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# Resilience of boreal forest ecosystems: a new approach to measuring

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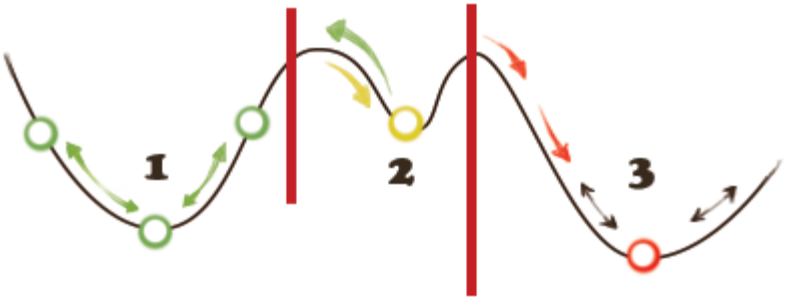
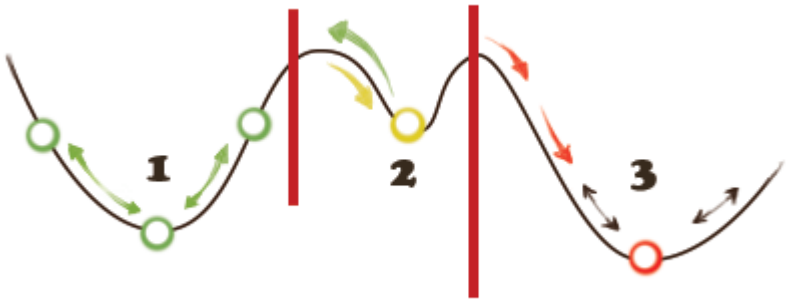
Photo: Alexandr Gladyshev

# Concepts and definitions

The **resilience** of an ecosystem is its capacity to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks. It is the capacity of a system to both withstand disturbances and to rebuild itself if damaged.



# Approach




1. Reference state – primeval or semi-natural forests
2. Intermediate state – managed forests, possibility to return to a steady state
3. Degraded forests

Ecosystem characteristic to be measured?

○

Coarse woody debris (CWD)

# Why CWD?

# CWD in ecosystem services

- Species diversity of
  - Fungi
  - Mosses
  - Lichens
  - Vascular plants
- Tree species regeneration

- Carbon cycling
- Climate change mitigation
- Nutrient cycling
- Energy flows and food webs

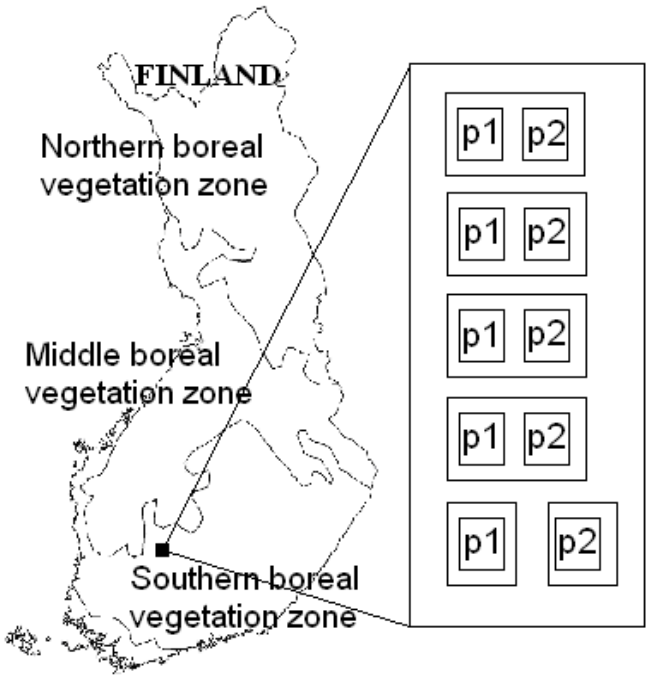
**Ecosystem resilience**

# Objective and hypothesis

- We examine the factors influencing the CWD quantity and quality in primeval and managed European boreal forests.

- We hypothesize that the natural disturbance regimes and forest management treatments drive the CWD dynamics.

# Study areas


FINLAND
Northern boreal vegetation zone
Middle boreal vegetation zone
Southern boreal vegetation zone
p1
p2
p1
p2
p1
p2
p1
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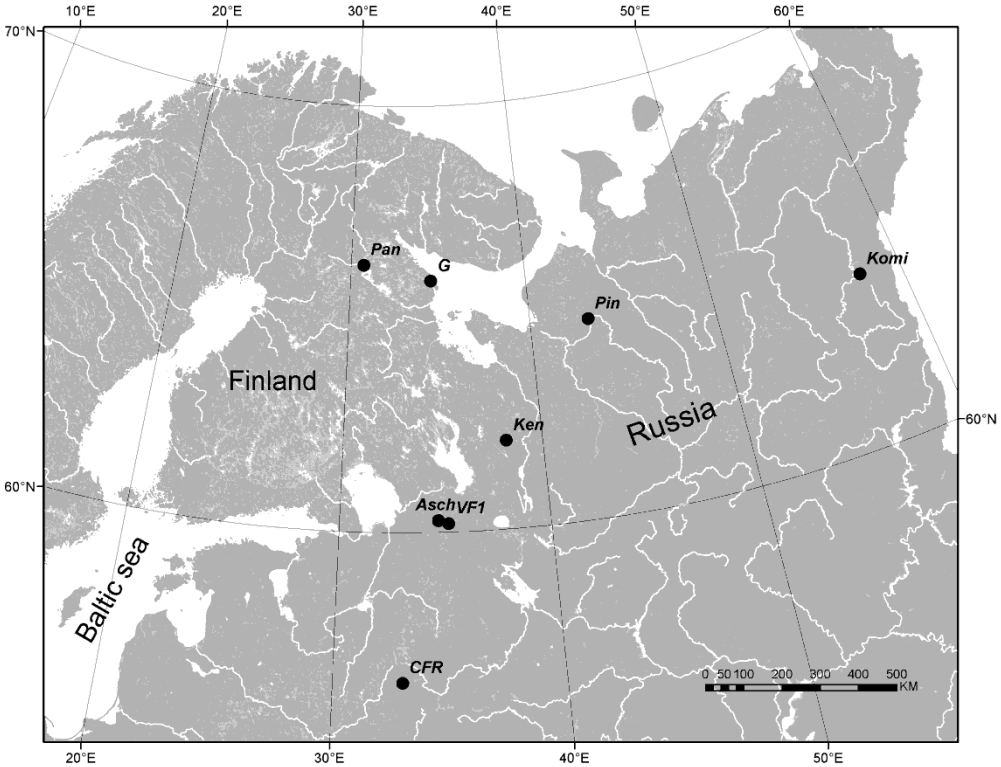
p1
p2


10°E
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40°E
50°E
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70°N
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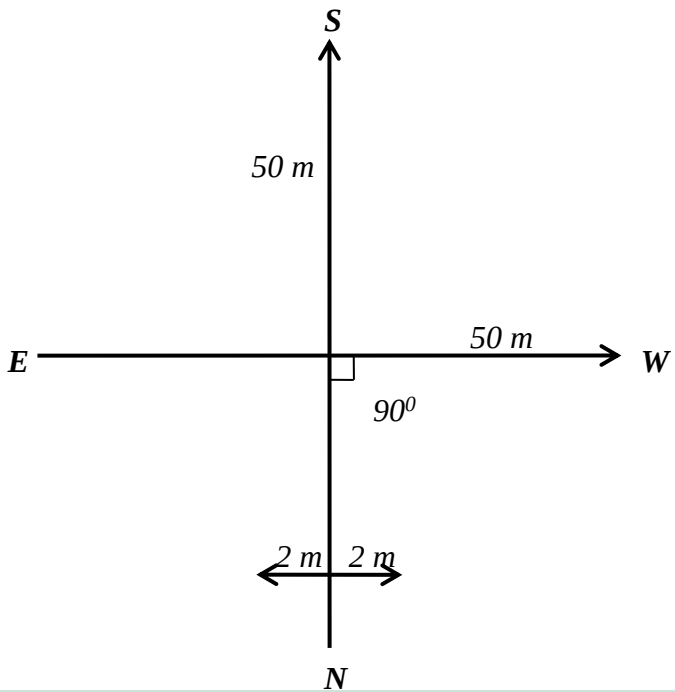
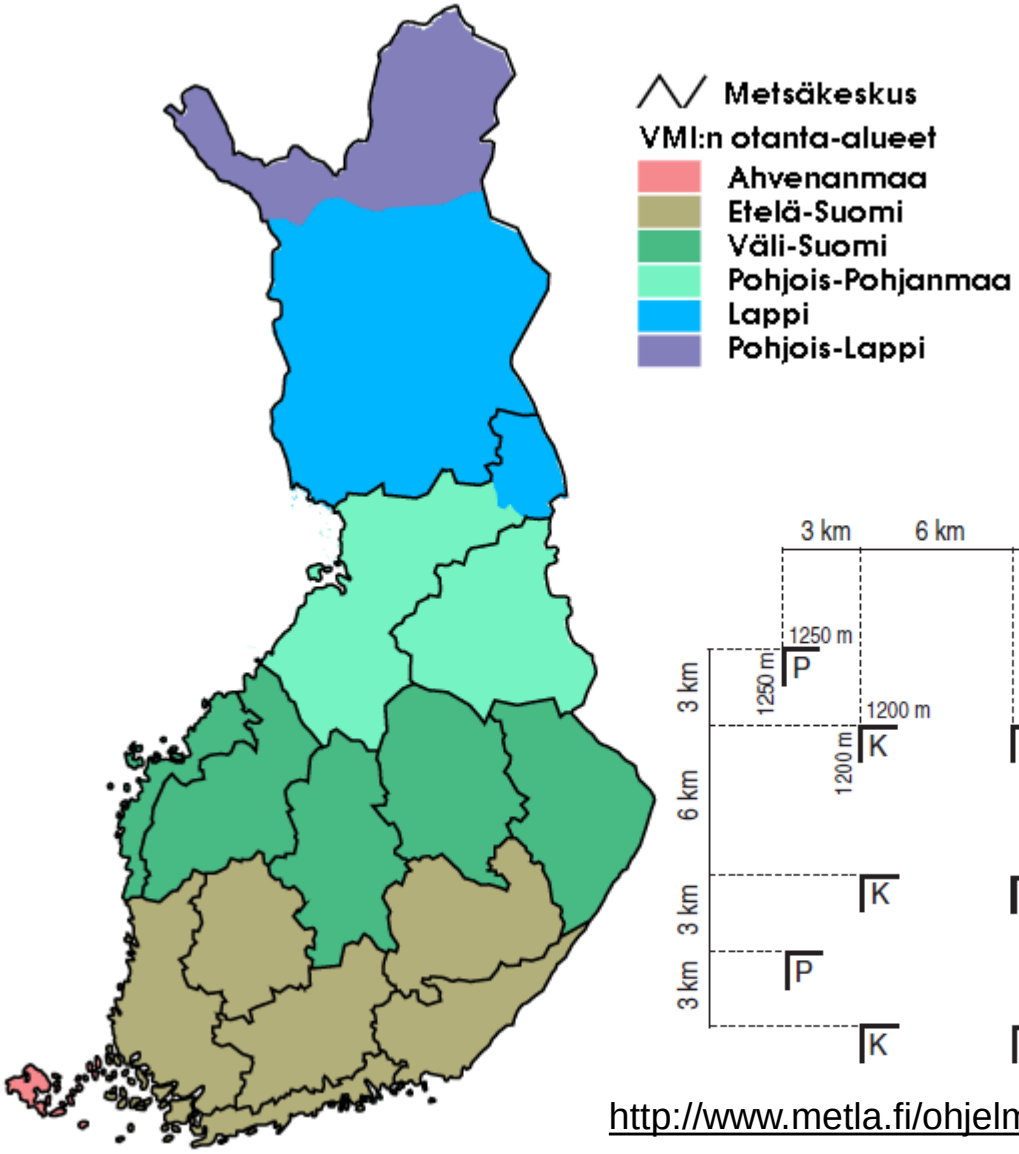
Pan
G
Komi
Pin
Finland
Russia
Ken
Asch
VF1
Baltic sea
CFR
0 50 100 200 300 400 500
KM

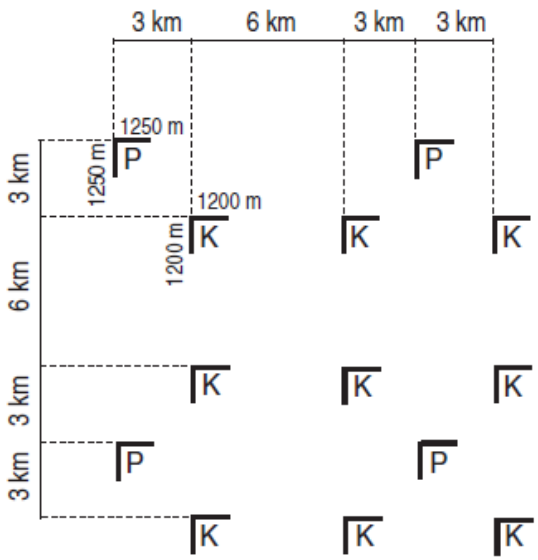
# Methods 1. CWD. Case Studies.

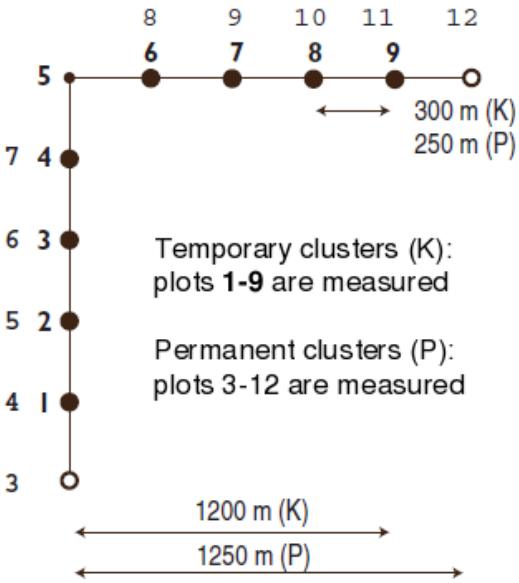
- Transect inventory of coarse woody debris (CWD): tree species, decay classes, size and position in primeval forests in Russia.
- Plot inventory on clear cut areas before and after treatments in Southern Finland.



# Methods 2. Forest Inventory, Finland

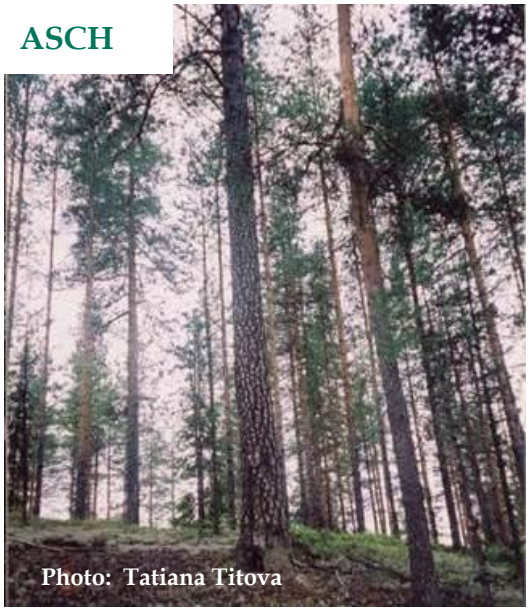



http://www.metla.fi/ohjelma/vmi/vmi11-otanta.htm

# Disturbance regimes and characteristics of the landscapes in Russia




## Aschozersky

Scots pine dominated, surface fire driven cohort dynamics

## Vepssky

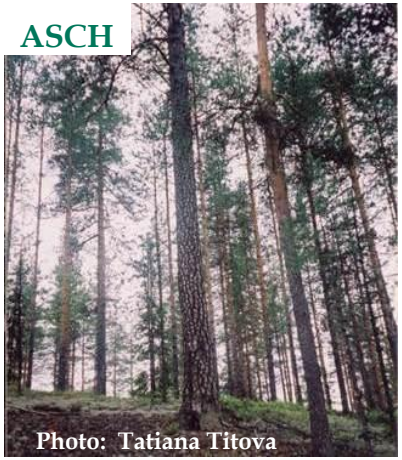
Norway spruce dominated, wind driven cohort dynamics

## Kenozersky

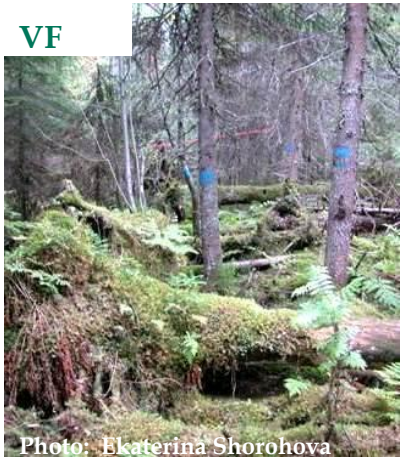
Norway spruce dominated, fine-scale gap dynamics

# Mean volume of CWD, $m^3$ $ha^{-1}$

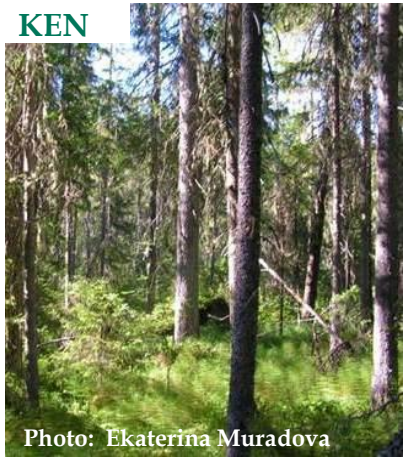
Asch - 52.3




VF - 207.0




Ken - 146.8

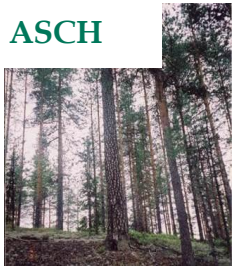



Managed forests in Southern Finland, average - 2.7

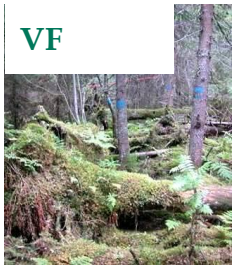
FFRI, 2006

# CWD distribution by decay classes

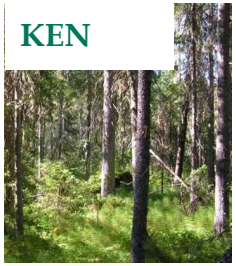
ASCH



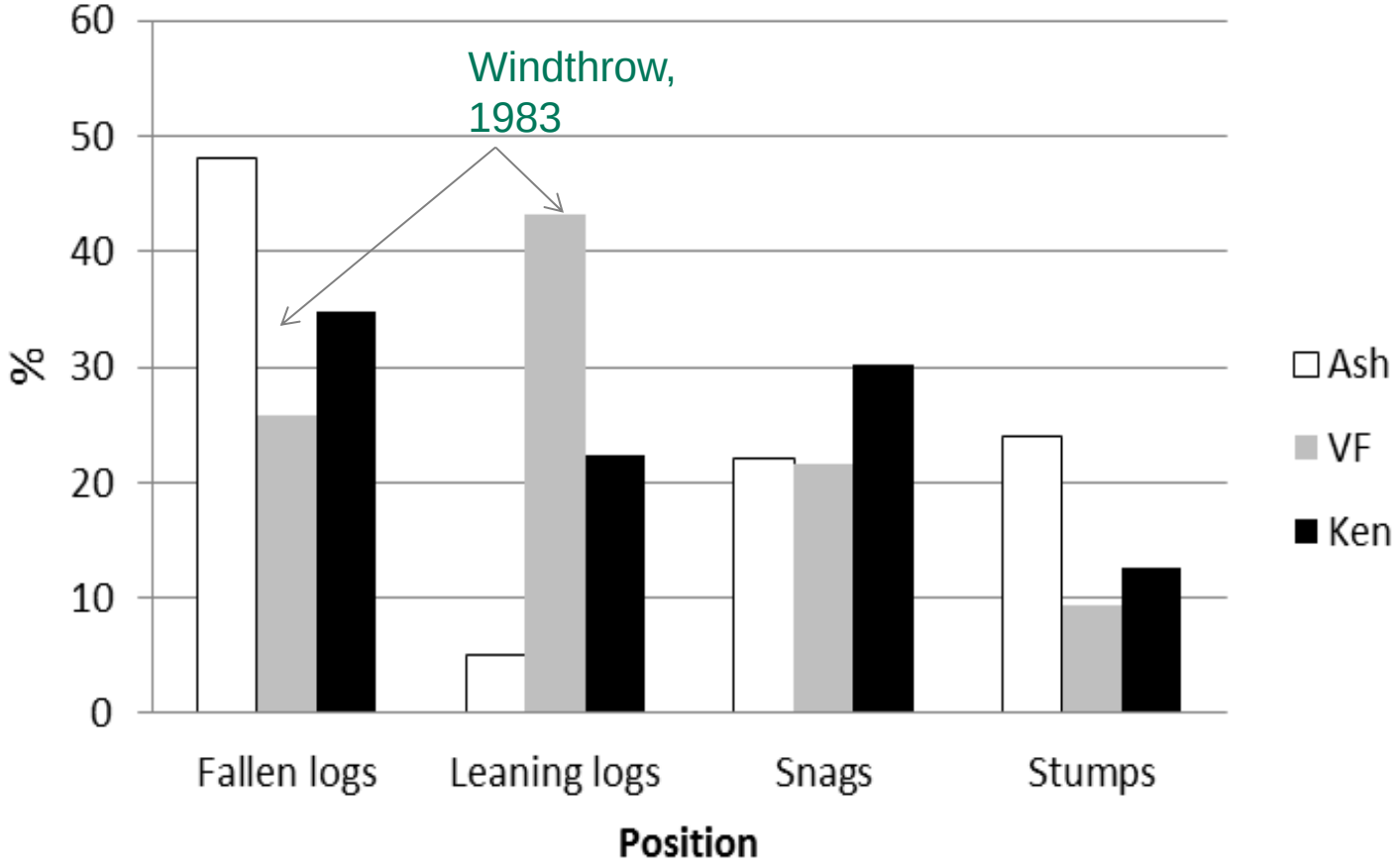
VF

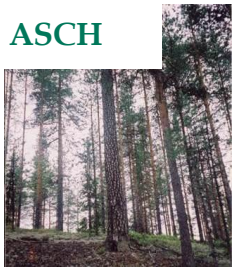


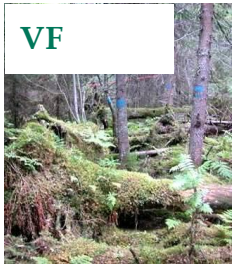
KEN

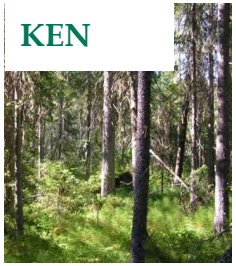


# CWD distribution by position

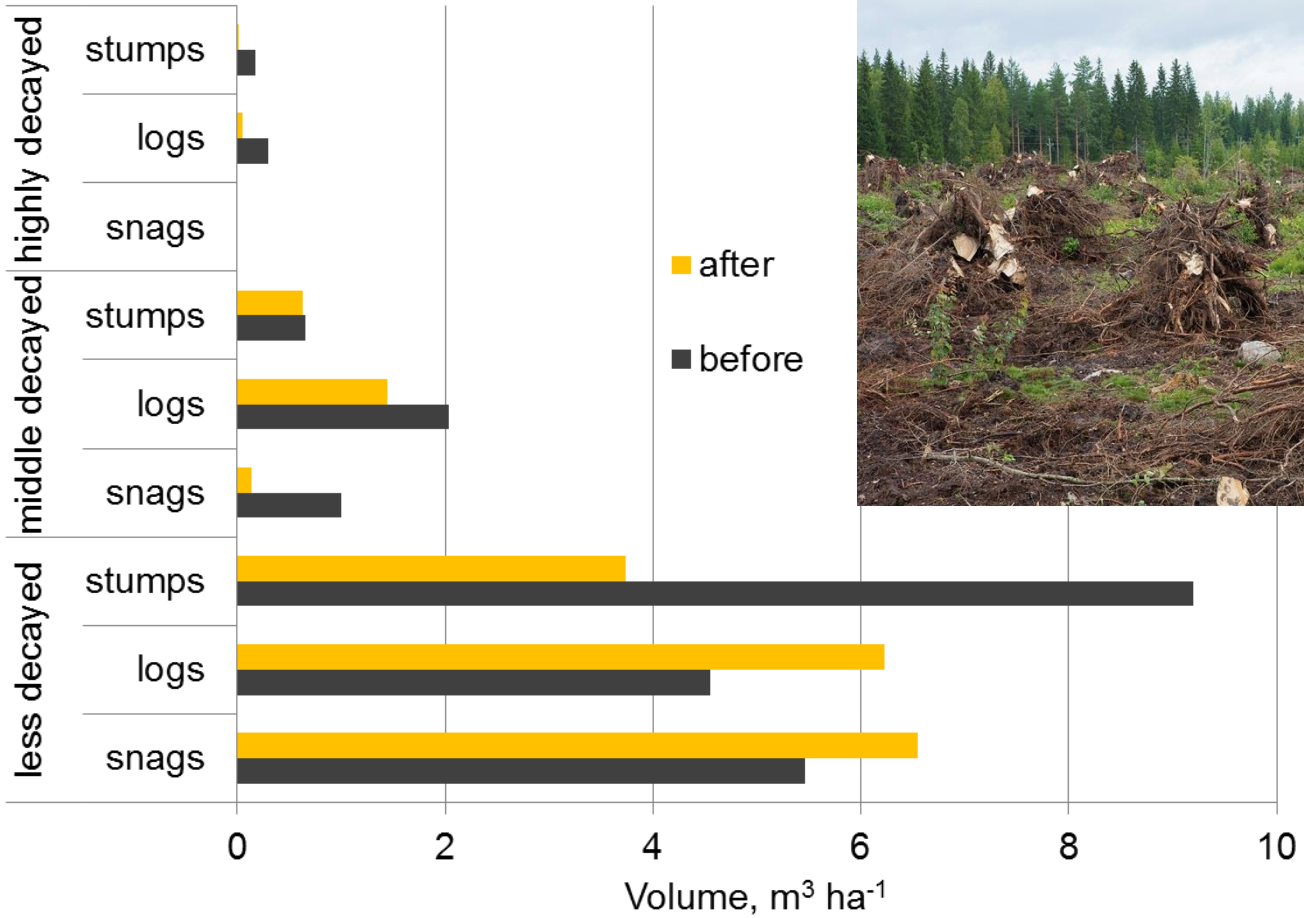


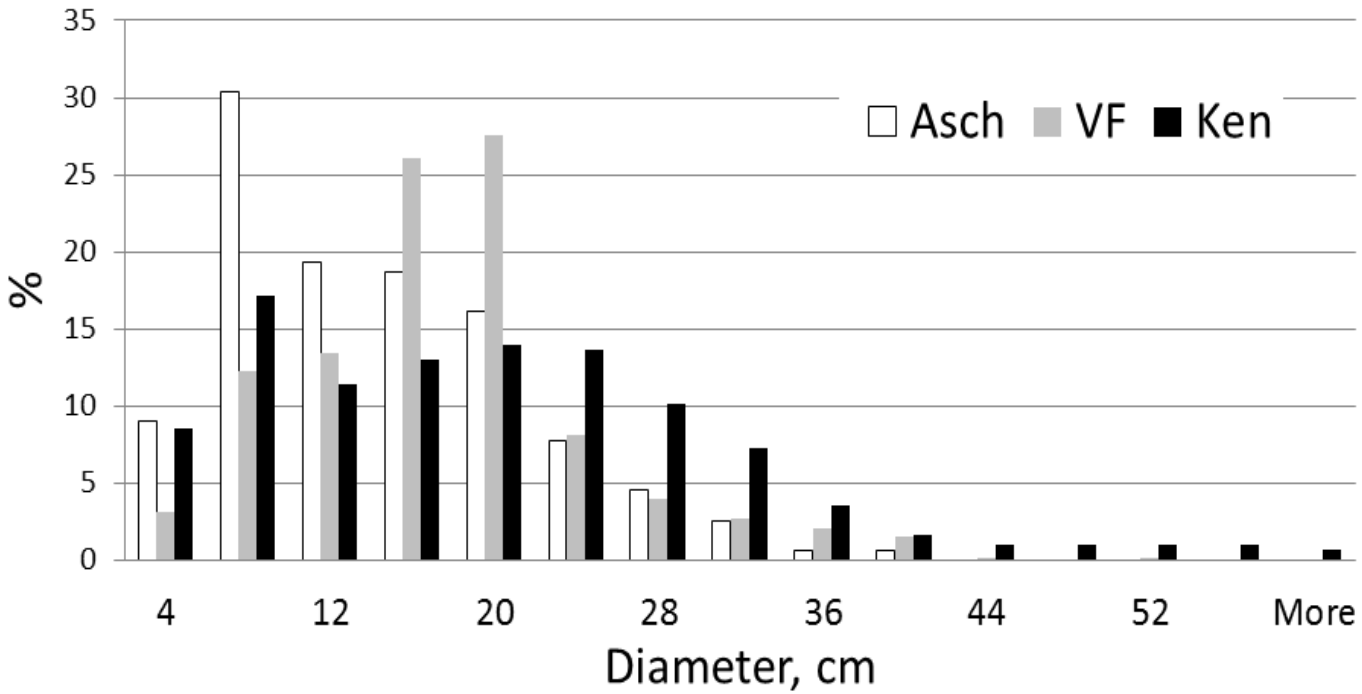



# Effects of mounding combined with stump harvesting on the CWD quality



Ref. Rabinovich-Jokinen & Vanha-Majamaa, 2010

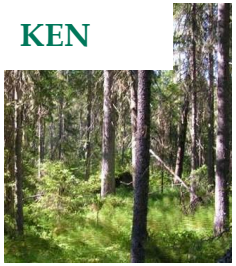
# CWD distribution by DBH



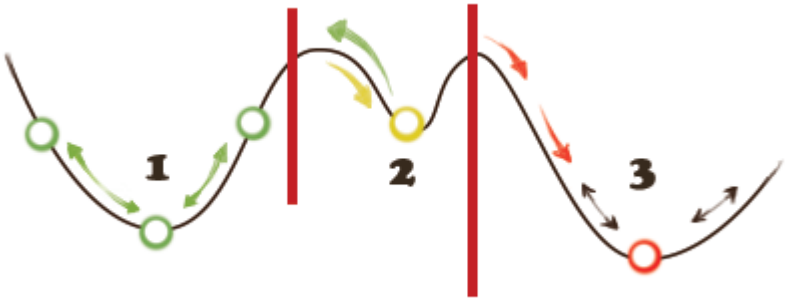

ASCH

VF

KEN



# CWD volumes

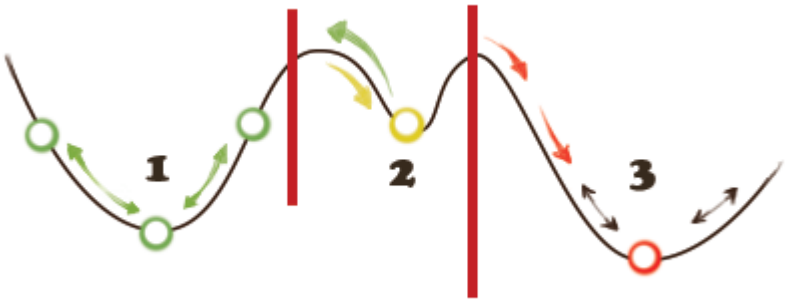



1. > 40 $m^3$ $ha^{-1}$ – min. in reference forests: threshold?

2. < 10 $m^3$ $ha^{-1}$

Restoration measures: dead wood creation.

# CWD quality




1. 1. All decay classes, position types and size groups in reference forests
2. Mainly less decayed stumps

Restoration measures: dead wood creation

~ 50 years to reach the resilience goal.

Multiple entries are preferable.

# Conclusions

- CWD quantity and quality depend on natural disturbance regime and forest management. Maximum CWD volumes are reached in wind-driven Norway spruce forests.
- Disturbance time, type and severity affect CWD distributions by decay classes, position types and size.
- CWD volume can be restored immediately.
- Restoration of CWD diversity and ecosystem resilience takes decades.

# Thanks for your attention!

EU, ENPI CBC,
**MULTIEFFORT**, (2012-2014)

*http://www.metla.fi/hanke/7530/index-en.html*

METLA

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