Impact of climate change-driven biodiversity loss on human livelihoods

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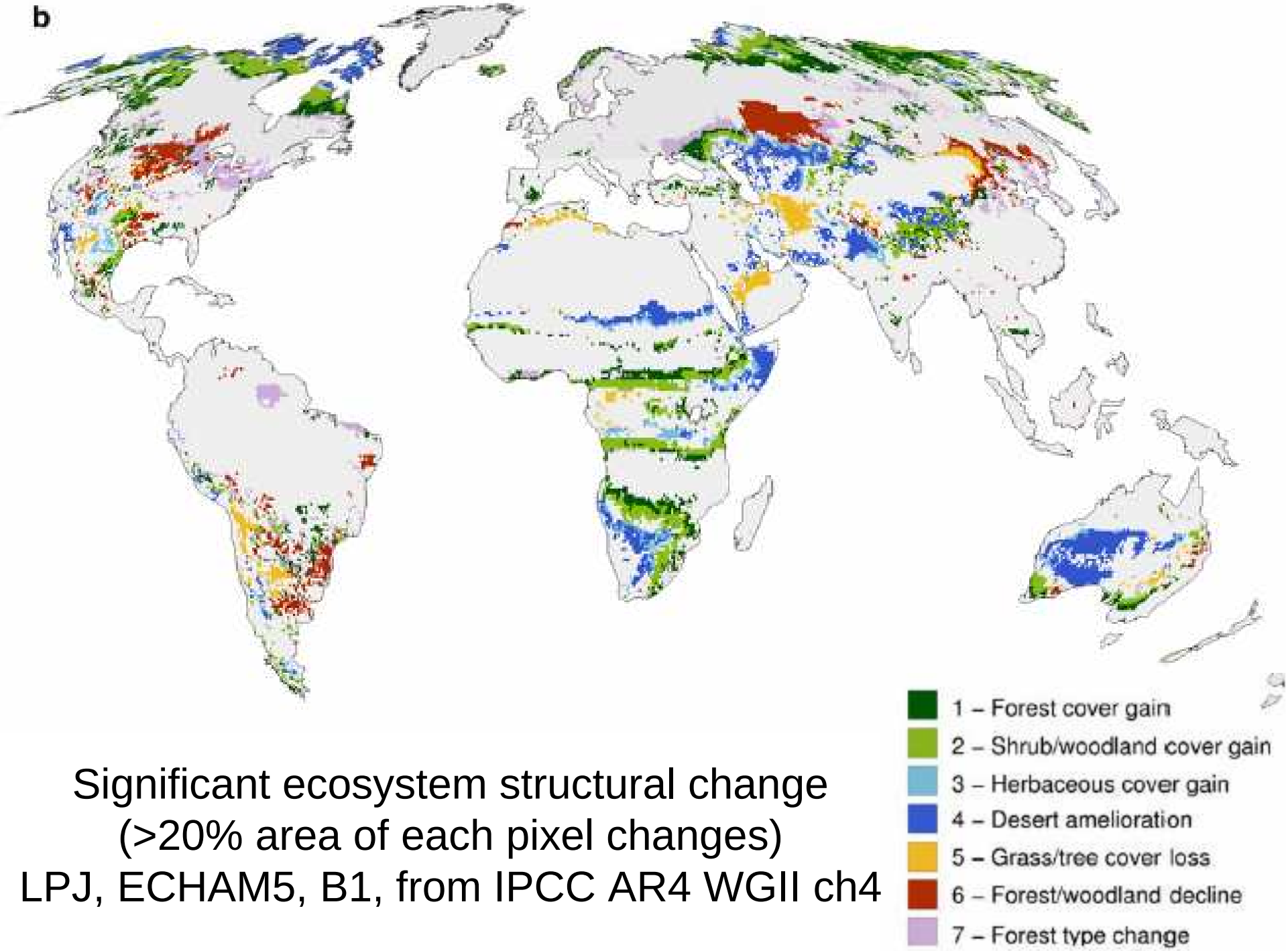
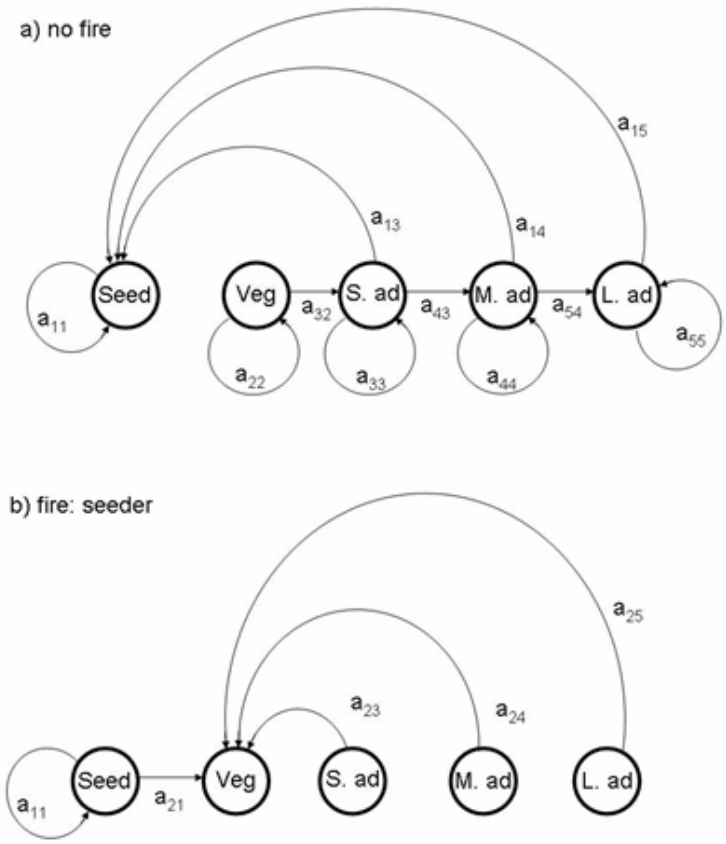
IPCC AR4 WG2 concludes:

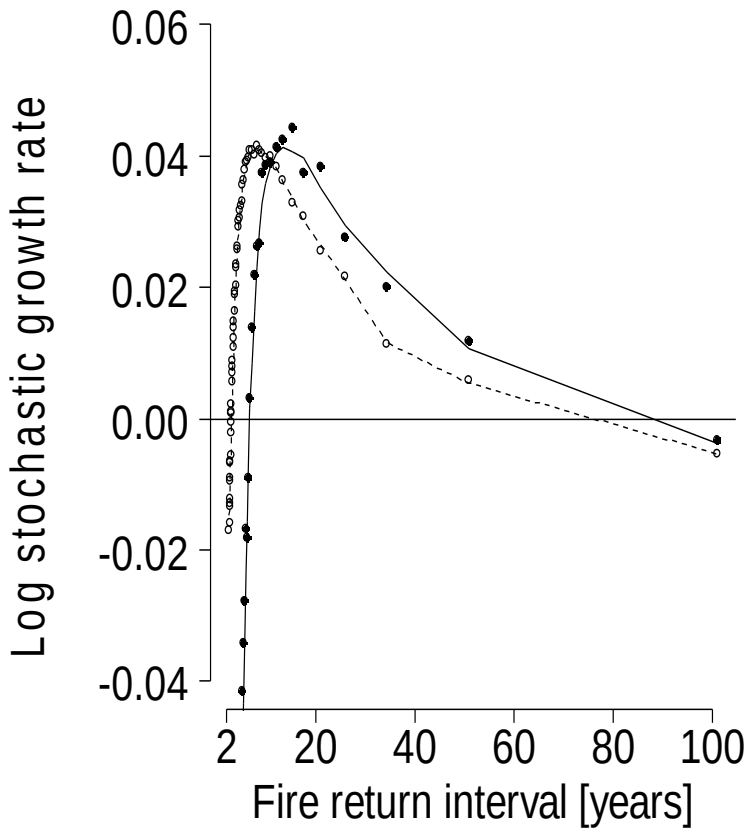
- **biodiversity** Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5℃ above present (1980-19 99).
- **ecosystem resilience** The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects,ocean acidification), and other global change drivers (e.g., land use change, pollution, overexploitation of resources).
- **ecosystem services** For increases in global average temperature exceeding 1.5-2.5℃ and in concomitant atmospheric carbon dioxide concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions, and species' geographic ranges, with predominantly negative consequences for biodiversity, and ecosystem goods and services e.g., water and food supply.



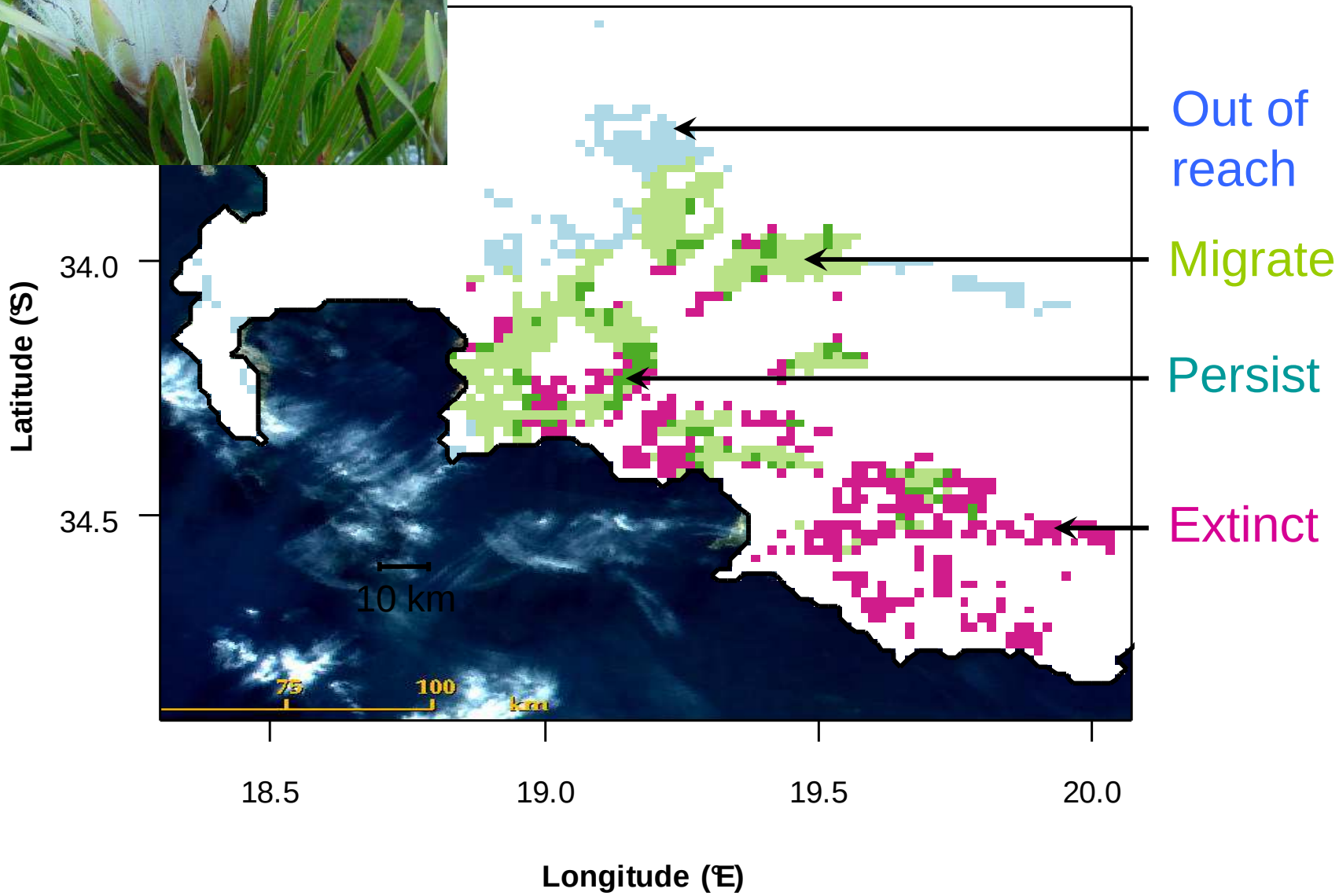
Significant ecosystem structural change
(>20% area of each pixel changes)
LPJ, ECHAM5, B1, from IPCC AR4 WGII ch4

Getting more sophisticated than bioclimatic envelope modelling: adding demography





The importance of dispersal
Protea longifolia

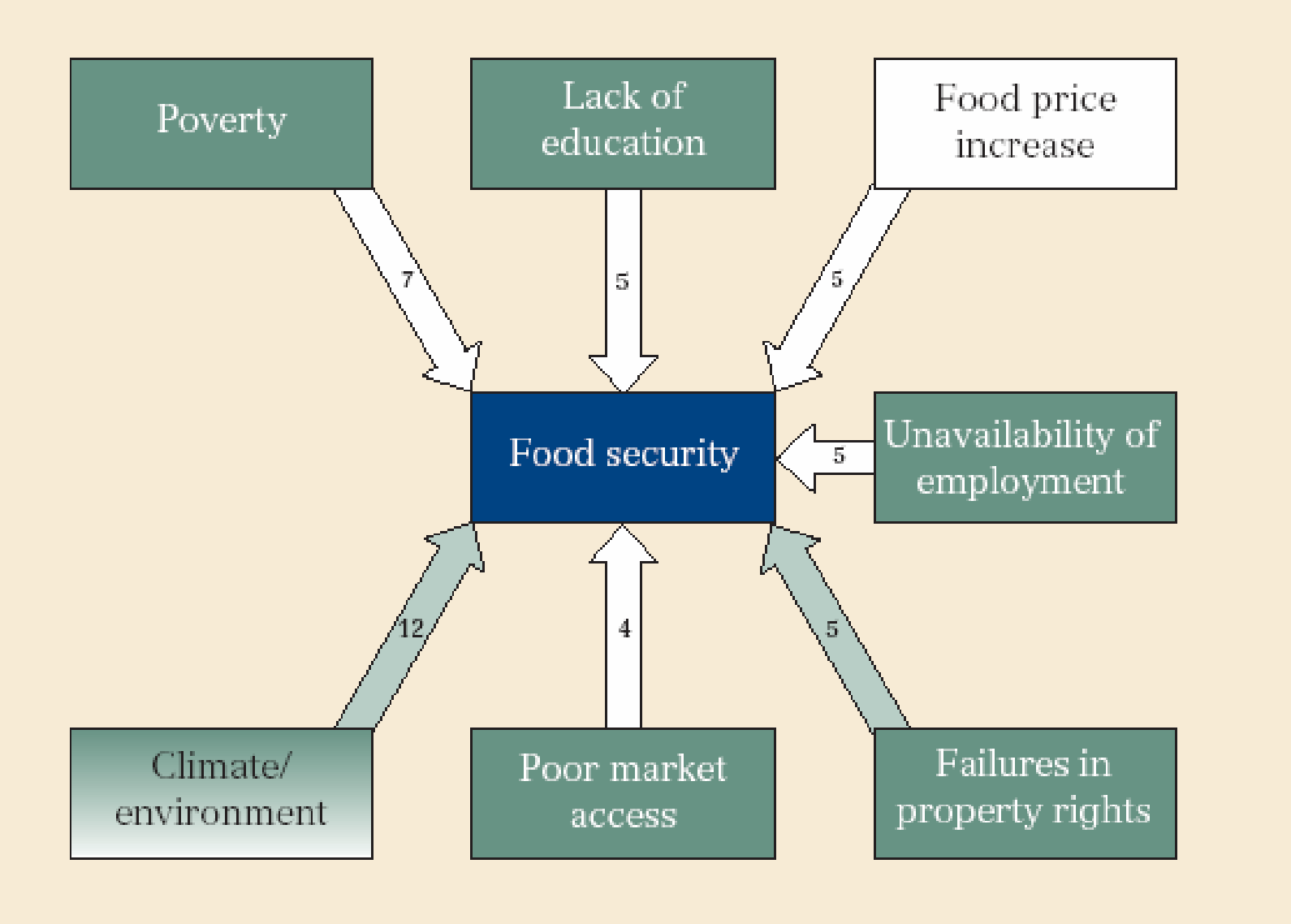


Livelihoods, defined

A livelihood comprises the assets (natural, physical, human, financial and social capital), the activities and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household." (Ellis, 2000)

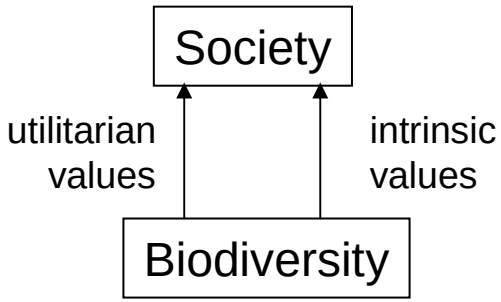
'Livelihoods' include assets that fall outside of traditional economics, and are critical for assessing conditions of poverty, as opposed to economic wealth

Livelihoods emphasise the many dimensions of survival strategies, and their adaptability



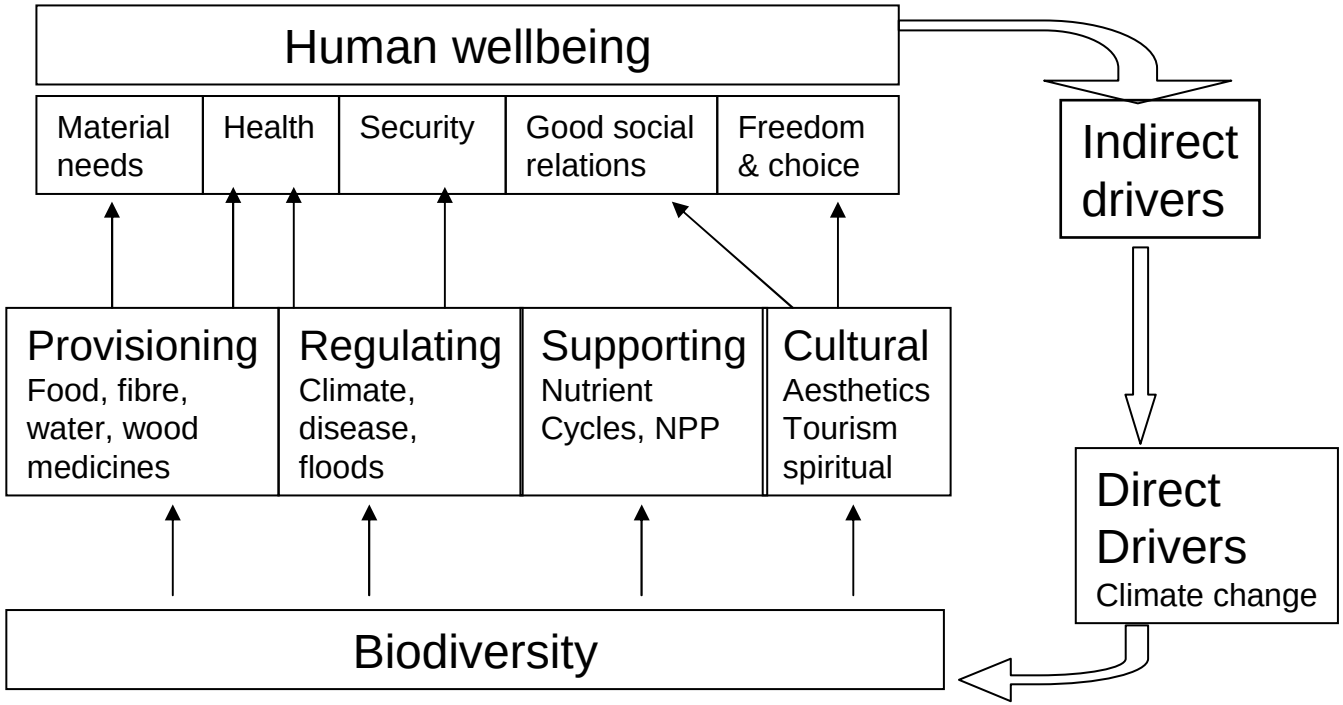
Alison Misselhorn, in Southern African Millennium Assesment

How does biodiversity link to ecosystem services, and services to human wellbeing?



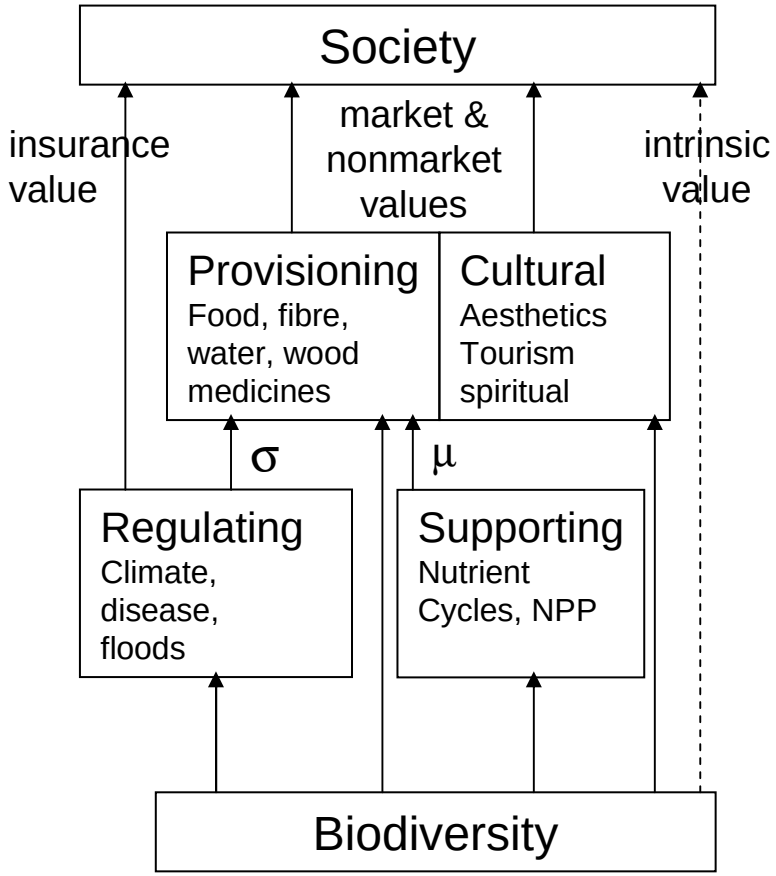
The naïve view

How does biodiversity link to ecosystem services, and services to human wellbeing?



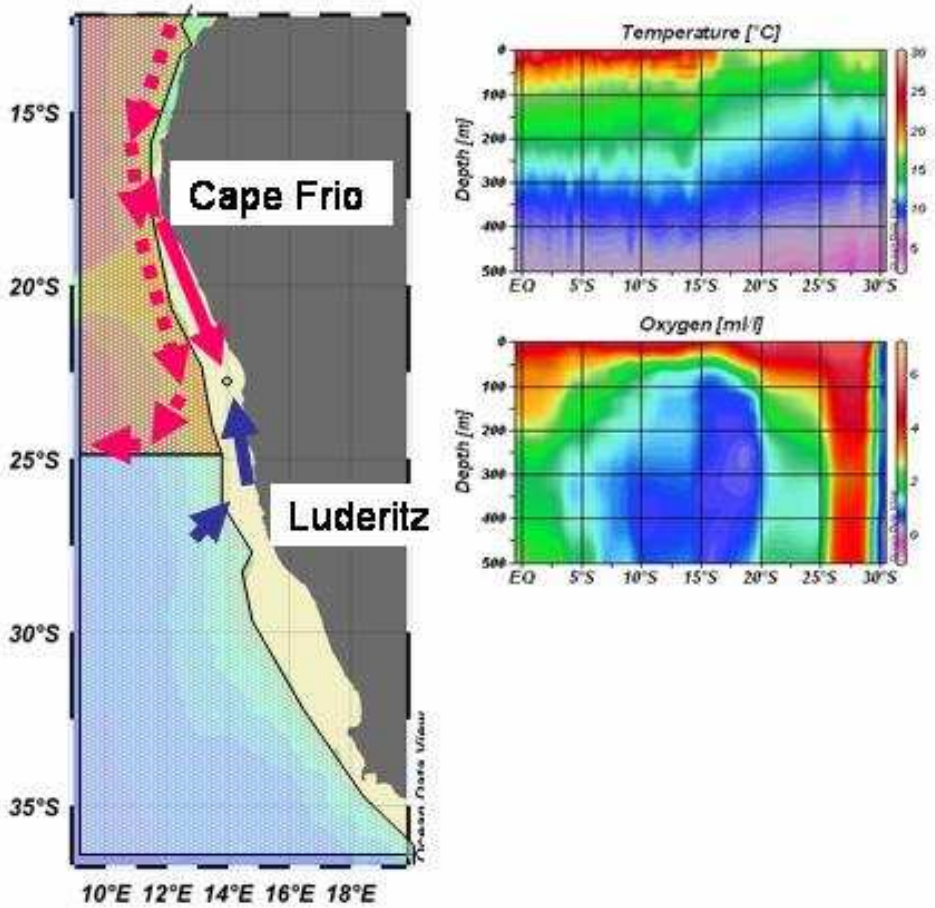
The Millennium Ecosystem Assessment scheme

How does biodiversity link to ecosystem services, and services to human wellbeing?



Kinzig, Perrings & Scholes (in prep)

Example 1: Namibian fisheries

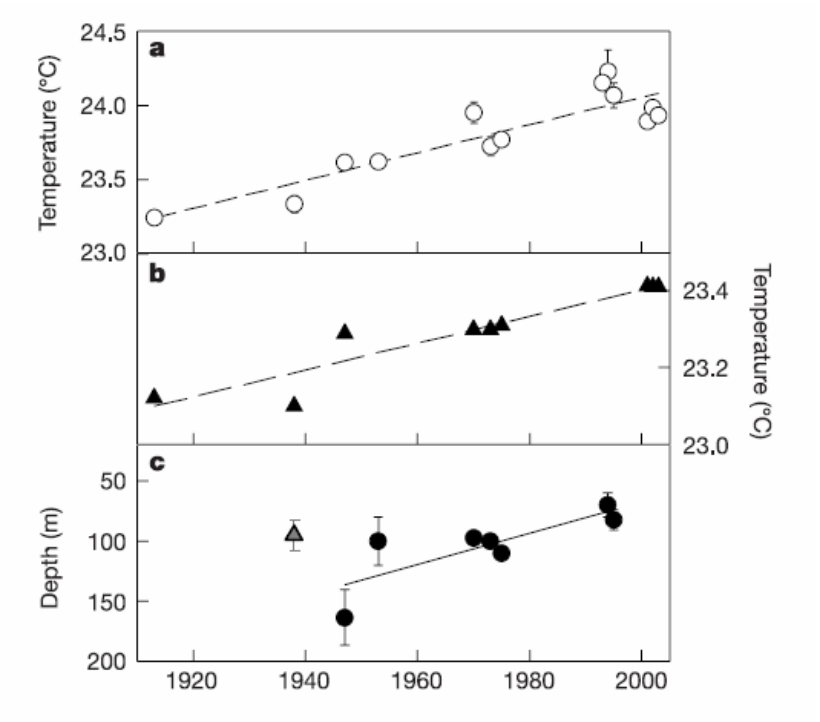


Monteiro, P.M.S., A. van der Plas, V. Mohrholz, E. Mabille, A. Pascall, W. Joubert (2006) The variability of natural hypoxia and methane production in a coastal upwelling system: oceanic physics or shelf biology? *Geophysical Research Letters*. 33: L16614, doi:10.1029

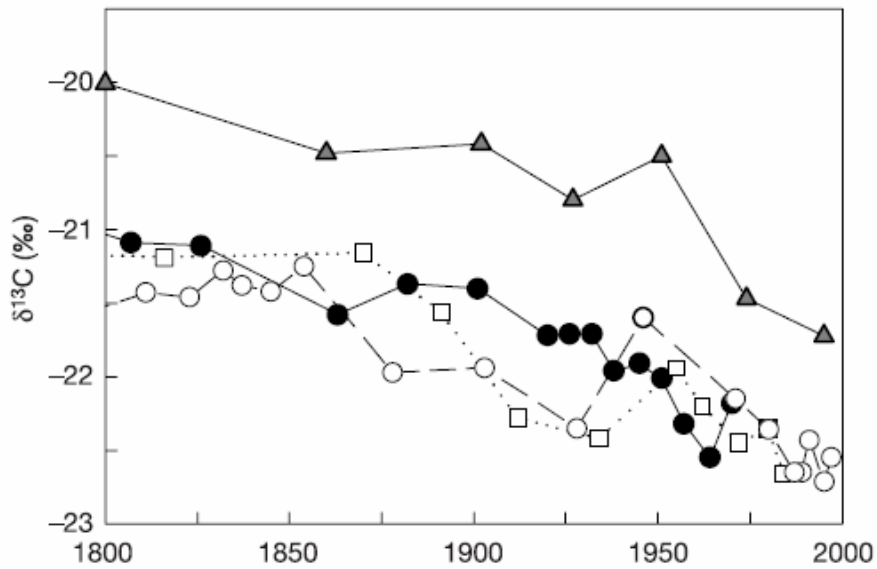
Example 2: Lake Tanganyika

Provides 20-40% of the animal protein needs of the surrounding population

30-50% decline in culepid fish
Harvest since 1970%, larger decline in pescivorous species

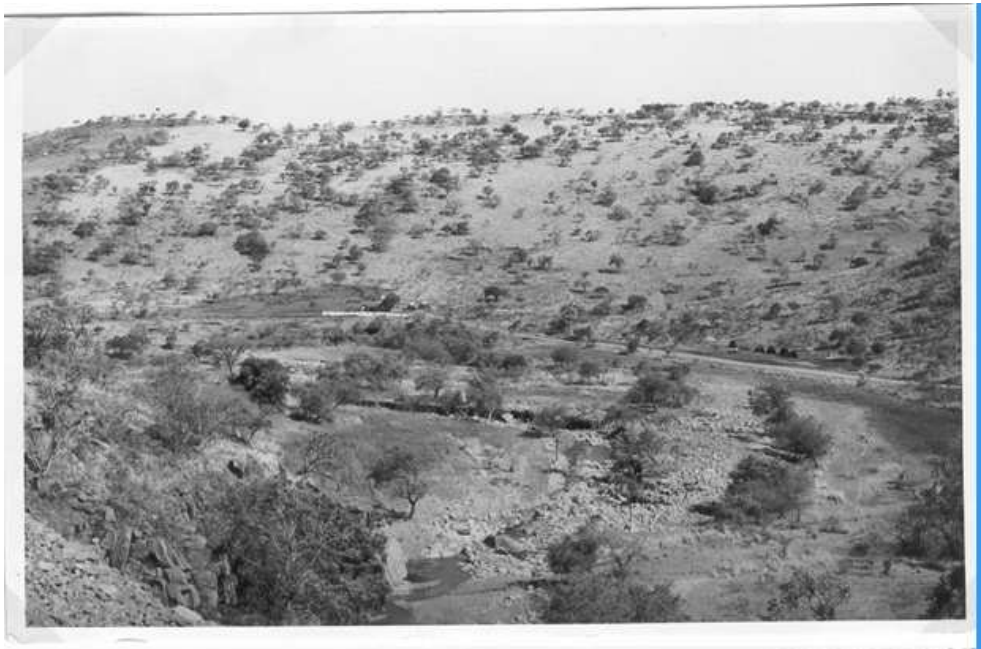


Primary productivity proxy



O'Reilly et al 2003 Nature 424:766-768

Example 3: Cattle, trees and CO_2



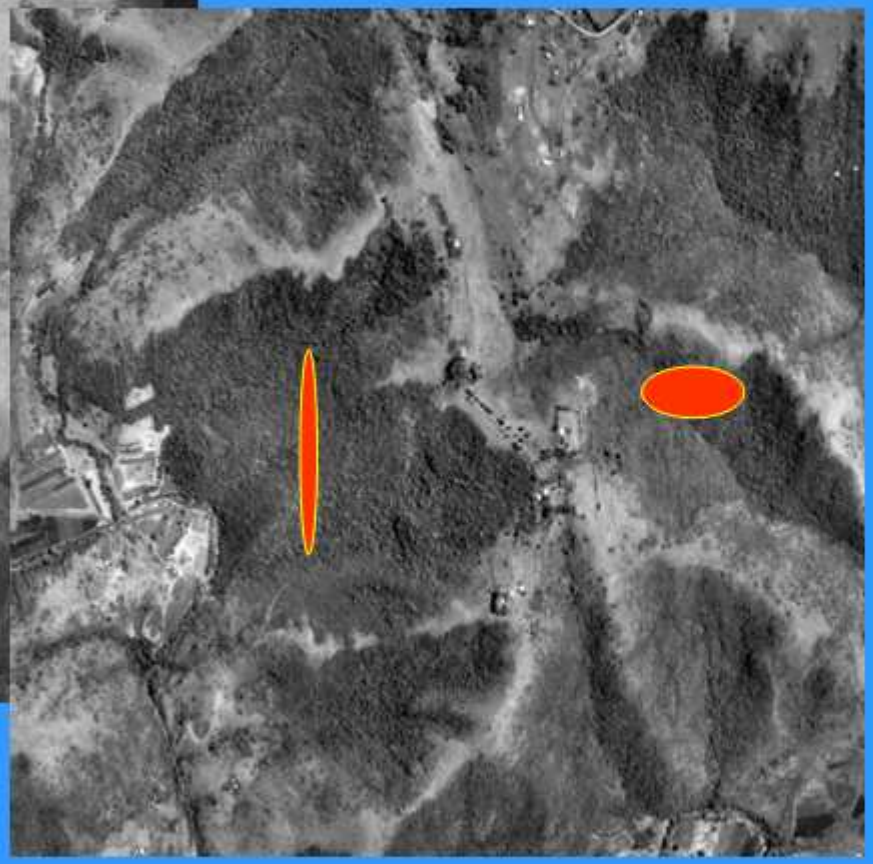
Trees have increased
in savannas since 1950s
WORLDWIDE

Open savanna, S. Africa
1955

Same place, 1998

(from T. Hoffmann, IPC)

Hluhluwe Game reserve 1954



Hluhluwe GR 2001

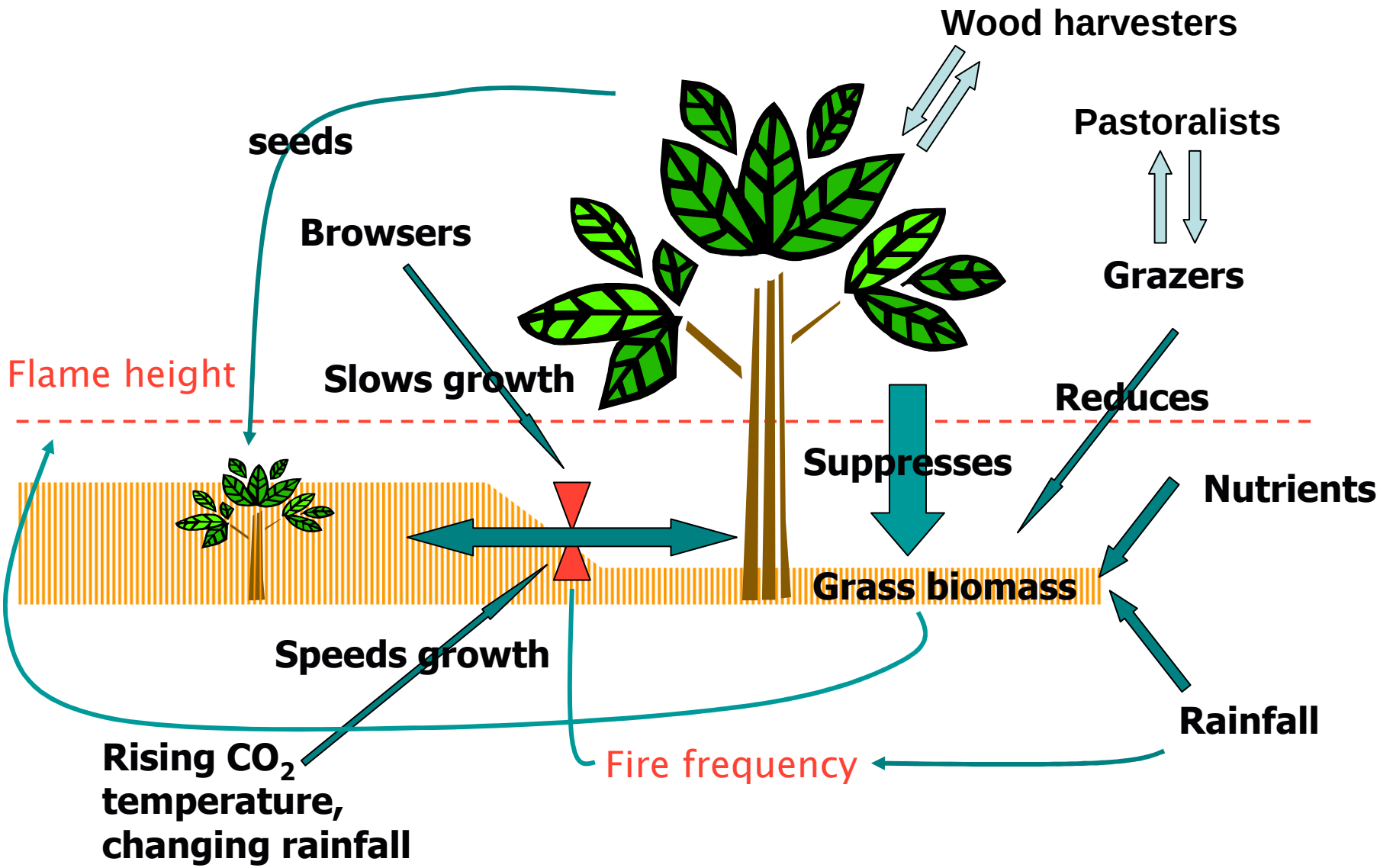
Conservation area – forests expanding, grasslands disappearing
Communal area – the same!

There have been dramatic changes in the productivity of savanna trees since the Last Glacial Maximum, especially belowground

This may have led to a threshold being crossed in tree-grass interactions, making trees more able to escape from the ‘fire trap’

Picture: Barney Kgope

Some of the tree-grass interactions…



Conclusion 1

Ecologically and physiologically-constrained spatial demographic models are needed to assess and manage biodiversity changes that could cause livelihoods impacts

Conclusion 2

Impacts on livelihoods occur mostly *indirectly*, via provisioning services, including 1) changes in mean yield; 2) reliability of yield

Conclusion 3

The examples we have of livelihood impacts via biodiversity changes are the result of *systemic* change, rather than individual species processes