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Species Survival Commission

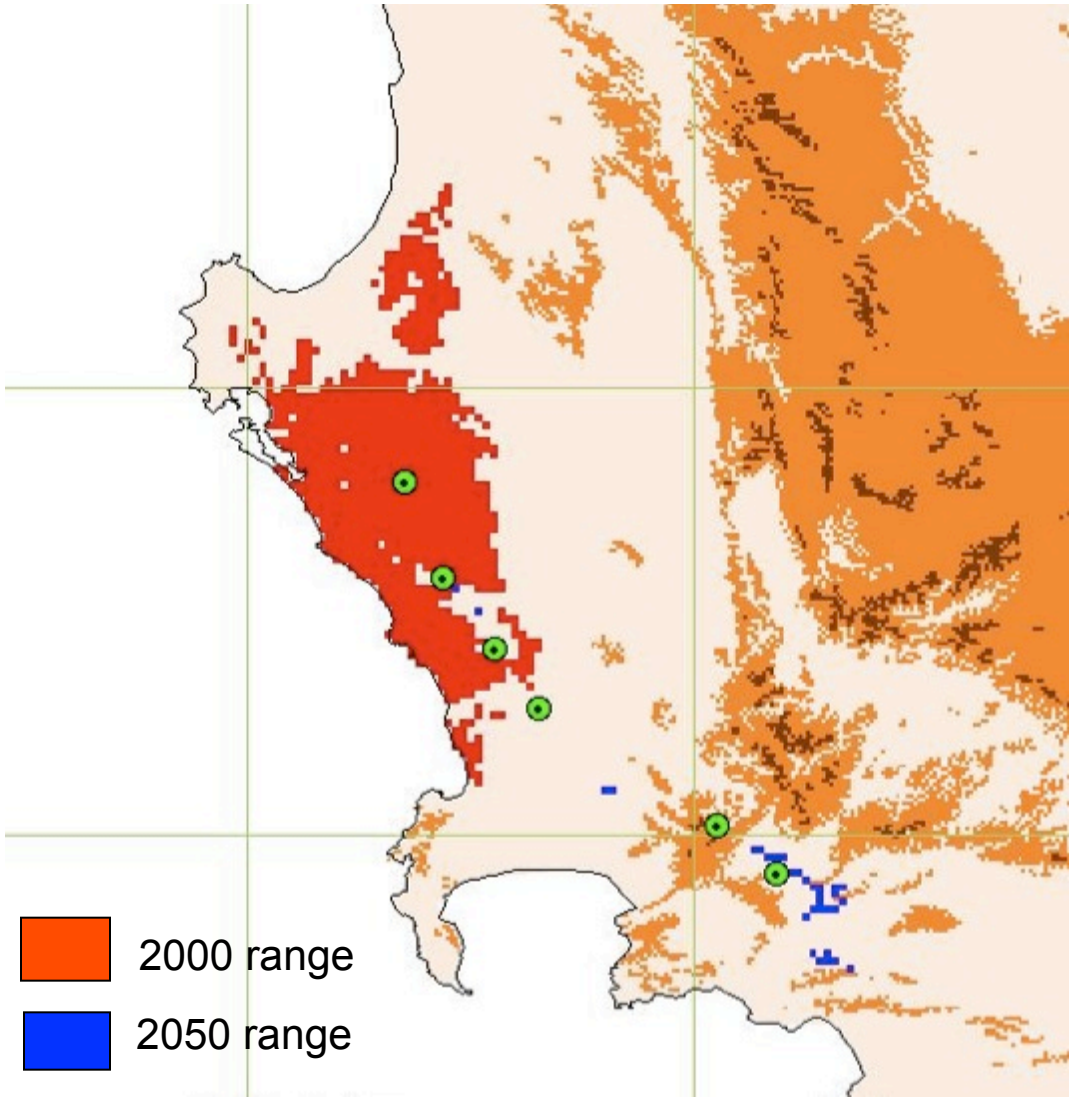
Assessing
Species' Vulnerability
to
Climate Change

Wendy Foden
IUCN Species Programme
Cambridge, UK

Thomas et al. 2004

"We predict, on the basis of mid-range climate-warming scenarios for 2050, that 15-37% of species in our sample of regions and taxa will be 'committed to extinction' "

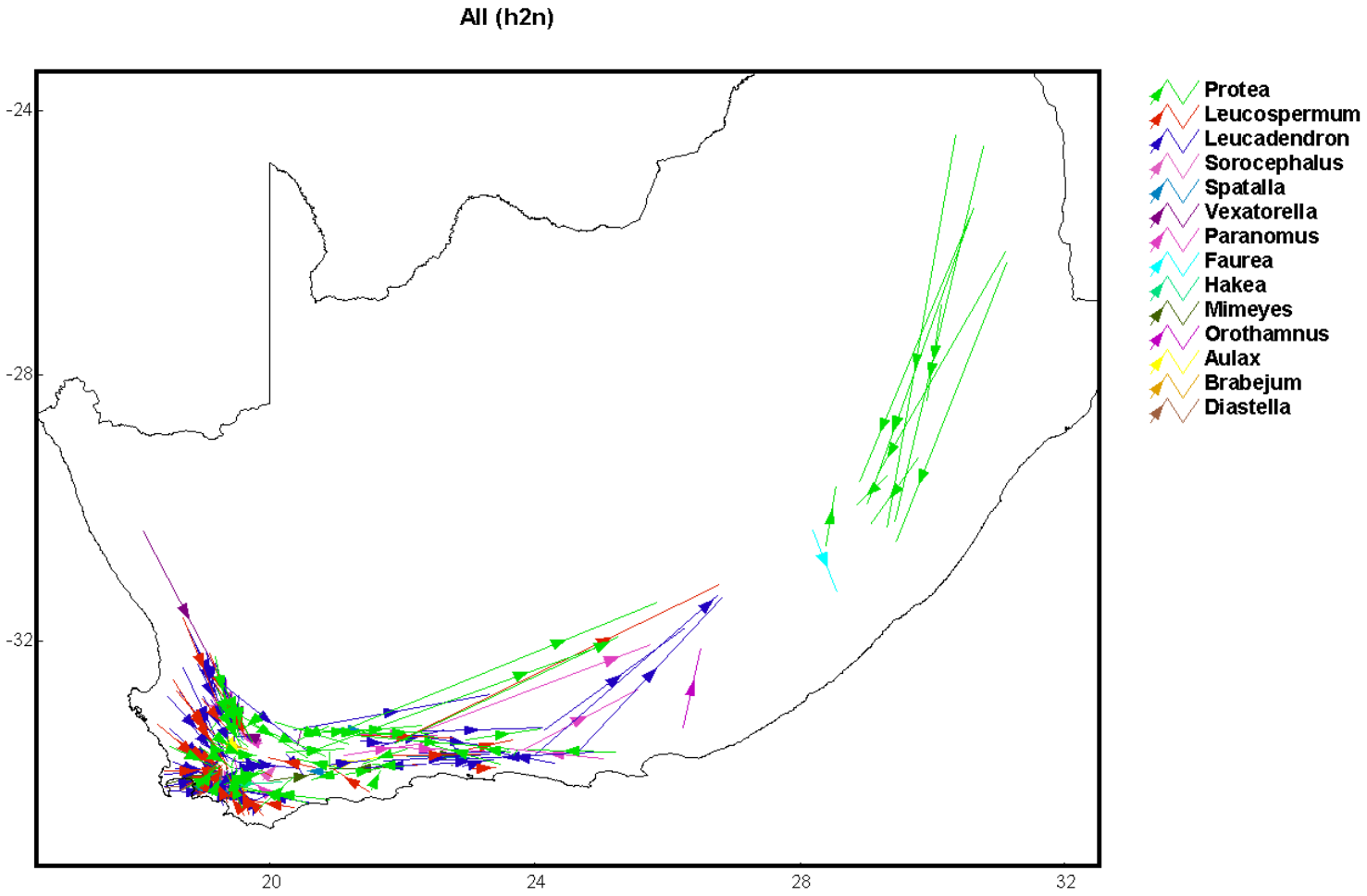
Leucospermum tomentosum: range centres in 10 year time slices



	Distances moved (km)	Average altitude (m)	Average latitude (°S)
Present	0	88.57	33.21
20%	25.3	113.83	33.43
40%	20.0	137.93	33.59
60%	17.2	194.85	33.72
80%	46.4	269.91	33.98
100%	17.4	296.06	34.09

Midgley et al 2002

Projected 2050 Range Centroid Shifts of Proteaceae in the Cape Floral Region



Midgley et al 2002

Leatherback Turtles and climate change

Turtle-y exposed to climate change

Arctic Foxes and climate change

Out-foxed by Arctic warming

Salmon and climate change

Fish in hot water

Koalas and climate change

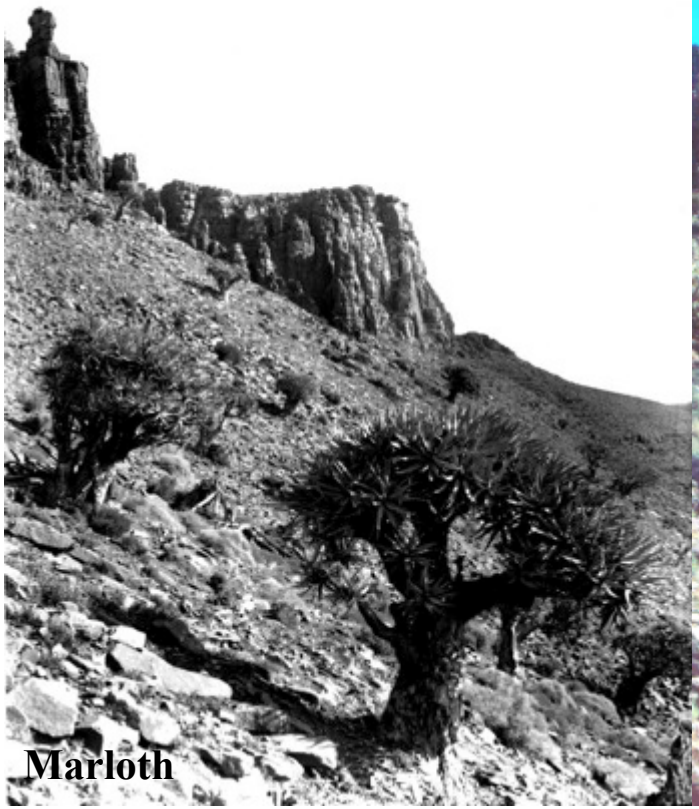
Hungry for CO_2 cuts

Quiver Trees and climate change

Hoffmann and Kaleme have used repeat photography to track changes in *Aloe dichotoma* populations

Calvinia

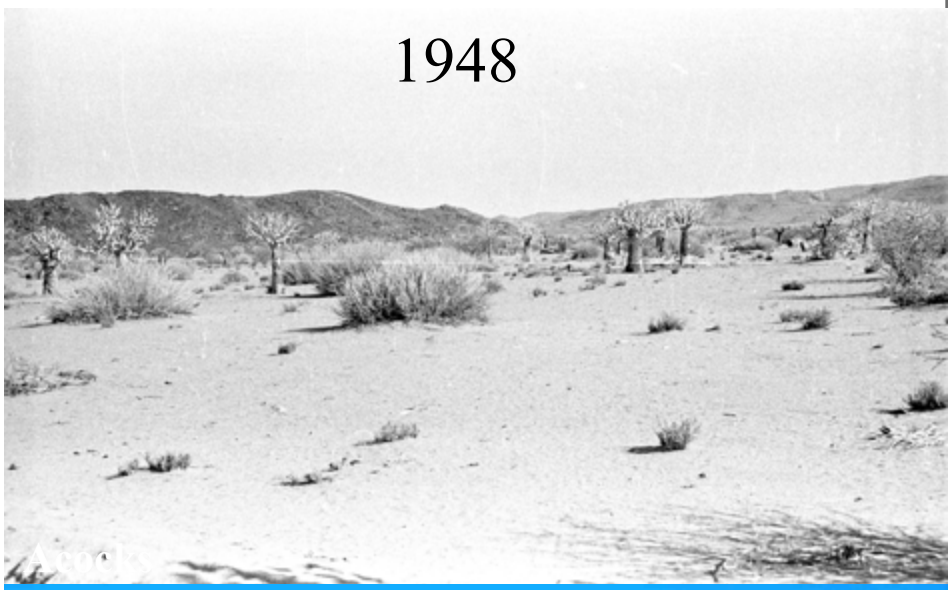
1904

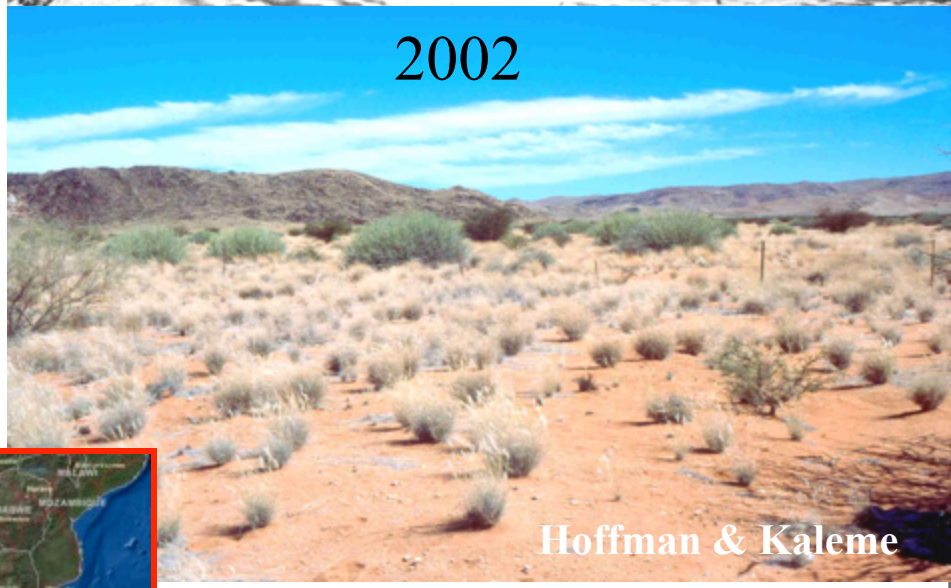


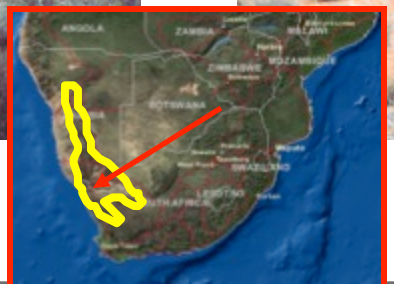
2002

Increase of 108% over 98 years

Pofadder District



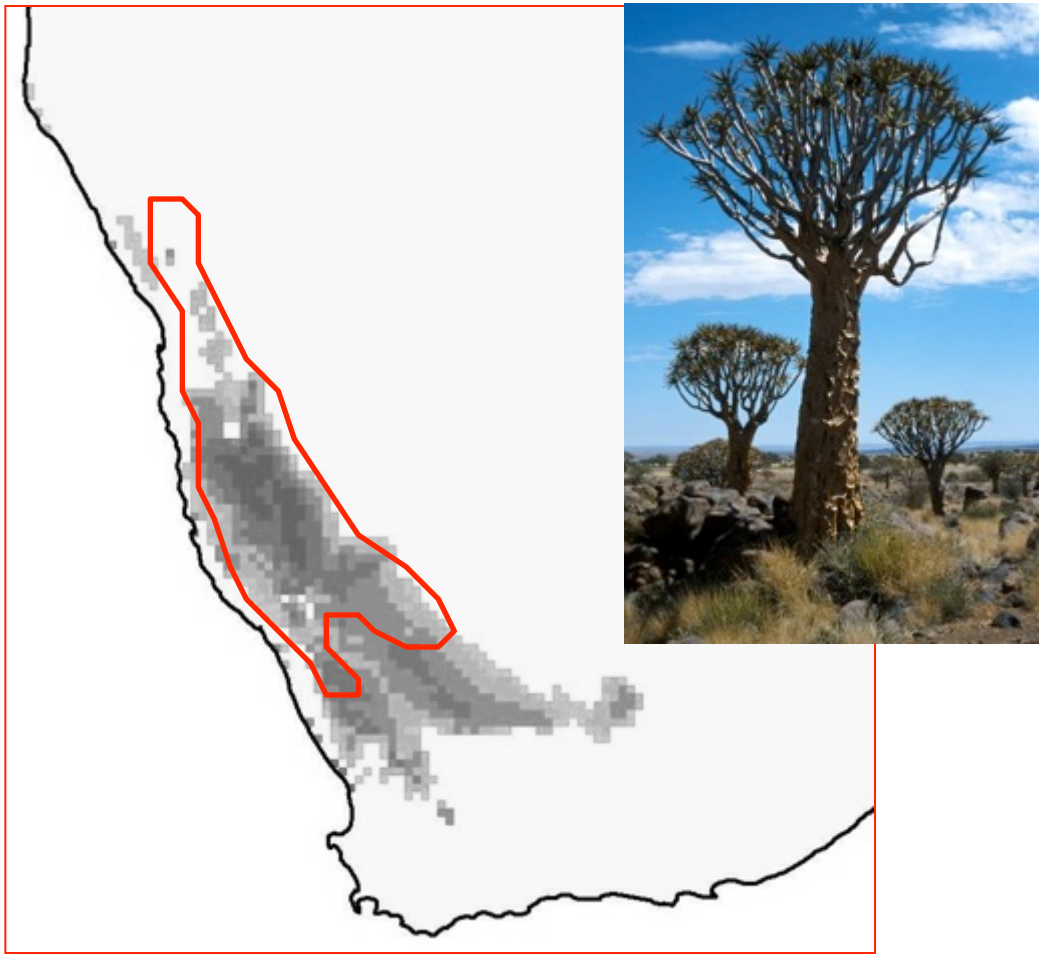




Decline of 52%

Decline of 80%

Aloe dichotoma's range is being **squeezed** between…..



A rapidly contracting trailing range edge

Slow or limited dispersal at the leading range edge

Cultivation of savanna trees (C_3 photosynthesis) at a range of CO_2 concentrations

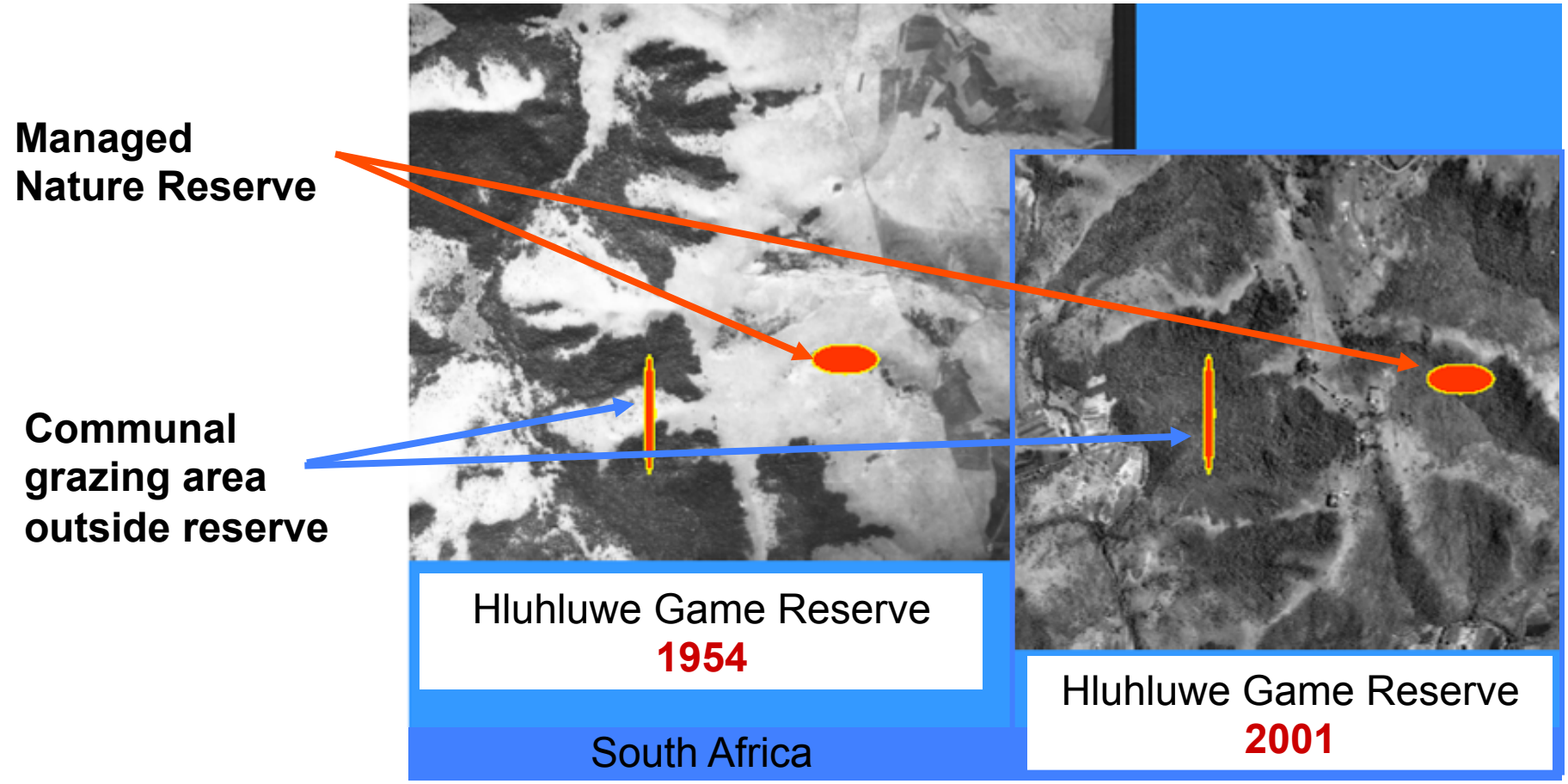
- Plants exposed to a full range of CO_2 levels viz. 180, 280, 370, 550, 700 and 1000 ppm, in Open Top Chambers
- Plants - *Acacia karroo*, *Acacia nilotica*, *Dichrostachys cinerea* and *Themeda triandra*.

Kgope et al. (2005)

Cultivation of savanna trees (C_3 photosynthesis) at a range of CO_2 concentrations (100-700ppm)

Bush Encroachment

Increased CO_2 levels are causing shifts in savannah dynamics due to improved C_3 (tree) vs. C_4 (grass) competitive ability

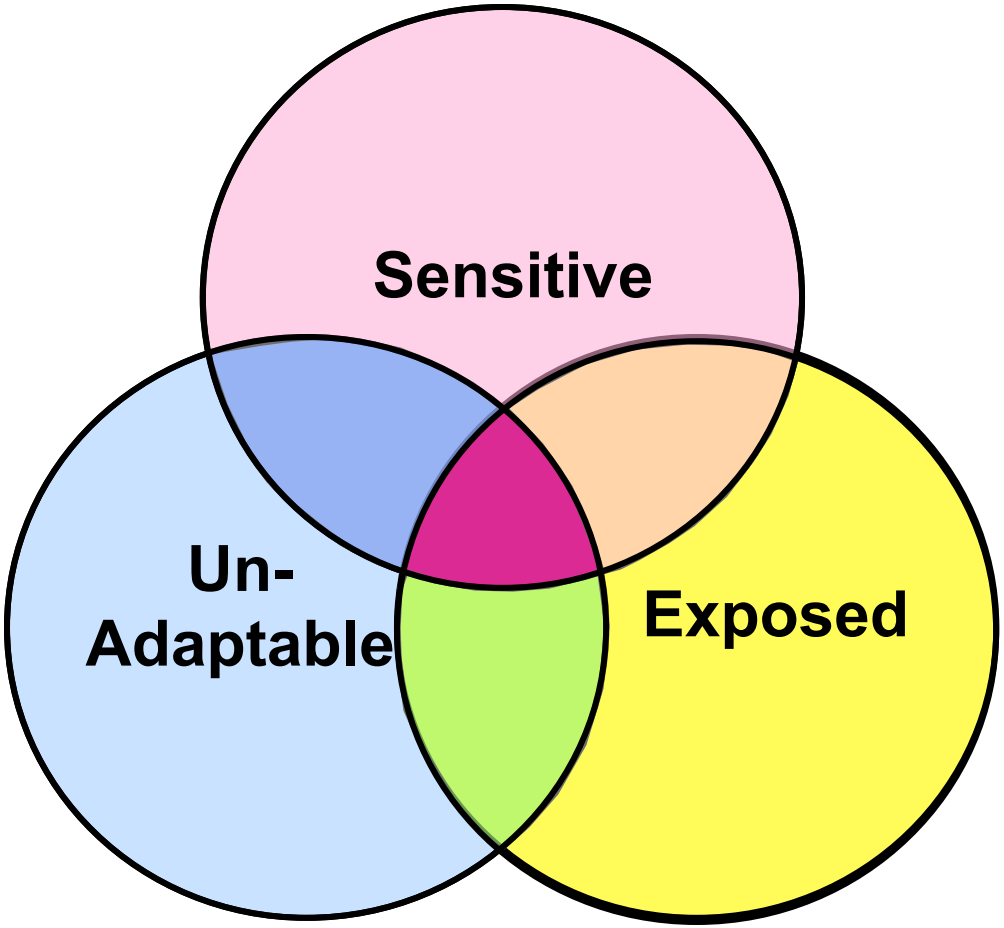


Bond et al (2005)

Thomas et al. 2004

"We predict, on the basis of mid-range climate-warming scenarios for 2050, that 15-37% of species in our sample of regions and taxa will be 'committed to extinction' "

Which species are most **susceptible** to climate change?



Sensitivity and Unadaptability Traits

>90 detailed traits

SENSITIVITY to Climate Change

A. Specialised **habitat**

B. Narrow **environmental tolerances or thresholds**

C. **Environmental triggers**
which are likely to be disrupted
e.g. for migration or breeding times

D. **Interspecific interactions**
which are likely to be disrupted
e.g. changes in food sources, disease,

competition & mutualisms

E. **Rarity**

POOR ADAPTABILITY to Climate Change

A. Poor dispersal ability

Low maximum dispersal distances

Barriers to dispersal

B. Poor evolvability

Low genetic diversity

Slow turnover of generations

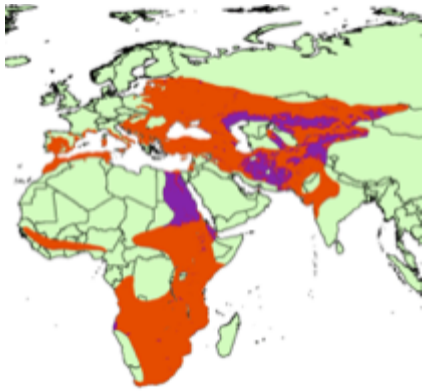
Low reproductive output

EXPOSURE to Climate Change

A. Sea level rise

B. Temperature change

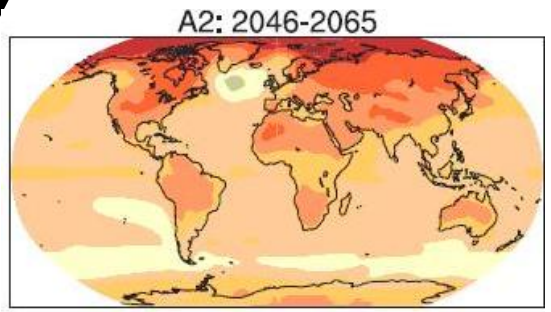
Heat waves, ice/snow melt



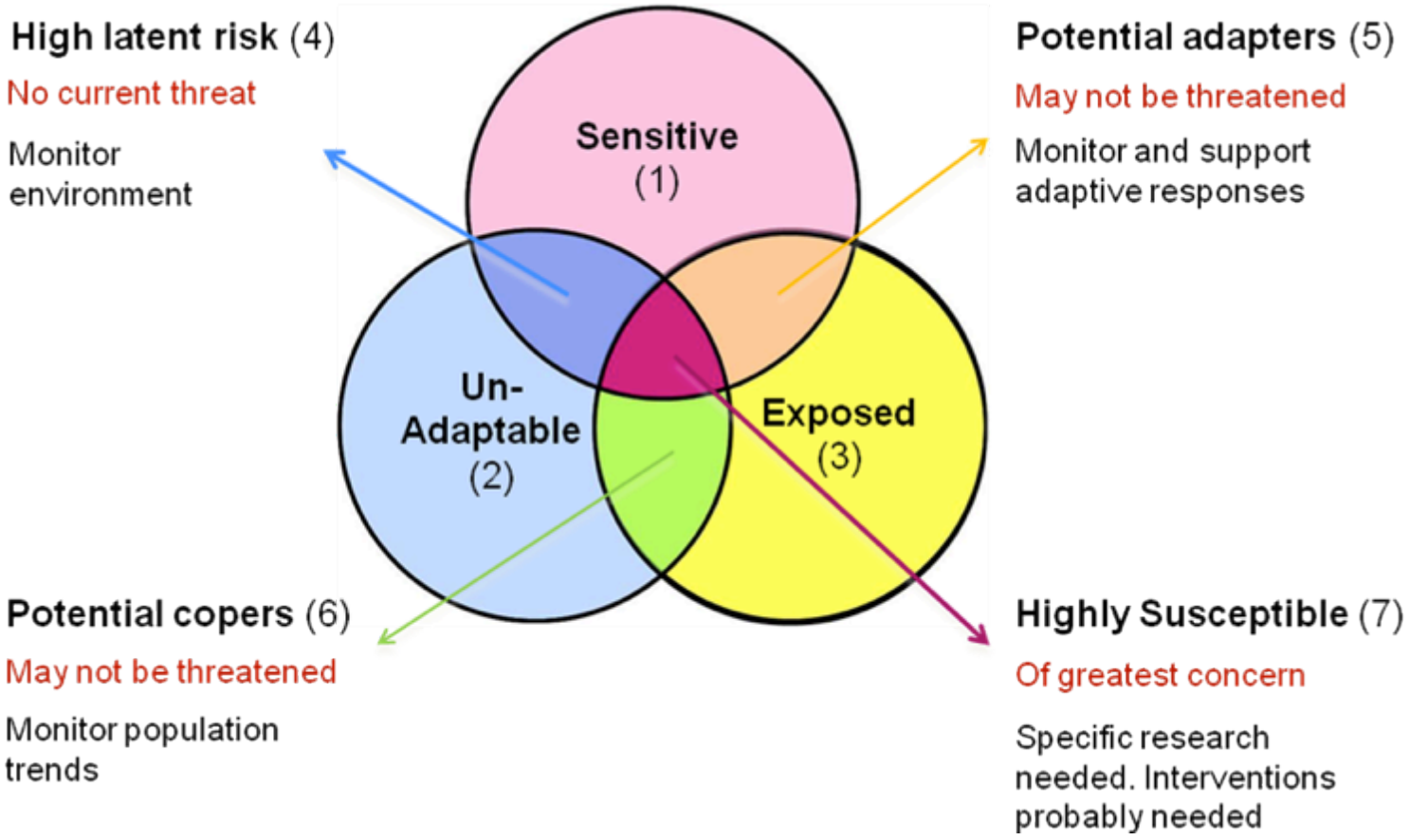
C. Precipitation change

Droughts, floods, extreme storms, changing river flow

D. Ocean Acidification



7 Forms of Susceptibility and their Implications for Conservation



Pilot Species Groups

- Birds (~9,856 spp.)
- Amphibians (~6,204 spp.)
- Warm-water reef-building corals (797 spp.)
- South African Proteaceae (389 spp.)

25 detailed traits

Assessing Species' Susceptibility to Climate Change

W. Foden, G. Mace, S. Butchart, J-C. Vie, S. Stuart, A. Angulo, L. DeVantier, A. Gutsche, E.Turak, S. Donner, L. Cao, R. Ackakaya, V. Katariya, R. Bernard, A. Hughes, R. Holland, S. O'Hanlon, S. Garnett, C. Sekercoglu

Trait Group	Biological Trait	No. of species qualifying		
		Birds	Amphibians	Corals
A. Specialised habitat and/or microhabitat requirements	Altitudinal range narrow and at high elevation	224		
	Restricted to habitats susceptible to climate change	820	757	15
	High degree of habitat specialisation	693		28
	Dependence on a particular microhabitat	438	889	
	Contribution of trait group	**46%**	**42%**	**5%**
B. Narrow environmental tolerances or thresholds that are likely to be exceeded due to climate change at any stage in the life cycle	Global temperature tolerances likely to be exceeded			61
	Larvae particularly susceptible to heat stress			108
	Sensitive to increased sedimentation			143
	Vulnerable to physical damage from storms and cyclones			183
	Contribution of trait group	**0%**	**0%**	**68%**
C. Dependence on specific environmental triggers or cues that are likely to be disrupted by climate change	Environmental trigger/cue disruption observed or likely	316	315	
	Contribution of trait group	**9%**	**10%**	**0%**
D. Dependence on interspecific interactions which are likely to be disrupted by climate change	Dependent on very few prey or host species	27		
	Dependent on an interspecific interaction that is likely to be impacted by climate change	44		
	Susceptible to chytridiomycosis and/or enigmatic decline		1,034	
	Susceptible to breakdown of coral-zooxanthellae interaction			144
	Contribution of trait group	**2%**	**32%**	**25%**
E. Poor ability or limited opportunity to disperse to or colonise a new or more suitable range	Low maximum dispersal distances	1,500		73
	Geographic barriers limit dispersal opportunity	709	744	117
	Limited opportunity to establish at new locations	769	602	55
	Low genetic diversity or known genetic bottleneck	63		
	Contribution of trait group			

Assessing Vulnerability of Albertine Rift Species to Climate Change

January 2010 – December 2011

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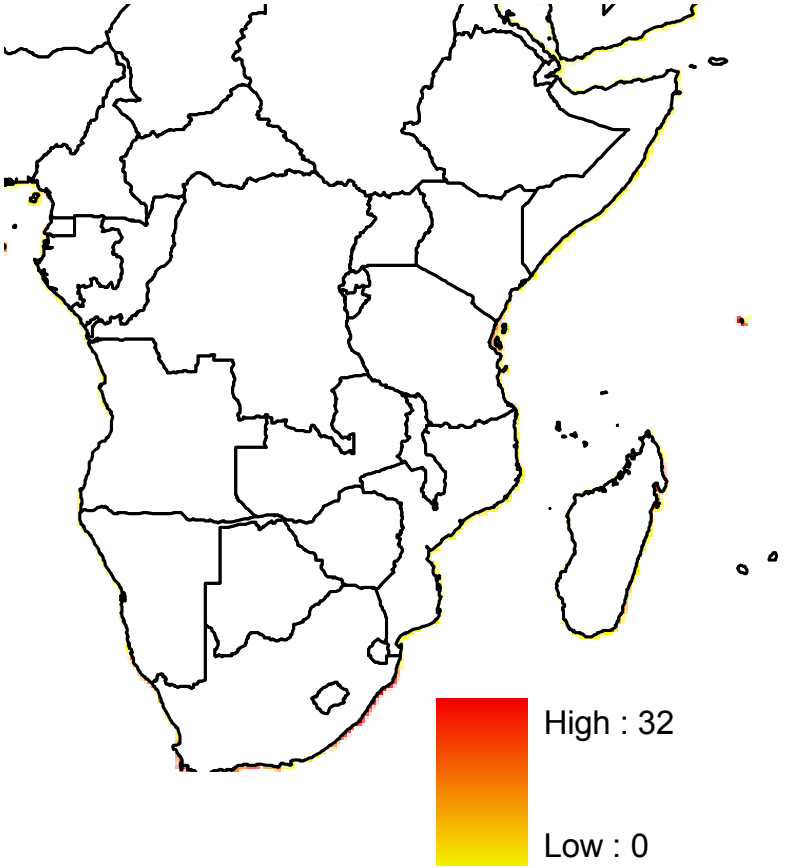
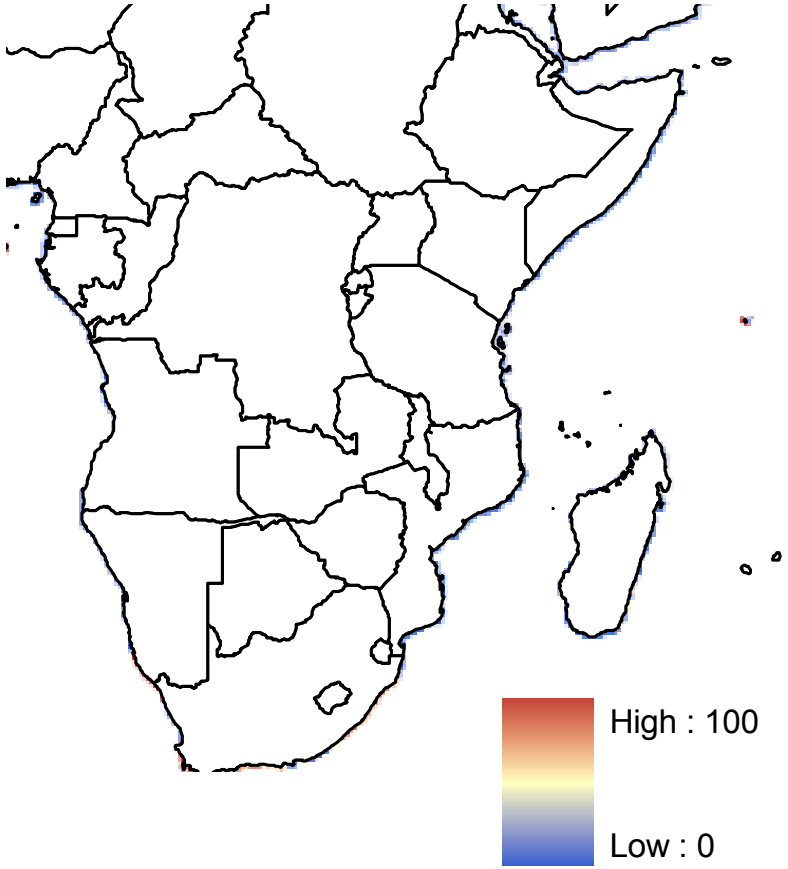
Threatened amphibians

Total numbers

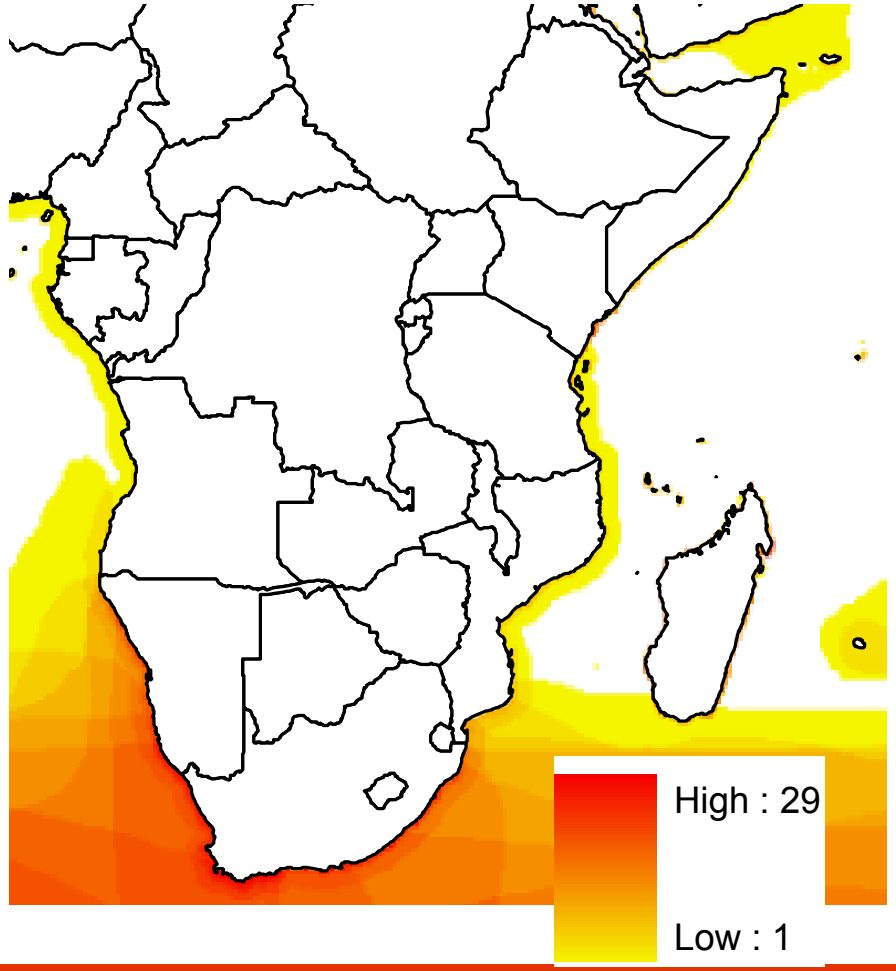


Proportion of total species

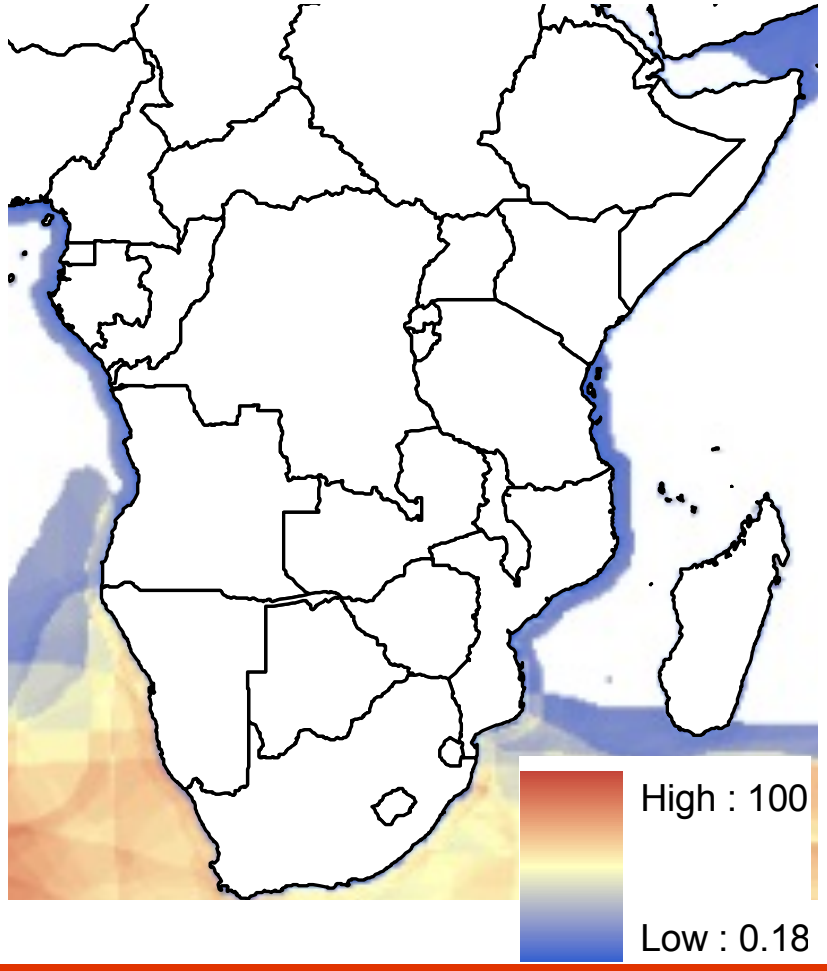


Threatened birds

Total numbers



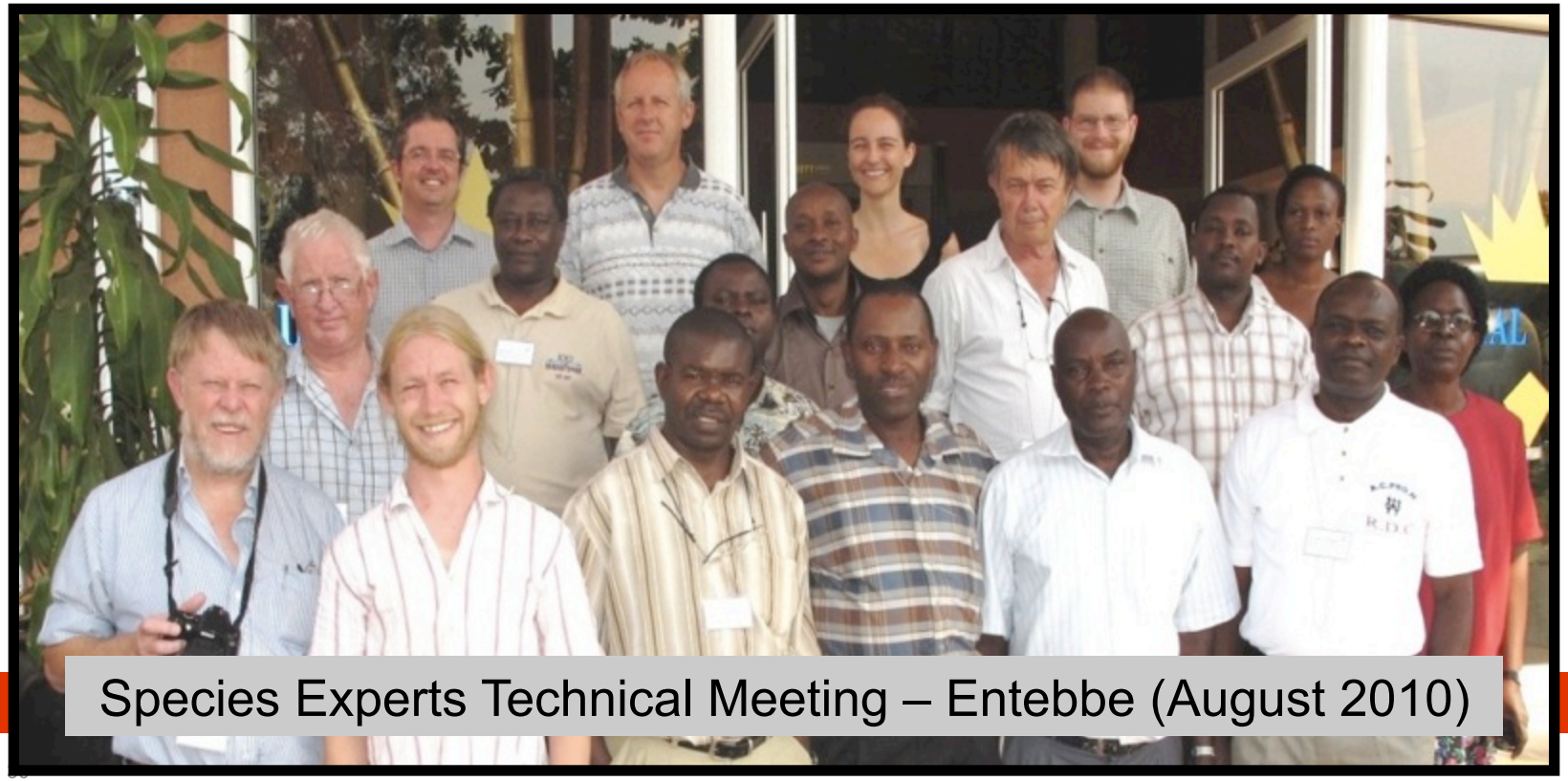
Proportion of total species



Assessing climate change susceptibility of human utilised species in the Albertine Rift

Using the susceptibility framework approach to assess:

397mammals	~1000 fishes	(120 amphibians)
175 reptiles	260 plants	(1060 birds)



Species Experts Technical Meeting – Entebbe (August 2010)

TRAFFIC

IUCN

We're gathering information on the use and livelihoods values of Albertine Rift species

→Projections of future declines (and resilience) of important resource species

Assessing climate change vulnerability of Albertine Rift species

→ 'Holistic' assessments of species' vulnerability

→Contribution to assessment of human's vulnerability

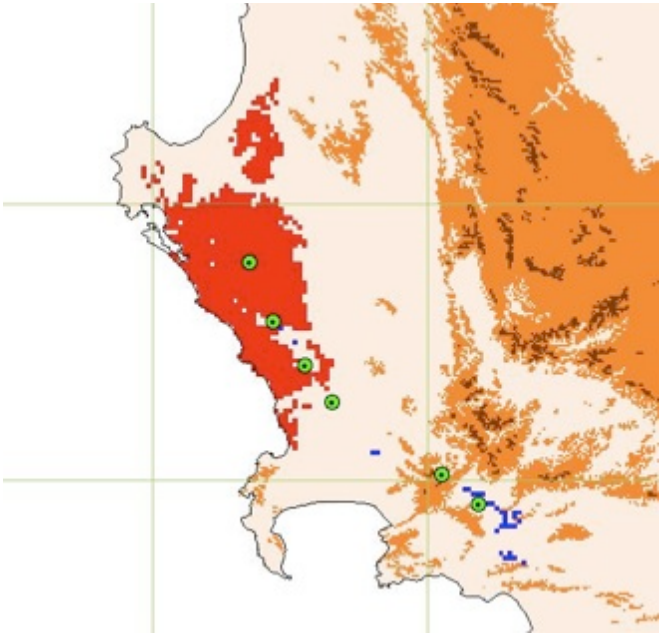
→Key information for adaptation strategies for both biodiversity and humans (e.g. lists of susceptible species per PA, inputs into regional and local monitoring strategies, human development plans, species management plans, regional and taxonomic conservation prioritisation, etc.)

Research Community

"Thank God! A panel of experts!"

Reintroductions and Invasives SG's are drafting

IUCN Guidelines on Assisted Migration



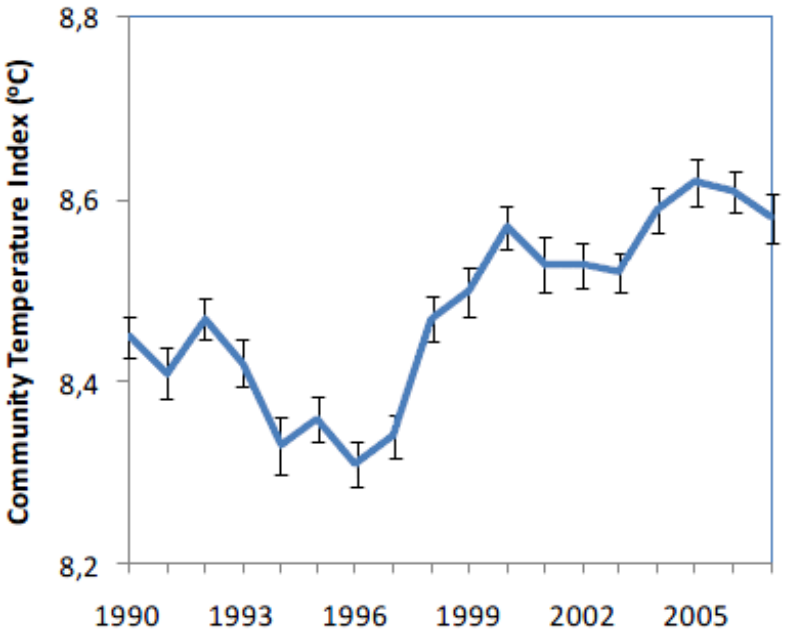
The European Butterfly Climate Change Indicator

Changes in Community Temperature Index (CTI)

Species Temperature Index (STI) – long-term average temperature experienced by a species over its range

Community Temperature Index (CTI) – the average STI in an assemblage

Increased CTI= butterfly communities increasingly composed of species associated with warmer temperatures



Overall shift (1990-2007) corresponds to:

206 ±148km in the UK;

125 ± 62km in France

Birds shown to move 86km over this period

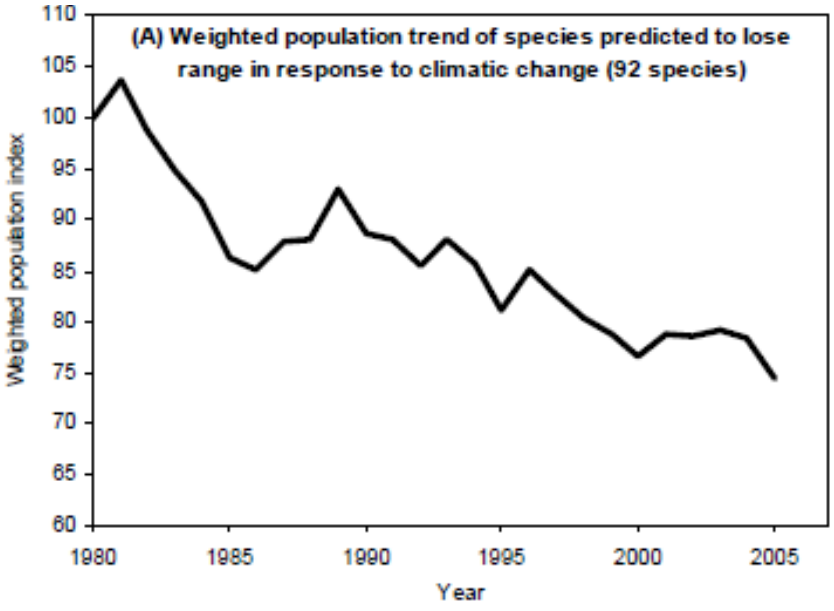
Van Swaay et al. 2009 - unpublished

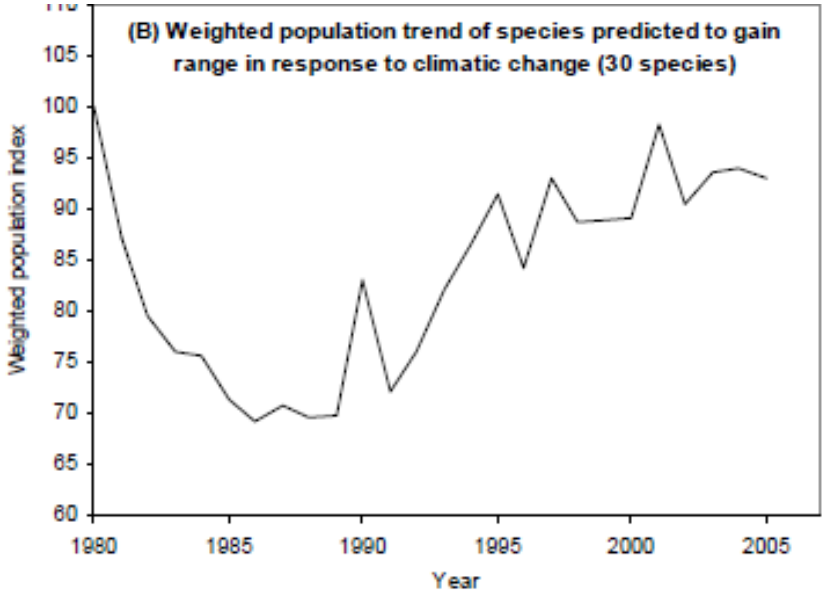
An Indicator of the Impacts of Climate Change on European Bird Populations

Gregory et al. 2009 – PLoS ONE

Found a significant positive relationship between observed population changes and bioclimatically modelled change in potential range (based on population trends in 108 Species from 20 European countries (1980-2005))

Used this to derive a Climate Impact Indicator – ratio of population index for those gaining vs. those losing range (applied to 122 species in 26 European countries)





An Indicator of the Impacts of Climate Change on European Bird Populations

Climate Positive vs. Climate Negative Species

Gregory et al. 2009 – PLoS ONE