



EUROPEAN FOREST INSTITUTE

Marcus Lindner

Biodiversity conservation and forest management in European forest ecosystems in times of climate change

Forest Biodiversity in a Changing Climate: Understanding Conservation
Strategies and Policies, Freiburg, Germany, 22-23 September 2011

www.efi.int





Outline

Intro: climate change impacts and need for adaptive forest management in Europe

Challenge: biodiversity conservation under climate change

Trade-offs or Synergies: adaptive forest management and biodiversity conservation

Recommendations: adapting conservation management

Facing Climate Change Impacts

Increased growth rates in the North



Higher risk of storm and insect damages



Shifting species suitability



More intense and frequent forest fires

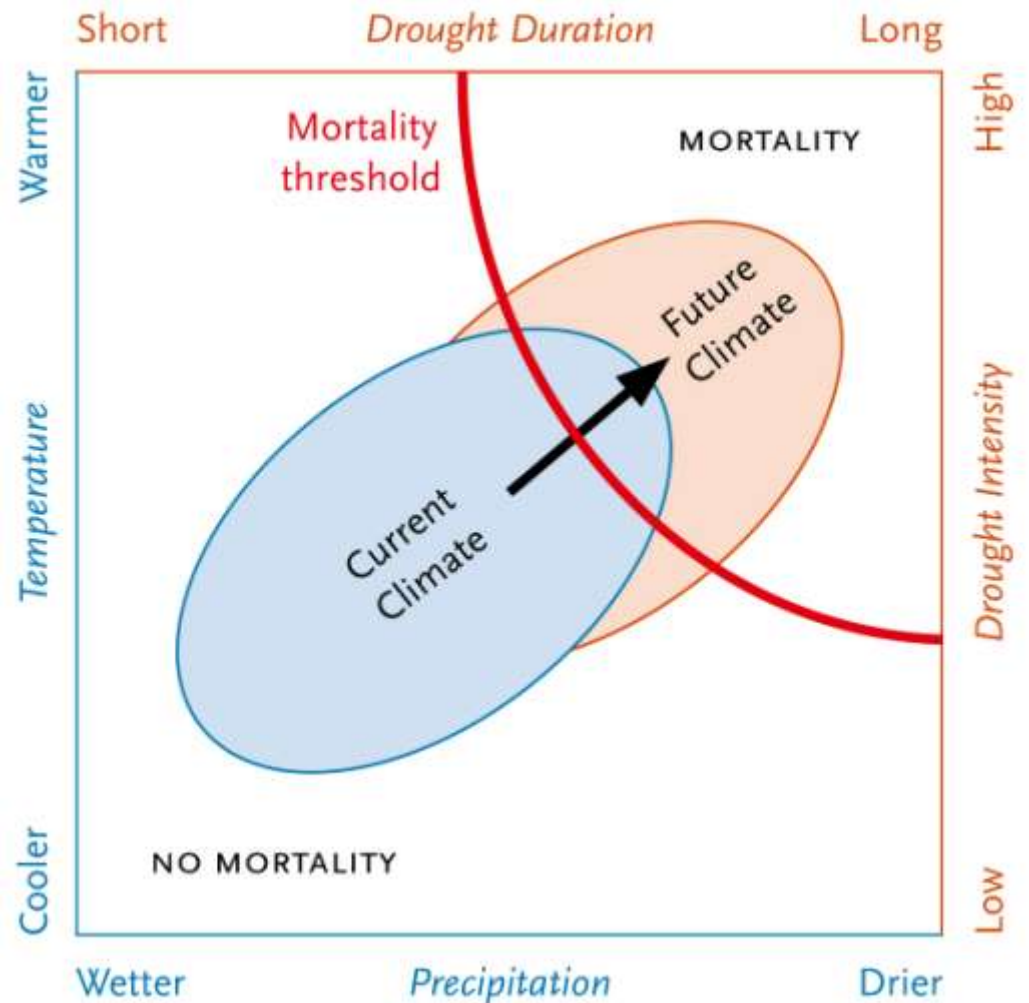


Impact of climate change on European forests

Drought

Increasing temperature and decreasing summer precipitation increases drought risk

(Allen et al. 2010. Forest Ecology and Management 259:666-684)





Impact of climate change on European forests

Storms

Since 1990, several storms have caused widespread damage in European forests

The frequency of high intensity storms is likely to increase

(Gardiner et al. 2010)





Impact of climate change on European forests

Pests



The European spruce bark beetle benefits from warm/dry summers and storm events. Pest outbreaks reach into higher altitudes
(Netherer and Schopf, 2009)





Trends in mean climate + enhanced variability

Forests and their species will have to adapt

- to long-term changes in climate
- to increased variability with more extreme weather events (e.g. prolonged drought, storms and floods)
- to shifting seasonal water availability
 - in most regions winter precipitation is projected to increase
 - summer precipitation is likely to decline especially in central and southern Europe



The Challenge:

Biodiversity conservation under climate change

“It is no longer safe to assume that all of a species' historic range remains suitable [...]

Plans and assumptions about protected areas need to be reconsidered!”

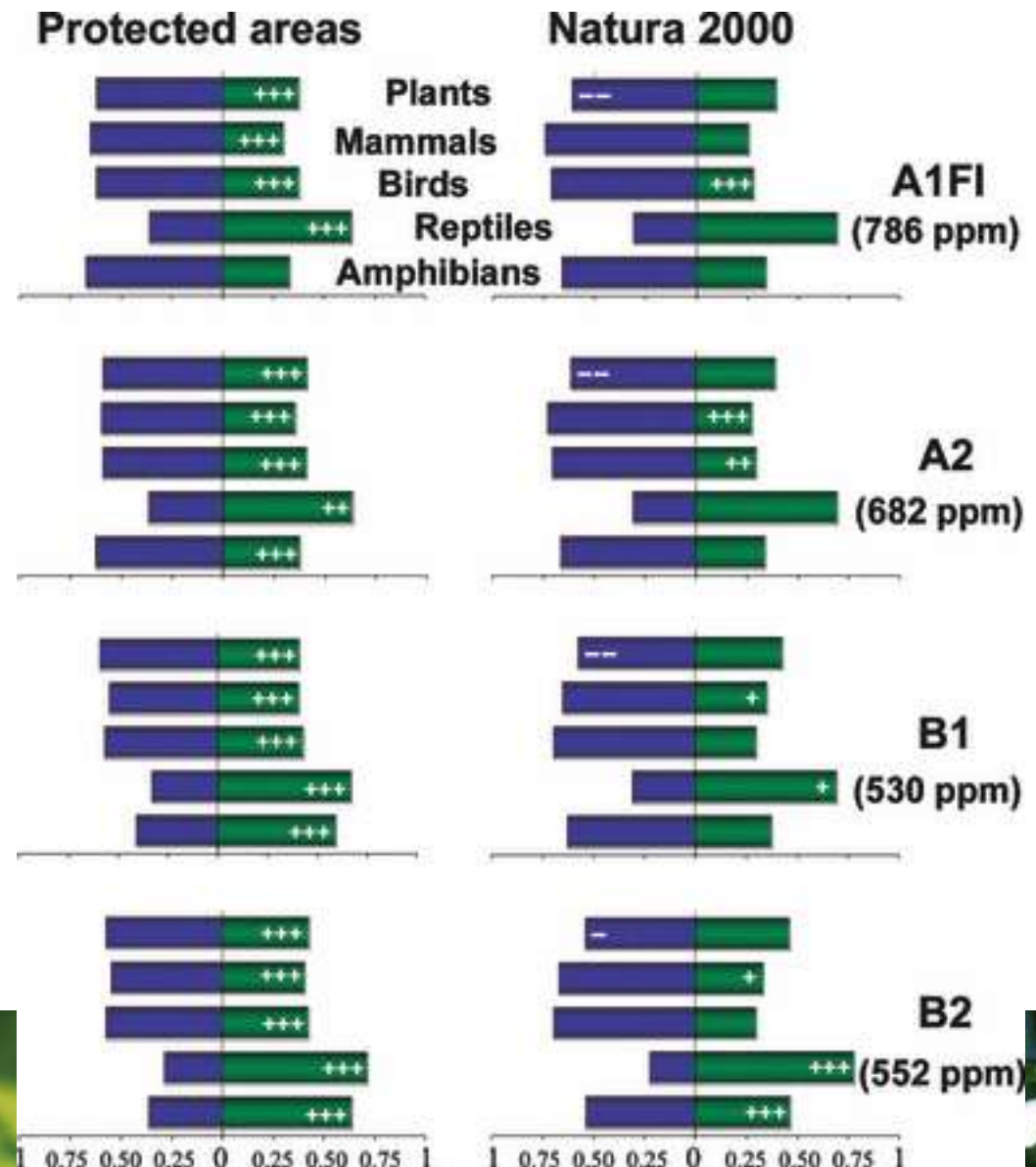
McCarty (2001), Conservation Biology 15, 320-331.



Climate Change and species in European conservation areas

Proportion of species projected to **gain climatic suitability** in European conservation areas under four emission scenarios by 2080 (**winners; green**) or **lose (losers; blue)**

Araújo et al. 2011. Ecology Letters 14, 484–492





Focus of biodiversity conservation



- ❑ Flagship species (e.g. Capercaillie) are usually important targets of biodiversity conservation

Many of such rare species are likely to lose their habitats in a future climate

- ❑ Protected areas were often established to conserve traditional landscape features that became threatened by intensive land use practices

Aktionsplan
AUERHUHN

- KURZFASSUNG -

Juli 2009

Rudi Suchant, Veronika Braunsch, Judith Ehrlicher



Climate change and conservation policies

“Climate change is a severe challenge for established conservation policies, which by nature are conservative, focusing on preserving existing species and ecosystems, or even restoring what has been”

Niels Strange et al. (forthcoming): Conservation policies and planning under climate change, Biological Conservation

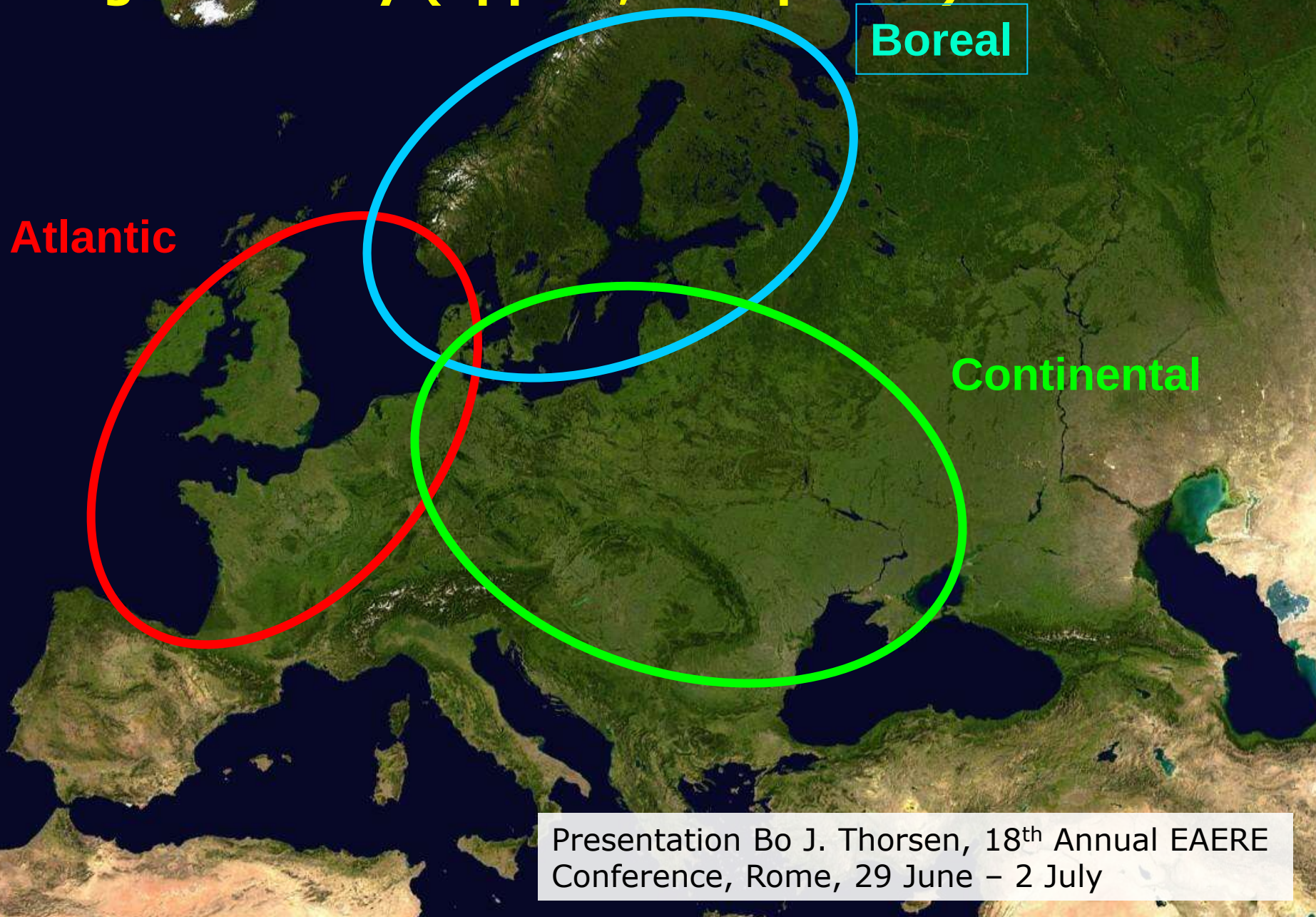


Climate change and conservation policies

What should be the focus of biodiversity conservation under climate change?

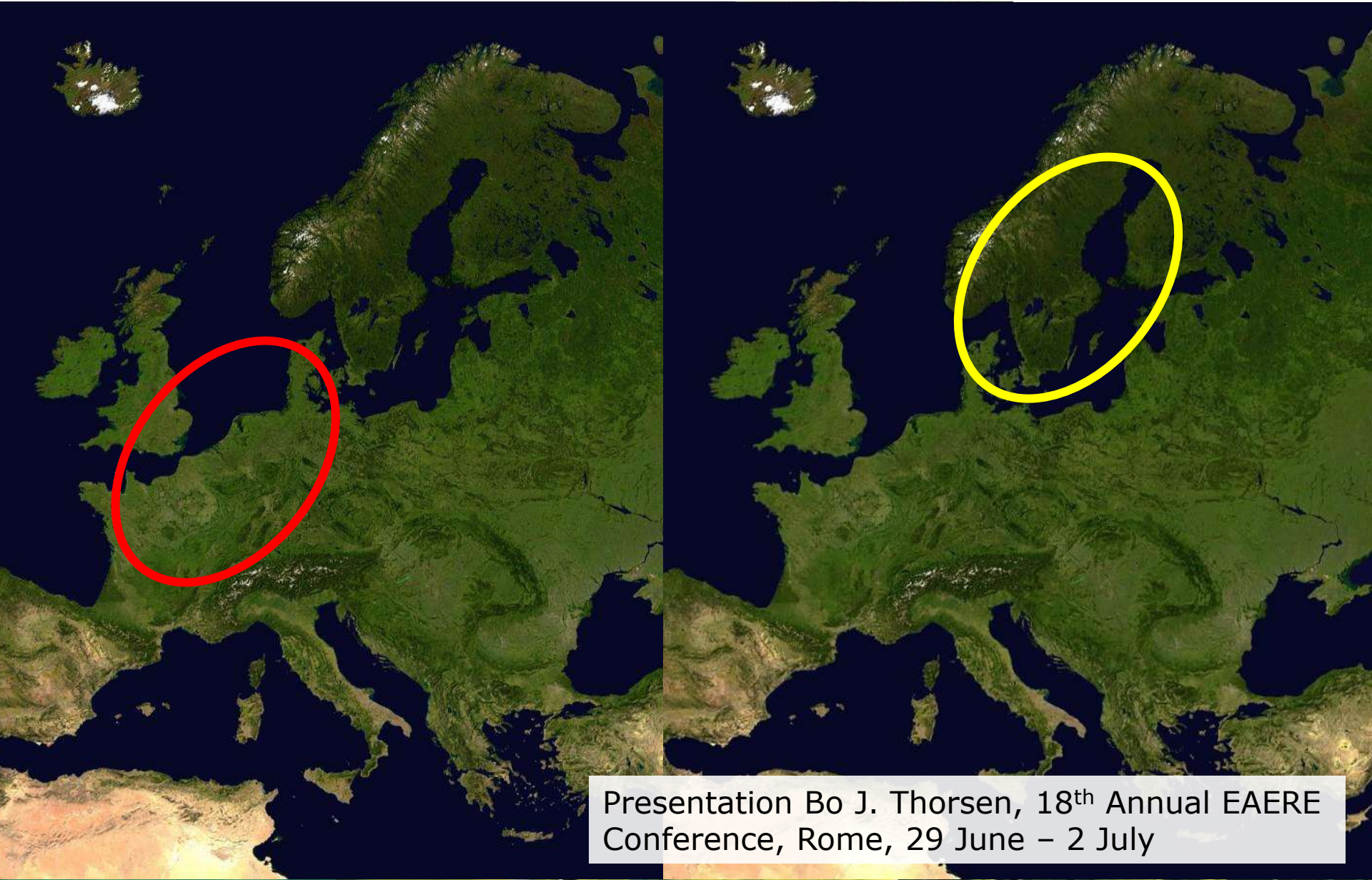
- ☐ Currently present rare species?
- ☐ Immigrating rare species that loose their current habitats?
- ☐ Currently common species, that might become threatened in the future?

**DK a small country – very few nature areas –
large diversity (app 30,000 species)**



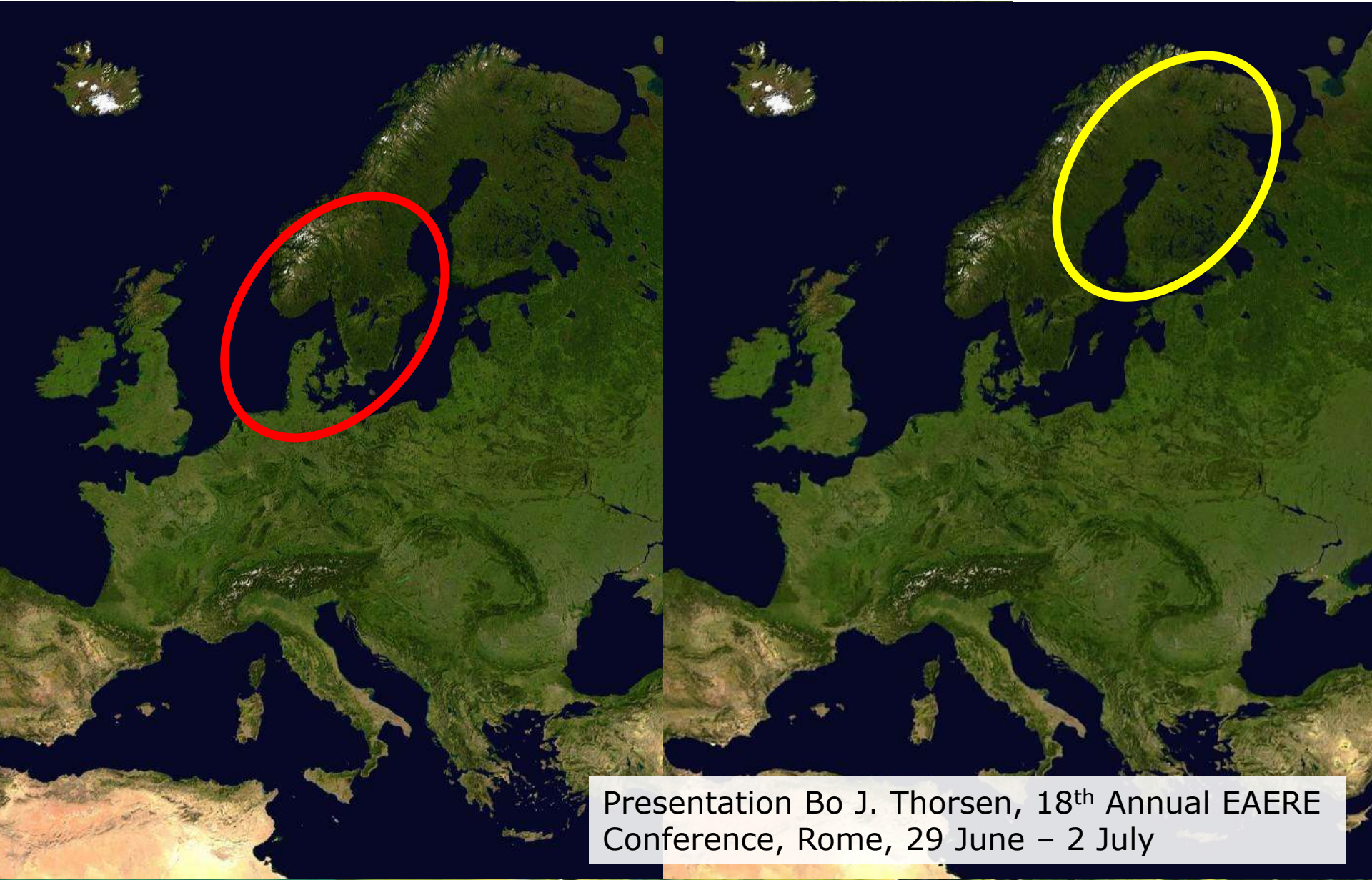
Presentation Bo J. Thorsen, 18th Annual EAERE
Conference, Rome, 29 June – 2 July

Potential change effects of climate change:



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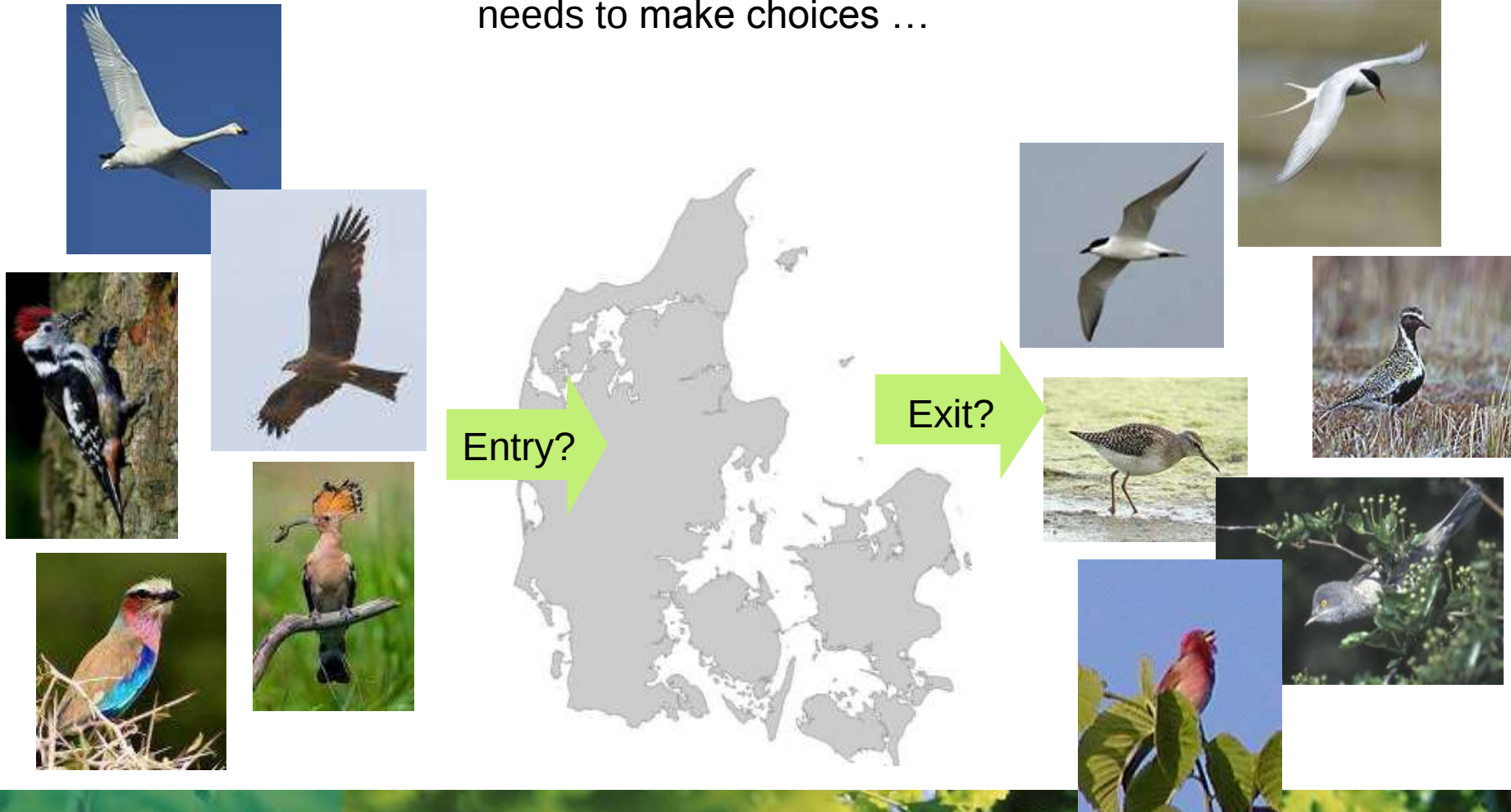


Presentation Bo J. Thorsen, 18th Annual EAERE
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Some species more likely to e/im-migrate:

Conservation management
needs to make choices ...





The conservation management dilemma: Where should we direct our effort with CC?

☐ A Native Species Focus

- Should we focus our effort on protecting species native to a geopolitical area and fight to protect them in spite of CC pressures?
- And how do we address the issue that these species may change distribution within the area?

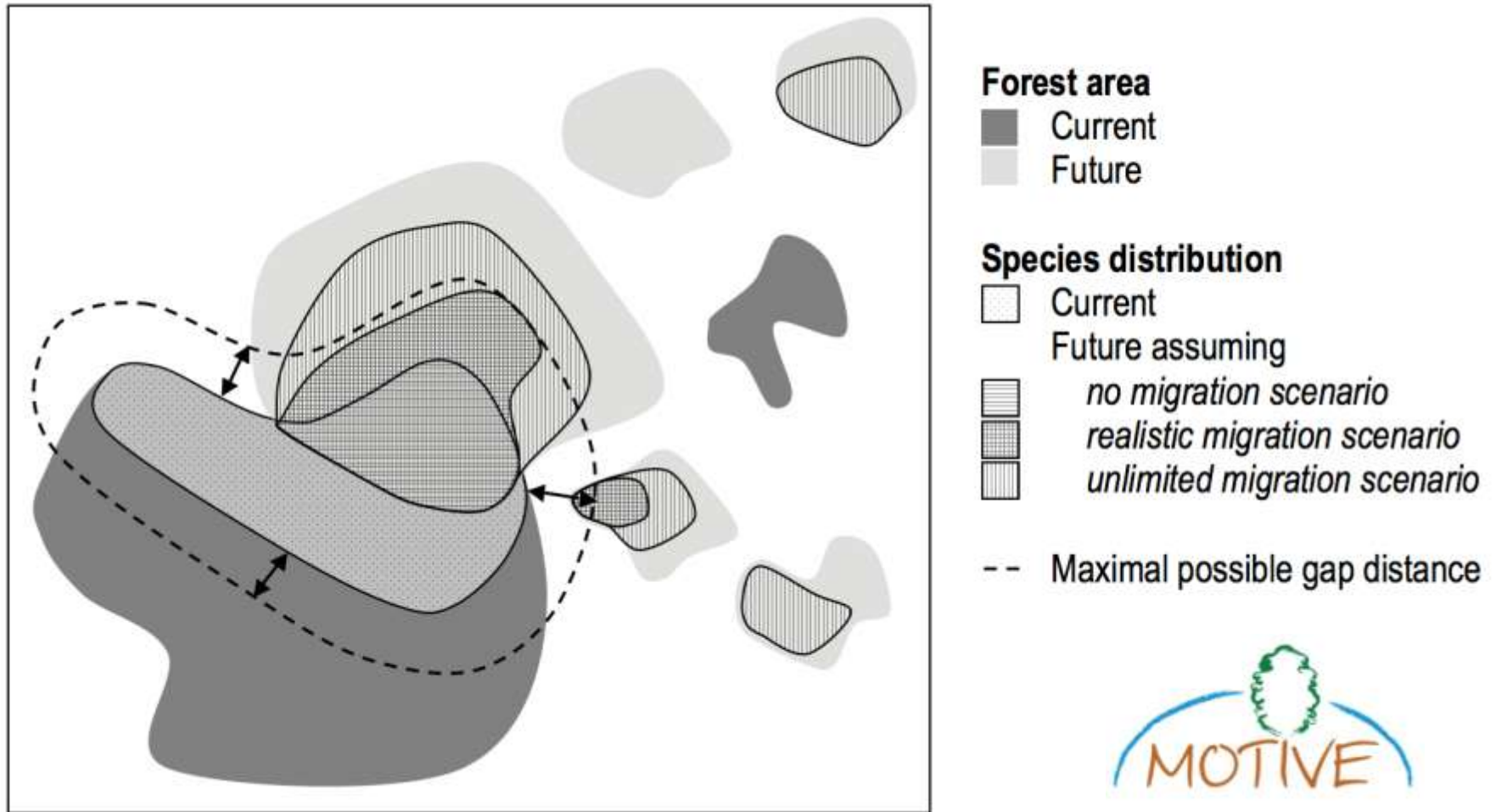
☐ An All Species Focus

- Should we instead give equal weight to the protection of immigrating species – climate refugees - as well as native?
- How do we address the issue that these species may be in need of protected habitats different from those the current native biodiversity depend on?



Projecting future distribution ranges

(Meier et al. 2011, Global Ecology and Biogeography)



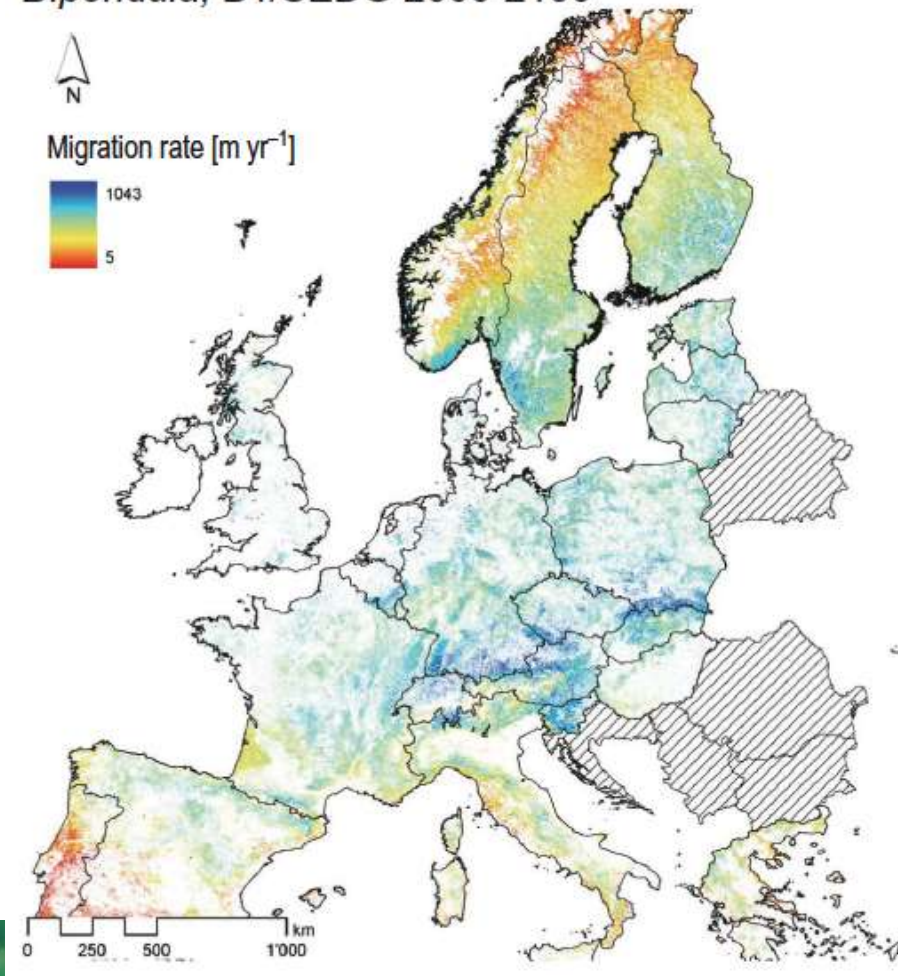


Modeled annual migration rate

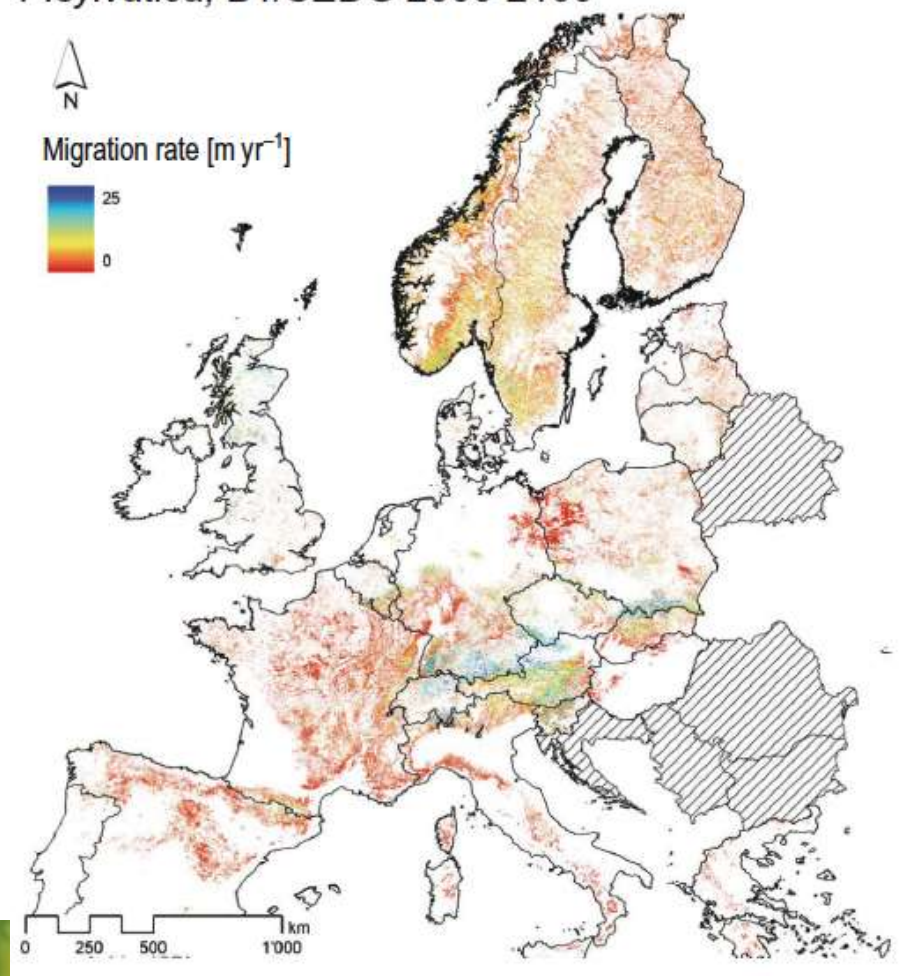
- (time lags corrected for L-fragmentation)



B.pendula, B1/SEDG 2000-2100



F.sylvatica, B1/SEDG 2000-2100





Future projected species distribution of birch and beech; Hybrid SDM and tree migration

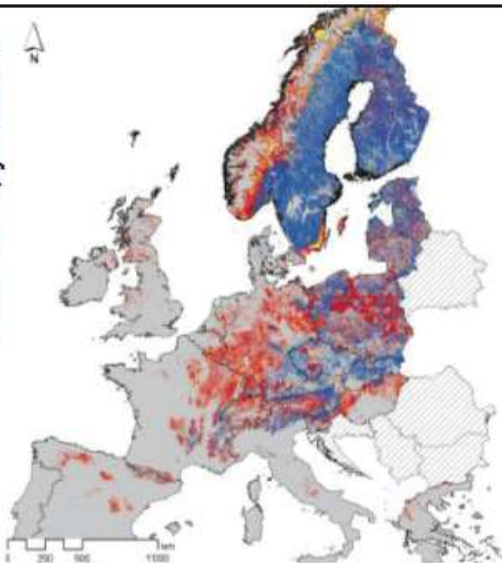


B.pendula

- No migration scenario
- Realistic migration scenario
- Unlimited migration scenario

- *B.pendula* in ICP Forest Level 1
- Areas of model predictions
- Additional areas for model calibration

A1fi/GRAS, year 2050



A1fi/GRAS, year 2100

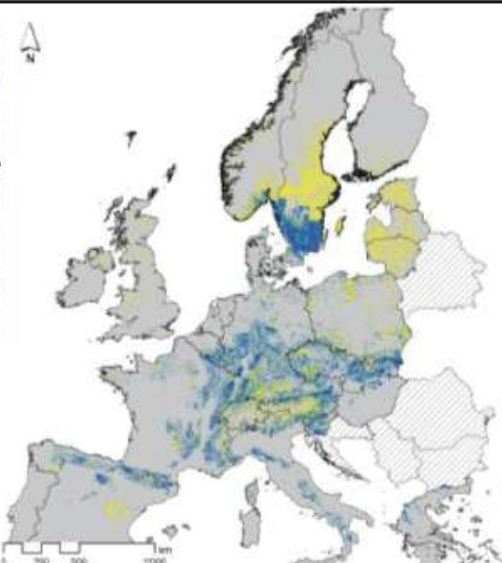


F.sylvatica

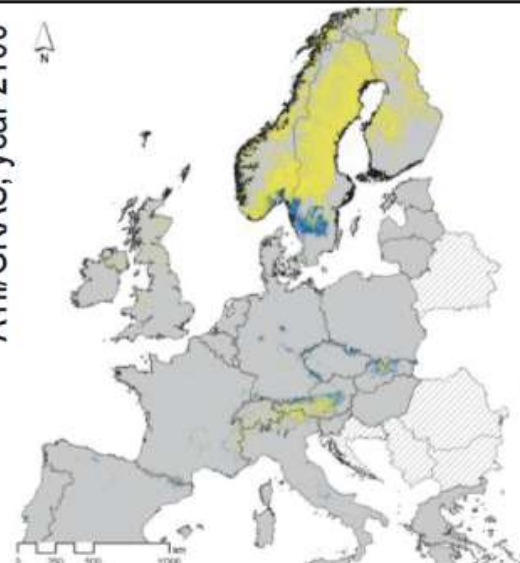
- No migration scenario
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- *F.sylvatica* in ICP Forest Level 1
- Areas of model predictions
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A1fi/GRAS, year 2050



A1fi/GRAS, year 2100





Adaptation measures review

Study "Impacts of climate change on EU forests and options for adaptation"; DG Agri 2008

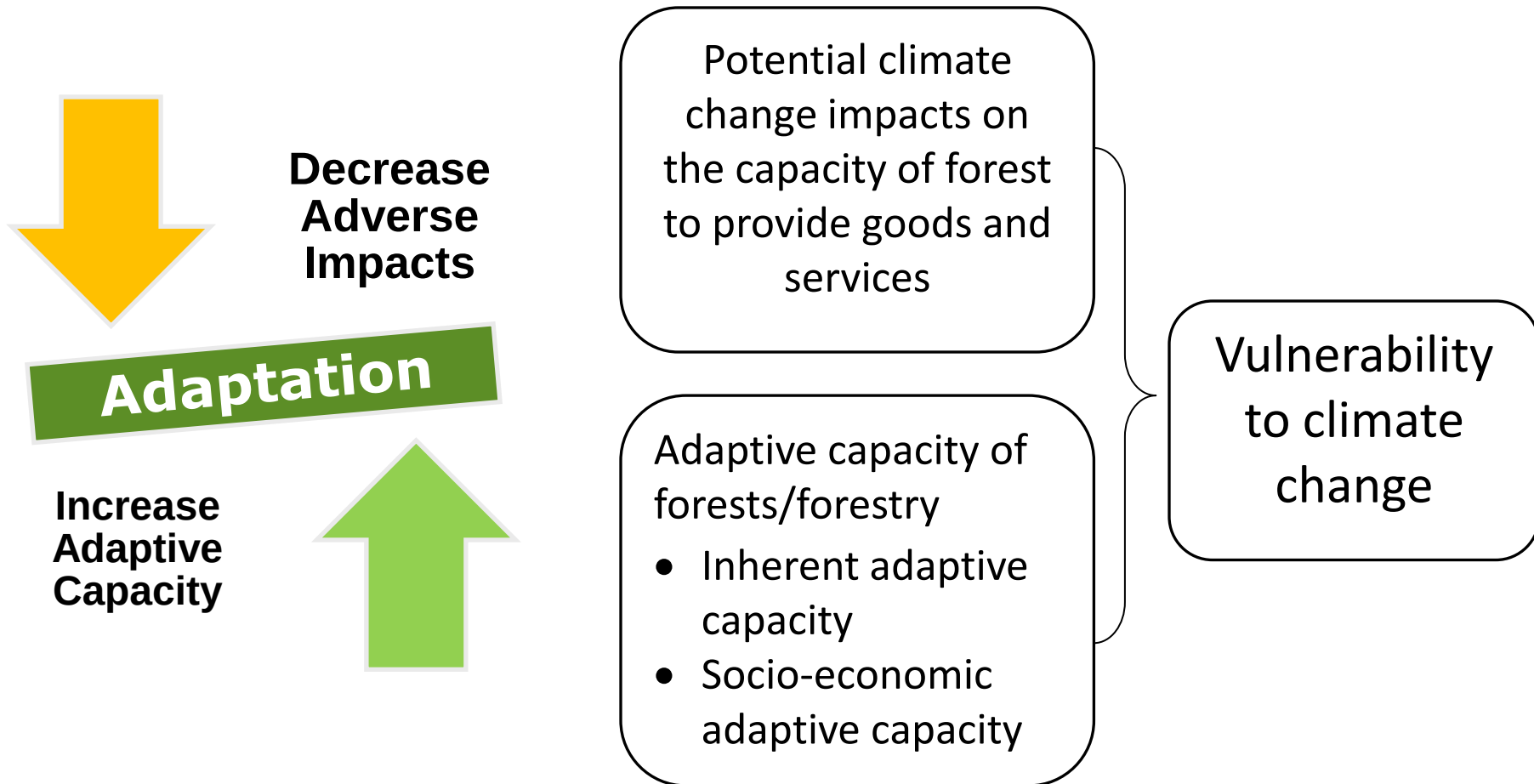
- Scientific perspective based on literature review
- Survey of ongoing and planned measures in EU member states
(Questionnaire to Ministries and national research institutes)

COST Action FP0703 ECHOES "*Expected Climate CHange and Options for European Silviculture*" 2007 – 2012

- Database of adaptation measures in 19 European countries



Adaptation for reduced CC vulnerability





Adaptation strategies at different levels

Level of action

Stand level

Adaptation actions

- forest regeneration
- tending and thinning of stands
- harvesting

Forest management

- management planning
- forest protection

Policy level

- infrastructure and transport
- nurseries and forest tree breeding
- further adaptation options in risk management and policy



Regeneration

- Manipulation of species and stand composition
- Enhance genetic diversity
- Natural regeneration
 - Using multiple fruiting years
 - Enrichment sowing and planting
- Artificial regeneration
 - Mixing seedlings from different seed stands
 - Plant productive species from other regions



Photo T. La Mantia



Tending and thinning

- To favour mixed stands of suitable tree species
- Diverse tree composition and ground vegetation
- Intensified thinning





Harvesting

- Small scale harvesting interventions
- Systems which support natural regeneration
- Diverse harvesting practices





Management planning

- Reduced rotation length in response to increased growth rates and to lower the risk of financial losses from disturbances

→ Loss of large diameter trees





Risk management

PESTS AND FIRE

- Removal of forest residues
- Wind throw clearings
- Sanitation fellings
- Removal of dead trees





Infrastructure and transporting

- Dense forest road network to small-scale thinning and harvesting practices
- Support to mitigate large scale disturbance impacts

→ Fragmentation of ecosystems





Possibilities for Targeted Adaptation in Conservation Management

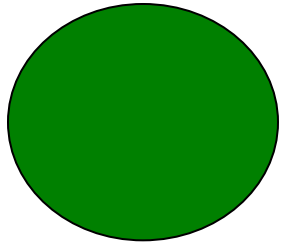
Focus: Protected Areas (MSc thesis Sophie Lewis, 2010)

Imperial College
London



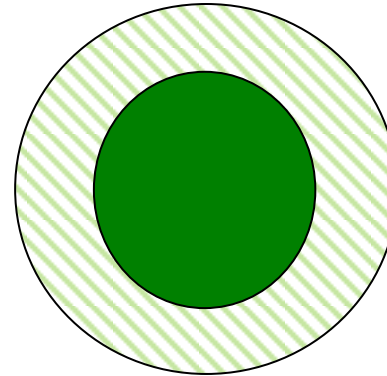
Adaption Strategies

1



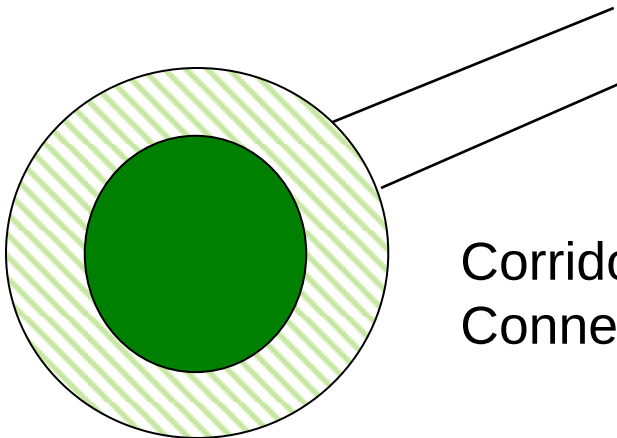
Core Areas

2



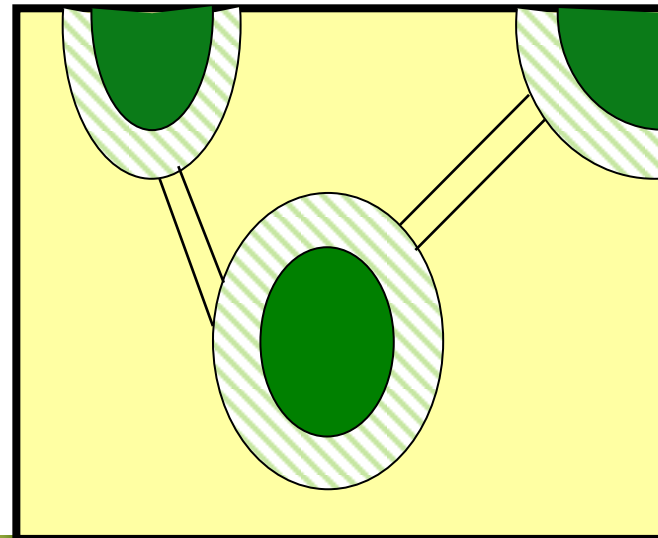
Buffer zones

3



Corridors /
Connectivity

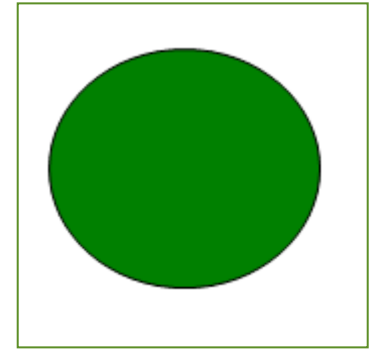
4



Protected
Area
Network



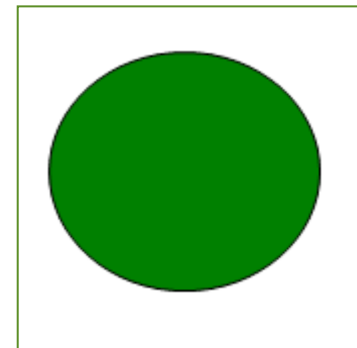
Core protected area design



- Large/Extended areas are more likely to contain viable populations of species. Species are less affected by fragmentation (McNeely 1994; Hannah 2008; Virkkala *et al.* 2008)
- High latitudinal/longitudinal and topographic diversity will provide local variation in climatic, edaphic and hydrologic habitat features, thus increasing the likelihood of a species being able to adapt to changing temperatures (Halpin 1997, Li *et al.* 2006)
- High habitat diversity enhances resilience of forest biodiversity (Graham 1988)



Core protected area management

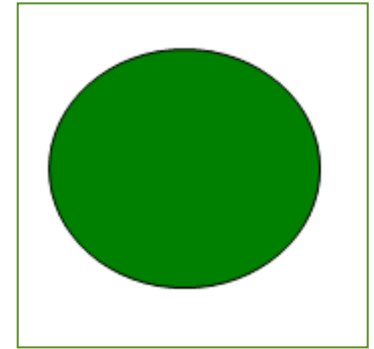


- Restoring populations of threatened and endangered species
 - Increasing population size and genetic diversity
- Managing to reduce future stresses
 - Invasive species, pests, and disease
- Managing to reduce browsing pressure

Browsing may prevent plant species from shifting their ranges and migrating to higher altitudes (Hulme 2005)



Core protected area management



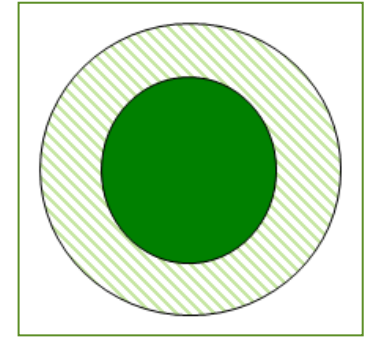
- Continual review of management strategies to deal with uncertainties (Hannah *et al.* 2002):

(1) scenario-building, (2) enhanced monitoring and (3) biological survey work, (4) review and revision of adaptive management strategies

- Close monitoring of species that are likely to be threatened by climate change (Skov & Svenning 2004)



Buffer zones



- No tilling, close to nature forestry
- Aid in species range shifts

Species may shift their range outside the protected forest area into the buffer zone, therefore an agreement with the land-owners of the buffer zone that states that the protected area may be extended into the buffer zone, may potentially be a good adaptation strategy (Hannah *et al.* 2002).

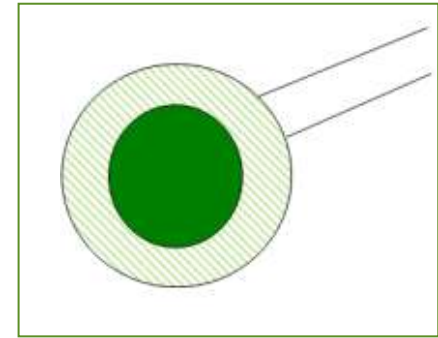
- Help maintain microclimate





Corridors

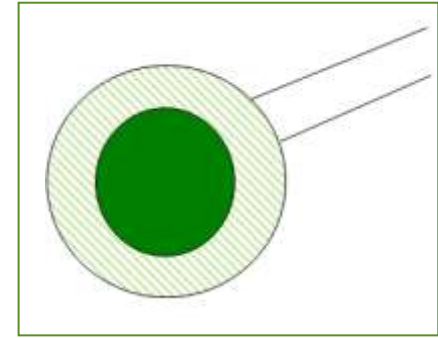
- Continental scale corridors could aid in species range shifts, they should
 - run parallel to longitudinal, altitudinal and coastal-inland gradients (Graham 1988, Kettunen *et al.* 2007) regardless of any political boundaries (Li *et al.* 2006).
 - be designed considering the most sessile species
 - offer functional and physical connectivity



European Green Belt (2006).
The Green Belt Initiative



Corridors – counter arguments

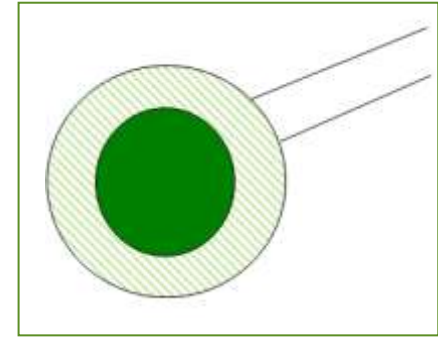


- Little supporting evidence of actual effectiveness in assisting species migrations (Bailey 2007).
- Corridors are insufficient in aiding the dispersal of slow migrating species (Pearson & Dawson 2005)
- Can potentially harm biodiversity by spreading pests, disease, invasive species, and fire (Simberloff *et al.* (1992)





Assisted Migration:

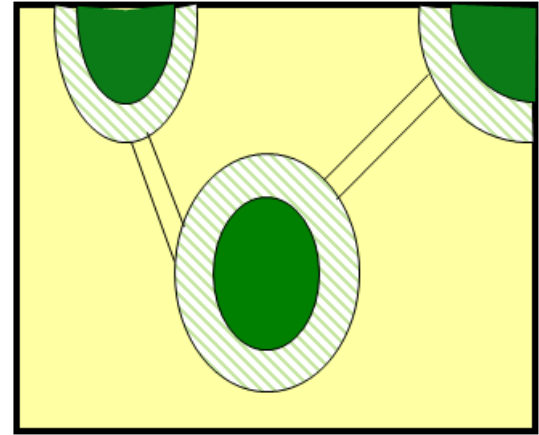


- Species with slow dispersal rates such as forest plants may be candidates for assisted migration (Honnay *et al.* 2002)
- Crossing barriers of species dispersal
- Active ecological restoration of appropriate sites for species in new locations may aid the implementation of assisted migration (Harris *et al.* 2006; Ibanez *et al.* 2006).





Protected Area Network Throughout Europe



- More protected areas could help preventing species extinctions Hannah *et al.* (2007)
- More altitudinal & latitudinal/longitudinal variation (Halpin 1997)
- Include areas of major transitions between vegetation formations
- Create networks of protected areas to reduce barriers and obstacles between them (Mansourian *et al.* 2009)
- Protect refugia sites (Hannah *et al.* 2002)





Choices for Conservation Management under Climate Change

“Future conservation efforts should be fully aware that the distribution of biodiversity, and species of concern, will be dramatically altered by climate change and that increased extinctions risk is one of the possible outcomes. [...] Conserving biodiversity will require approaches above and beyond those that are currently implemented in Europe”

Araújo et al. 2011. Ecology Letters 14, 484–492



Choices for Conservation Management under Climate Change

- Traditional conservation policies are not suitable for changing environmental conditions
- There is a need for a paradigm shift in conservation management!
- Future biodiversity protection policy needs to be holistic and planned across borders



Choices for Conservation Management under Climate Change

- Reclassifying existing conservation areas can improve conservation outcome (*Fuller et al. 2010, Nature 466*)
- Designation of new conservation areas might be needed
- Integrated management of landscapes to facilitate species movements (*Araújo et al. 2011*)



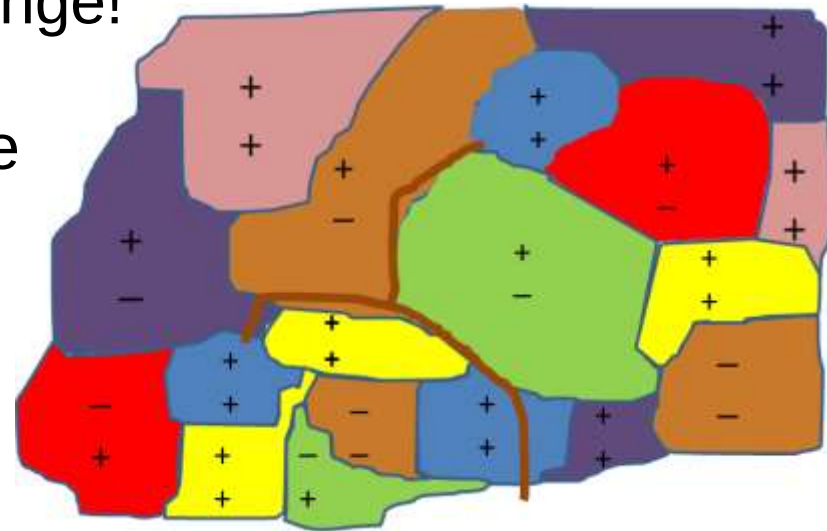
My personal conclusions:

Which species to focus on?

- ❑ All species require attention – don't wait too long before adjusting the conservation focus!

Process-oriented biodiversity conservation approaches are mandatory under climate change!

Be aware of trade-offs in adaptive management strategies and make use of combining different strategies





Thank you for your attention!

I would also like to acknowledge

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Nick Zimmermann

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Contact:

Marcus.Lindner@efi.int