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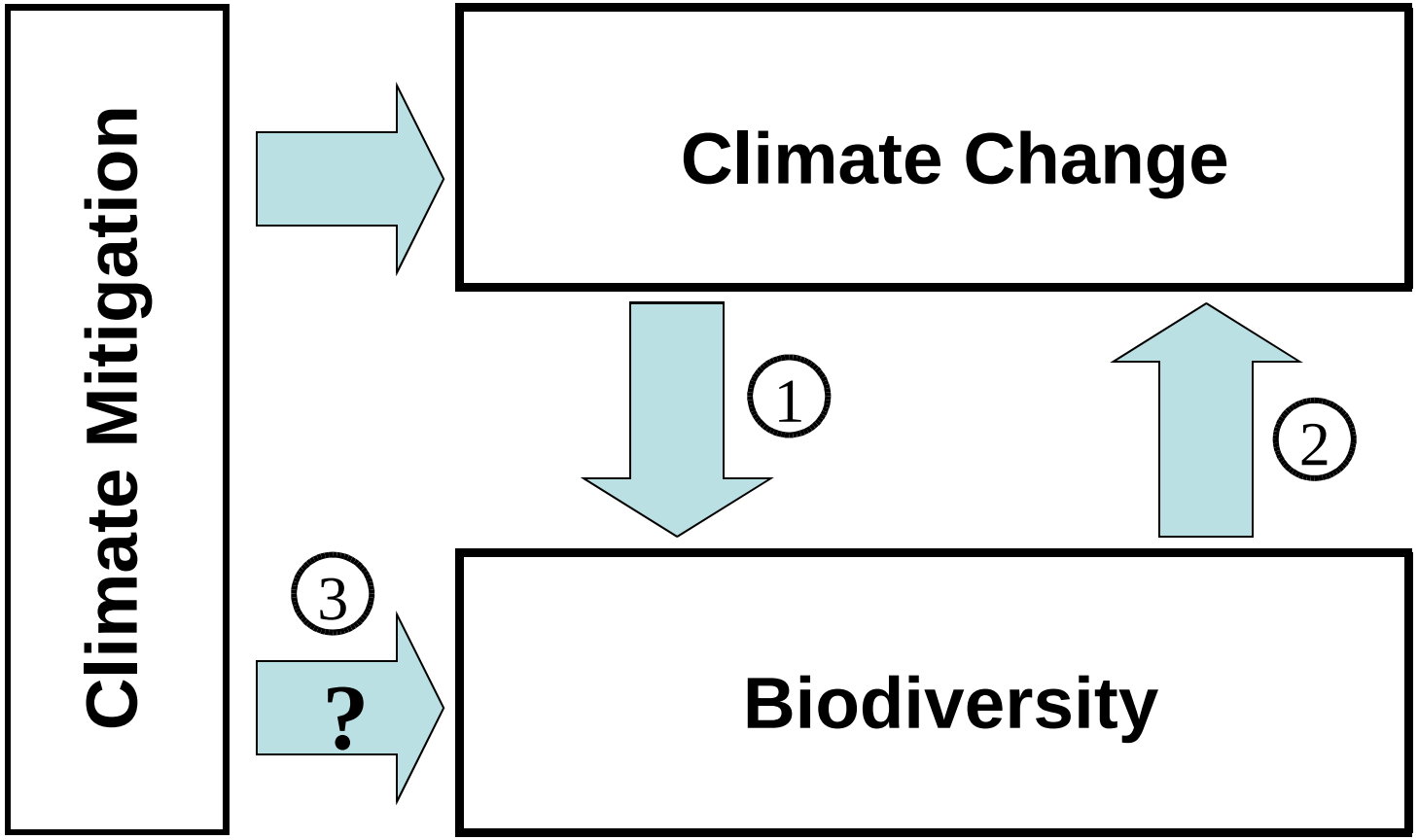
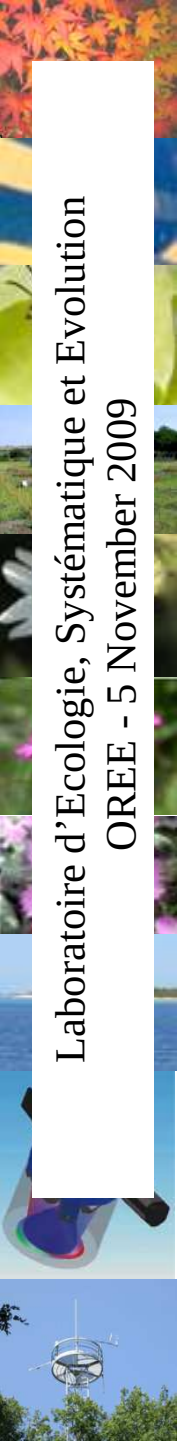
OREE - 5 November 2009

Interactions Between Climate Change and Biodiversity



Paul Leadley, Professor, Université Paris-Sud 11



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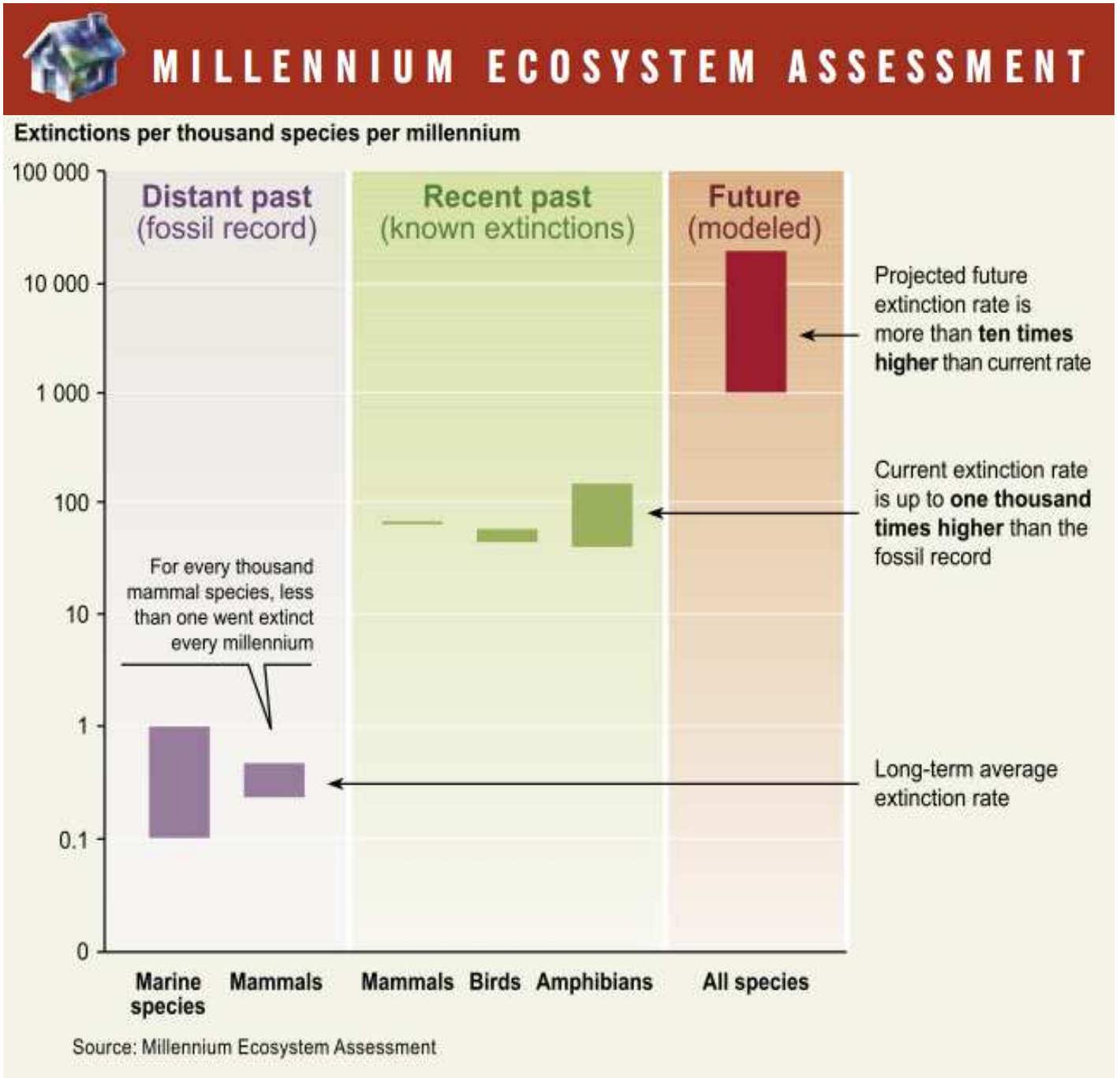
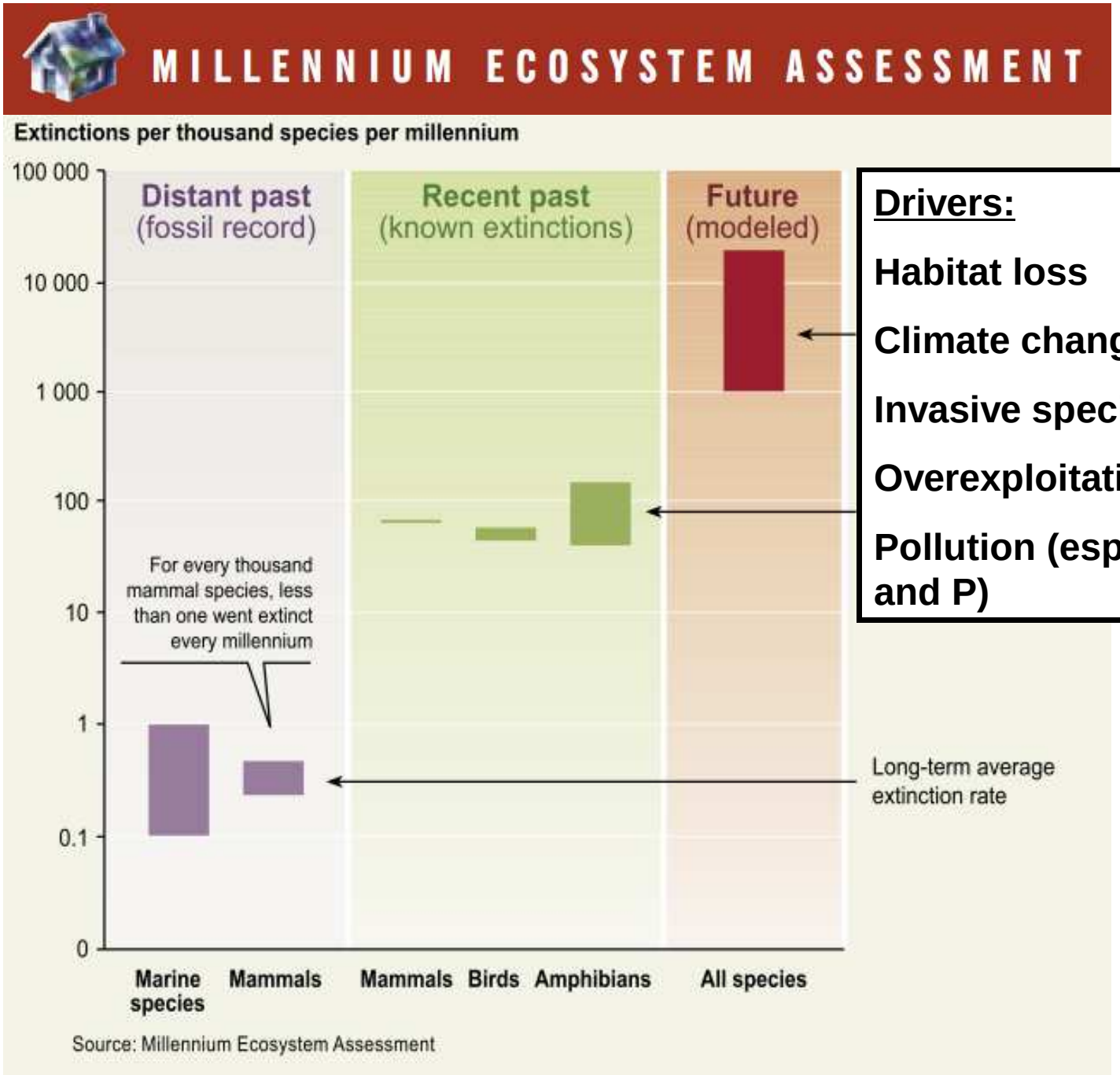
Impact of Climate Change on Biodiversity


MILLENNIUM ECOSYSTEM ASSESSMENT
Extinctions per thousand species per millennium
100 000
10 000
1 000
100
10
1
0.1
0
Distant past
(fossil record)
Recent past
(known extinctions)
Future
(modeled)
Projected future extinction rate is more than ten times higher than current rate
Current extinction rate is up to one thousand times higher than the fossil record
For every thousand mammal species, less than one went extinct every millennium
Long-term average extinction rate
Marine species
Mammals
Mammals
Birds
Amphibians
All species
Source: Millennium Ecosystem Assessment



Drivers:

Habitat loss

Climate change

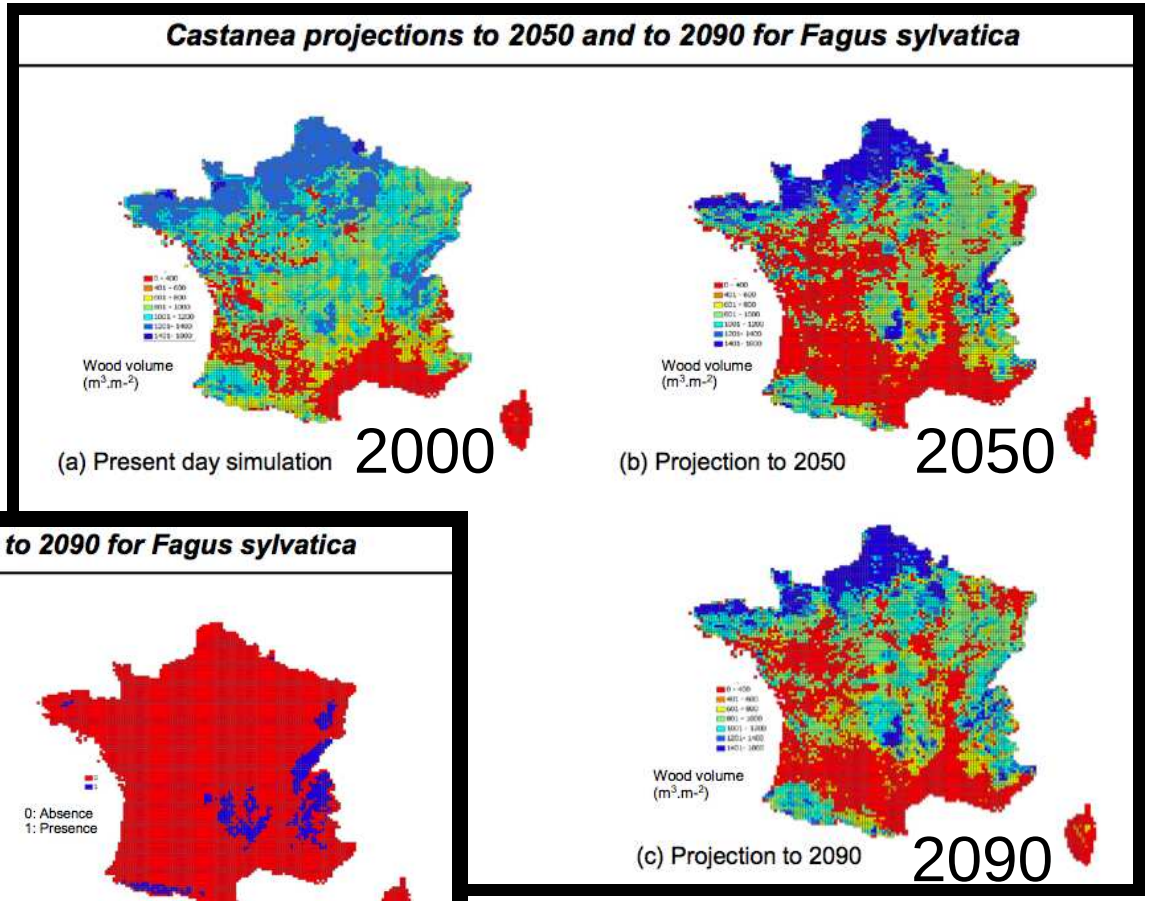
Invasive species

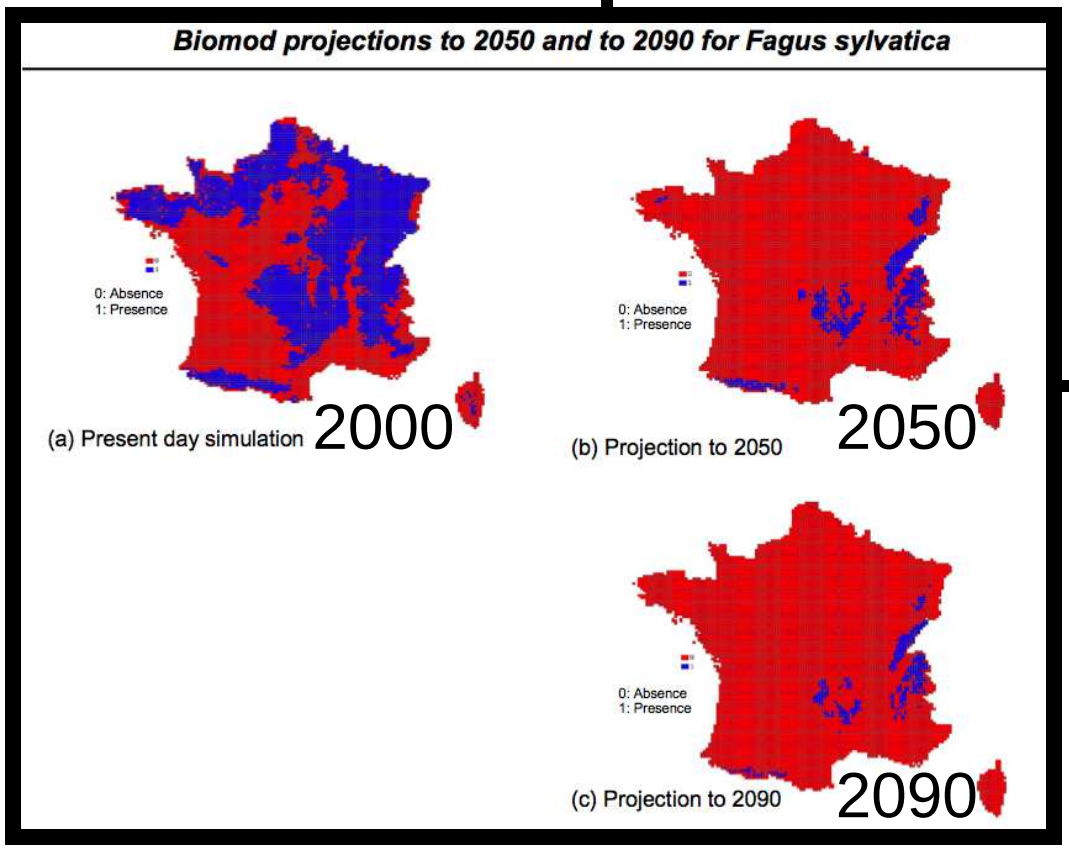
Overexploitation

Pollution (esp. N and P)

Climate change impacts on European Beech

Thuiller et al. 2003, 2005
LECA, Grenoble
Niche-based model



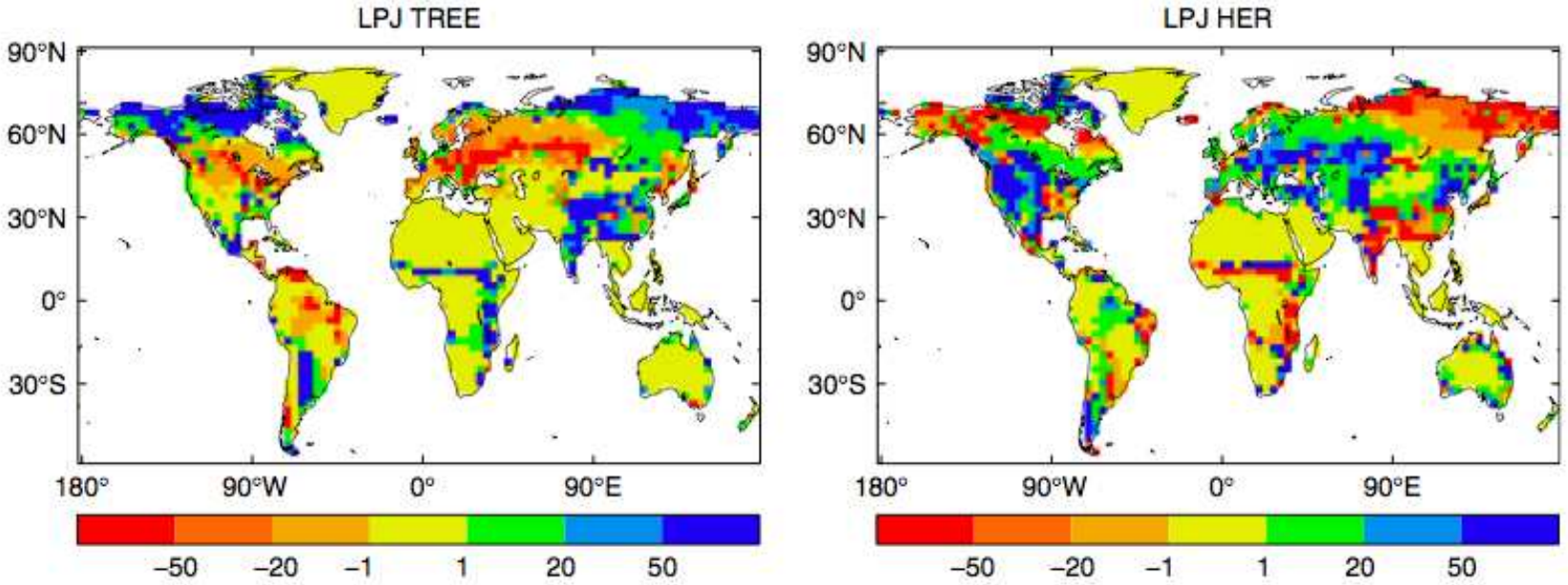


Mechanistic tree growth model
Davi et al. 2008
A. Cheaib, C. François, E. Dufrene
ESE Lab, Orsay

Global Biome Shifts

Trees

Herbaceous



% change 2100 vs. 1860

Projected changes in the abundance of trees and herbaceous species from 1860 to 2099 based on a models of terrestrial vegetation dynamics and ecosystem function (LPJ), IPCC SRES A1FI emissions scenarios and a common climate model. **Sitch et al. (2008)**

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EDF Hydroécologie - Octobre 2008

Climate change and rising CO_2 impacts on coral reefs

Examples of what the future might look like

(photos from the Great Barrier Reef)

"Healthy" Coral reef

"Bleached" coral reef
= large areas already, most coral reefs in the next few decades

"Dead" reef
= middle to end of the 21st century

Hoegh-Guldberg et al. 2007 Science

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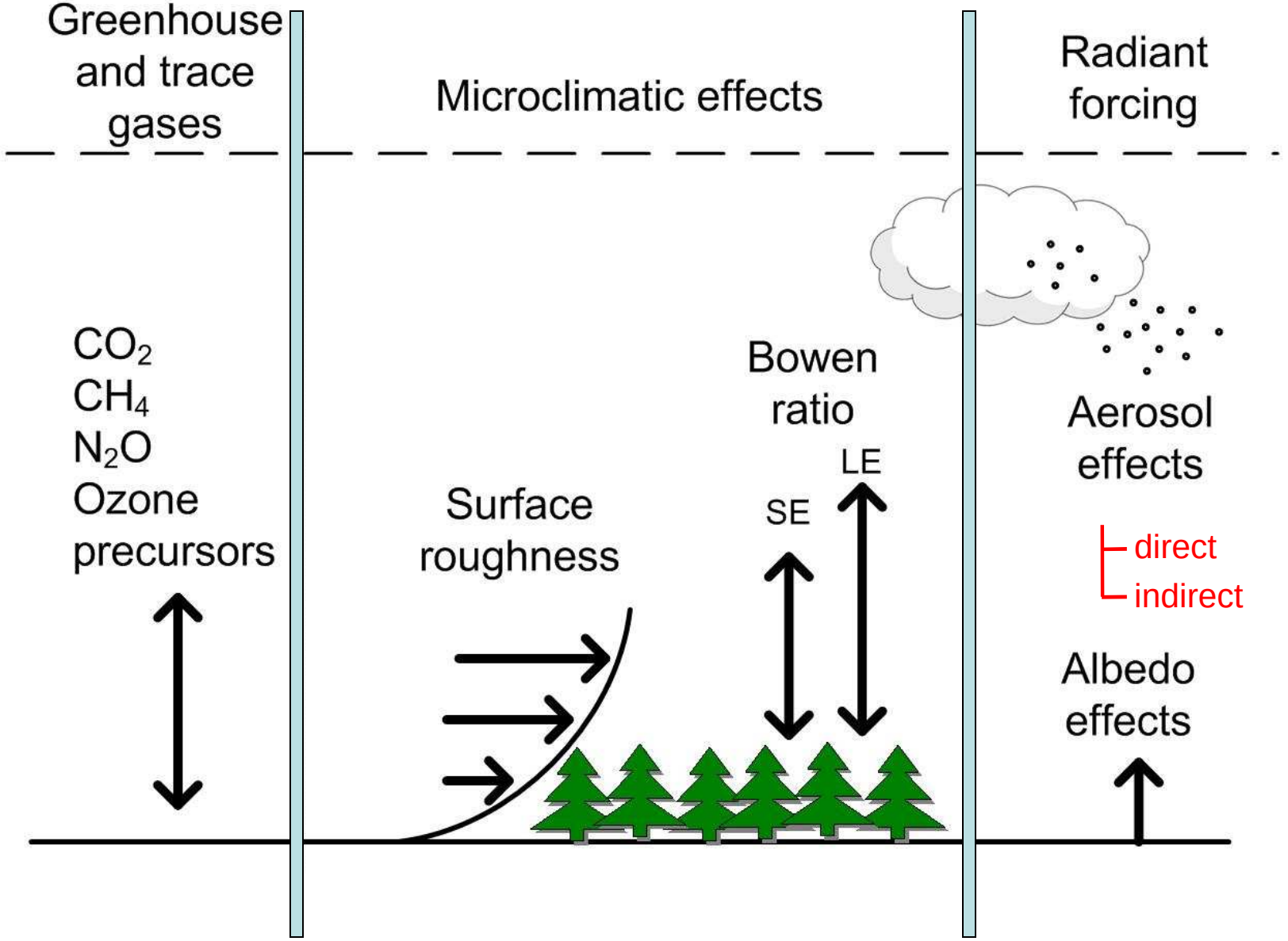
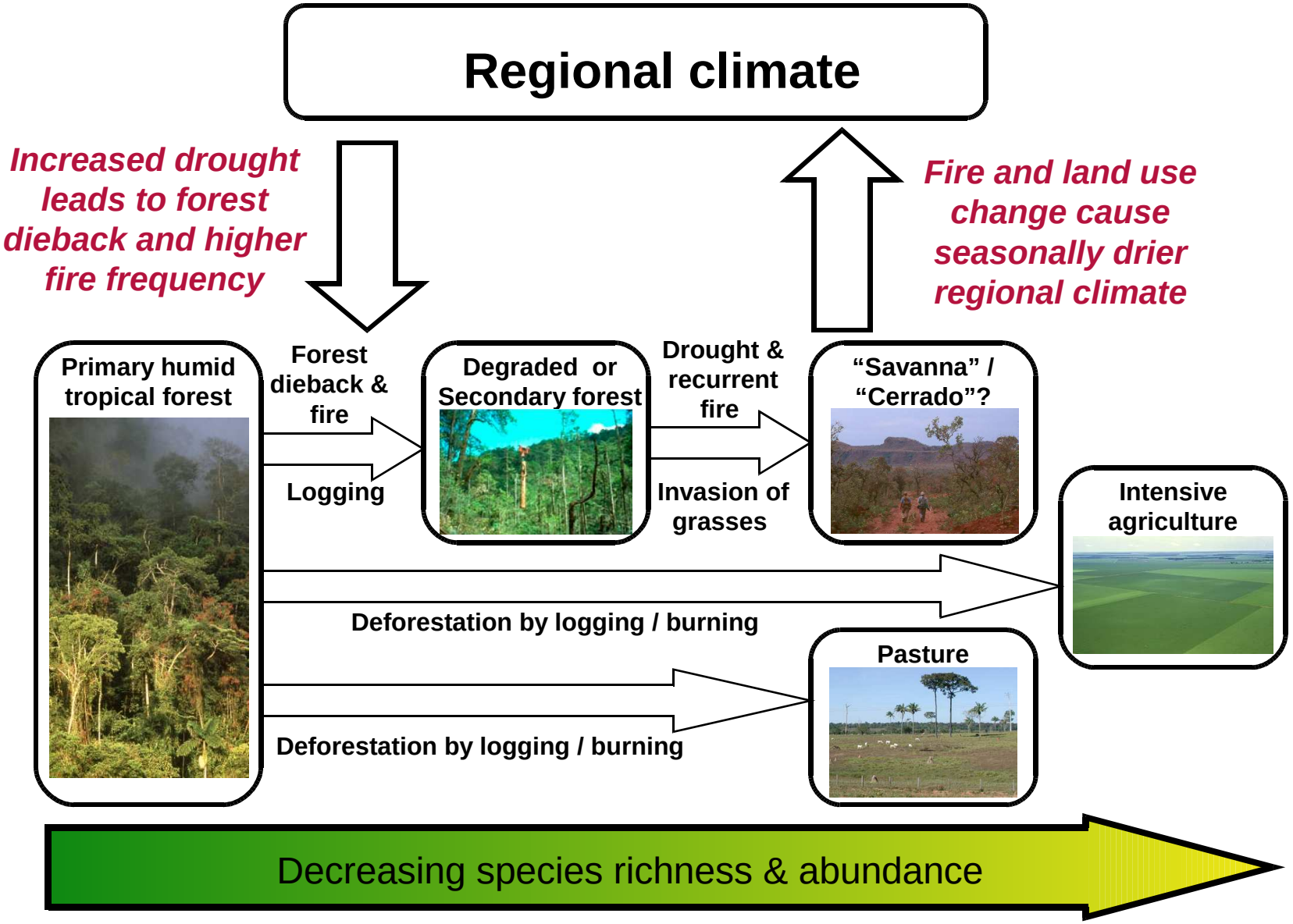
Feedbacks of Biodiversity Change on Climate

MECHANISMS OF LAND-ATMOSPHERE INTERACTIONS



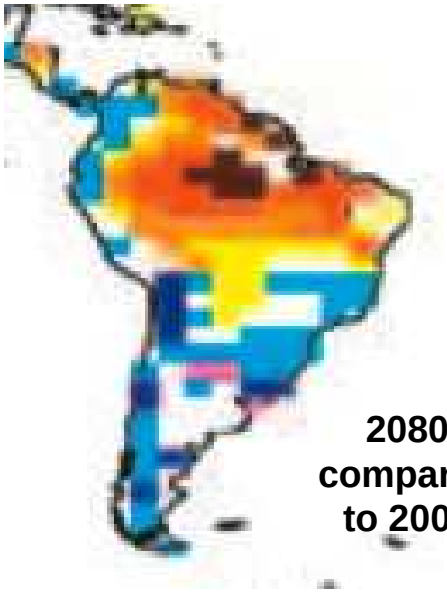
From RJ Scholes

Biodiversity / Climate Interactions in the Amazon



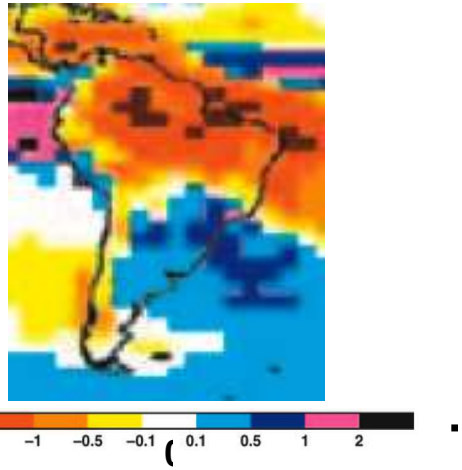
Biodiversity / Climate Interactions in the Amazon

A potential tipping-point of global importance caused by fire, deforestation, changes in regional climate and global climate change



2080 compared to 2000

Change in humid tropical forest (fraction of current)



Change in precipitation (mm / day)

Betts et al. 2004

Change in C storage (kg C / m²)

Biodiversity / Climate Interactions in the Arctic Tundra




Shifts in species dominance favoring shrubs

Short-term - Widespread in low stature tundra
Medium-term - Covers nearly all of current tundra areas
Long-term - Confined to isolated refugia and current areas of polar desert

Invasion of tundra by boreal tree species

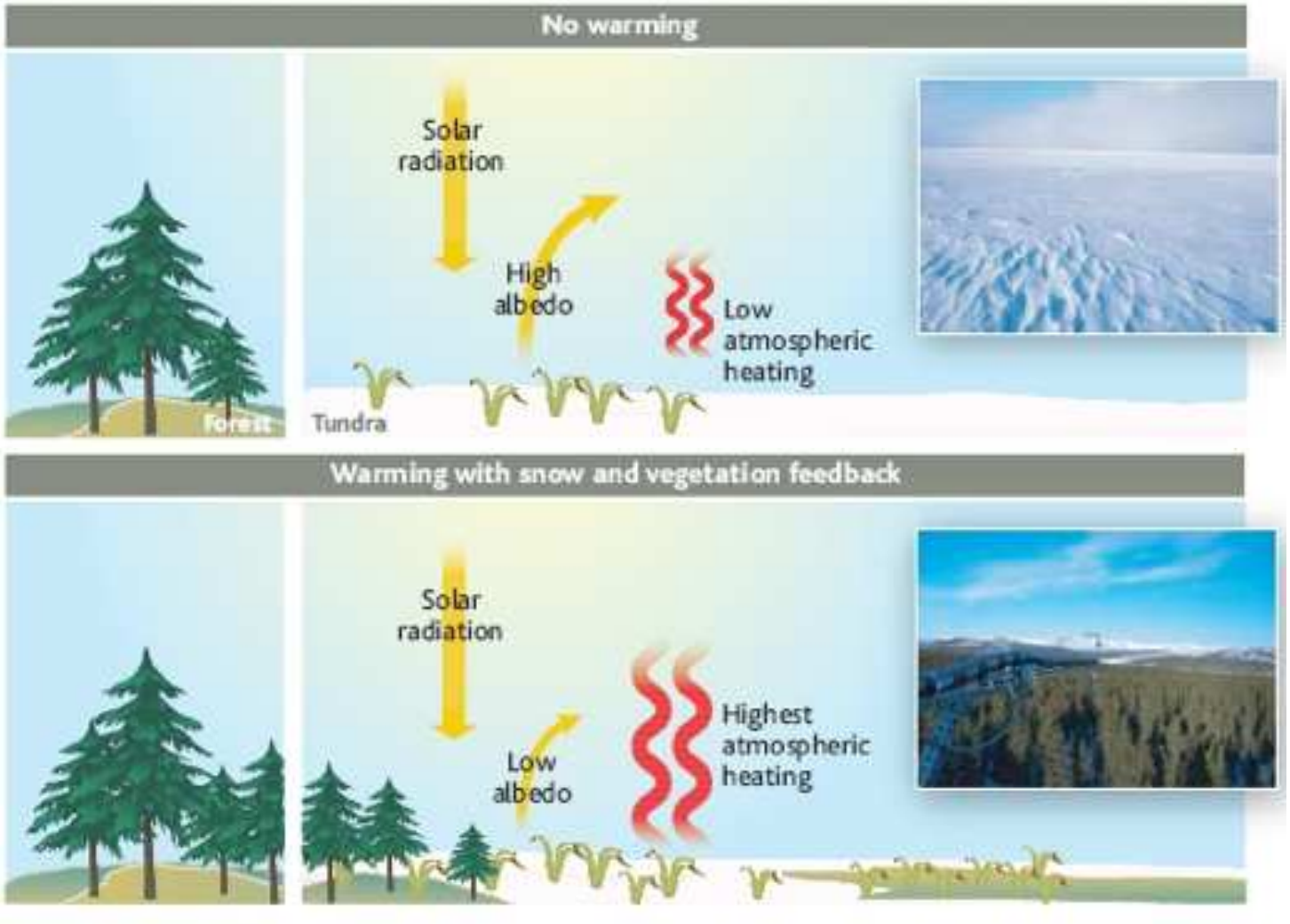
Short-term - At ecotones between boreal forest and tundra
Medium-term - Widespread in areas currently dominated by tundra
Long-term - Covers nearly all current tundra areas

Increasing dominance of boreal trees over tundra species

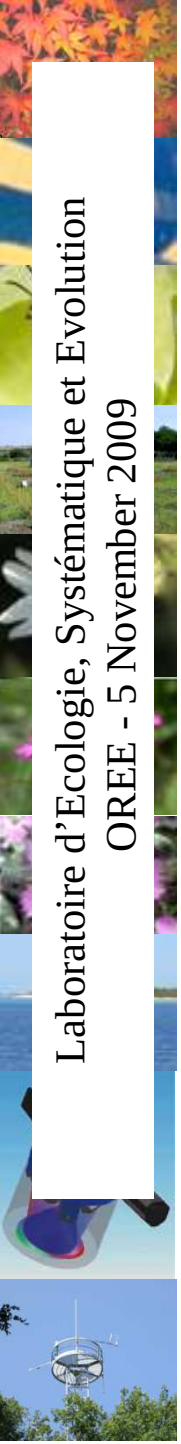
Medium-term - at ecotones between boreal forest and tundra
Long-term - Widespread in areas currently dominated by tundra

Biodiversity / Climate Interactions in the Arctic Tundra

A positive feedback between species range shifts and global warming



Modified from Foley et al.



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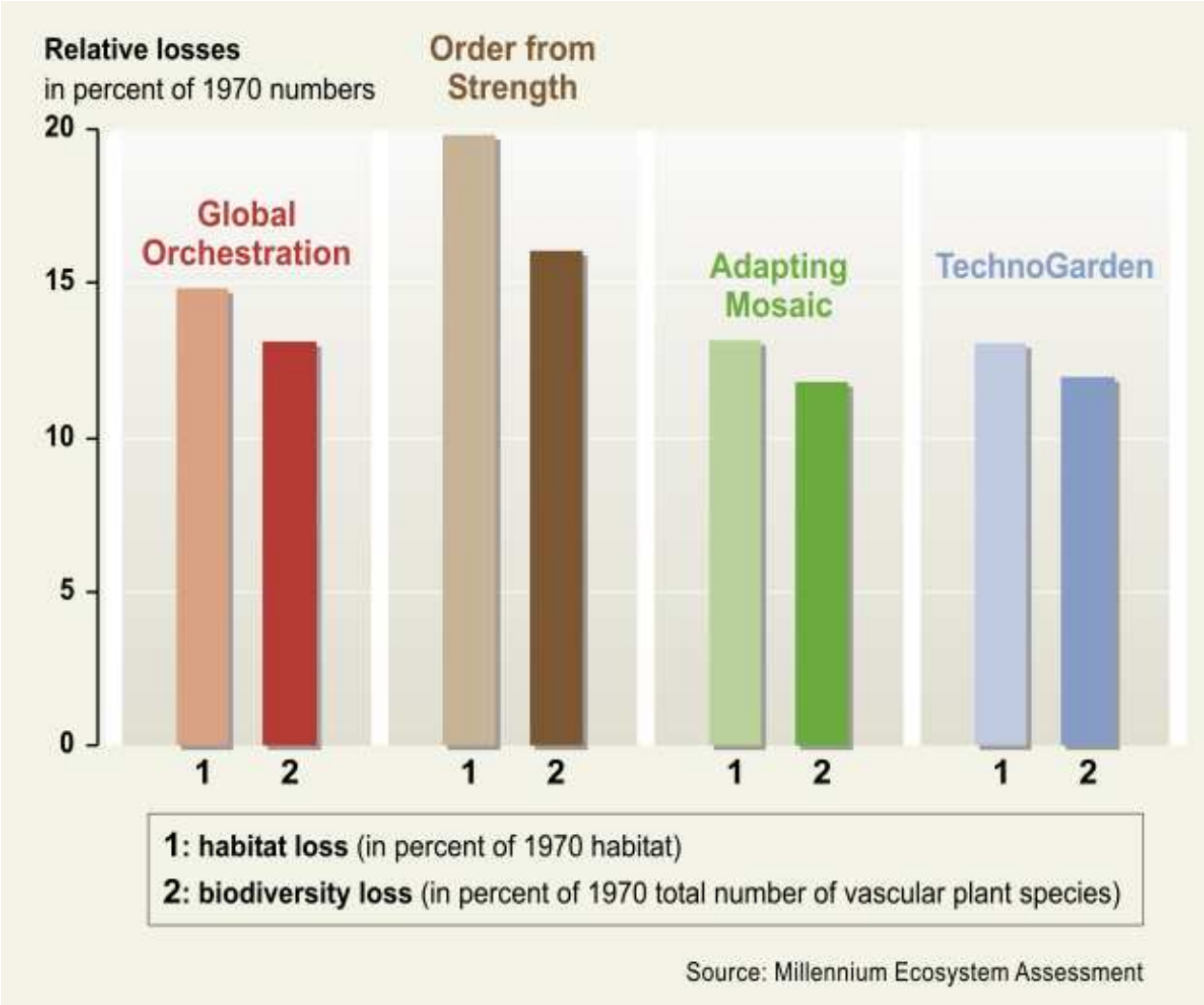
Interactions between climate mitigation and biodiversity

Projections for 2050 of habitat transformation and impacts on global plant diversity from the Millennium Assessement



Effects of Development Pathways on Climate and Biodiversity

Rapidly increasing consumption

- Continued heavy reliance on fossil fuels
- Continued high rates of deforestation
- Minor improvements in energy use & agricultural efficiency

Moderately increasing consumption

- Modest deployment of alternative energies esp. bioenergy
- Modest improvements in energy use & agricultural efficiency

- Large scale deployment of alternative energies <u>esp. bioenergy</u>
- Modest improvements in energy use & agricultural efficiency

Reduced consumption

- Large improvements in energy use & agricultural efficiency
- Modest use of bioenergy in alternative energies mix
- Protection of biodiversity esp. Intact forests

Global Biodiversity Outlook 3 - Scenarios synthesis

We find there is greater uncertainty in biodiversity projections than in previous assessments, in part because they did not examine sufficienty broad ranges of socio-economic scenarios

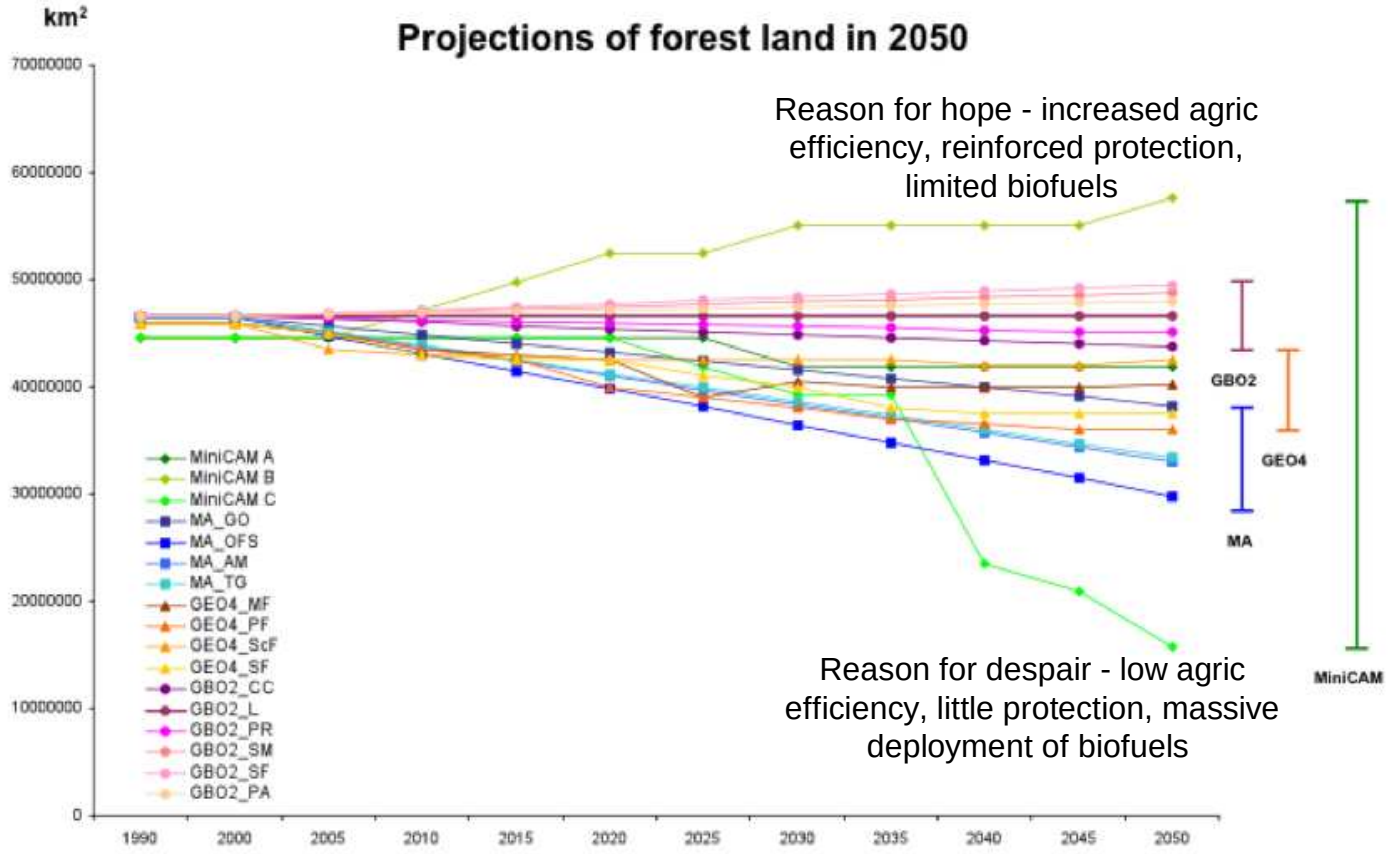
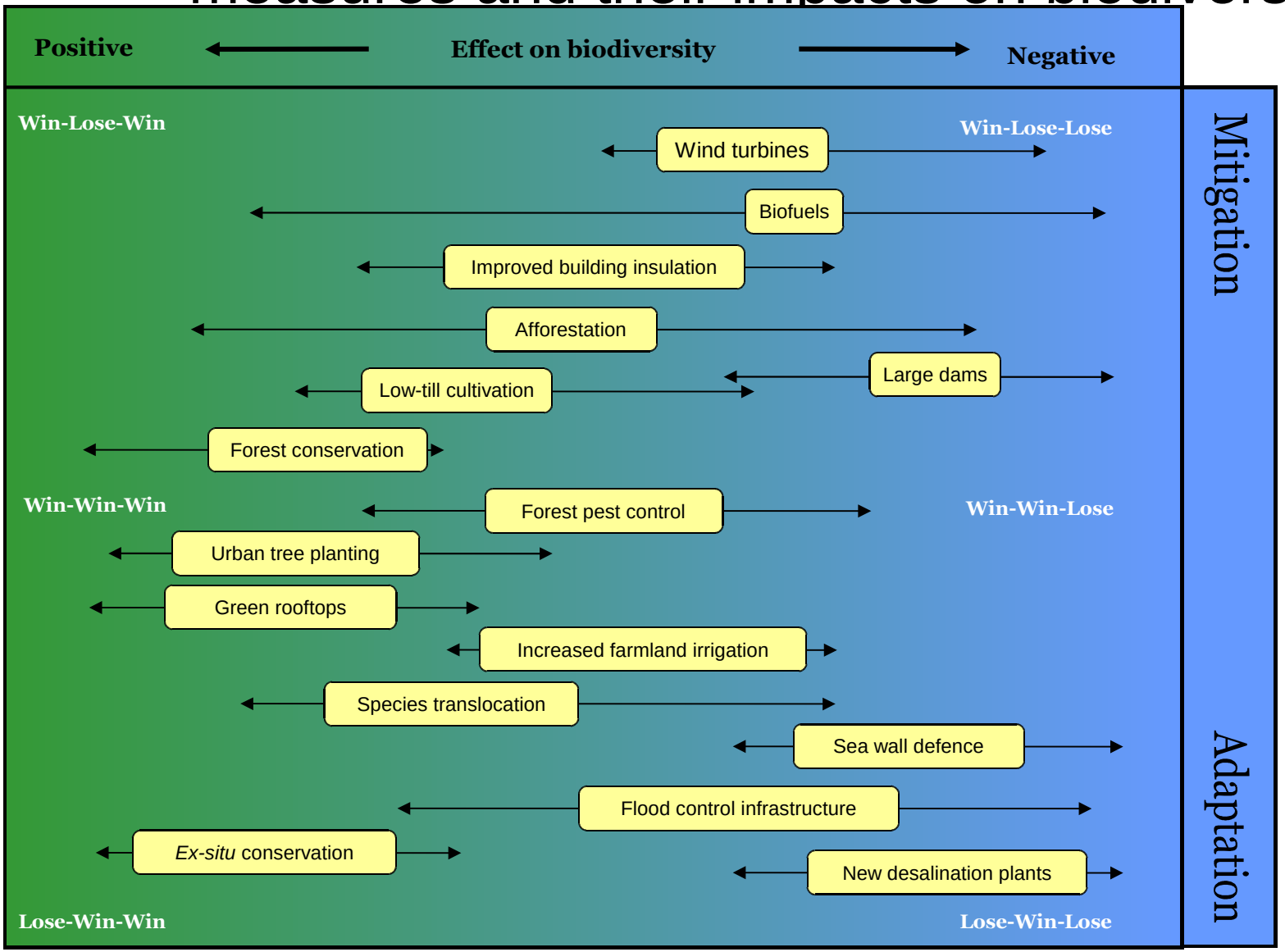


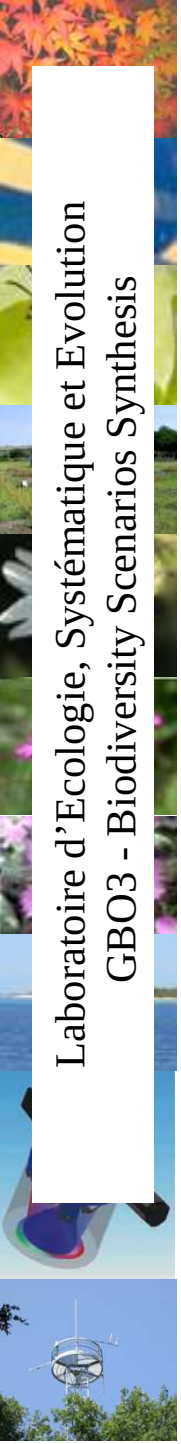
Figure 2.5. Change in forest land extent from 1990 to 2050 according to different global scenarios: MA scenarios (Sala et al. 2005), GBO2 scenarios (ter Brink et al. 2006), GEO4 scenarios (UNEP 2007) and MiniCAM scenarios (Wise et al. 2009).

The relationship between mitigation and adaptation measures and their impacts on biodiversity



From P. Berry

Paterson et al., 2008 Conservation Biology



Laboratoire d'Ecologie, Systématique et Evolution
GBO3 - Biodiversity Scenarios Synthesis

Global Biodiversity Outlook 3 - Scenarios

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UNEP WCMC

Convention on Biological Diversity

DIVERSITAS
an international programme of biodiversity science