Effects of drought on UK ecosystems and the implications for nature conservation in a changing climate

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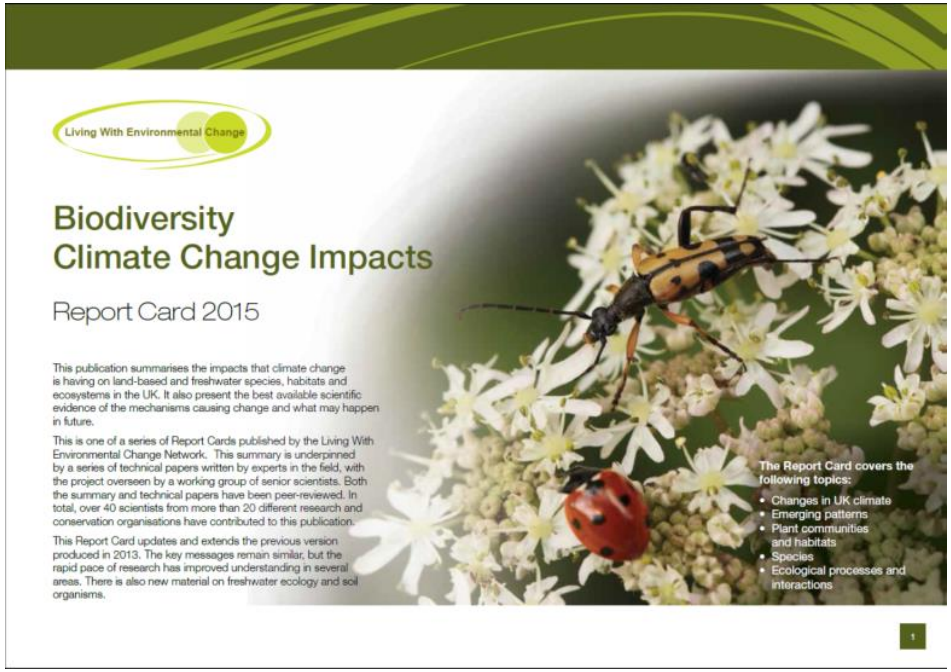
Species populations and habitats have been affected by year to year variations in rainfall and extreme weather events, particularly droughts.

Projected changes in these factors could have a major impact on biodiversity and ecosystems, with significant regional variations.



Morecroft & Speakman (2015; eds.) *UK Biodiversity Climate Change Impacts Report Card*

- Brief Survey of habitats with examples
- Identify Cross cutting issues and adaptation opportunities

Acknowledgements:

Many colleagues, past and present,

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Comparing habitats

Woodland

- Shallow rooted trees e.g. beech, birch, sycamore can die
- Drought can lead to changes in community composition
- Drought causes a reduction in rates of primary productivity and subsequent impact on secondary consumers
- Drought can increase sensitivity of trees to pests and pathogens
- Interactions with soil type, patch size, land use and management

Lady Park Wood following 1976 drought

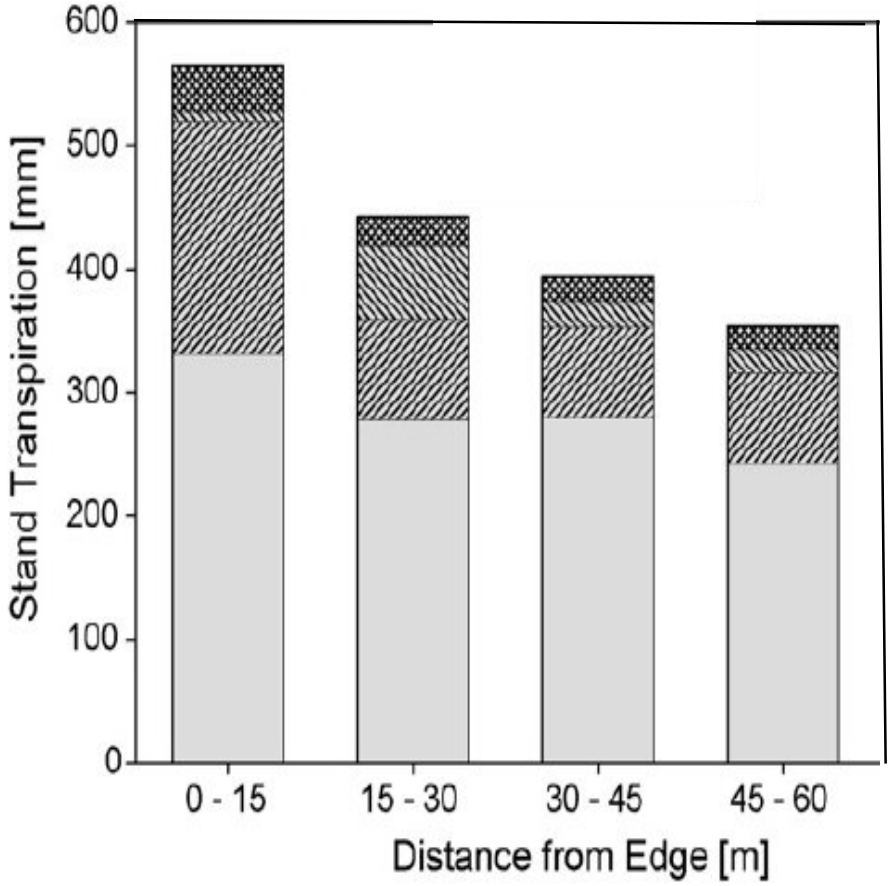
- Death of old beech and young birch trees
- Reduced tree growth rate and increased mortality continued for a few years

Peterken & Mountford (1996) *Forestry*
Cavin et al. (2013) *Functional Ecology*

1995 drought at Wytham Woods

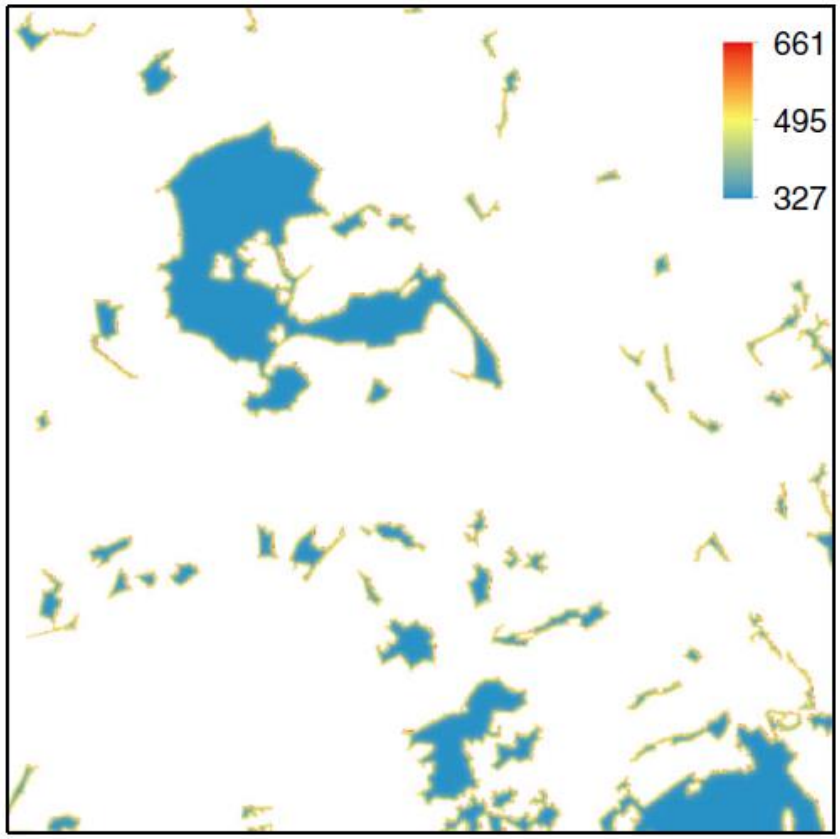
- Not preceded by dry winter c.f. 1976
- No widespread death of mature trees
- Some death of shrub layer
- Early leaf loss
- By early September Elder 58% defoliation on clay soils; 19% on thin limestone soils

Transpiration at the forest edge



Herbst *et al.*, (2007) *Forest Ecol. & Management*

Estimated evapotranspiration (mm) in forest fragments



UK wide

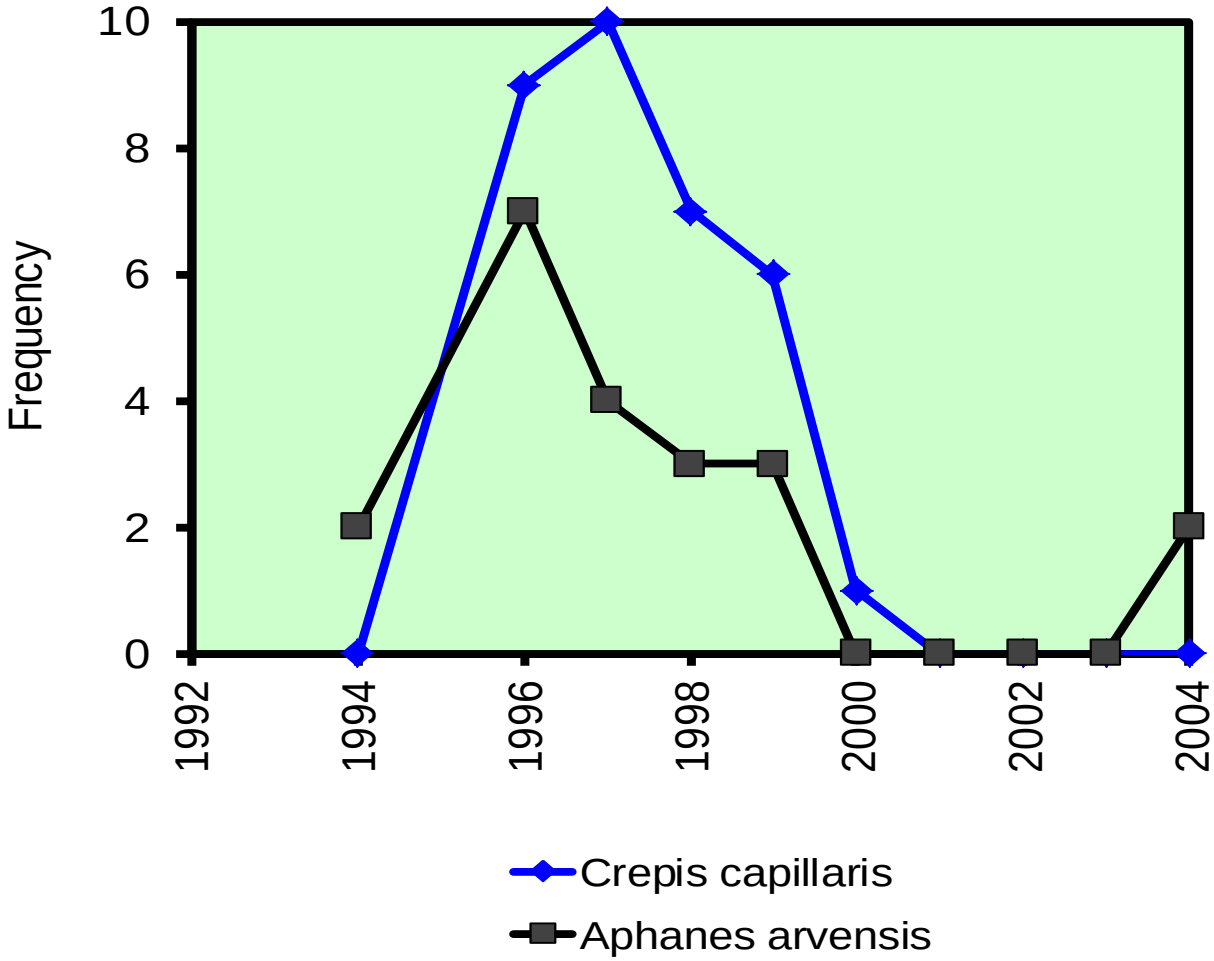
74 % of woodland area within 100 m of edge

Riutta et al. (2015) *Landscape Ecology*

Grasslands

- Old, low nutrient grasslands may be more resistant to drought compared to more recent and productive grasslands.
- Drought typically causes dieback of dominant grass species creating openings and gaps which leaves communities vulnerable to invasive species

Increase in ruderal species in grassland Wytham, Oxfordshire




Wytham Climate Change Experiment

Characteristics of grassland plant species increasing or decreasing during drought

'Winners'	'Losers'
Deep rooted	Shallow rooted
'Weedy' species (Fast reproduction, easily dispersed)	Grasses

Morecroft et al. (2004) Functional Ecology

Rivers, streams, lakes and ponds

- Some key species for conservation are vulnerable e.g. white clawed crayfish, natterjack toad, great crested newts
- Timing, duration, frequency and magnitude matter.
- c. 50% freshwater organisms can tolerate drying out,
- Some systems (e.g. headwaters, winterbournes) are adapted to periodic drying
- Impacts are often greater in modified c.f. natural systems
- Lack of 'flushing' events due to low flows can give algal communities a competitive advantage over *Ranunculus*
- Catchment characteristics and management modify response
- Opportunity to build resilience by good management

Pevensey Levels National Nature Reserve

- Biodiversity interest is in the ditches
- Local water control is possible
- Ground water fed through rive - gives some resilience
- New development in catchment may increase abstraction

Fen, Marsh, Swamp, bog

- Wetland macrophytes are often able to tolerate short term drought events, but impacts of long term and/or more frequent droughts are less certain
- Differing response of wetland species to drought conditions can lead to a more diverse macrophyte community
- Drought can lead to poor breeding success in wetland birds (e.g. lapwing, redshank and snipe)
- The rate of loss of carbon from peatlands can increase following a drought
- Large effects of catchment characteristics and management

Aspects of Resilience: restoring ecological processes

Restored blanket bog

Chippenham Fen National Nature Reserve

- Some local control of water possible
- Major abstraction issue
- Dry area of the country

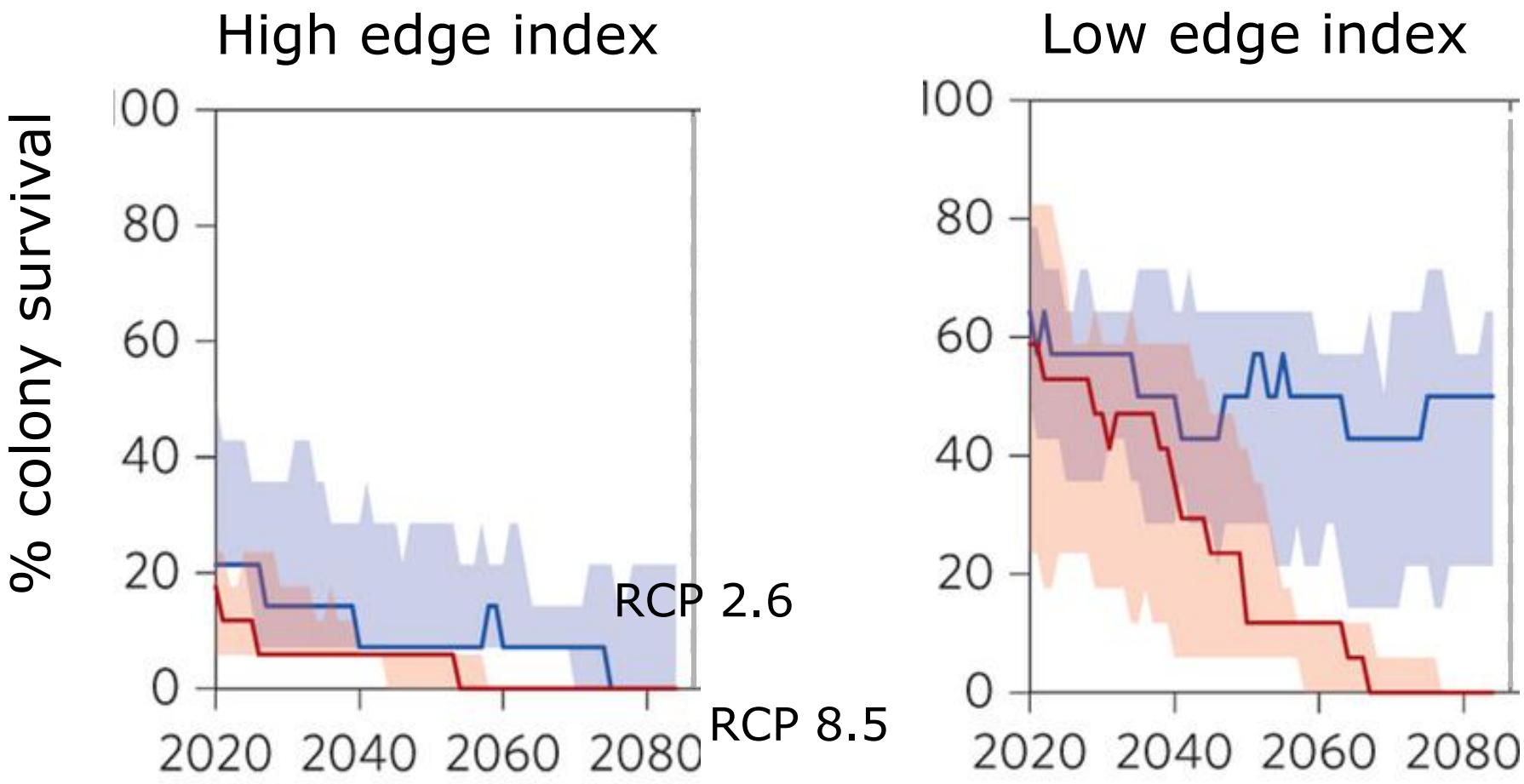
Cross-cutting issues

Responses of butterflies, moths and ground beetles to drought 1995- 1997

'Winners'	'Losers'
Southern distributed	Northern distributed
Dry habitats	Wet habitats
Mobile	Restricted mobility

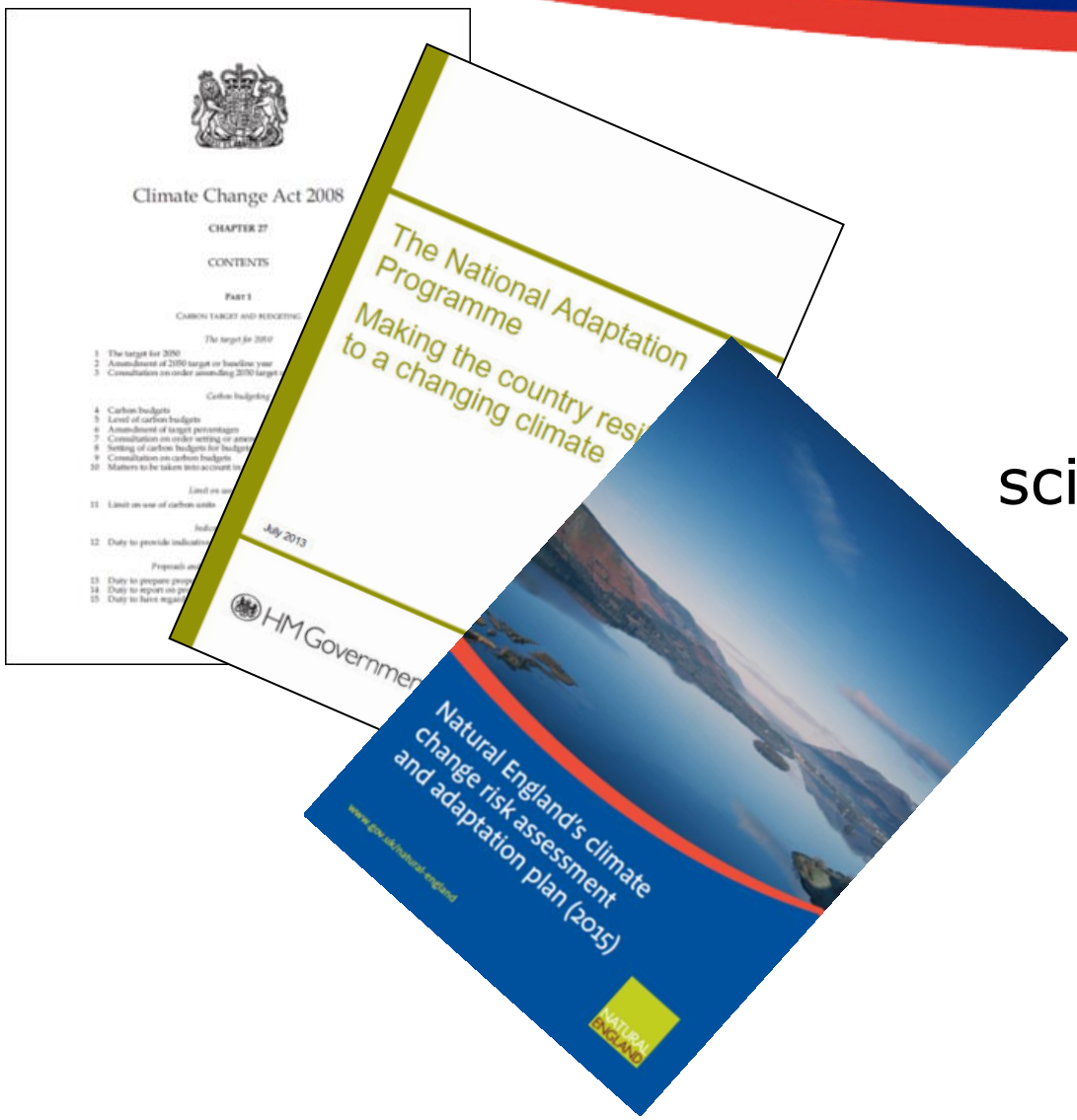
Morecroft et al. (2002) Global Ecology & Biogeography

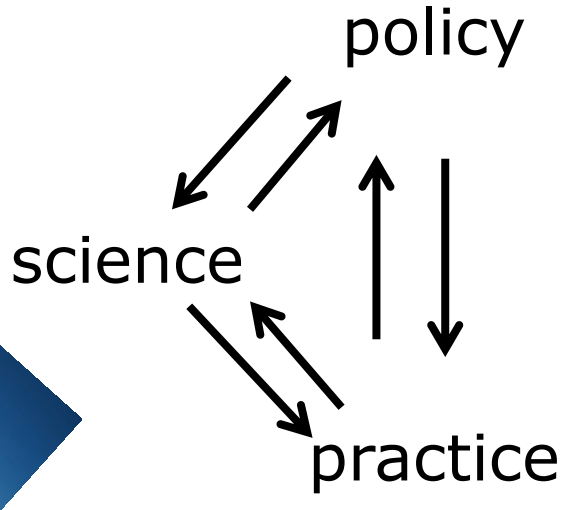
Impact of climate change on drought sensitive butterfly species



Oliver *et al.* (2015). *Nature Climate Change*

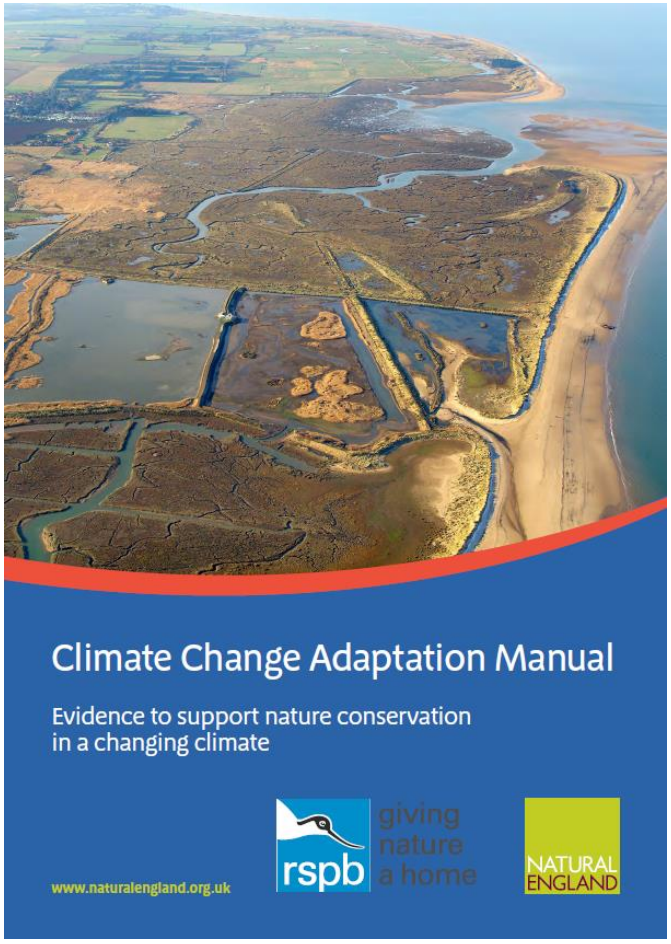
Conservation needs to adapt to climate change





Morecroft *et al*. (2014)
Nature Climate Change

Science → advice → action



Conclusions

- Drought affects a wide range of ecosystems and species
- Winners and losers amongst species
- Dry winter followed by dry summer increases risk
- Climate change adaptation should take account of drought risk
- Impacts modified by soil type, catchment, management
- Potential adaptation measures include, wetland restoration, reducing abstraction, water control structures, diversification of tree species.
- Strong links between science, policy and practice are essential