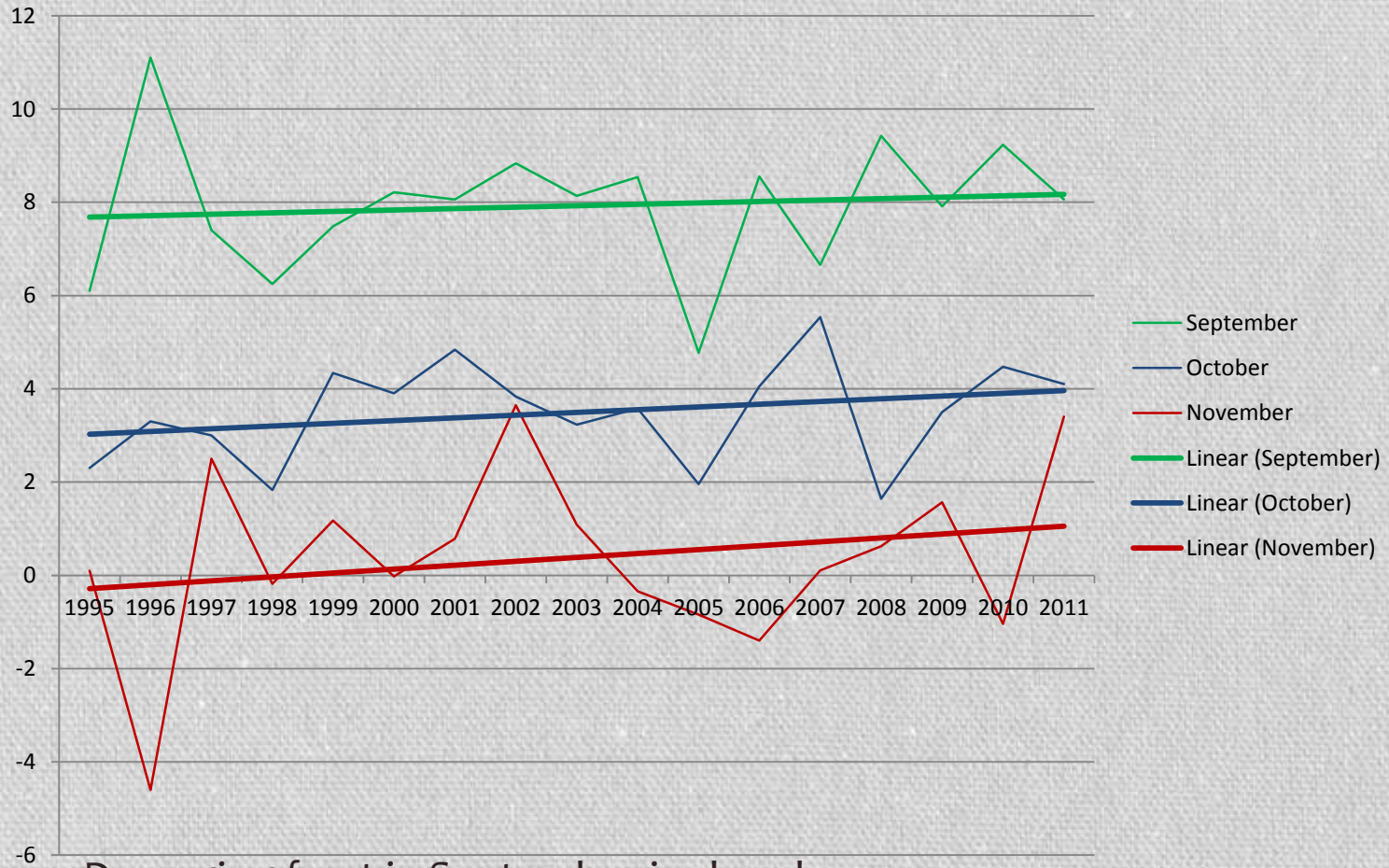
What about the future?

Mean monthly temperatures Egilsstaðir March-June 1995-2012



March and April are warming much faster than May.
Will *Larix sukaczewii* go the same way as *Larix sibirica*?

Mean Monthly temperatures Egilsstaðir Sept.-Nov. 1995-2011



Damaging frost in September is already rare.
Conditions for *Larix decidua* and *Larix occidentalis* will improve as the danger of frost in October decreases.

Larch in snow – a thing of the past?

