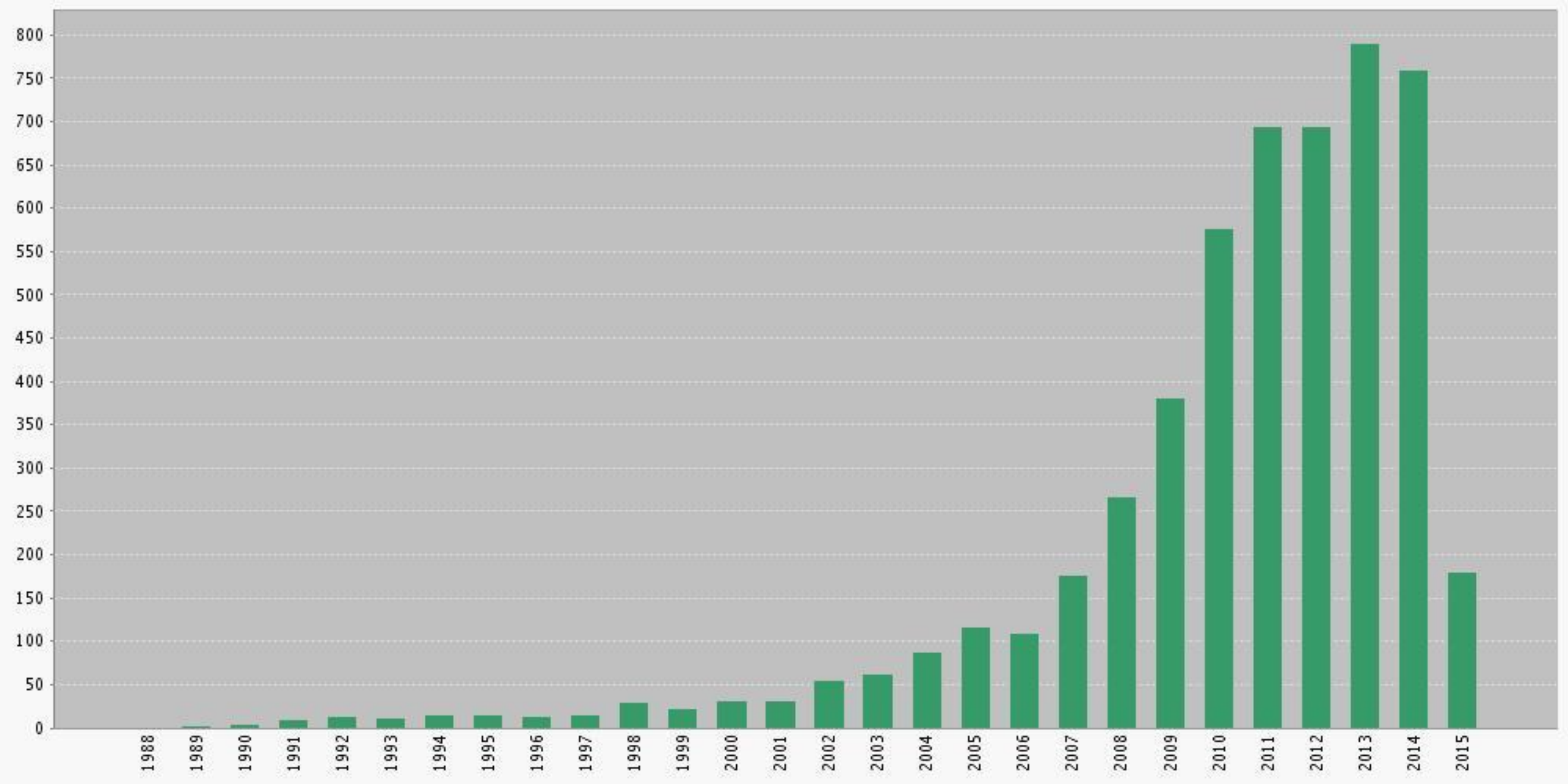
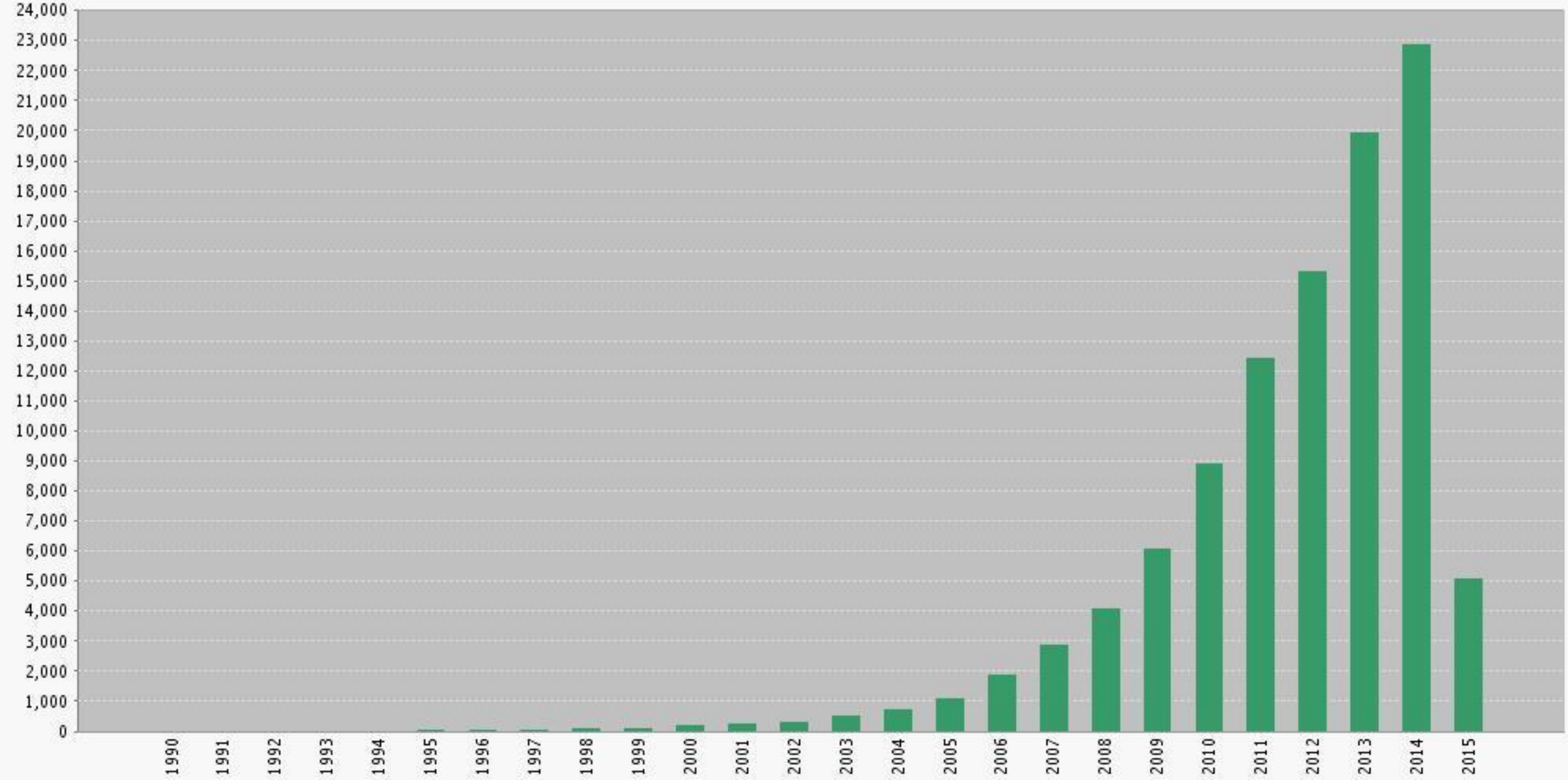
# Climatic change
# and
# biodiversity conservation

Brian Huntley




# Number of papers published annually

Web of Knowledge search using the search term
biodiversity AND conservation AND “climat* change”




# Number of citations annually

## Web of Knowledge search using the search term biodiversity AND conservation AND “climat* change”

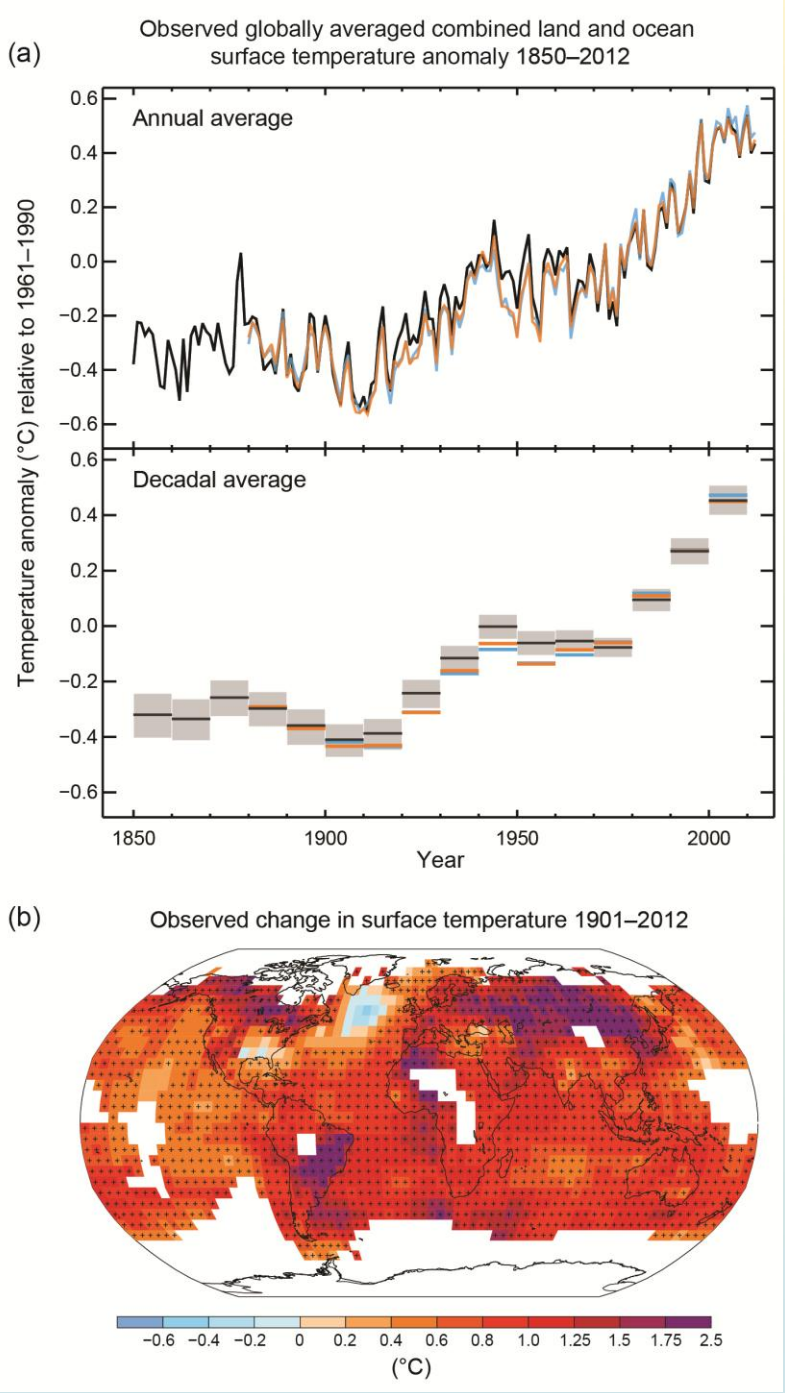
# Presentation outline

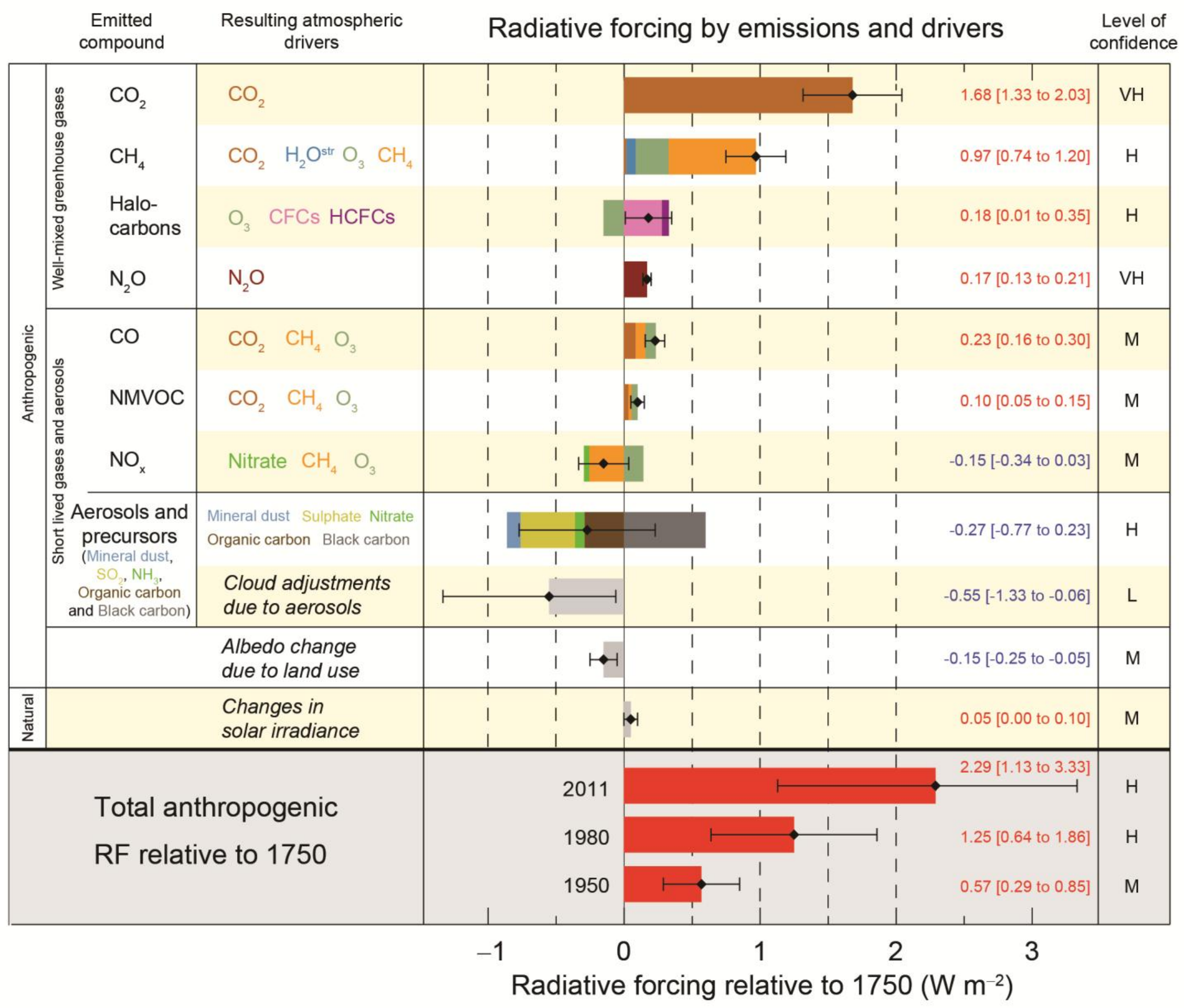
- Anthropogenic climatic change and why it challenges biodiversity conservation
- How species respond to climatic change
- Why biodiversity matters
- What needs to be done
- What is being done
- Priorities for the future

(a) Observed global mean combined land and ocean surface temperature anomalies, from 1850 to 2012 from three data sets. Top panel: annual mean values. Bottom panel: decadal mean values including the estimate of uncertainty for one dataset (black). Anomalies are relative to the mean of 1961−1990.

(b) Map of the observed surface temperature change from 1901 to 2012 derived from temperature trends determined by linear regression from one dataset (orange line in panel a). Trends have been calculated where data availability permits a robust estimate (i.e., only for grid boxes with greater than 70% complete records and more than 20% data availability in the first and last 10% of the time period). Other areas are white. Grid boxes where the trend is significant at the 10% level are indicated by a + sign.

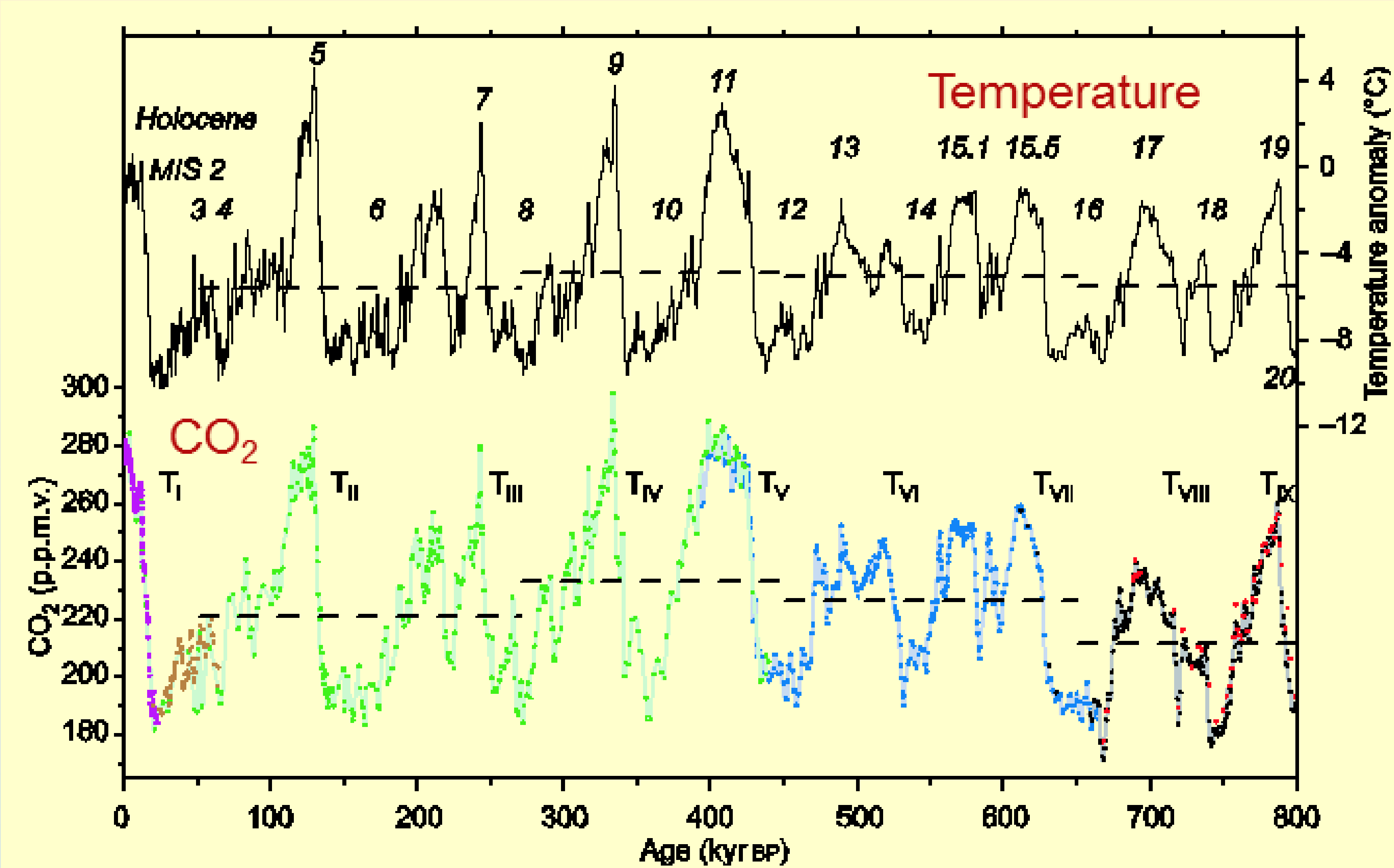
(Figure SPM.1 from the IPCC WG1 5th Assessment Report.)



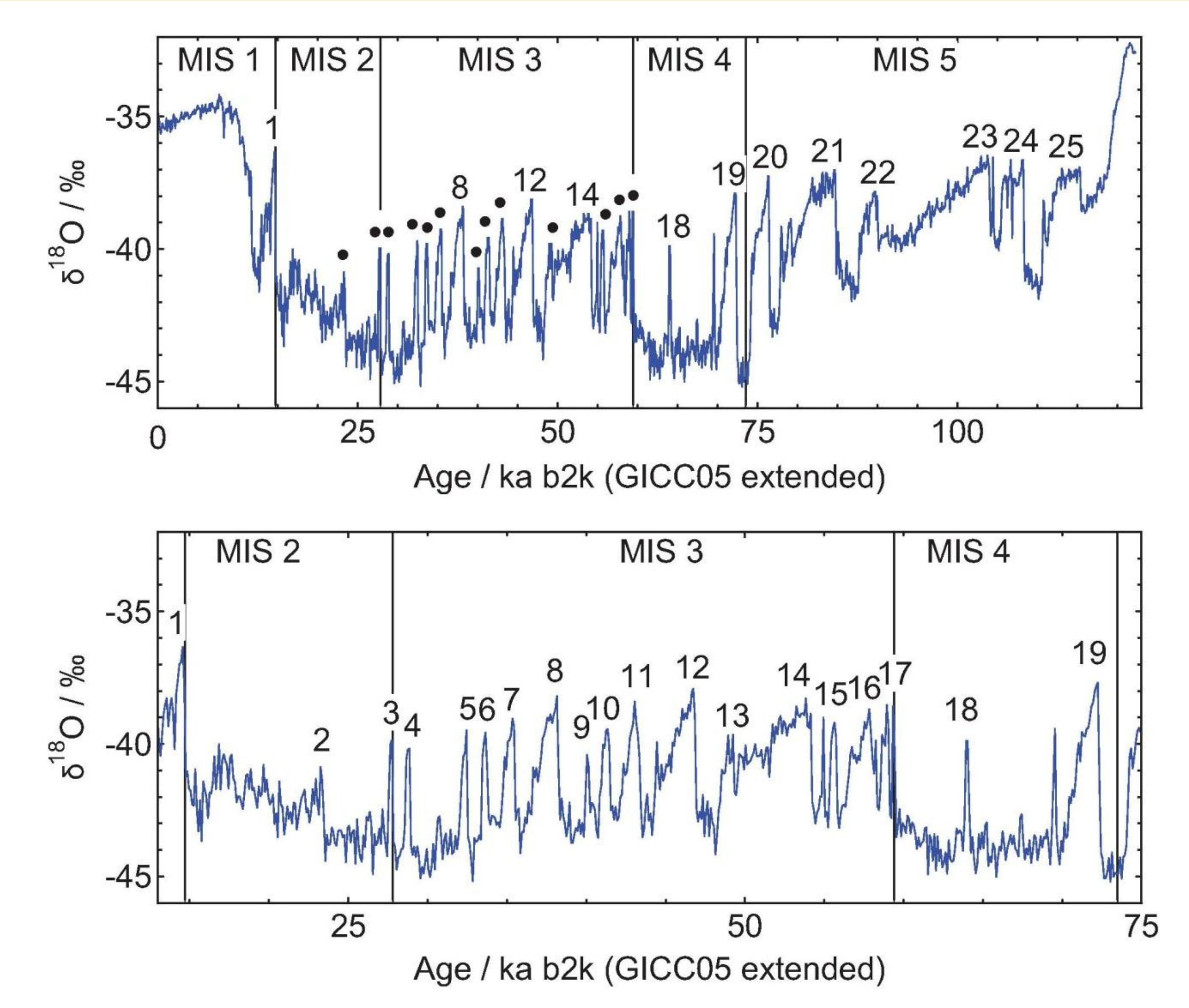



# Radiative forcing estimates in 2011 relative to 1750

(Figure SPM.5 from the IPCC WG1 5th Assessment Report.)



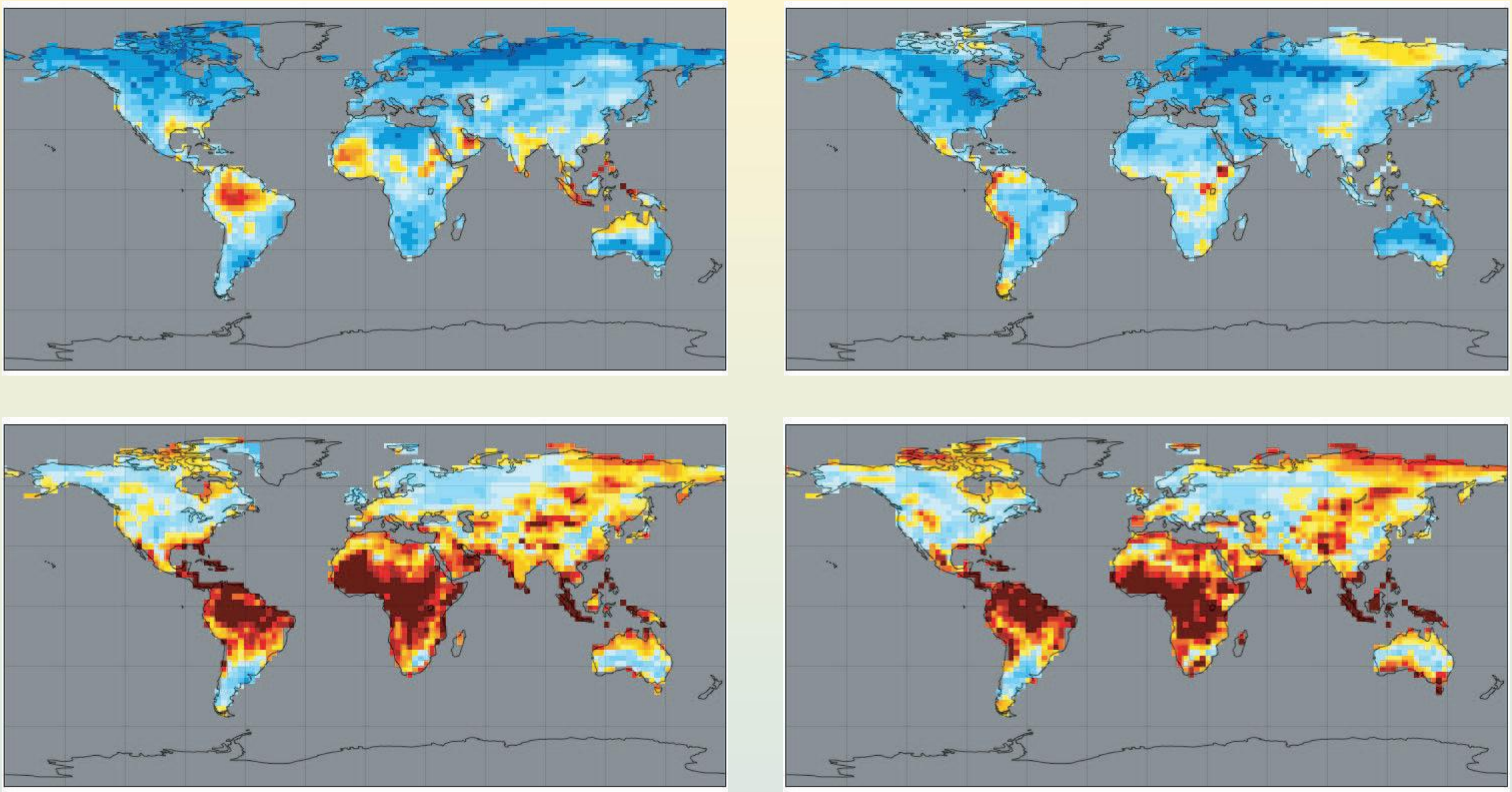

Antarctic temperature and atmospheric carbon dioxide records
for the past 800 ka from the EPICA ice core
(EPICA Community Members, 2004)




Dansgaard-Oeschger events in the NGRIP ice core, Greenland

0-123 ka above; Marine Oxygen Isotope stages 2-4 below

(from Wolff *et al*., 2010)



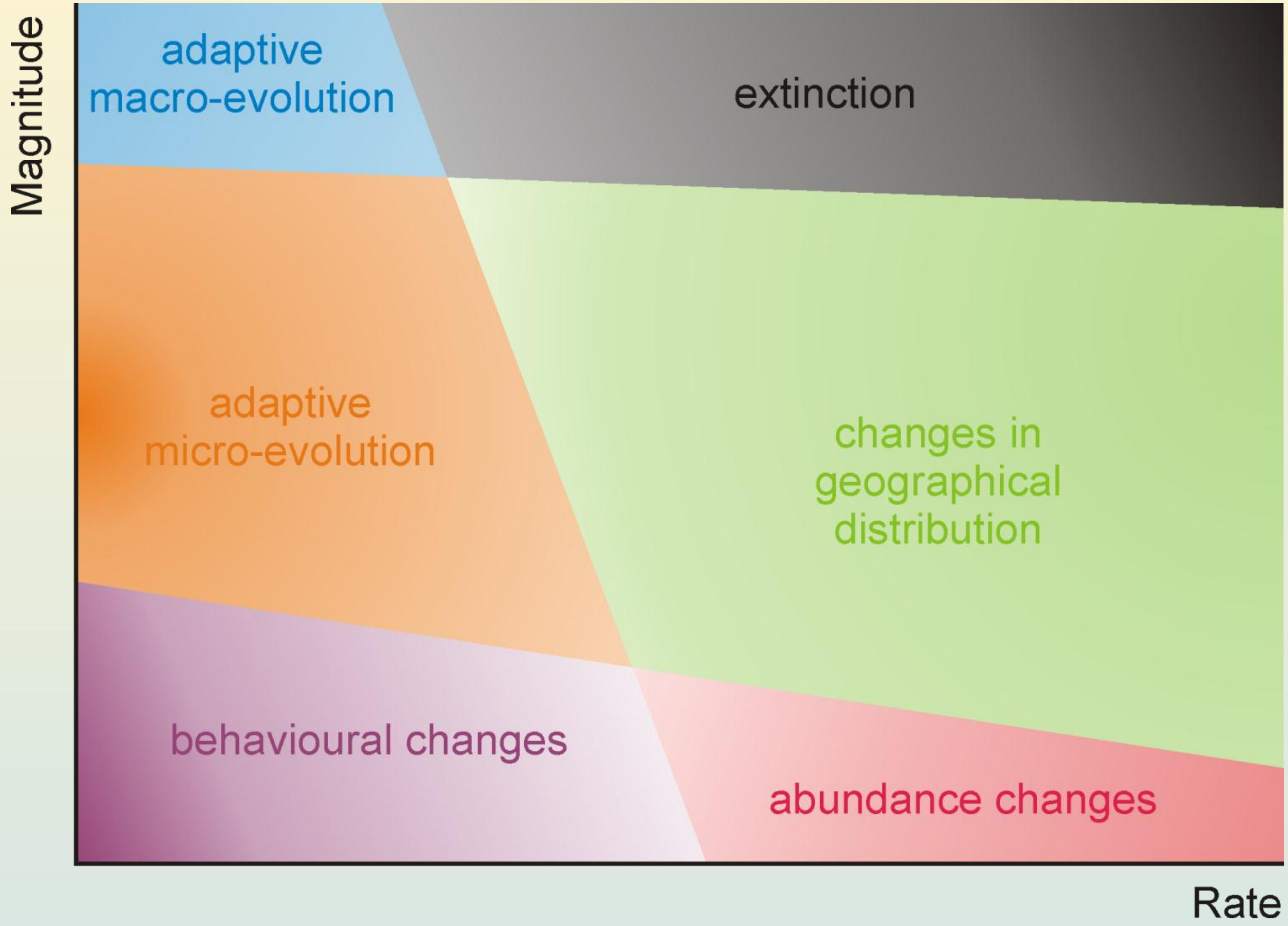
# Novel and Disappearing Climates

Novel (left) and disappearing (right) climates for the A2 emissions scenario. Upper figures show globally novel and disappearing climates; lower figures show novel and disappearing climates when the pool of potential analogues is restricted to grid points within 500 km of the target gridpoint.

(From Williams *et al*., 2007)

“the IPCC Business-as-Usual (Scenario A) emissions … will result in a likely increase in global mean temperature of … about 4°C above pre-industrial before the end of the next century” (IPCC, 1990)

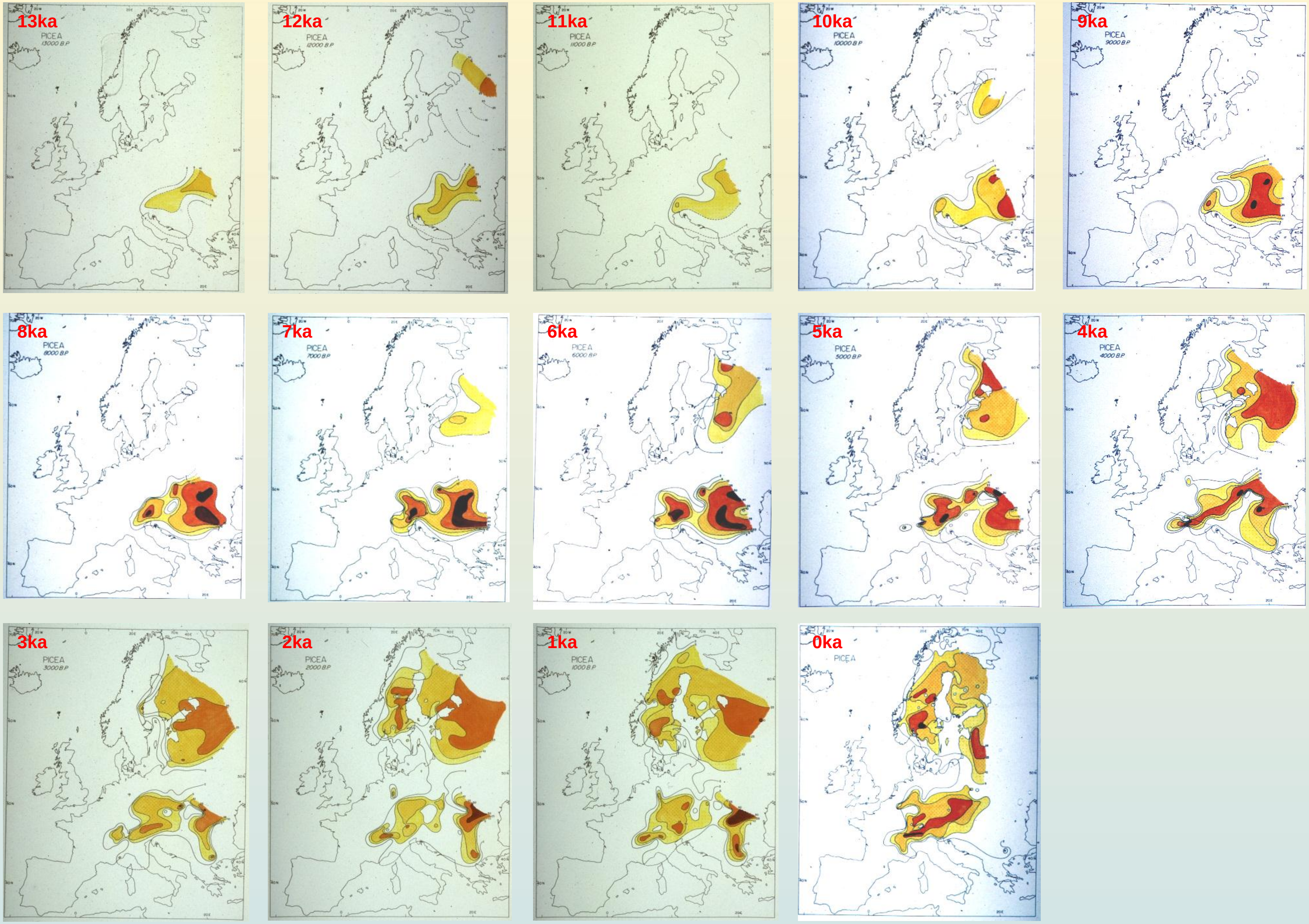
“relative to the average from year 1850 to 1900, global surface temperature change by the end of the 21st century is … about as likely as not to exceed 4°C for RCP8.5” (IPCC, 2013)



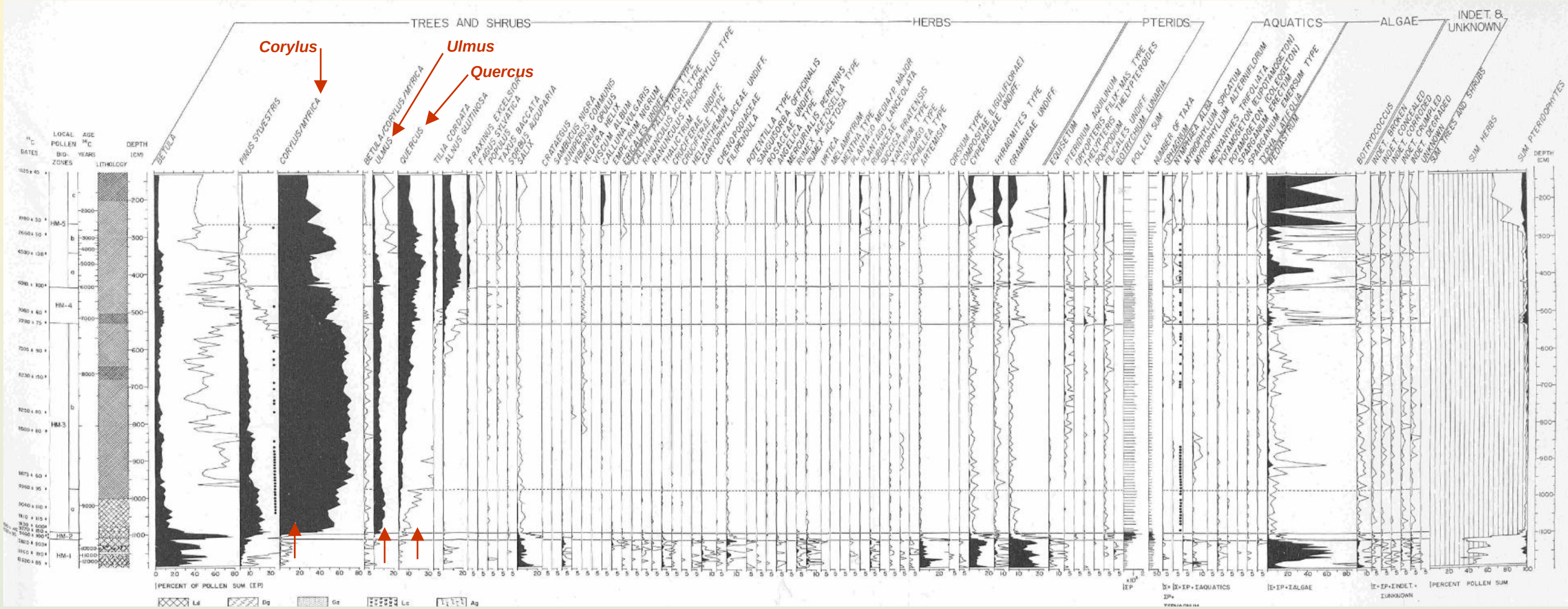

# Six potential responses of species to climatic change

The dominant response depends upon the rate and magnitude of the climatic change.

(From Huntley *et al*., 2010)

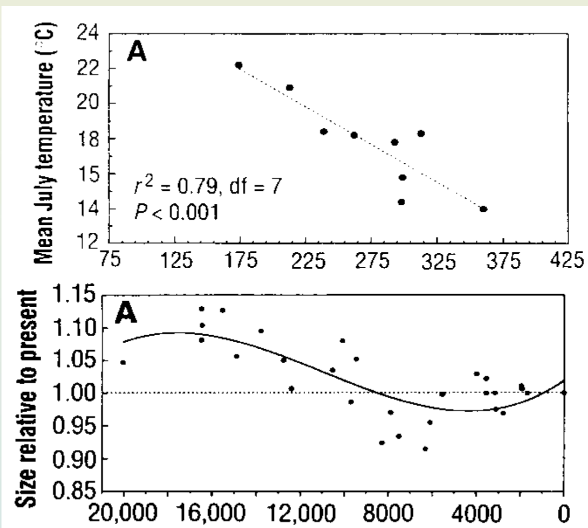



Isopoll maps for *Picea* (Spruce) showing how its range shifted during the late-glacial and Holocene. (From Huntley & Birks, 1983)

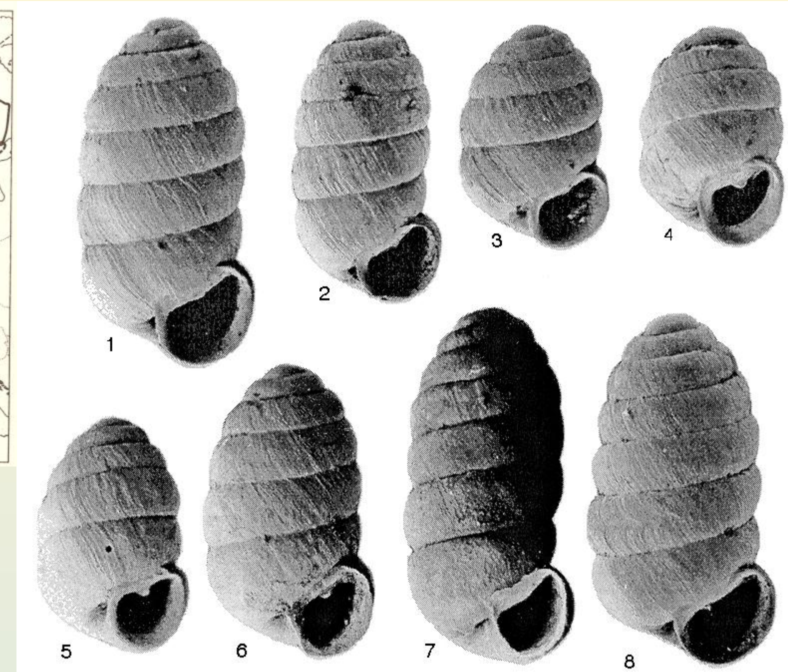



# Pollen diagram for Hockham Mere, Norfolk (Bennett, 1983)

The diagram shows late-glacial and Holocene changes in relative abundance of pollen taxa. Note particularly how the relative abundances of the three principal woody taxa, *Corylus* (Hazel), *Quercus* (Oak) and *Ulmus* (Elm) changed during the early and mid-Holocene.

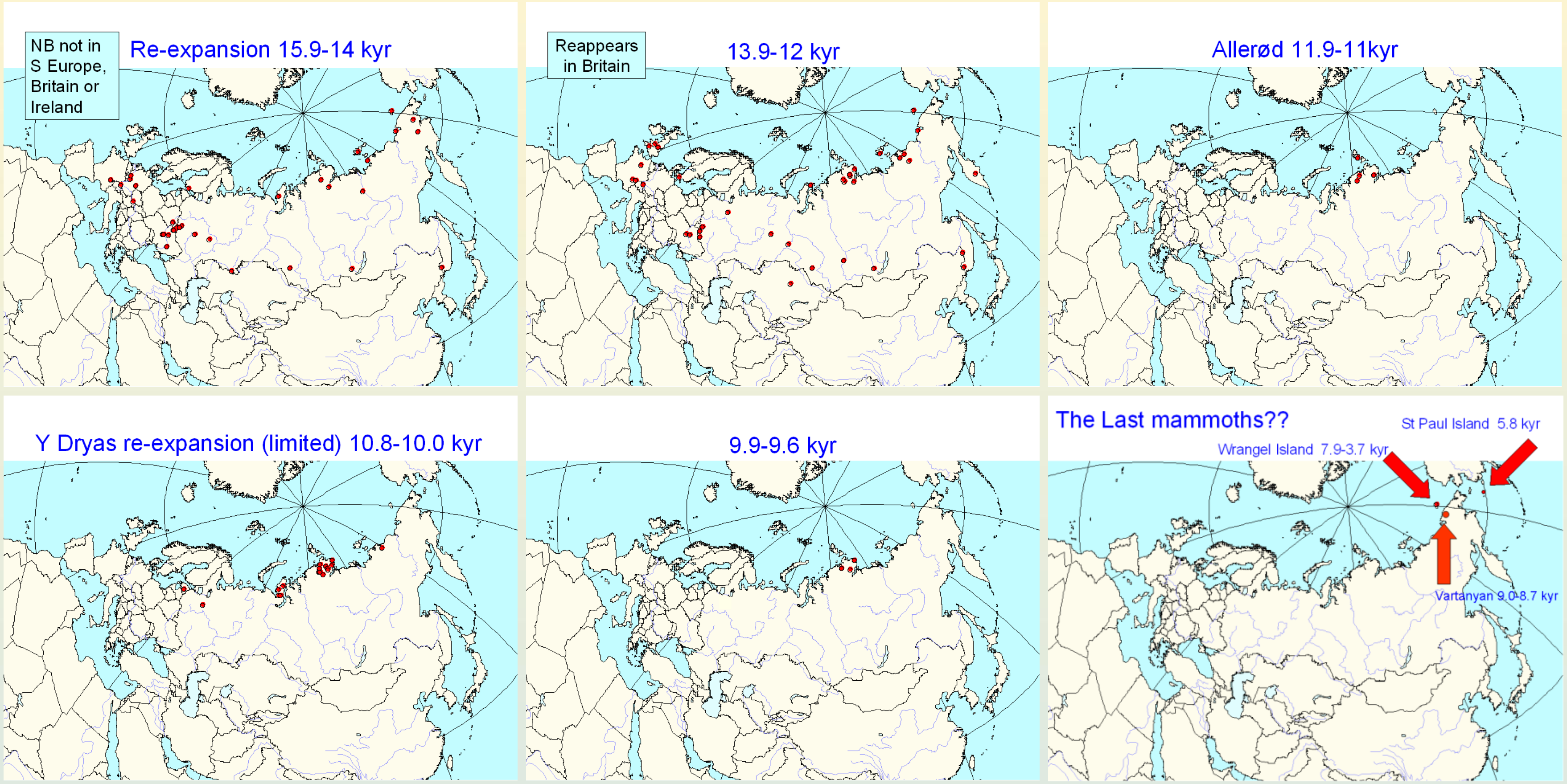





1–4: Recent individuals exhibiting clinal variation from E–W across modern range (Poland–France)
5–7: Fossil individuals from western Europe representing fully interglacial (5), interstadial (6) and fully glacial (7) conditions
8: Recent individual from Krakow (Poland) near eastern range limit

*Neotoma cinerea*
(Bushy-tailed Wood-rat)

*Pupilla muscorum*




# *Mammuthus primigenius* (Woolly Mammoth)

Maps showing the location of 14C-dated fossil remains of *Mammuthus primigenius* (Woolly Mammoth) for a series of time slices spanning the end of the last glacial stage and the early Holocene (A.J. Stuart). Although it persisted into the mid-Holocene on a small number of islands, it finally went extinct around 4000 years ago.

# *Ursus maritimus* (Polar Bear)


- Best known extent mammal that evolved in response to the long-term development and availability of a new habitat during the Pleistocene
- Evolved from *U. arctos* (Brown Bear) lineage
  - exploited new opportunities offered by the perennial sea-ice habitat in the Arctic basin
  - adaptations include
    - large body mass
    - white coat
    - more specialised and more carnivorous diet

“there are few observational studies of rapid evolution and difficulties in detection and attribution, so there is only *medium confidence* that some species have responded to recent changes in climate through genetic adaptations, and insufficient evidence to determine if this is a widespread phenomenon (thus *low confidence* for detection and attribution across all species)” (Settele *et al*., 2014)

“A large fraction of terrestrial and freshwater species face increased extinction risk under projected climate change during and beyond the 21st century, especially as climate change interacts with other pressures, such as habitat modification, overexploitation, pollution, and invasive species *(high confidence)*” (IPCC, 2014)

*Bufo periglenes* (Golden Toad)

Perhaps the most persuasive example of a species whose extinction can be attributed at least in large part to the direct and indirect effects of climatic change.

“past communities (and so also conditions of climate?) are not necessarily in existence today”…

thus

“our present plant communities have no long history ... but are merely temporary aggregations under given conditions of climate, other environmental factors, and historical factors” (West, 1964).

CBD Vision:

“By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining **ecosystem services**, sustaining a healthy planet and delivering benefits essential for all people.”

CBD Mission:

“Take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 **ecosystems are resilient and continue to provide essential services**, thereby securing the planet’s variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach.”

# 10 ‘composite’ recommendations

1. Target as a priority the most vulnerable regions/ecosystems.
2. Enhance the adaptive capacity of vulnerable species.
3. Improve knowledge of species and habitats of special concern.
4. Improve knowledge and understanding of the role of wildfire.
5. Improve knowledge of introduced alien species.
6. Implement monitoring.
7. Maintain or restore intact ecosystems.
8. Implement adaptive management practices and strategies.
9. Adopt holistic approaches to adaptation and mitigation.
10. Consider assisted colonisation and/or *ex situ* conservation.

# Recommendation No. 159

Recommends Contracting Parties to the Convention and invites Observer States to:

1. Urgently implement the practical conservation measures that have been recommended by the Group of Experts and encourage appropriate national bodies involved in nature conservation to adopt and use them as resources permit; urgent action should more particularly focus on implementing adaptive management practices and strategies, enhancing the adaptive capacity of vulnerable species (rare/endemic/threatened), minimising pressures and threats on species and habitats that are most vulnerable to climate change, and implementing monitoring of, inter alia; species' population trends, species behaviour, including phenology, and climate change impacts upon critical areas;
2. Take further steps to develop ecological networks, to promote and enhance the permeability of landscapes generally, and also enhance their protected areas networks, as appropriate, by increasing the extent of existing sites, designating new sites and establishing buffer zones, and ensuring they are sustainably and adaptively managed;
3. Take an appropriately long-term view, based on adaptive management methodologies, when formulating management plans and strategies for protected areas management;
4. Adopt, as appropriate, a more holistic approach when formulating strategies and plans for ecological networks or protected areas, and when developing conservation or recovery plans for individual species.In particular, encourage the general adoption of the examples of good practice reported, especially by Switzerland and Ukraine, with respect to taking into account their international context when planning ecological networks, and to developing networks and protected areas in partnership with their neighbours;
5. Adopt measures that encourage biodiversity conservation to be embedded across other sectors and taken into account when formulating policies or strategies for those sectors, also by informing policy-makers across the Parties about the opportunities for win–win solutions, for instance through the development and use of ecosystem-based approaches, when developing strategies for adaptation to climate change by their sector as well as for mitigation measures;
6. Undertake knowledge transfer activities using existing mechanisms, to encourage awareness by other stakeholders and the general public of the challenges posed and opportunities presented by climate change when considering biodiversity conservation, including its links to other sectors and the opportunities for win–win solutions;
7. Take account of the potential increased risk of wildfires as a result of climate change and embed, as appropriate, mitigation measures for consideration of this risk into protected area management plans;
8. Adopt the good practice, identified in the case of the United Kingdom, of implementing measures for the assessment of introductions that include assessment of the impacts of projected climate changes on species' invasion potential;

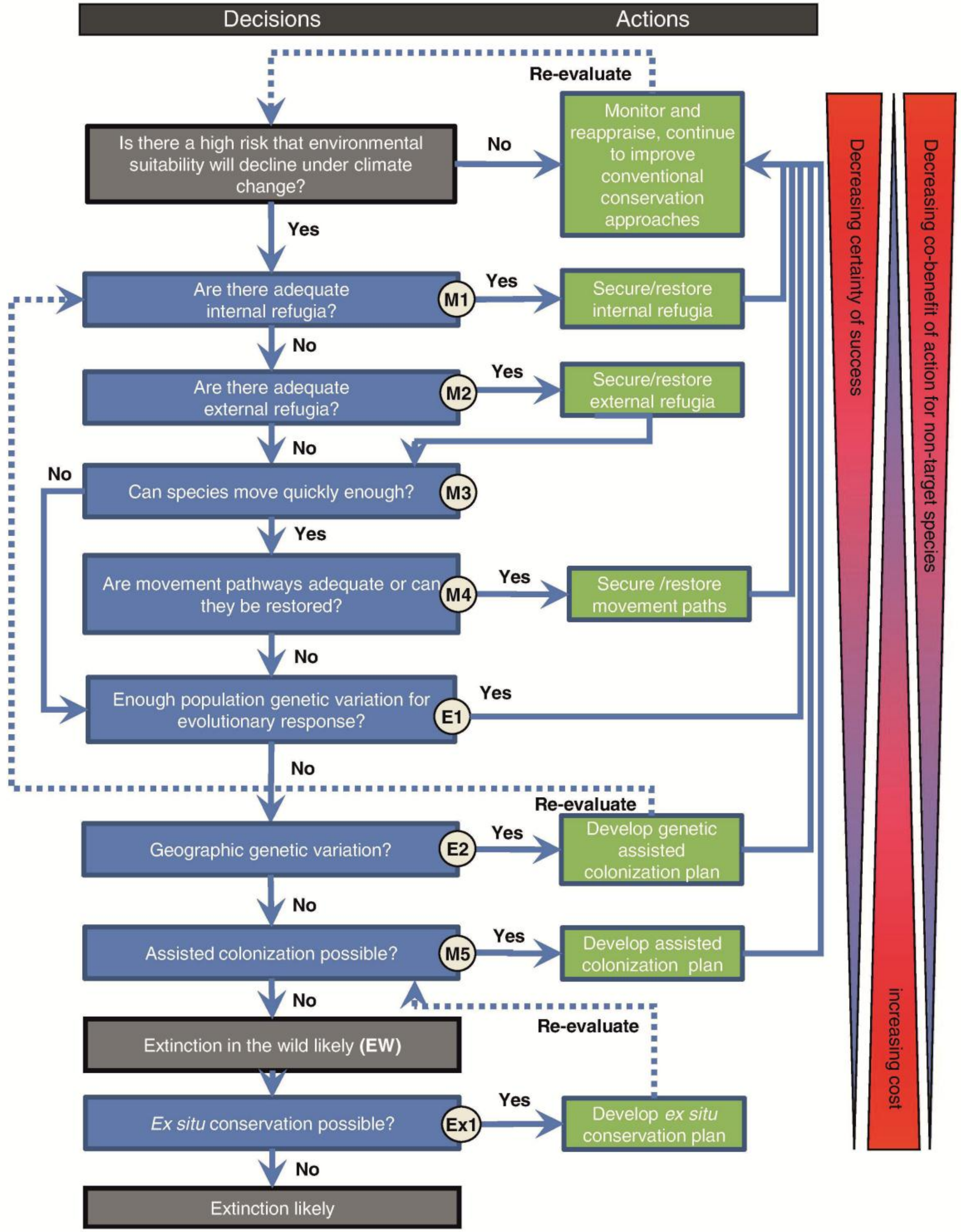
# Recommendation No. 159

Further instructs the Bern Convention Group of Experts on biodiversity and climate change to:

1. Take all necessary steps to ensure that the importance of the issue of climate change on biodiversity, and understanding the role of biodiversity in adapting to and mitigating the effects of climate change is well recognised by all Contracting Parties;
2. Promote awareness among Contracting Parties of the examples of good practice identified and urge their implementation;
3. Ensure that those persons preparing reports from Parties for the Group of Experts are fully informed about relevant activities, for example monitoring activities, being undertaken in their country, thus avoiding spurious identification of gaps in the activities of that Party or of priorities for new actions by the Party;
4. Assess the potential for introduced species already present in the national territory of Contracting Parties to become invasive under future climate conditions, in close co-operation with the Group of Experts on Invasive Alien Species, and using information and methodologies developed in other *fora*, where appropriate;
5. Inform the Standing Committee on the progress made in the implementation of this Recommendation.

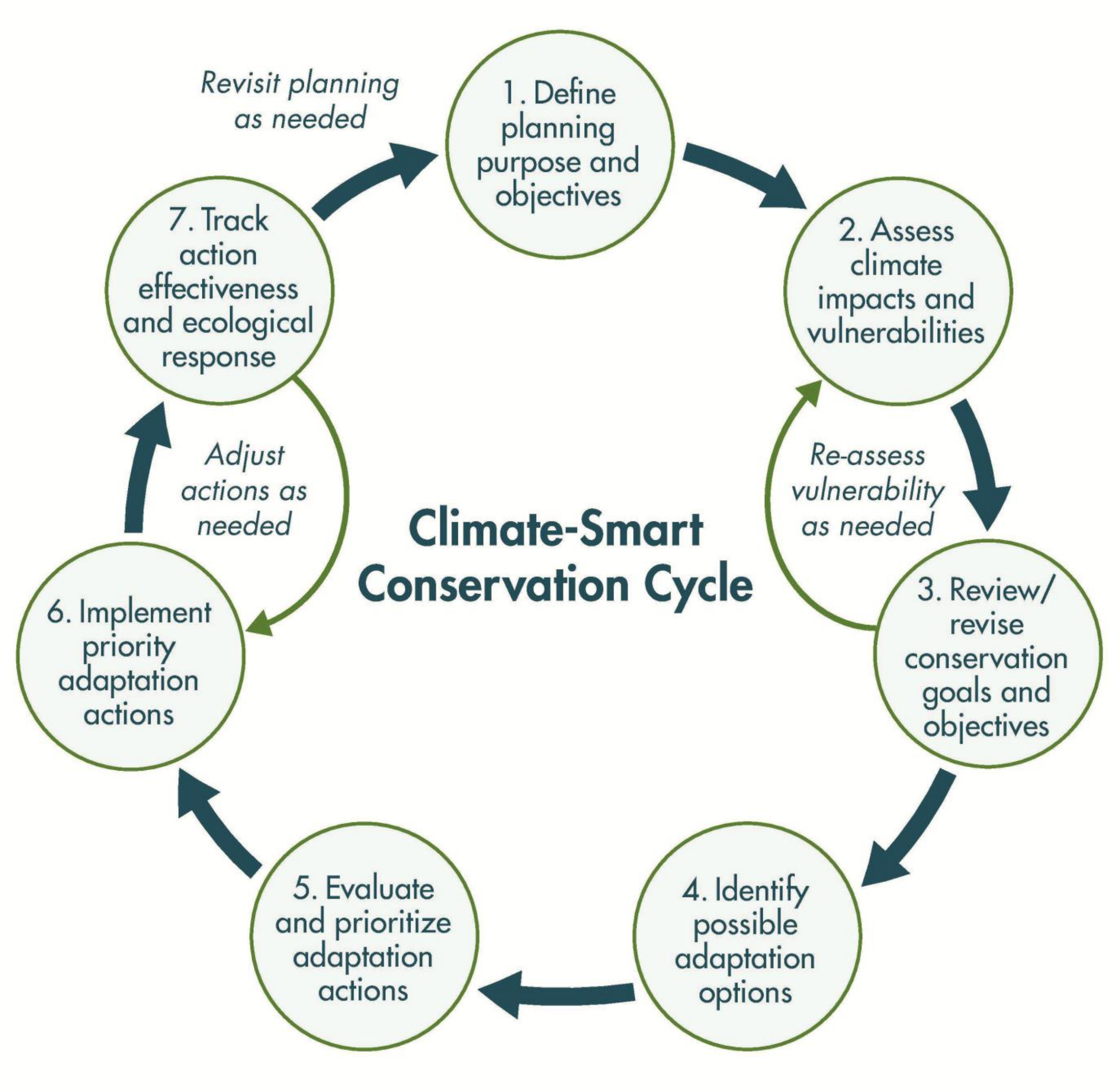
# Decision framework for management actions

(From Shoo *et al*. 2013)



# ‘Climate-smart’ conservation

(from National Wildlife Federation, 2013)



# Red-listing and climatic change

- Identifying species at risk with a sufficient lead time to take adequate action requires more frequent assessments than typically are being made;
- species at risk are more likely to be identified early if all criteria are used; and
- implementation of conservation actions as soon as a species is listed as Vulnerable is often necessary to avoid extinctions, 50% of which in one study occurred within 20 years of the species being raised to Critically Endangered.

# Concluding recommendations

- Develop or adopt clear ‘recipes’ and/or ‘decision support tools’ that will provide simple guidelines to be followed by those in the Parties seeking to implement the Group’s recommendations; where Parties have already developed such tools, share best practice.

# Concluding recommendations

- Complete assessments of the vulnerability of species to climatic change, focusing initially upon rare and range-restricted species, notably endemics and biome-restricted species, those already identified as threatened as a consequence of other pressures, and migrants; take an holistic, range-wide view of species when assessing their vulnerability, rather than a parochial national view of the species as it occurs within the territory of an individual Party.

# Concluding recommendations

- Ensure that adaptive management is implemented for all protected areas, and that management plans take into account climatic change and the need to facilitate species' responses; where good practice has already been implemented by some Parties, share best practice.

# Concluding recommendations

- Undertake a review of published research on how to render the wider landscape more permeable, and of evidence of the extent to which impermeability of the wider landscape is limiting species’ responses to climatic change.

# Concluding recommendations

- Take steps to encourage the wider uptake by the Parties of established monitoring schemes, the development of such schemes for a wider range of taxonomic groups, and the adoption by the Parties of well-established and common approaches to the monitoring of target species to assess the effectiveness of conservation measures.

# Concluding recommendations

- Assess the importance of biodiversity for the capacity of European ecosystems to adapt to climatic change and continue to deliver the ecosystem services upon which human society depends. Assessment also the value of ‘green infrastructure’ solutions when addressing both adaptation to climatic change and measures designed to mitigate climatic change. Ensure that the Parties are aware of the results of this assessment and encourage them to act accordingly when formulating policy.