UNIVERSITY OF CAPE TOWN

PLANT CONSERVATION UNIT

BIOTA

The impact of land use and climate on the vegetation of the western part of southern Africa over the last 200 years

Timm Hoffman[1], Rick Rohde[2] Norbert Jürgens[3]

[1] Plant Conservation Unit, University of Cape Town

[2] Centre of African Studies, University of Edinburgh

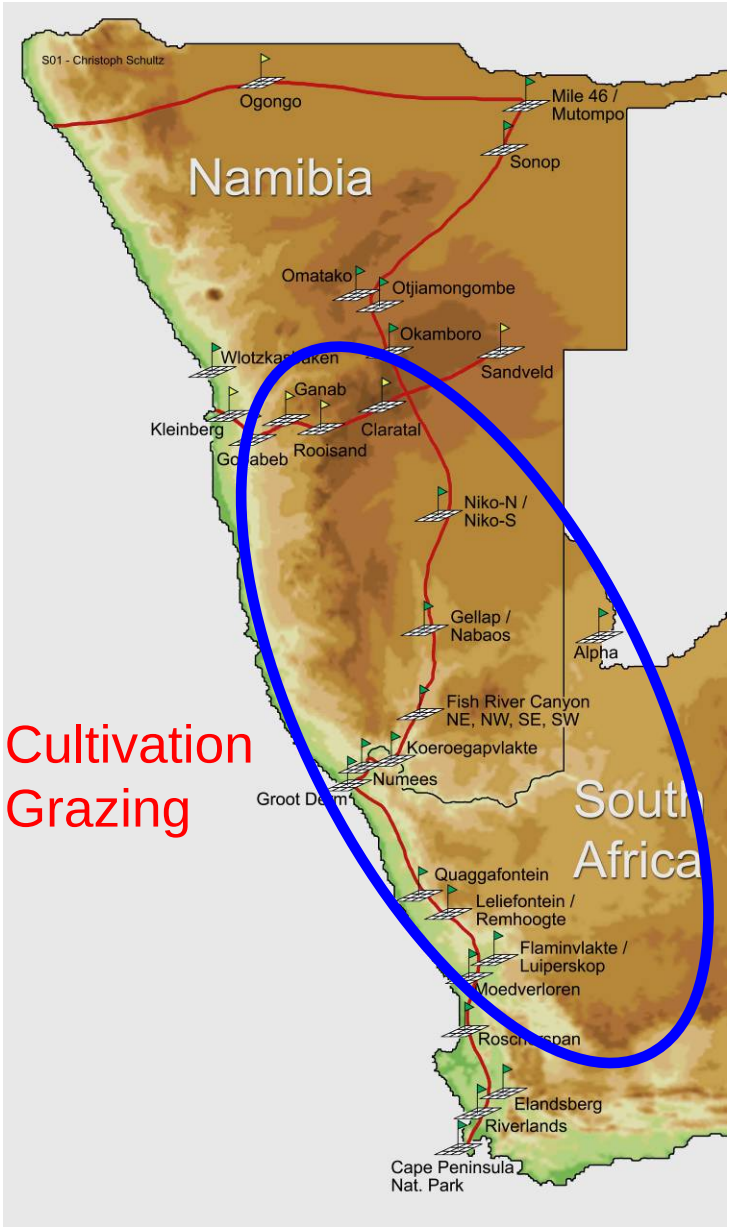
[3] Botany Department, University of Hamburg

BIOLOG

"Biodiversity of Africa - Observation and Sustainable Management for our Future!"
International Congress, 29 September – 3 October 2008, at Spier, RSA

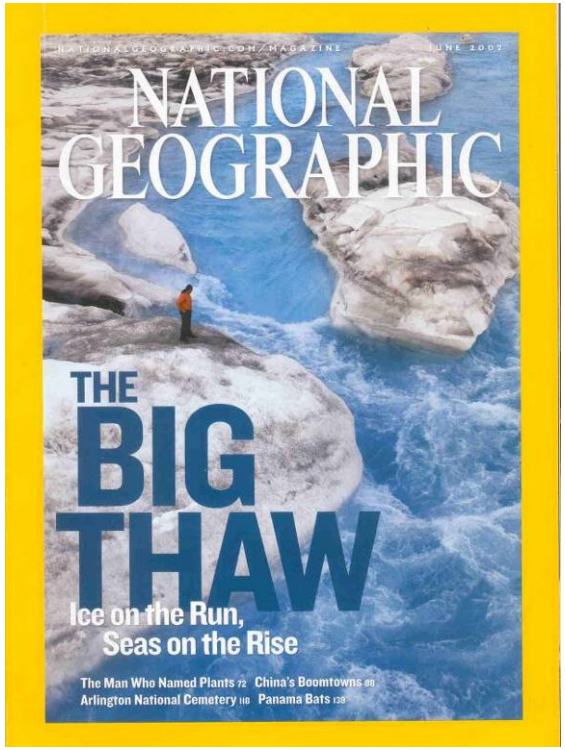
Projektträger im DLR

Federal Ministry of Education and Research

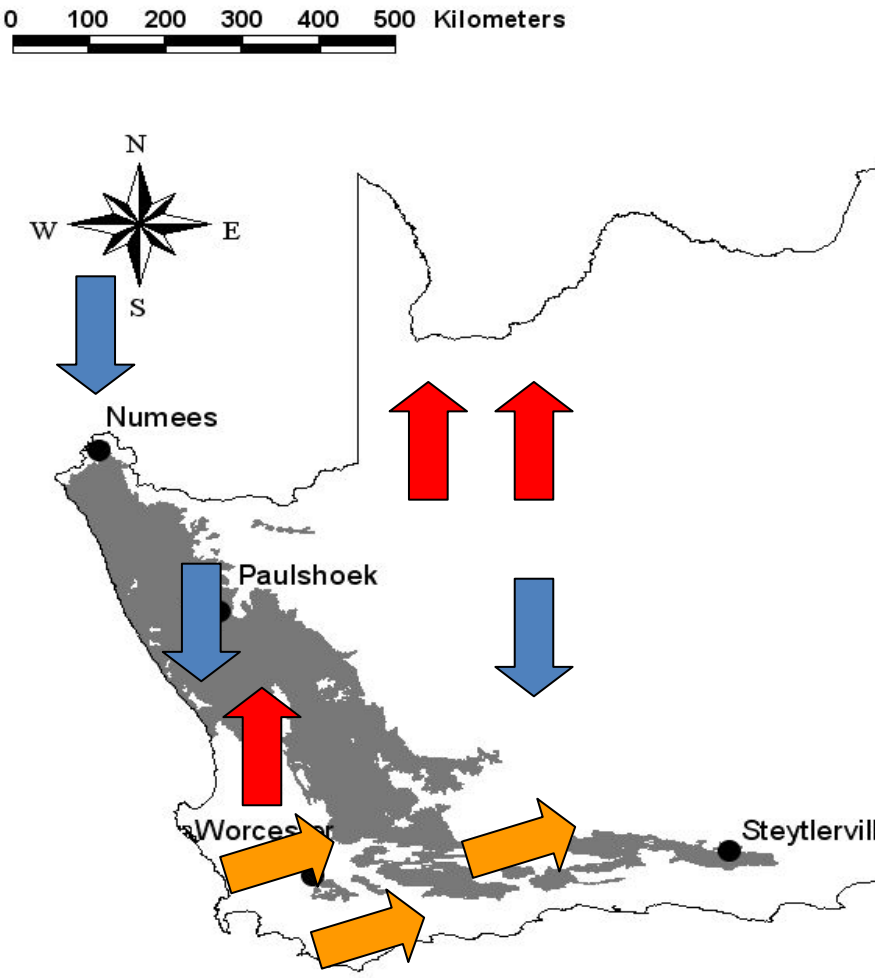


THE LARGER CONTEXT

1. Local evidence for global climate change truths



2. Anthropogenic versus climate change impacts



Summary for cultivation

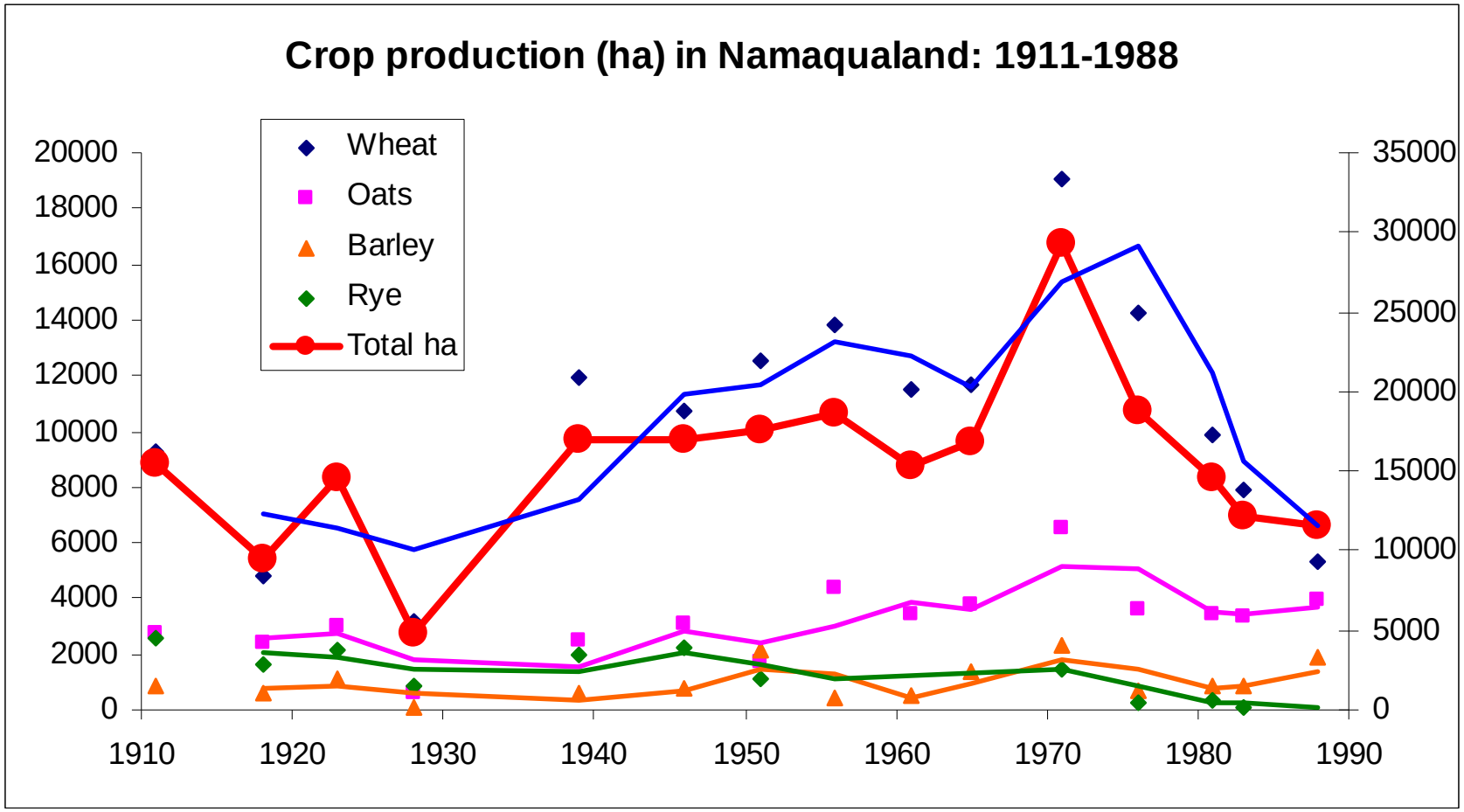
Generalisations are difficult – the historical and current impact depends on the region

Decline in dryland cropping in more marginal Karoo environments since 1970s (Namibia, Namaqualand, Upper Karoo)

Moderate increase in dryland cropping in renosterveld and Little Karoo

Significant increase in irrigated lands (Orange River, Sandveld - 1,000 ha/year since 1989)

What has happened to crop production in Namaqualand?



Significant decline in ha cultivated.
Abandonment of croplands more in marginal lands than higher rainfall areas
What are the implications for mass flower displays?


Steiner 1967

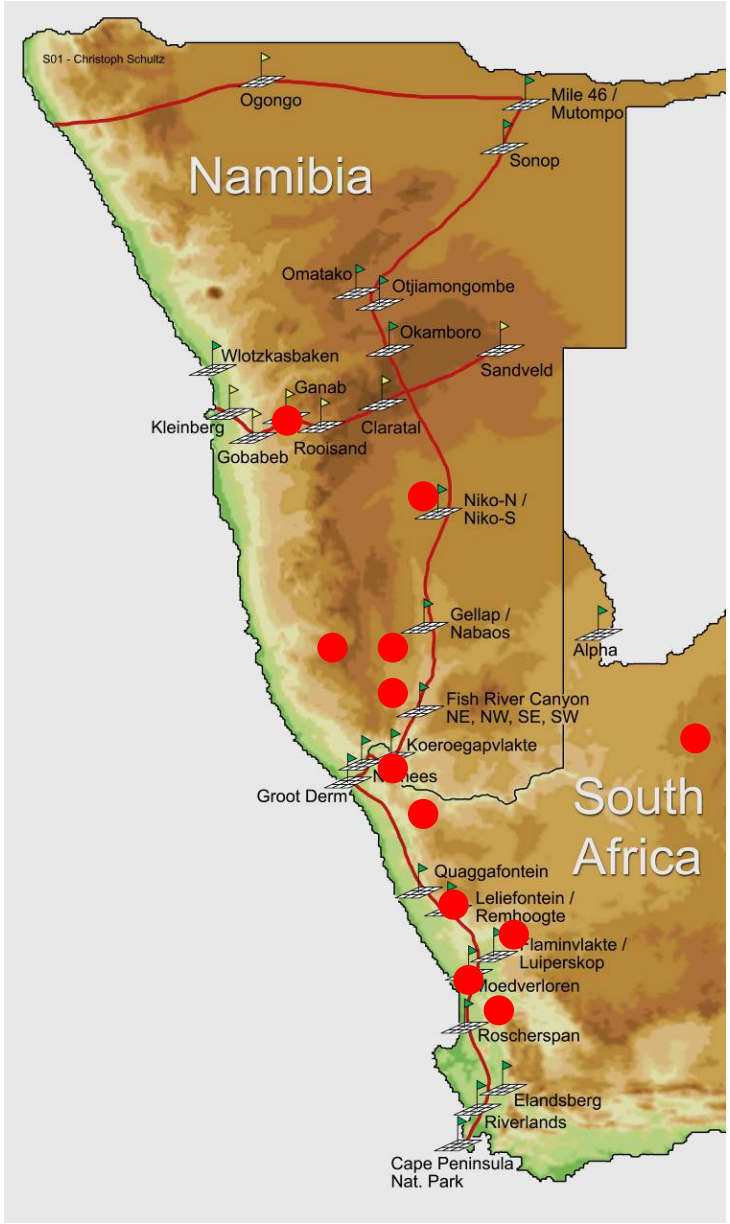

Rohde & Hoffman 2003

Grazing impacts

Species

Community

Landscape



Arid savanna

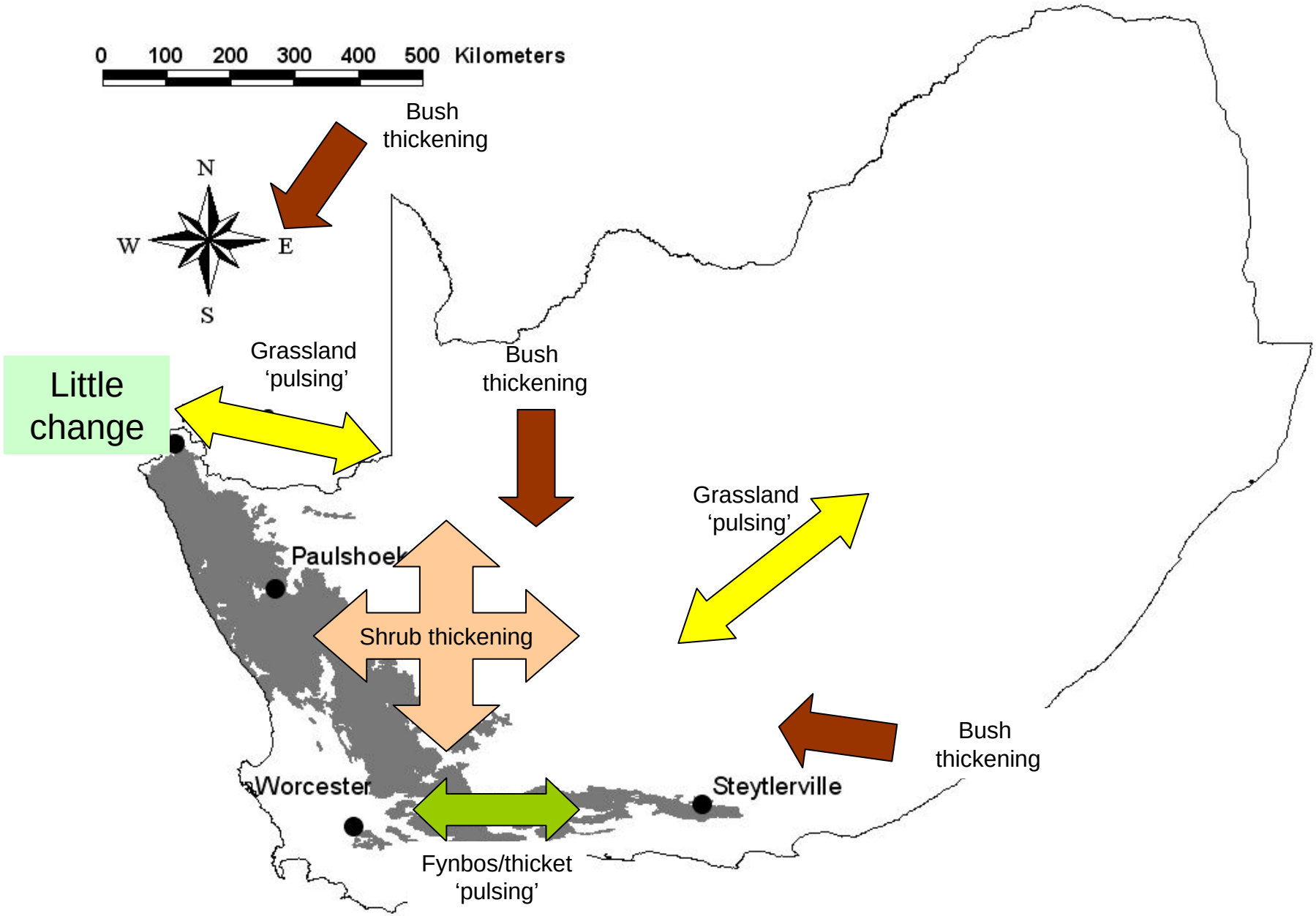
Desert

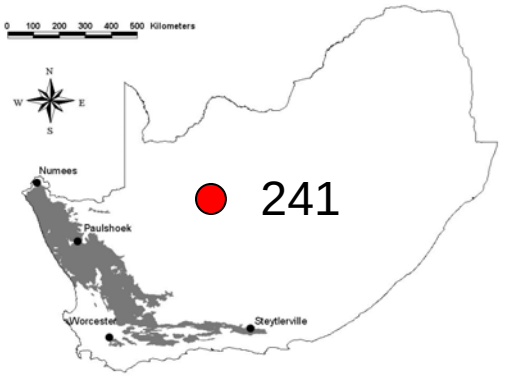
Desert grassland

Succulent shrubland

Ephemeral rivers

Selected from collection of >500 repeat photographs of southern Africa


0 100 200 300 400 500 Kilometers
Bush thickening
N
W
E
S
Grassland 'pulsing'
Bush thickening
Little change
Grassland 'pulsing'
Paulshoek
Shrub thickening
Bush thickening
Worcester
Steytlerville
Fynbos/thicket 'pulsing'



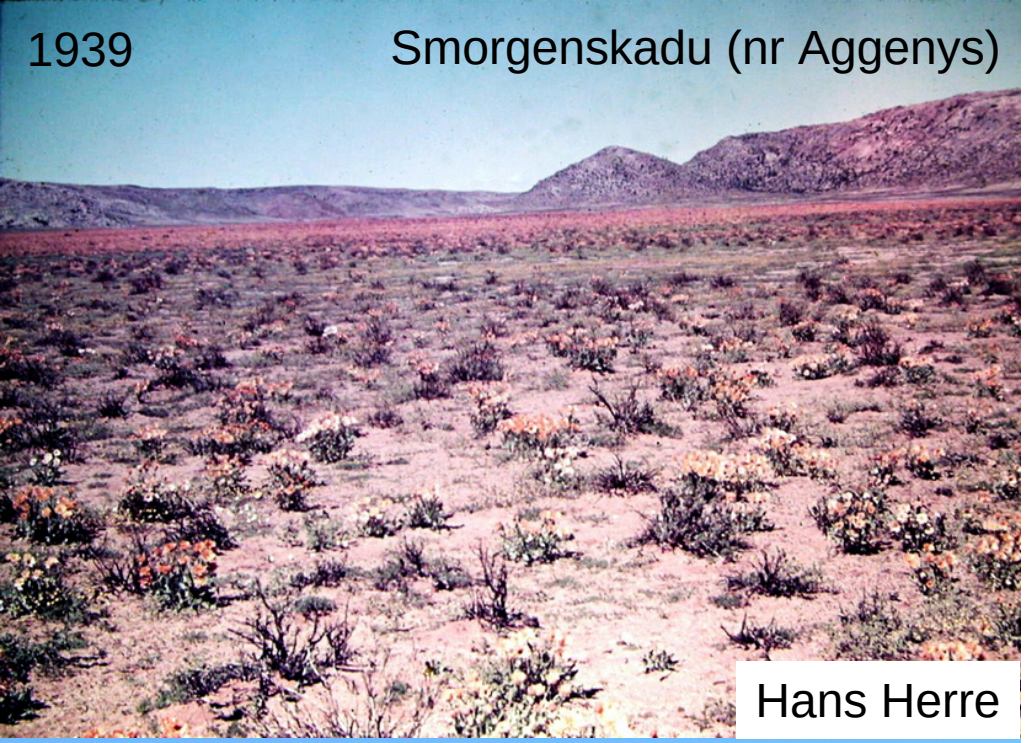
BUSH THICKENING

An increase in *Tarchonanthus camphoratus* on the hillslopes and *Acacia tortilis, A. erioloba, A. mellifera* and a range of grasses on the plains

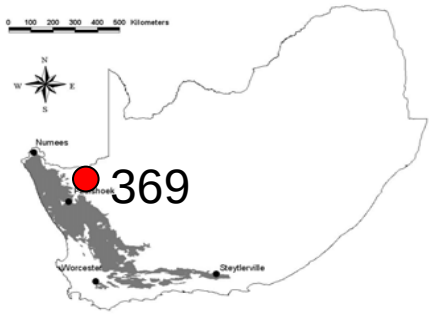

1914


Jürgens 2005

DESERT GRASSLANDS



In some cases there have been quite dramatic shifts

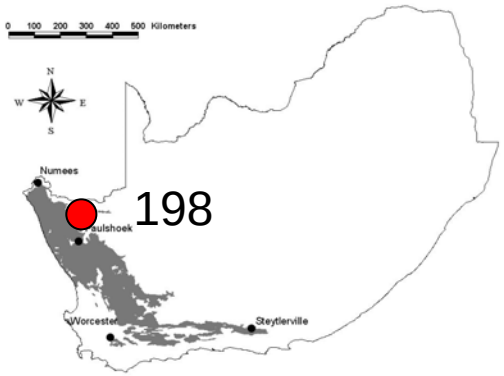


For example, at this site there has been a shift from annuals, ?succulent shrubs to grassland (*Stipagrostis brevifolia*)

This biome shift has been strongly influenced by land use.

This site is close to the farmhouse which in the early 20th century had the only source of water for a wide area.

Borehole technology enabled farmers to rest the veld which resulted in an expansion of grasses

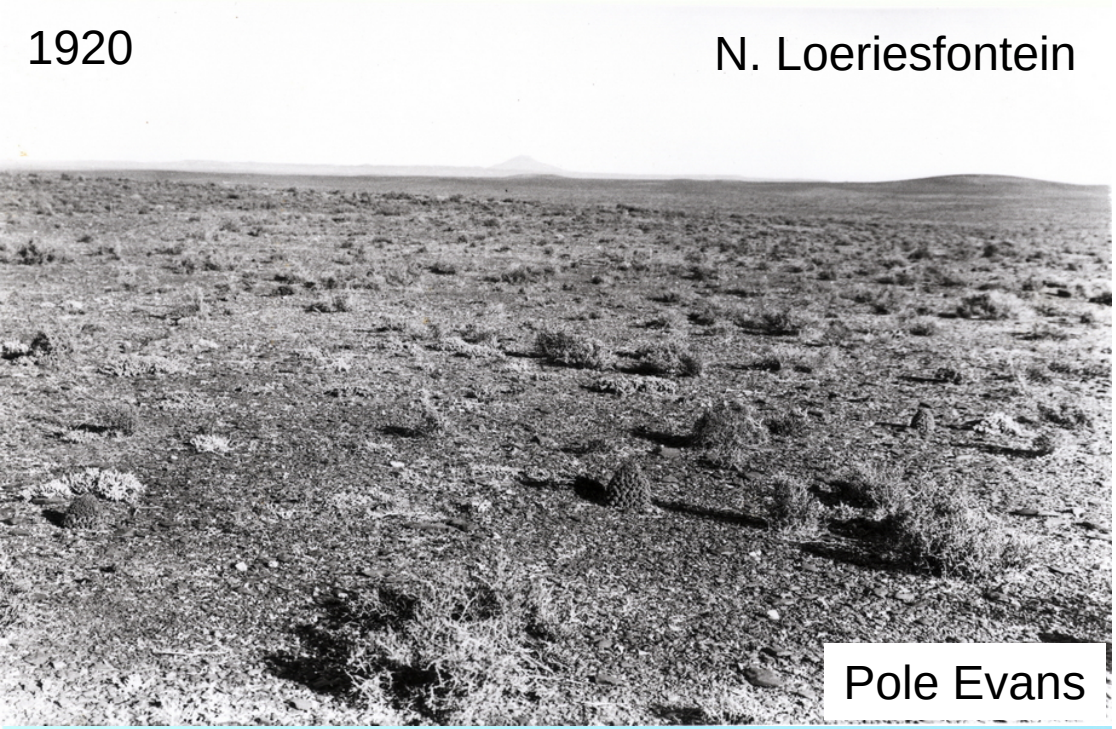


This pattern is repeated at a few other sites as well which have experienced a shift from annuals to *Stipagrostis brevifolia* grassland

The pattern is strongly influenced by season and time of year

1920

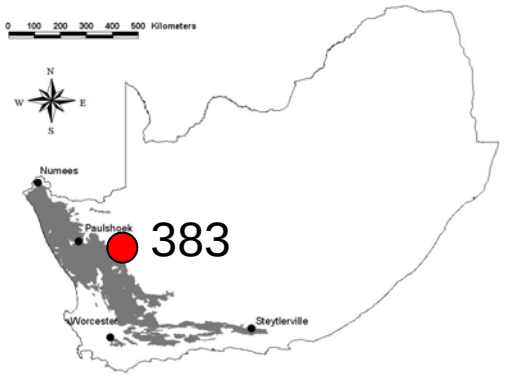
N. Loeriesfontein



Pole Evans

2005

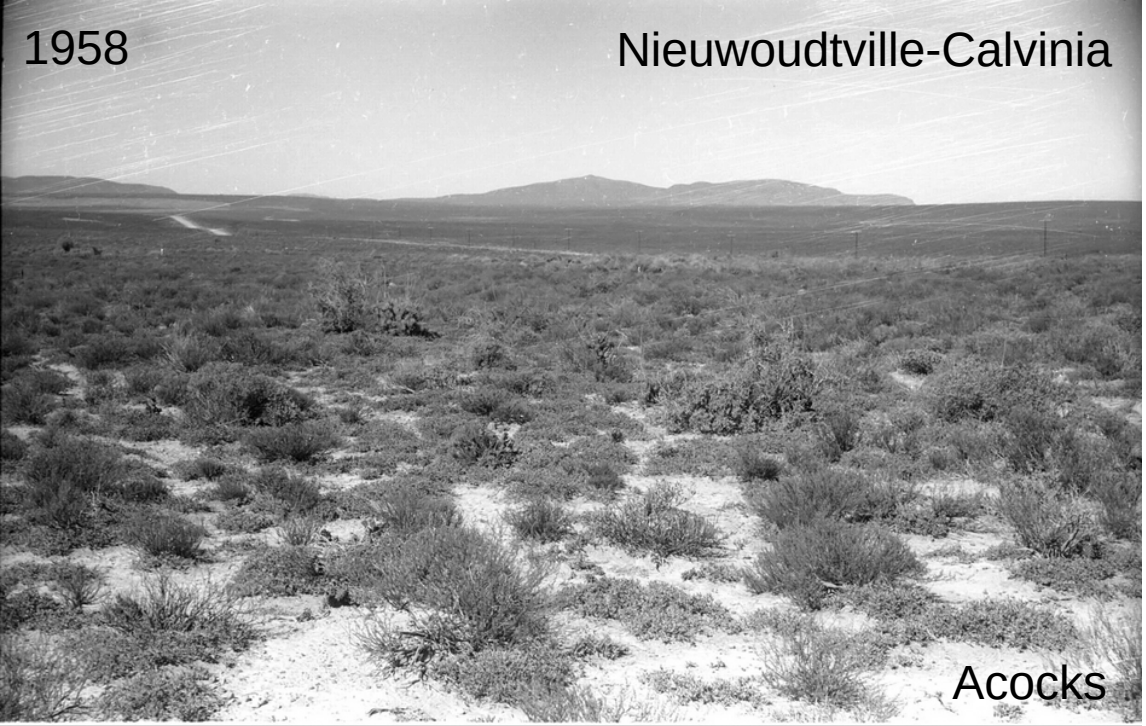
Rohde & Hoffman

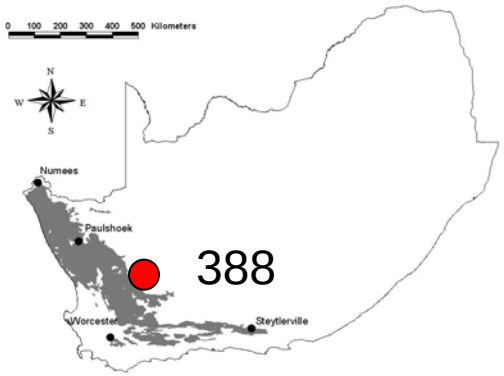


SHRUB THICKENING

Significant increase in shrubs (e.g. *Ruschia spinosa, Eriocephalus spinescens, Lycium cinereum,* (spiny) *Tripteris* sp.

Heuweltjie in middle distance has also thickened up a lot.



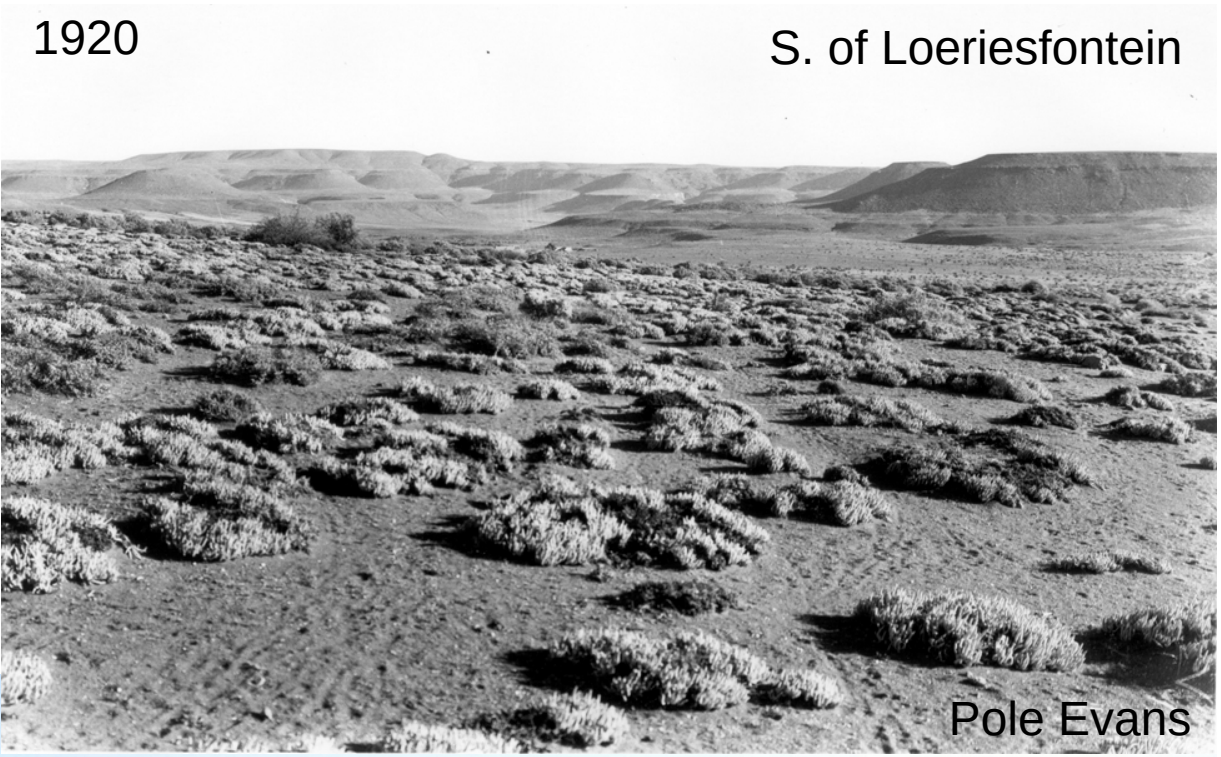


General finding from the repeat photographs suggest that there has been an overall increase in cover relative to images that were taken in the early or middle part of the 20th century

This site shows very little change in composition but a slight increase in cover

1920

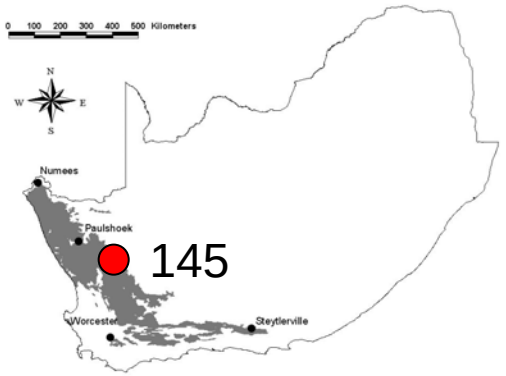
S. of Loeriesfontein



Pole Evans

2002

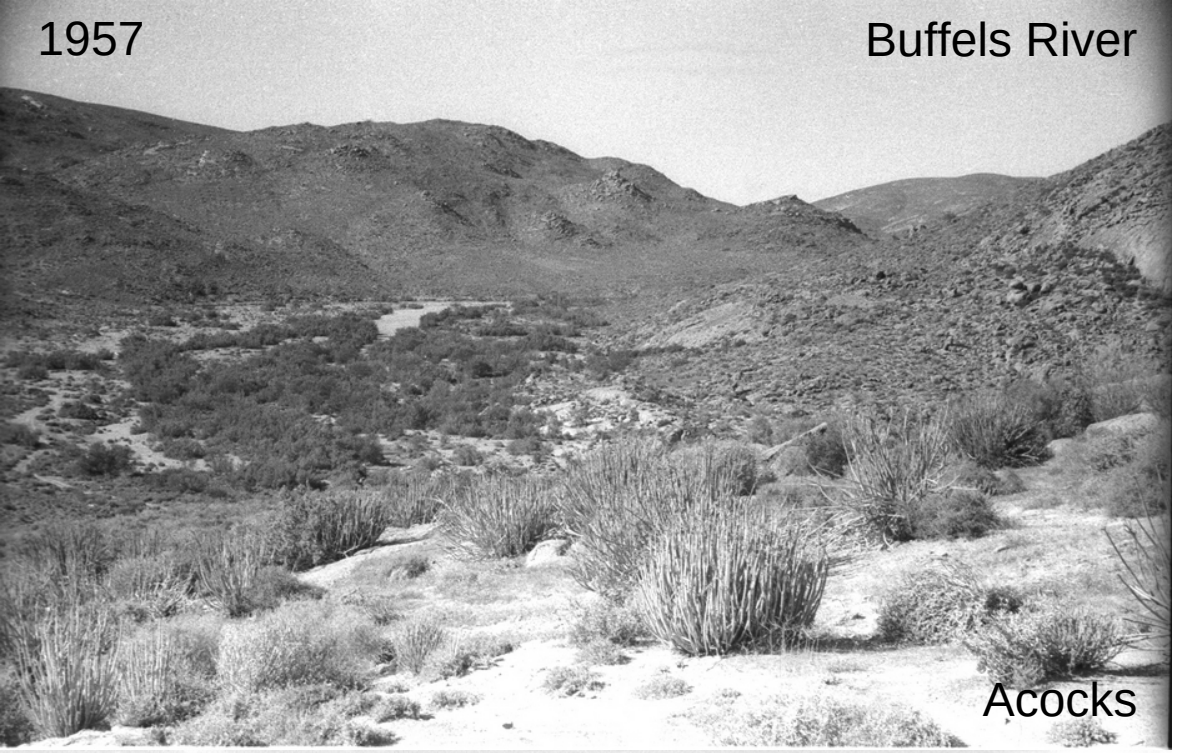
Rohde & Hoffman

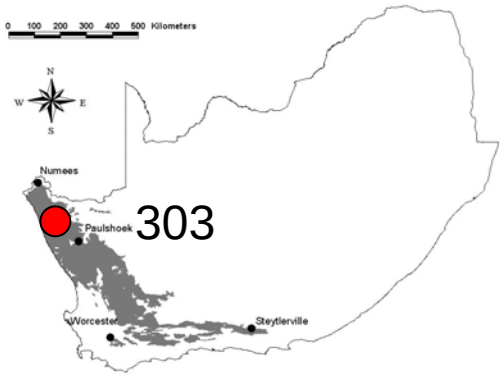


SHRUB THICKENING

INTO SUCCULENT KAROO

Reduction in prostrate succulent species (*Cephalophyllum, Brownanthus*) and an increase in non-succulent shrubs such as *Zygophyllum microphyllum, Blepharis, Tripteris, Eriocephalus*)

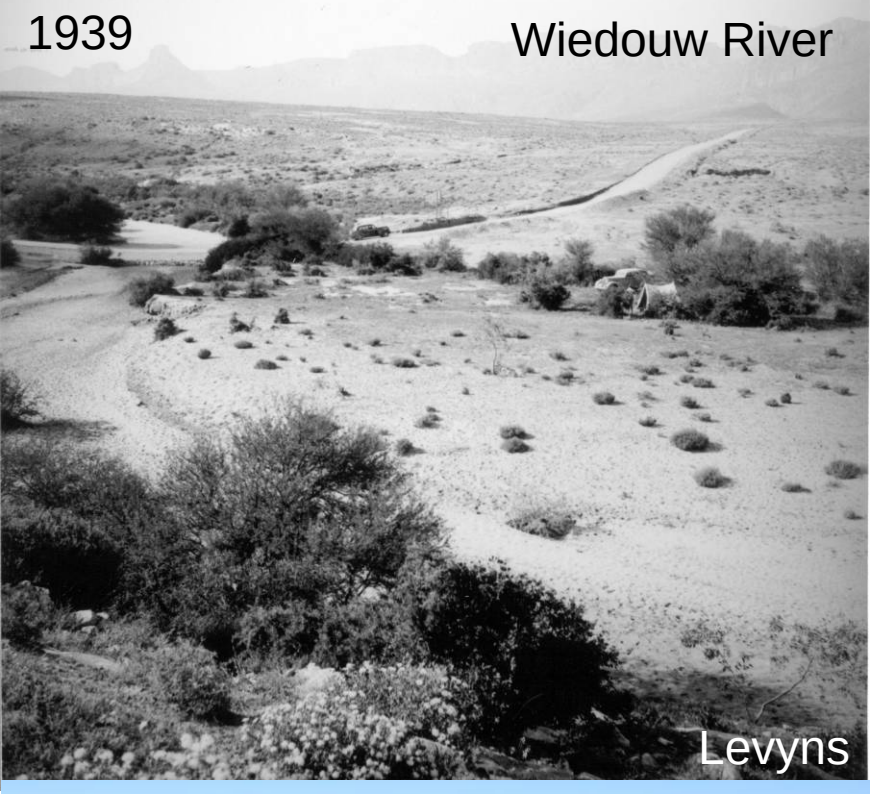


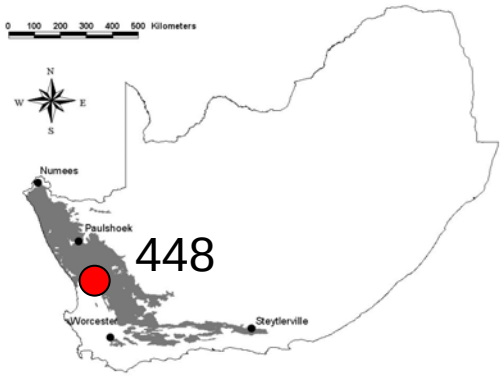


EPHEMERAL RIVERS

Ephemeral river systems which are vegetated have not changed much

No evidence of large floods which have ‘cleaned out’ the river systems (*vide* Laingsburg floods of 1981)

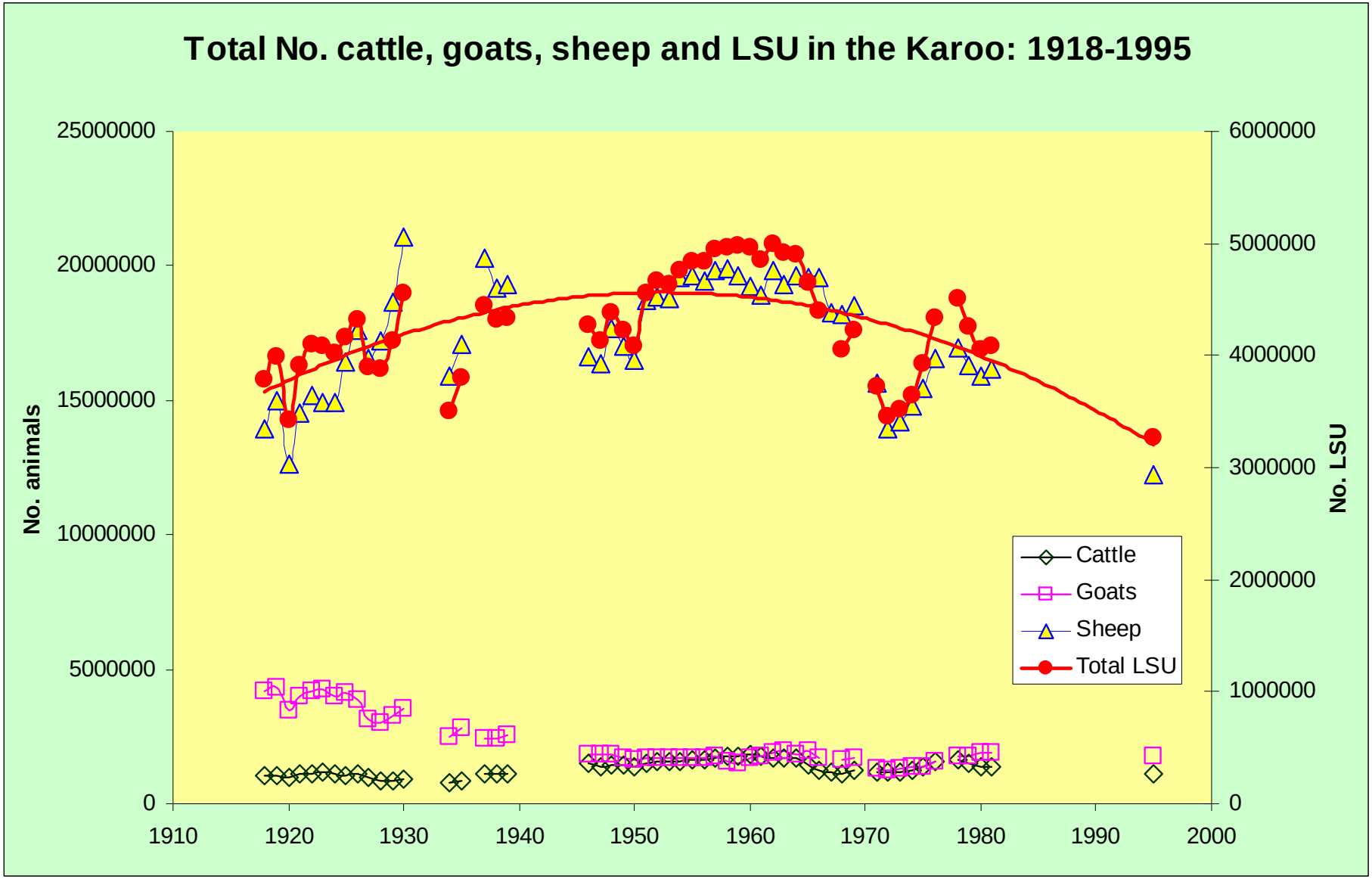




EPHEMERAL RIVERS

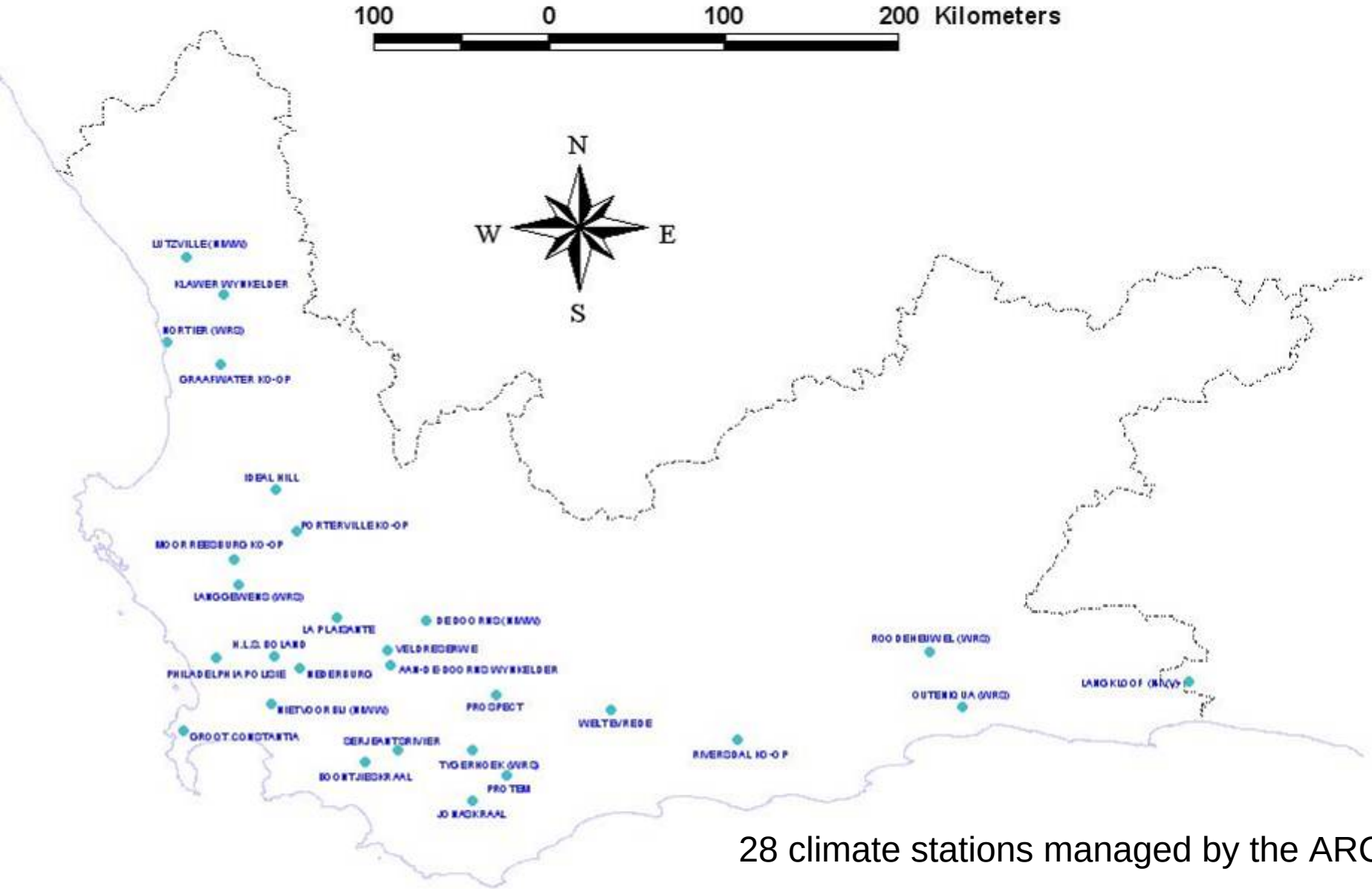
Acacia karroo has increased considerably in ephemeral river systems which in earlier times were not wooded

This particular ephemeral river also has a dense understory of Oleander

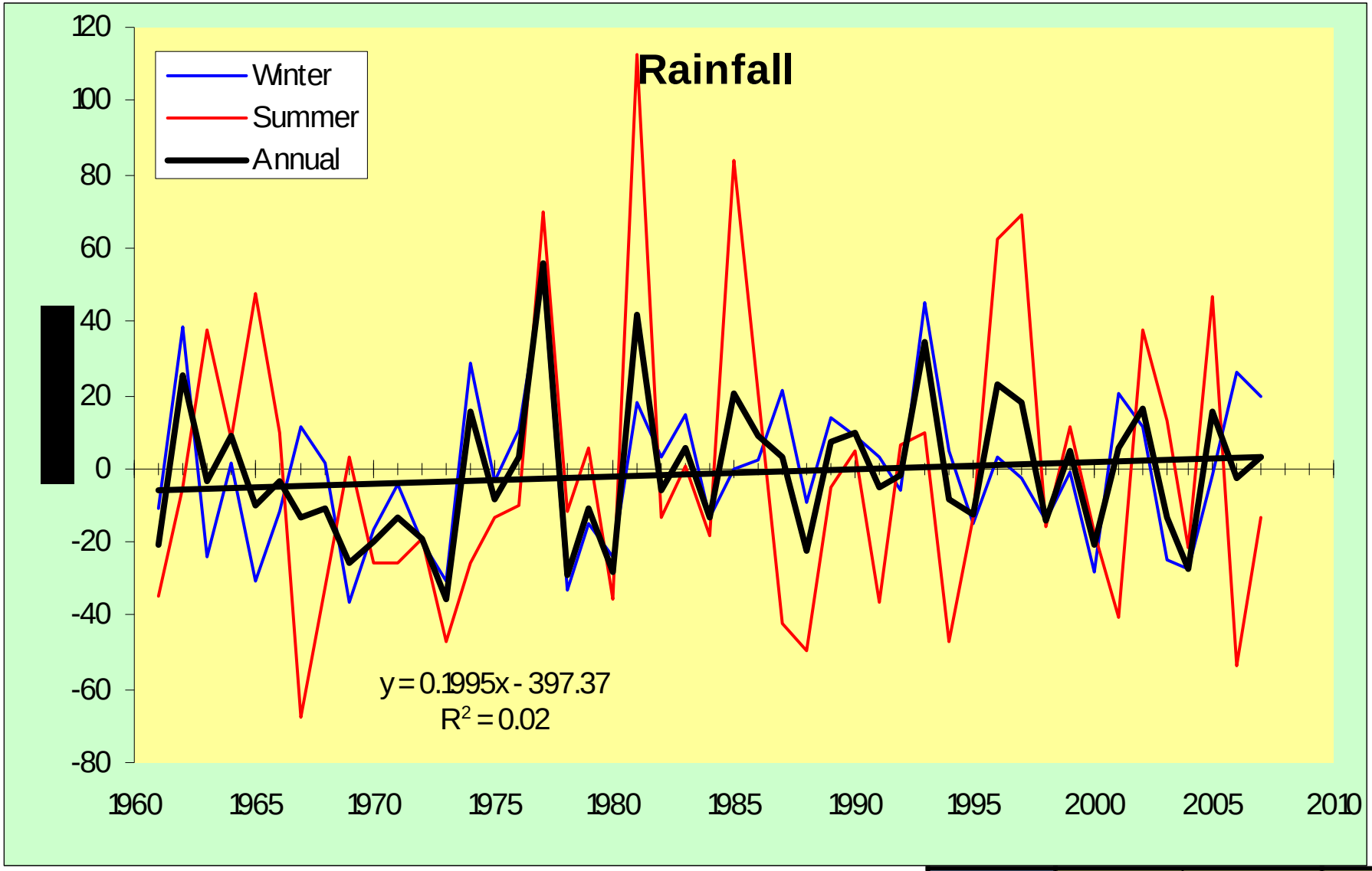


Reasons for decline include: loss in productivity (degradation); stock reduction scheme of 1960s; shift to different breeds and increase in commercialisation; active extension service and increased conservation consciousness;

BUT CLIMATE IS ALSO IMPORTANT

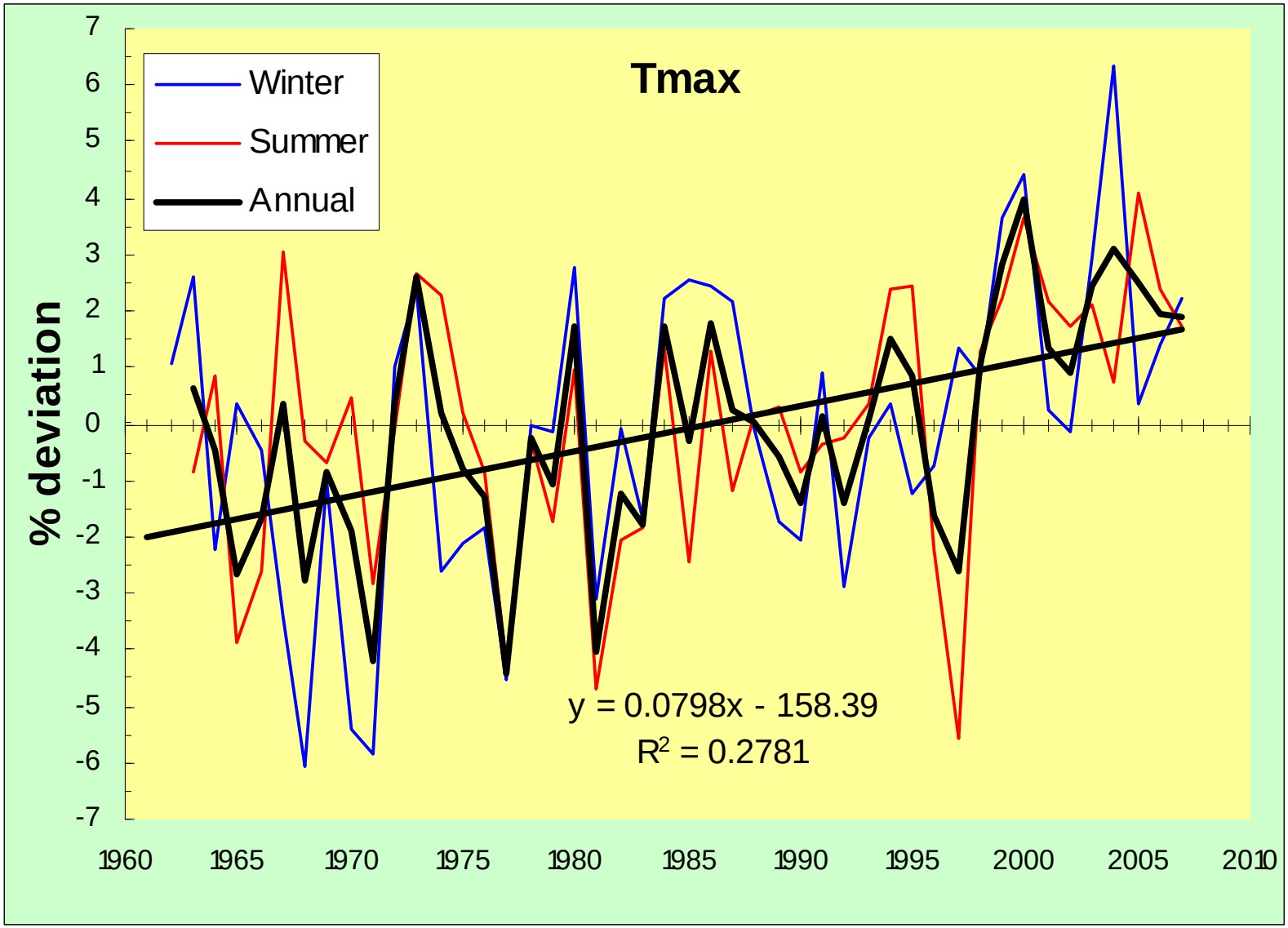


28 climate stations managed by the ARC



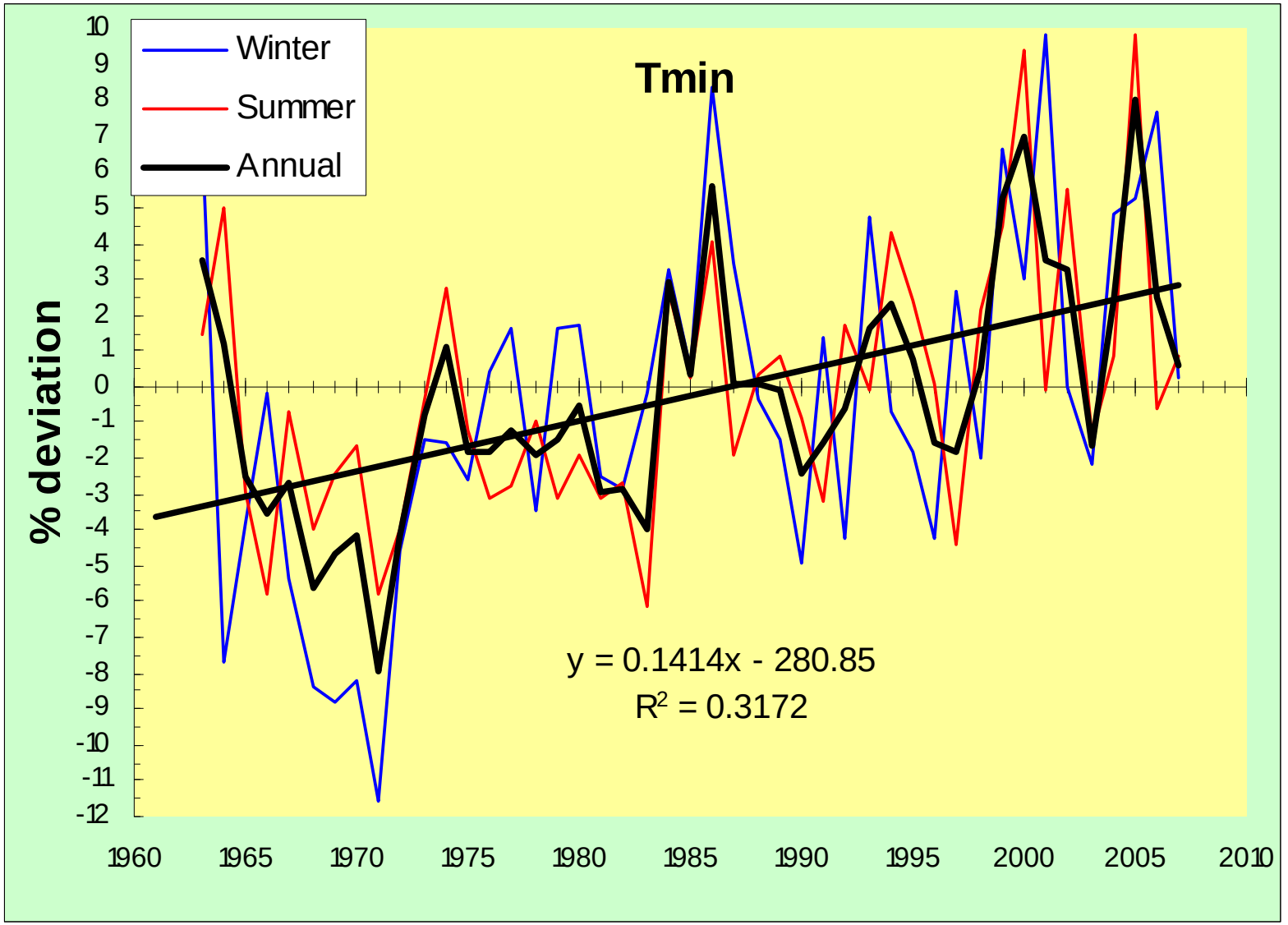
+10 mm per decade

Rainfall	Increase	Decrease	NS
Winter	4	0	24
Summer	4	0	24
Annual	4	0	24



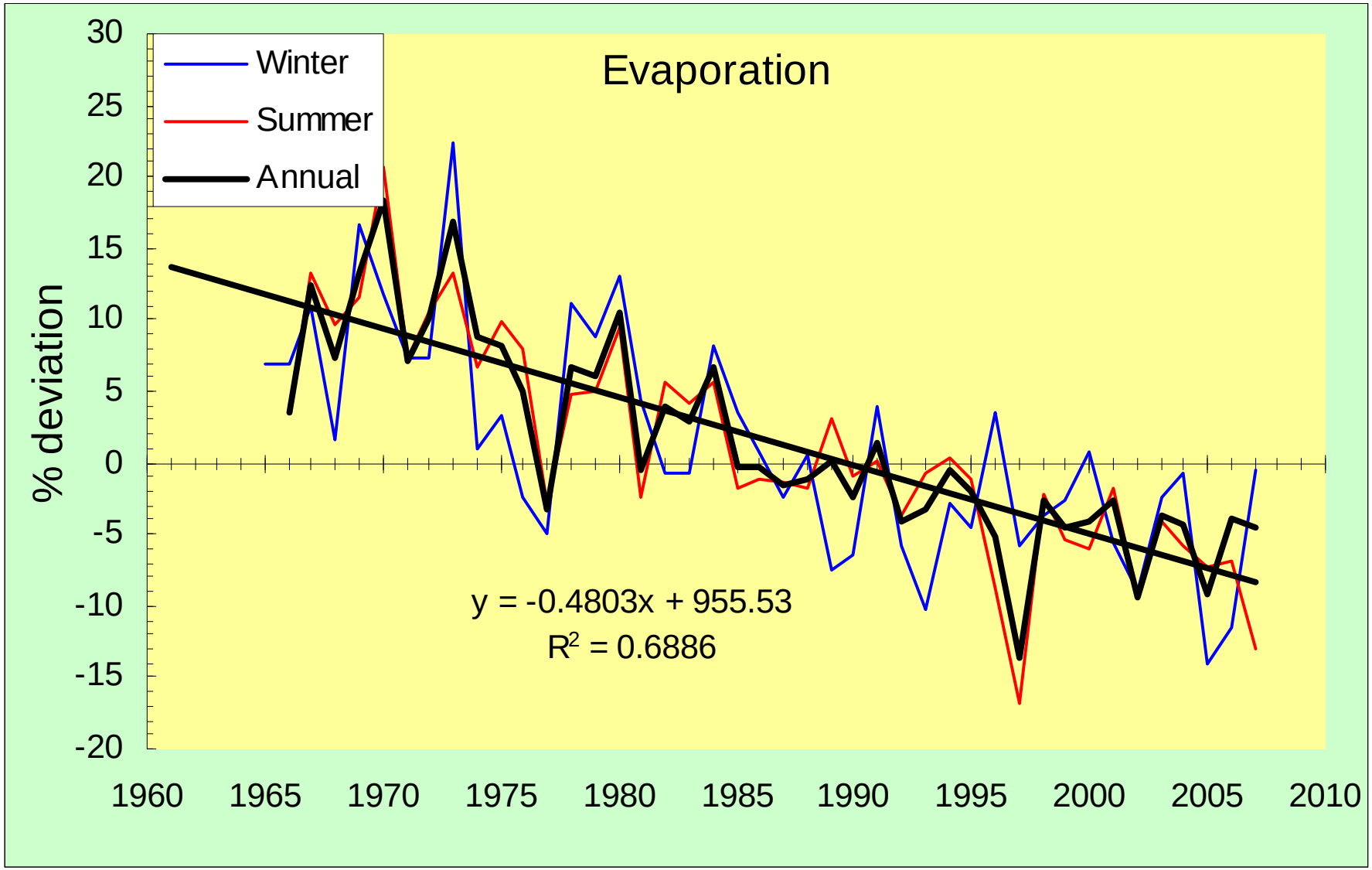
+0.23 °C per decade

Tmax	Increase	Decrease	NS
Winter	20	0	8
Summer	22	0	6
Annual	23	0	5



+0.19 °C per decade

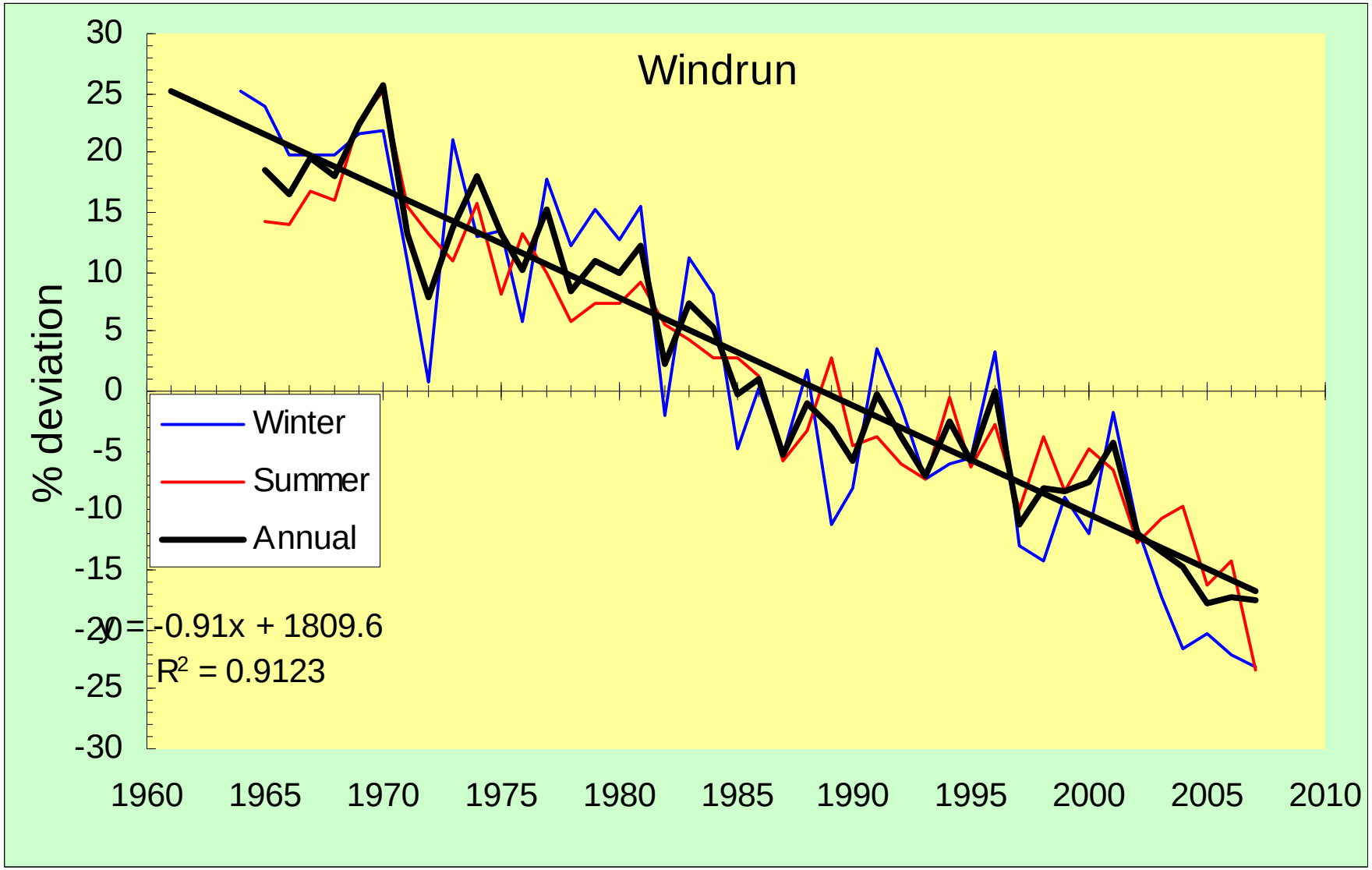
Tmin	Increase	Decrease	NS
Winter	17	0	11
Summer	21	0	7
Annual	21	0	7



25% decline since 1965

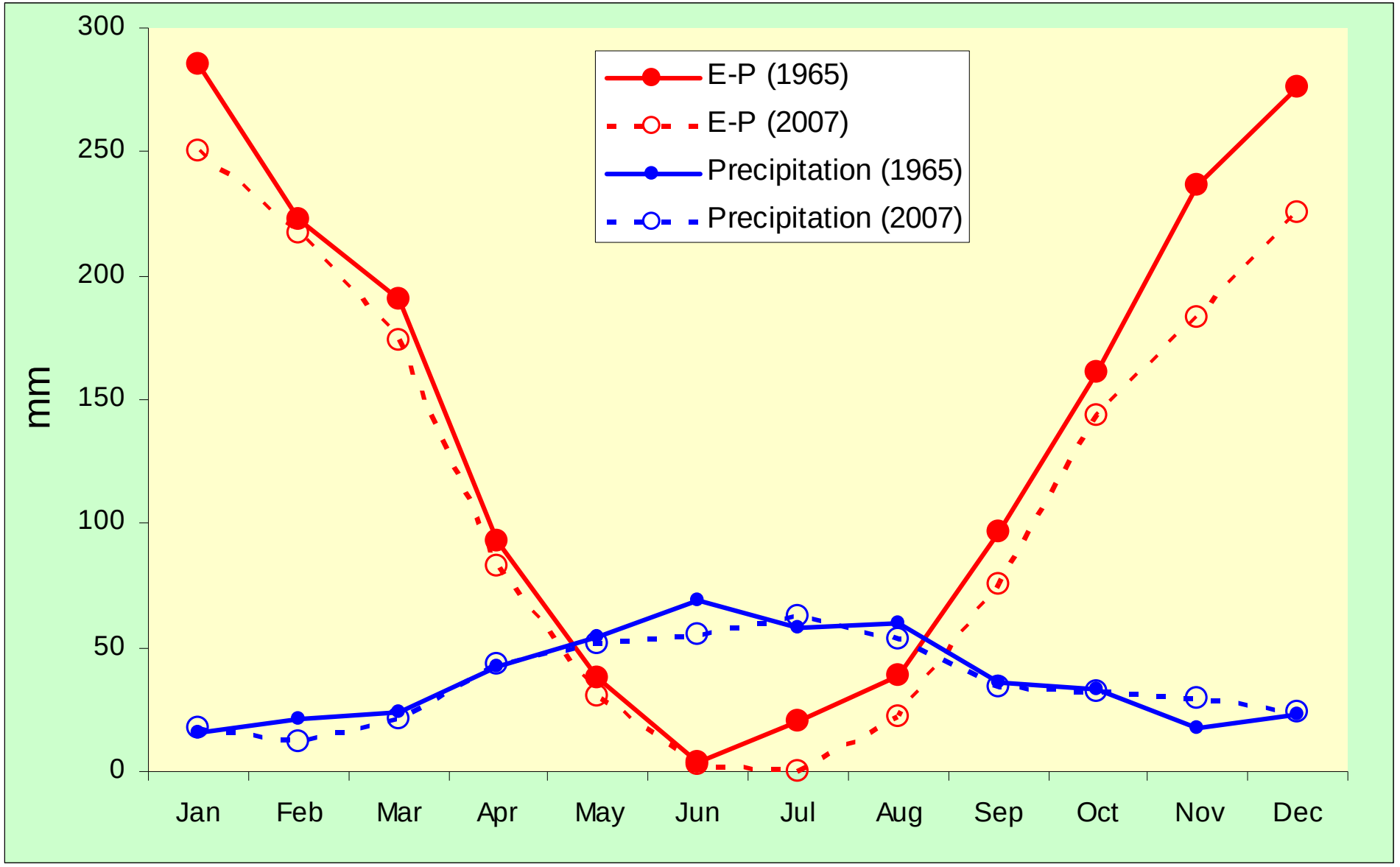
The 'Evaporation Paradox'

Evaporation	Increase	Decrease	NS
Winter	0	17	10
Summer	0	22	6
Annual	0	24	4



26% decline in wind run since 1965

Wind	Increase	Decrease	NS
Winter	0	26	2
Summer	1	25	2
Annual	1	26	1



25% decline in evaporation over last 35 years but no change in rainfall

This has tremendous implications for ecosystem water balance

SOME FINAL THOUGHTS

We have relatively good historical reconstructions of past climates for some areas of southern Africa (although perhaps we rely too much on rainfall and temperature data only);

Very weak reconstructions of historical landscapes;

Very weak understanding of historical rates of change and the timing of change in response to land use and climate impacts;

This is important since it guides management (“What are we managing for?”)

TWO FURTHER ‘PROVOCATIVE’ THOUGHTS

There is little evidence from this work and most of the images in the repeat photographic collection that the impact of climate change is “upon us”

OR

that ‘land degradation’ has occurred over large areas of the western parts of southern Africa in the last 50-100 years