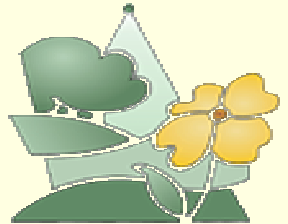


# Millennium Ecosystem Assessment

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DIVISION  
FOREST, NATURE  
AND LANDSCAPE  
RESEARCH

## *Forest ecosystems in Flanders A Selective Review*

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# MEA - Forests

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  - ◆ *Health & vitality*
  - ◆ *Changes in forest soils*
  - ◆ *Changes in biodiversity*
  - ◆ *Forest recreation*
- ◆ Conclusions

# Introduction

- ◆ Human well-being and progress partly depends on the management of forest ecosystems
- ◆ Progress towards a (more) sustainable development are essential for the current and future generations
- ◆ Forests form the dynamic end stages of (natural) succession for > 90% of the area of Flanders both under the current & future climate
  - ◆ Relaxation of other land use will initiate a succession towards forests, so deforestation is theoretically reversible
  - ◆ Yet succession & establishment of species is slow (decades, centuries); forest species, in evolutionary terms, are adapted to a predictable & stable environment



# Introduction: drivers of change

- ◆ Overall **population density** (1999) = 439 people/km<sup>2</sup> (ranging from 325 (Limburg) to 572 (Antwerp)) → extremely densely populated
- ◆ Urbanisation (incl. industrialisation) increases fastly (as shown in **built up areas**) !!!

Region	% 2003	# km <sup>2</sup> /year 2003-1980	1980 (km <sup>2</sup> )	1990 (km <sup>2</sup> )	2000 (km <sup>2</sup> )	2003 (km <sup>2</sup> )
Flanders	14.9	33.9	1237.2	1557.7	1943.0	2016.3
Wallonia	8.2	16.5	726.2	870.6	1057.0	1106.7
Brussels	44.0	0.5	59.8	66.5	70.3	71.0

- ◆ Economic changes : **globalisation**  
→ Major drivers of change

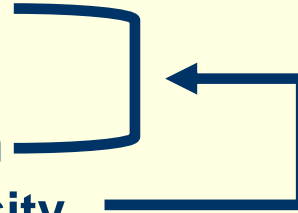
# Forest Ecosystem services (FES)

## ◆ Benefits people obtain from ecosystems

### ● Supporting services

- ✦ Soil formation
- ✦ Nutrient cycling
- ✦ Primary production

➔ Area & Biodiversity



### ● Provisioning services

- ✦ Wood, water, food, genetic resources...

### ● Regulating services

- ✦ Climate, Air quality, water purification, Flood & drought control, ...

### ● Cultural services

- ✦ Recreation, educational, aesthetic, cultural heritage & other nonmaterial benefits

### Provisioning Services

*Products obtained from ecosystems*

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

### SUPPORTING SERVICES

*Services necessary for the production of all other ecosystem services*

- Soil formation
- Nutrient cycling
- Primary production

### Regulating Services

*Benefits obtained from regulation of ecosystem processes*

- Climate regulation
- Disease regulation
- Water regulation
- Water purification

### Cultural Services

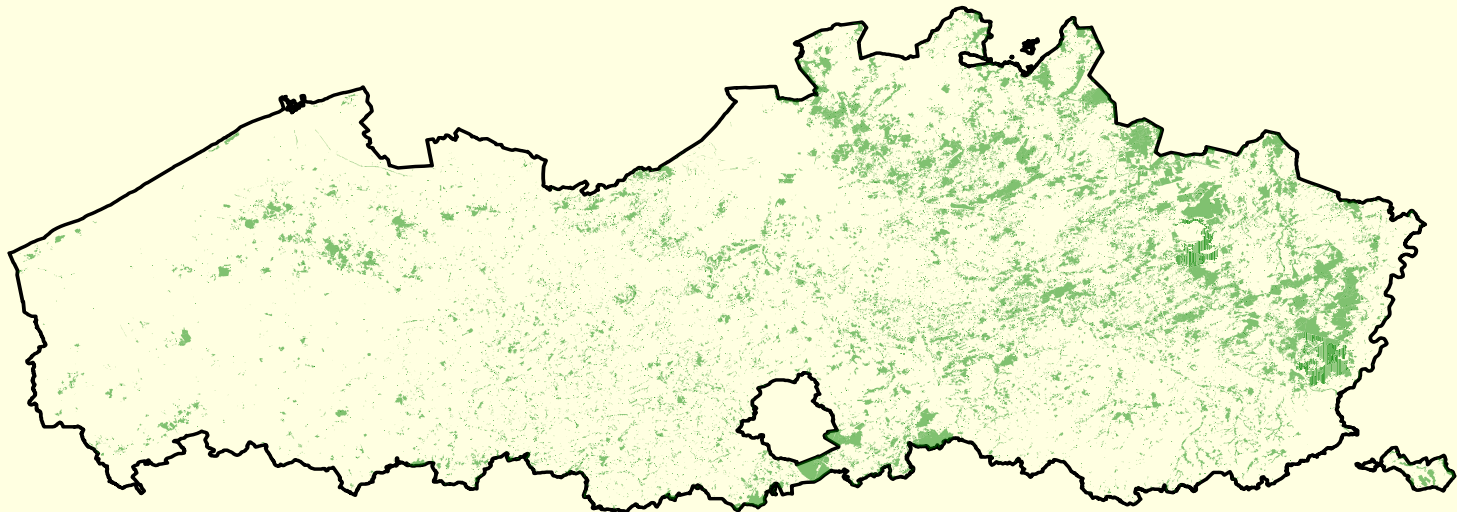
*Nonmaterial benefits obtained from ecosystems*

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage



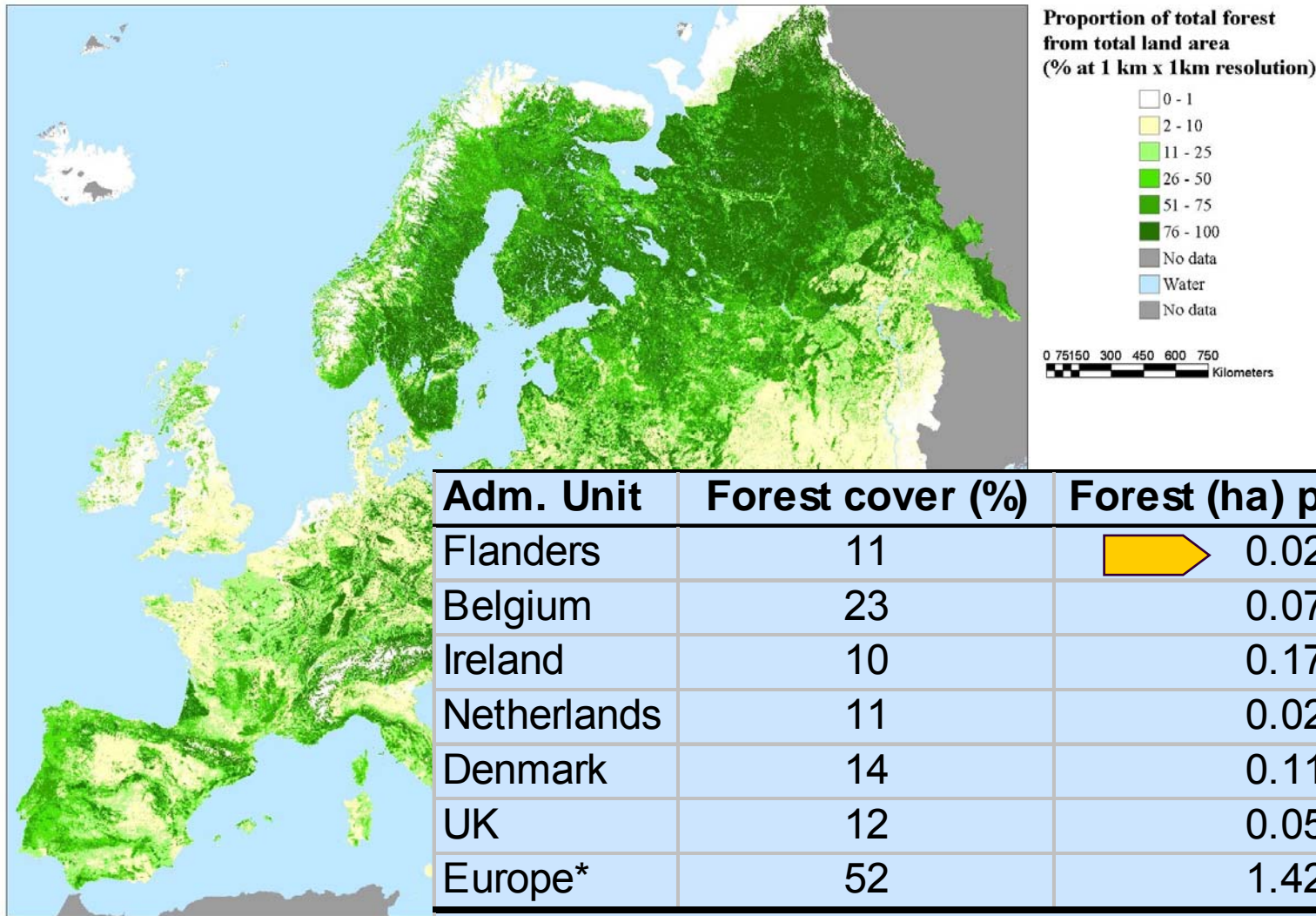
# Forest area in Flanders

- ◆ The first and most important indicator of a forest ecosystem millenium assesment (supporting service). Without forest area not a single ecological service of the forest can be rendered.
- ◆ Therefore, monitoring forest area trends is crucial. It is also a key indicator in most international standards of C&I



- ◆ Extent in 2006:  $\pm 146.000$  ha ( $\pm 11\%$  of total area)

# Forest area: Flanders vs. other



Source: MCPFE 2003

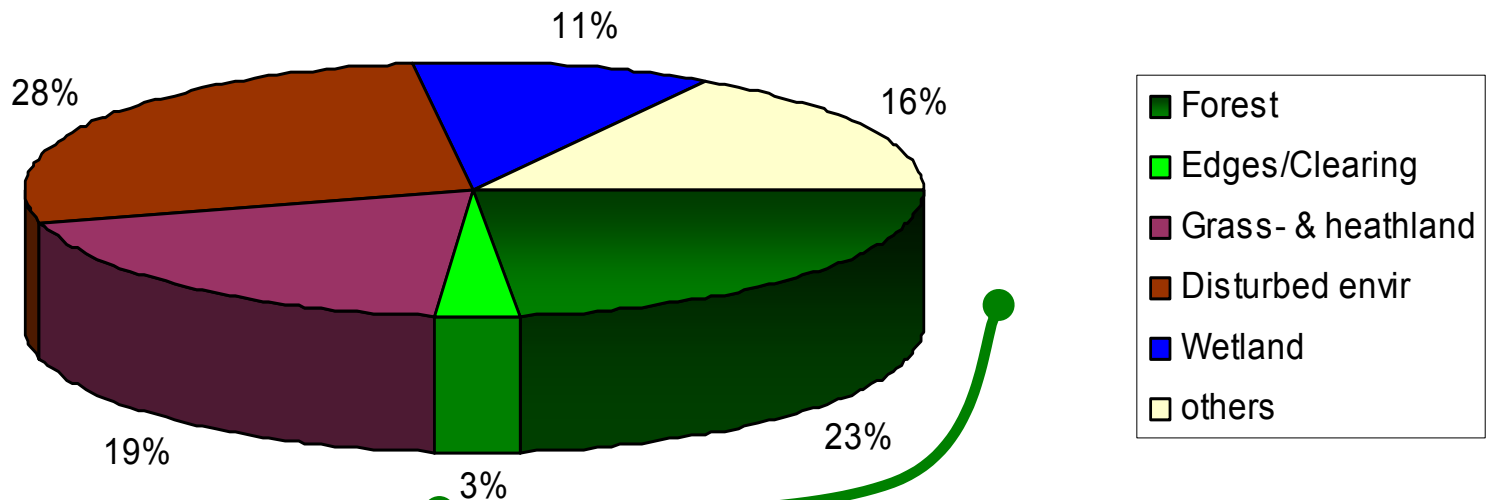
\* MCPFE countries (MCPFE 2003)

# Biodiversity: plant species

- ◆ ± 60 % of wild flora of Flanders occurs in our forests
- ◆ Forests support not only forest (plant) species, but also non-forest (plant) species

## → Forest: umbrella for biodiversity

- ◆ 21 forests with a total size of 4060 ha = total plant species number : 751



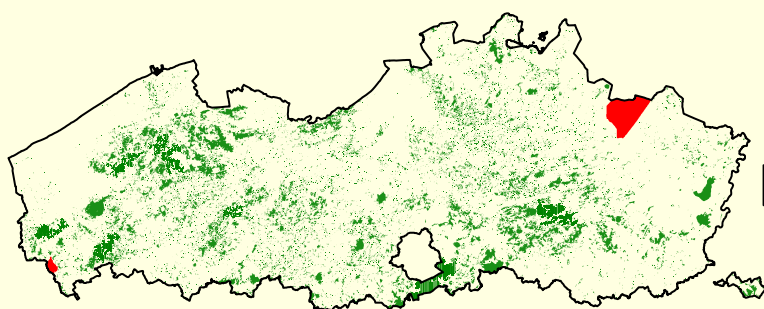
- ◆ ± 26 % forest plant species vs. 74 % non-forest plant species

(Source: Hermy et al. unpubl.)

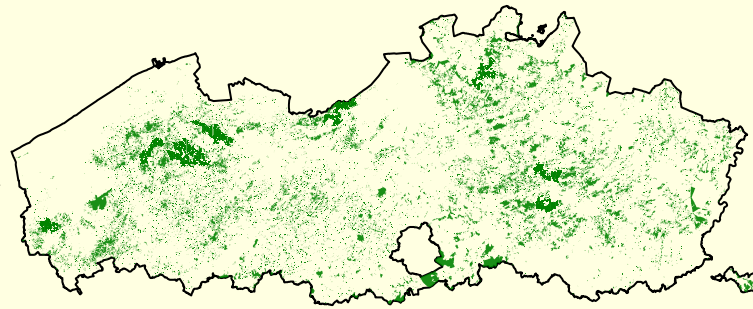


# Forest ecosystem change

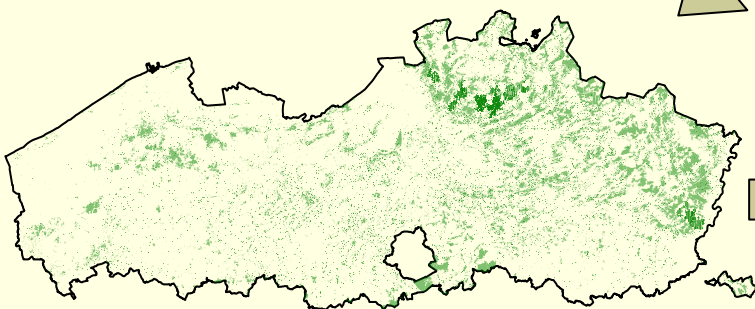
## ◆ Forest area between 18th & 21th Century



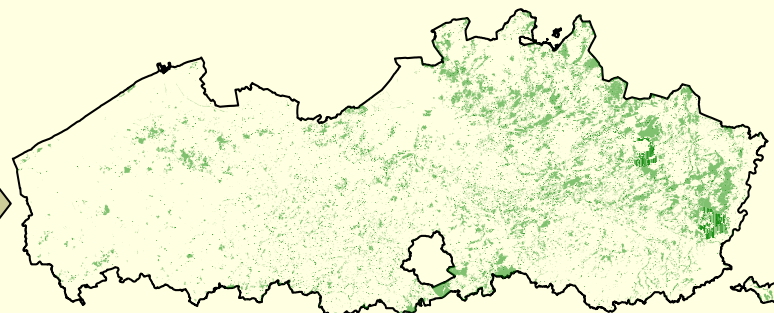
1770-1775: ± 147,000 ha



1850-1852: ± 131,000 ha



1910-1930: ± 166,000 ha



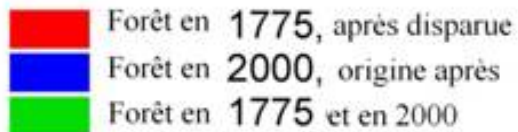
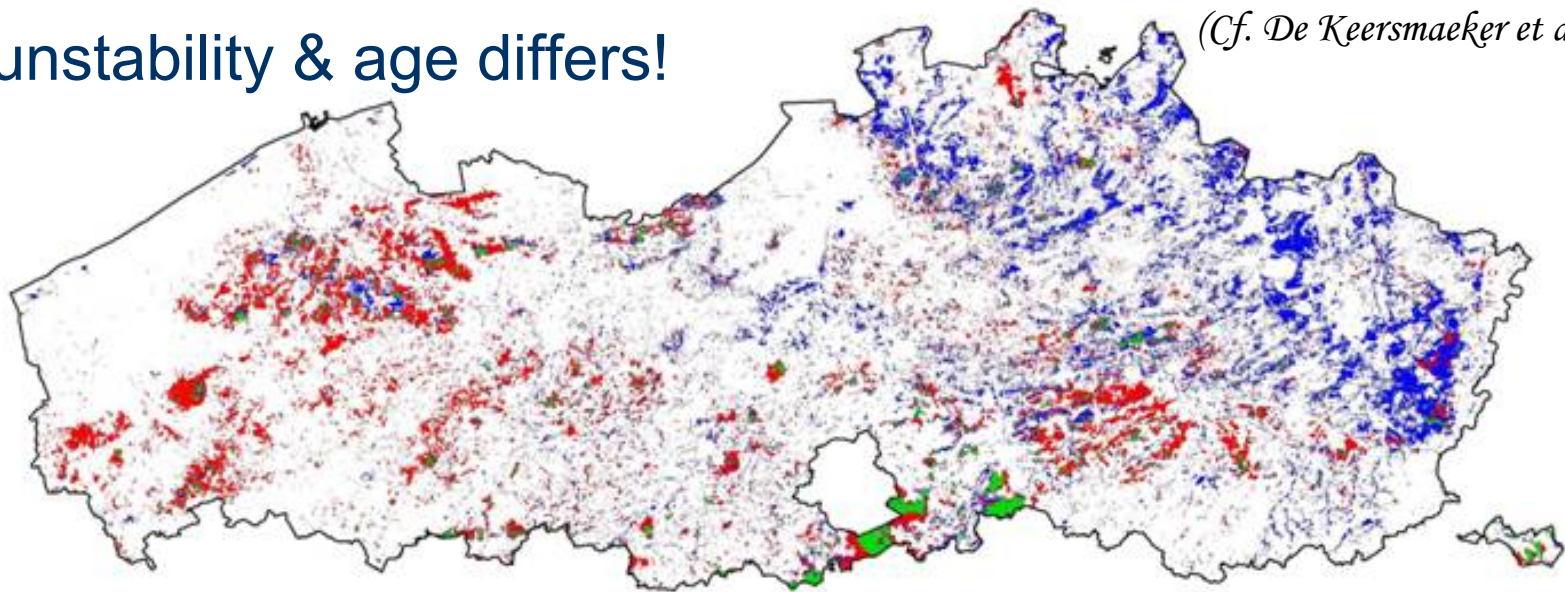
2000: ± 150,000 ha

Source: De Keersmaecker et al. 2001 – Report INBO

# Forest land use

unstability & age differs!

(Cf. De Keersmaecker et al. 2001)



1775

Forest today (**blue + green**)

- ◆ Ancient forest (AF) (**green**): forested on all maps since 1770 → AF: ± 23.000 ha or 1.7% of Flanders or ± 15.7 % of Flander's forests → **AF : reference (target)**

# Forest ecosystem change: area

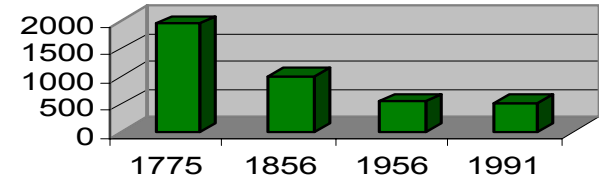
◆ So, fragmentation ↑

- ◆ forest size ↓
- ◆ n° of fragments ↑
- ◆ edge length ↑

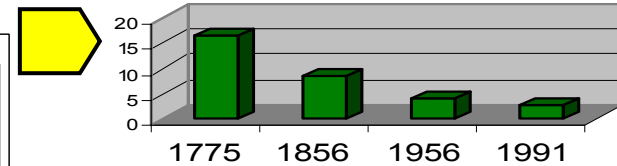
Flanders

80km<sup>2</sup> E of Leuven

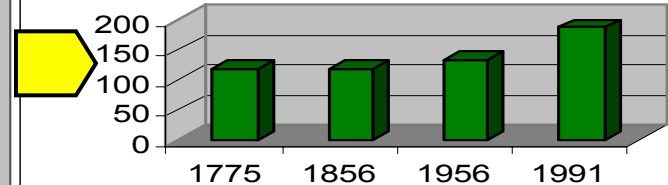
**Total forest area (ha)**



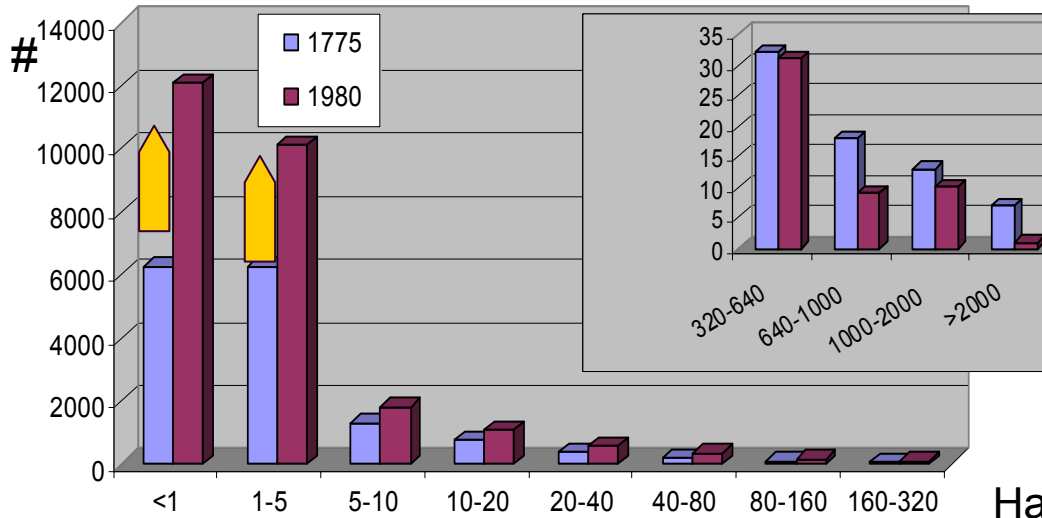
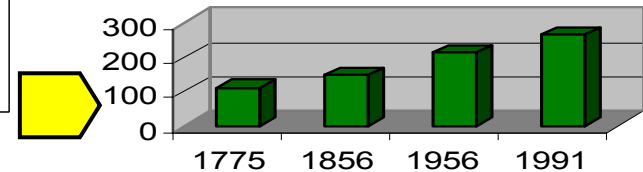
**Average size (ha)**



**Number of fragments**



**Edge length (m/ha)**



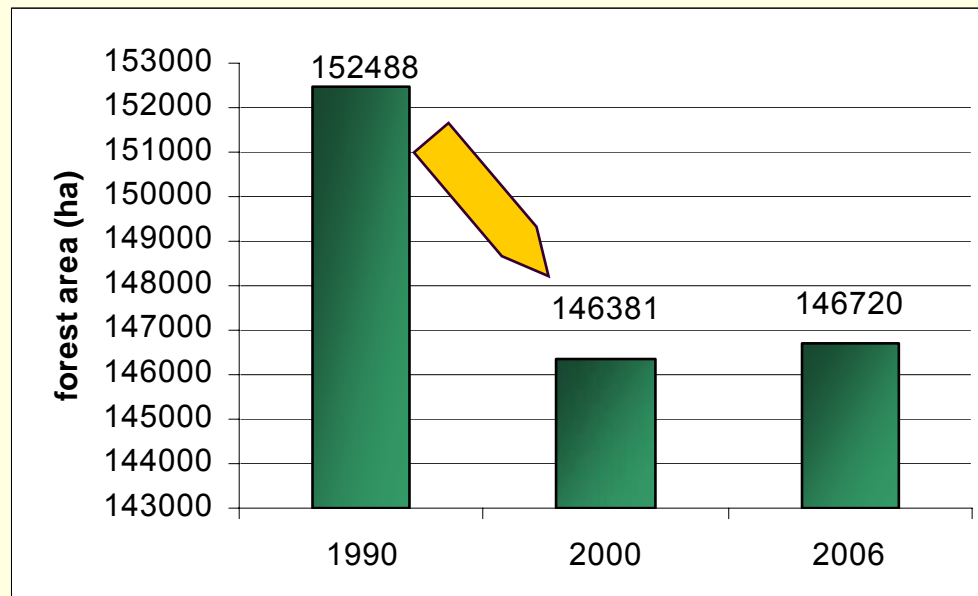
(Source: Hermy & Vandekerckhove 2004)

(Source: Jacquemyn et al. 2001 – J. Biogeogr.)

# Forest ecosystem changes

## ◆ Recent forest area changes

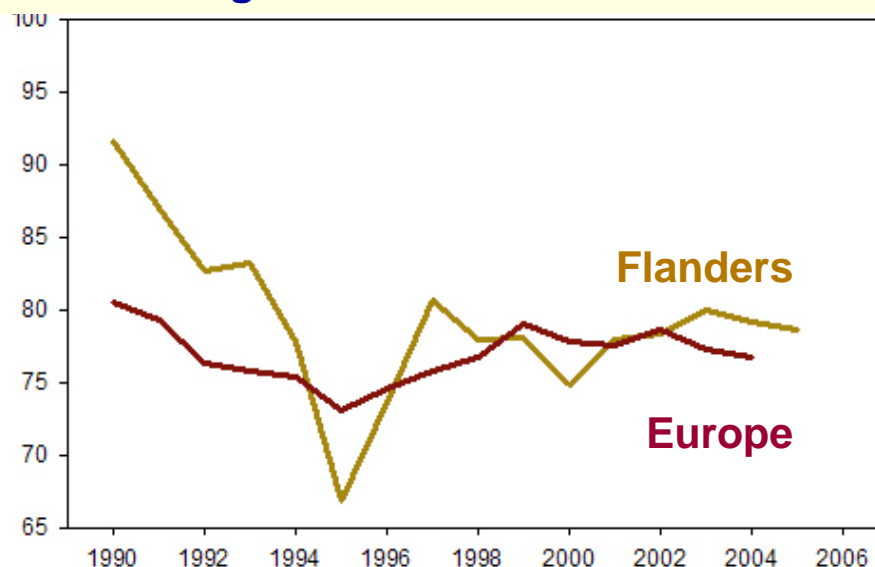
- ◆ Between 1990 and 2000, 6000 ha was lost (deforestation of 6108 ha = -4%)
- ◆ In 2000 the Flemish government added a moratorium on deforestation in the forest law. Deforestation can only be permitted in certain planning areas and must be compensated with new forest or with money in an afforestation fund. The result is that between 2000 and 2006 the forest area increased with 339 ha.



# Forest health & vitality

- ◆ Another essential condition for the forest to provide ecological services. Without sufficient forest vitality ecological services of the forest can only be poorly rendered.
- ◆ Also here, monitoring forest vitality trends is crucial. It is also a key indicator in most international standards of C&I

## % non-damaged trees between 1990-2005



Source: Sioen & Roskams 2005 & Natuurindicatoren, 2006  
[www.natuurindicatoren.be](http://www.natuurindicatoren.be)

- **Stable (20% damaged), but in general: situation remains critical/alarming**
- both 'good' and 'bad' news: oak vitality is stabilizing, popular damage increases

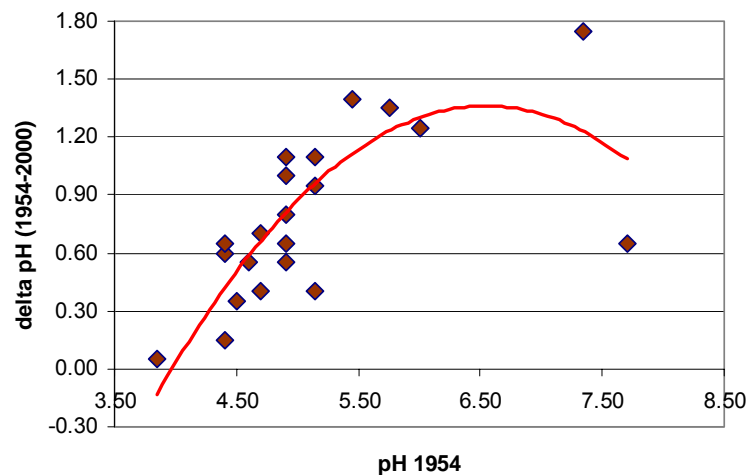
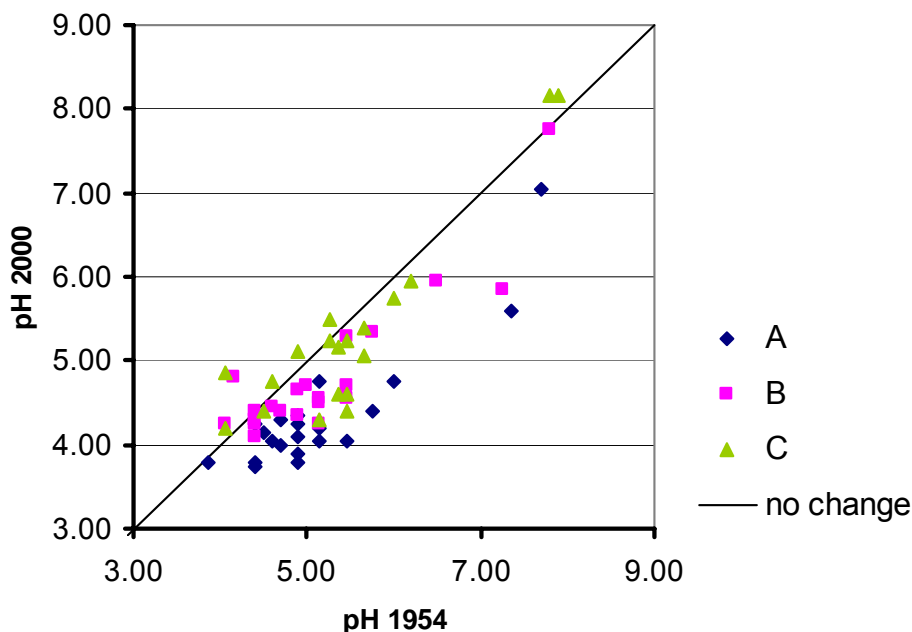
# Changes in forest soils

## ◆ Acidification in forests:

- ◆ Changes in soil pH (ex. Meerdaal forest): 1954 → 2000
- ◆ Mean pH of the topsoil solution in 2000 is estimated to be 0.55  $\text{pH}_{\text{H}_2\text{O}}$  units lower than in 1954, with the largest changes in intermediate pH range.

→ **A major driver: Atmospheric deposition of nitrogen (& sulfate)**

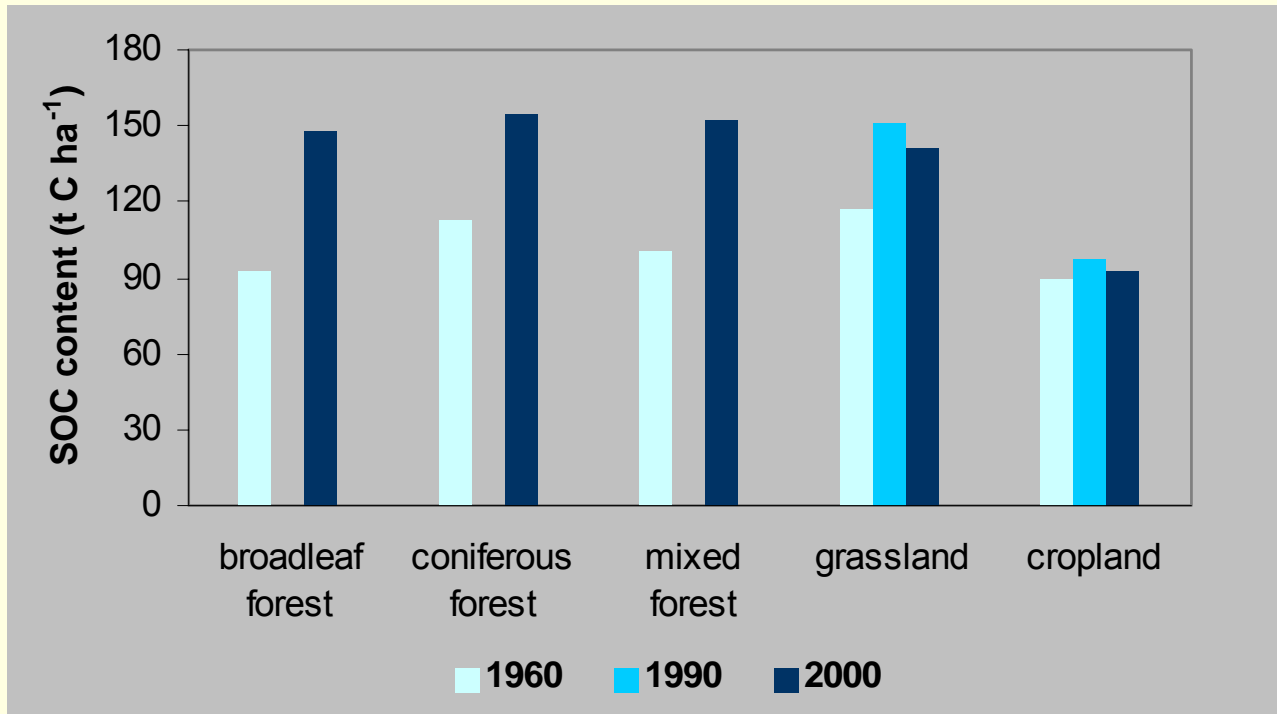
- ◆ But often interfering with other changes (E.g. light levels (shading ↑), soil humidity ↓))



(Source: Bauwens et al, unpubl.)

# Soil Organic Content

*SOC content (t C ha<sup>-1</sup>) in 1960, 1990 and 2000*



*SOC per land use type (0-100 cm)*

(Source: Lettens, S., J. et al. 2005\_ Global Change Biology 11: 2128-2140)

# Changes in biodiversity: plant spp.

## ◆ At least locally:

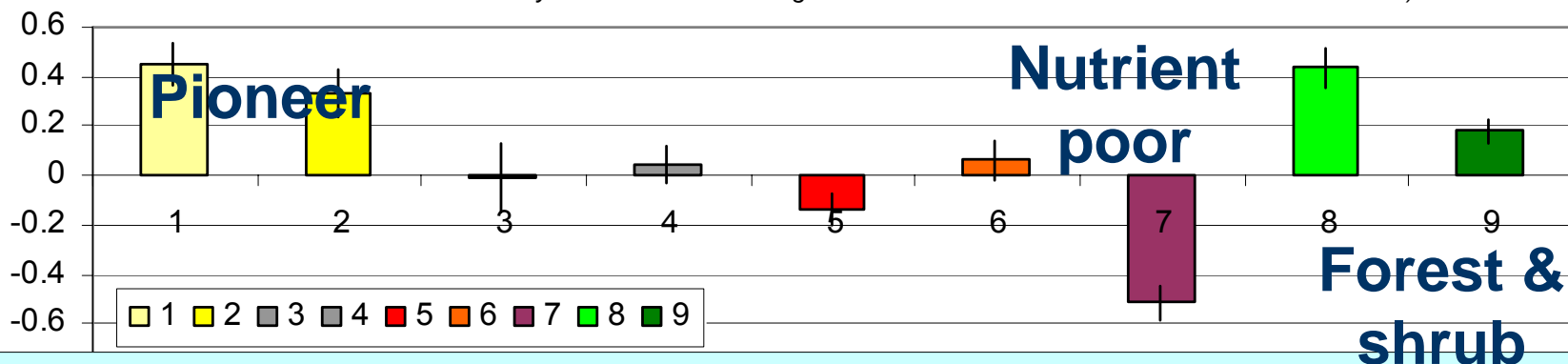
- ◆ Increase in species from (weakly) acid soils (*Oxalis acetosella*, *Dryopteris spp.*, *Pteridium aquilinum*, ...) &
- ◆ Decrease in more neutrophilous species such as *Primula elatior*, *Potentilla sterilis*, *Scrophularia nodosa*, *Valeriana repens*, *Stachys sylvatica*, *Anemone nemorosa*, *Polygonatum multiflorum*, ... (Lameire et al. 2000, Bauwens et al., unpubl.)

## ◆ Overall changes?

- ◆ Positive, but species from nutrient poor acid soils decrease (disturbance?)!

mean trend index between 1940-1971 to 1972-2004

Source: calculated from Van Landuyt et al. 2006 – following method of Telfer et al. 2002 – Biol.Cons. 107: 99-109)

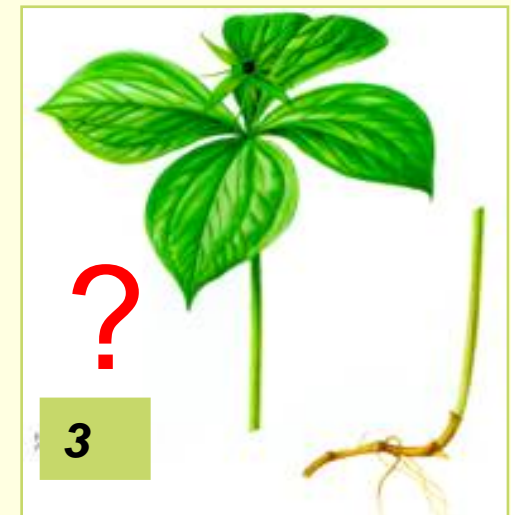


1: pioneers antropogenic places; 2: pioneers natural places; 3: salt marshes & dunes; 4: plants from waterbodies & their edges; 5: fertilized grasslands; 6: dry graslands, walls; 7: nutrient poor habitats (heathlands, bogs); 8: plants forest edges & shrub; 9: forest plants



# Extinction debt in (ancient) forests?

- ◆ Following (recent) habitat changes (fragmentation & in environmental conditions) – **critical “loads” are constantly exceeded** - individual habitat patches may lose species over time as they pay off their **“extinction debt.”**
- ◆ Particularly species with relatively low rates of population extinction and colonization (“slow” species) will maintain extinction debts for particularly prolonged periods



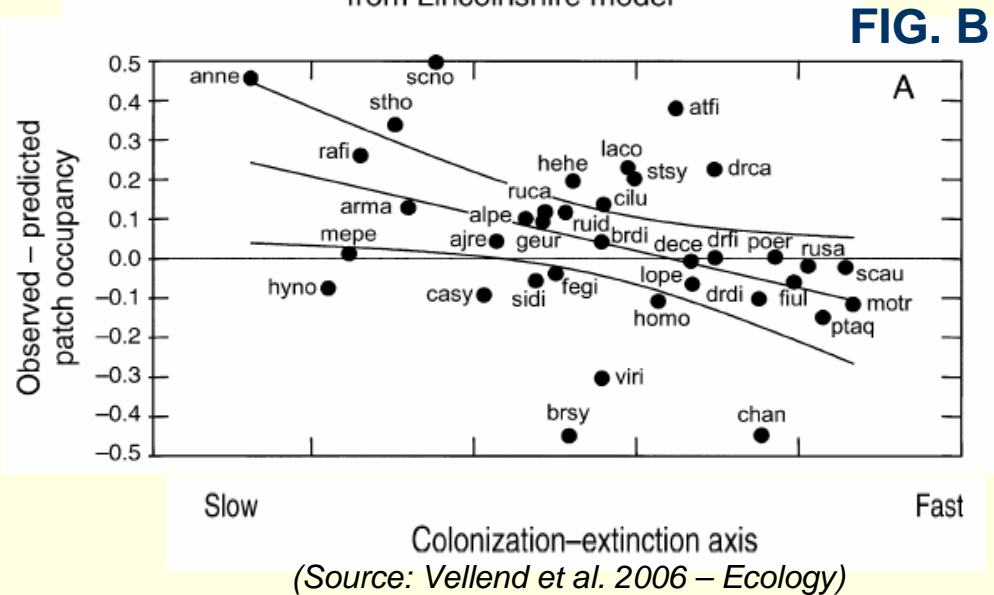
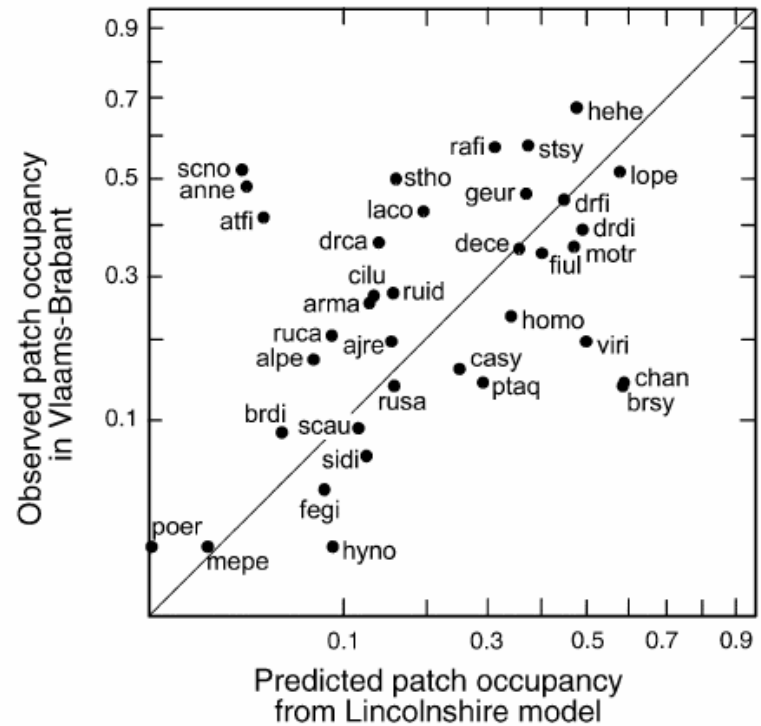


# Extinction debt !

Logistic regression models predicting the presence–absence of 36 plant species were first parameterized using data from Lincolnshire

Consistent with extinction debt theory, for relatively slow species (but not fast species) these models systematically underpredicted levels of patch occupancy in Vlaams-Brabant

*Thus, more than a century after forest fragmentation reached its current level an extinction debt persists for species with low rates of population turnover*



# Changes in biodiversity: birds

## ◆ Forest breeding bird species:

- ◆ Positive development
  - + A generally more extensive forest management (as direct financial gains from forests decrease) with longer rotation cycles
  - + Increased recreation may locally yield a decrease !

	n° of species						
% change	R: Red list species; B: bird directive spp						
no longer breeding							
> 50% decrease							
20 - 50% decrease							
no change		R					
20-50% increase							
> 50% increase					B	B	B

	Ficedula hypoleuca (b.vliegenv), Phylloscopus sibilatrix (fluitcr)
	Coccothraustes coccothr. (appelv), Jynx torquilla (draaih), Picus viridis (gr.sp), Columba oenas (holend), Loxia curvirostra (kruisbek)
	Strix aluco (bosuil), Parus palustris (glansk), Regulus regulus (goudh), P.cristatus (kuifm), P. ater (zw m),
	Sitta europaea (boomkl), Buteo buteo (Buizerd), Dryocopus minor (kl.b.sp), D. medius (m.b.sp), Accipiter nisus (sperw), Pernis apivorus (w espend), D. martius (zw .sp)

(Source: Natuurindicatoren, 2005. Boskwaliteit: Trends broedvogels van bossen (1990-2002). INBO [www.natuurindicatoren.be](http://www.natuurindicatoren.be))

# Forest recreation

- ◆ Recreation (& social function in general) increases
- ◆ Access to the public is stimulated through subsidies to forest owners (since 1991) & designation of play zones (tot.area 1486 ha) in 269 areas has been achieved

*(Bossenverklaring 2003)*

Distribution (%) of visits to forests & nature areas in 1996 & 2000

<b>Frequency</b>	<b>1996</b>	<b>2000</b>	<b>Diff (2000-1996)</b>
Never	21.9	17.8	-4.1
Once a year	18.9	12.8	-6.1
Several times per year	42.7	43.1	0.4
Once a month	8.3	11	2.7
Several times per month	8.2	15.3	7.1

*(Source: Adm. Planning & Statistiek 2002 – Stativaria 50: 50-60)*

# Why are forests important for you?

- ◆ None-use values
  - ◆ Legacy & existence values
- ◆ Questionnaire: interviews (Flemish pop., dec. 1998- feb.1999, n=783)

Why are forests important?		
Reasons	%	Rank order
As places for relaxation & fresh air	79.3	1
As recreation areas	60.4	2
Consciousness that it will exist for future generations	55.2	3
Consciousness that it can be visited in the future	37.5	4
Consciousness that it is there	28.6	5
As places that keeps our traditions, stories & culture	13.3	6
As places for spiritual inspiration	7.3	7
As places for wood production	6.6	8
As places for hunting	2.7	9

(Source: Moons et al. - 2000)

# Conclusions

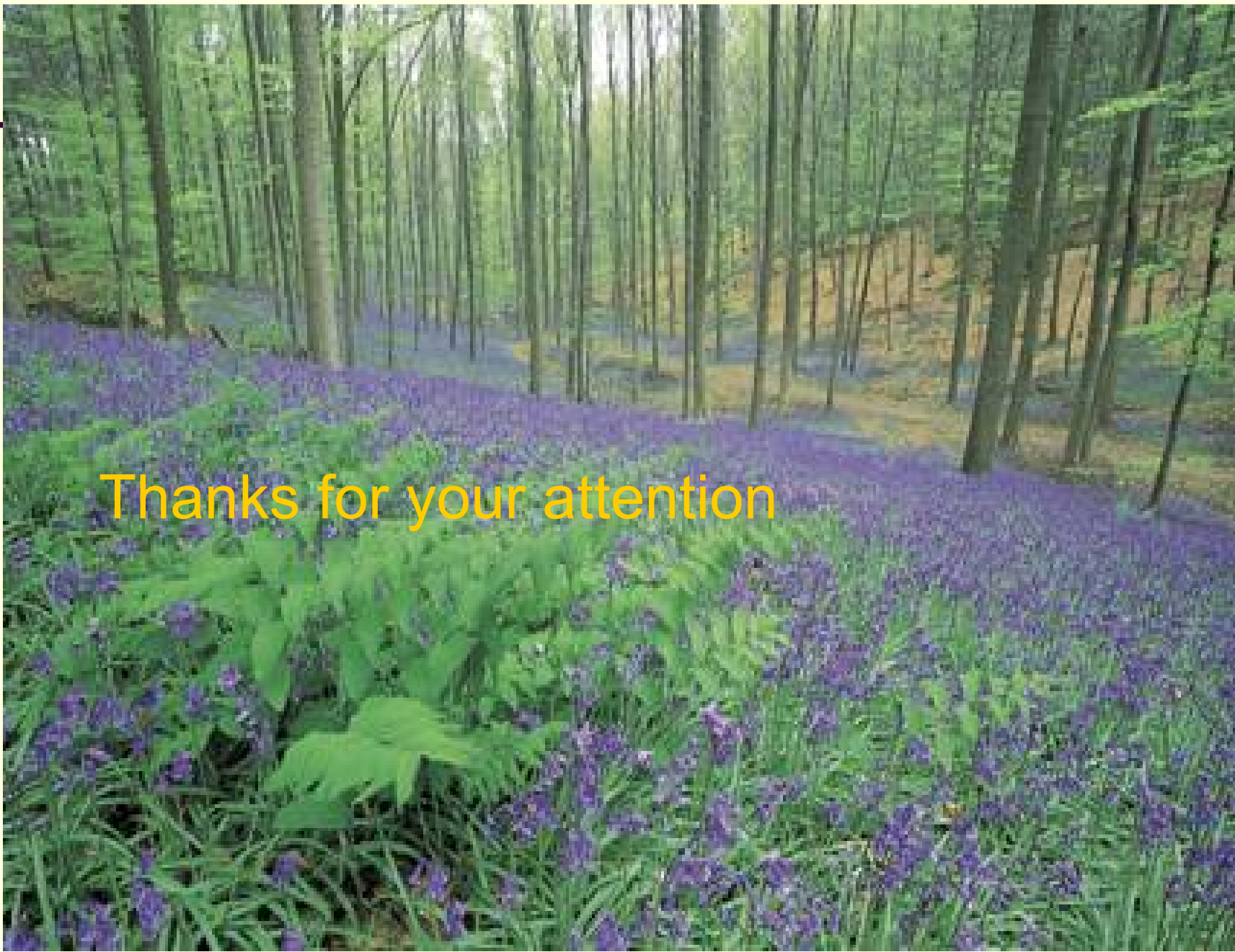
- *Forest is the potential natural ecosystem for most of Flanders & is an umbrella for biodiversity (supporting function) ~ natural credit*
- *Forests have a long tradition of use by humans (historical/cultural function)*
- *Forests offer the best control of external forces from the sun, wind, precipitation, erosion, leaching of nutrients compared to other terrestrial ecosystem (shelter function) ... a consequence of their structure*



# Conclusion

- ◆ *Regulating services : demands increase, yet capabilities threatened?*
- ◆ *Provisioning services : demands globally increase, yet stocks increase (but environmental debt ?)*
- ◆ *Cultural services: recreational demands increase, more accessible forests are available; yet global forest cover remains extremely low compared to many other European countries*





Thanks for your attention