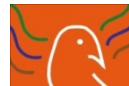
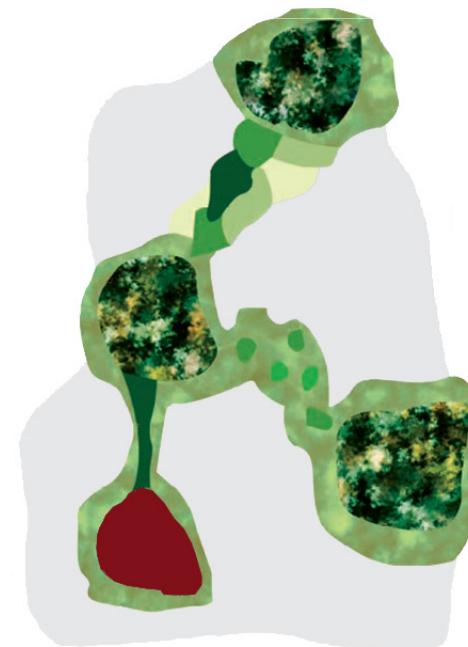
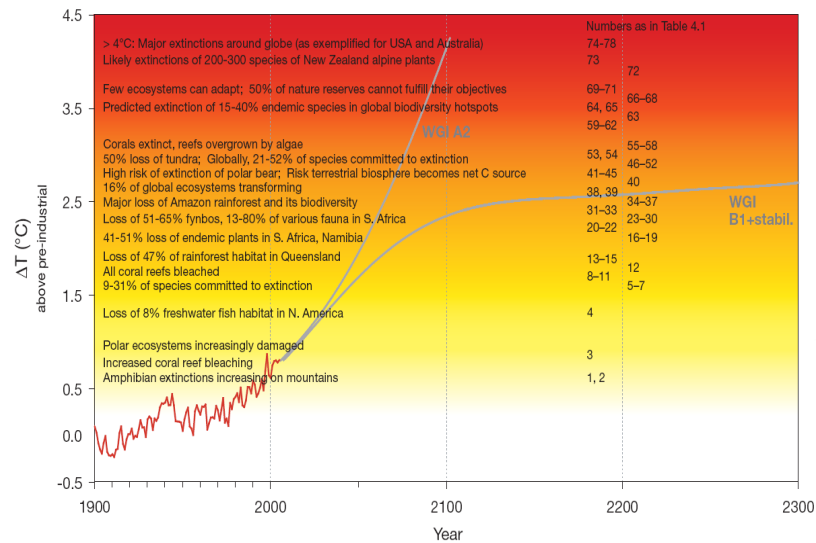


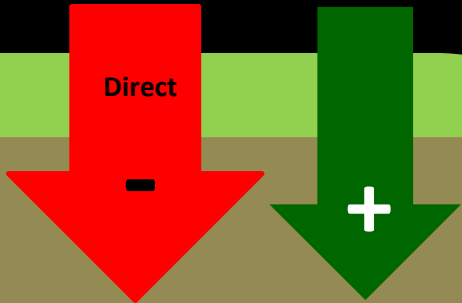
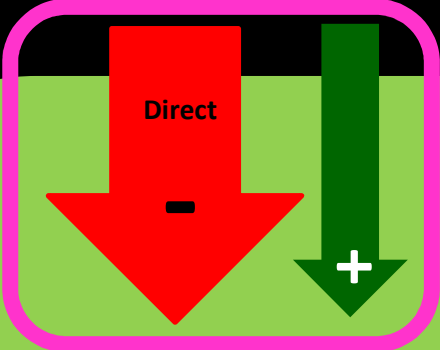
Protected areas, biodiversity and climate change in Europe: challenges, opportunities and potential responses



Yves de Soye, January 2010

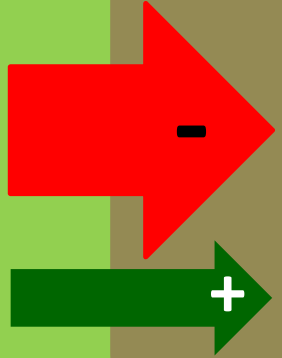


Climate change & impacts on physical environment



Human society

Biodiversity and ecosystem services



Direct impacts of climate change on biodiversity in Europe

Reviews in 2008 - 2009

Secretariat of the Convention on Biological Diversity

CRD Technical Series No. 42

REVIEW OF THE LITERATURE ON THE LINKS BETWEEN BIODIVERSITY AND CLIMATE CHANGE

Impacts, Adaptation and Mitigation

Convention on Biological Diversity

UNEP



T-PVS/Inf (2009) 10 rev

CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE AND NATURAL HABITATS

Standing Committee
29th meeting
Bern, 23-26 November 2009

PROTECTED AREAS AND CLIMATE CHANGE IN EUROPE

Report prepared by
Professors Miguel B. Araújo
National Museum of Natural Sciences, CSIC, Madrid, Spain &
Rui Nabarro Biodiversity Chair, CIBIO, University of Évora, Portugal

With contributions by Ms. Raquel Garcia

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MACIS

Minimisation of and Adaptation to Climate change Impacts on biodiversity

Deliverable 1.1:
Climate change impacts on European biodiversity – observations and future projections

Specific targeted research project (STREP)

Contract period 01 November 2006 – 31 October 2008
Contract no. 044399 (SSPI) MACIS

Authors
Jürgen Olofsson, Thomas Hickler, Martin T. Sydes, Miguel B. Araújo, Emilio Balatto, Pam M. Berry, Simona Bonelli, Mar Cabeza, Anne Dubuis, Antoine Clausen, Ingolf Kühn, Heini Kujala, Jake Piper, Mark Hounsome, Josef Setälä and Wilfried Thuiller

and MACIS Co-ordination Team

April 2008

Project Website www.macis-project.net

1 MACIS D 1.1

Impacts of climate change and selected renewable energy infrastructures on EU biodiversity and the Natura 2000 network

Task 1 – Impacts of climate change on EU biodiversity: evidence and modelling results

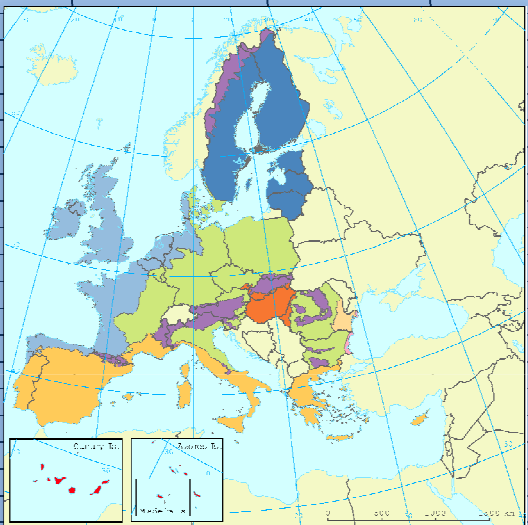
This report was prepared by:

Nikki Hodgson, Eleanor Glen, Mike Harley, Maria Pooley, Todd Sajwaj, Roxi Schiopu (all AEA) and Yves de Soye (IUCN).

August 2009, updated version of October 2009

Task 1: Climate change impacts: evidence & models

Biogeographic zone	Alpine	Atlantic	Black Sea	Boreal	Continental	Macaronesian	Mediterranean	Pannonian	Steppic
Physical effects									
Increase in sea level and coastal flooding	N/A	OE MP		CM		OE			
Increase in annual average temperature	OE MP	OE MP	OE	OE MP	OE	OE MP	OE MP	OE MP	
Increase in extreme weather events		OE MP		MP	OE			MP	
Increased drought	OE MP	OE	OE		OE	OE MP	C MP	OE MP	
Increased precipitation, run-off and flooding	OE MP		OE	OE MP	OE				
Change in snowlines and duration	OE MP	MP							
Increased carbon dioxide		OE MP		OE MP		OE			
Increased forest fire	OE MP			OE	CO				
Increased disease and infestation	OE MP			OE MP					
Increased rate of change in temperature	OE								
Shifts in water quantity and quality			OE		OE				
Decreased river discharge			OE MP						
Increased biomass and carbon sequestration				OE MP	OE MP				
Decreased plant productivity						OE			
Increased humidity						OE MP			
Increased ocean acidification						OE			
Effects on biodiversity and ecosystems									
Altitudinal movement of plants/animals/habitats	OE MP	MP			OE MP	OE			
Latitudinal movement of plants/animals/habitats		OE MP		MP	OE MP				
Seasonal changes in plants		OE							
Changes in limiting resources									
Increase in species richness	OE MP			OE MP					
Earlier life cycle events		OE	OE	CO					
Decreased life cycle events						OE			
Longer growing season		OE	OE	OE	OE				
Range contraction and extinction	OE MP				OE MP	OE	OE		
Gain in climate space	OE MP	OE MP		MP	OE MP	OE			
Loss in climate space	OE MP	OE MP							
Loss of glacial extent	OE								
Land use constraints		OE							
Breeding decline and sea level rise		OE							
Increase in species competitive advantage									
Increased invasive species									
Loss of wetlands									
Decoupling of species interactions		OE							
Increased species mixing									
Vulnerability									
Identification of vulnerable species and/or habitats	OE	OE MP							
Identification of resilient species and/or habitats									
KEY									
Observed evidence exists and showing impact - OE									
Model prediction exists and showing impact - MP									
Contradiction in observed literature CO									
Contradiction in modelled literature CM									
Not applicable N/A									



Data gaps :

- Macaronesia, Mediterranean & Eastern EU
- Majority of EU species, esp. species of Community Interest
- Habitats and species interactions
- Vulnerability of species and habitats

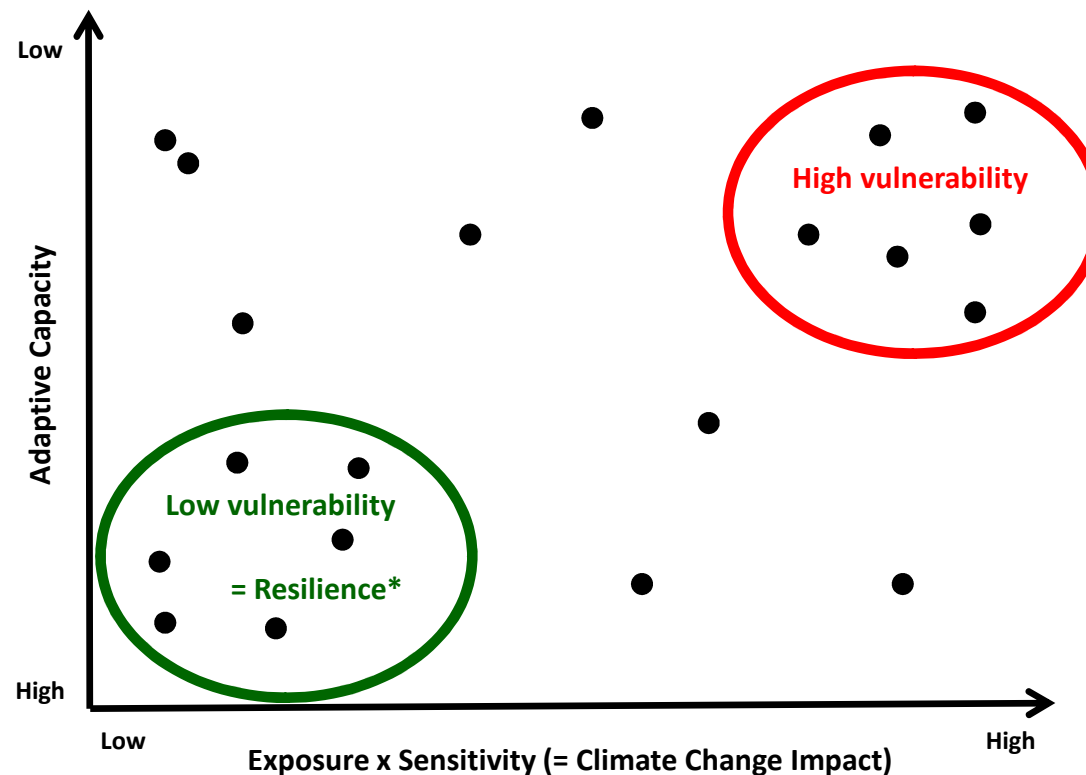
Task 2a and 3a: N2000 species & network vulnerability

Vulnerability assessment - necessary terminology (IPCC AR4, 2007):

- **Impact** - a function of **exposure** and **sensitivity**;
- **Adaptive capacity** - stay and adapt, or track changing climate;
- **Vulnerability** - a function of exposure, sensitivity, and adaptive capacity.

⇒ ***Vulnerability = Impact / Adaptive Capacity***

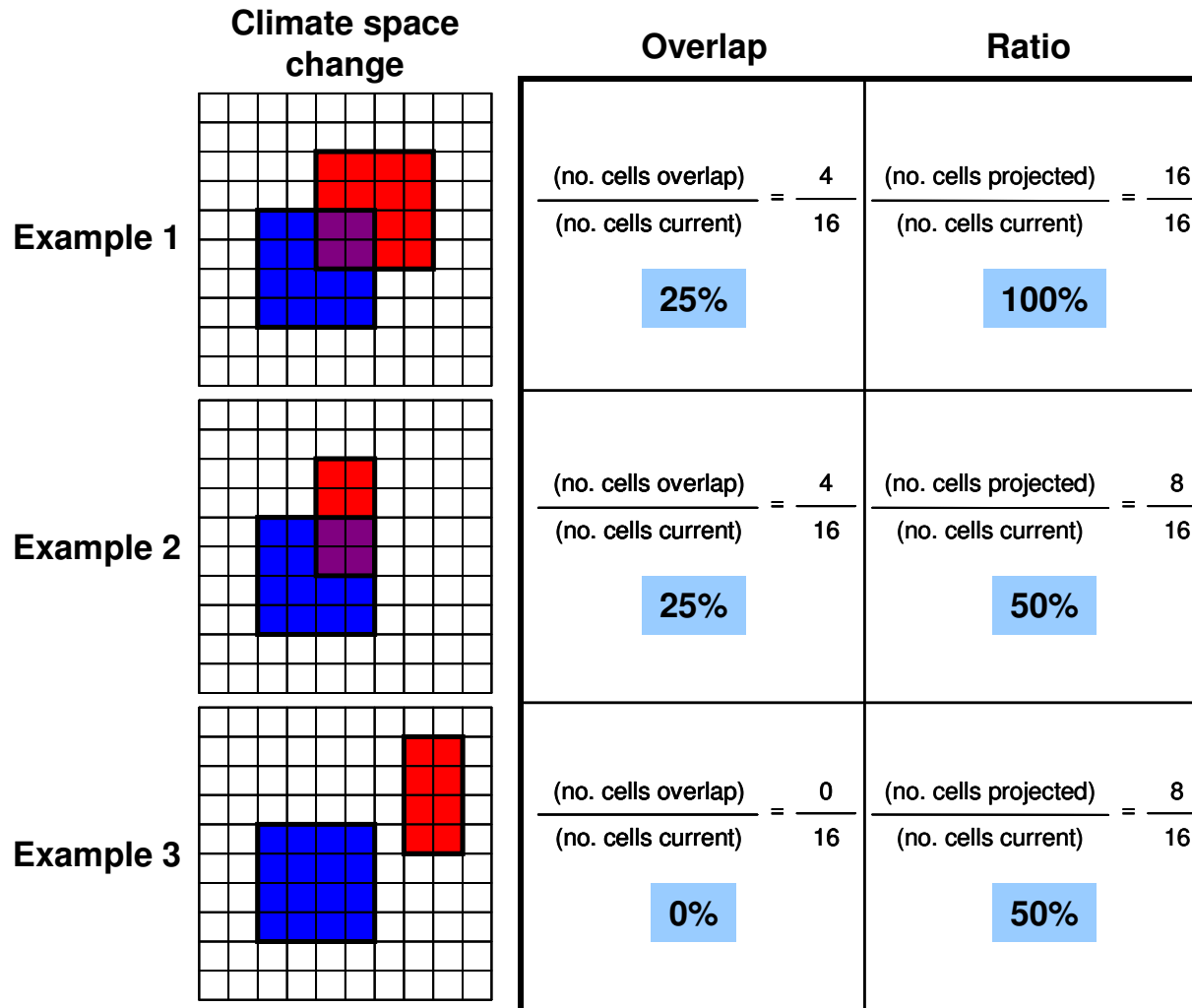
⇒ ***Vulnerability = Exposure x Sensitivity / Adaptive Capacity***



Vulnerability = Exposure x Sensitivity / Adaptive Capacity:



Changes in potential suitable climate space: Overlap & Ratio



Task 2a and 3a: N2000 species & network vulnerability



Vulnerability = Exposure x Sensitivity / Adaptive Capacity:

0 = no constraint on adaptation
 1 = moderate constraint
 2 = severe constraint



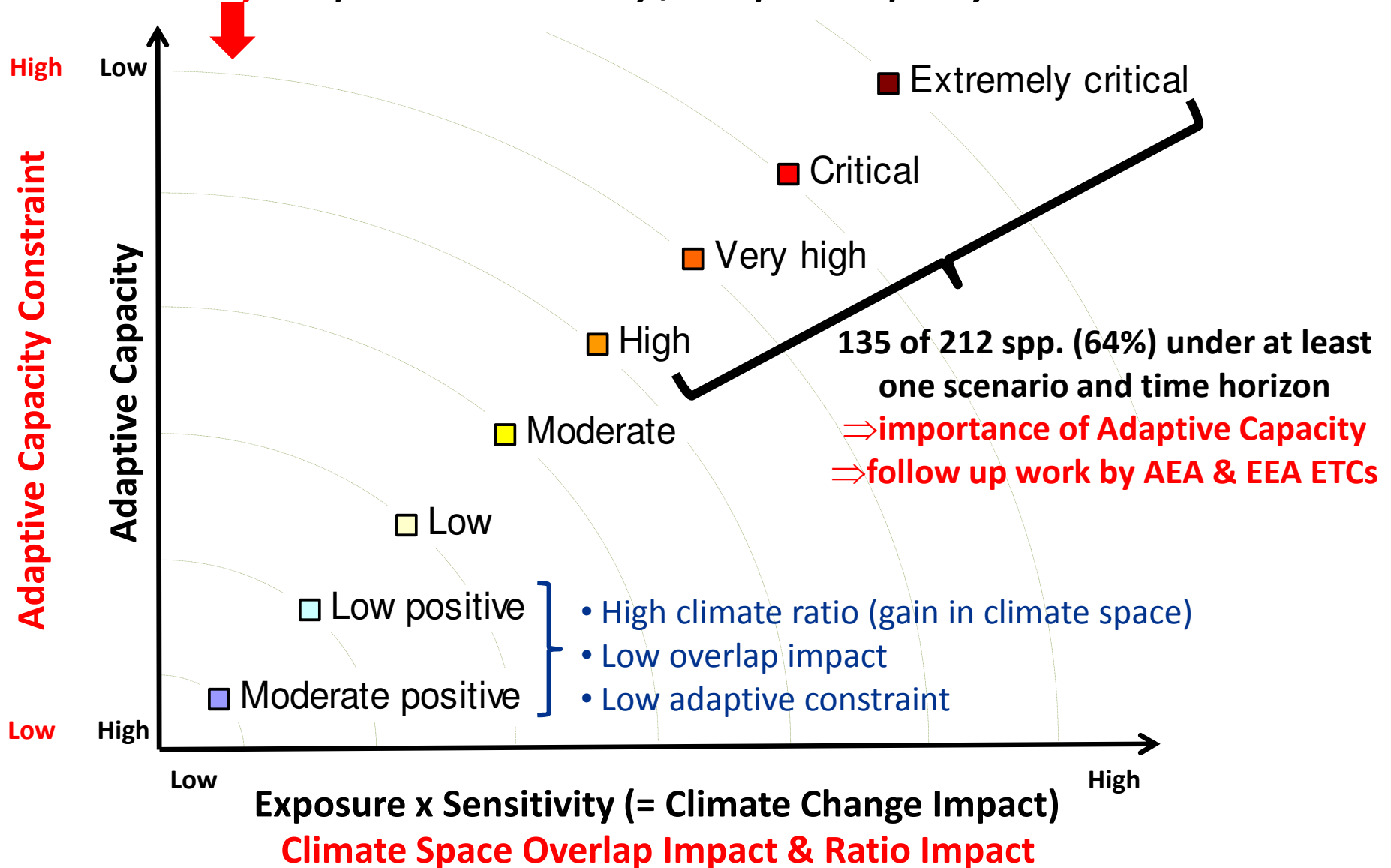
Adaptive Capacity Restriction	Ecological Trait	Adaptive Capacity Constraint
General restrictions	Small population and/or range in Europe	
	Low survival and/or productivity rates	
	Long generation times	
	Declining population in Europe	
	Low genetic diversity	
	Specialised and uncommon habitat requirements	
	Narrow niche	
	Critical association with another vulnerable species	
Subtotal		
Colonisation restrictions If Climate Overlap Impact Score is Moderate, High or Very High, add scores for:	Barriers to dispersal (e.g. water, topography and man-made barriers)	
	Limited dispersal and/or colonisation ability	
	Mainly distributed in fragmented habitats that limit dispersal	
Subtotal		



Total Adaptive Capacity Constraint Score

Task 2a and 3a: N2000 species & network vulnerability

Vulnerability = Exposure x Sensitivity / Adaptive Capacity:



*: Resilience – amount of change a system can undergo without changing state (IPCC AR4, 2007)

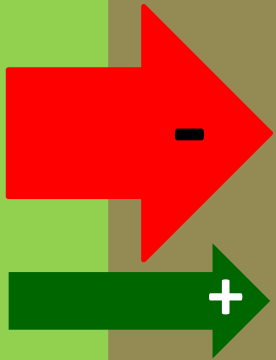
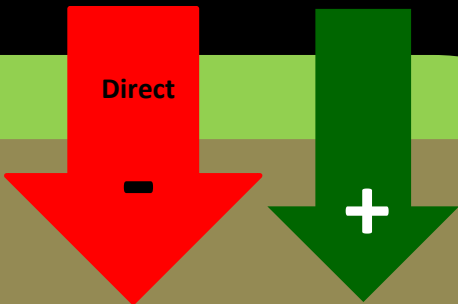
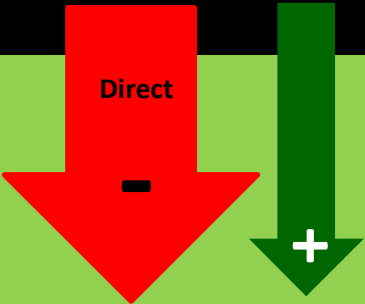
Climate change & impacts on physical environment

Biodiversity and ecosystem services

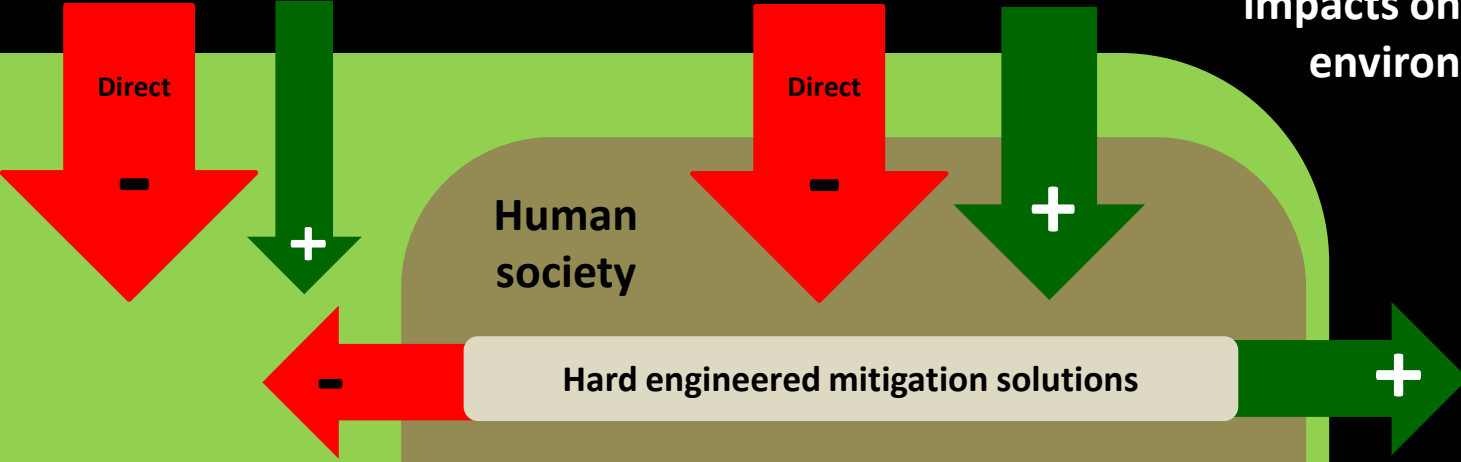
Human society

Mitigation
Avoiding the unmanageable
= Reducing emissions

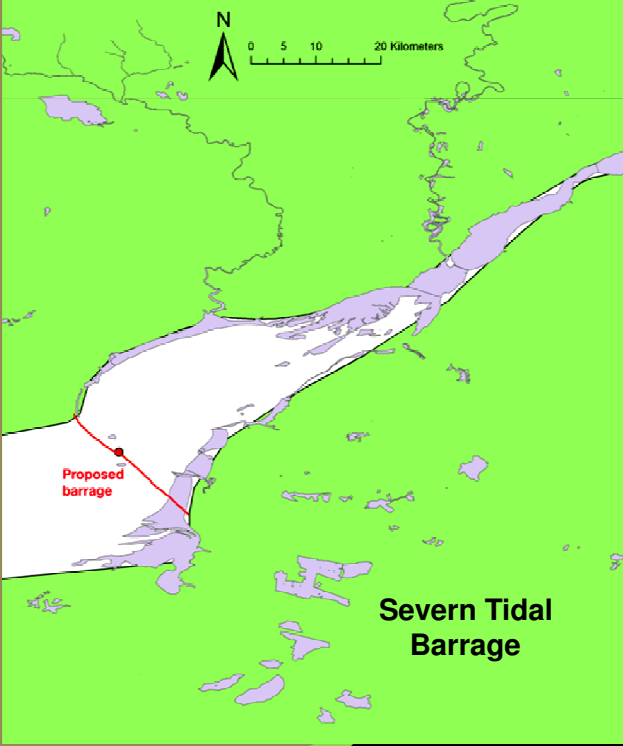
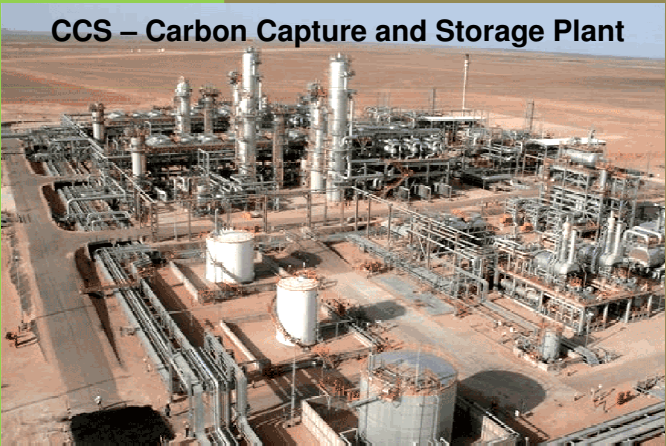
Adaptation
Managing the unavoidable
= Adapting human society



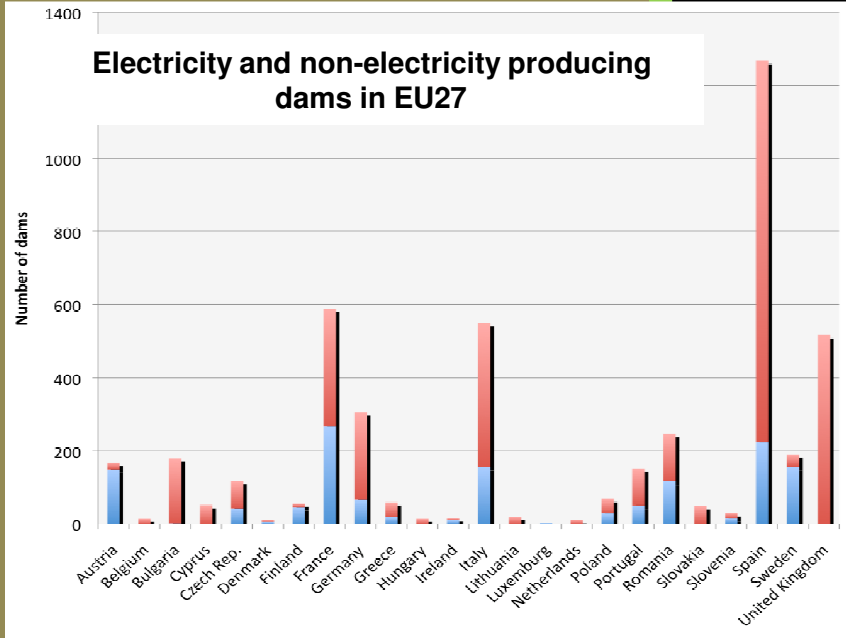
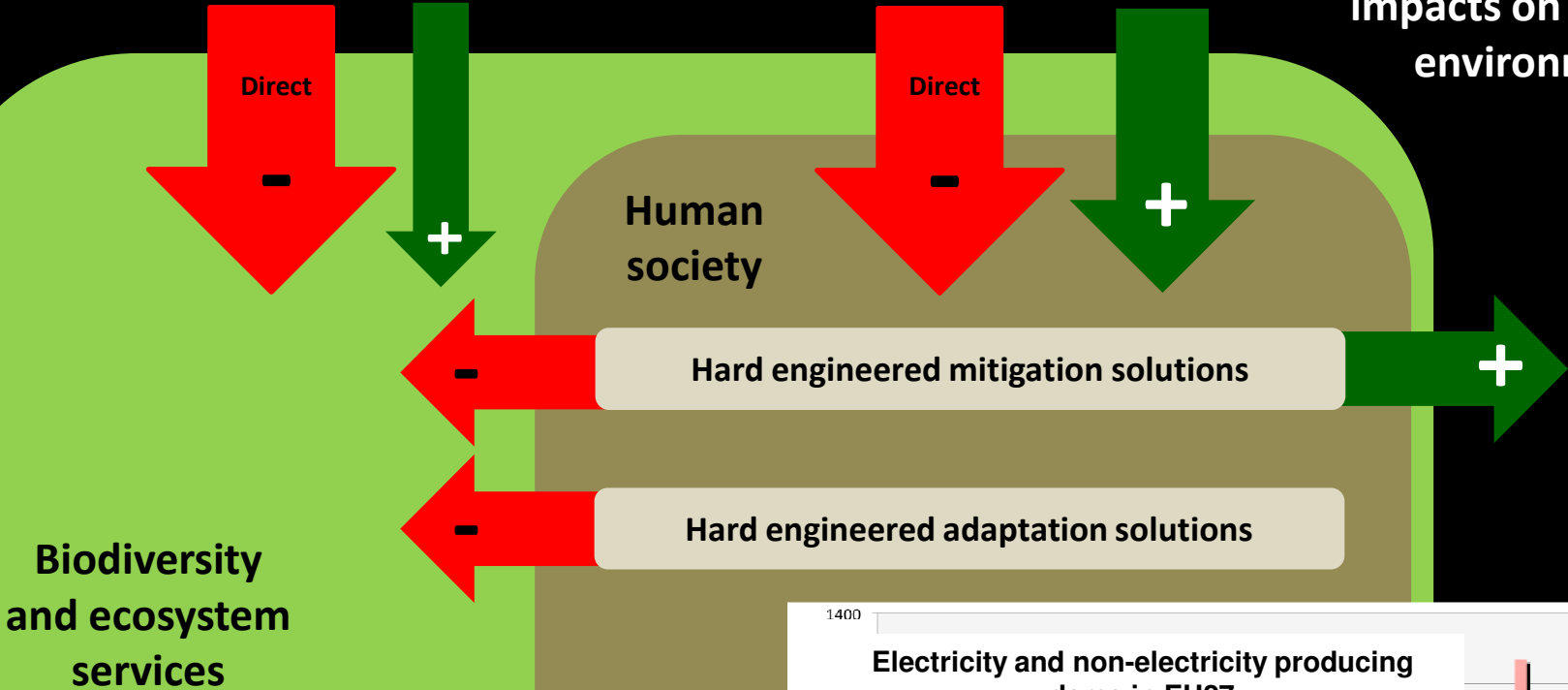
Climate change & impacts on physical environment



Biodiversity and ecosystem services



Climate change & impacts on physical environment



Climate change & impacts on physical environment

Direct

Direct

Human society

Biodiversity and ecosystem services

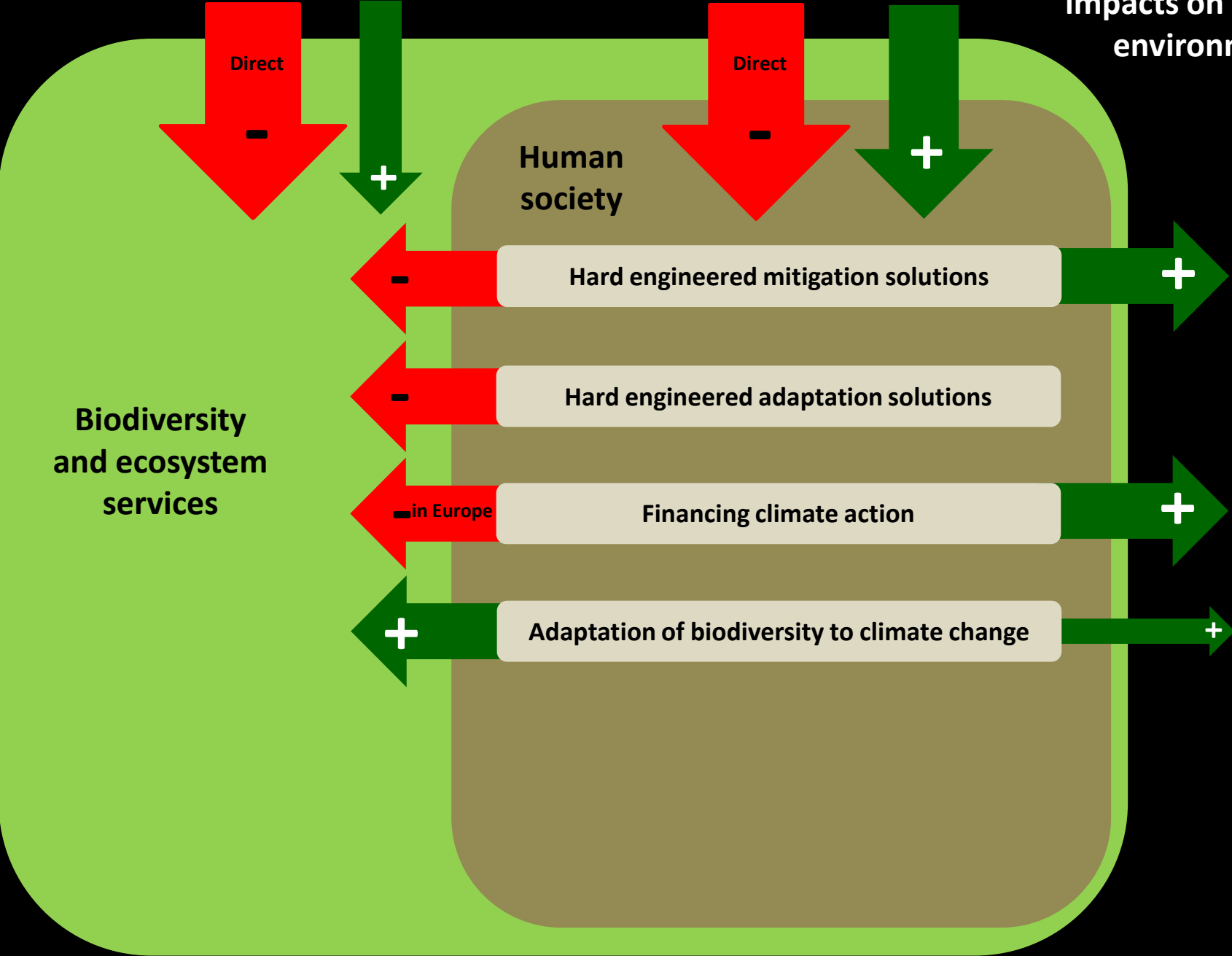
Hard engineered mitigation solutions

Hard engineered adaptation solutions

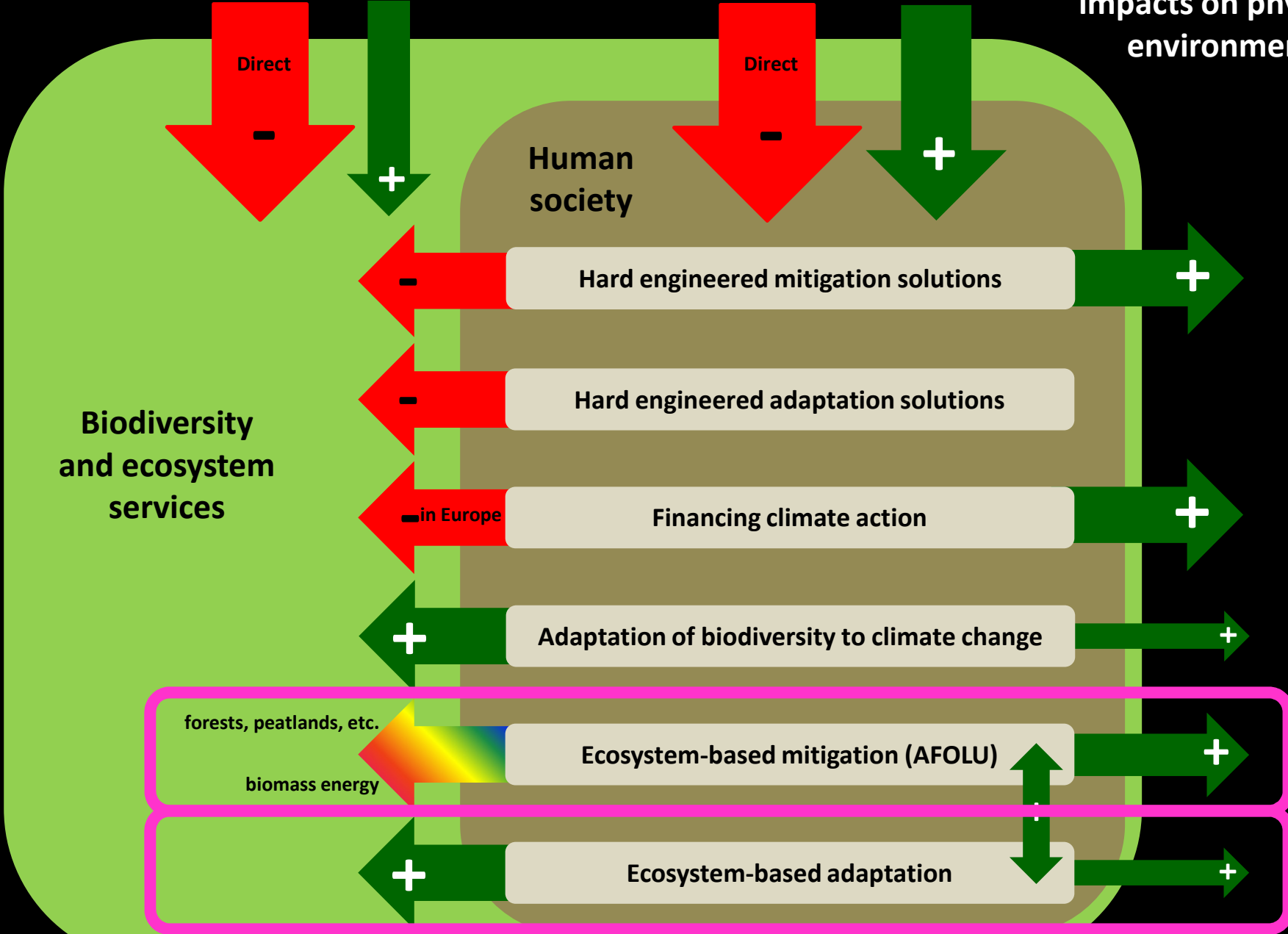
Financing climate action

- in Europe

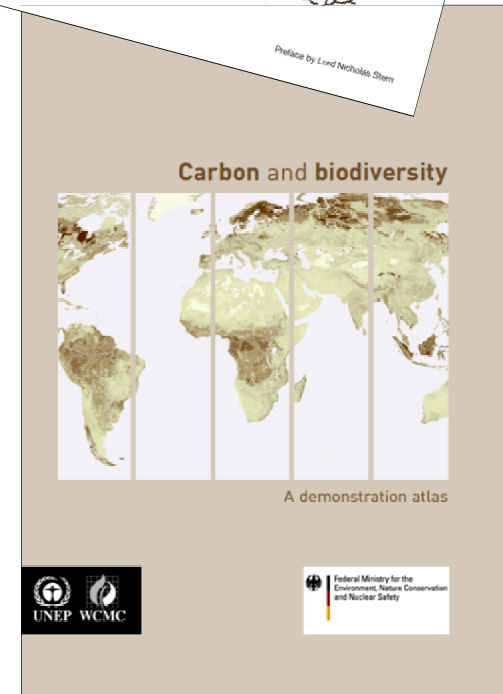
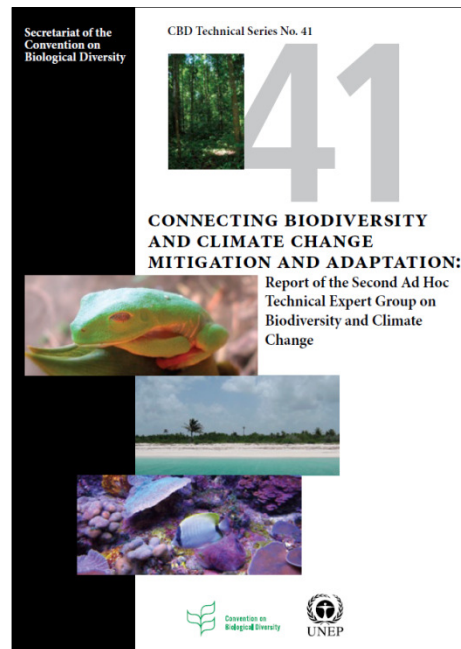
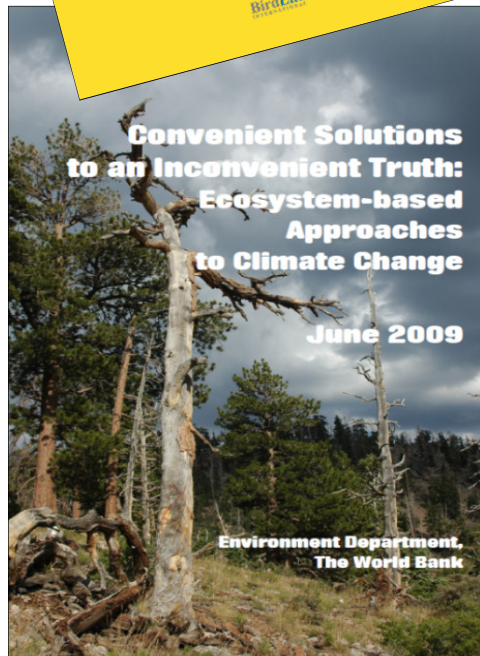
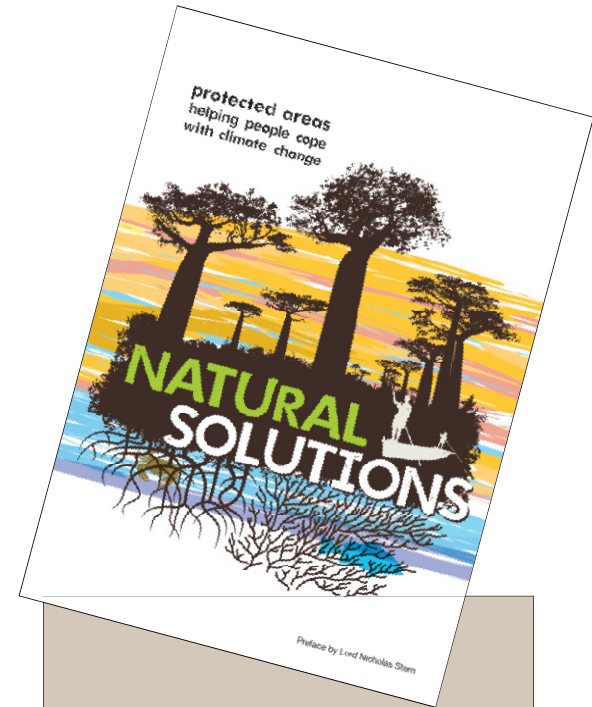
Climate change & impacts on physical environment



Climate change & impacts on physical environment



Ecosystem-based approaches – Natural Solutions

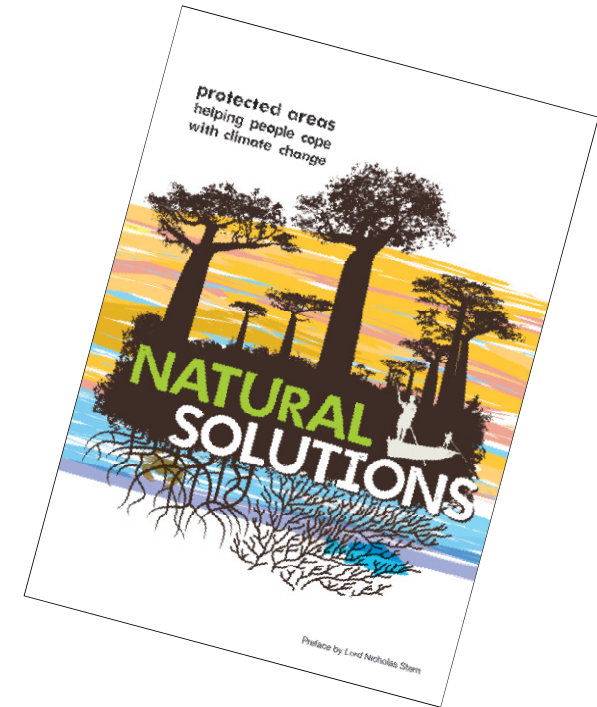


Ecosystem-based approaches – Natural Solutions

PACT 2020 - Protected Areas and Climate Turnaround Initiative

IUCN-World Commission on Protected Areas

November 2009 Workshop,
hosted by the Government of Andalucía in Granada

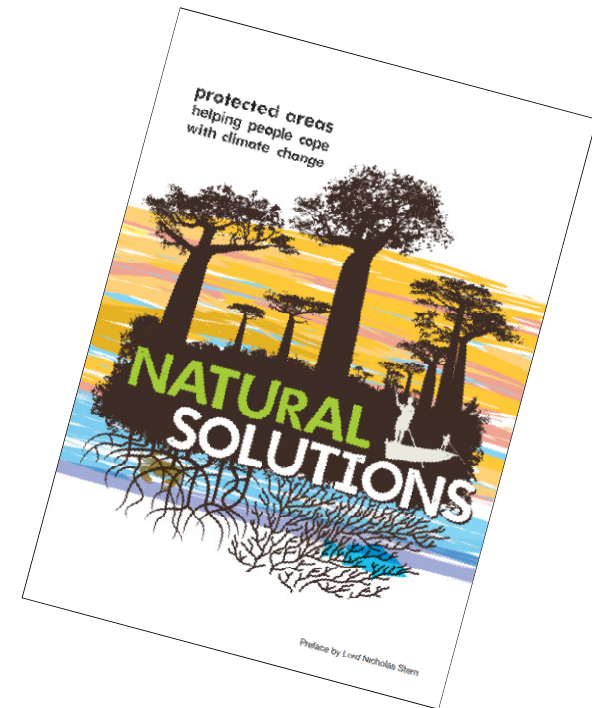


<p>Contents</p> <p>Preface 3 Acronyms/abbreviations and glossary 6 Executive summary and key policy statements 7</p> <p>Section 1 Introduction 13 The consequences of climate change for nature, natural resources and the people who depend on them 13 International and national responses – how policy makers view the role of protected areas 19 The potential of the world's protected areas system to address climate change 22 Why protected areas? 25 Ways in which protected areas assist climate change mitigation and adaptation 28</p> <p>Section 2 Mitigation – The role of protected areas 29 Mitigation potential of protected areas 30 Forests and mitigation 31 Wetlands, peat and mitigation 34 Marine and coastal ecosystems and mitigation 37 Grasslands and mitigation 41 Soils and mitigation 43</p> <p>Section 3 Adaptation – The role of protected areas 45 Safeguarding water 51 Providing clean water 54 Supporting marine and freshwater fisheries 58 Safeguarding rivers, wetlands and sea coasts 62 Addressing health issues under climate change 65 Biodiversity conservation and maintaining ecosystem resilience 68</p>	<p>Section 4 Opportunities to use protected areas to address climate change 71 Opportunities to expand the protected areas system, integrate it into broader conservation strategies and national and local climate change mitigation and adaptation plans 72 Financing protected areas networks 78 The use of protected areas as tools to strengthen REDD schemes 80</p> <p>Section 5 Implications of climate change for protected areas 87 Policy, management and governance 87 Likely climate change impacts on protected areas 89 Planning and managing protected areas under climate change 93 Governance implications of using protected areas for climate change mitigation and adaptation 98</p> <p>Section 6 Policy recommendations 101 Recommendations for ensuring protected areas become a vital part of national and international policy instruments 102</p> <p>Acknowledgments and references 103 Acknowledgments 104 References 106 Authors' biographies inside back cover</p>	<p>Section 1 Ways in which protected areas assist climate change mitigation and adaptation</p> <p>KEY MESSAGES</p> <p>Protected areas can help nature and society to mitigate climate change by sequestering and storing carbon in natural ecosystems, and to adapt to current and predicted changes through the provision of various forms of ecosystem services.</p> <p>Protected areas can assist to both mitigate and help adapt to climate change. Mitigation is achieved by storing and sequestering carbon that would otherwise be emitted as CO₂ or methane into the atmosphere and adaptation is achieved through a range of environmental goods and services that address directly some of the key impacts of climate change on people. These include how people manage their land, water and forests in the past, at present and in the future.</p> <p>Figure 2: The three "pillars" of protected area benefits</p> <p>Mitigation</p> <ul style="list-style-type: none"> Sequestration of carbon and storage in trees and dead vegetation in: <ul style="list-style-type: none"> Forests Wetlands Marine systems Soils and humans <p>Adaptation</p> <ul style="list-style-type: none"> Resilient human systems, such as: <ul style="list-style-type: none"> Coastal water Water food Water energy Water health Water tourism Water recreation Water and humans 	<p>Mitigation: The role of protected areas</p> <p>Forests and mitigation</p> <p>KEY MESSAGES</p> <p>Forests are the world's largest terrestrial carbon stock and continue to sequester in old-growth phases, but risk losing this characteristic due to deforestation, degradation and the longer-term impacts of climate change. Protected areas offer an important way to maintain and enhance carbon stores in forests, although they need careful management if they are to succeed.</p> <p>The Potential</p> <p>Protected areas can assist to both mitigate and help adapt to climate change. Mitigation is achieved by storing and sequestering carbon that would otherwise be emitted as CO₂ or methane into the atmosphere and adaptation is achieved through a range of environmental goods and services that address directly some of the key impacts of climate change on people. 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Some natural ecosystems particularly cloud forests and some old-growth forests can increase net water in catchments, while most wetlands help to regulate water flow, and their protection can help to alleviate climate-induced water stress.</p> <p>The challenge</p> <p>Many countries are already facing water shortages and this is likely to intensify in the future. The impact of climate change on water availability is likely to be more variable and significant areas will have less total rainfall. Some natural ecosystems particularly cloud forests and some old-growth forests can increase net water in catchments, while most wetlands help to regulate water flow, and their protection can help to alleviate climate-induced water stress.</p> <p>Figure 3: The three "pillars" of protected area benefits</p> <p>Mitigation</p> <ul style="list-style-type: none"> Sequestration of carbon and storage in trees and dead vegetation in: <ul style="list-style-type: none"> Forests Wetlands Marine systems Soils and humans <p>Adaptation</p> <ul style="list-style-type: none"> Resilient human systems, such as: <ul style="list-style-type: none"> Coastal water Water food Water energy Water health Water tourism Water recreation Water and humans 	<p>THE ARGUMENTS FOR PROTECTION</p> <p>This book clearly articulates for the first time how protected areas contribute significantly to reducing impacts of climate change and what is needed for them to achieve even more. As we enter an unprecedented scale of negotiations about climate and biodiversity it is important that these messages reach policy makers loud and clear and are translated into effective policies and funding mechanisms. Lord Nicholas Stern</p> <p>ICM-WCA International Union for Conservation of Nature World Commission on Protected Areas 100, rue de la Woluwe 1200 Brussels 28 Belgium www.iucn-wca.org</p> <p>The Nature Conservancy 2500 North Quarter Drive Arlington, VA 22203-7088 USA www.nature.org</p> <p>Environment and Energy Group United Nations Development Programme 100 East Street, 9th Floor New York, NY 10007 USA www.undp.org</p> <p>WWF International 2000 Boulevard René-Lévesque Borin New York, NY 10001 USA www.wwf.org</p> <p>Department of Environment The Wood Bank 1000 North Street, 9th Floor New York, NY 10007 USA www.environment.gov</p> <p>WWF International 2000 Boulevard René-Lévesque Borin New York, NY 10001 USA www.wwf.org</p>
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Ecosystem-based approaches – Natural Solutions

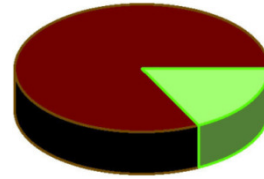
European Council Conclusions - December 2009

“10. HIGHLIGHTS the mitigation and adaptation potential of resilient wetlands, oceans, forests, peatlands and grasslands and other ecosystems, and that conservation, restoration and sustainable use of these ecosystems result in carbon emission reductions, carbon storage and increased adaptation potential; **RECOMMENDS the development and use of ecosystem-based approaches for the mitigation of and adaptation to climate change**”



Terrestrial carbon stores in soils & biomass

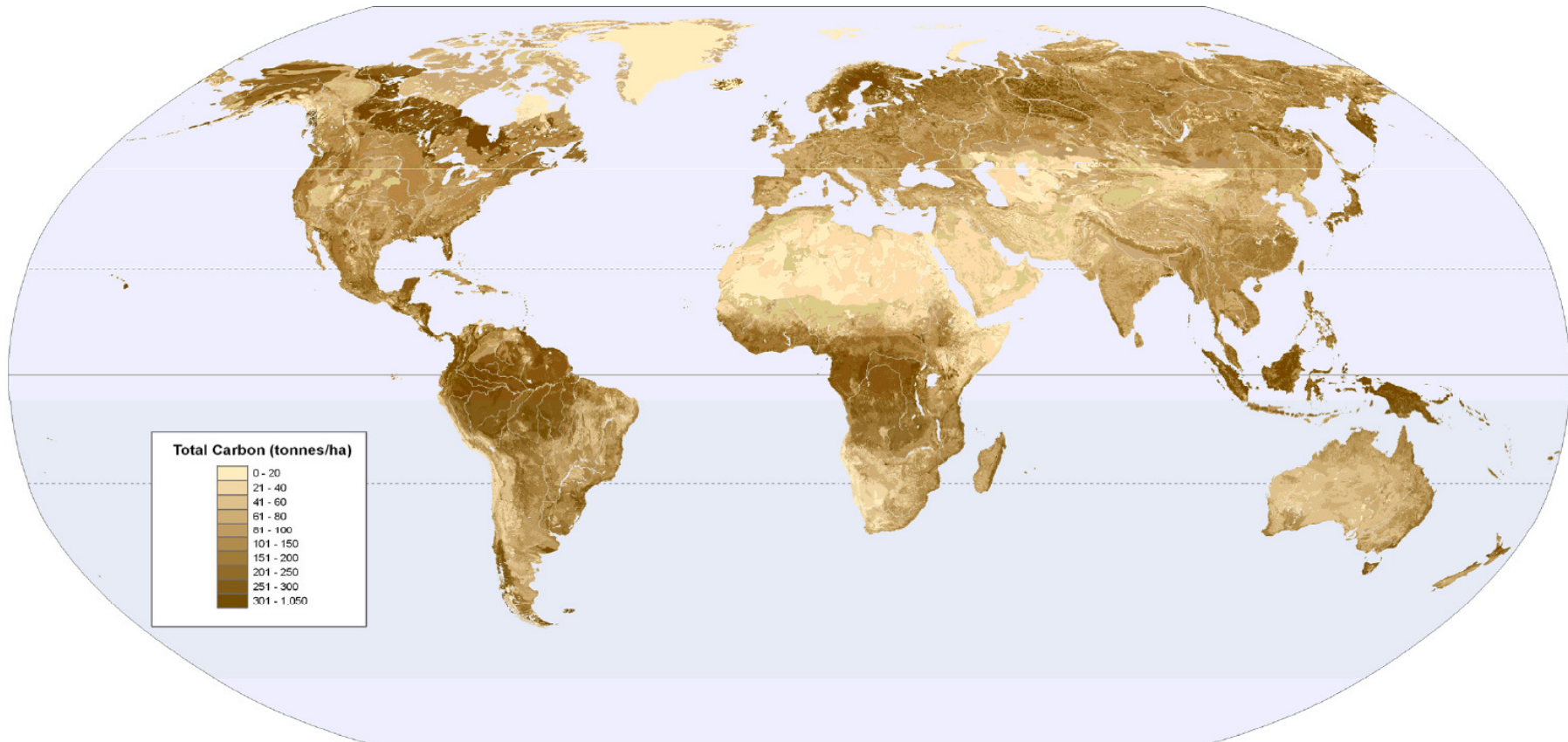
85% outside protected areas



15% inside protected areas

19% of the world's forests inside protected areas

Updated global map of terrestrial carbon stocks

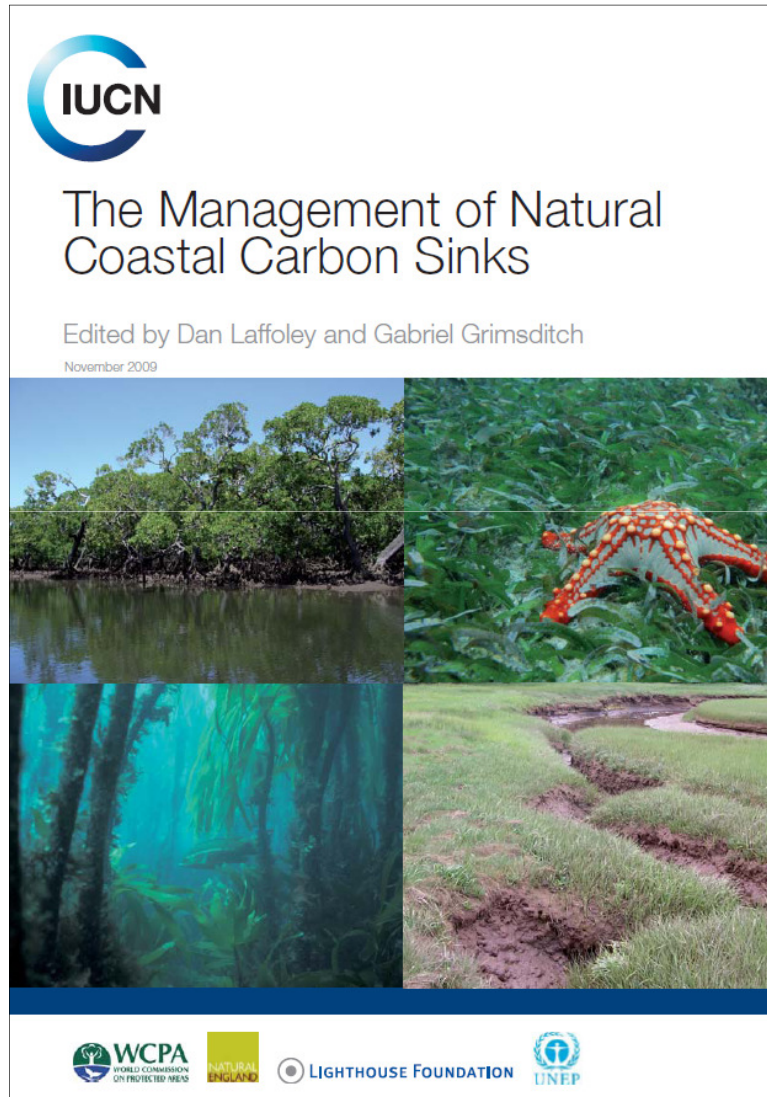


Ecosystem-based mitigation

Two elements:

1. Sequester: withdraw carbon from the atmosphere
 - In Europe: improved carbon management on agricultural lands!
 - With increasing temperature, carbon sinks could turn into carbon sources
2. Store: maintain existing carbon stores (or counter their degradation)
 - Mainly in natural ecosystems as carbon in modified ecosystems degraded
 - In Europe: temperate & boreal forests; peatlands; primarily in soils

Marine coastal ecosystems: the missing carbon sink?



- Salt marshes, mangroves and sea grass beds (esp. *Posidonia*) highly effective in carbon sequestration per unit area
- Start considering also marine ecosystems in ecosystem-based mitigation
- Context: ongoing designation of MPAs in Europe

Ecosystem-based adaptation

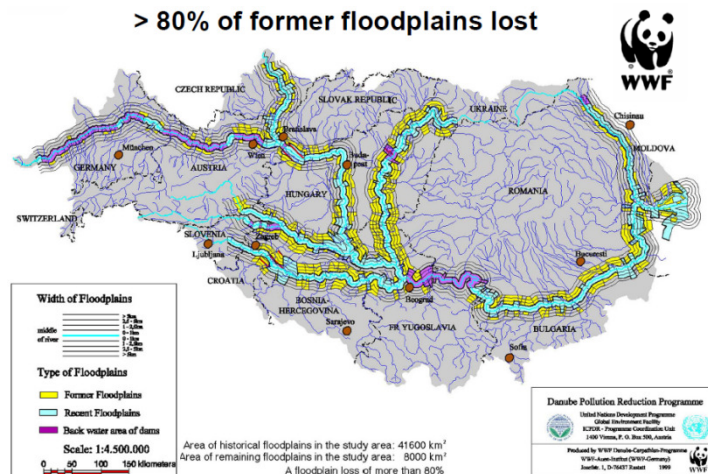
“... as part of an overall adaptation strategy... the sustainable management, conservation, and restoration of ecosystems to provide services that **enable people to adapt to the adverse impacts of climate change.**”

Report of the CBD's Ad Hoc Technical Expert Group on Biodiversity and Climate Change

- **Two elements:**

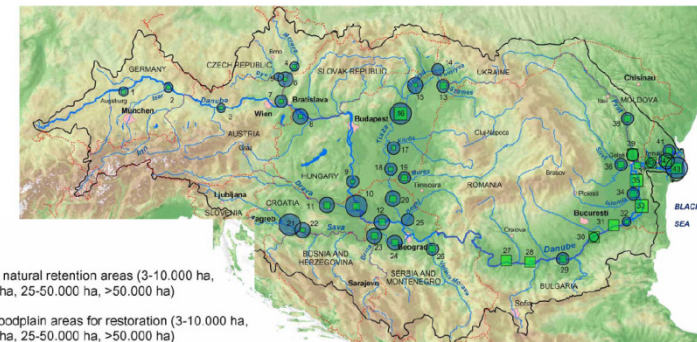
1. Protect by reducing the risk from natural disasters, e.g.

- stabilise soil and snow to prevent landslides
- provide space for floodwaters



Restoration potential

- 43 floodplains with high potential for flood risk mitigation
- total: >10,500 km² remaining areas; >7,000 km² restoration sites



Legend



Remaining natural retention areas (3-10.000 ha, 10-25.000 ha, 25-50.000 ha, >50.000 ha)



Potential floodplain areas for restoration (3-10.000 ha, 10-25.000 ha, 25-50.000 ha, >50.000 ha)

Ecosystem-based adaptation

“... as part of an overall adaptation strategy... the sustainable management, conservation, and restoration of ecosystems to provide services that **enable people to adapt to the adverse impacts of climate change.**”

Report of the CBD's Ad Hoc Technical Expert Group on Biodiversity and Climate Change

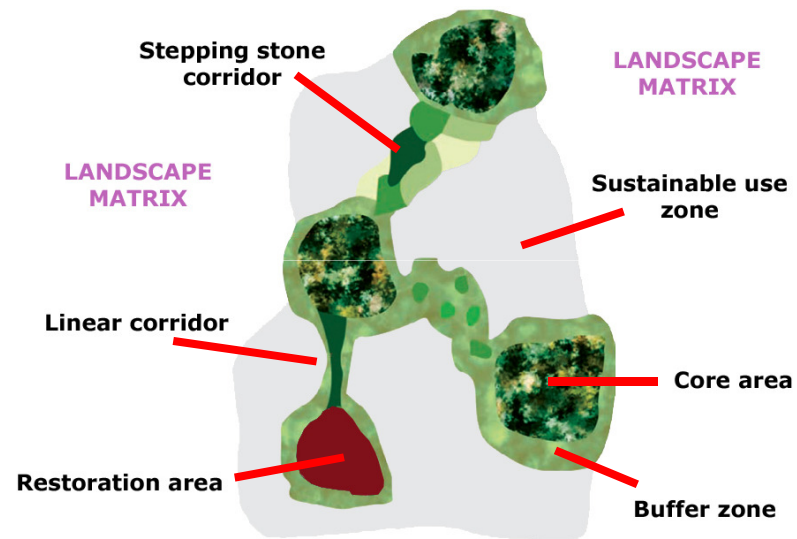
- **Two elements:**
 1. Protect by reducing the risk from natural disasters, e.g.
 - stabilise soil and snow to prevent landslides
 - provide space for floodwaters
 2. Provide resources and services to human communities, e.g.
 - clean water flows
 - rebuilding fish stocks to maintain sustainable fisheries

A word of caution against failures of adaptations measure – unforgiving as affecting human communities => avoid complacency

Implications of EbM & EbA for biodiversity management and protected area networks in Europe

Which strategy and investment most effective for...

... ecosystem-based adaptation?



... protecting carbon storage?

... carbon sequestration?



**Which strategy and investment
most effective for...**

**... ecosystem-based
adaptation?**

**... protecting carbon
storage?**

**... carbon
sequestration?**

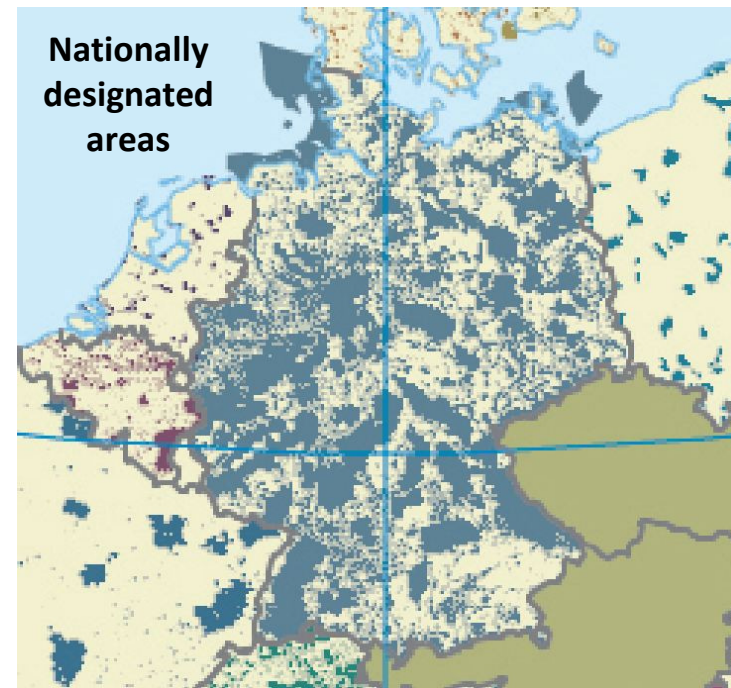
**and in which region
and biome?**

12 recommendations for biodiversity safeguards, biodiversity adaptation and ecosystem based solutions to climate change

1. Enhance resilience of species and habitats by reducing non-climatic pressures on biodiversity
2. Reduce fragmentation, by enhancing *functional* connectivity through ecological networks and restoration.
 - Further develop Pan-European Ecological Network, complete the designation and begin implementation of terrestrial and marine Natura2000 and other networks.
 - Particular attention to threatened species and habitats that are highly vulnerable to climate change and fragmentation, considering management interventions (assisted colonisation, ...).
 - Make connectivity legally binding in nature legislation
3. Facilitate greater permeability of the wider land- and seascape matrix, especially through the integration of protected area networks into multi-functional landscapes.
4. Deliver conservation management (direct payments, agri-environment measures, cross-compliance, ecosystem services, etc.)
5. Adapt biodiversity conservation planning and management to address direct and indirect climate change impacts.

12 recommendations for biodiversity safeguards, biodiversity adaptation and ecosystem based solutions to climate change

6. Increase and strengthen PA coverage and network to store and sequester more carbon (e.g. focusing on areas of high carbon loss) and to provide climate change adaptation services.
7. Change PA management to store and sequester more carbon and provide more services for human adaptation.
8. If more or larger PAs areas are not an option, although biodiversity and climate objectives are not met, ensure greater effectiveness and raise the degree of protection afforded to existing PAs.



12 recommendations for biodiversity safeguards, biodiversity adaptation and ecosystem based solutions to climate change

6. Increase and strengthen PA coverage and network to store and sequester more carbon (e.g. focusing on areas of high carbon loss) and to provide climate change adaptation services.
7. Change PA management to store and sequester more carbon and provide more services for human adaptation.
8. If more or larger PAs areas are not an option, although biodiversity and climate objectives are not met, ensure greater effectiveness and raise the degree of protection afforded to existing PAs.
9. Build and apply new concepts for Invasive Species and their interaction with ecological networks. Control harmful invasives as opposed to benign climate migrants.
10. More now than ever: Integrate biodiversity considerations in other sectors (agriculture, forestry, energy, climate change, etc.) to avoid impacts both from both standard practices and from maladaptive climate change adaptation and mitigation responses harmful to biodiversity; recognising the importance of spatial planning and SEA/EIA.
11. Increase and ring-fence funding for biodiversity conservation, protected area management, biodiversity adaptation and biodiversity-friendly measures in other sectors, while reducing subsidies harmful to biodiversity and public goods.

12 recommendations for biodiversity safeguards, biodiversity adaptation and ecosystem based solutions to climate change

12. Research and monitoring: ecological research and inventories in less studied countries, effect of species interactions, determine vulnerability of habitats.
 - Compile the opportunities for linking ecosystem based adaptation and mitigation to PAs and ecological networks in Europe.
 - Fundamental ecological research on biodiversity & global change interactions
 - Higher resolution models of CC impacts
 - Field research: spatial distribution and conservation status of species & habitats in the EU, esp. those of Community Interest & vulnerable to CC, and enter into N2000 database
 - Conduct climate envelope mapping for all taxa groups and habitat types, with a fully standardised methodology (model type, SRES, time horizon)
 - Refine and complete analysis of vulnerable species against Natura 2000 sites to determine species, habitat or site-specific actions.
 - Identify indicator species to warn of climate change impacts in N2000 sites
 - Monitor impacts and cost-effectiveness of biodiversity adaptation measures
 - Identify further ecosystem management measures to help biodiversity adaptation, and climate change mitigation and adaptation; develop policies to support such measures.

Thank you



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