Restoration of ecosystem services

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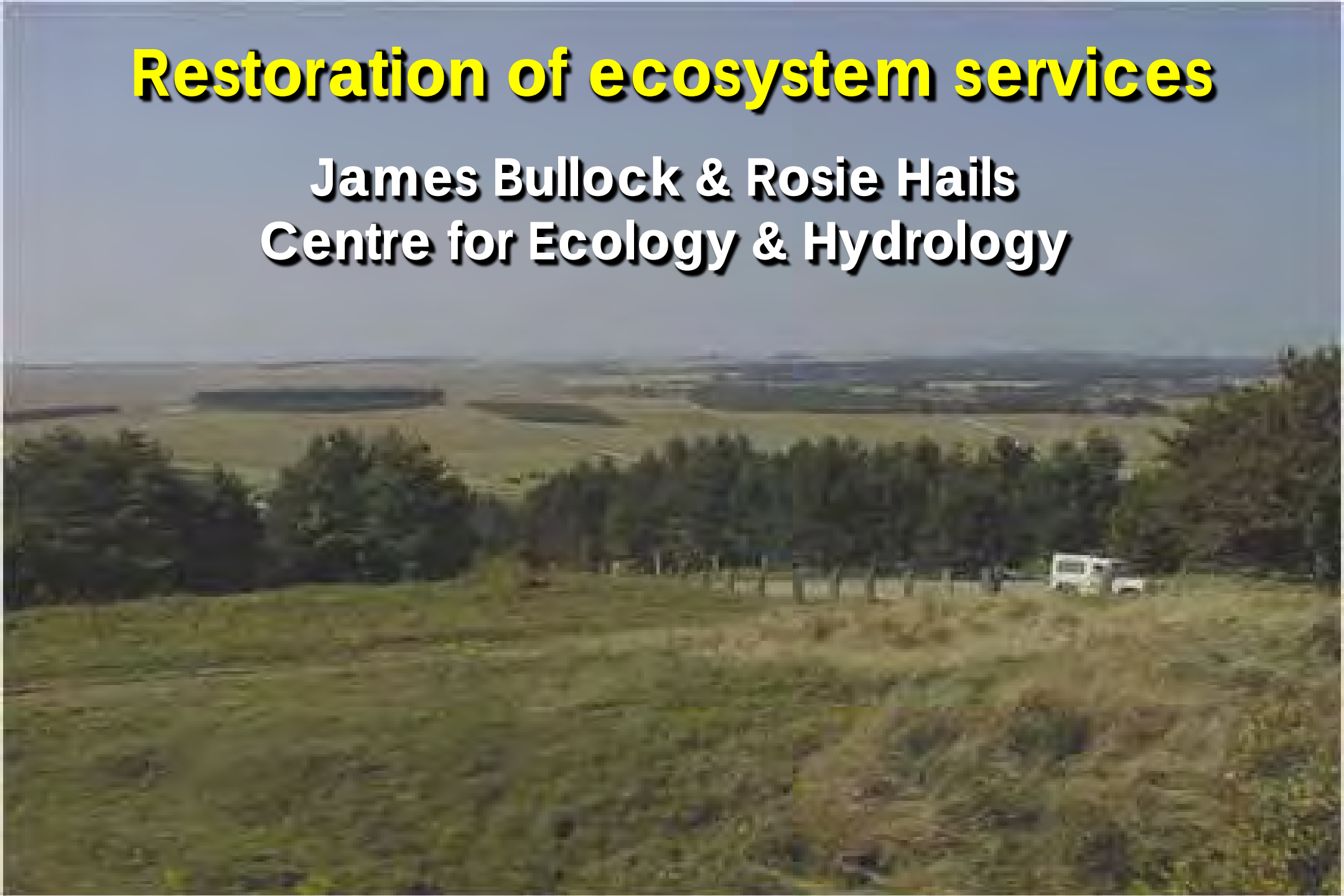


Questions for this talk

- How easy is it to restore ecosystem services?
- What are the targets for restoration of ES
- Are there conflicts in restoring multiple ES & biodiversity?
- How might we deal with multiple restoration aims?

Habitat restoration - examples

(a) Planting trees

Digging out river meanders

Amending contaminated soils

Removing alien plants

Restoration projects have enhanced many services

Global meta-analysis of restoration projects

Provisioning: marine and freshwater fisheries, livestock production, timber products

Regulating: water quality (pollutants, sediment), water holding & runoff, water table, soil pollution, sea defence

Supporting: soil compaction, carbon sequestration, soil fertility, respiration & decomposition, soil moisture, primary production

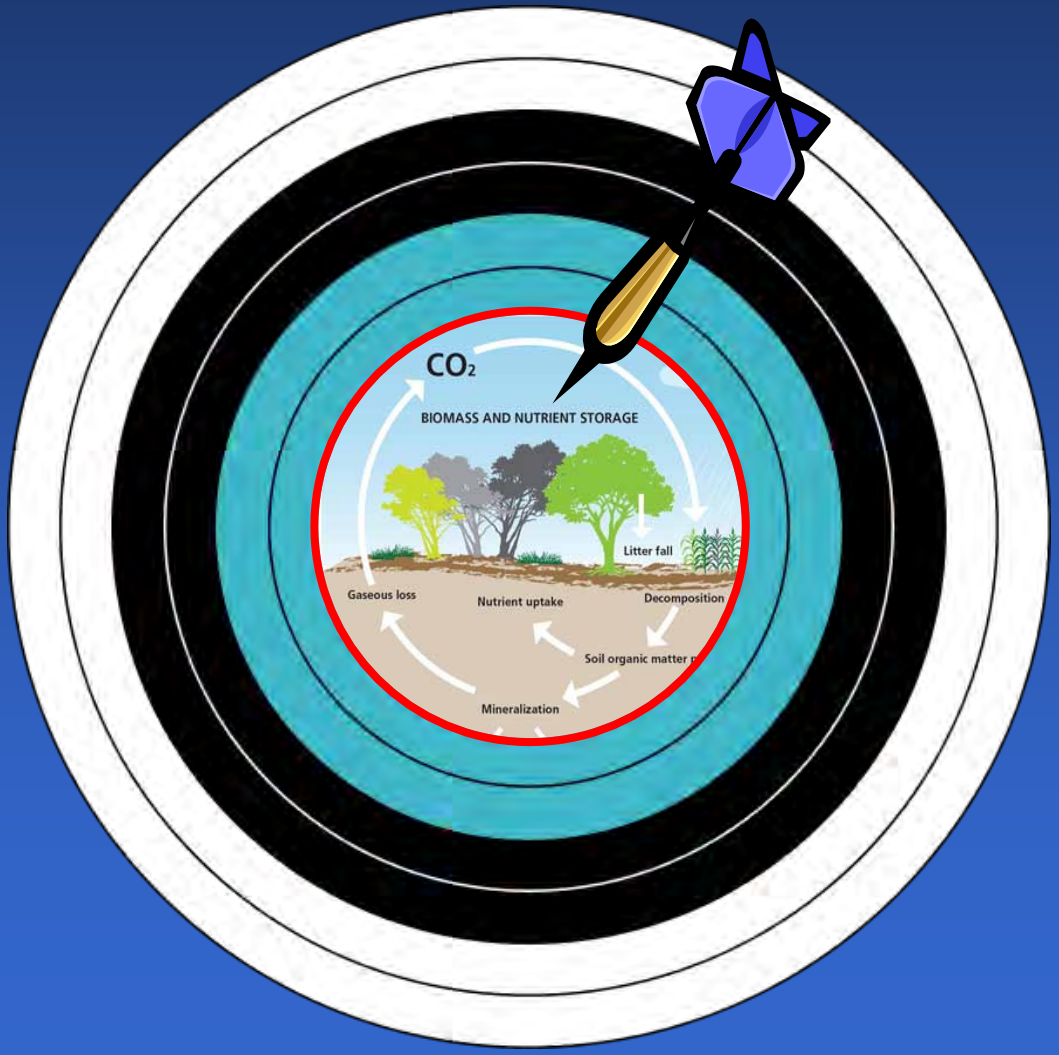
Cultural: Little measured evidence

Rey Benayas, J.M., Newton, A.C., Diaz, A. & Bullock, J.M. (2009) Enhancement of biodiversity and ecosystem services by ecological restoration: a meta-analysis. *Science, 325, 1121-1124.*

Setting ecosystem service targets for restoration

Based on:

Reference ecosystem **or** **Maximising specific services?**

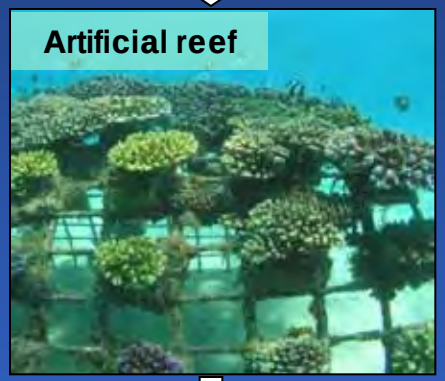


A restoration meta-analysis; target = reference ecosystem

89 restorations across the world – tropical/temperate, aquatic/terrestrial

Degraded state

Restoration



Reference

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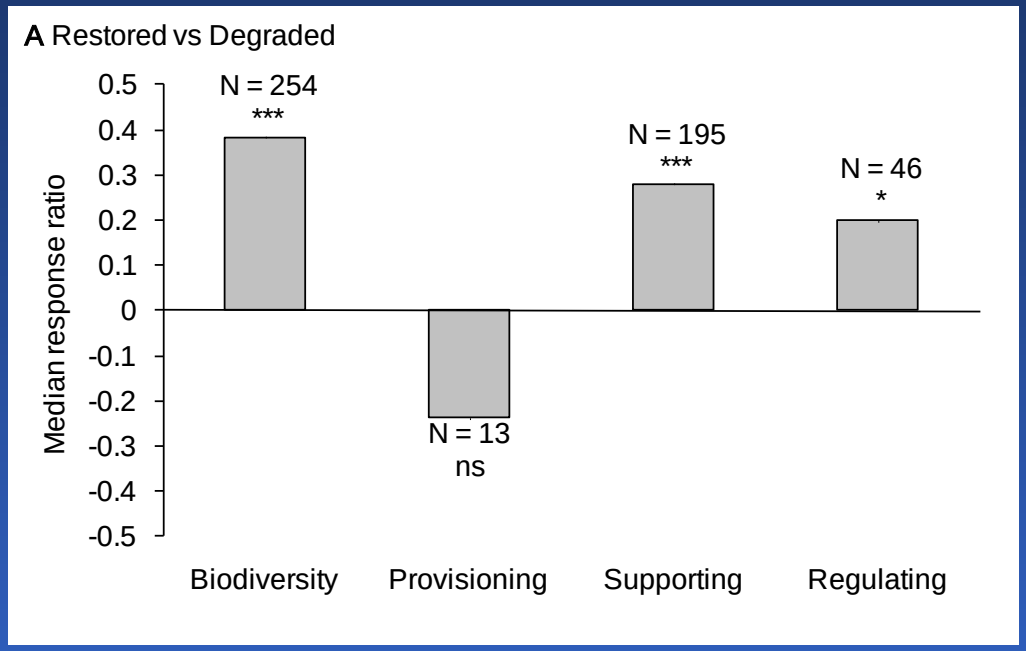
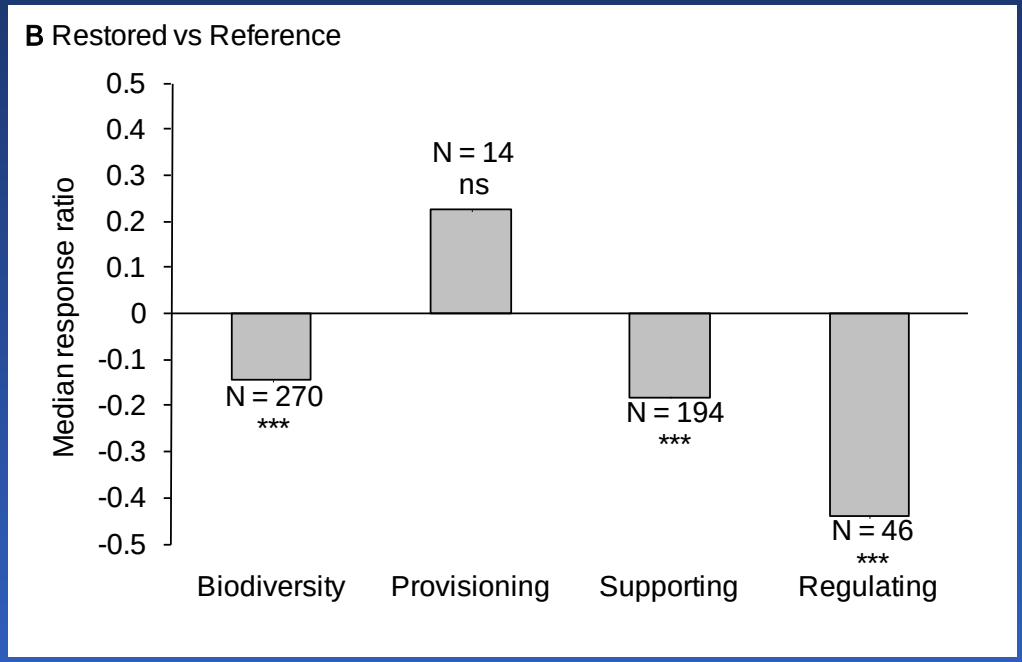
Restorations are only partly successful

89 restorations across the world – tropical/temperate, aquatic/terrestrial





Restored systems have 25% more service provision than degraded systems (biodiversity 44%)

Restored systems have lower service provision - 80% - than targets (biodiversity 86%)

Rey Benayas et al. (2009) Science

Services can take a long time to match the target

Ballantine et al. (2009) Ecol. Appl.

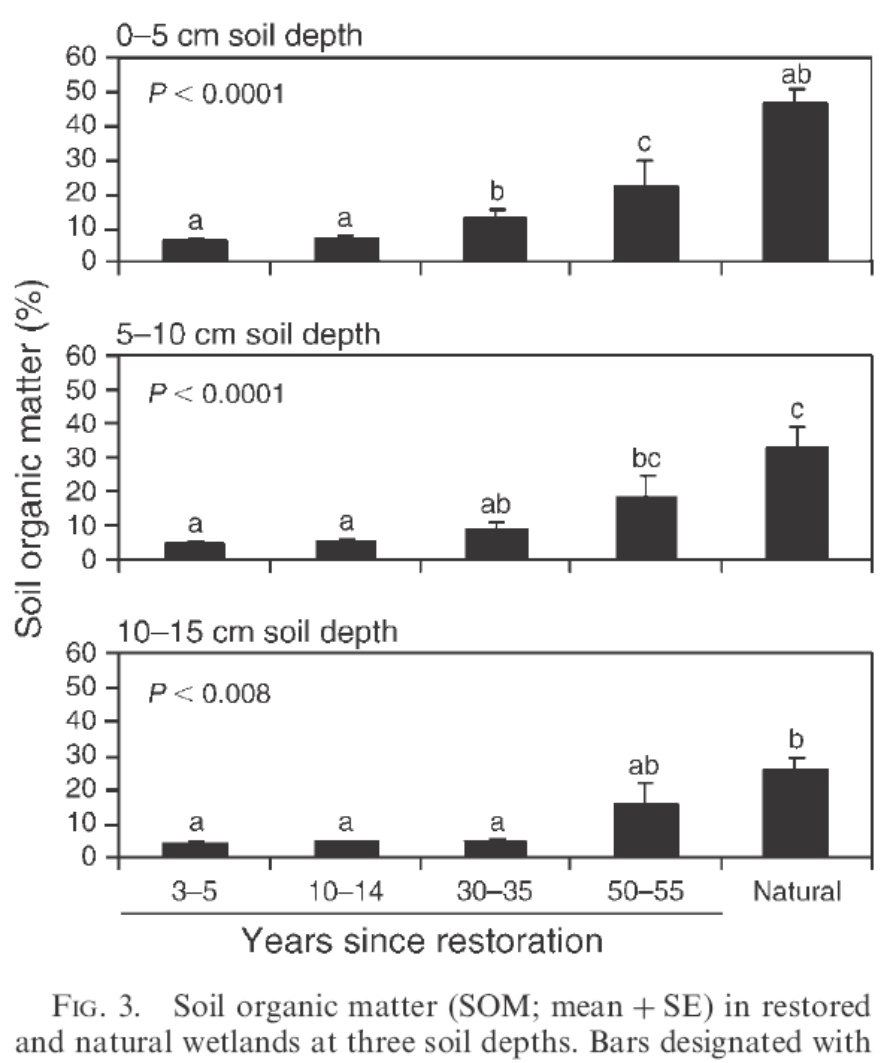
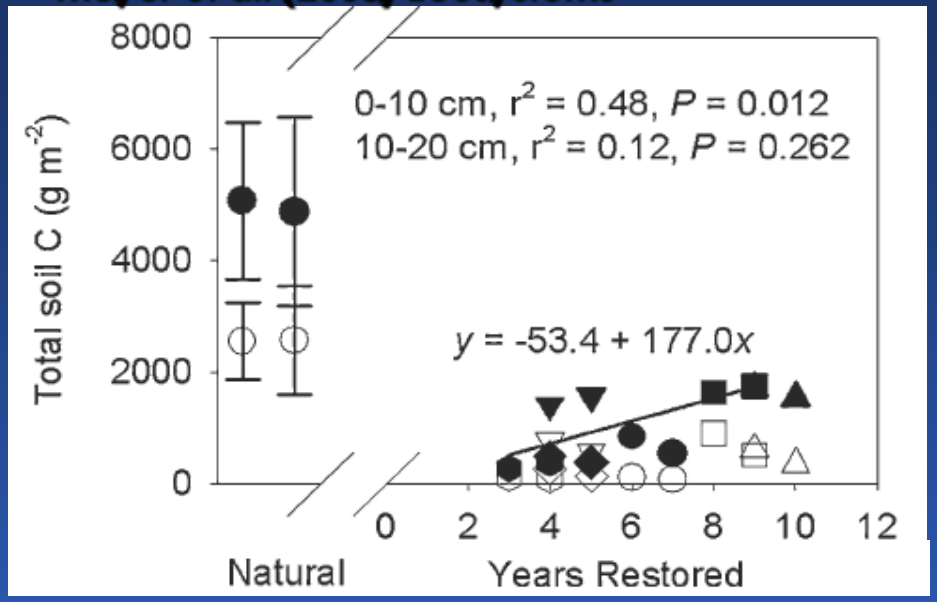


FIG. 3. Soil organic matter (SOM; mean + SE) in restored and natural wetlands at three soil depths. Bars designated with

Meyer et al. (2008) Ecosystems



2 USA studies of wetland restorations

Slow rate of carbon build up

Target unachievable?

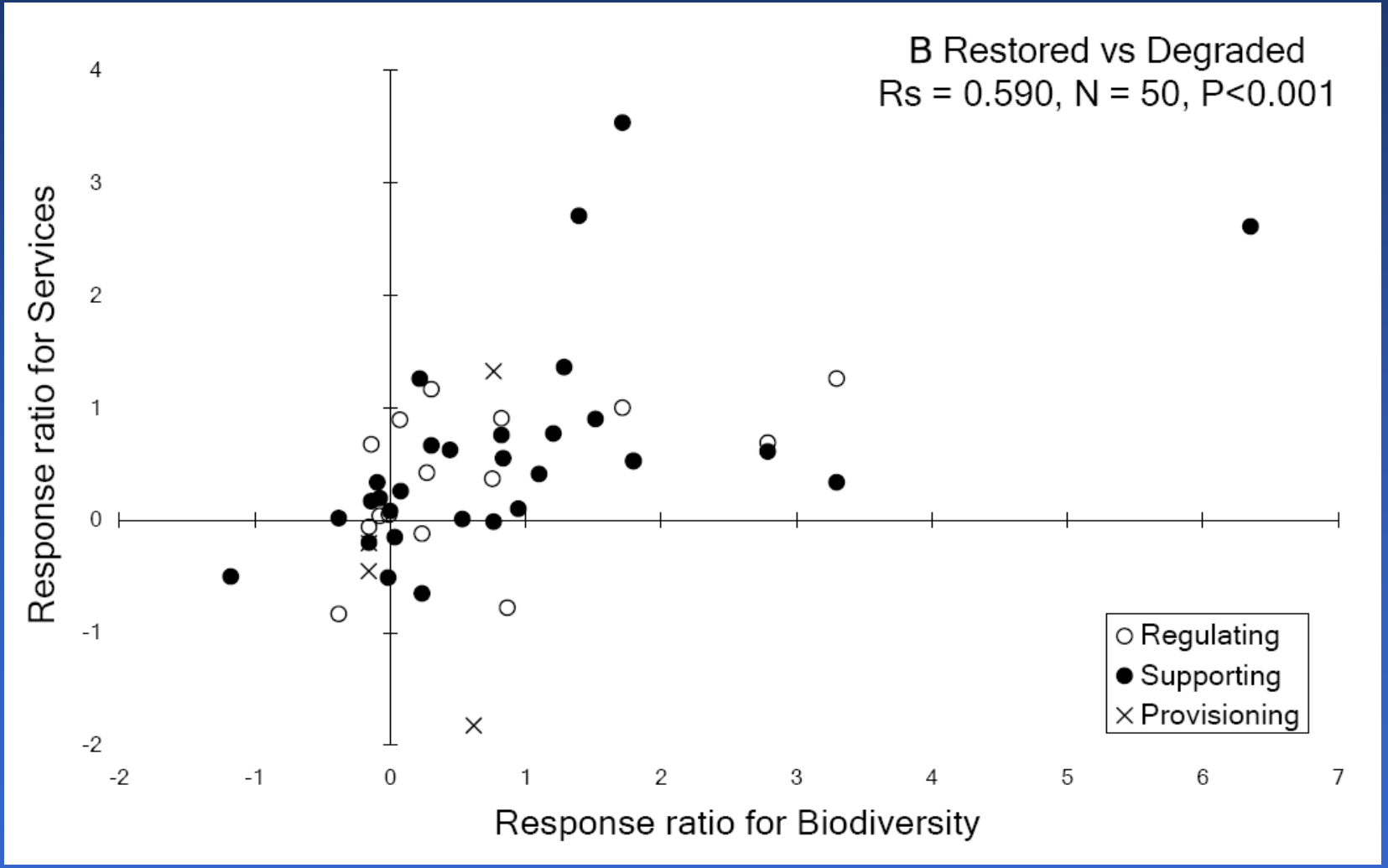
Targeting specific services

China's 'Grain to Green' program. Afforestation of agricultural land to reduce soil erosion & flooding

Scottish Forestry Strategy: increase woodland from 17% to 25% during 21st century. Main aim: increase C sequestration

Conflicts or synergies?

Correlated restoration of services & biodiversity
Cause & effect?

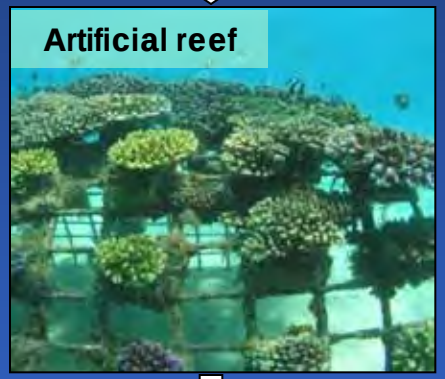


Rey Benayas et al. (2009) Science

From a very degraded start – restoration enhances services & biodiversity

Degraded state

Restoration



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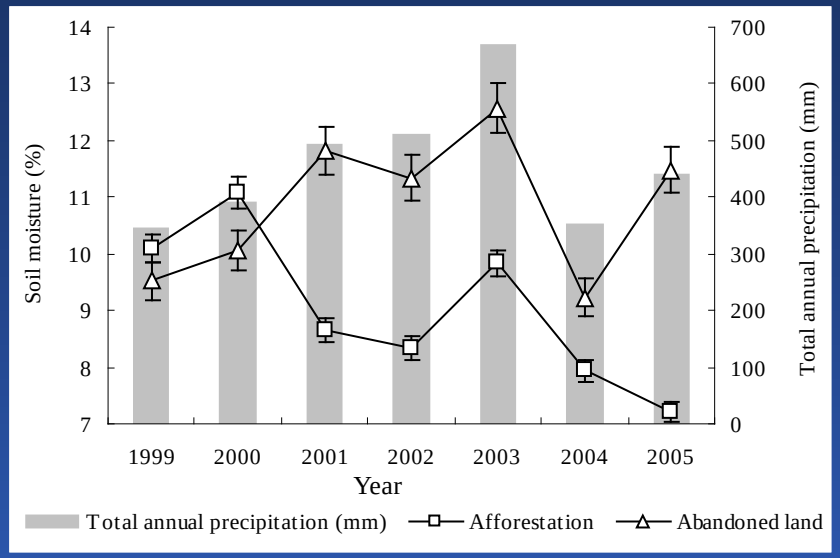
Conflicts or synergies?



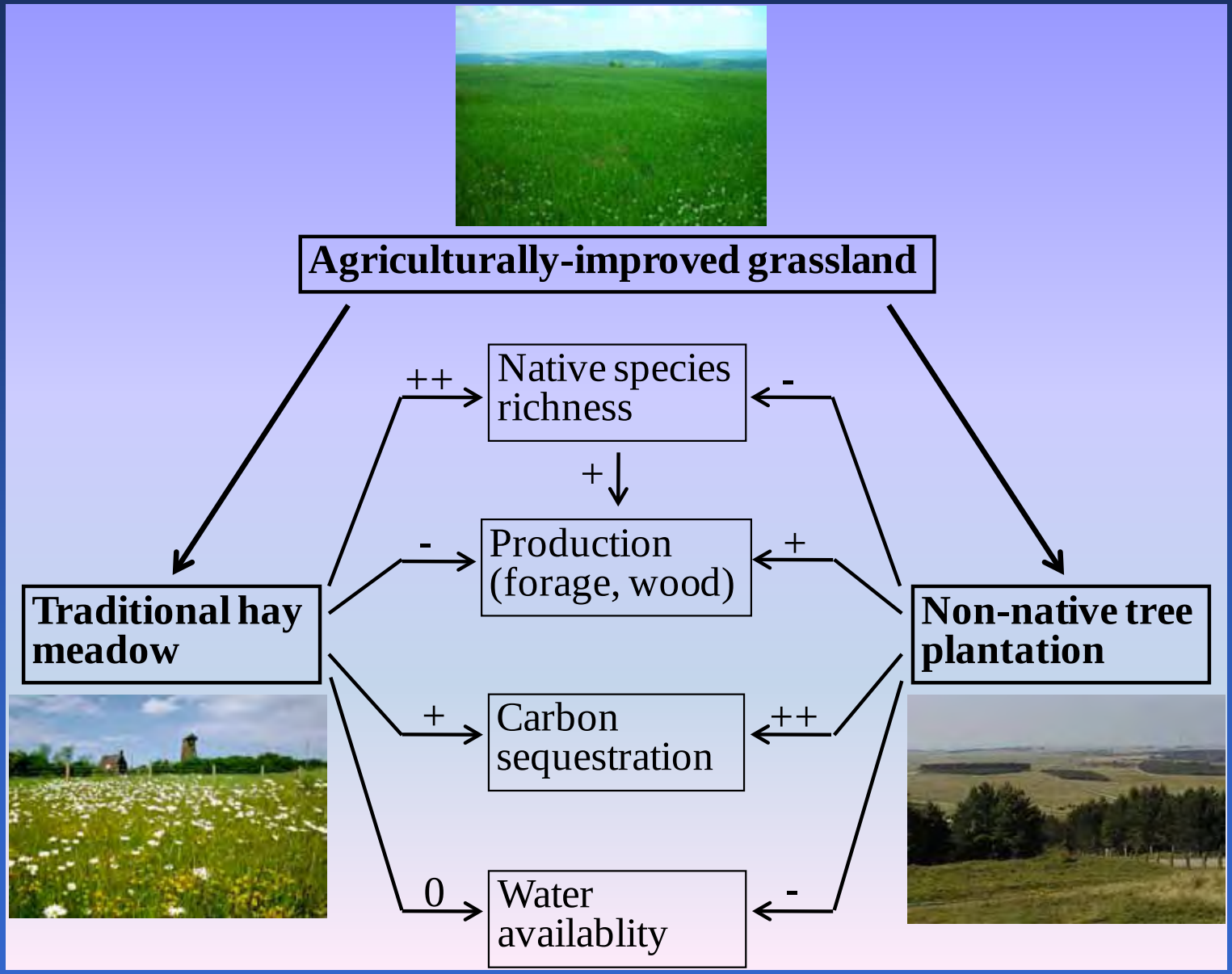
'Grain to Green' program. In arid lands re-afforested areas reduce water availability

Cao et al. (2009) J. Appl. Ecol

Restoration of natural forest structure increases pine shoot beetle damage in adjacent production forestry

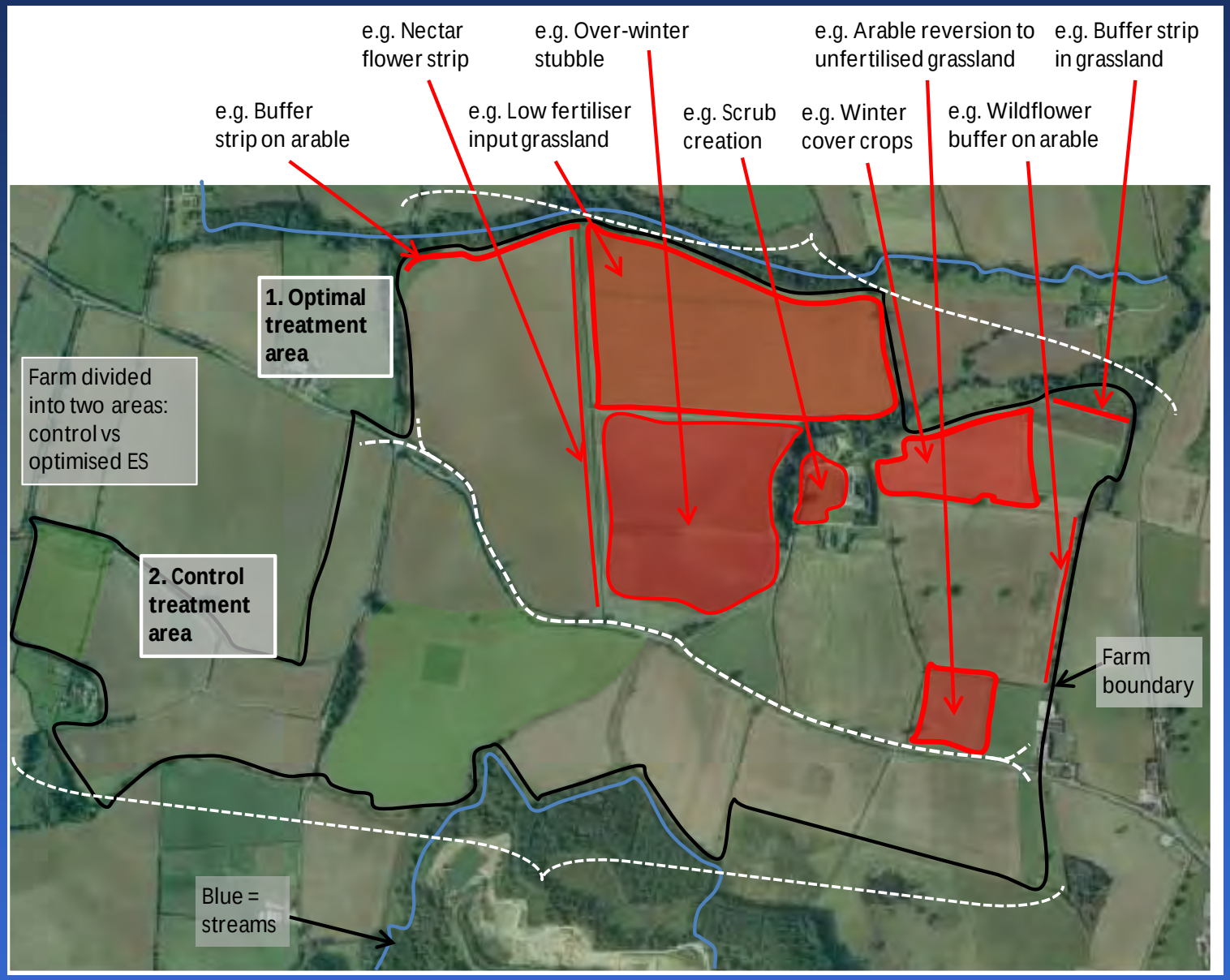
Komonen & Kouki (2008) Forest Ecol. Man.

Conflicts or synergies? – comparing alternatives



Bullock et al. in prep

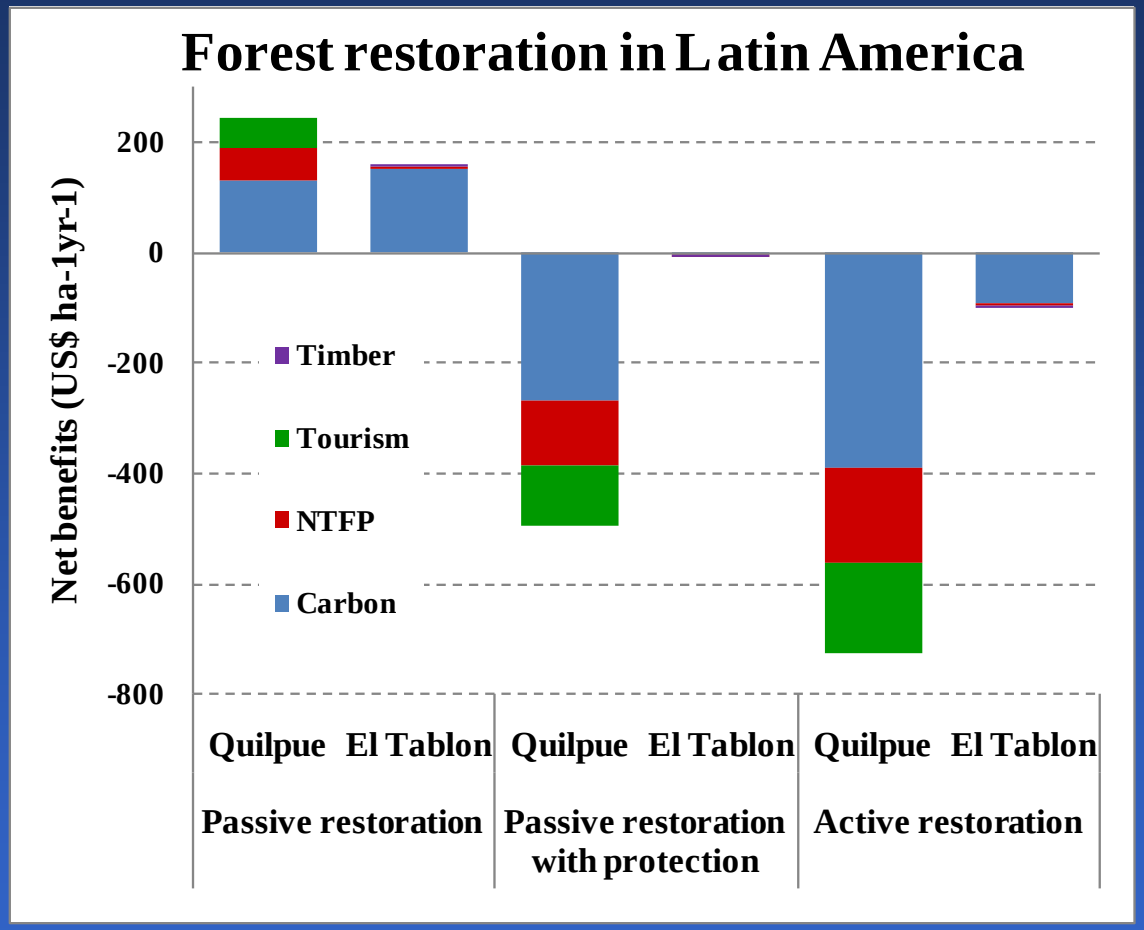
Landscape-scale projects?



Solve conflicts & enhance synergies?

New CEH project for Defra

Ecosystem services and valuation



Birch, J., et al. (in press) Cost-effectiveness of dryland forest restoration evaluated by spatial analysis of ecosystem services. *PNAS.*

- Markets for ES allow cost:benefit analysis
- Example: forest restoration in drylands
- Active restoration – greater costs, so passive approach greater net benefit

Conclusions

- As with biodiversity, restoration of ES can be slow and incomplete
- There are possible synergies and conflicts in restoring multiple ES & biodiversity
- Problems arise if single ES are targeted
- Landscape approaches may avoid conflicts
- Market values of ES may allow funding of restoration