ENVIRONMENTAL CHANGE INSTITUTE
Oxford University Centre for the Environment

Modelling threats to ecosystems

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and RUBICODE and CLIMSAVE partners

Outline

- A conceptual framework for ecosystem services, which links ecosystem service providers and beneficiaries
- Traits as a means of assessing multiple ecosystem processes and services
- How to link conservation and ecosystem services
- Problems that still need solutions
- Use of bioclimate envelope models for informing habitat management (adaptation) for climate change

RUBICODE research themes

(Rationalising BIodiversity COnservation in Dynamic Ecosystems)

– Frameworks and concepts for the assessment of ecosystem services in terrestrial and freshwater ecosystems.

– Approaches for linking ecosystem service provision to functional traits.

– Indicators for monitoring ecosystem services.

– Socio-economic and environmental drivers of biodiversity change.

– Strategies for conserving and managing biodiversity and the services it provides that take account of drivers of biodiversity change.

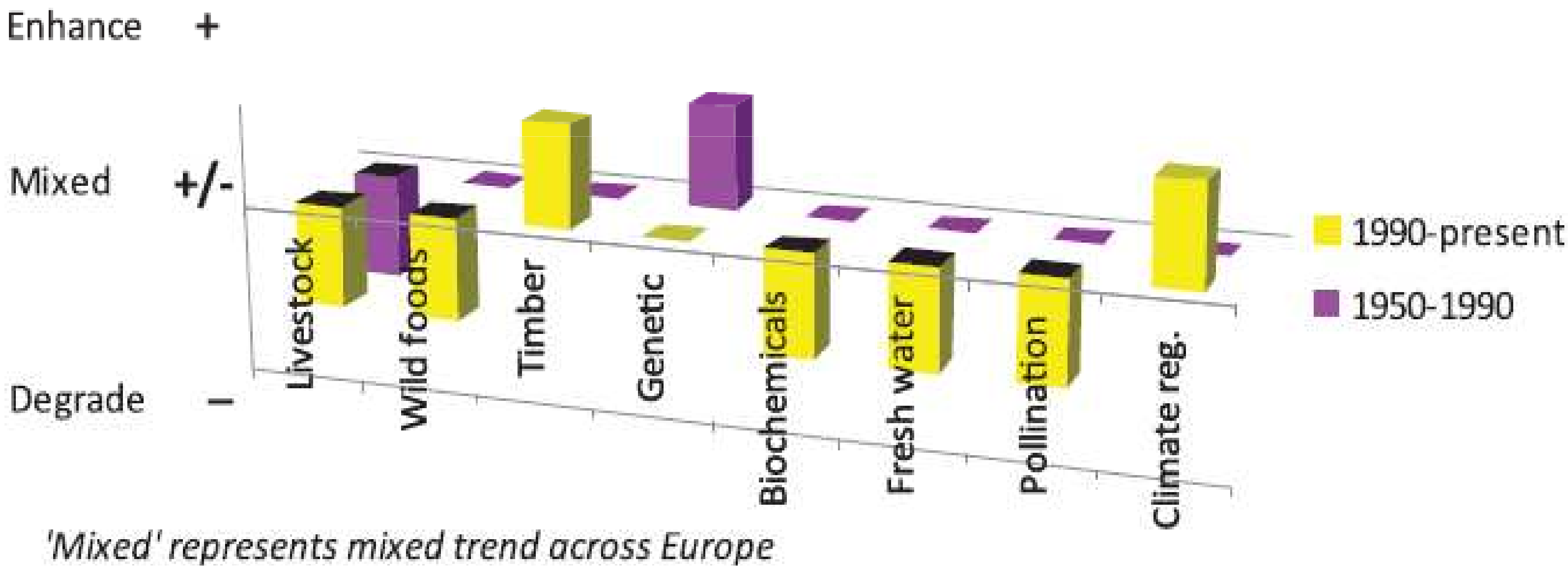
– Identification of current gaps in knowledge and future research needs.

Qualitative ranking of the importance of services in different European ecosystems

Ecosystem service	Key	Some	No	Unknown
Food and fibre	A, G, M, R	F, H, S, W		
Timber/fuel/energy	A, F, M, R	G H, S, W		
Freshwater	F, M, R	G ,H, W	A(-), S	
Genetic resources	F, G, H, M	A, R,		A, F, M, S, R, W

Harrison et al., 2010

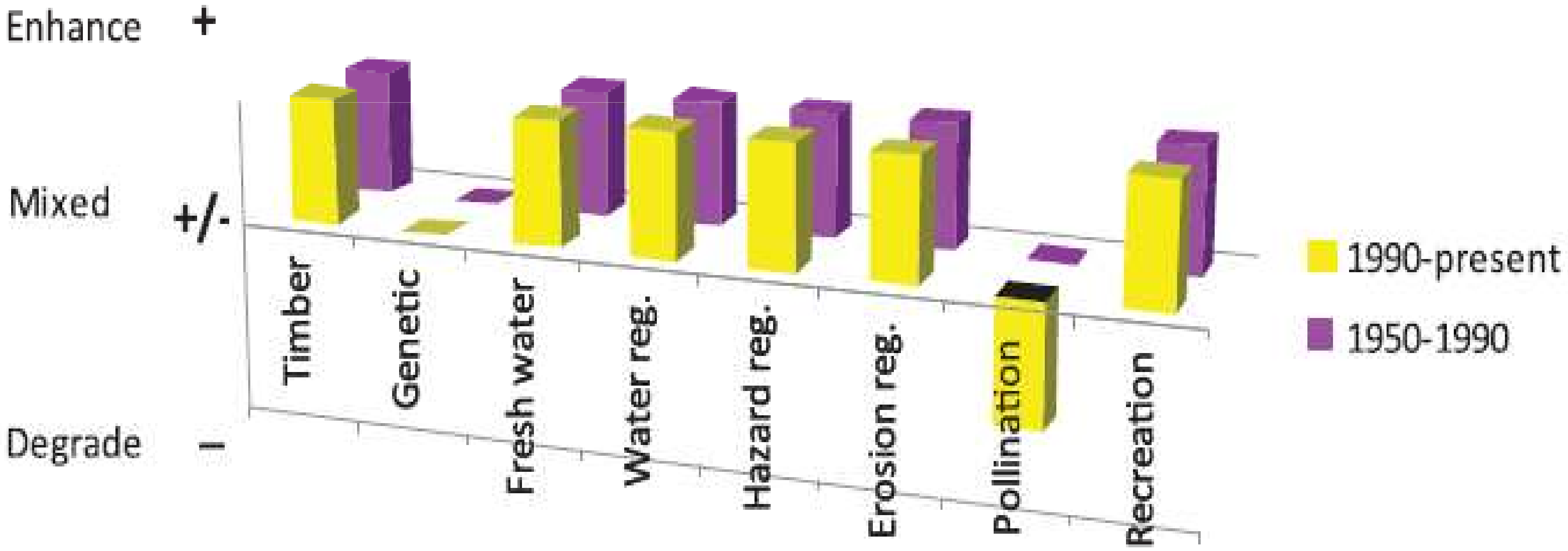
Status and trends in ecosystem services



Trends in the status of forest ecosystem services. Data sourced from (1).

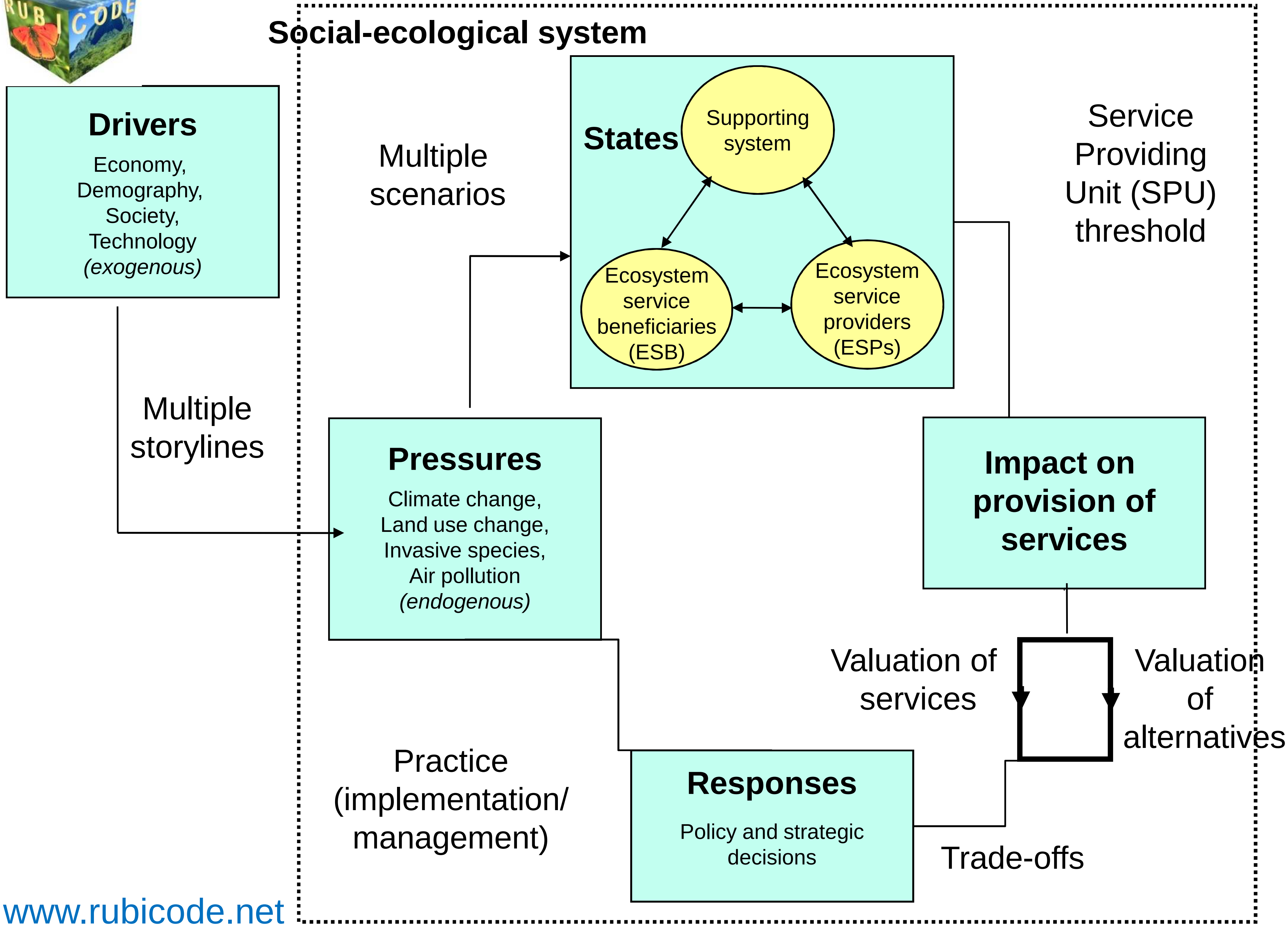
From Harrison et al., 2010

Status and trends in ecosystem services



from Harrison et al., 2010

S. Lavorel



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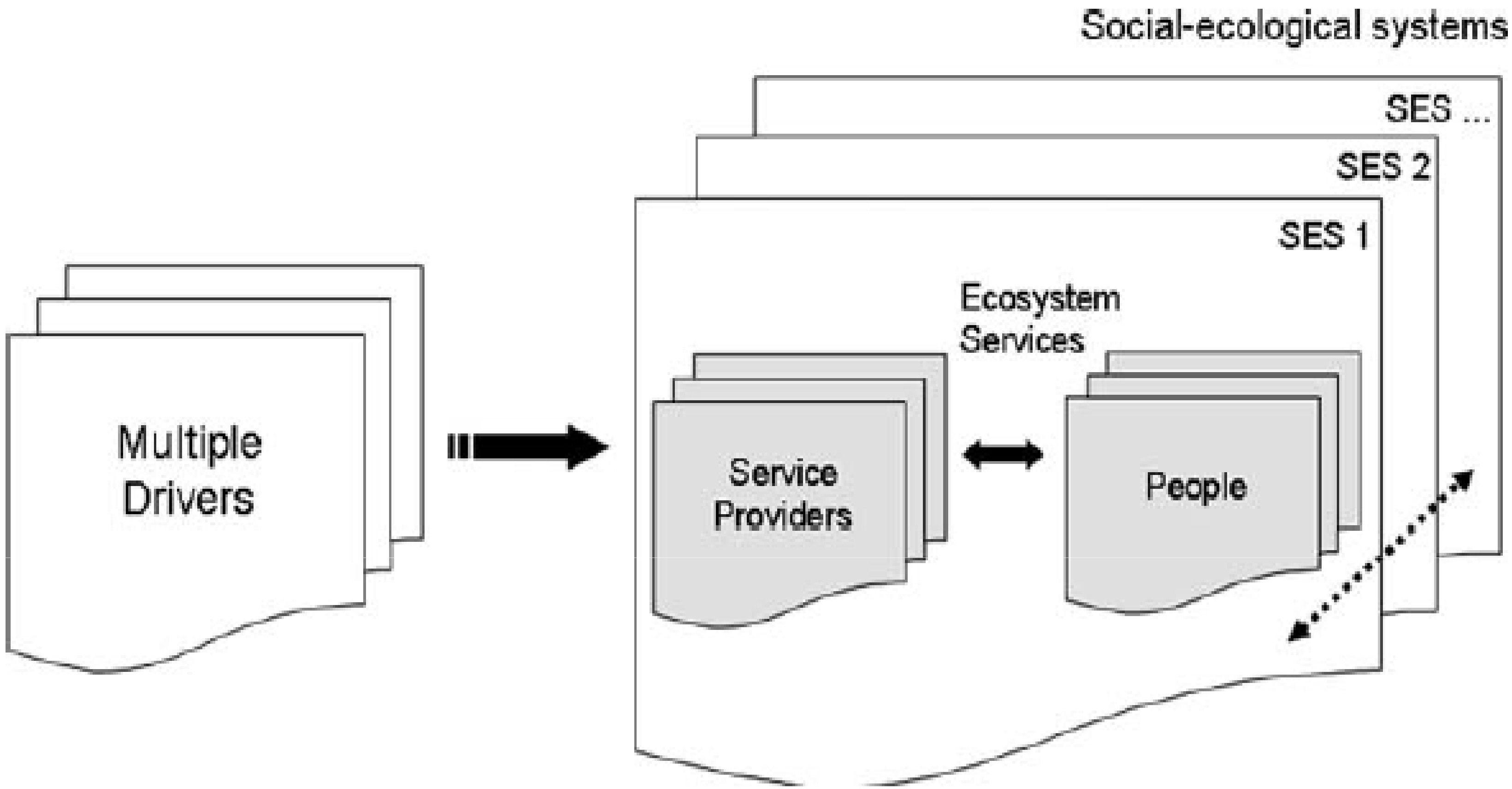
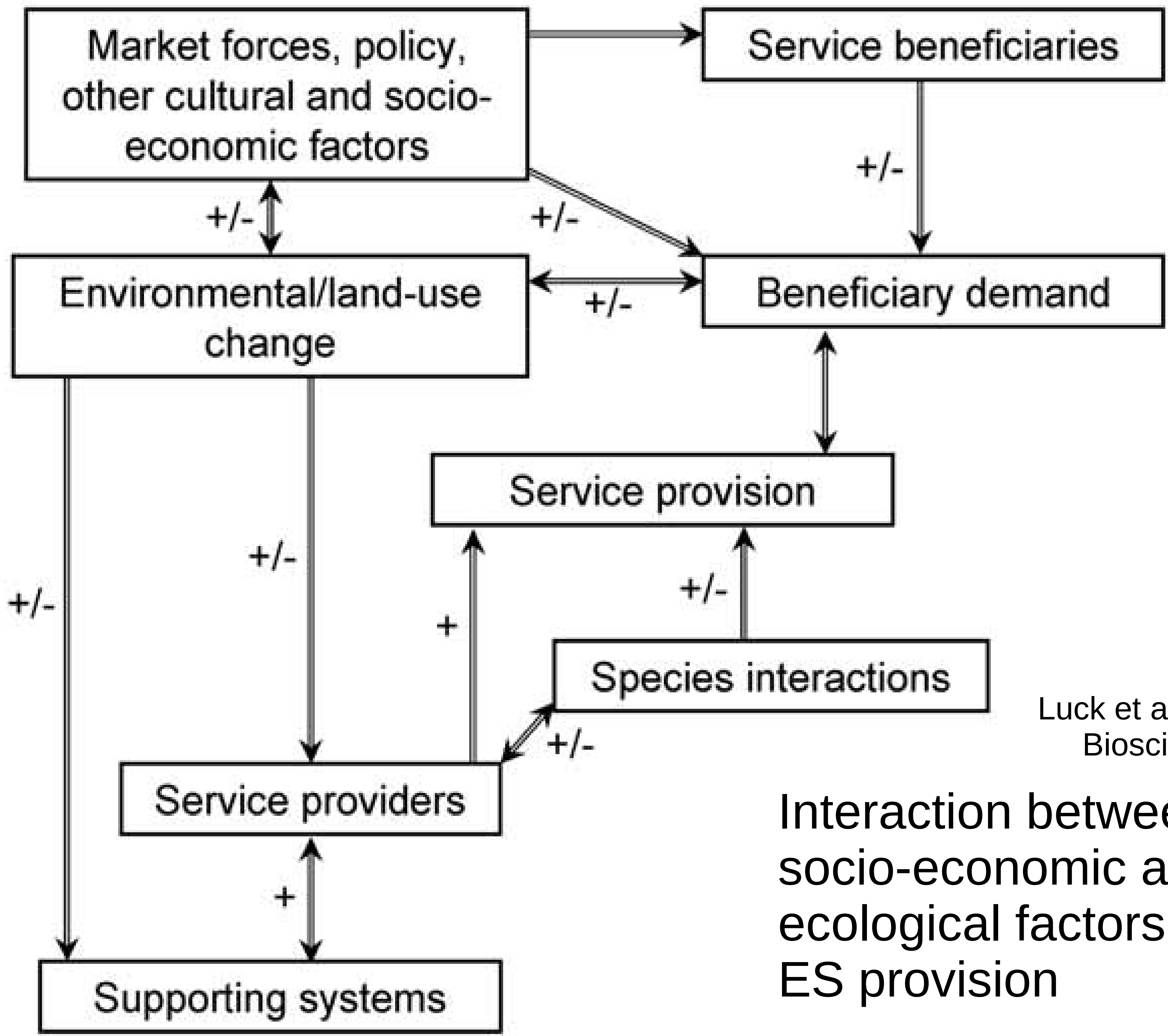
Framework for Ecosystem Service Provision

Multiple systems and multiple services



Rounsevell et al, 2010

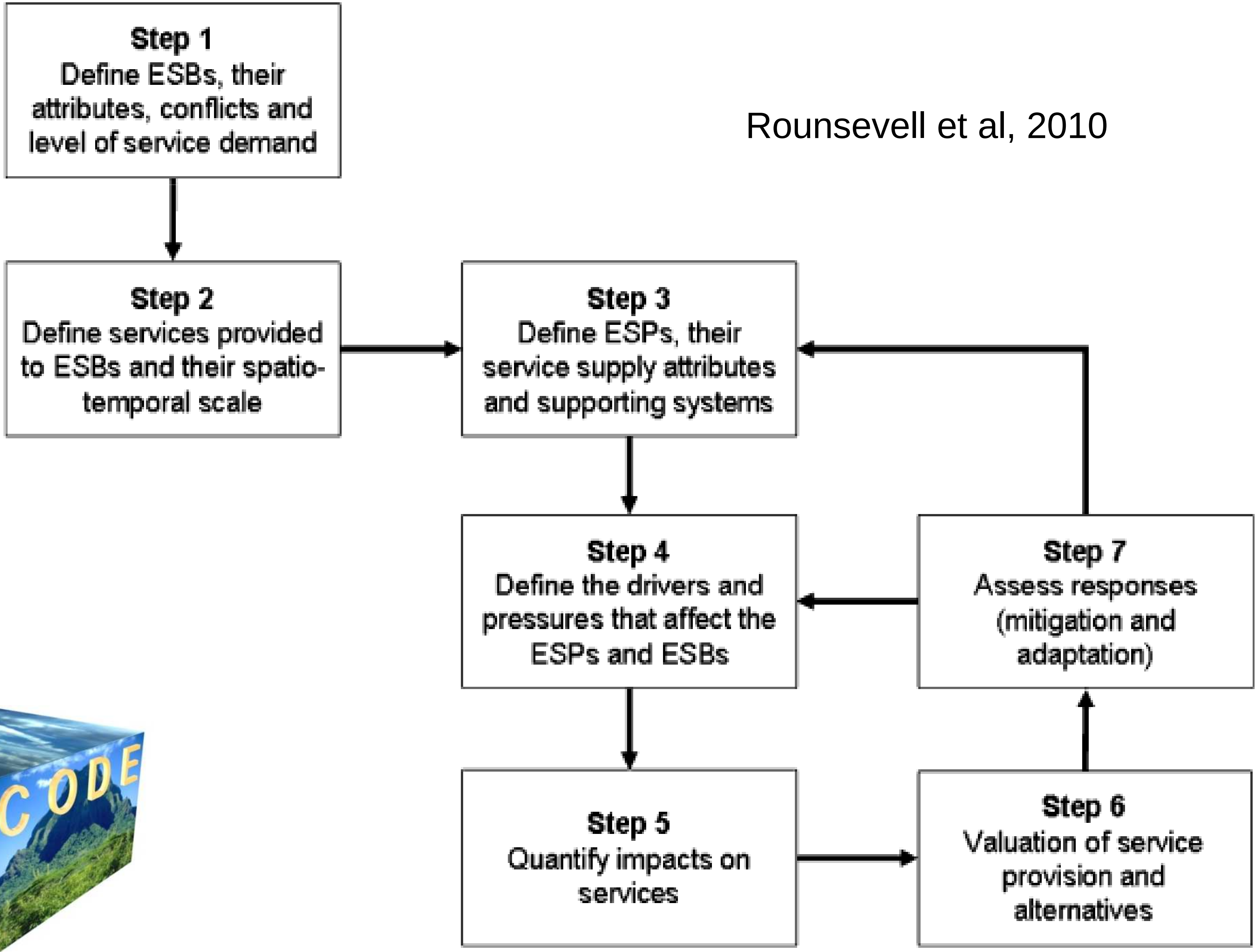


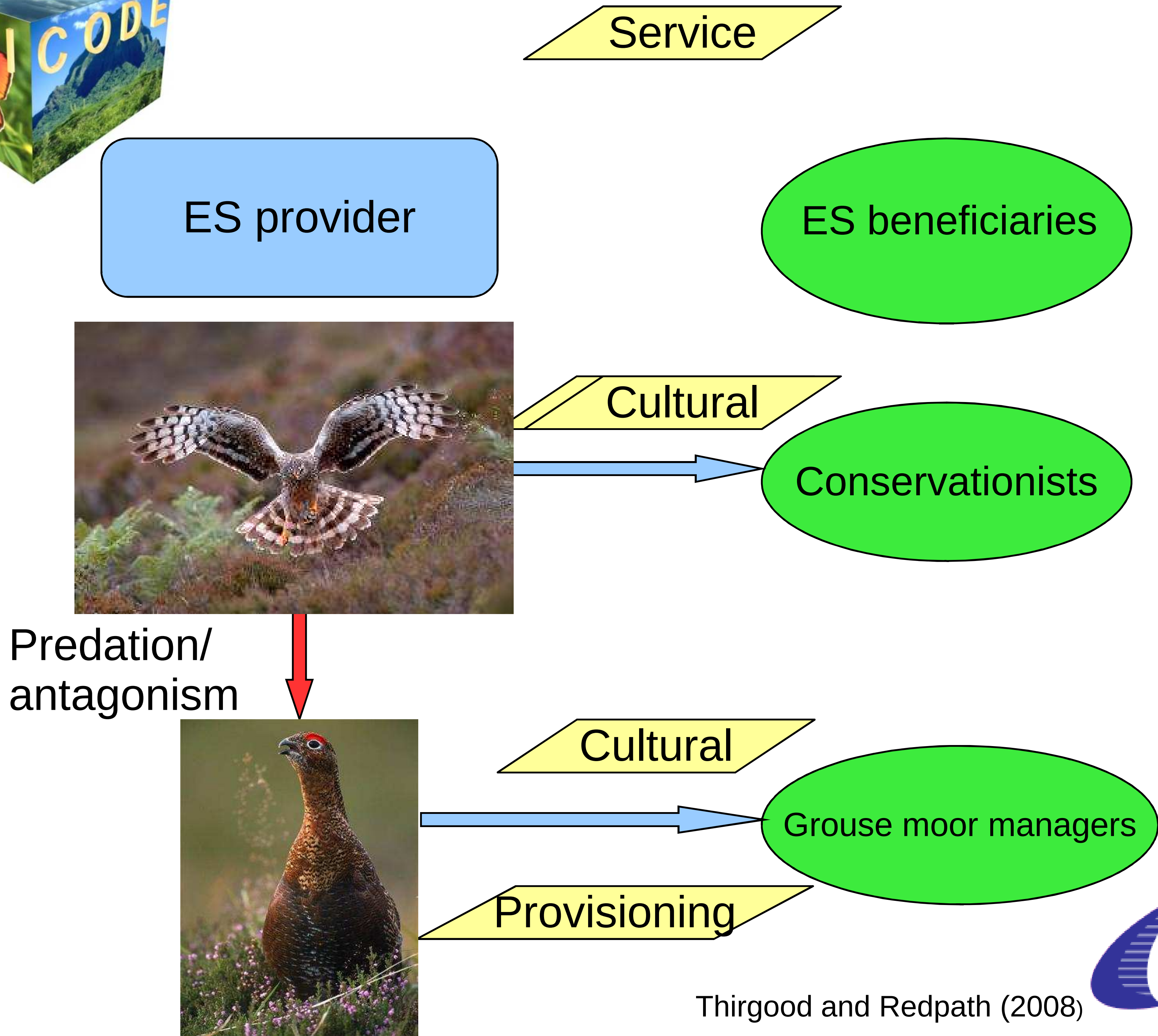
Luck et al., 2009, Bioscience

Interaction between socio-economic and ecological factors in ES provision

Stepwise implementation strategy of the conceptual framework

Rounsevell et al, 2010





Thirgood and Redpath (2008)

	Grouse managers	Conservationists
Pressure	Harrier numbers	Killing of harriers
State	Grouse populations	Harrier populations
Impact	Grouse population numbers.	Harrier population numbers.

Advantages of FESP

1. Explicitly identifies role and attributes of ESBs

2. ESB focus highlights the potential for conflict between beneficiaries

3. Makes comparison across competing services clear

4. Makes explicit the potential for different ESPs, thresholds of biology (SPUs) that is needed to supply a given service, and the role of valuation in assessing trade-offs between service provision strategies as part of the response decision process

5. Can identify the mechanisms of either mitigation or adaptation to the environmental change problem

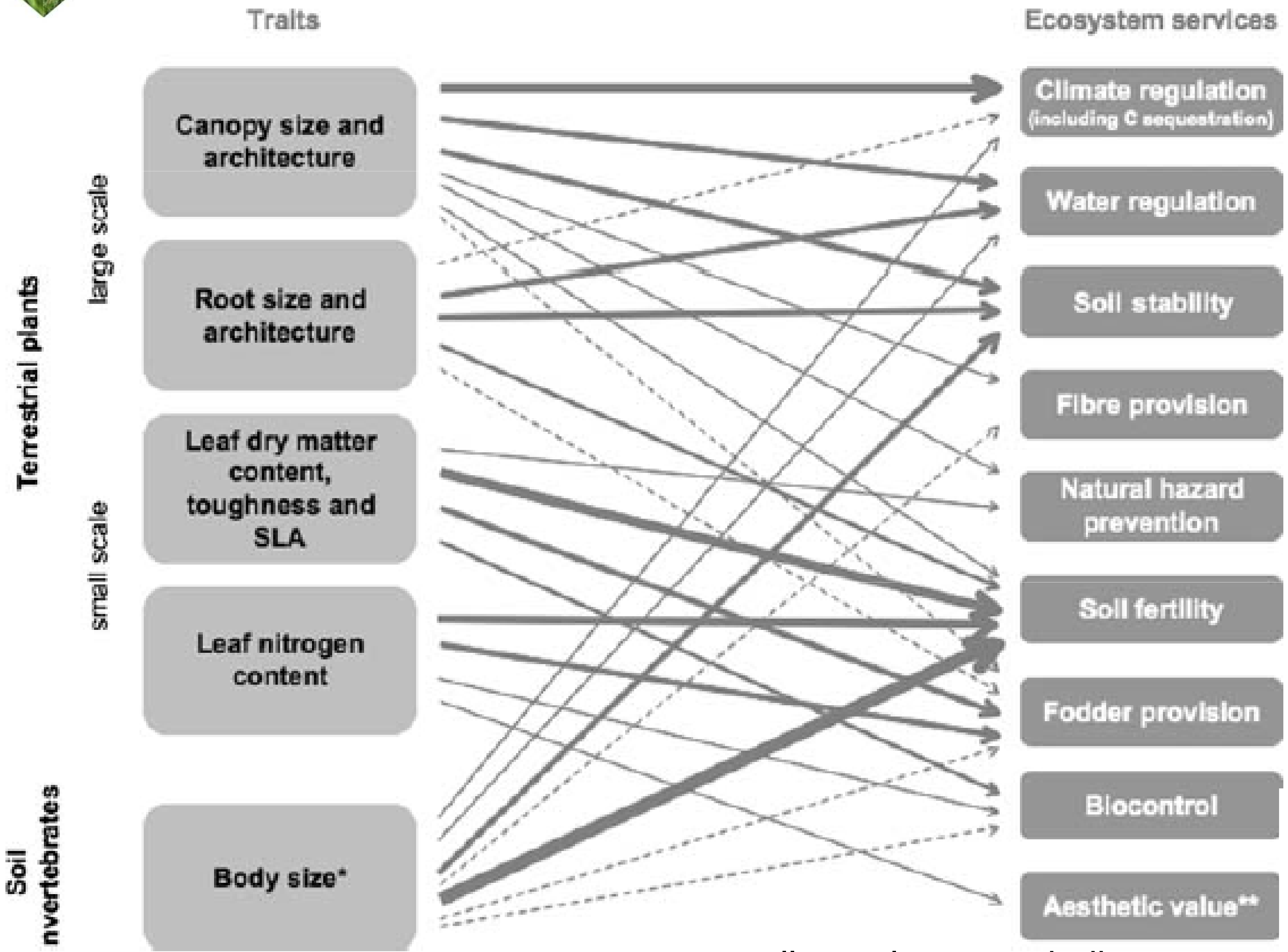
Limitations of FESP

1. Needs more comprehensive testing

2. It does not describe in detail the ecological or human processes that make up complex social-ecological systems

3. It does not help in making the value judgments that are needed to translate state variables into impacts through the definition of thresholds

Plant and invertebrate traits and the relation to multiple services



De Bello et al., 2010 Biodiv. Conserv,

Key points from trait analysis and ES provision

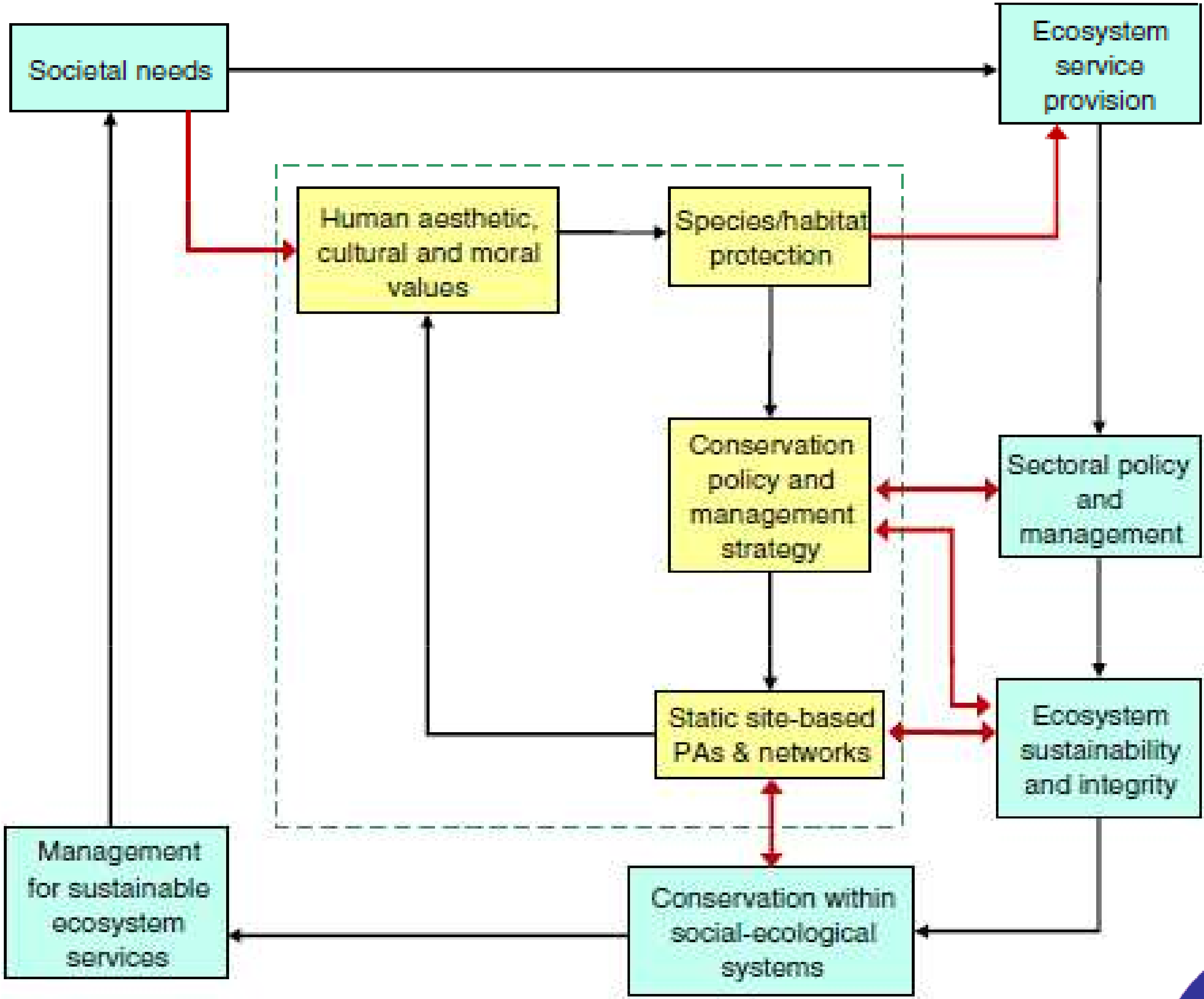
- Type, range and relative abundance of functional traits exert a significant control over services

- several individual traits simultaneously affect the delivery of multiple services;

- single services often depend on multiple traits, leading to clusters of associated traits and services;

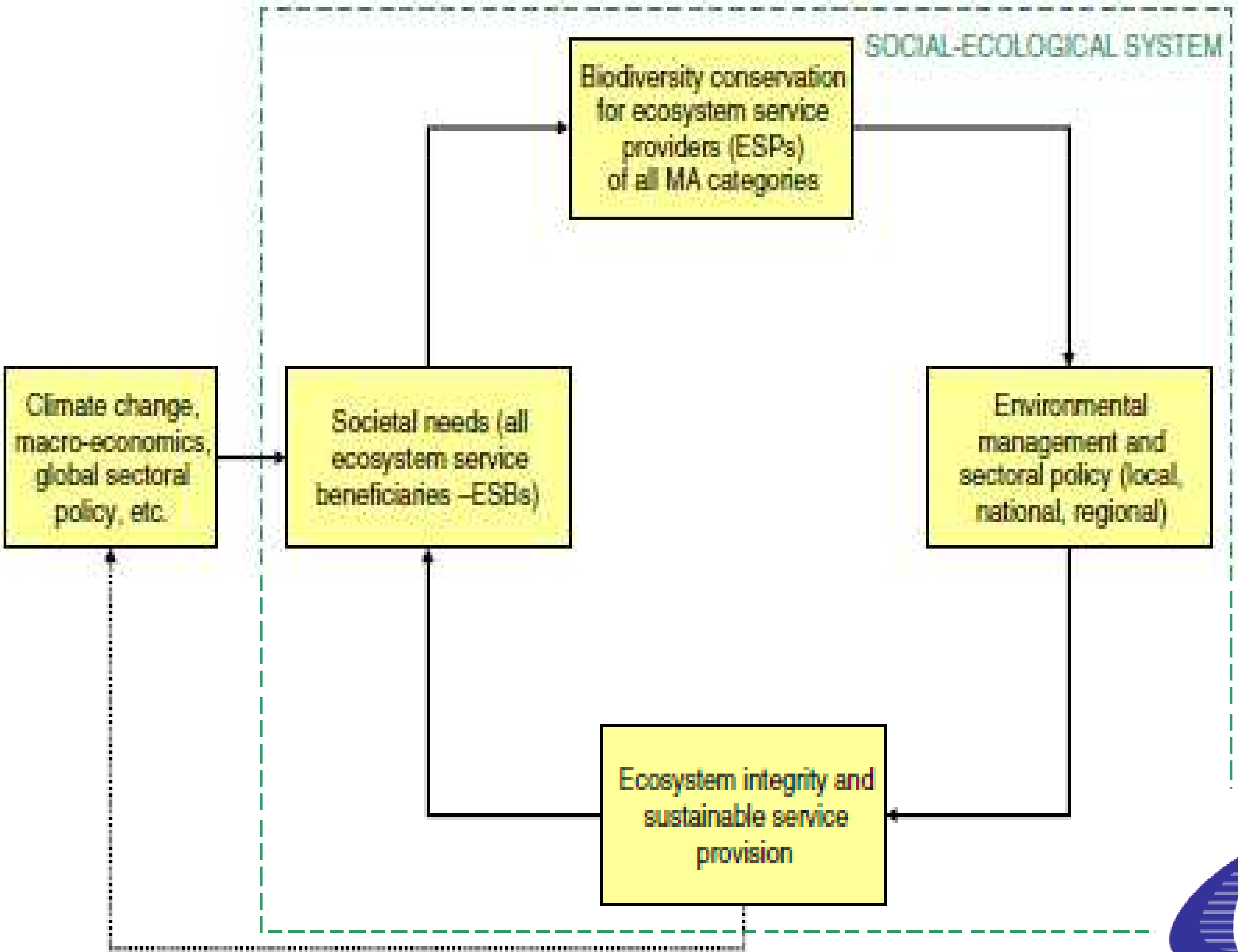
- clusters can provide a basis of ecosystem management, although they may involve trade-offs and feedbacks.

A framework for integrating conservation into ecosystem services



Haslett et al., 2010

A framework for integrating conservation and ES into SES



Haslett et al., 2010

CLIMSAVE Research Themes

1. Analysing the policy and governance context for adaptation.

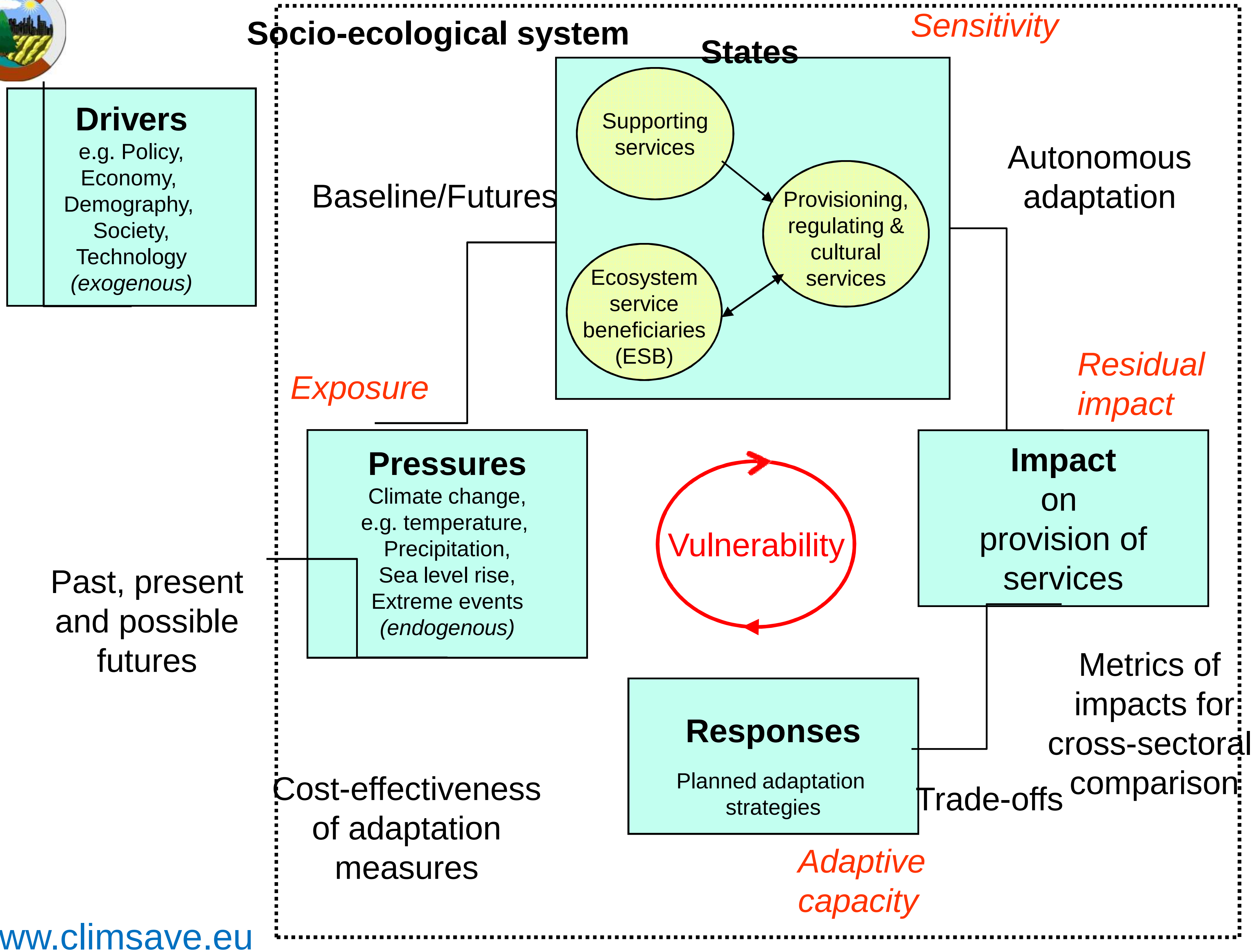
2. Developing an integrated assessment platform which includes linkages and feedbacks between key sectors.

3. Integrating stakeholder input into climate change impacts and adaptation research through the development of participatory scenarios.

4. Analysing the cost-effectiveness of adaptation strategies.

5. Identifying vulnerability hotspots through metrics of impacts and adaptive capacity across sectors.

6. Investigating sources of uncertainty to inform appropriate policy options.



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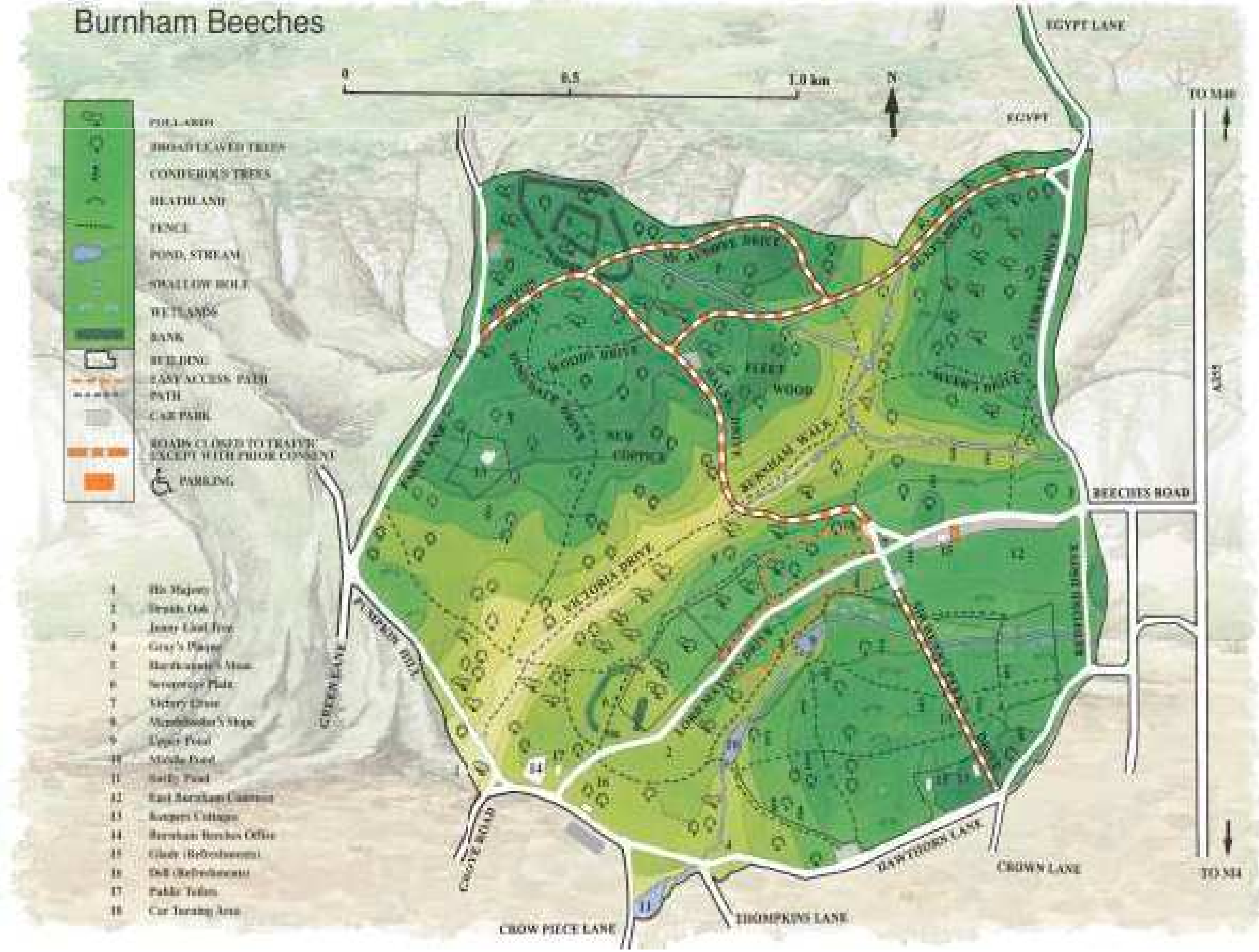
Use of bioclimate envelope models in a local context

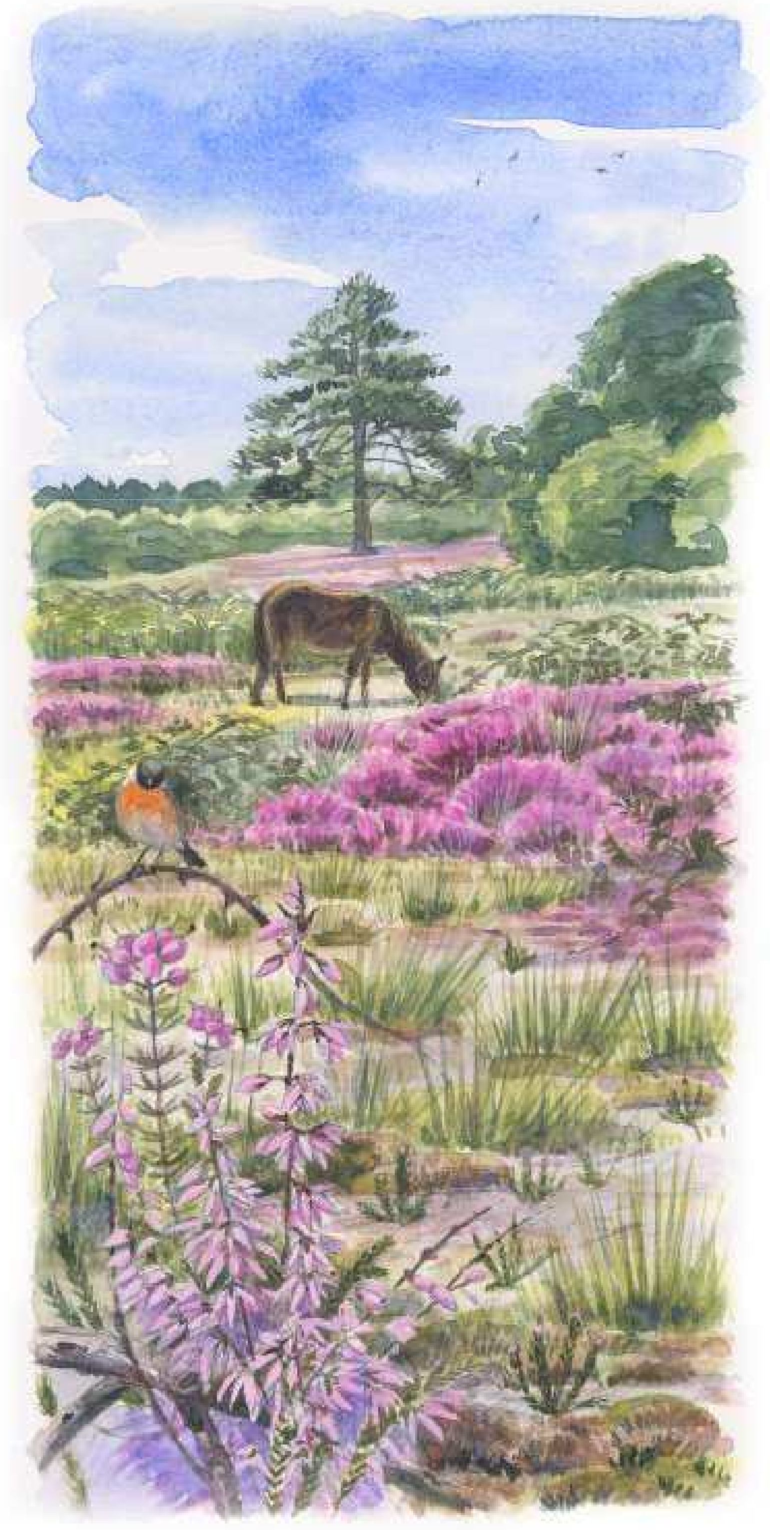
Location of Burnham Beeches, SAC

220 hectares of ancient semi-natural woodland, wood pasture, heath & mire: SSSI, NNR, SAC

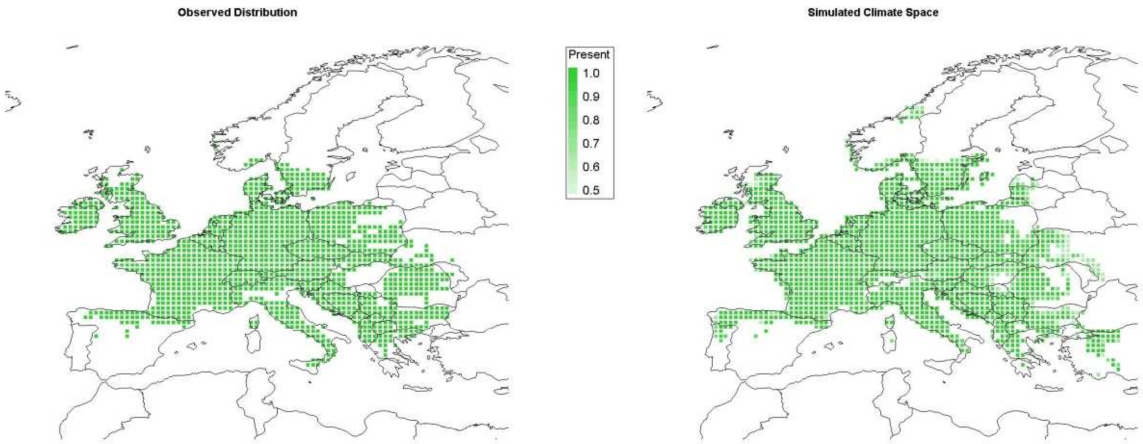


Burnham Beeches

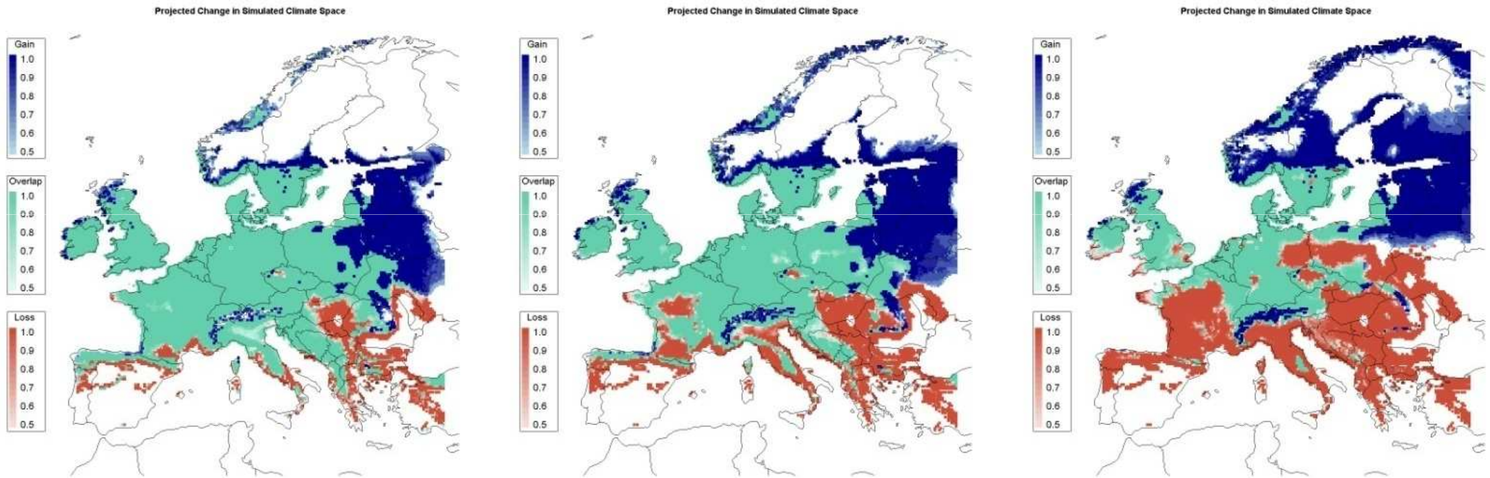
- 105 species modelled (90 plants, 6 birds, 4 mammals, 2 butterflies, 1 amphibian, 1 ant and 1 beetle)
- Concentrated on two main habitat types
  - Woodland (acid beech & oak)
  - Heathland (wet & dry)



Fagus sylvatica (Beech)



Observed distribution (L) Simulated current potential suitable climate space (R)



2020s **2050s** **2080s**

Branch
BIODIVERSITY
SPATIAL PLANNING
CLIMATE CHANGE

Results – beech woodland

- Beech appeared more resilient than in previous studies (growth loss but not complete disappearance)
- Most sensitive species likely to be:
  - Betula spp., Acer pseudoplatanus, Fraxinus excelsior and Quercus spp.
  - Rubus fruticosus, Oxalis acetosella, Arum maculatum, Melampyrum pratense

Overall scenario: Woodland more open and of lower canopy, scrubby species like whitebeam

Implications of climate change for conservation of beech woodland

- Ensure next generation of canopy tree species survives to be future pollards
- Drought effects likely to be compounded by other stresses such as root compaction & high nutrient levels
- Masting frequency & production may change

Indirect effects – some potential to increase sensitivity

- Pests & pathogens
  - E.g. *Phytophthora* sp. and heather beetle
- Grey squirrels
- Changes in palatability of different species
- Some rare (desirable) species may increase
  - E.g. sand lizard and Dartford warbler

Woodland adaptation measures (1)

- Reduce other stresses
  - E.g. air pollution, compaction, other demands for water, squirrel damage
- Habitat restoration
  - Buffer existing reserves, assist migrating species
- Increase landscape connectivity
- Increase size of the reserve

Woodland adaptation measures (2)

- Increase habitat heterogeneity
  - Reintroduce grazing over wider area
- Focus conservation efforts on north facing slopes
- Introduction of a wider range of genotypes
- Re-introduce species
  - Lime (Tilia) more tolerant than oak (Quercus robur)
- Introduce new species
  - To maintain structure e.g. downy oak (Q. pubescens), Mediterranean heathers (e.g. Erica vagans)
  - To maintain function, especially wood decay

Issues beyond the scope of a site manager

- Decisions on introducing non-native species/genotypes e.g. Holm oak (Q. ilex)

- Which tree species are good replacements for native species?

- Increasing size, number and connectivity of reserves and buffering them

- Other research needs e.g. relationship of beech & water tables on different soil types, wood decay

Future challenges (1)

- to understand the ecological underpinnings of service provision, ecosystem dynamics, and methodologies and tools for ecosystem service assessment

- to understand how various drivers are affecting ecosystem services and to develop tools to predict how these changes might affect the provision of ecosystem services in the future.

- to develop adequate classifications of services and values, enhance value estimates and incorporate the dynamic nature of ecosystems in valuation methodologies

Future challenges (2)

- to understand further how traits affect relationships between organisms in different trophic levels and how these are affected by environmental change and affect service provision

- to further investigate the sustainable provision of ecosystem services within the bounds of management for conservation

- to research the links between governance, public perceptions and attitudes, planning and communication of ecosystem services

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Further information on RUBICODE

Website: www.rubicode.net

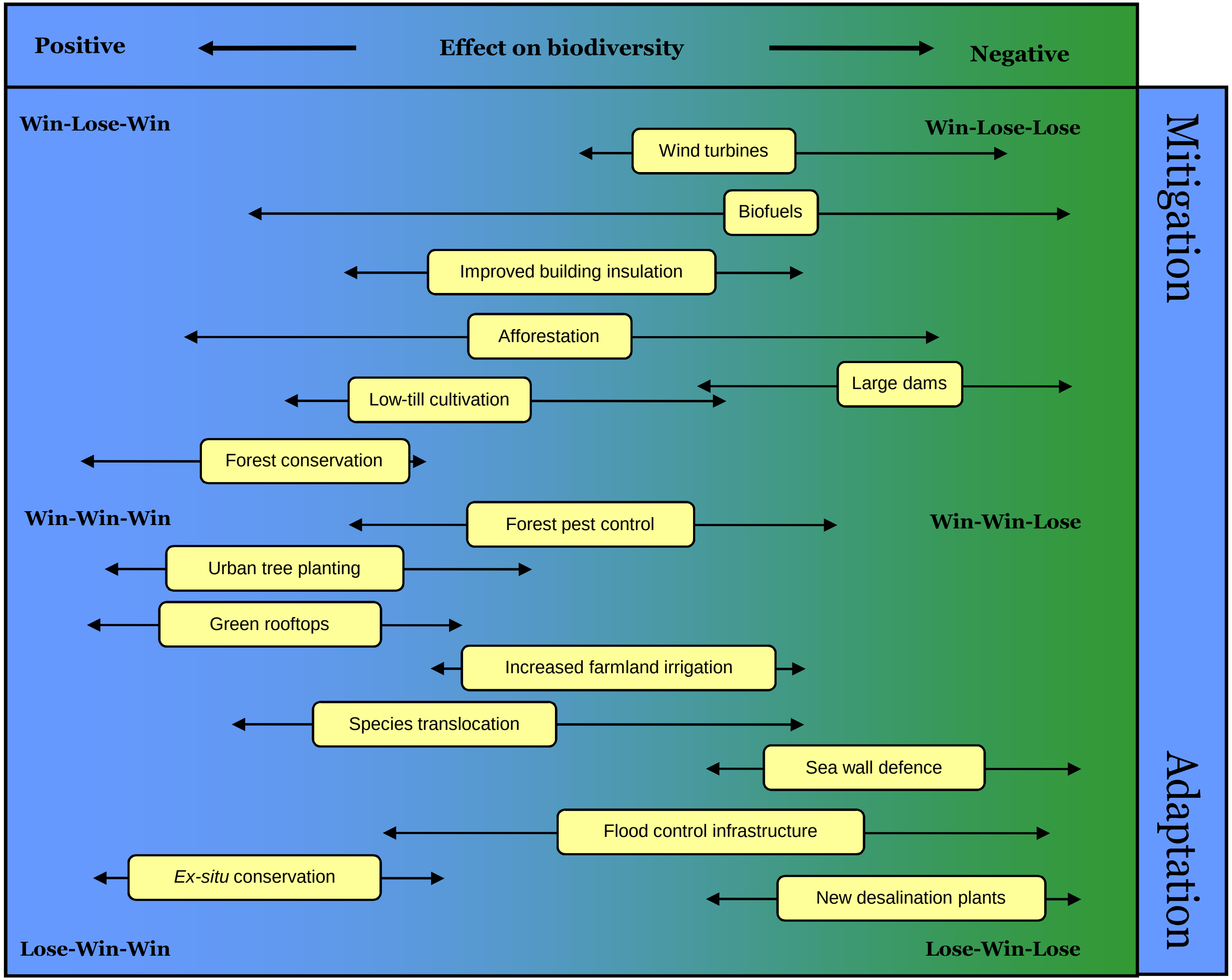
Papers: Biodiversity Conservation – September 2010

Further information on CLIMSAVE

Website : www.climsave.eu

Thank you!

Known and potential relationships between mitigation and adaptation measures and their impacts on biodiversity



Paterson et al. (2008)