

Current and future consequences of invasion by alien species: A case study from South Africa

Brian van Wilgen
Dave Richardson

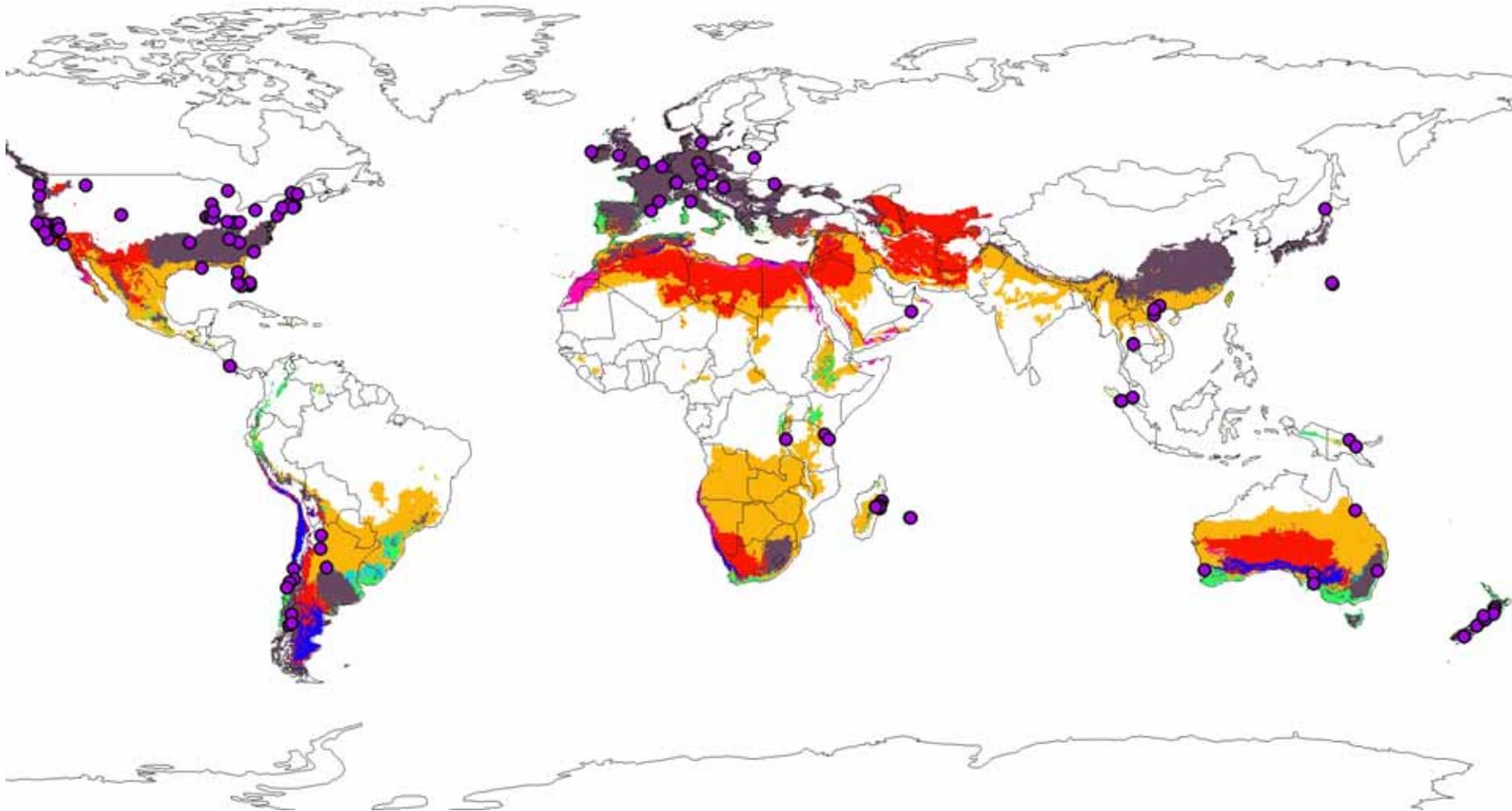


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South Africa as a case study

- Relatively good understanding of the invasion problem
- Large country with a wide range of ecosystems, and many invasive species
- A history of control programmes
- A microcosm of the world. Ratio of rich to poor approaches global average. This accentuates the problem of finding equitable solutions that address the needs of developed and developing sectors of society.

Extent of major biomes in South Africa and their distribution across the world



Scope of the case study

- Review all groups of alien species
 - How many are there?
 - How do they arrive?
 - How many are invasive?
- How well do we understand the current impacts?
 - In ecological terms
 - In economic terms
- What are the future impacts likely to be?
- Conclusions (state-of-the-art)

Invasive species in South Africa

- Terrestrial ecosystems
 - Plants
 - Mammals
 - Birds
 - Reptiles and amphibians
 - Invertebrates
- Freshwater ecosystems
- Marine ecosystems

Plants in terrestrial ecosystems

- About 8000 species introduced to South Africa
- About 250 of these regarded as invasive
- About 80 of these are regarded as “transformers”

- Major invasion pathways
 - Horticulture
 - Agriculture and pasture improvement
 - Forestry
 - Accidental

Fynbos ecosystems most
invaded

Major threat to
conservation and
water supply

Mammals

- Many introductions, but few have become invasive
- Only six species have established viable feral populations
- Himalayan tahr recently eradicated from Table Mountain National Park, amid much public disapproval

- Major introduction pathways
 - Agriculture
 - Fur trade
 - Biological control
 - Hunting
 - Pet trade

Birds

- 48 species have been introduced to the wild
- Only seven species have established viable feral populations – all commensal with humans
- A further 13 have geographically restricted ranges, or are decreasing

- Major introduction pathways
 - Deliberate introductions
 - Escaped pets
 - Hunting
 - Self-introduced

Reptiles and amphibians

- Over 280 species or subspecies have been introduced
- A few have established feral populations, but no serious invaders – yet

- Major introduction pathways
 - Pet trade
 - Zoos and collections

Terrestrial invertebrates

- No detailed account of introductions available
- Of the top 40 crop pests in South Africa, 42% are alien
- Some serious problems
 - European wasp, wood wasp, verroa mite, Argentine ant

Introduction pathways

- All accidental
- All biological control agents released to date have been host-specific

Invaders of freshwater ecosystems

- 11 species of invertebrates listed in 1988
- 10 species of gastropod (two very invasive, and two recent arrivals spreading, 2003)
- 58 alien and translocated fish species (most detrimental)
- 4 recently-introduced freshwater crayfish have established feral populations
- 21 escaped aquatic plants, 13 declared as invaders

Pathways for the introduction of freshwater aquatic species

- Aquarium trade
- Recreational and subsistence fishing
- Ornamental plants
- Interbasin transfers
- Accidental

Invasive Alien Fishes

Marine organisms

- Recent review identified 10 alien species that have established viable populations
- Only one (Mediterranean mussel) has established extensive populations
- Pathways:

Almost all accidental, on from marine-based trade on ships

Current levels of impact of invasive alien species

- Terrestrial ecosystems
 - Surface water resources
 - Grazing resources
 - Biodiversity
 - Fire regimes and erosion
- Human health and safety
- Freshwater aquatic ecosystems
- Marine ecosystems
- Assessment of economic impacts

Surface water resources

Mainly due to woody plant invaders

Estimated 3.3 billion m³ per year

7% of country's runoff

Impacts on grazing resources

Campuloclinium

Mesquite, jointed cactus, tussock grass,
triffid weed, satansbos, and others

Can have significant impacts, but these are
poorly studied

Jointed cactus R530 million/yr? (R7 = 1\$)

Chromolaena

Impacts on biodiversity

A few scattered studies, but poorly quantified

Reduced abundance and density of native plants
(on small plots)

Invasion by *Prosopis* reduces density and diversity of birds

Invasion by *Chromolaena* changes sex ratios of crocodiles

Invasion by Argentine ant impacts on native ants and seed dispersal

Human health and safety

Parthenium weed now in South Africa

Serious impacts elsewhere (Australia, India, Ethiopia)

Severe dermatitis, allergies and toxicity in humans and livestock

Impacts on freshwater aquatic systems

Freshwater ecosystems degraded by pollution, nutrient enrichment, water extraction, erosion, impoundments.

Invasive alien plants exacerbate existing problems

Alien fish now dominate many river systems

More than half of red-listed fish species have invasive species as main threat

Direct predation and disruption of food chains and ecosystem function

Alien invertebrate snails compete with native species for food and space

Marine ecosystems

- Only one species (the Mediterranean mussel, *Mytilus galloprovincialis*) found to have significant **positive** benefits.
- Large increases in inter-tidal biomass
- Enhanced food supply for inter-tidal predators (eg African Black Oystercatcher)
- Significant economic benefits

Economic assessments

- Economic value of water used by invasive black wattles (1.4 billion US\$ net present value)
- Reduced economic value of fynbos as a result of invasions (47 million US\$/4000 ha)
- Harvested products from fynbos (~ 12 US\$/ha)
- Benefits of biological control research (C:B ratios of 1:8 to 1:709)
- Not all impacts are negative – eg forest industry brings in US\$300 million, and downstream industries worth US\$1.6 billion

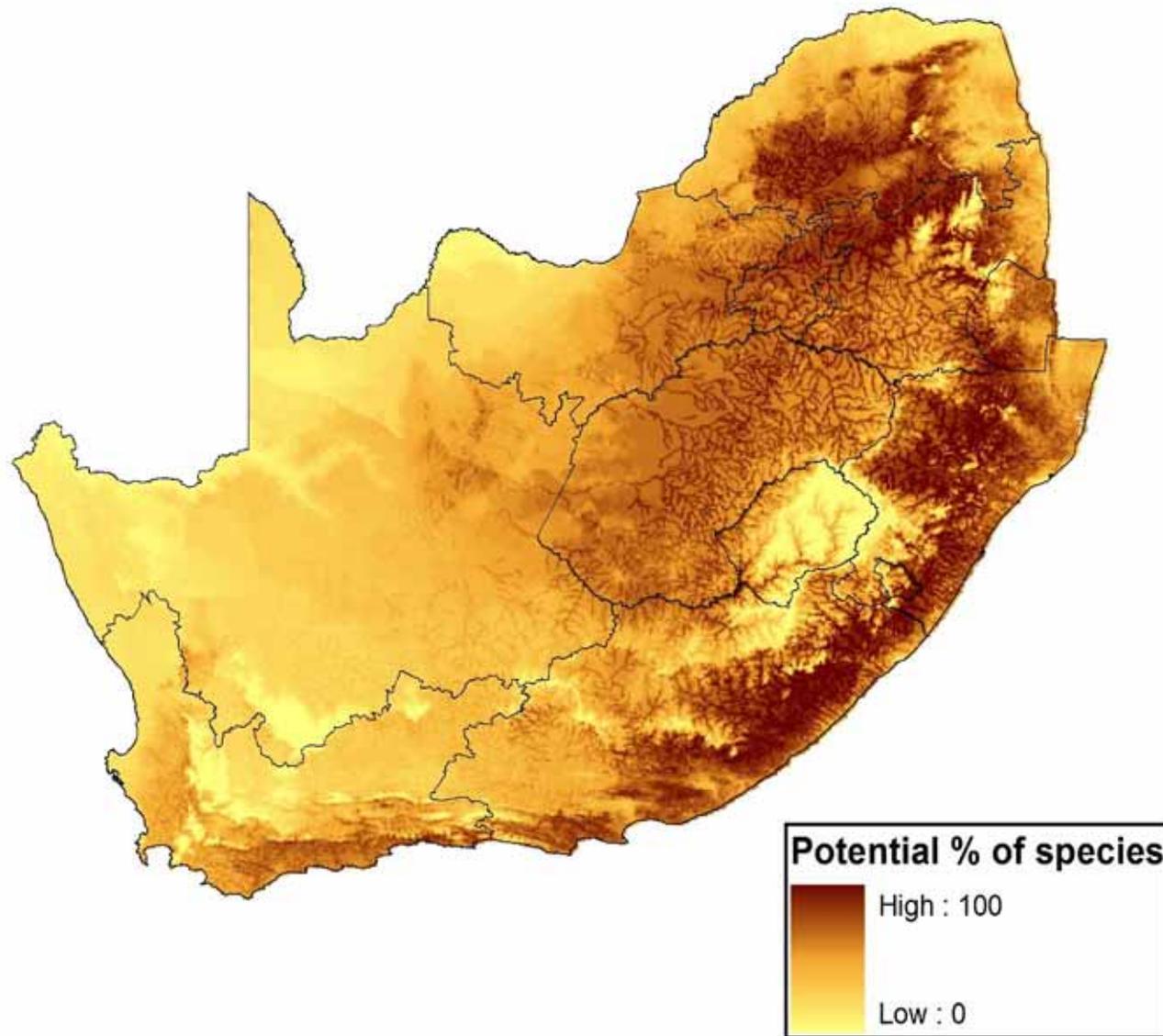
Future impacts

- Only study done has addressed invasive alien plants
- Based on species that are already a problem, but have not yet occupied full potential range
- Analysis done for separate biomes
- Addressed impacts on surface water resources, grazing and biodiversity

Selection of invasive alien plant species

- **Species of current importance**
 - All species occurring in > 10% of quarter degree squares in biome
 - Eliminated species under biological control
 - Subsets of species that impact on particular ecosystem services
- **Species of potential future importance**
 - All species with potential to invade >20% of each biome
 - Eliminated species under biological control
 - Subsets of species that impact on particular ecosystem services

POTENTIAL DISTRIBUTION – based on climatic suitability (all species shown)



Source: Rouget *et al.* (2003)

Five terrestrial biomes (area in km² x 1000)

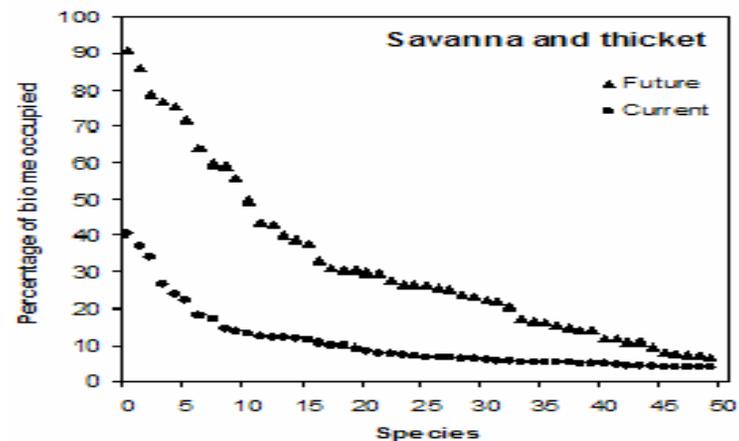
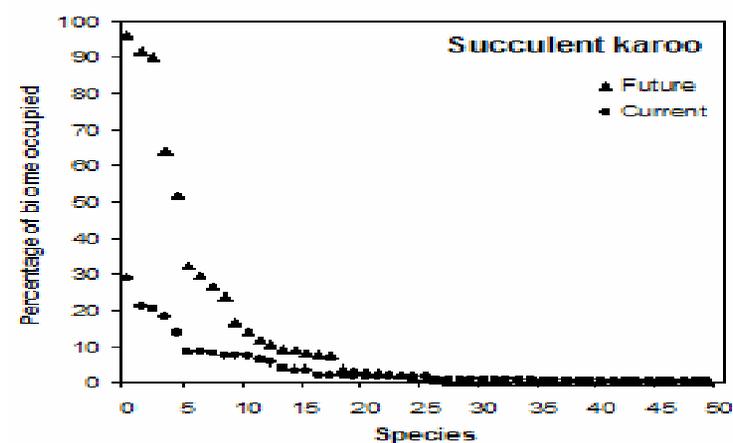
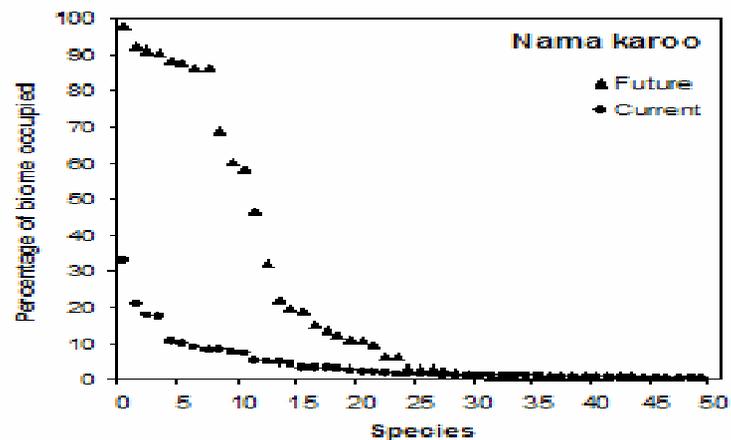
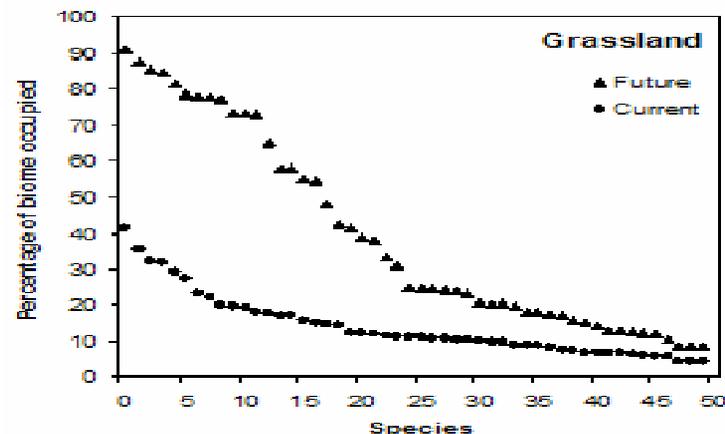
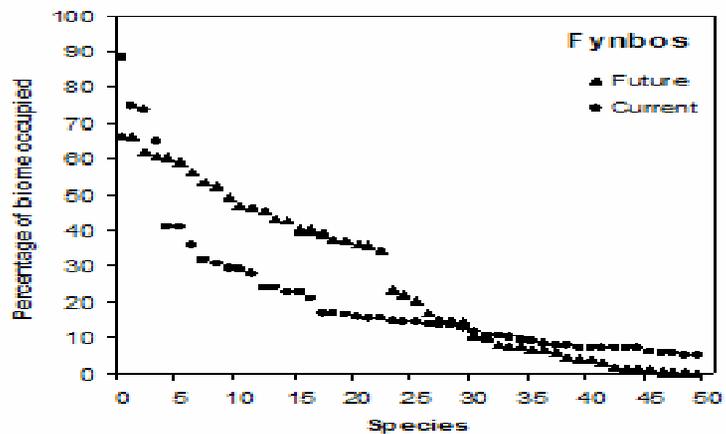
Fynbos (70)

Nama-karoo (360)

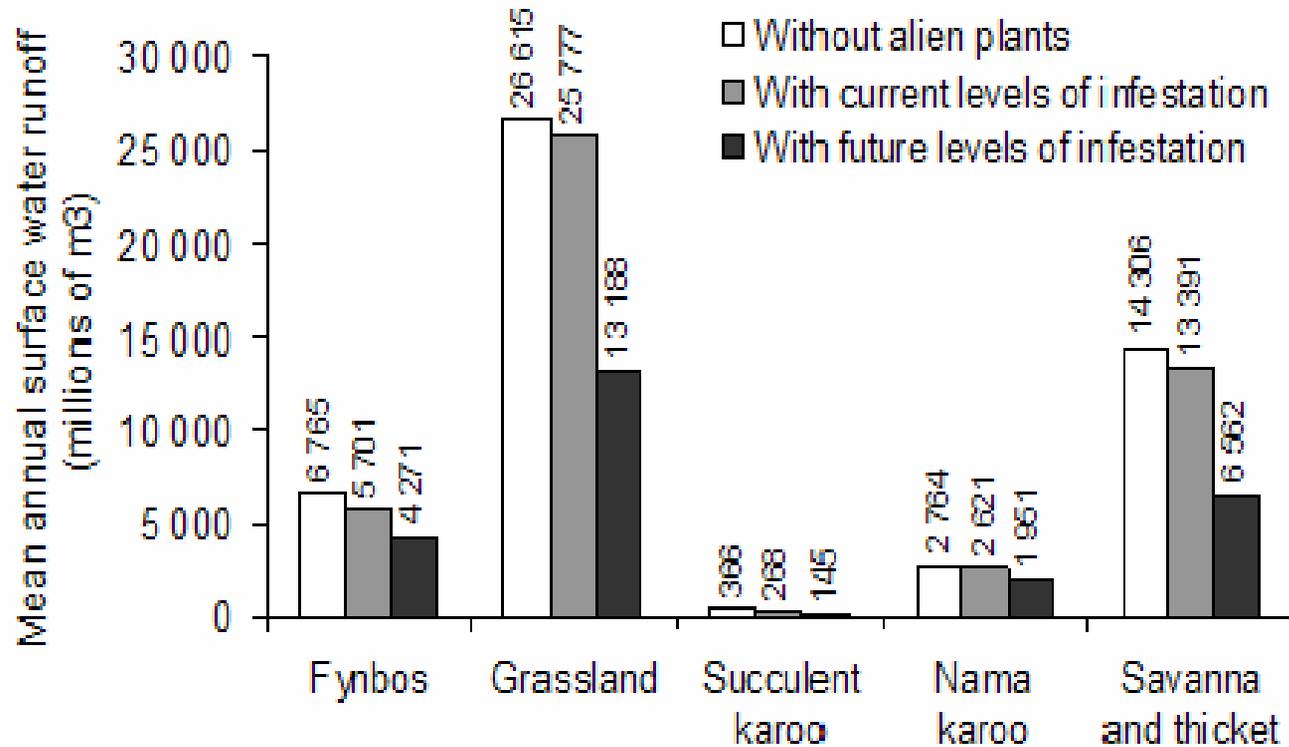
Grassland (350)

Succulent karoo (80)

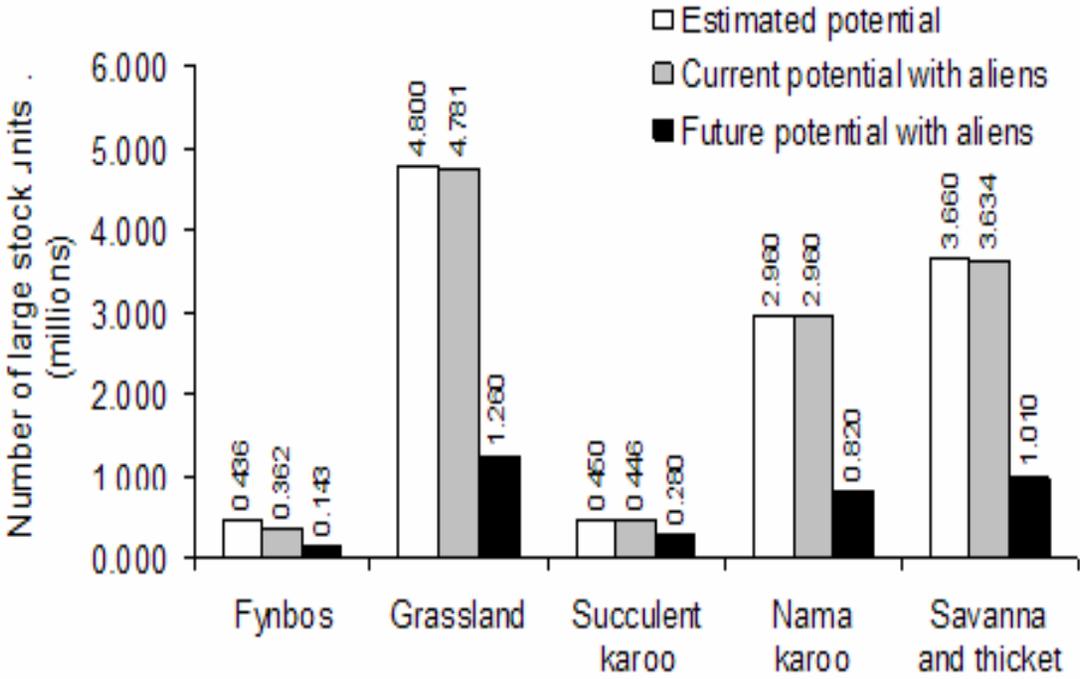
Savanna (400)



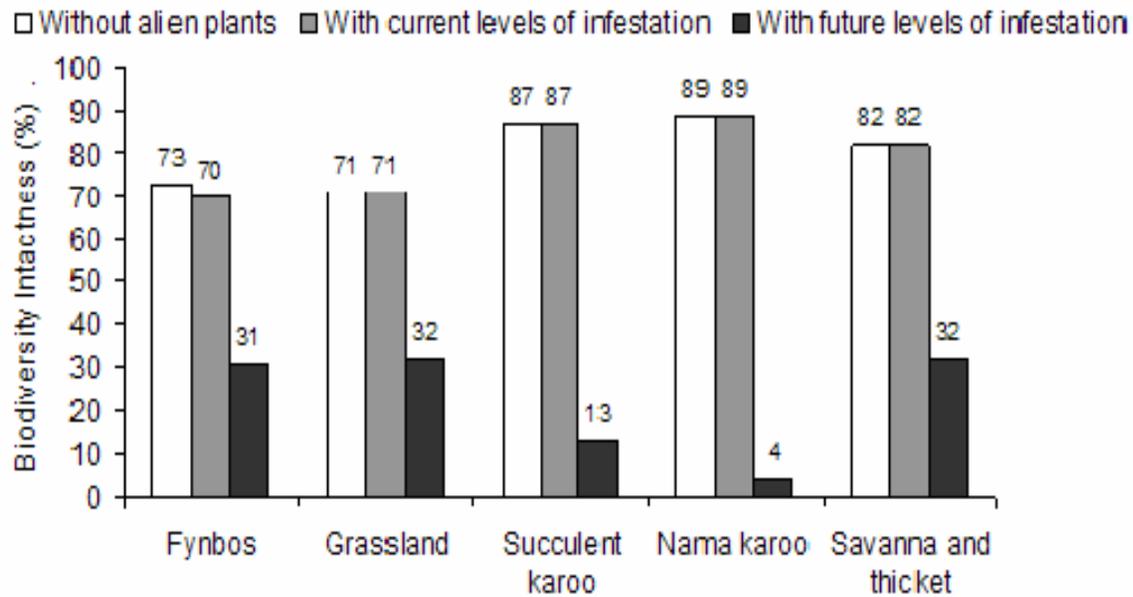
Impacts on surface water runoff



Impacts on grazing



Impacts on biodiversity intactness index (BII)



Conclusions

- We have some idea of which alien species are in the country, but need a decent catalogue
- Terrestrial plants, and freshwater aquatic organisms have the biggest impacts
- No large impacts (yet?) from mammals, birds, reptiles, marine organisms.
- Jury is out on invertebrates

Conclusions (continued)

- Ecological studies on impact are rare and scattered
- Translation of ecological impacts into economic terms is in its infancy
- Rate of arrival of new species not known
- We do not have robust models that can predict rate of expansion and time to reach maximum extent
- Problems emerging with regard to pragmatic, practical legislation to deal with the problem, and capacity to implement this legislation

Acknowledgements

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