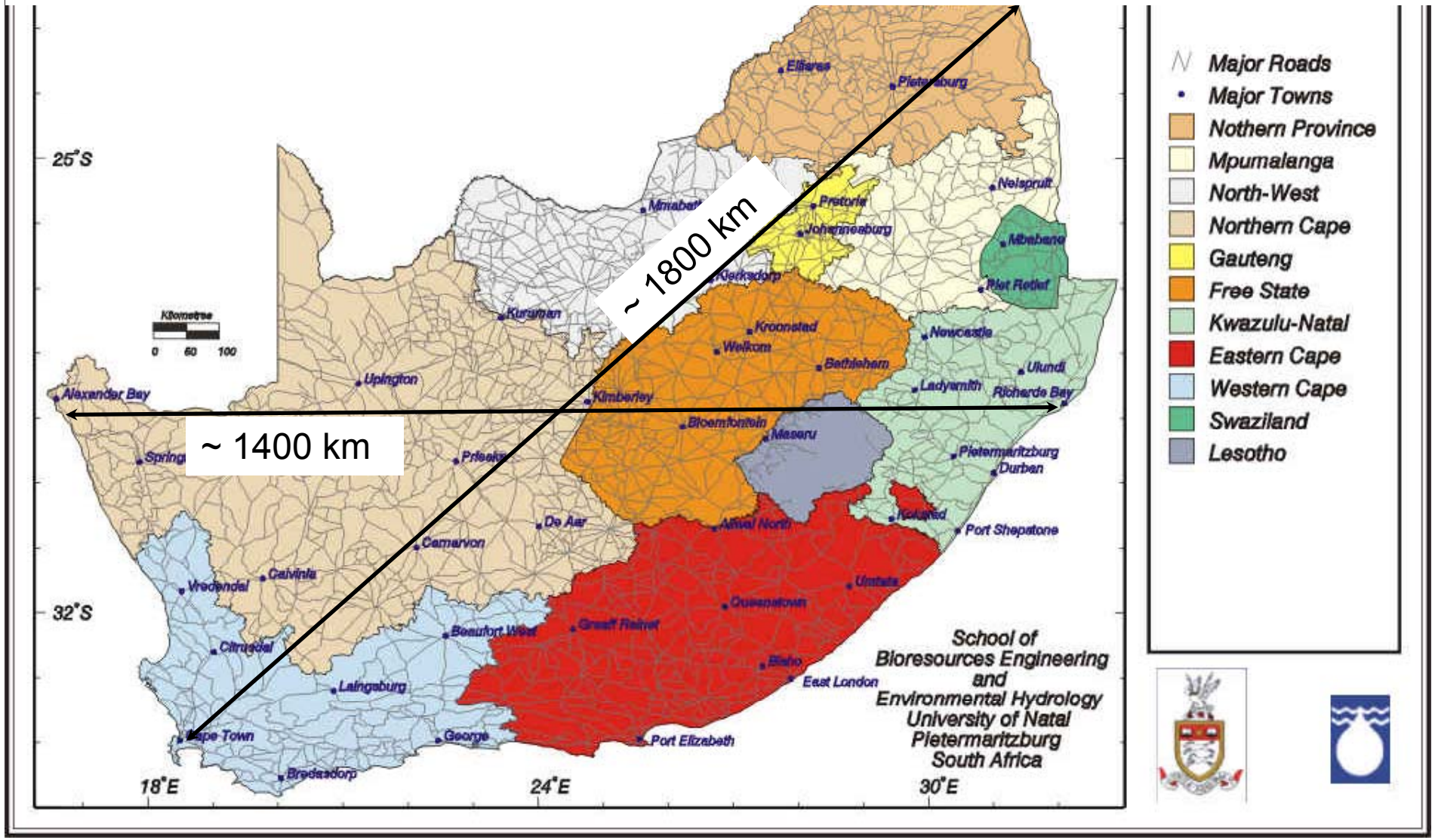
Invasive Alien Plants in South Africa
Problems & Unique Solutions

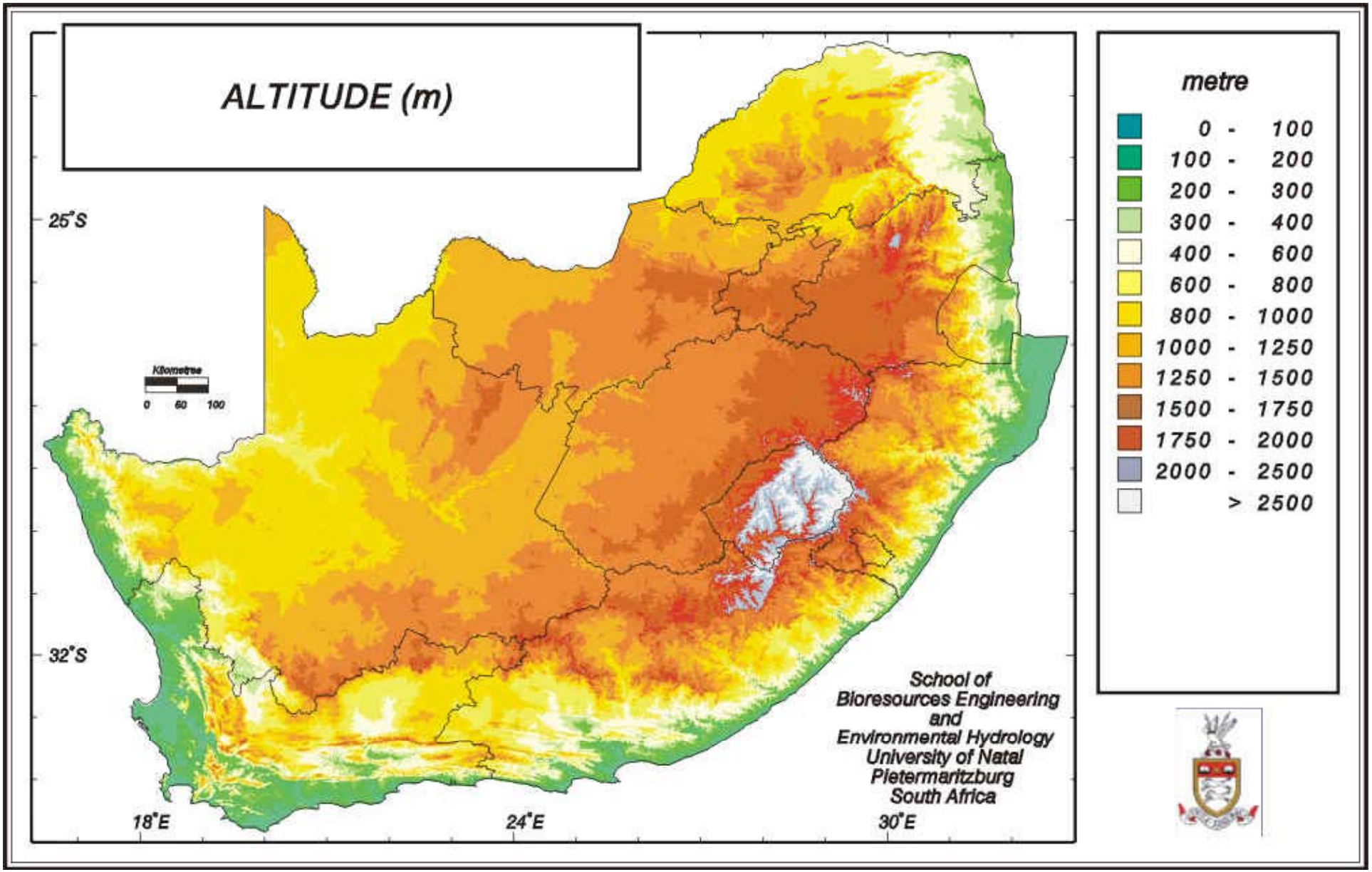
NOT FOR FURTHER DISTRIBUTION – LECTURE MATERIAL ONLY

Why is SA an interesting case study for studying alien plant invasions?

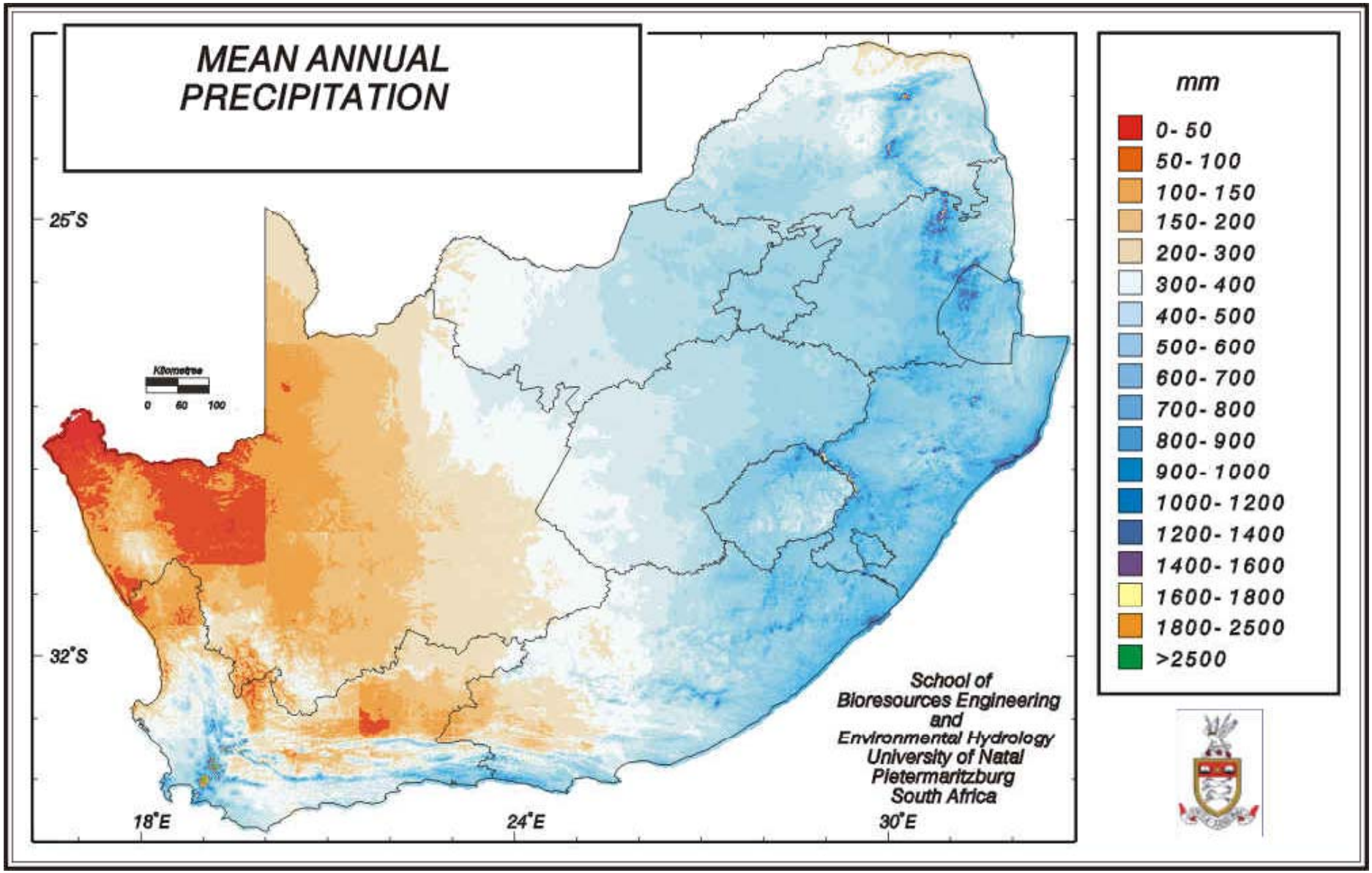
Relatively large country (1.2 million Km²)



Heterogeneous landscapes & biomes

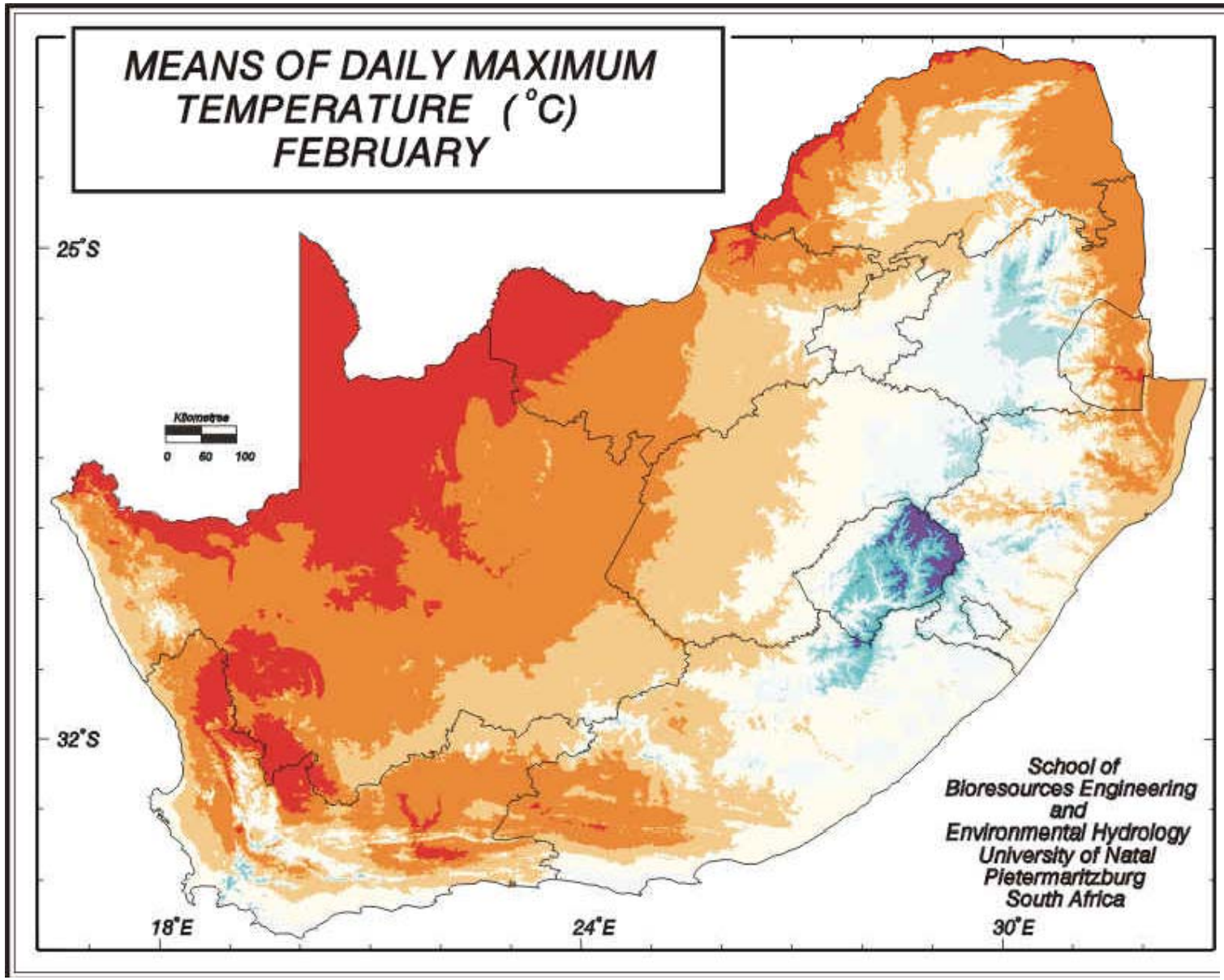


High rainfall gradient



SUMMER

Most of the country has mean daily max > 26 Deg C

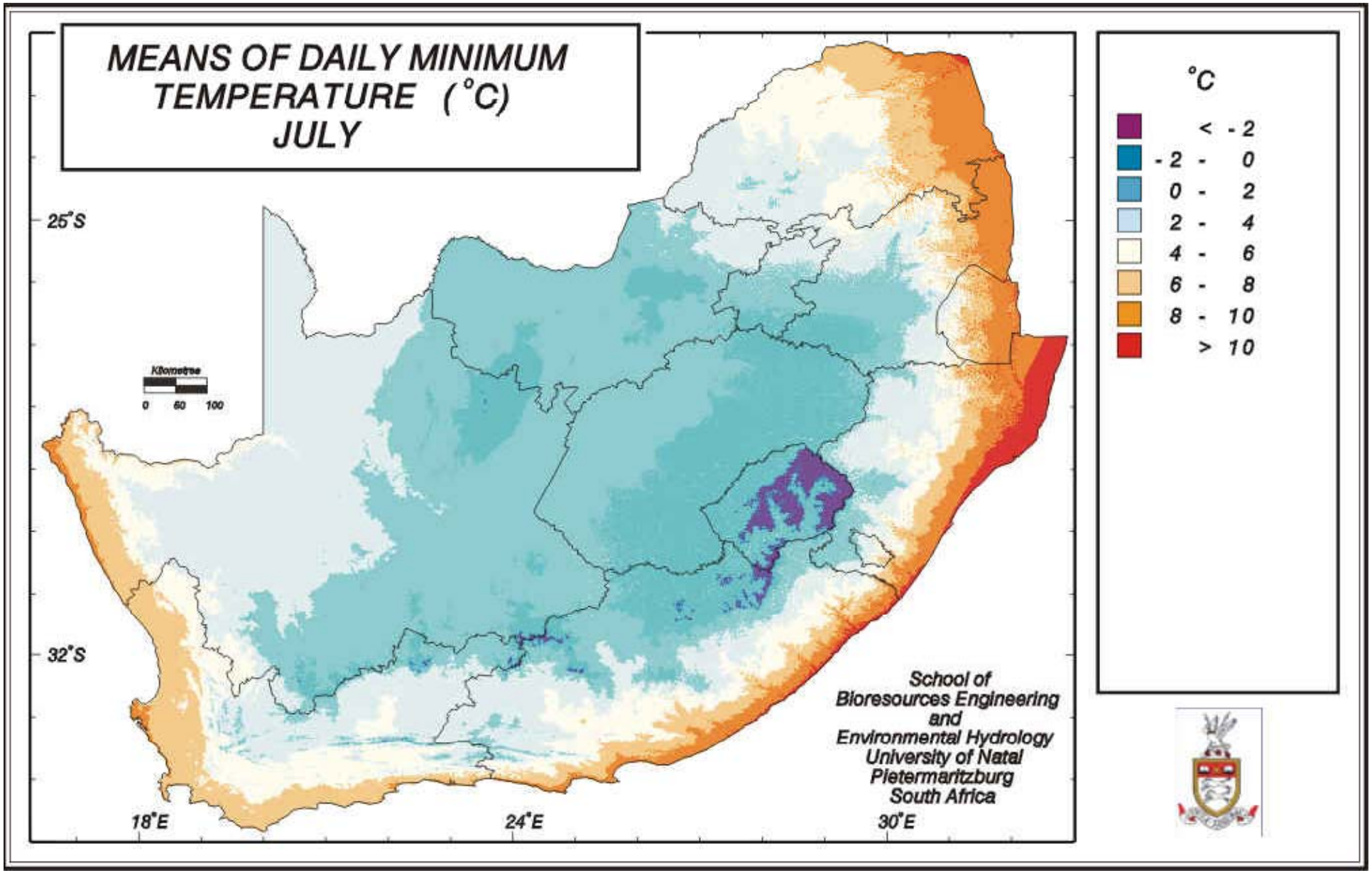


This week in Skukuza (home)

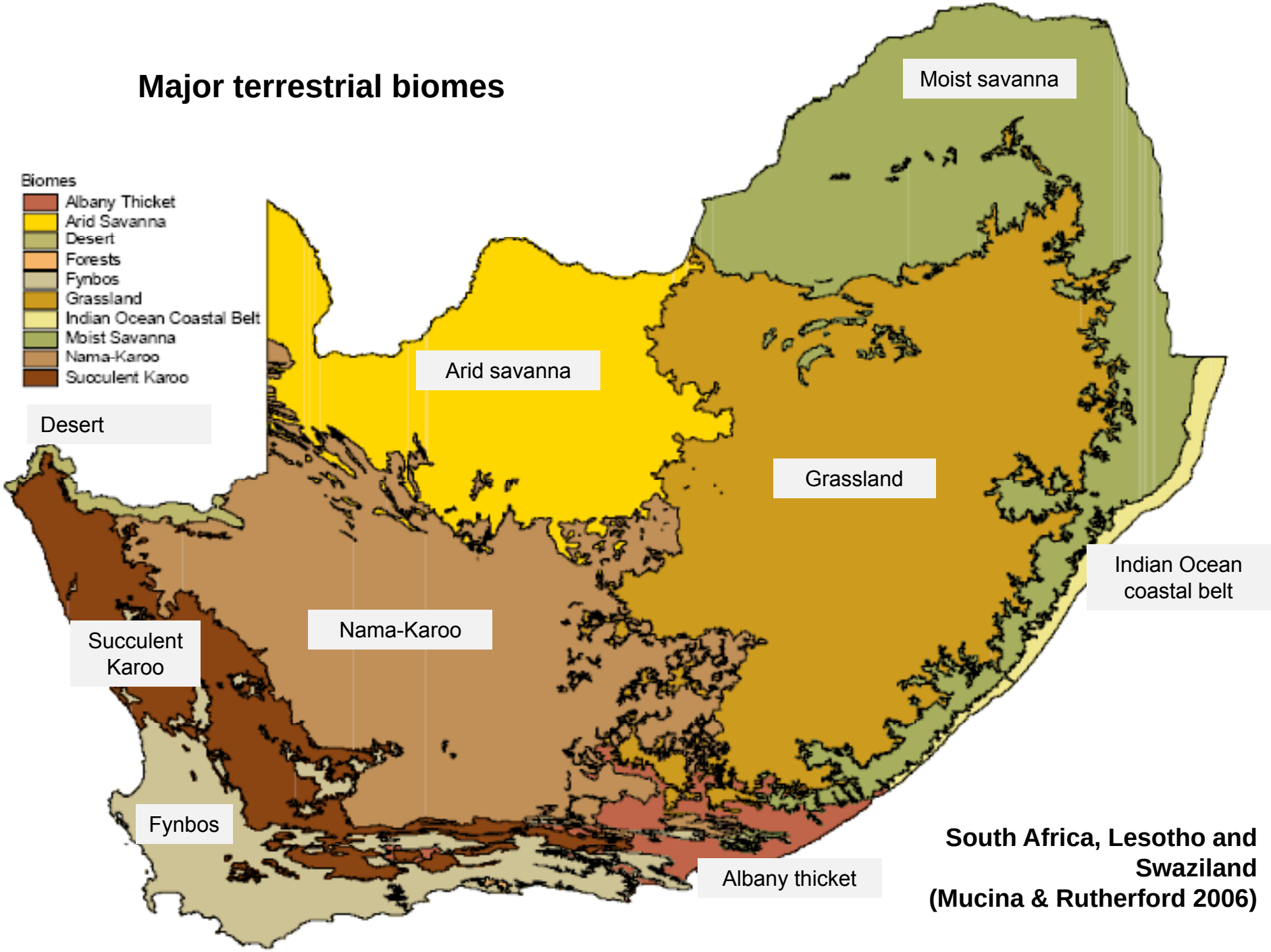
37°C
38°C
37°C
40°C

WINTER

mean daily minimum < 6 Deg C



Major terrestrial biomes



South Africa, Lesotho and Swaziland (Mucina & Rutherford 2006)

- Large number invasive species

KEY STATISTICS [plants]:

Introduced into South Africa:
- 750 tree species
- 8000 herbaceous species

- 1 000 species naturalised
- ~200 invasive

Of the 200:
- 84 species introduced from South and Central America
- 14 from North America
- 30 from Australia
- 29 from Europe
- 36 from Asia

- 45% of species from Australia have become important pests

All invasive species in SA

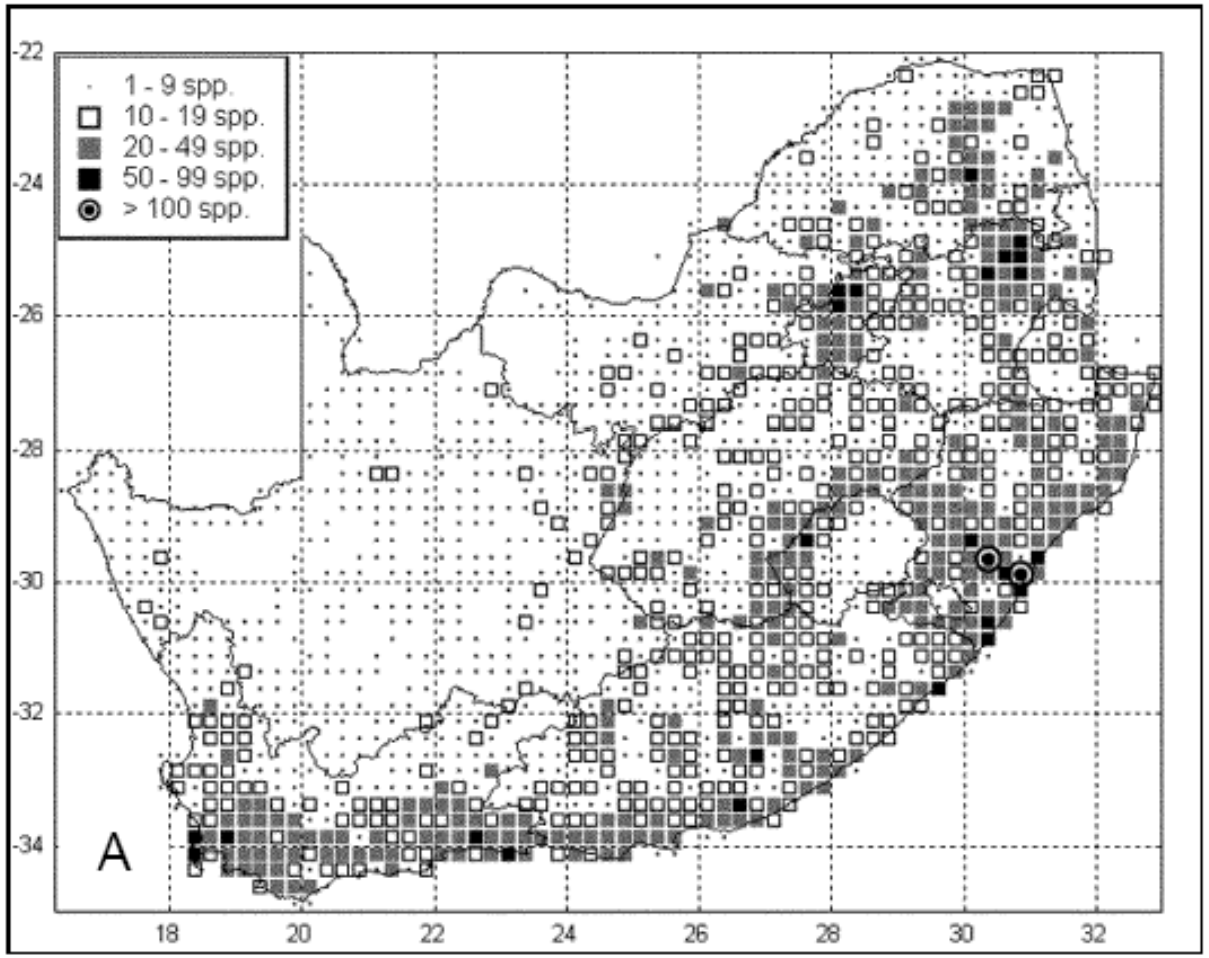
Group	# introduced	#invasive	Major pathways
Mammals	no estimates	6	Deliberate introductions for agriculture & pet trade; some accidental
Birds	no estimates	6	Deliberate introductions for agriculture & pet trade; some accidental
Reptiles & Amphibians	280	1	Pet trade; some accidental
Freshwater	>60 fish & invertebrates	58	recreational fishing; inter-basin water transfer; aquaculture
	23 aquatic plants	13; 5 serious problems	Ornamental

Van Wilgen & Richardson (2010)

- Large area of SA invaded !!

South African Plant Invaders Atlas

- Distribution, abundance & habitat types
- Commenced in 1979 completed in 1993
- Contains almost 60 000 locality records
- Approximately 600 naturalized alien plant species

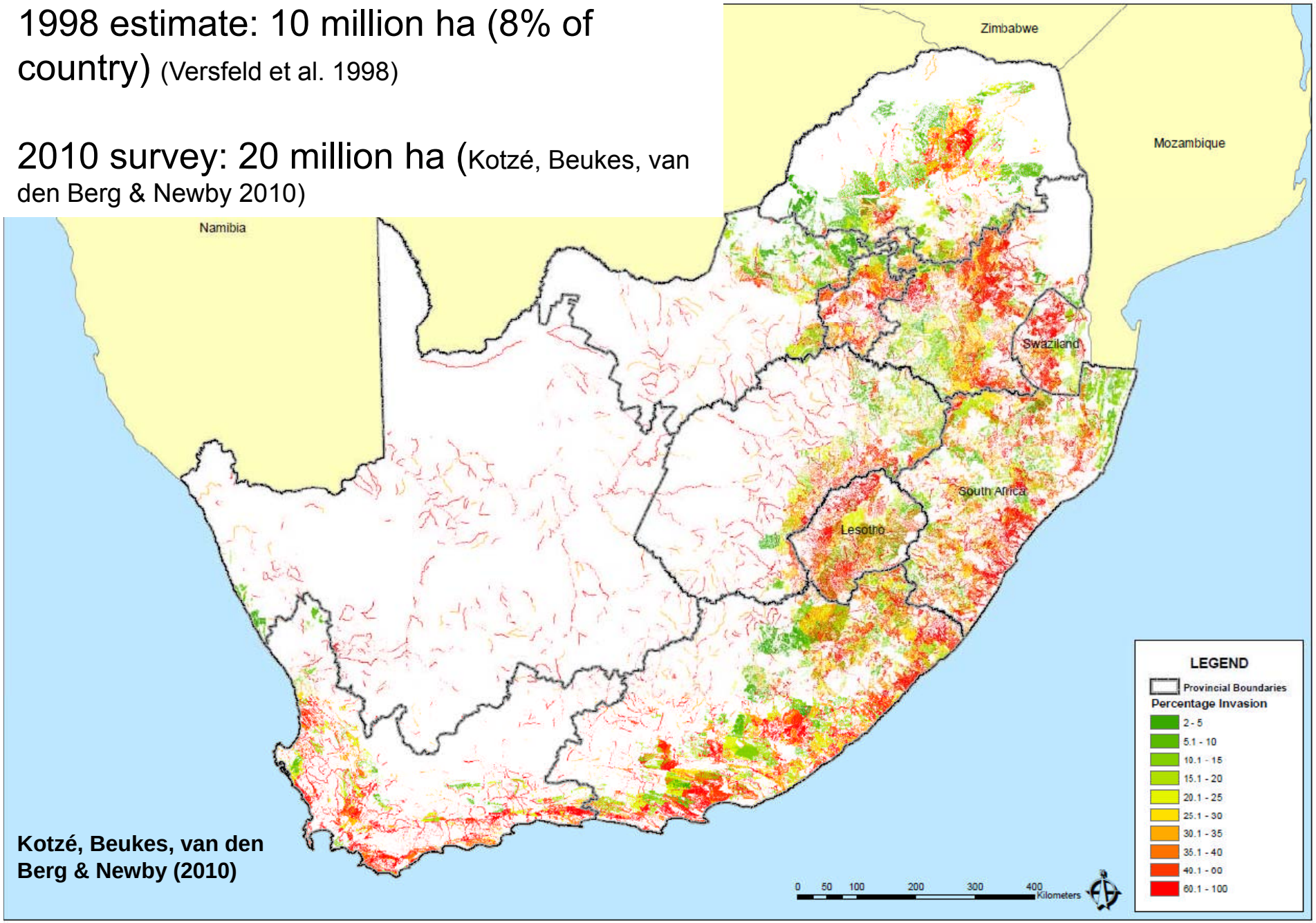


IAP species / quarter-degree square

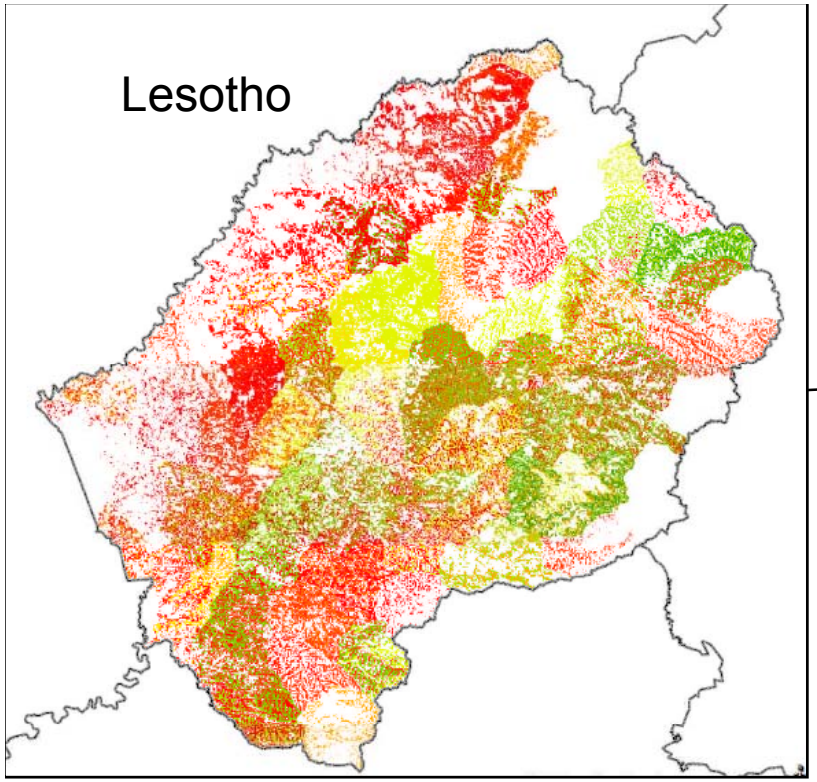
Henderson (2007)

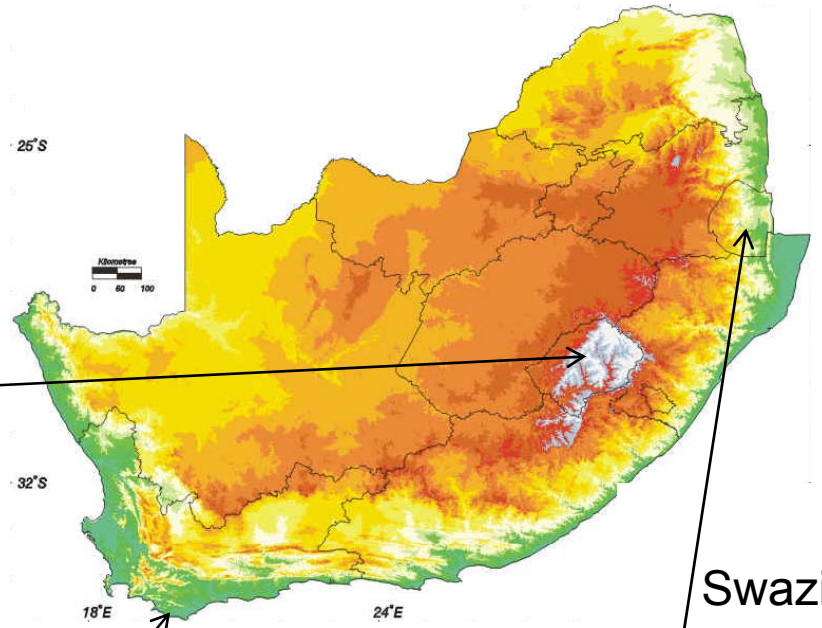
1998 estimate: 10 million ha (8% of country) (Versfeld et al. 1998)

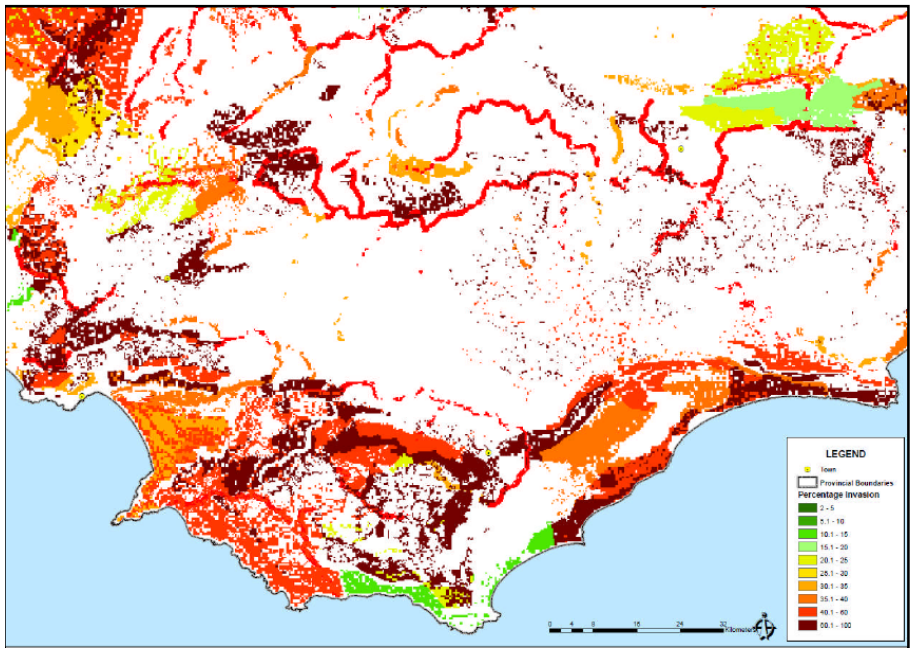
2010 survey: 20 million ha (Kotzé, Beukes, van den Berg & Newby 2010)



Kotzé, Beukes, van den Berg & Newby (2010)

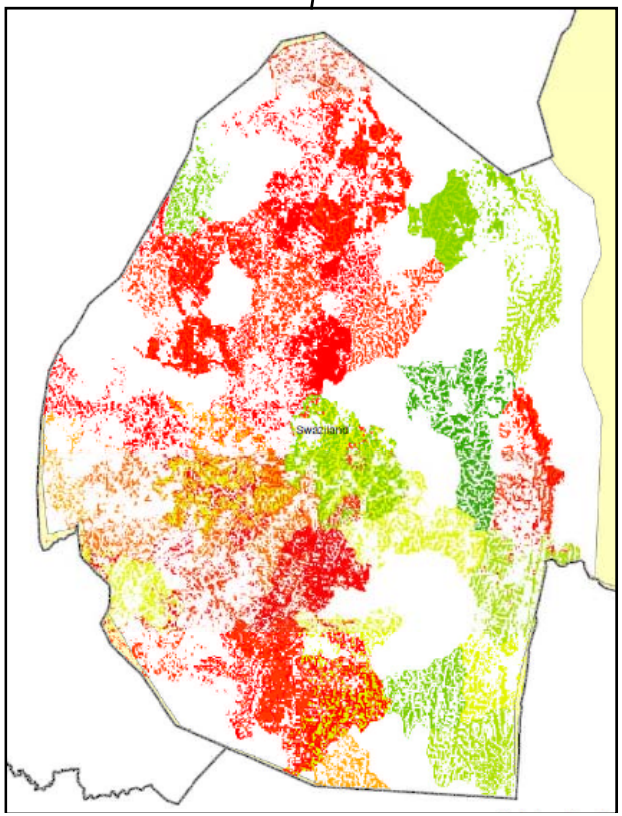


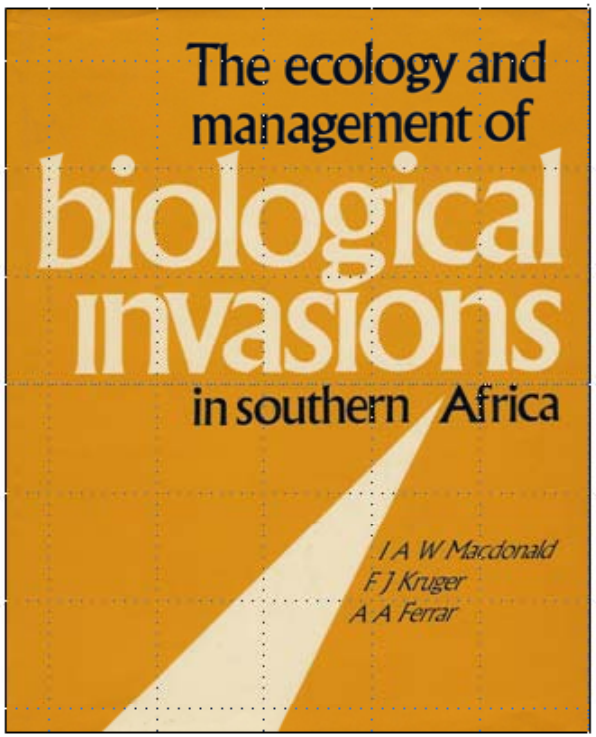


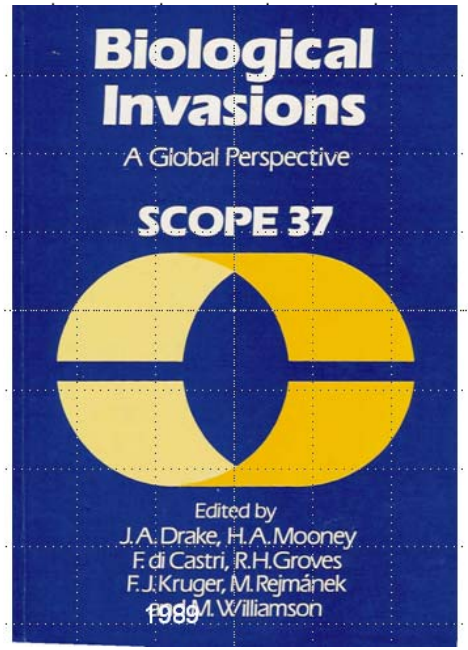


Agulhas plains

Swaziland







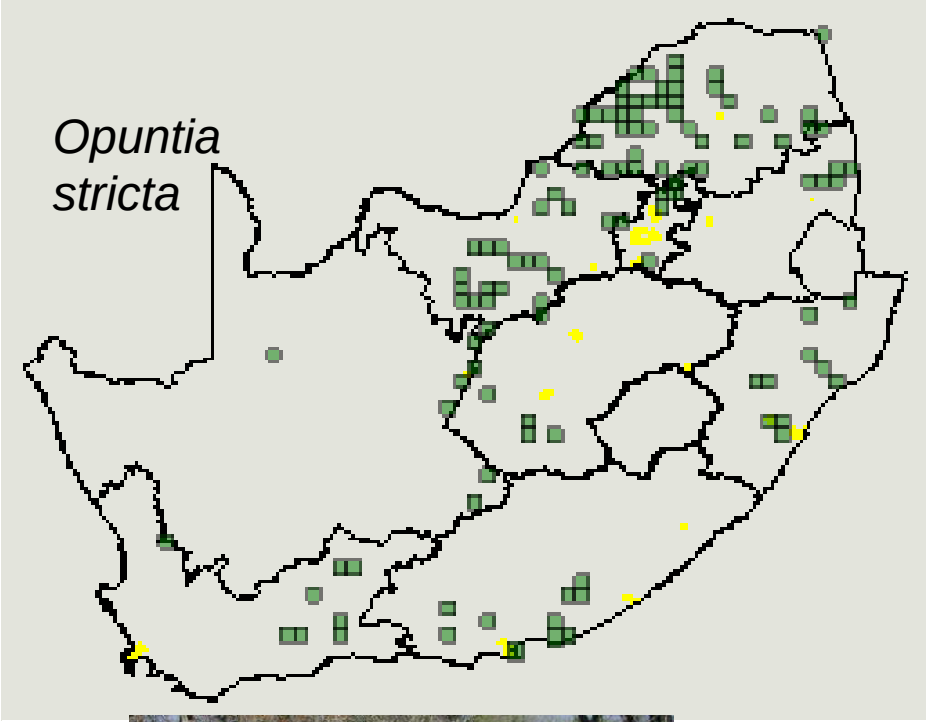
South Africa:

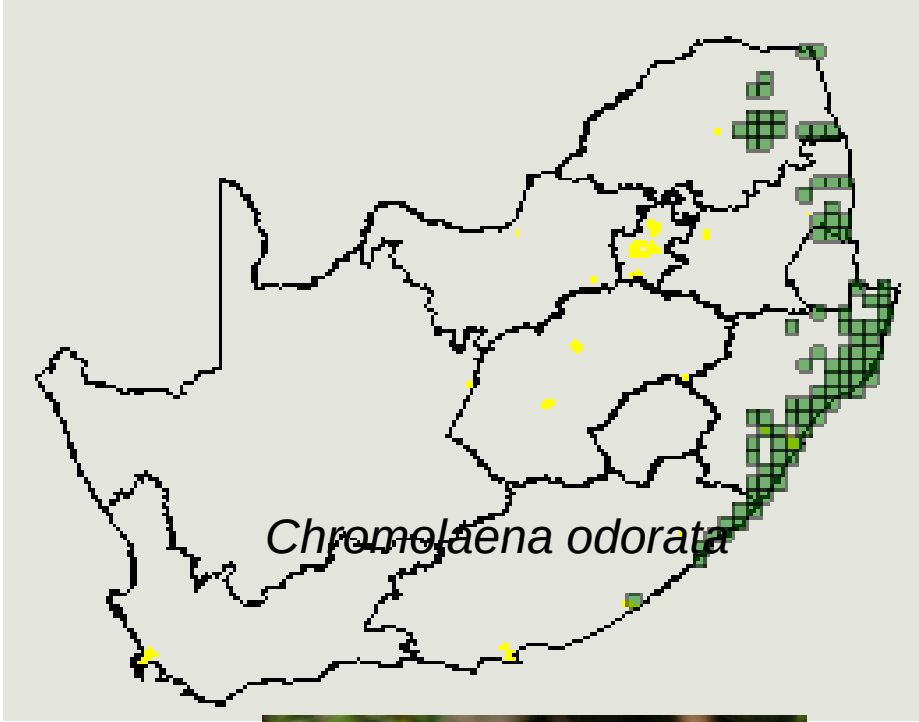
- Relatively good scientific understanding of plant invasions

- Role in invasion sciences: SCOPE programme 1980s (Macdonald et al 1986, Drake et al 1989)

- History of management efforts

- SA microcosm of world- *ratio of rich to poor about same as world average* (not common in one country)- accentuates the need for equitable solutions

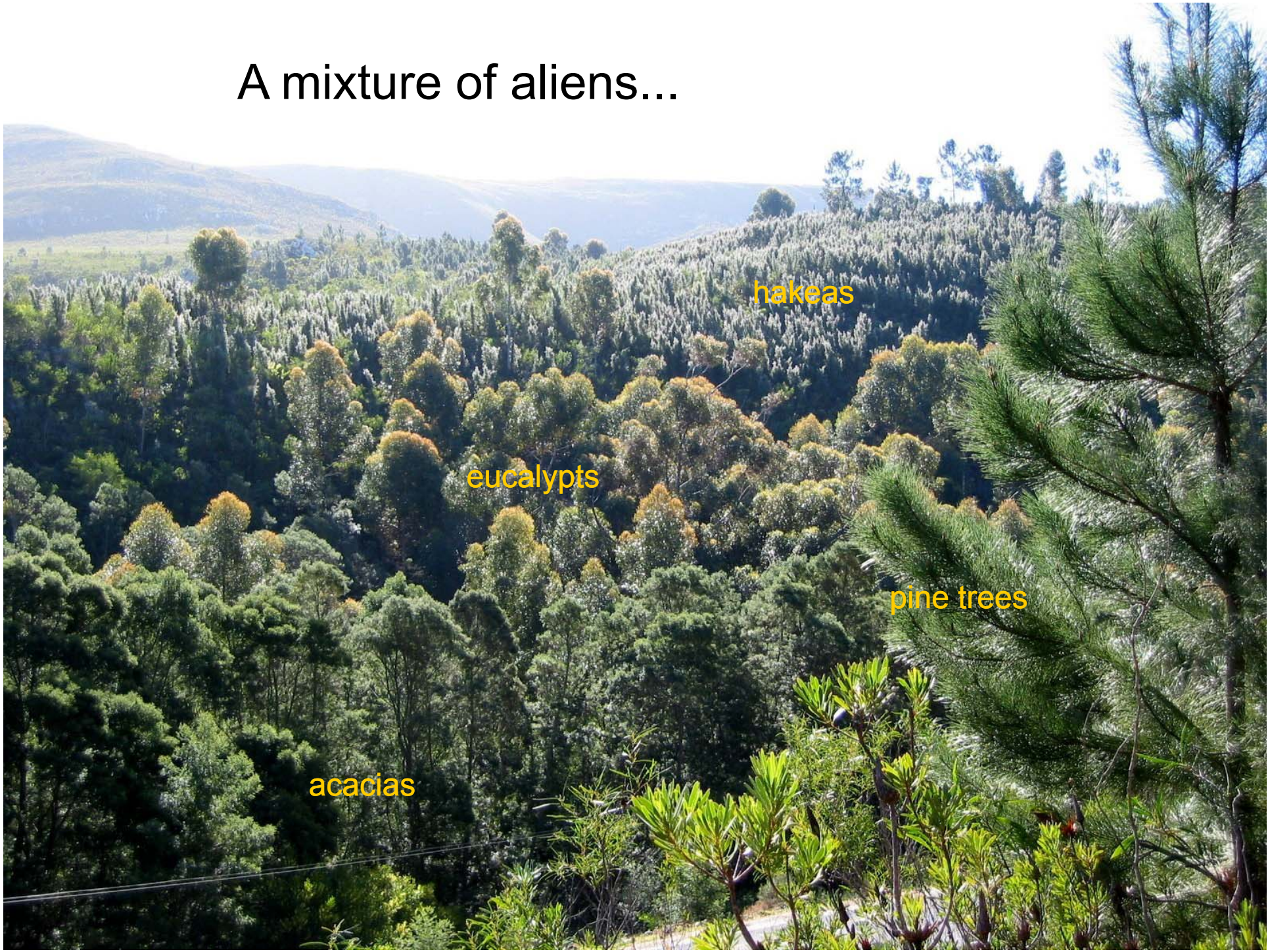




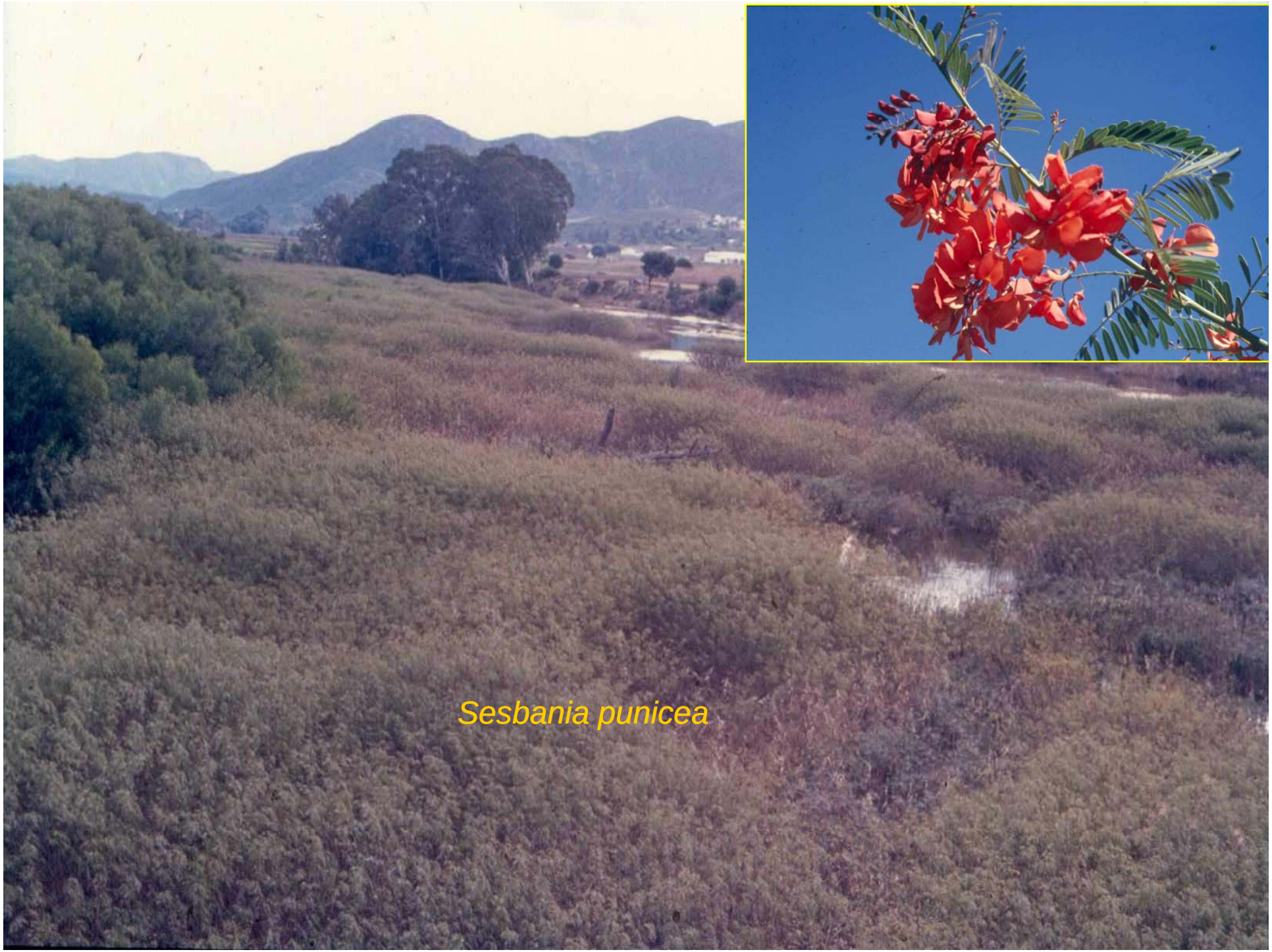
Henderson (2007)

hakea
pine trees
eucalypts and acacias
Fynbos- globally recognised centre of endemism

A mixture of aliens...



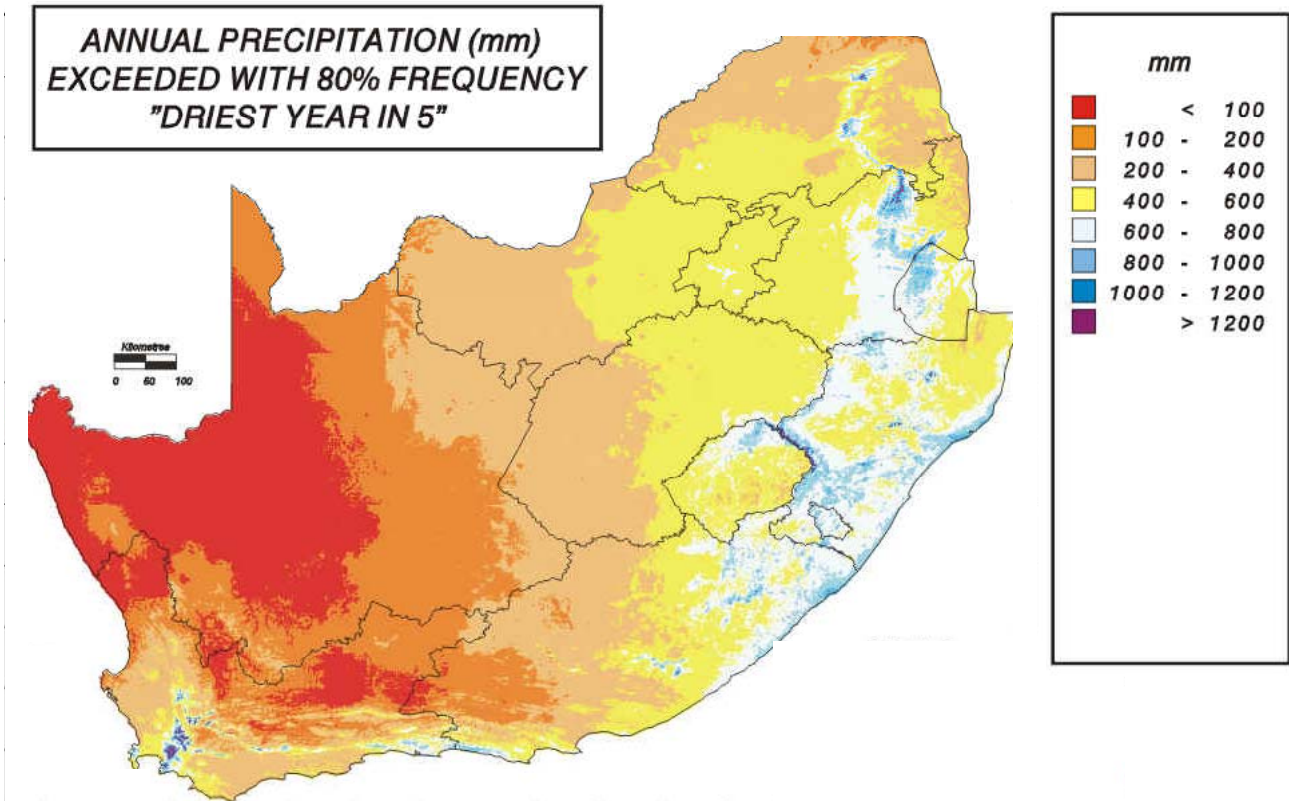
eucalypts
acacias


Sesbania punicea

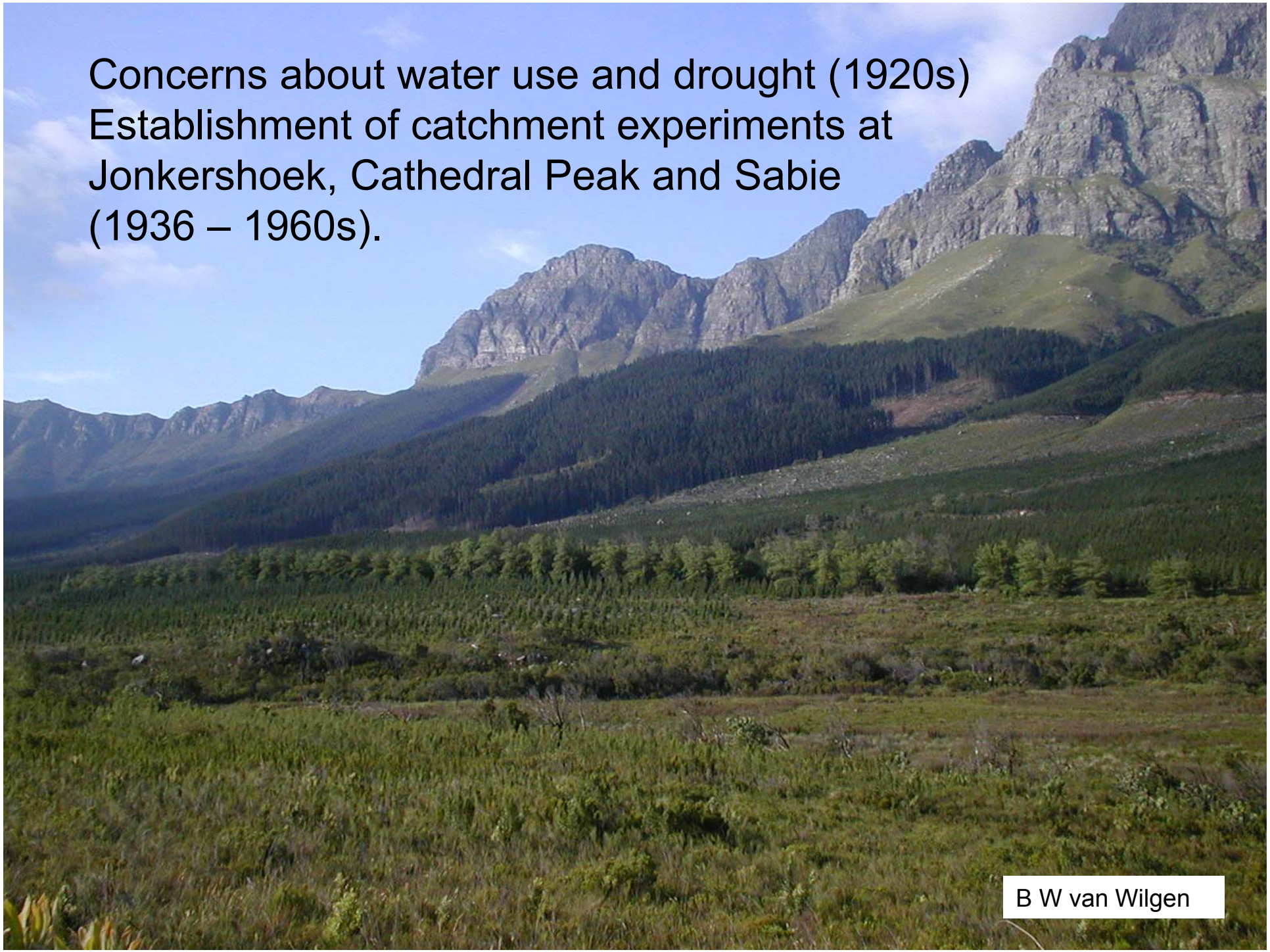
Impacts

- Biggest impact:

Loss of water run-off



- Not all IAPs replacing native vegetation use more water than invaded vegetation
- But, trees use more water than grasslands & shrublands (large portion SA biomes (very little indigenous forest)
- Seasonally dormant vegetation replaced by evergreen trees
- Current estimate 10 million ha use 3.3 billion m² water in excess of what natural vegetation would (~7% SA water runoff)


Concerns about water use and drought (1920s)
Establishment of catchment experiments at Jonkershoek, Cathedral Peak and Sabie (1936 – 1960s).
B W van Wilgen

Impacts of pine plantations – surface water runoff

Afforestation reduces surface water runoff

- 82% reduction in stream flow 20 years after afforestation of grassland with *Pinus patula*

- 55% reduction in stream flow 23 years after afforestation of fynbos with *Pinus radiata*

BW van Wilgen

Biodiversity

- Impacts poorly understood
- Most studies small scales and most in fynbos (Mediterranean type ecosystem).
- Plant related studies have indicated:
  - reduced abundance and diversity of plants
  - increased biomass
  - change in litter fall
  - nutrient cycling
- Ants:
  - Change in composition of communities
  - domination by single species
  - change seed dispersal
  - seeds not stored underground - protects from fire & loss in germination
- Beetles:
  - Prosopis change beetle numbers (especially large and rare species)
- Birds:
  - changes in bird habitat
  - loss of frugivoes and insectivores
- Crocodiles:
  - *Chrololaena odorata* in riparian and wetlands leads to altered crocodile sex ratios due to reduced soil temperatures

Changes fire regime

Invasion of grassland by tall trees increases amount of fuel that can burn significantly

•From: Fuel loads of grass and shrubs 0.3 – 4 tonnes / ha

•To: Invaded trees increase by 10-25 tonnes

•Ecosystems in SA resilient to fire (evolved with fire) and regular burning

• But increase fuel loads, increased intensity = range of negative effects

•Physical damage to soil = erosion
E.g. 6 tonnes / ha in *Pinus* vs 0.1 tonnes / ha in fynbos.

Human health

- Very little known in SA
- *Parthenium hysterophorus*
  - dermatitis,
  - toxic to animals,
  - crop loss due to allelopathy
  - direct competition
- *Lantana*
  - photosensitivity in cattle

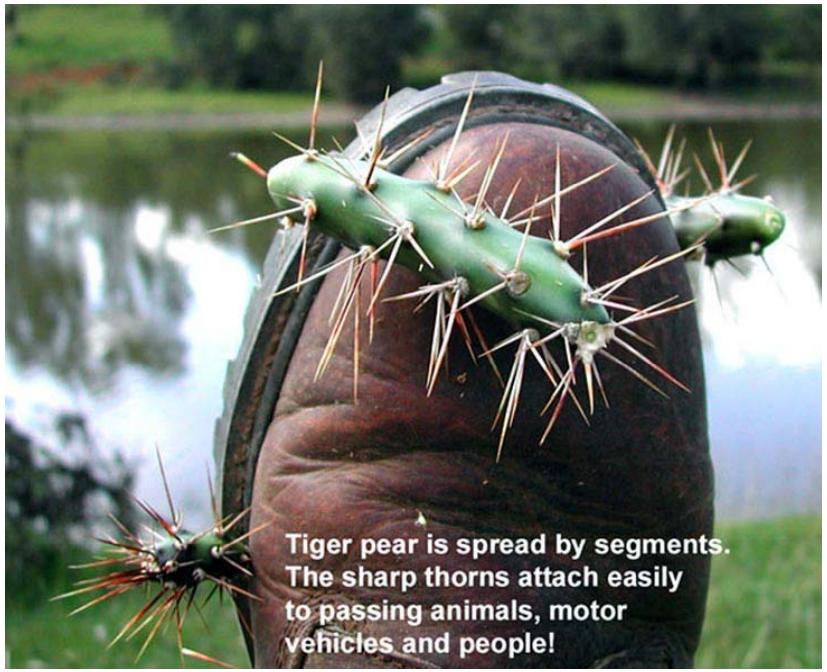
Impacts freshwater related fauna

- 30 IUCN listed fish in SA > 16 have IAS listed primary threat
- 3 more have IAS as secondary threat
- alien fish almost outnumber indigenous fish

- Alien trees lead to local extinction of shade intolerant dragonflies and damselflies
- Removal of alien trees led recovery of species thought extinct.

Oreochromis niloticus invading Limpopo river – hybridises with indigenous *O. mosambicenses*

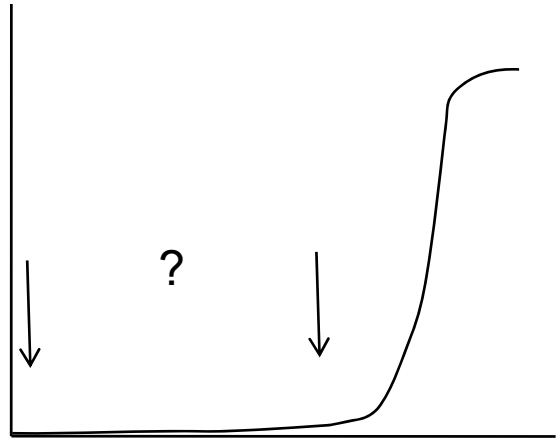
Agriculture



Grazing resources:

- Reduced access, or replacement of palatable grazing
- Injure – tongues, mouth & feet.
- May become lame - sores & abscesses as barbed spines adhere to different parts of their bodies
- Jointed cactus (*Opuntia aurantiaca*) = 1.9 million ha
- estimate impact to ~R280 /ha /year (CZK630)
- = loss ~R520 million / year grazing potential

Future impacts??

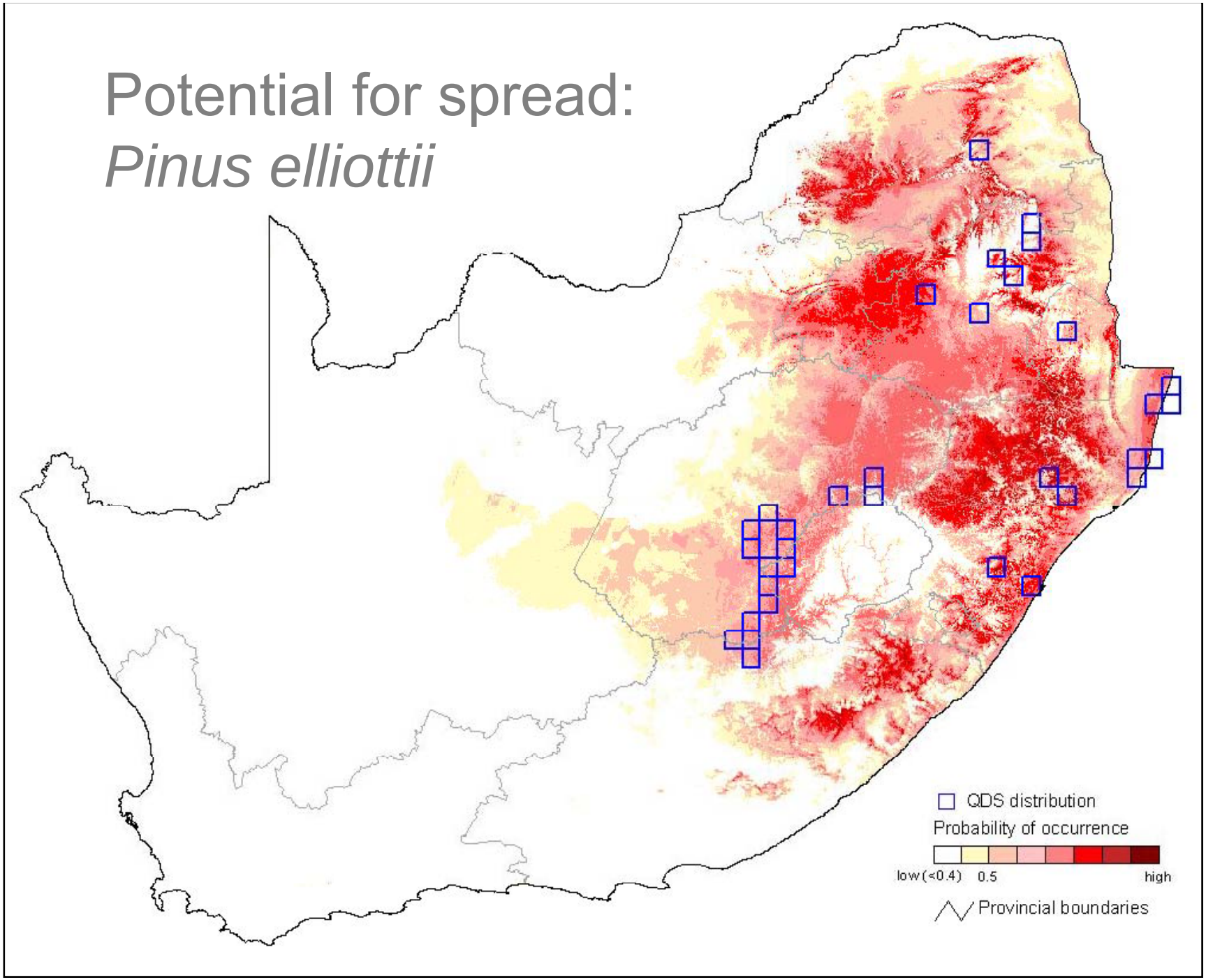


- **Current trends - substantially worsening situati**
- Many species only established now – **many still m**
- Long lag phase - **difficult to predict which species & when**
- Modeling **potential water loss**- current estimated loss of water runoff (7%) & 56 IAPs
  - if they were to reach their full potential, reductions could be up to **8 times higher**.
- Current **reductions** in **grazing** of 1% could **increase to 71%**

- Accepting model errors & assumptions > **significant & potentially massive impacts**

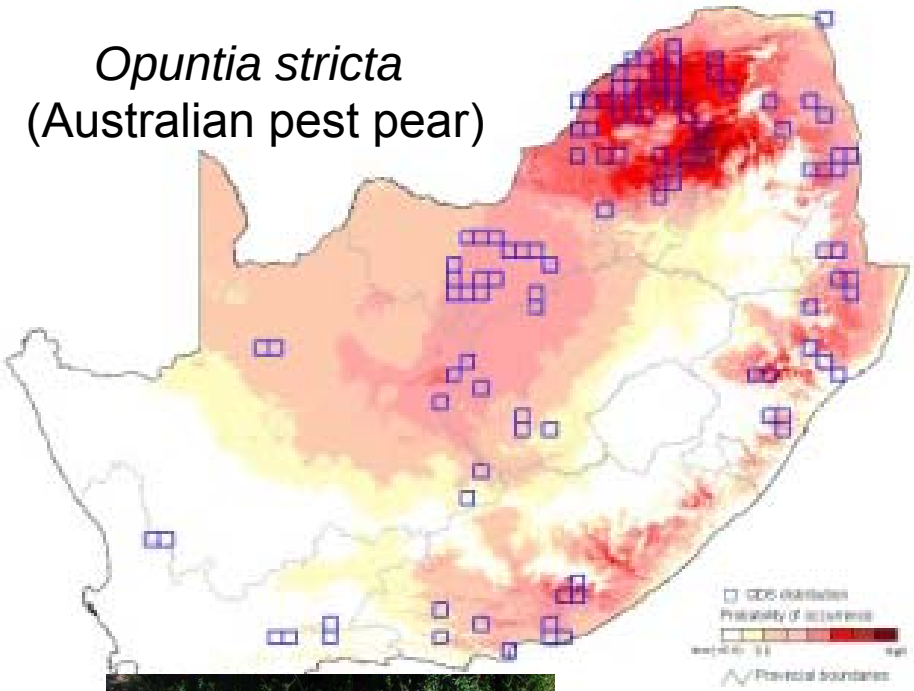
- Therefore: already large area, large impacts;
  - **relatively low compared to potential**

Potential for spread: *Pinus elliottii*

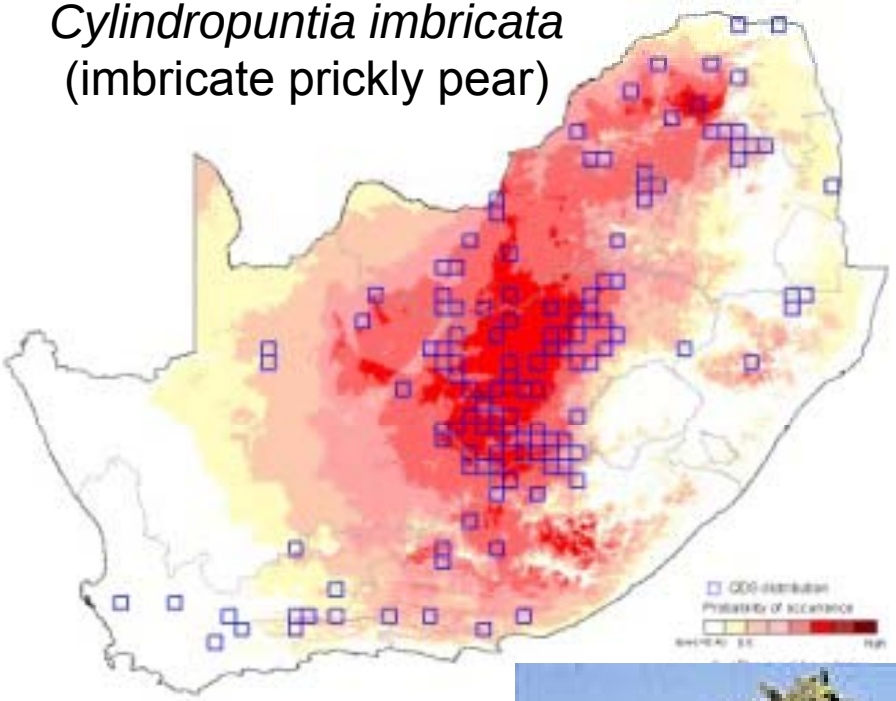


Modeling potential distribution

Opuntia stricta
(Australian pest pear)



Cylindropuntia imbricata
(imbricate prickly pear)



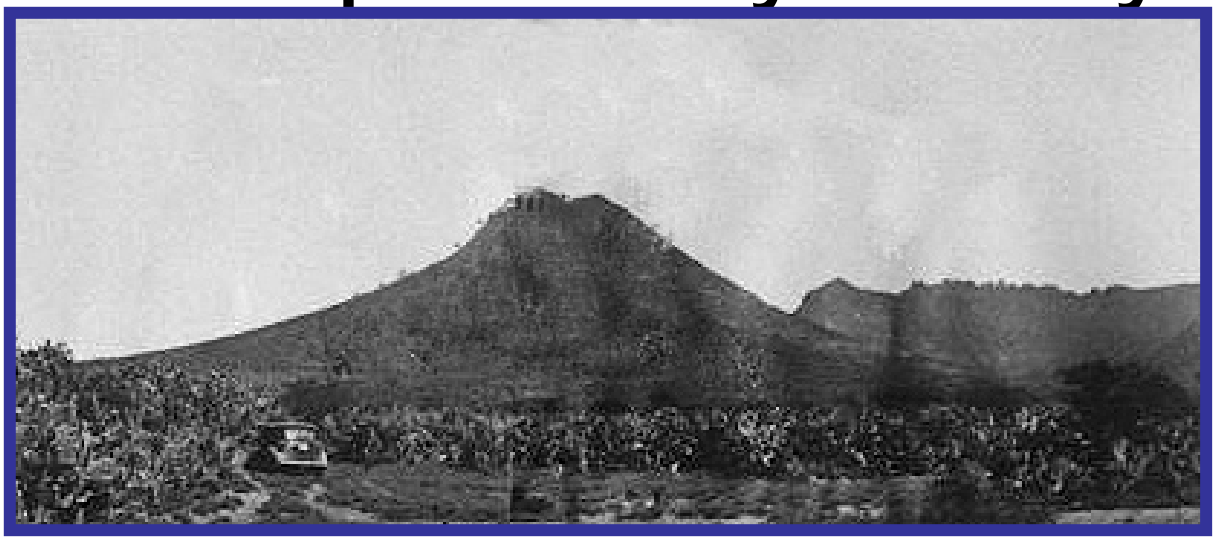
Rouget et al (2004)

Early control efforts

- Peter MacOwen (**1888**) and Rudolph Marloth (**1908**) – concerns IAPs will replace indigenous vegetation
- Wicht (**1945**) **'one of the greatest, if not the greatest, threats to which the Cape vegetation is exposed, is suppression through the spread of vigorous exotic plant species**'.
- Control in 1st half 20 century erratic and uncoordinated > little to no effect
- Some efforts later better documented, still lacked ecological understanding of IAPs & lack of follow-up > wasted efforts and money.
  - E.g. Macdonald (1989) showed that of the first 47 years efforts on Cape Peninsular 'almost totally ineffective for the first 35 years.
- Biological control also started at early stage; met with good success
  - 1913 *Cactoblastis cactorum* released on *Opuntia moncantha*
  - 1936 1913 *Cactoblastis cactorum* released on *O. ficus-indica*
- Not well organized until 1970s, resulted in 22 agents released in 70s, 30 in 1980s, 33 in 1990s.

Opuntia ficus-indica – Eastern Cape Province

Descriptions by Pettey (1948)

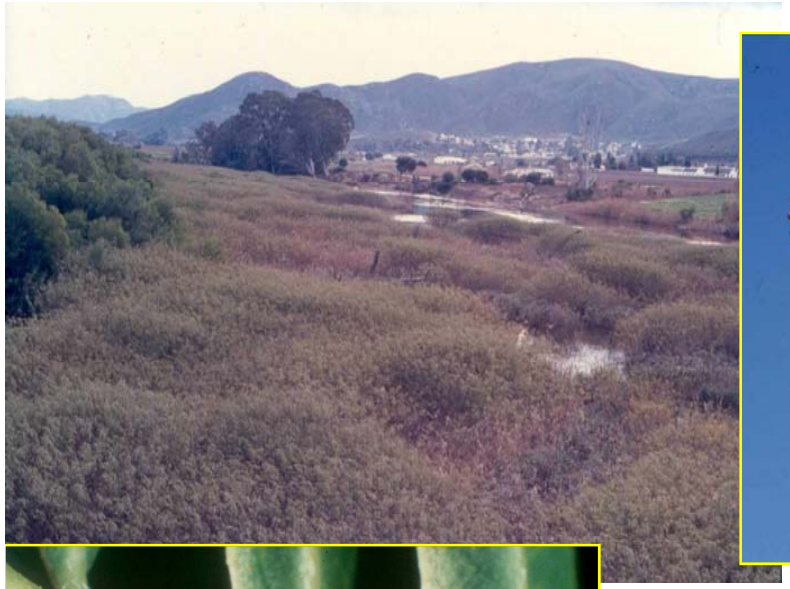


Descriptions by Dodd (1940)

Cactblastis cactorum

Dactylopius opuntiae

Opuntia stricta



seed-feeder

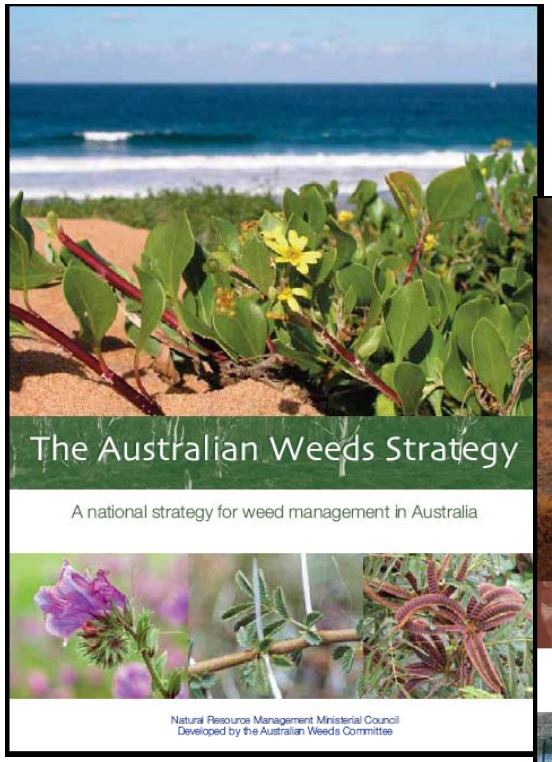
Sesbania punicea

Bud feeder

99.7% reduction in seed set

Acacia longifolia

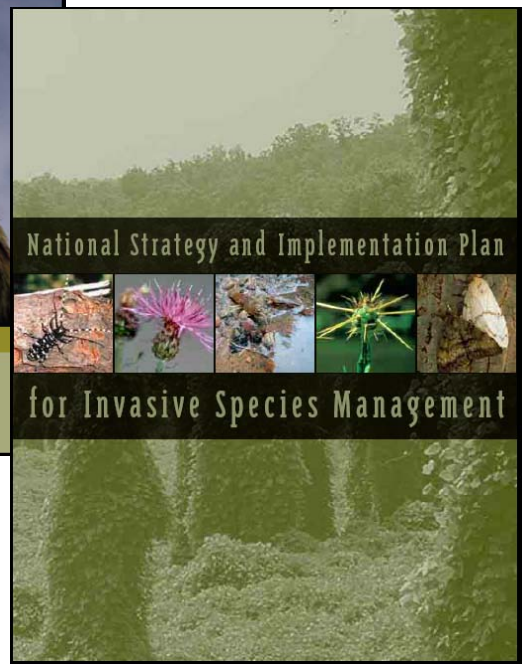
Gall wasp



Australian Pest Plant

Australian Pest Animal

New Zealand Biosecurity

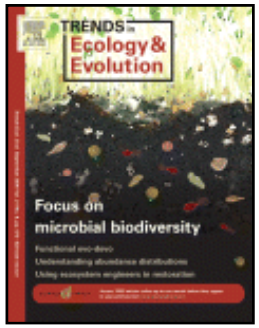


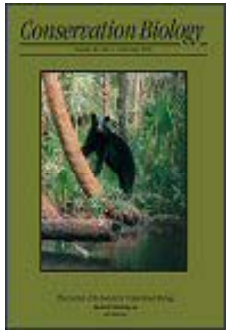
USA

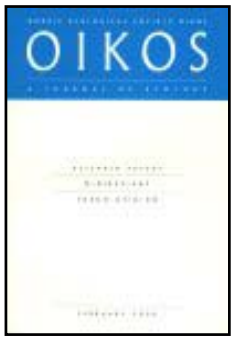
International concern at policy and strategy level..!!

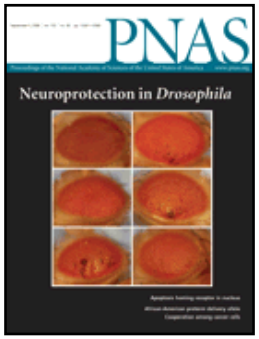
Globally - increase of awareness and concern

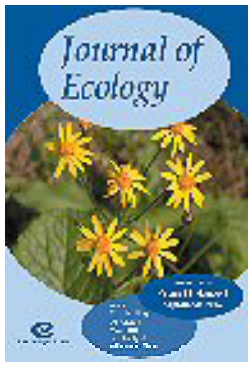
Massive growth in science field











ARID REGION
SUBTROPICAL / BUSH
SAVE THE ENVIRONMENT
INVASIVE ALIEN PLANTS
KEY STATISTICS
water & forestry
Working for Water Programme
Toll-free Number 0800 005 376

Awareness

Setting the scene for a national clearing programme

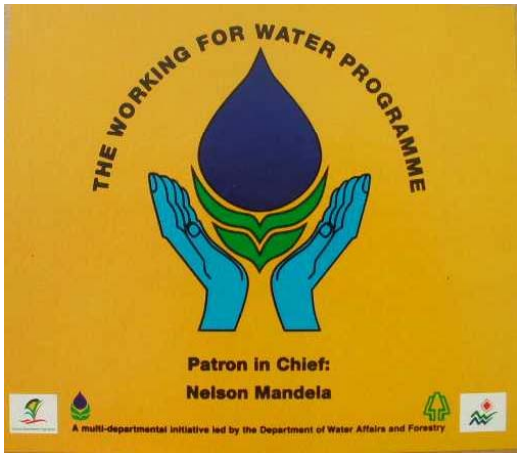
1994: The New South Africa- rainbow nation

- Democratic government-
- changes brought to many aspects of country;
- new found optimism;
- willing and eager to find new activities and approaches- **right opportunity, right time.**

Ecologists argued to government:
1) IAPs large and growing threat,
2) specific threat to water resources- Urgent attention
3) Can use as tool to provide jobs

Innovative solutions!

Working for Water



South Africa's Flagship Invasive Alien Plant control programme.

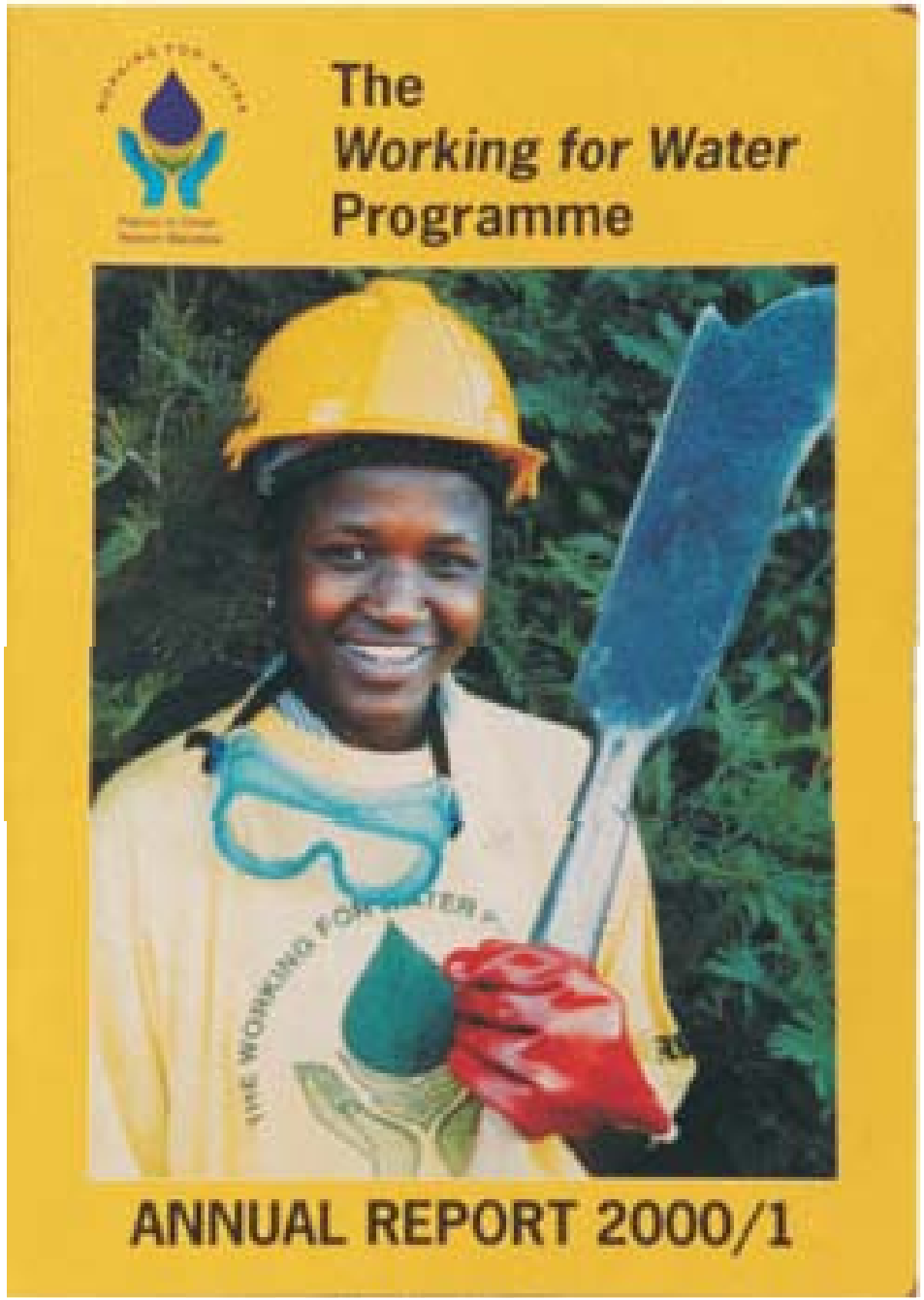
National, inter-departmental programme - Initiated 1995.

Goals:

1) Conserving essential ecosystem resources
2) provide employment for rural poor
   (~20,000 – 30,000)

water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

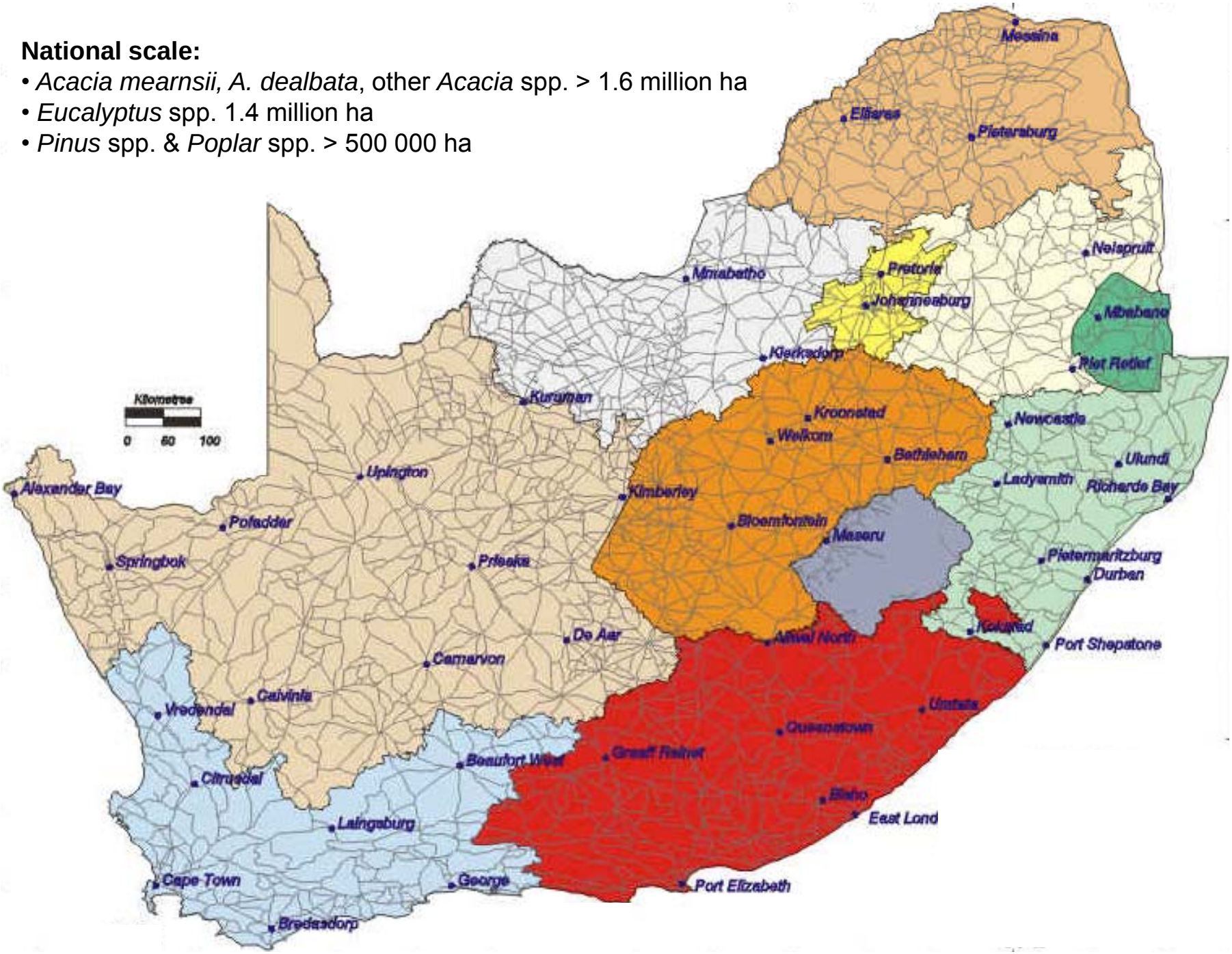
EXPANDED PUBLIC WORKS PROGRAMME
CONTRIBUTING TO A NATION AT WORK



Working for Water Programme

National scale:

- *Acacia mearnsii, A. dealbata*, other *Acacia* spp. > 1.6 million ha
- *Eucalyptus* spp. 1.4 million ha
- *Pinus* spp. & *Poplar* spp. > 500 000 ha



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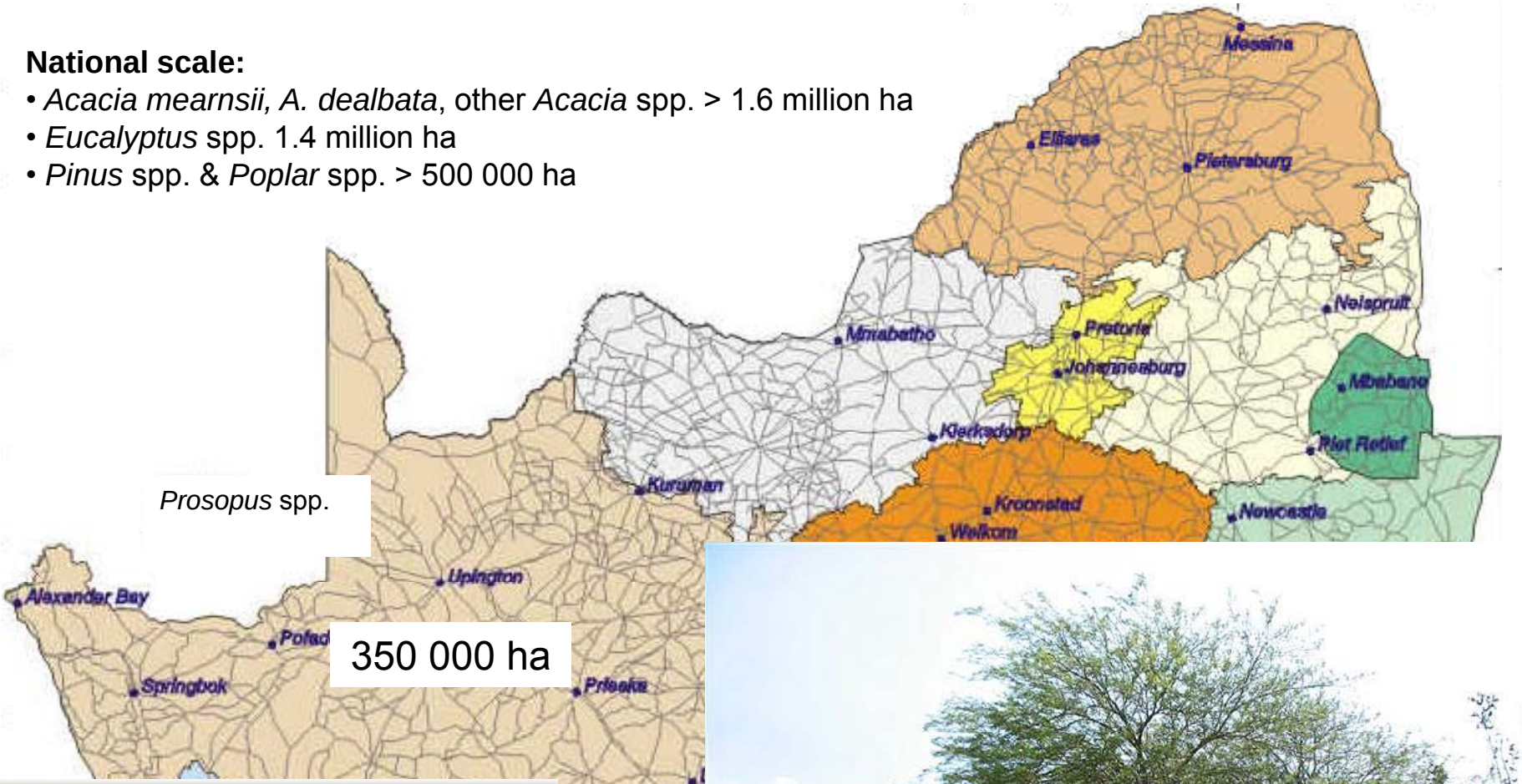
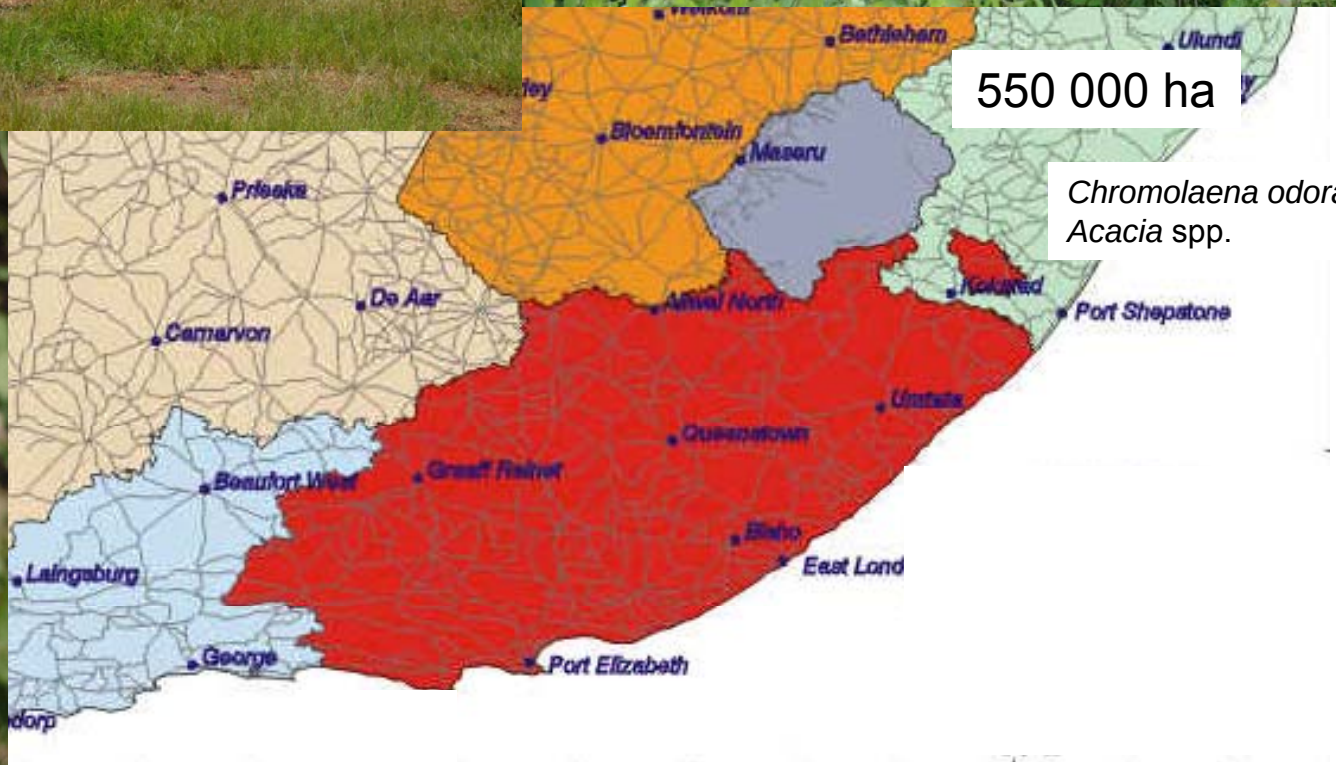


Prosopus spp.

350 000 ha

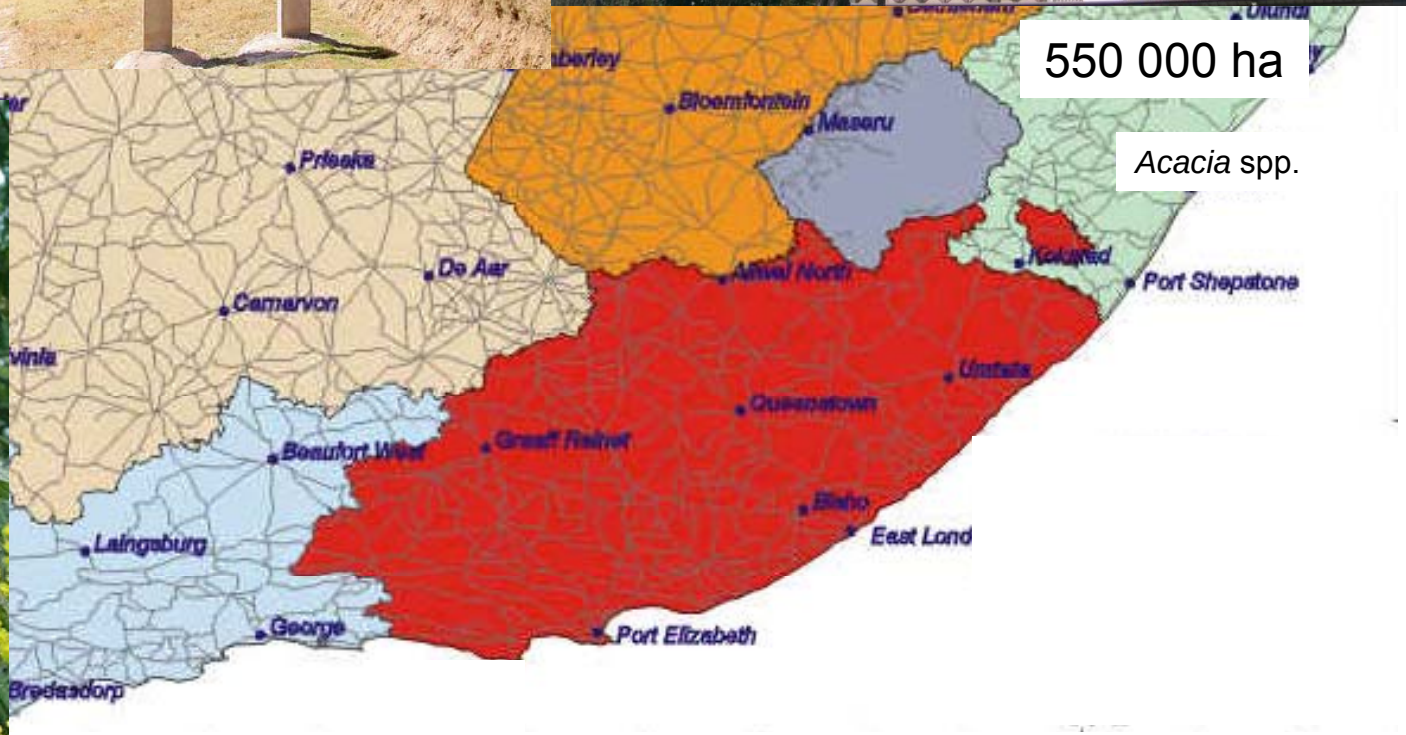


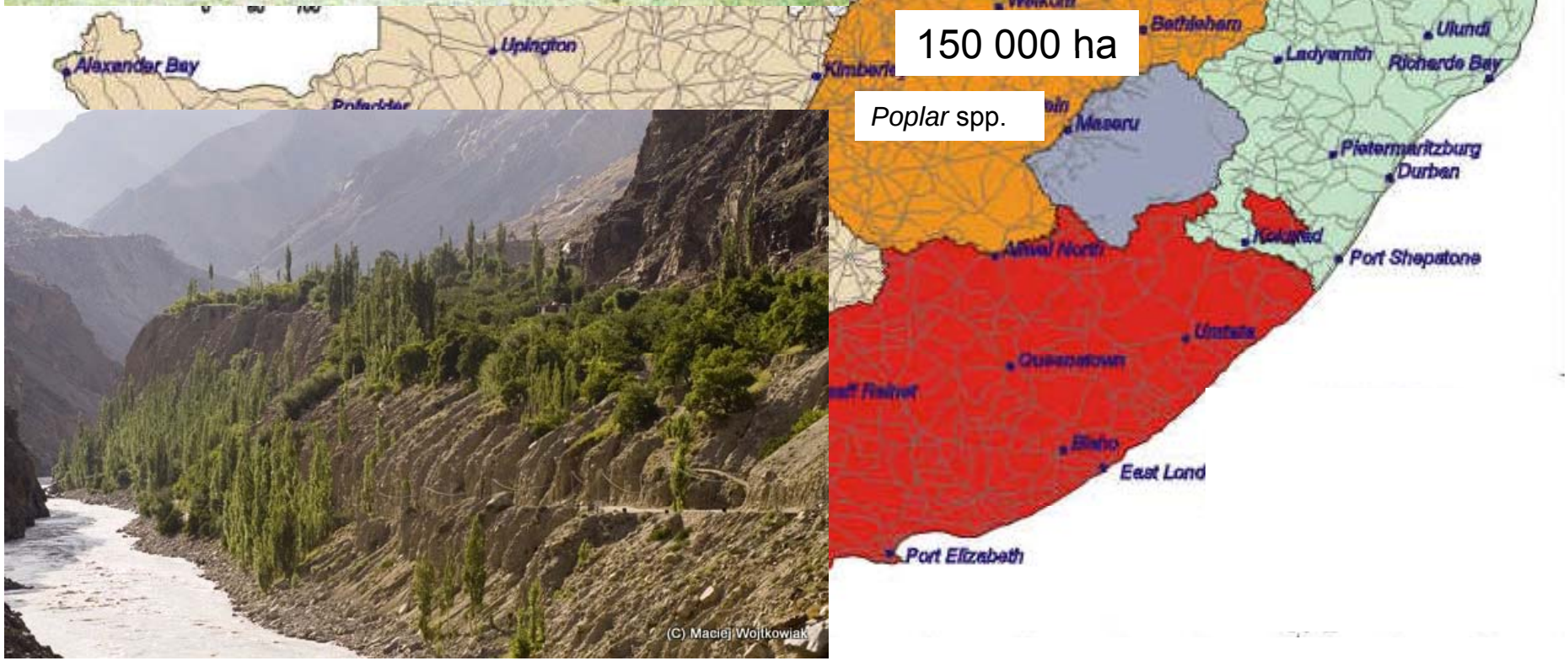
550 000 ha

Chromolaena odorata
Acacia spp.

550 000 ha

Acacia spp.





150 000 ha

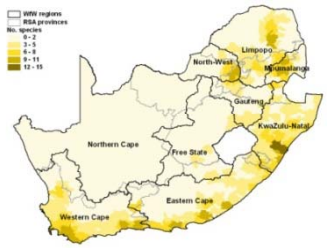
Poplar spp.

(C) Maciej Wojtkowiak

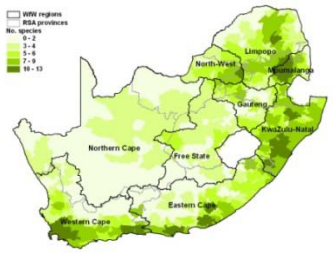
Future?

- Research into Biological Invasions set to increase significantly boosted by the DST-NRF Centre of Excellence for Invasion Biology
- Increasing biological control capacity
- Private landowner agreements
- Risk assessment on imported species
- Prevention – harbours; airports; other ?
- OPTIMISM

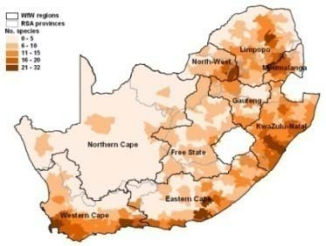
Systematic, strategic planning



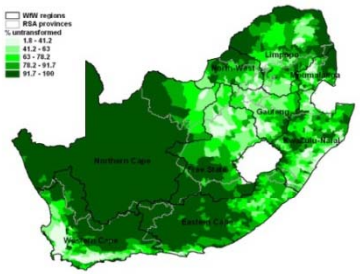
Abundance



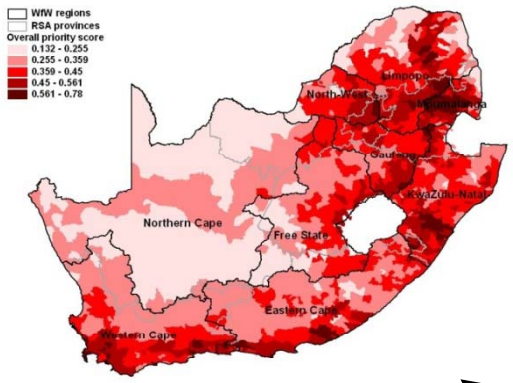
Effect



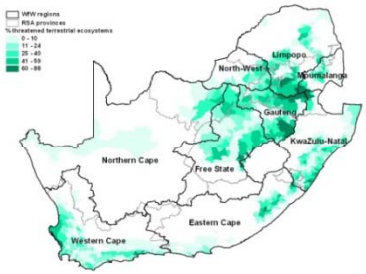
Range



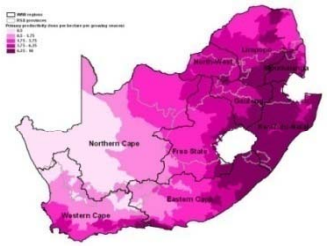
Disturbance



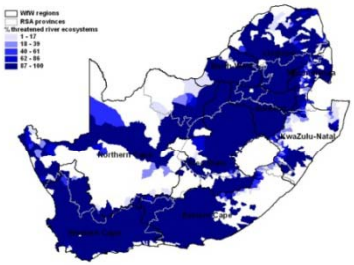
Systematic prioritisation composite



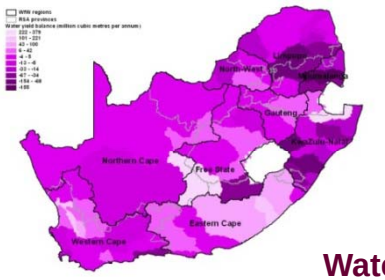
Terrestrial biodiversity



Agriculture



River biodiversity



Water

Working for Water

Aim to maintain & grow budget

Started:

- 1995/6 financial year R25 million (EUR 2.5)

Current:

- 2010 – 2011 financial year: R668 million (EUR68,000)

Need:

- R34bn over the next 25 years (clear 20 million ha)

Implementation legislation and policies- well developed, poorly implemented

WANTED: All illegal invader plants and weeds

National Department of Agriculture

Every South African citizen has a responsibility to combat invader plants and weeds

Did you know that some of the plants in your garden or on your farm land are illegal and will be declared unwanted in South Africa in the very near future?

These plants cause damage to our natural resources. YOU can help to fight declared weeds and invader plants by eradicating/controlling these plants on your land.

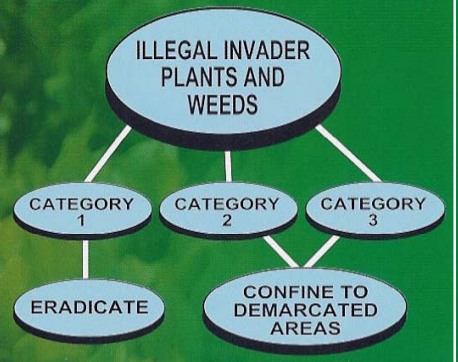
What is Government's position on invader plants?

The National Department of Agriculture recently published new draft regulations on the control of weeds and invader plants. Regulations 15 and 16 of the Act on Conservation of Agricultural Resources, 1983 (Act no 43 of 1983) list the plants which are defined as weeds and invader plants. The regulations allow government to enforce the eradication/control of invader plants and weeds. Since these plants are spreading at an alarming rate, it became increasingly important to revise the regulations.

Proposed amendments to Regulations 15 and 16 dealing with declared weeds and invader species were published for public comment before 31 March 2000, pending promulgation later on this year.

A total of 152 species are to be included in the amended regulations.

Regulations 15 and 16 provide for three categories of invader plants and weeds:



CATEGORY ONE PLANTS (Weeds)

These plants are to be declared as weeds and must be eradicated where they occur. No trading of these plants is to be allowed.

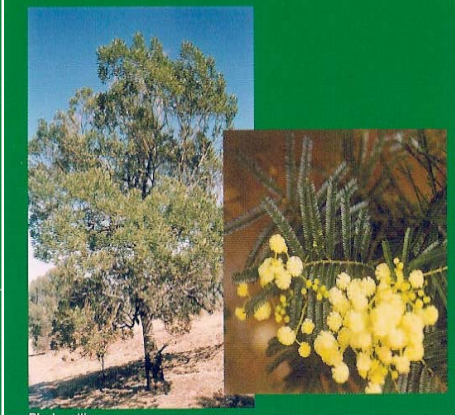
Lantana

Some examples are:

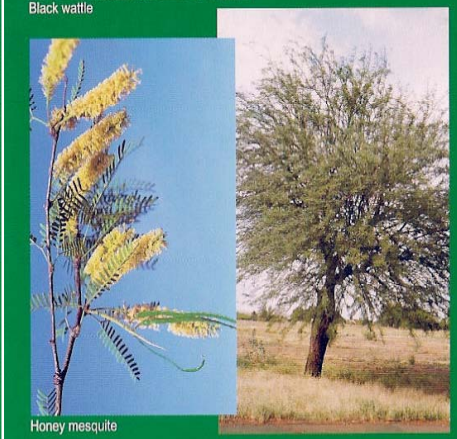
- Bugweed (*Solanum mauritianum*)
- Mauritius thorn (*Caesalpinia decapetala*)
- Triffid weed (*Chromolaena odorata*)
- Lantana (*Lantana camara*)
- Rock hakea (*Hakea gibbosa*)
- Queen of the night (*Cereus jamacaru*)
- Pereskia (*Pereskia aculeata*)
- Water hyacinth (*Eichhornia crassipes*)
- Jointed cactus (*Opuntia aurantiaca*)

CATEGORY TWO PLANTS (Commercial invader plants)

These plants have recognised commercial value, provided they are grown under controlled conditions. Trading with these plants and its products is allowed.



Black wattle



Honey mesquite

Some examples are:

- Black wattle (*Acacia Mearnsii*)
- Honey mesquite (*Prosopis glandulosa*)
- Bluegum (*Eucalyptus spp*)
- Pine spp (*Pinus spp*)
- Poplar spp (*Populus spp*)
- Silver wattle (*Acacia dealbata*)
- Bramble (*Rubus fruticosus*)

CATEGORY THREE PLANTS (Ornamental invader plants)

These plants are mainly used for ornamental purposes in demarcated areas. Trading with these plants will no longer be allowed.

Jacaranda

- *Some examples are:*
- Giant reed (*Arundo donax*)
- Show-berry bushes (*Cotoneaster spp*)
- Syringa (*Melia azedarach*)
- Jacaranda (*Jacaranda mimosifolia*)
- Guava (*Psidium guineense*)

Why are these plants so dangerous?

- Increase fire and erosion risk
- Cause loss of biodiversity
- Use more water than indigenous plants
- Out-compete natural vegetation
- Desertification in arid areas
- Replace valuable grazing and agricultural land

For more information, please contact:

Hélette Prinsloo
National Department of Agriculture
Tel: (012) 319-7559
Fax: (012) 329-5938
E-mail: HeletteP@nda.agric.za

Innovation and action..!

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NOT FOR FURTHER DISTRIBUTION – LECTURE MATERIAL ONLY

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