

Recent forests in France – dynamics, diversity and interplay with climatic change

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Returning & planted forests – the forest transition



Impacts on the diversity of forests



New forests – management and climatic change

1_ Returning forests & planted forests – the forest transition



Causse Méjean / Southern France (2011)
Fields surrounded by wastelands



Cézallier (La Godivelle 2016)
Conifer afforestation

The forest transition – a recent discovery

The forest transition

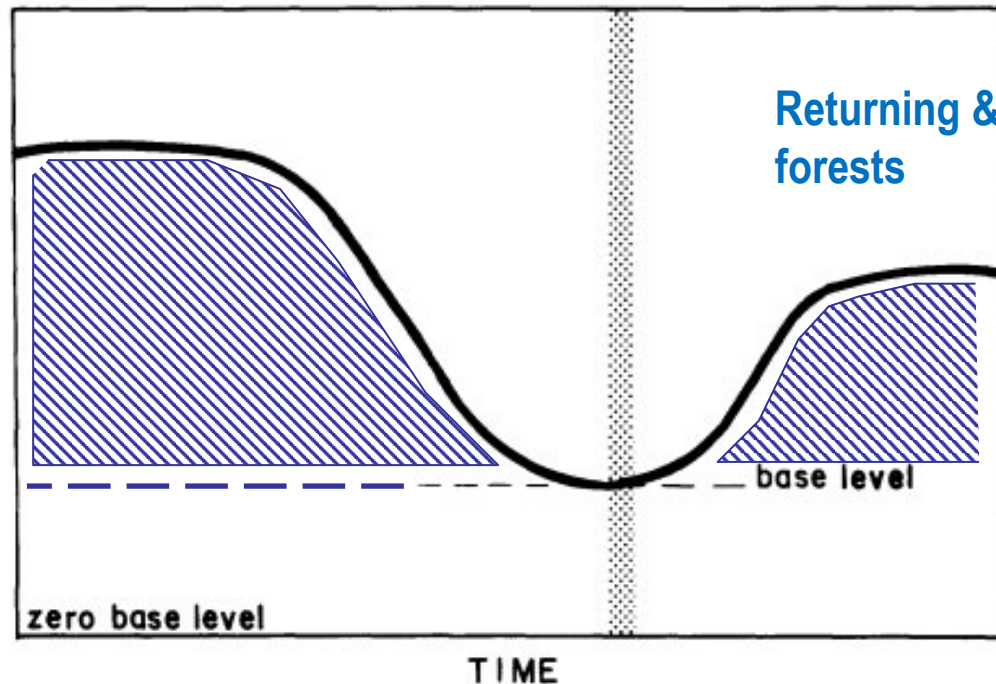
A S Mather, Department of Geography, University of Aberdeen, Elphinstone Road, Aberdeen AB9 2UF

Summary *The concept of the forest transition or forest-area transition is discussed in terms of the change from decreasing to expanding forest areas that has taken place in many developed countries. Similarities between historical deforestation in now-developed countries and current deforestation in developing countries are outlined. The question of why and how the forest transition takes place is posed, and some preliminary discussion of the variables that may influence it is presented. Prospects for a forest transition in the tropical world and the world as a whole are considered.*

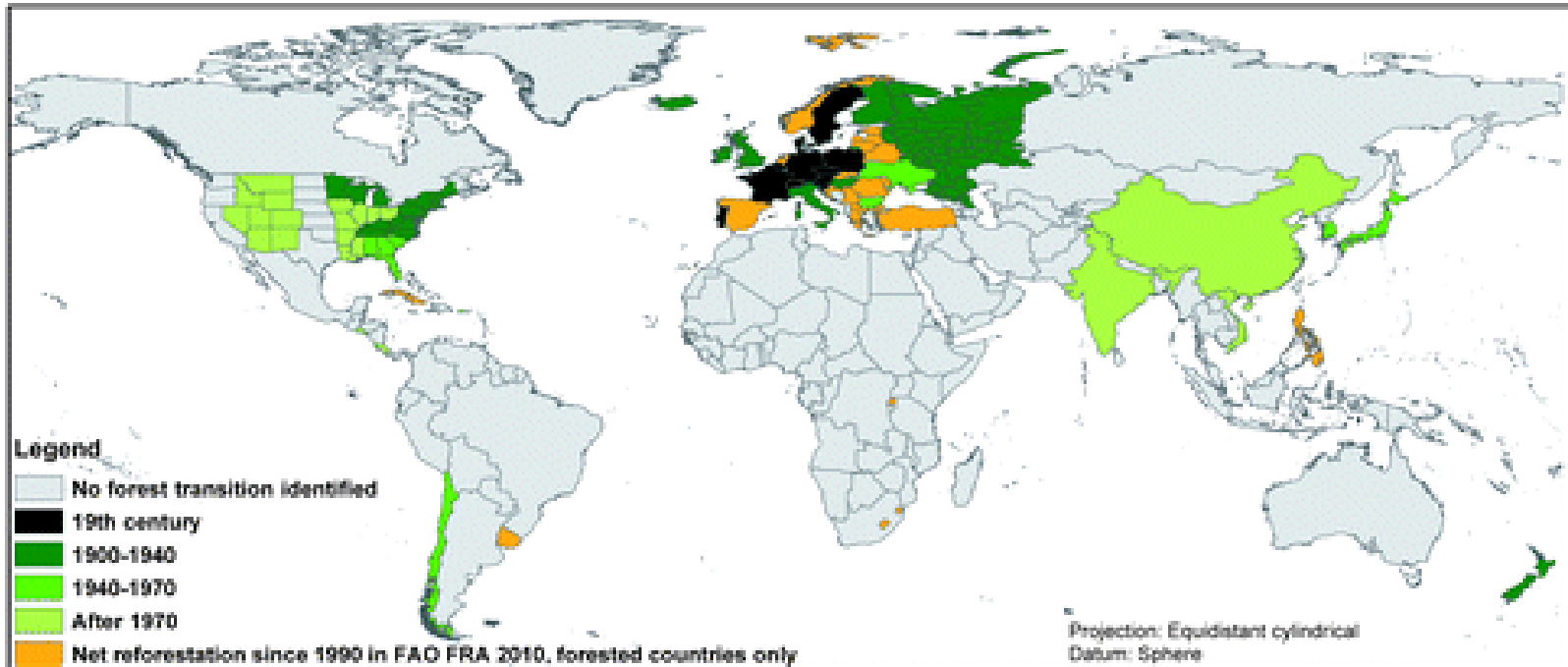
Primary, anthropized forests

RESOURCE
EXTENT

Forest minimum



An ancient process in Europe... extending worldwide



 Meyfroidt P, Lambin EF. 2011.
Annu Rev. Environ. Resour. 36:343–71

Meyfroidt & Lambin 2011


- energy/material – substitution for wood
- increased agricultural yield – substitution for space

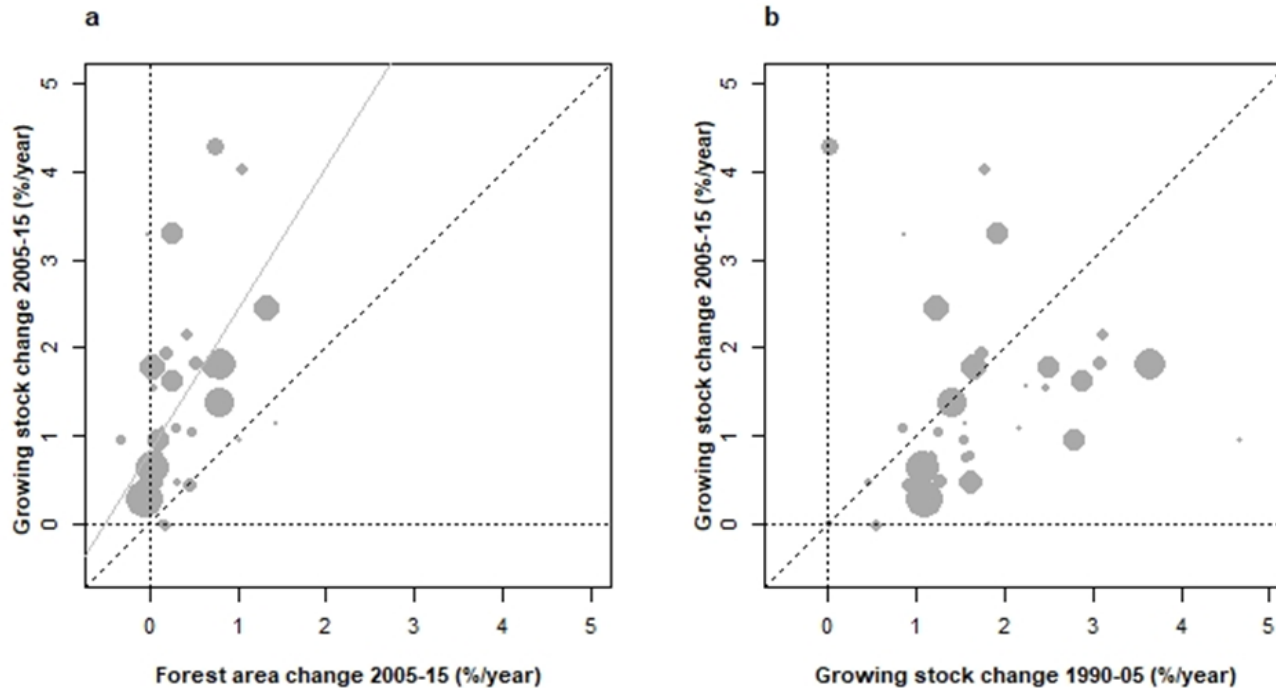
Areal changes... growing stock changes

PLOS ONE

RESEARCH ARTICLE

Inflation of wood resources in European forests: The footprints of a big-bang

Jean-Daniel Bontemps *



Bontemps 2022

Forest extension in Europe (SOEF 2015)

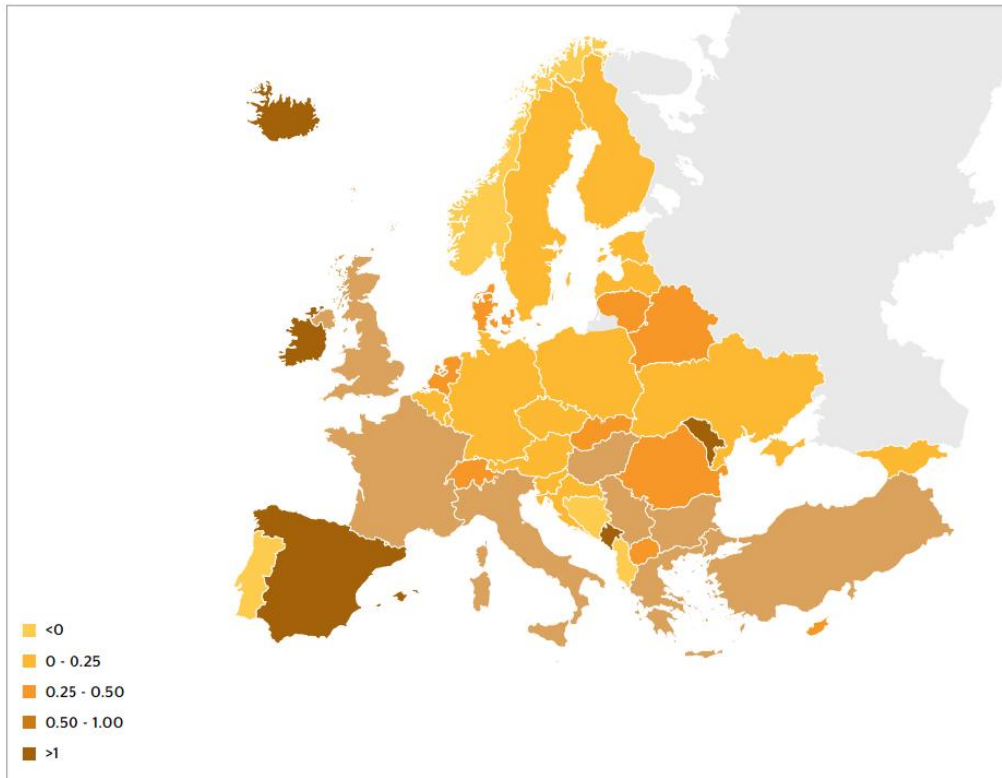


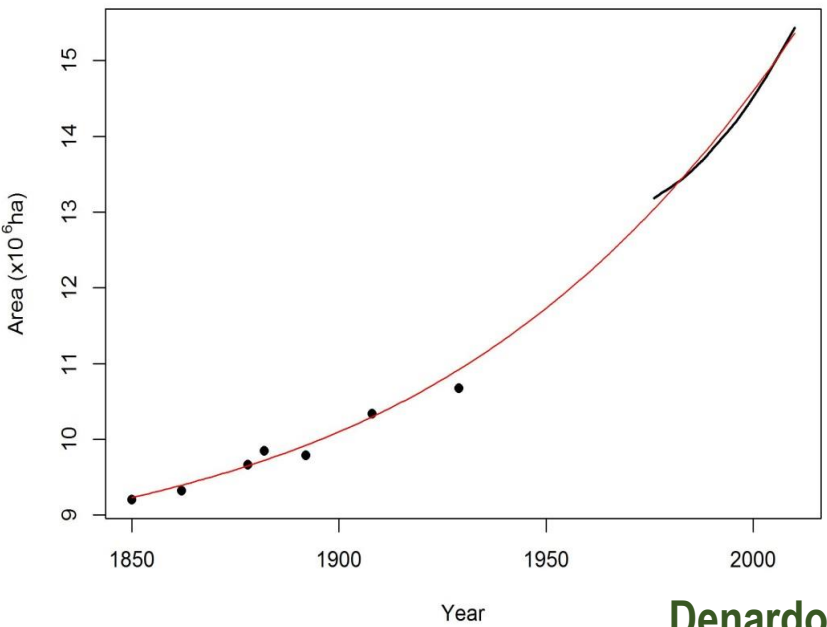
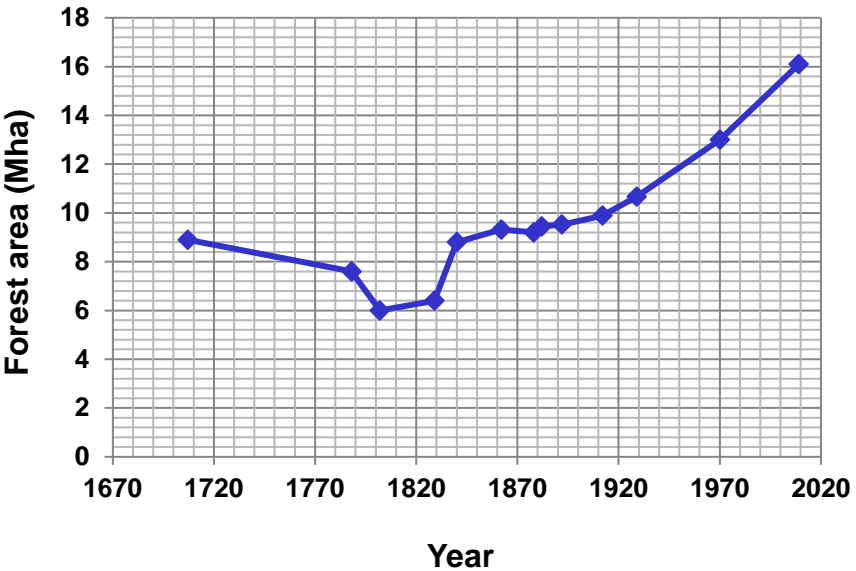
Figure 23. Annual rate of change in forest area by country 1990-2015 (percent)

| | Area 2015 Mha | 2005-2015 ha/yr | 2005-2015 % |
|---------------|------------------|--------------------|----------------|
| Sweden | 28,1 | -14 500 | -0,05 |
| Finland | 22,2 | +5 500 | 0,03 |
| Spain | 18,4 | +114 000 | 0,64 |
| France | 16,9 | +113 000 | 0,69 |
| Norway | 12,1 | +2 000 | 0,02 |
| Germany | 11,4 | +3 500 | 0,03 |
| Poland | 9,5 | +23 500 | 0,25 |
| Italy | 9,3 | +54 000 | 0,6 |

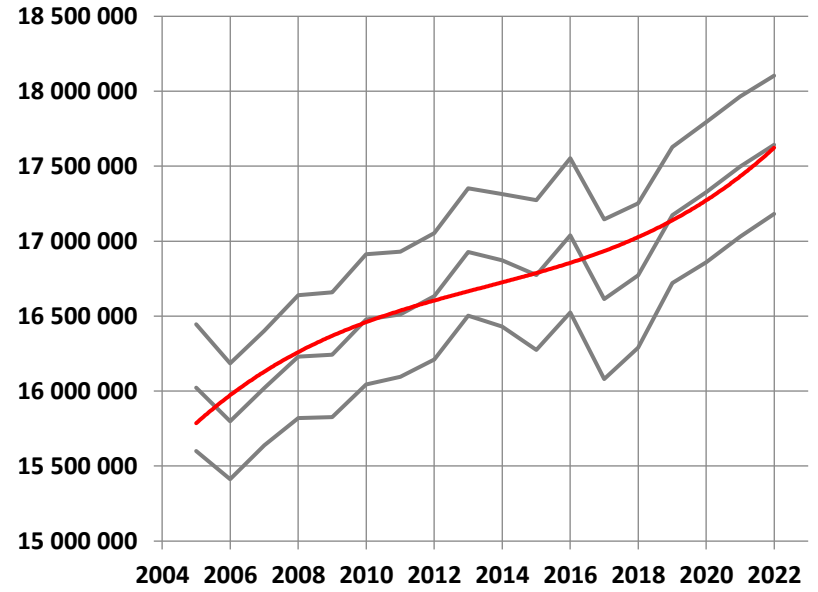
➤ more intense with recent FTs, especially strong in France

➤ +23 Mha over 30 years in Europe

Forest extension in France



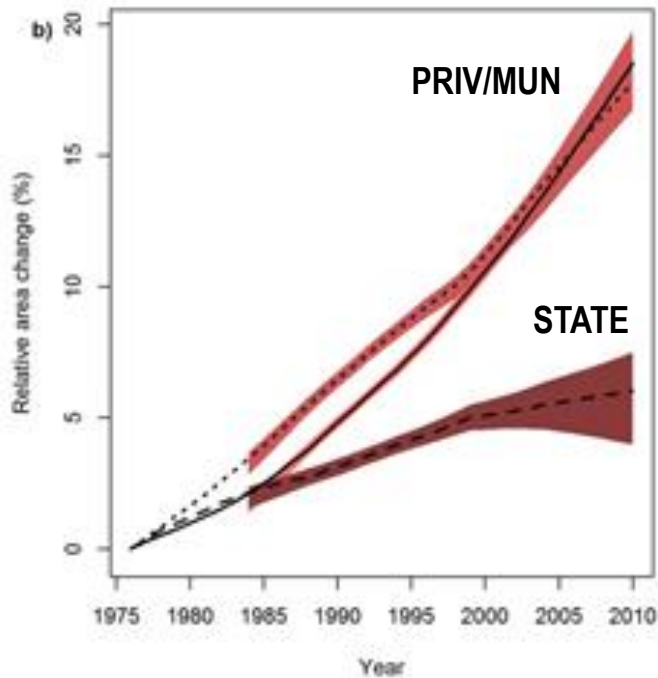
Denardou 2019



NFI 2024

➤ +90'000 ha/yr on average

The dynamic of private forests

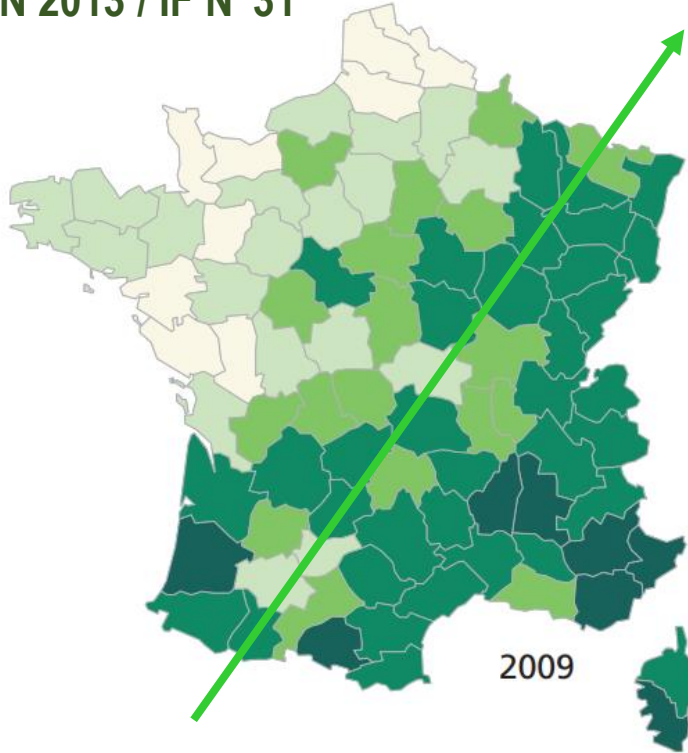


- +20% change in private/municipal forests
- 3/4th of the forest area is **private**
- = **future new forest resources**

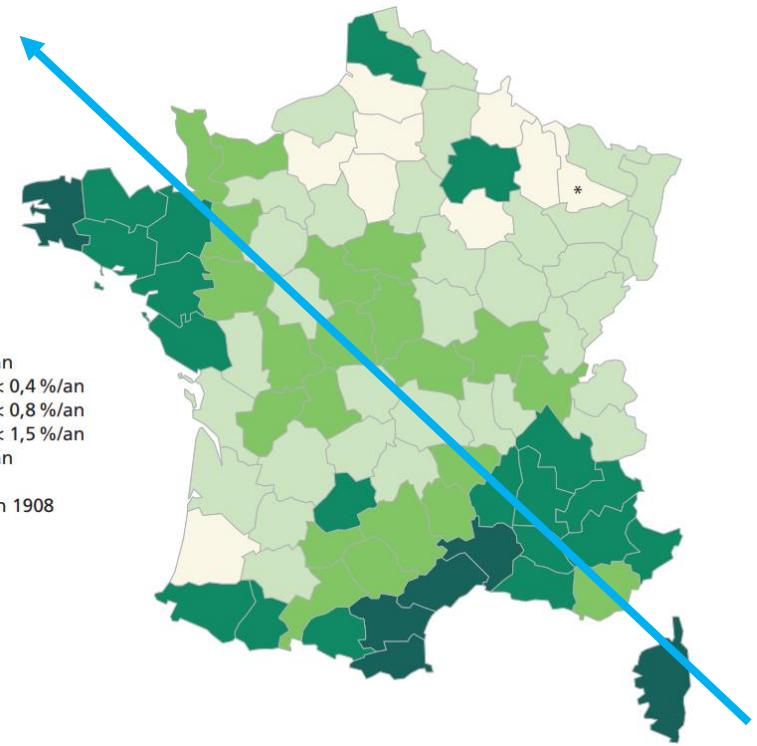
Denardou 2019

Changes across space – the second diagonal

IFN 2013 / IF N°31



Area 2009

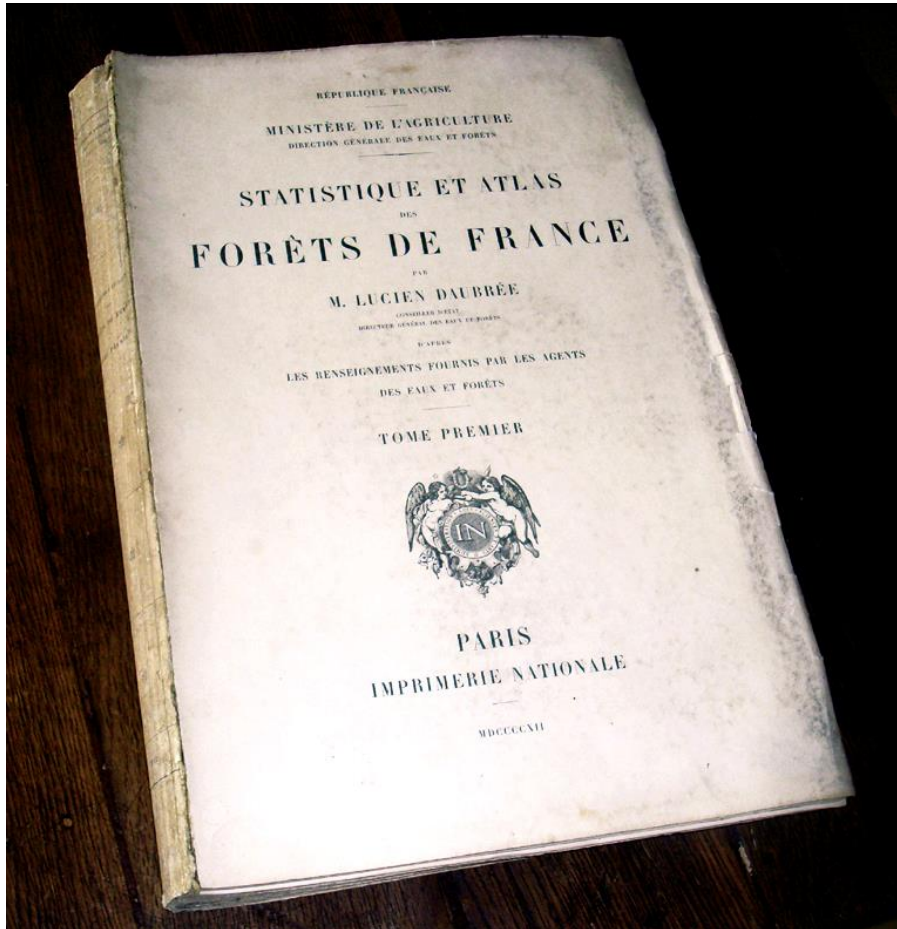


Areal change 1981-2009

- * taux négatif
- taux $< 0,1\%/an$
- taux $\geq 0,1$ et $< 0,4\%/an$
- taux $\geq 0,4$ et $< 0,8\%/an$
- taux $\geq 0,8$ et $< 1,5\%/an$
- taux $\geq 1,5\%/an$
- hors France en 1908

2_ Impacts on the diversity of forests

Daubrée statistics (1912) – one century of changes



- areal statistics, by *department*
- composition, structure, ownership
- Dpt-digitized (Audinot et al 2020)

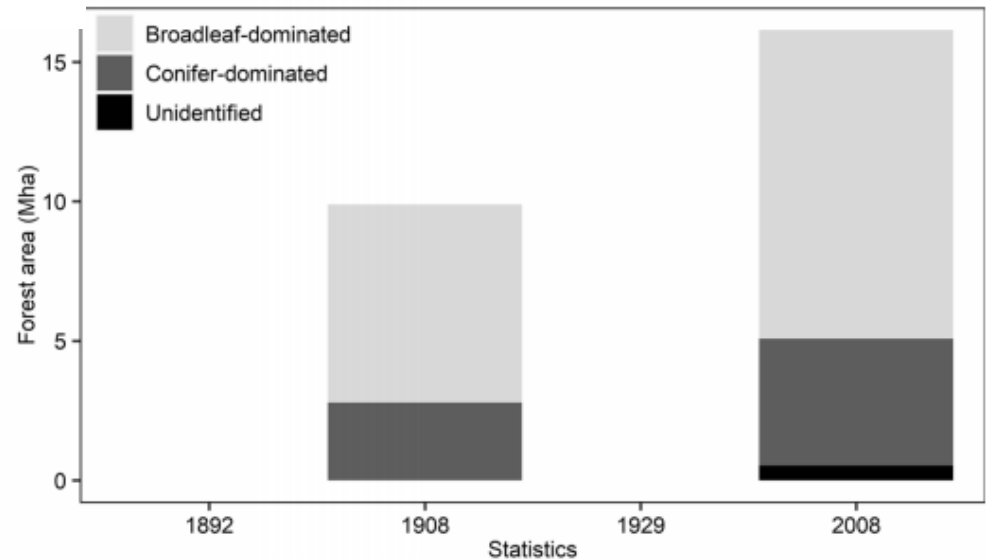
Broadleaf/conifer ratio has remained constant

RESEARCH PAPER

Ancient forest statistics provide centennial perspective over the status and dynamics of forest area in France

Timothée Audinot^{1,2}  · Holger Wernsdörfer² · Jean-Daniel Bontemps¹

- Broadleaved : +3.6 Mha
- Conifers : +1.6 Mha
- +34%/+38% in area
- FFN plantation program = 1.2 Mha



Audinot et al 2020

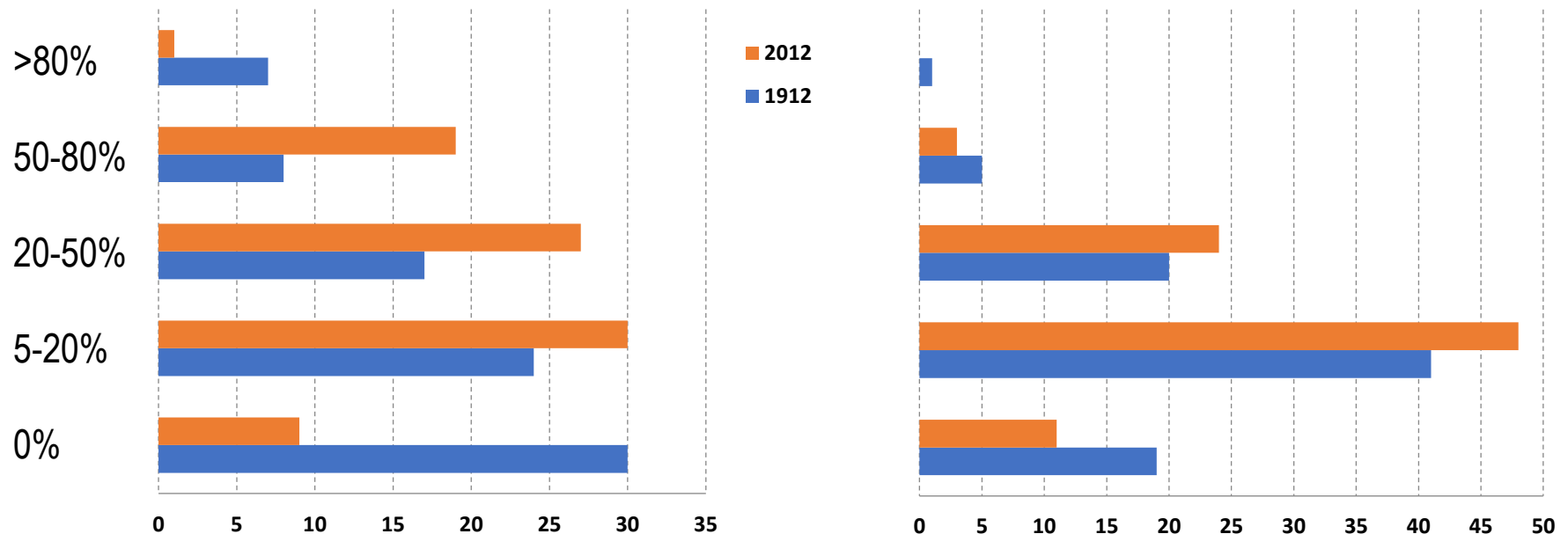
Conifer afforestation – origins for the debate ?

- Daubrée : 49 dpts without conifers
- Conifers have appeared in 29 dpts (1/3 rd)

Conifer fraction

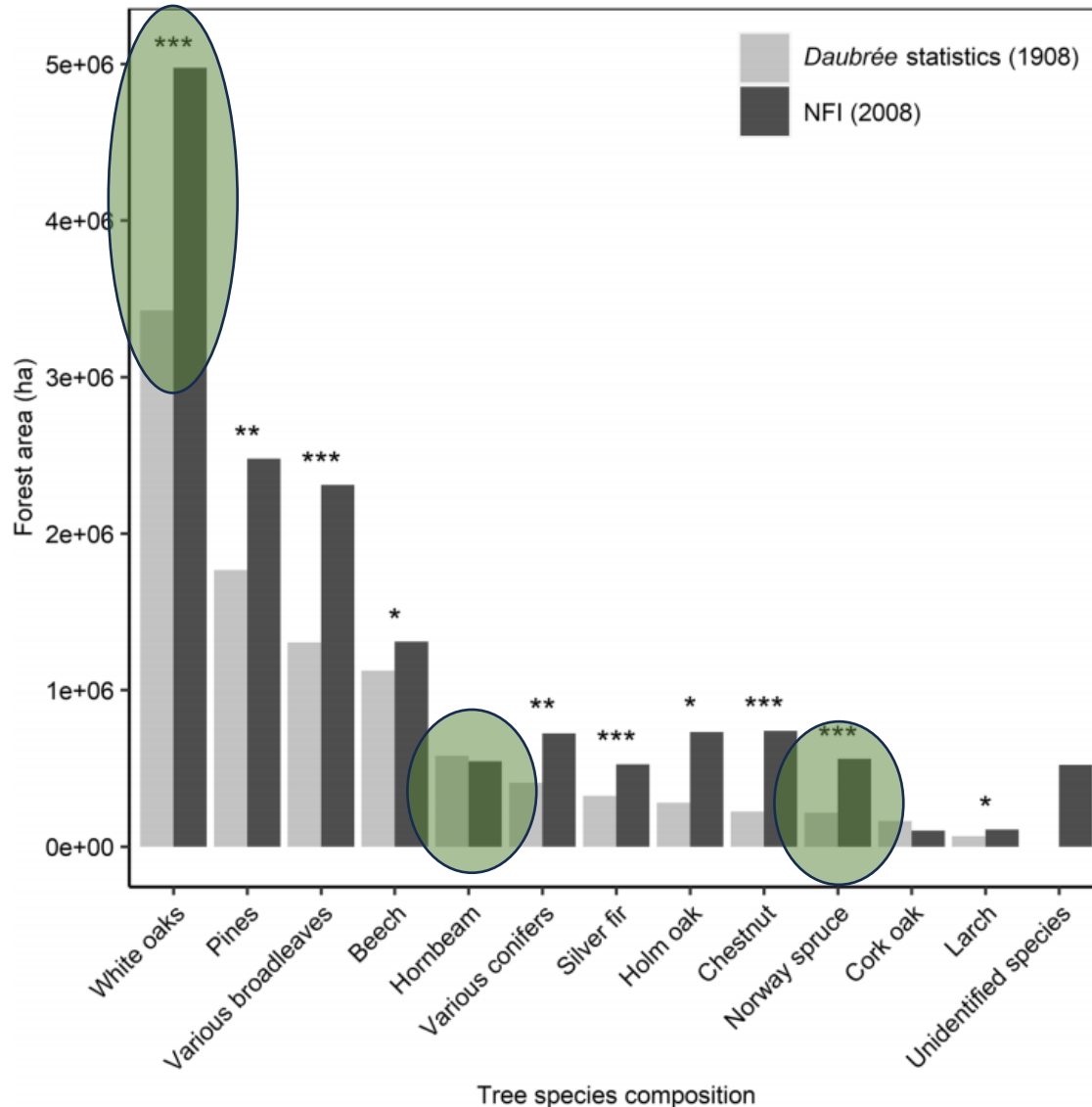
Public forests

Private forests



➤ More acute in public forests, dpts with 50/80% have doubled

Most initial tree species show an extension



➤ Strongest = oaks/broadleaves

➤ Norway spruce : +400'000 ha

FT – a net diversification in tree species

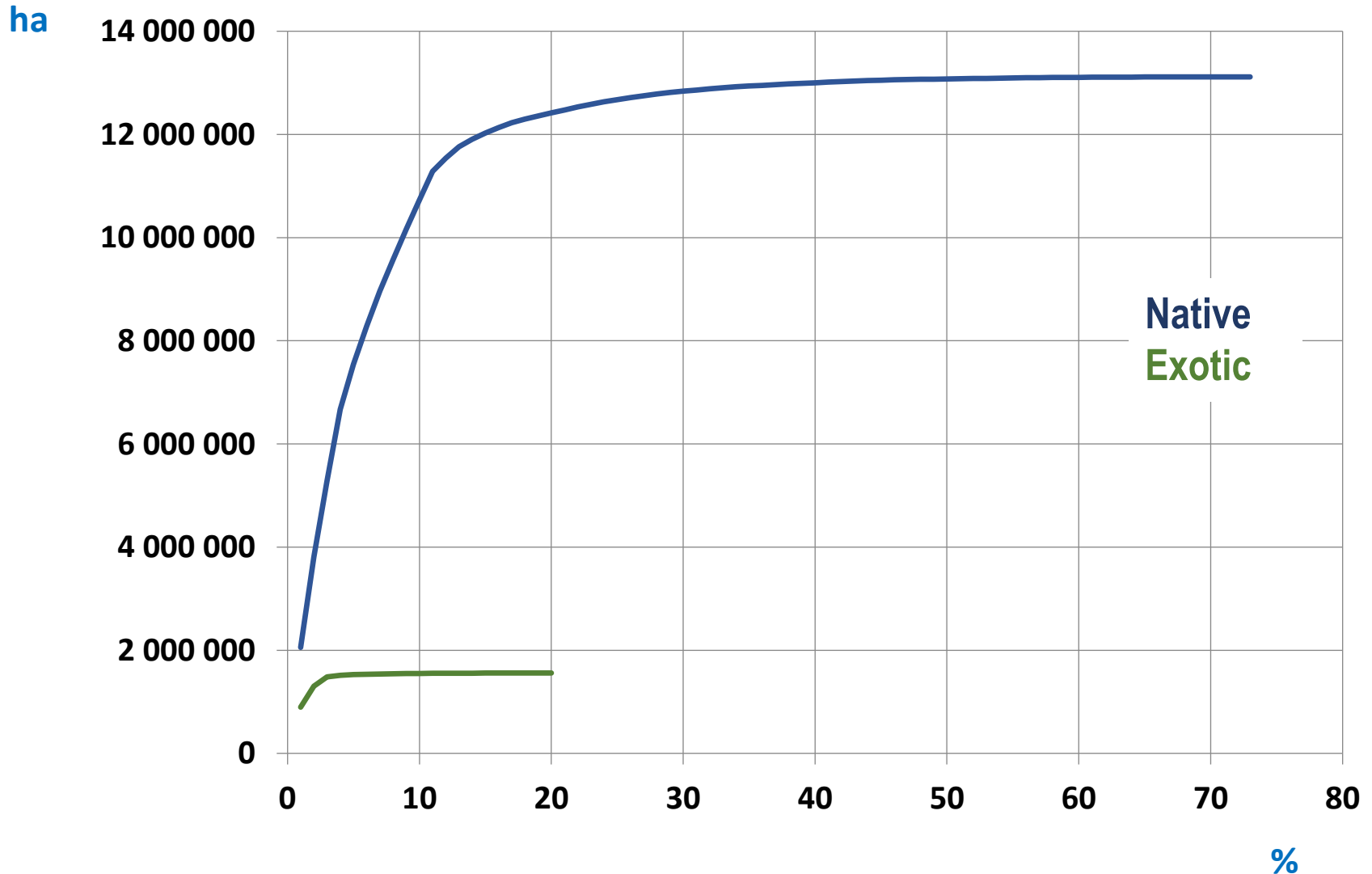
NFI – 2016 / 2020 – tree species in the canopy

| Category | N species | Area (Mha) | Area (%) | Max species area (%) |
|--------------|------------|---------------|----------|------------------------|
| Native | 77 | 14,606 | 86,0 | 12,1 (pedunculate oak) |
| Exotic | 33 | 2,380 | 14,0 | 5,3 (maritime pine) |
| TOTAL | 110 | 16,984 | | |

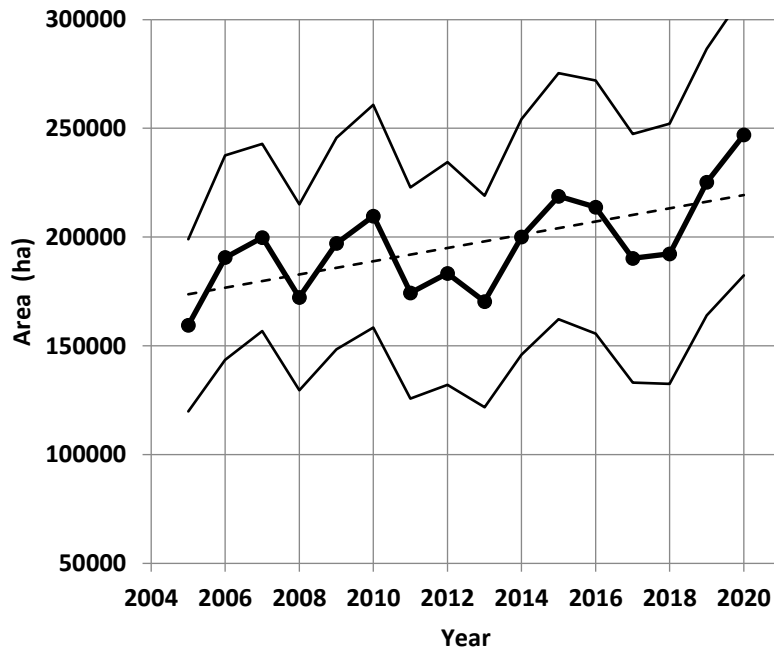
- **Some emblems**

- Maritime pine 900'000 ha, Douglas fir 400'000 ha
- Austrian black pine, Black locust, poplar (200'000 ha)
- **New extended monocultures, but a diversification at country scale**

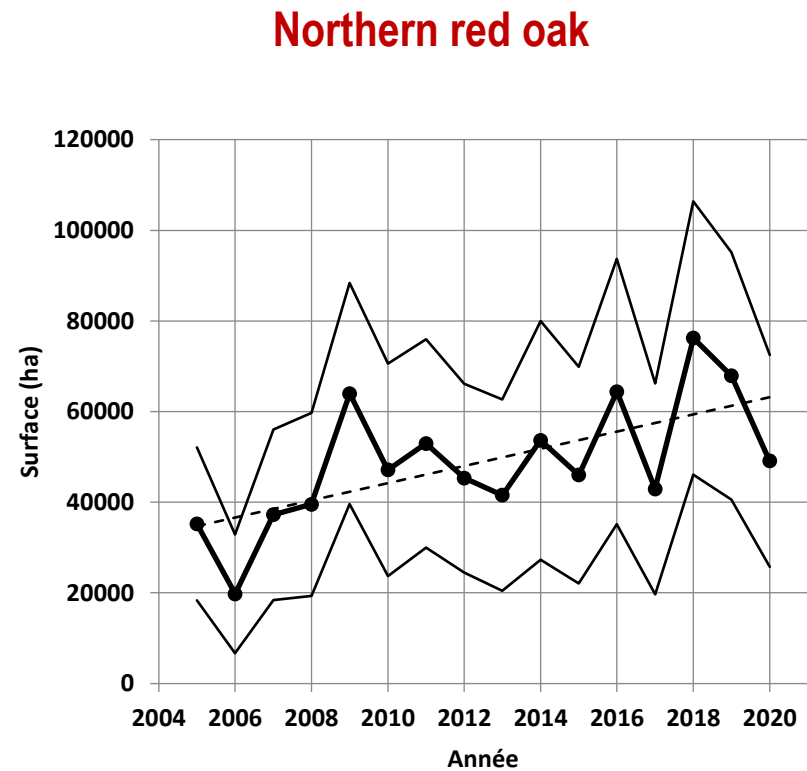
About the strength of « forest interventionism »



Invasive exotic tree species in forests ?



Austrian black pine



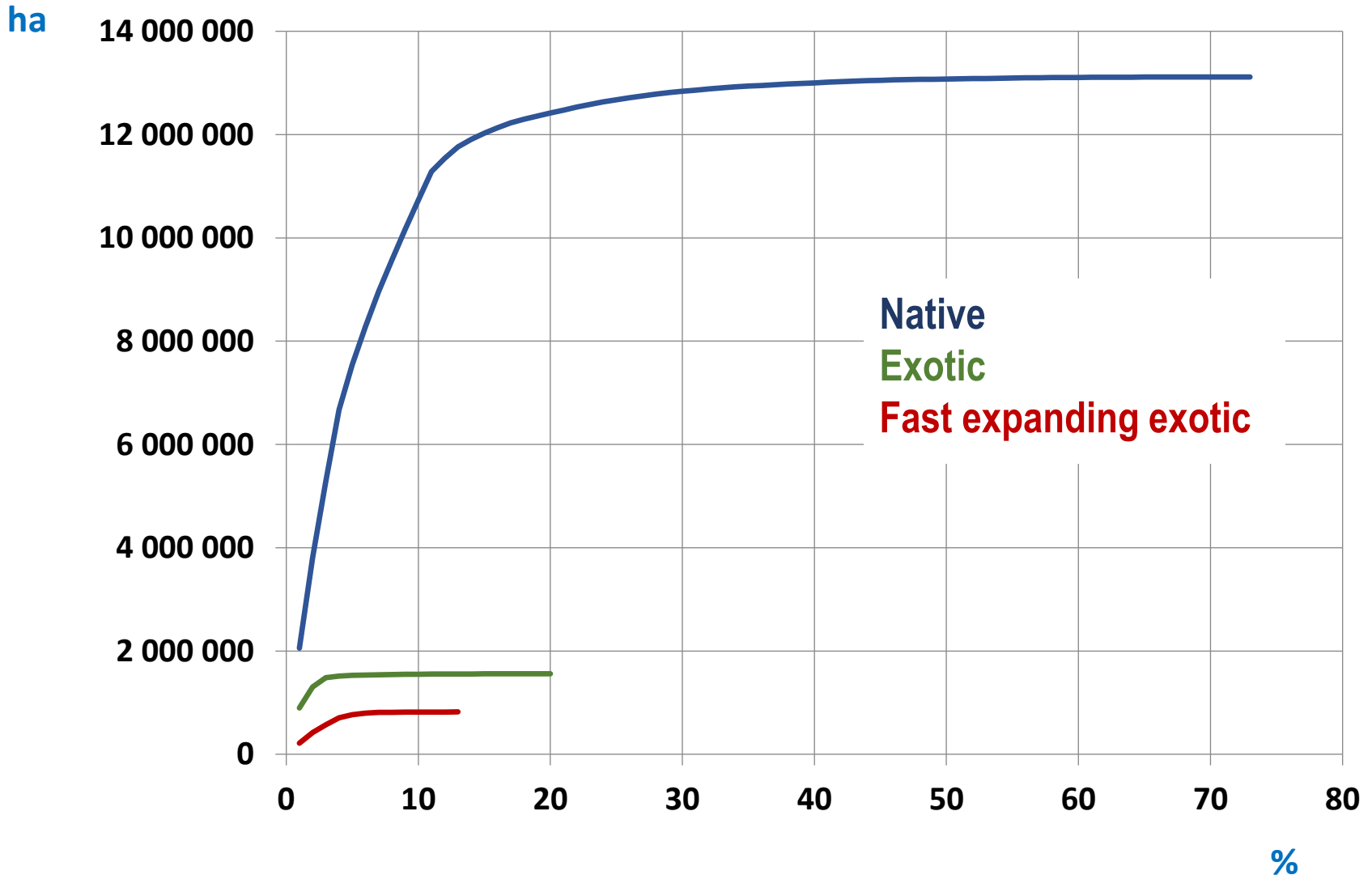
Northern red oak

Invasive exotic tree species in forests ?

| Tree species | Initial area (ha, 2005-09) | Absolute trend (ha/yr, 2005-20) | Relative trend (%/yr) |
|---------------------|-------------------------------|------------------------------------|--------------------------|
| Black locust | 187 000 | +1 000 (0.5) | +0.5 |
| Austrian black pine | 186 000 | +3 000 (<0.01) | +1.6 |
| Corsican pine | 168 000 | -300 (0.8) | -0.2 (0.8) |
| Northern red oak | 39 000 | +1 900 (<0.01) | +4.9 |

- Some extensions are faster than the total area
- **Yet favoured by forest policies**
- **And remain anecdotal in the total**

About the strength of « forest interventionism »



What are returning forests made of ?

- Forest FAO definition (2004) : **>0.1 cover fraction**
- NFI – composition inferred **>0.2 cover fraction**, GS inferred **>7.5 cm dbh**
- **Recent returning forests form « undefined » categories**
- **1.2 Mha of undefined composition, with 0.8% of the growing stock**
- 15 year-equivalents of forest extension, **1.0 Mha are private forests...**

What are returning forests made of ? (NFI)

- Focus on « **undefined** » or « **low** » vertical structure

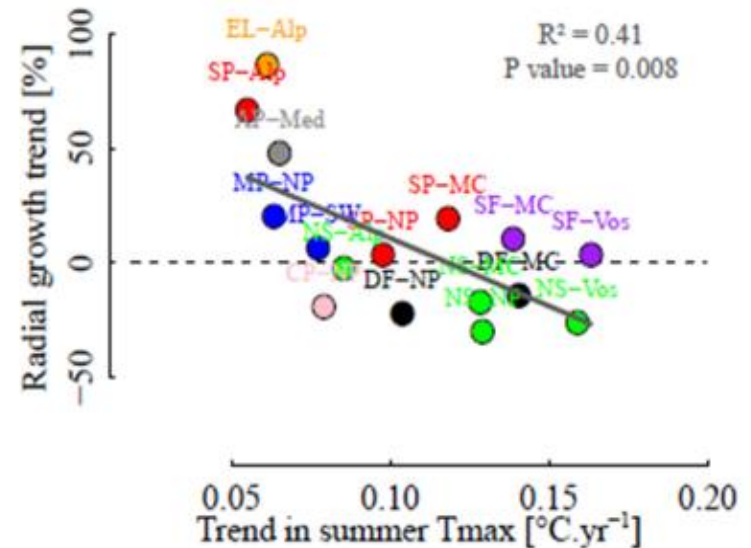
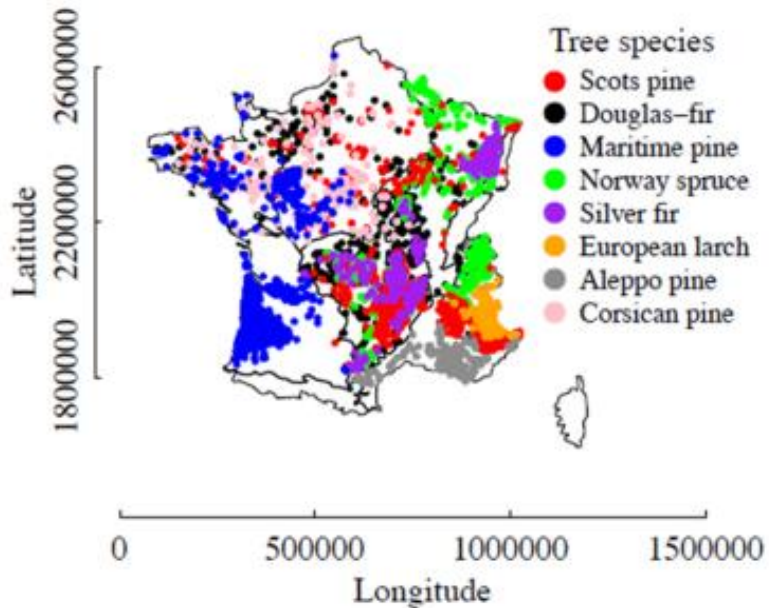
| COMPOSITION | TOT |
|-------------------------------|------------------|
| Undefined | 910'000 |
| Oak + broadleaves | |
| Broadleaves | 390'000 |
| Pine / + broadleaves | |
| Conifers + broadleaves | 160'000 |
| TOT | 1'460'000 |

- **broadleaved** forests (mixtures)
- **broadleaf/conifer** mixtures, importance of **pine species**

3_ New forests – management and climatic change

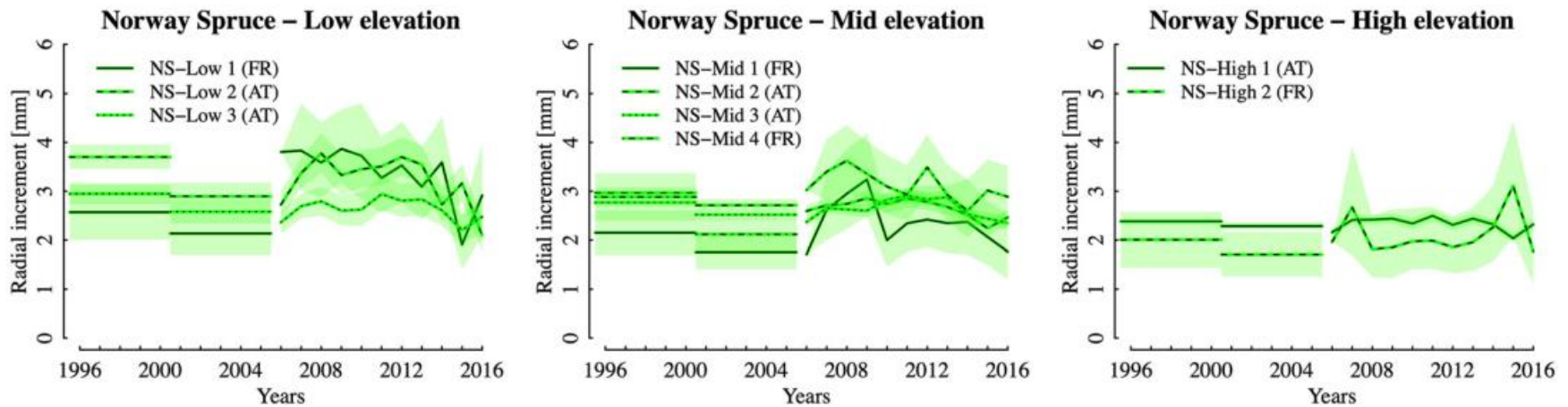
Conifer forests – the clear (–) footprint of CC

A



Ols et Bontemps 2020

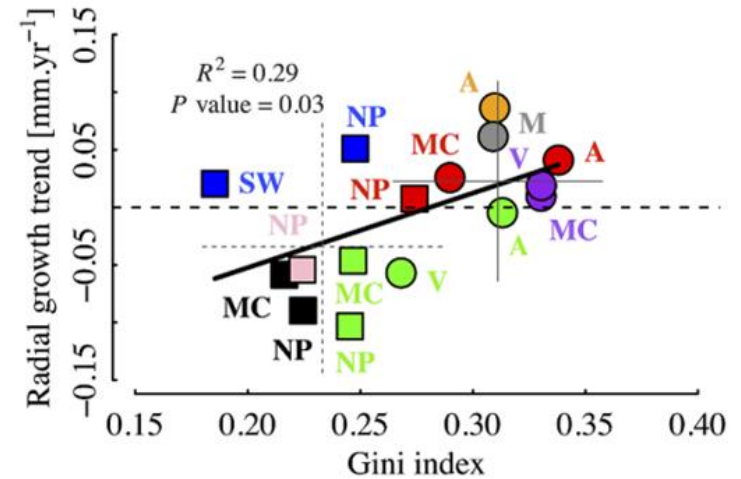
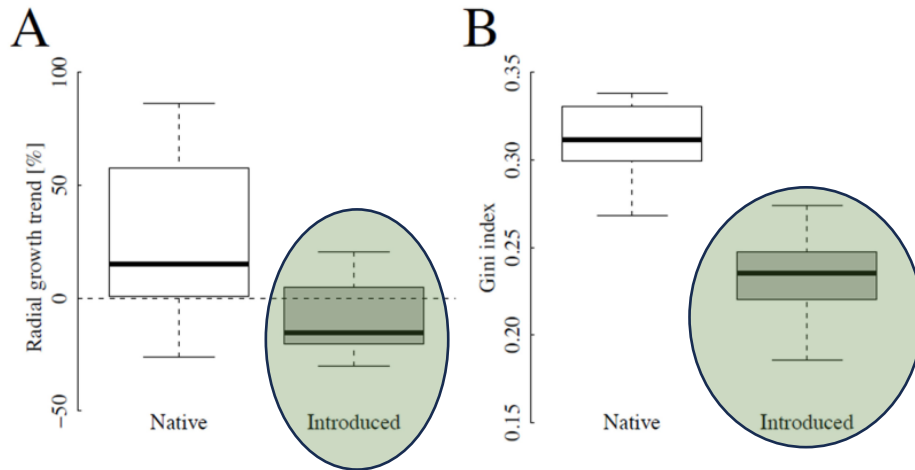
Conifer forests – the clear (–) footprint of CC



Ols et al 2021

- Scots/Corsican pines, Norway spruce – stronger declines in lowlands

Growth declines – exotism or plantation ?



- Exacerbation of **competition** in plantations ?
- A matter of **forest management** ?

Ols et Bontemps 2020

New forests are private – ownership structure

| Ownership size | Area (million) | Owner number | Proportion | Management plan (PSG) |
|------------------------|----------------|--------------------|------------|-----------------------|
| < 1 ha | 3.3 | 2.4 million | 48% | No |
| [1 ha, 4 ha[| 1.4 | 700'000 | | |
| [4 ha, 10 ha[| 1.6 | 260'000 | | |
| [10 ha, 25 ha[| 1.8 | 120'000 | 14% | New |
| [25 ha, 100 ha[| 2.1 | 46'000 | 38% | Yes |
| > 100 ha | 2.8 | 11'000 | | |
| TOTAL | 13.0 | 3,5 million | | 38% → 52% |

Agreste 2012

- Property < 1 ha for 1/4th of the area
- No management plan **on half the area** (6.3 million ha)
- **What do « sustainable management » and « adaptation » mean ?**

Private forests – a few additional facts

Production not an
objective on 60%
of forests > 1ha

(6 Mha)

Can management plan extension really fix it ?

1/4th owners are
never present in
their forests

(1.4 Mha)

Free evolution of forests ?

Owners are >75 yrs
old on 1/6th of the
area

(1.8 Mha)

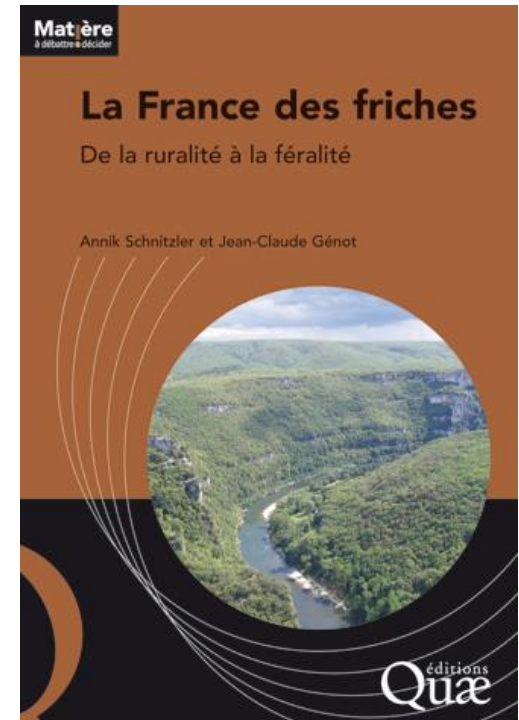
Returning forests – options for the future

■ Voluntarism...

- De Galbert et al (2015) – *valorisation agricole/forestière de l'espace rural*
- **land action and consolidation, biomass valuation**

■ Wilderness ?

- EP resolution on the wilderness in Europe (2009)
- Schnitzler & Genot (2012) – *la France des Friches*
- **Returning forests to consolidate a wilderness option**



Non-management, the worst possible option ?

Environmental hazards

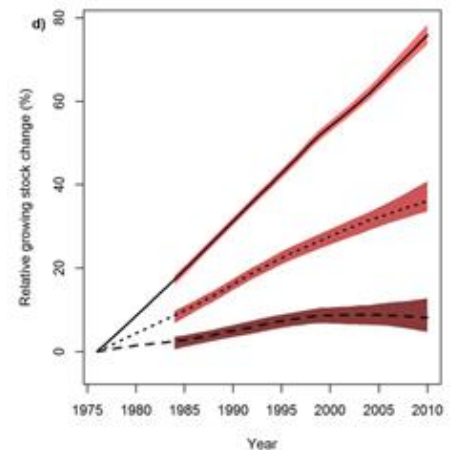
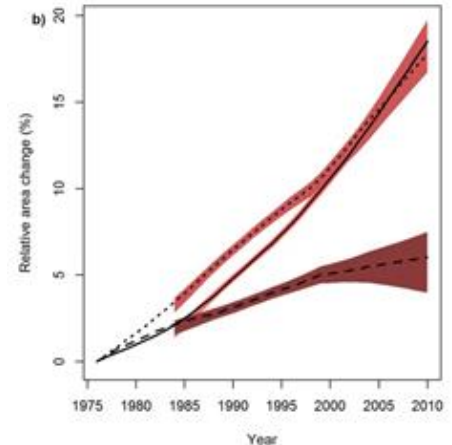
- exposition \propto area
- sensibility (drought, fire, storm) \propto **growing stock density**
- if not managing for wood, managing for risks ?

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PARK SCIENCE • VOLUME 28 • NUMBER 3 • WINTER 2011–2012

Climate change: Wilderness's greatest challenge

By Nathan L. Stephenson and Constance I. Millar



“ Landscapes disrupted in these ways are both unhealthy and unattractive “

New CC-adapted exotic species: statistical zeroes

| Origin | Tree species | Volume (%) |
|--|-------------------|------------|
| Strategic afforestation (20th century) | Norway spruce | 7.7 |
| | Douglas fir | 4.3 |
| | Corsican pine | 1.5 |
| | Black pine | 1.1 |
| | Sitka spruce | 0.5 |
| | Northern red oak | 0.2 |
| Recent afforestation Presumably CC-adaptive | Exotic larch | 0.14 |
| | Grand fir | 0.14 |
| | Atlas cedar | 0.10 |
| | Weymouth pine | 0.06 |
| | Caucasian fir | < 0.01 |
| | Eucalyptus | < 0.01 |
| | Mediterranean fir | < 0.01 |
| | Lebanese cedar | < 0.01 |

Synthesis

- **Strong forest extension** on the continent and France
 - New forest territories, mainly **private forests**
 - B:C ratio **unchanged**, tree **diversity increase** at country scale
 - **Restricted role** of forest interventionism
 - **Vulnerability** of lowland plantations, **non-management** of returning forests
 - **Anecdotal importance** of adaptive introductions
- **Priority – forest renewal ? Or land consolidation & more active management ?**

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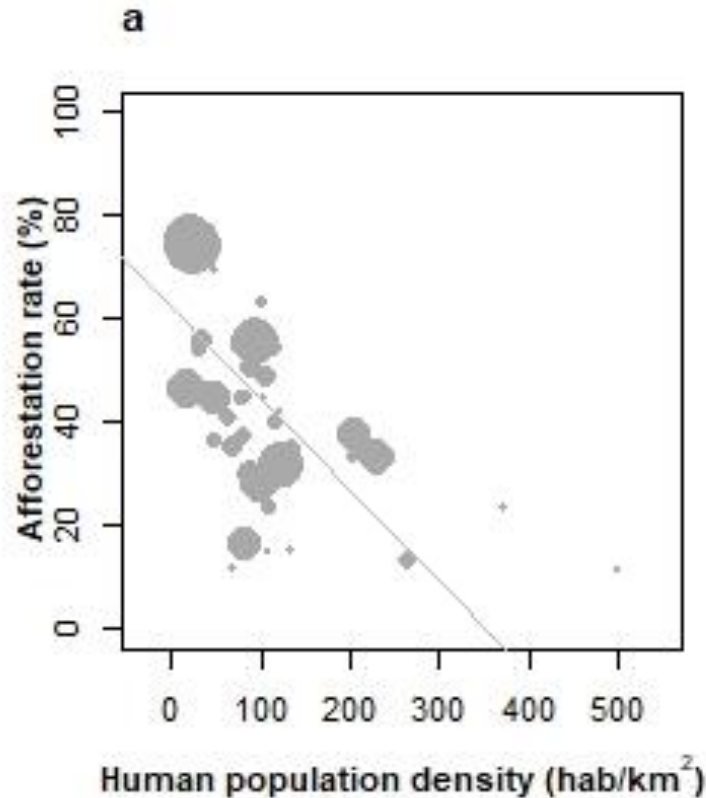
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Sancy-Monts Dore (2014)
Grazing lands between natural afforestation and plantations

The footprint of past demographic pressure



- Despite decades of increase
- Legacy of « ancient » forests

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