

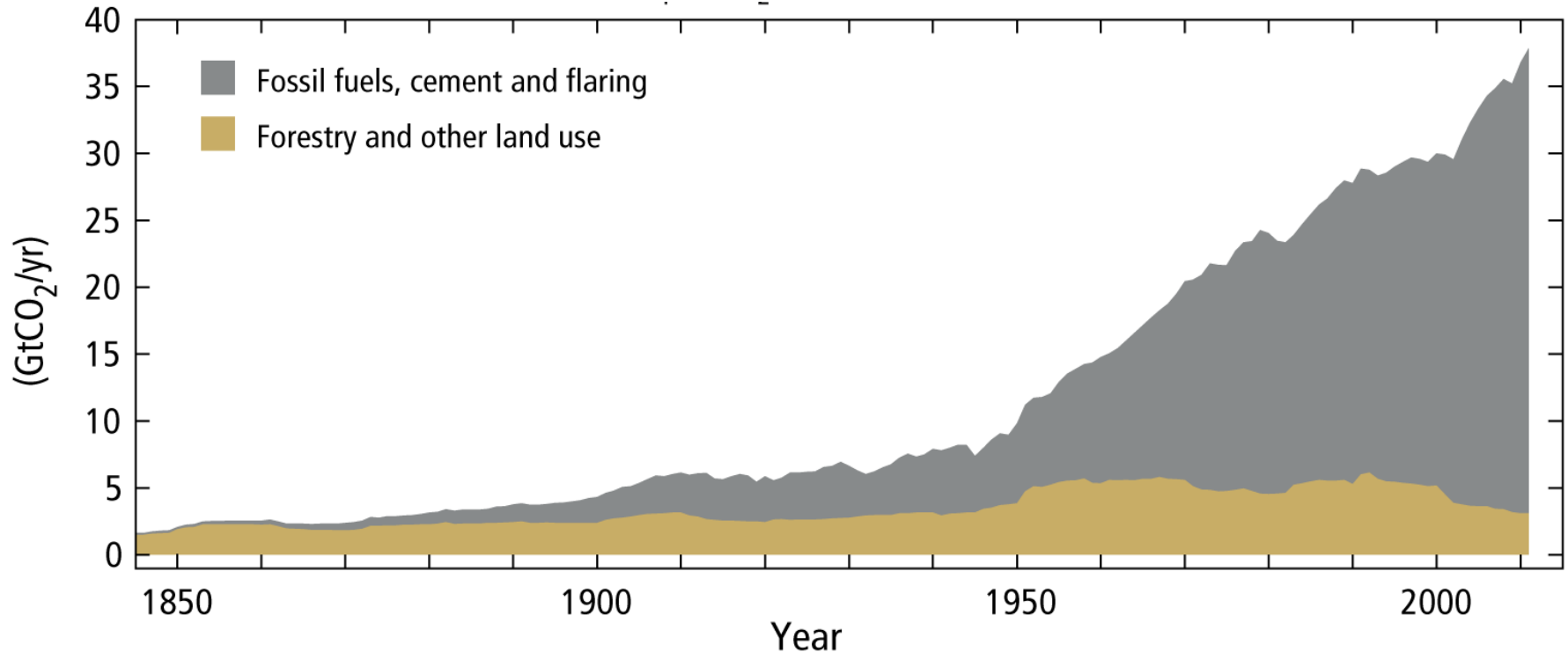
A photograph of a dense forest with tall, thin trees and a fallen log in the foreground. The text is overlaid on the image.

# Climate Change and Forest

## How can forests and wood use help meet climate goals?

J. Bo Larsen, Copenhagen University

# Global anthropogenic CO<sub>2</sub> emissions

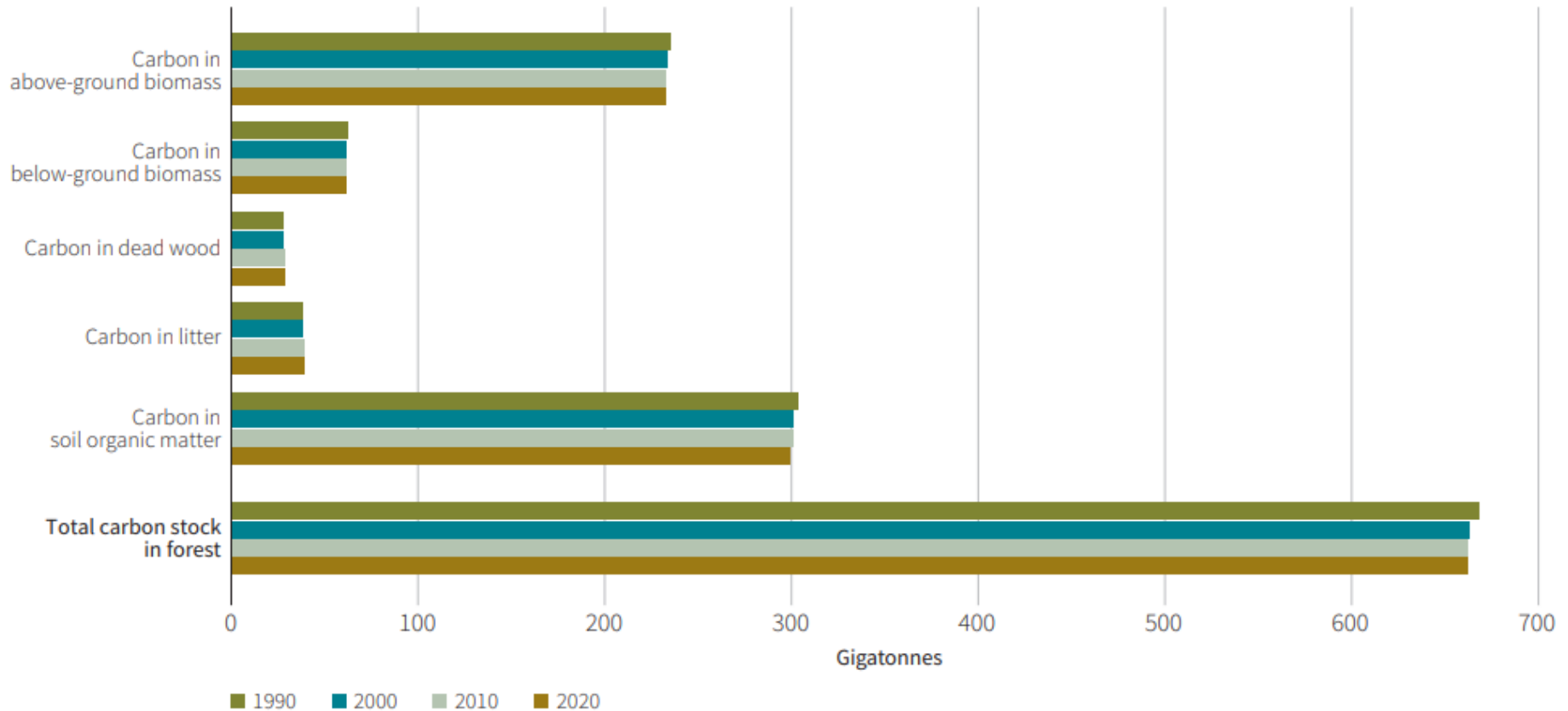


**Figure 1.5** | Annual global anthropogenic carbon dioxide (CO<sub>2</sub>) emissions (gigatonne of CO<sub>2</sub>-equivalent per year, GtCO<sub>2</sub>/yr) from fossil fuel combustion, cement production and flaring, and forestry and other land use (FOLU), 1750–2011. IPCC, 2014

# World forest carbon pool

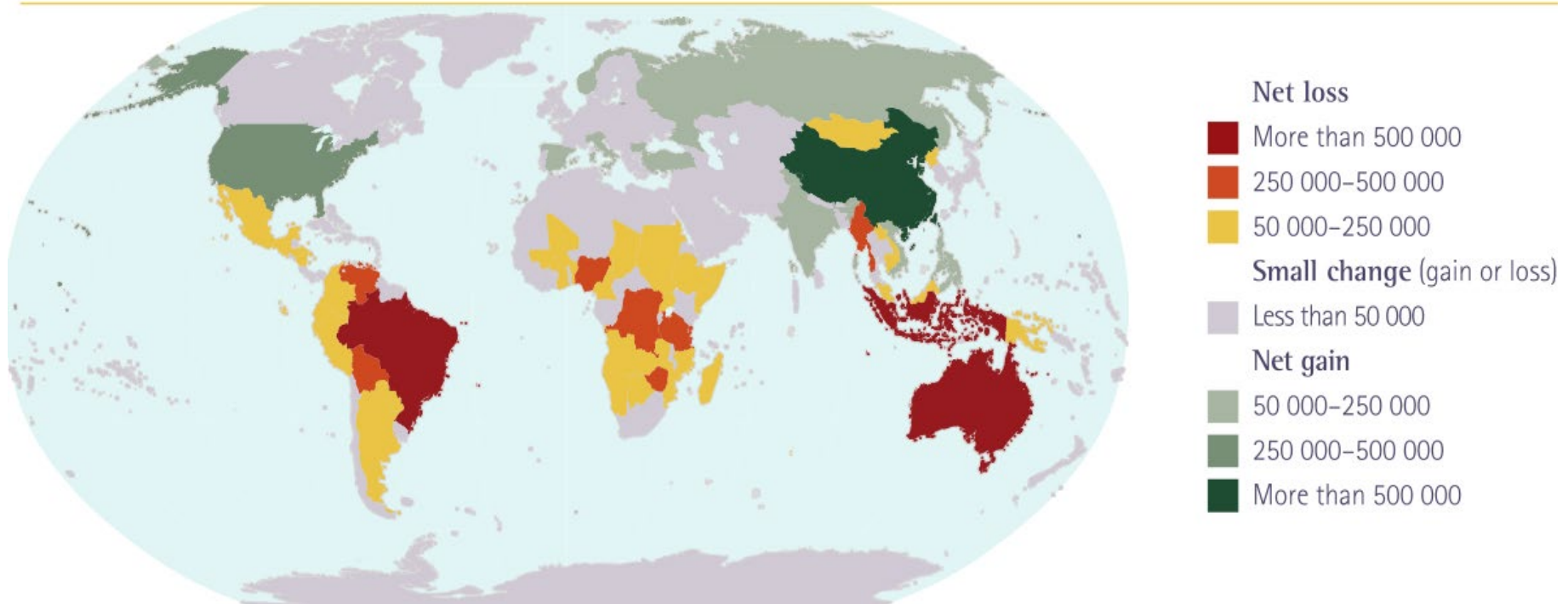
(Global Forest Resource Assessment 2020)

FIGURE 23. Trends in total forest carbon stock, by carbon pool, 1990–2020



# Net change in forest area by country

Net change in forest area by country, 2005–2010 (ha/year)



# Climate change and forests

Forests are equally players and targets in the “green-house drama”:

- Climate change mitigation
- Climate change adaptation

# Adaptation is essential for mitigation!



## Droughts and fires

- More extreme weather events induced by climate change
- Forest fires high on the agenda since disastrous fires hit Portugal in 2017
- More fire incidents also in countries north of the Mediterranean (e.g. Germany, Ireland)
- Droughts and heat waves in various European regions (e.g. Greece, Portugal)
- Droughts have an amplifying effect on fire

## Storms

- Windstorms are a major disturbance factor in European forests
- Examples like Lothar (1999) and Kyrill (2007) caused widespread damages
- Areas affected by windstorms have a much higher risk to be further damaged by insects or pests
- Windstorms can devastate confined regions (e.g. storm Gudrun in Sweden)
- Smaller events can add-up to significant amounts over multiple countries (e.g. winter 2017/18)









## Biotic threats

- Climate change has strong impact on biotic threats (e.g. bark beetle or pests)
- Several European countries are heavily affected by bark beetle (e.g. Poland, Czech Republic)
- Pests typically follow abiotic damages (drought or wind)
- New diseases are difficult to predict but can spread rapidly
- Damage caused by game is a major obstacle to natural forest regeneration in Europe

# Forests mitigating climate change by:

- Storing carbon in the forest  
(forest management, afforestation)
- Substituting fossil fuels  
(bioenergy/biofuels)
- Substituting cement and steel in human structures (buildings/architecture)
- Substituting oil in industrial production  
(bioeconomy)

# Forestry and wood use mitigation activities

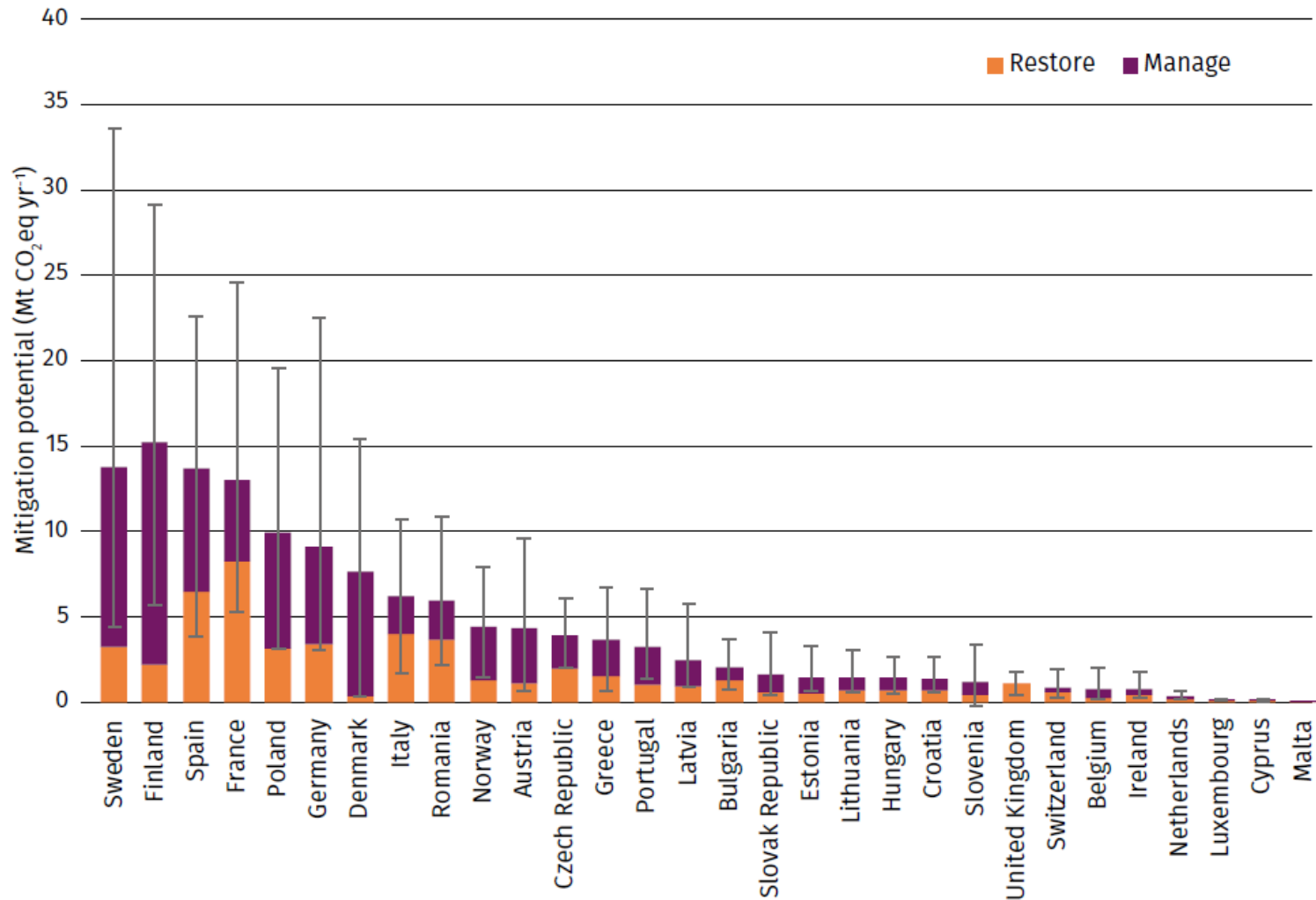
Category	Activity	Mitigation potential (MtCO <sub>2</sub> eq yr <sup>-1</sup> )*	Interaction with adaptation
Protect	Avoiding deforestation	EU 27 + 3  11 (11 - 11) EU 27  10 (10 - 10)	Supports adaptation of surrounding forests
	Forest conservation	EU 27 + 3  58 (46 - 69) EU 27  53 (41 - 63)	Supports natural adaptation but decreases options for active adaptation
Manage	Forest harvesting (decreased)	EU 27 + 3  78 (1 - 286) EU 27  70 (1 - 259)	Can foster drought tolerance but decrease stand stability
	Active management (other than harvesting)	EU 27 + 3  72 (11 - 186) EU 27  65 (10 - 169)	Possible trade-off between carbon storage and fitness



# Forestry and wood use mitigation activities

Category	Activity	Mitigation potential (MtCO <sub>2</sub> eq yr <sup>-1</sup> )*	Interaction with adaptation
Restore	Forest restoration	EU 27 + 3  115 (14 - 245) EU 27  105 (13 - 222)	Careful selection of species and forest types for restoration improves resilience
	Afforestation/ Reforestation	EU 27 + 3  54 (19 - 83) EU 27  49 (17 - 75)	Possible trade-off between establishing resilient forests or maximising sequestration
Wood use	Shifts in wood uses (including by-products)	EU 27 + 3  15 (-70 - 391) EU 27  14 (-63 - 354)	Balance between generating revenues to support adaptation actions and increasing harvest pressure which may hamper adaptation
	Cascading (end-of-life)	EU 27 + 3  -1.5 (-26 - 9) EU 27  -1.4 (-24 - 8)	Can reduce harvest pressure on forests to enable focus on adaptation and natural processes
	Increased efficiency	EU 27 + 3  -0.6 (-6 - 8) EU 27  -0.5 (-5.5 - 7.5)	Can reduce harvest pressure on forests to enable focus on adaptation and natural processes

# Forest-based mitigation potential



**Figure 2.** Forest-based mitigation potential by 2050 at the country level.

# Forest management options

## Natural forest



## Far from natural forest



## Closer-to-nature forest

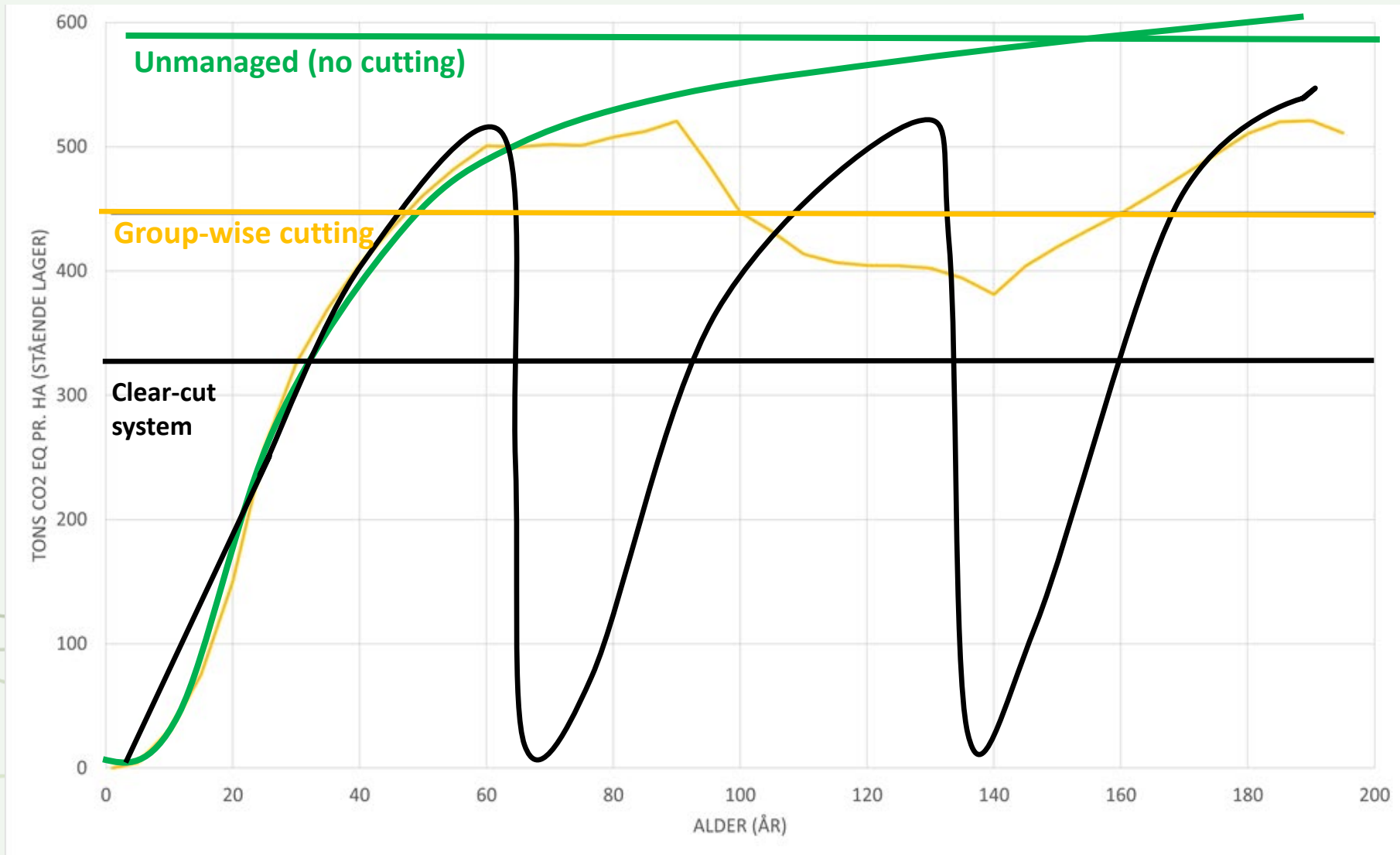


Silver fir and beech

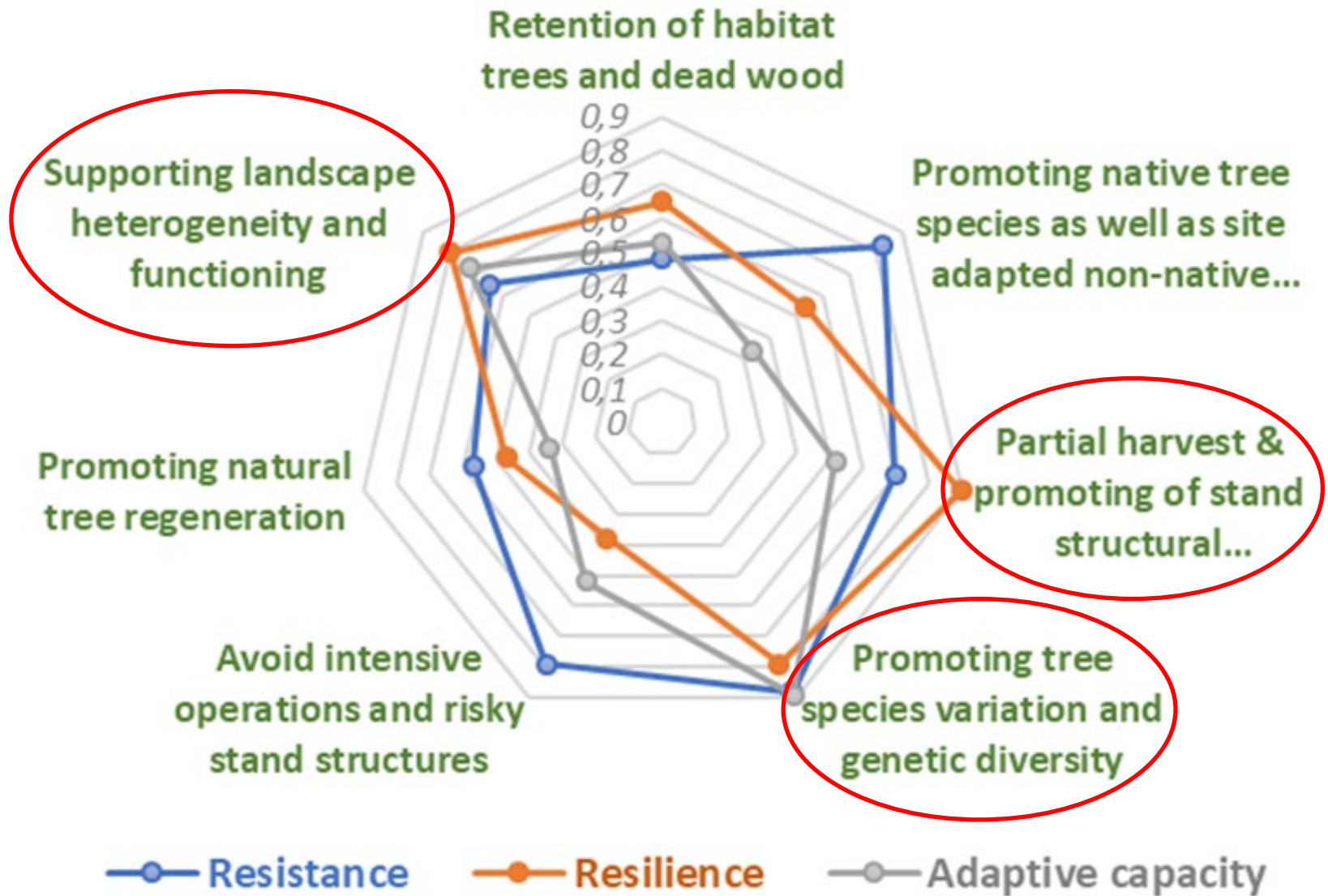
Douglas fir, Norway spruce and Beech

Beech, sycamore maple and ash

# Management and long-term storage



# Management, biodiversity and stability/adaptation



# Conclusions

## **Forests and forestry are key players in CC mitigation**

- Deforestation accelerate climate change (stock goes down)
- Afforestation mitigate climate change (stock increases)
- Forest management can to a certain degree increase carbon stock and its permanence
- Proper use of harvested wood can extend storage time (in buildings) and substitute CO<sub>2</sub> emitting materials (cement, steel) as well as fossil fuels
- Set-aside forest increases carbon stock but reduce long term mitigation due to loss of the substitution effect