Economic Impacts of Biological Invasions

Guy Preston
National Programme Leader
The *Working for Water* Programme
South Africa

“Based on an estimated $31 trillion in world GNP, the $1.4 trillion in losses from invasive species represents nearly 5% of the world economy."

Pimentel, D (Ed). *Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal and Microbe Species*. CRC Press, Boca Raton, 2001.

We know too little to be able to say with confidence that invasive alien species are causing losses equivalent to 5% of the global Gross National Product.

Still, we do know the figure is very high – and that it is growing exponentially.

Perspective: Africa's combined GNP is about 1.7% of the global figure.

Annual Costs of Invasive Alien Species

Australia	US$ 13 billion
Brazil	US$ 50 billion
India	US$ 116 billion
South Africa	US$ 7 billion
UK	US$ 12 billion

(Source: Pimentel et al. 2001)

Some examples

- Invasive rats: One-third of all African grain
- Black Sea (Comb jelly): $1-2 billion lost fisheries revenue
- Golden apple snail (worldwide): $55-250 billion per year
- Black wattle (South Africa) $1.4 billion /yr
- Soy bean rust (Brazil): $1 billion/yr

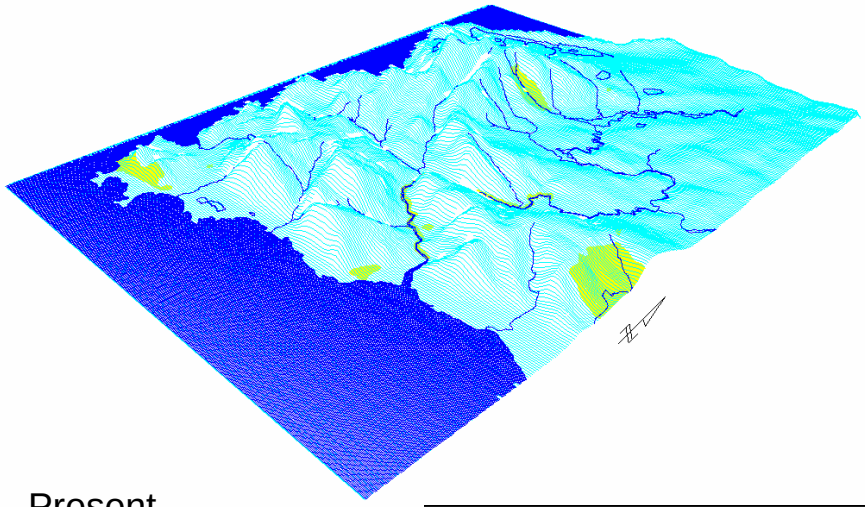
INDICATIVE COSTS OF SOME INVASIVE ALIEN SPECIES (costs in US$)

SPECIES	ECONOMIC VARIABLE	ECONOMIC IMPACT
Introduced disease organisms	Annual cost to human, plant, animal health in USA	$41 billion per year
A sample of alien species of plants and animals	Economic costs of damage in USA	$137 billion per year
Salt Cedar (*Tamarix spp*)	Value of ecosystem services lost in western USA	$7-16 billion over 55 years
Knapweed and Leafy spurge	Impact on economy in three US states	$40.5 million per year direct costs $89 million indirect
Zebra mussel (*Dreissena polymorpha*)	Damages to US and European industrial plants	Cumulative costs 1988-2000=$750 million to 1 billion
Most serious invasive alien plant species	Costs 1983-92 of herbicide control in Britain	344 million/year for 12 species
Six weed species	Costs in Australia agroecosystems	$105 million/year
Pinus, Hakeas, and Acacia	Costs on South African Floral Kingdom to restore to pristine state	$2 billion
Water hyacinth (*Eichornia crassipes*)	Costs in 7 African countries	$20-50 million/year
Rabbits	Costs in Australia	$373 million/year (agricultural losses)
Varroa mite	Economic cost to beekeeping in New Zealand	$267-602 million

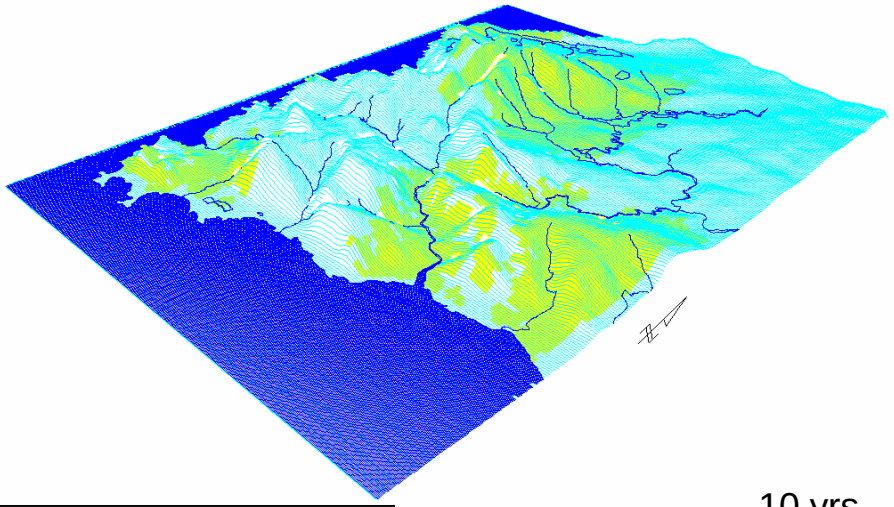
THE
WORKING FOR WATER
PROGRAMME

A multi-departmental initiative led by
the Department of Water Affairs and Forestry

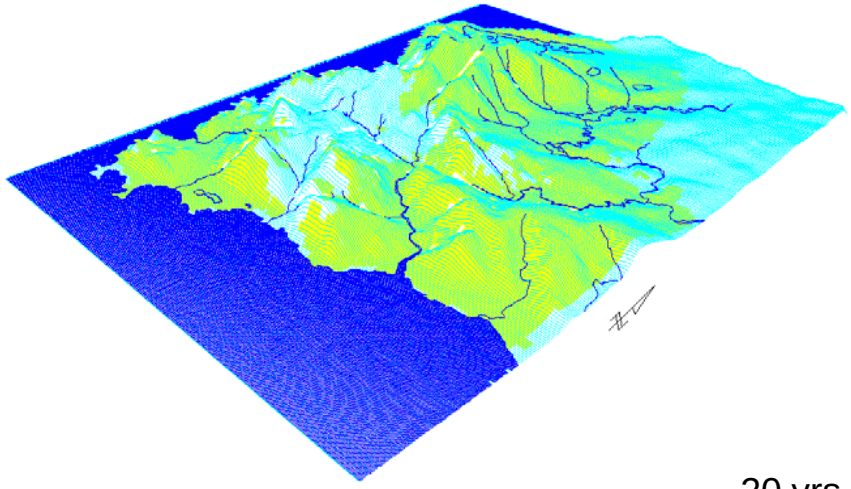
The possible extent and rate of spread over 20 years in a fire prone Fynbos mountain catchment.



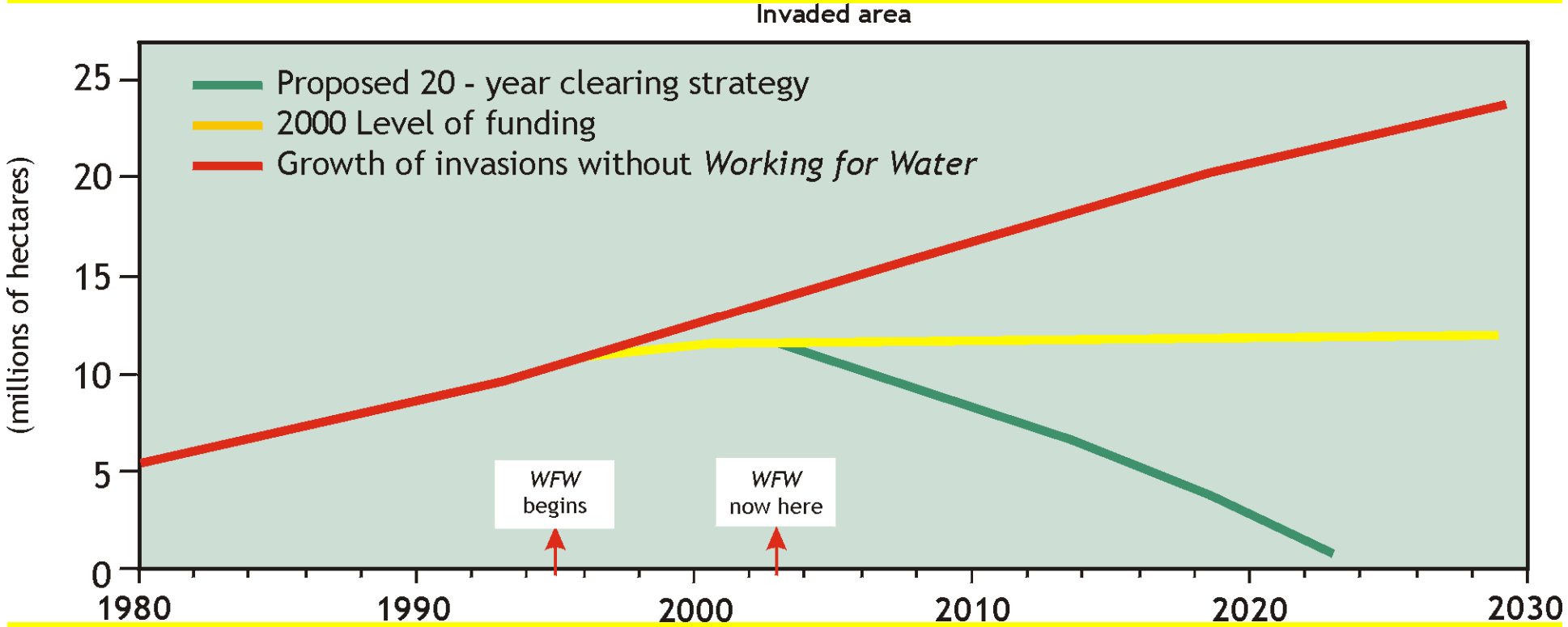
Present

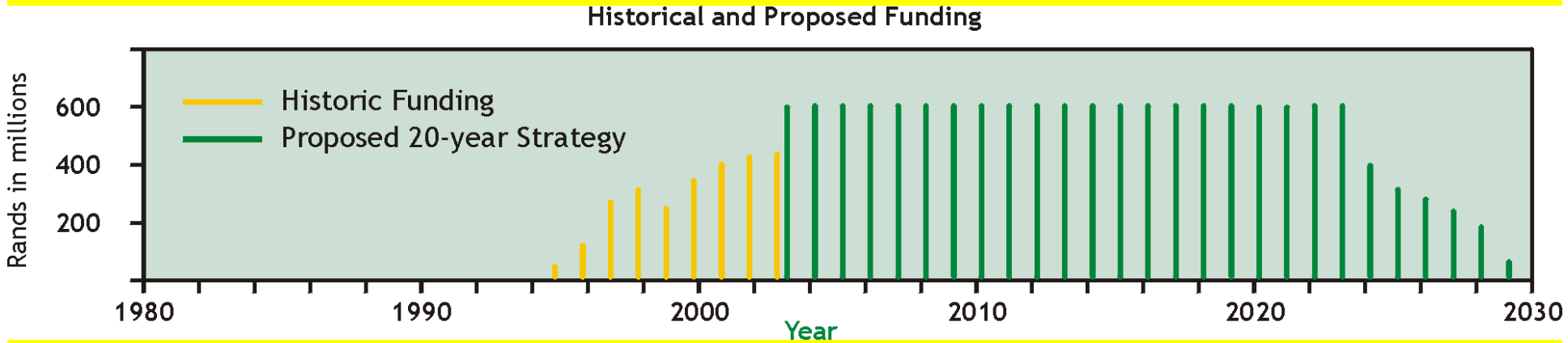


10 yrs

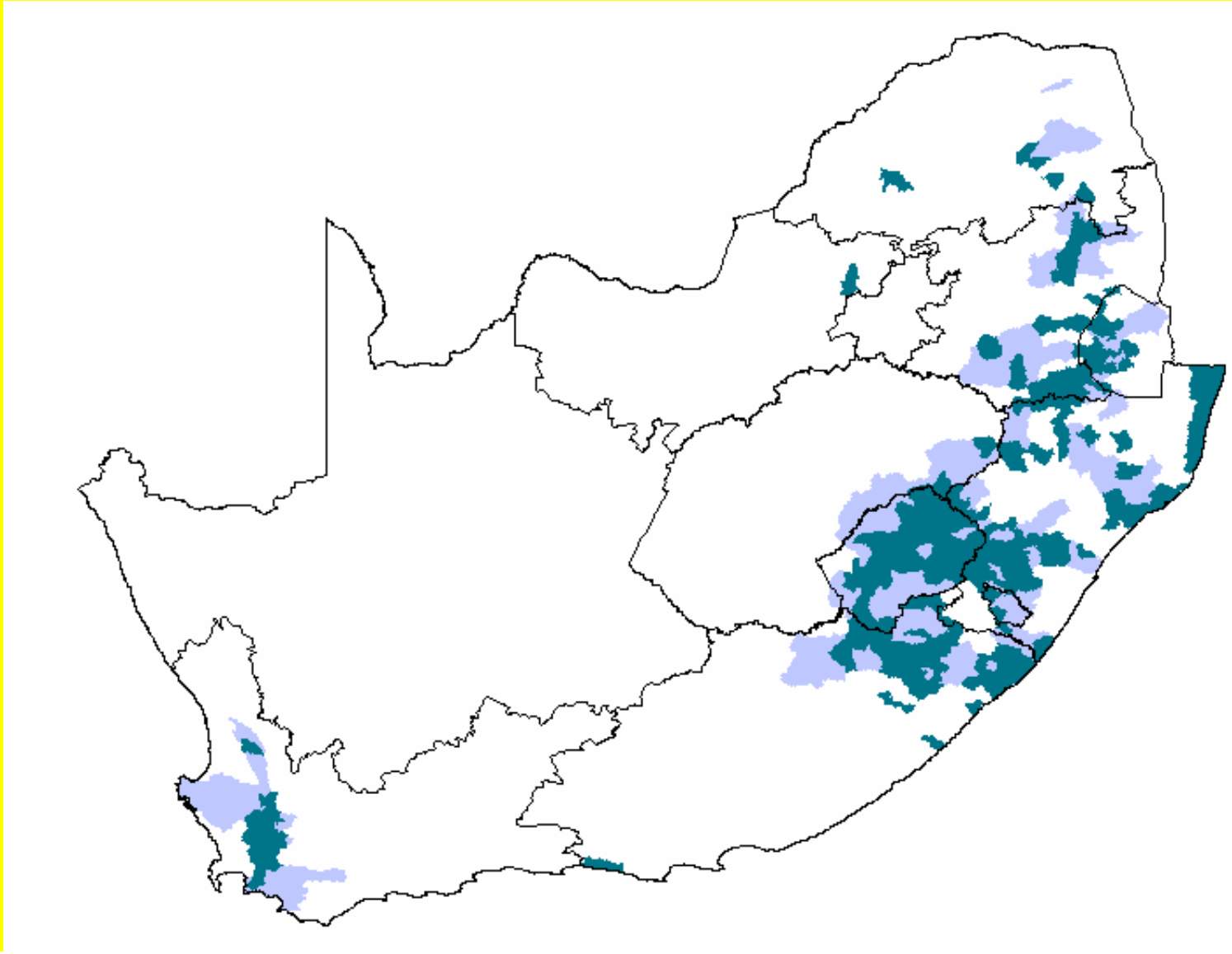


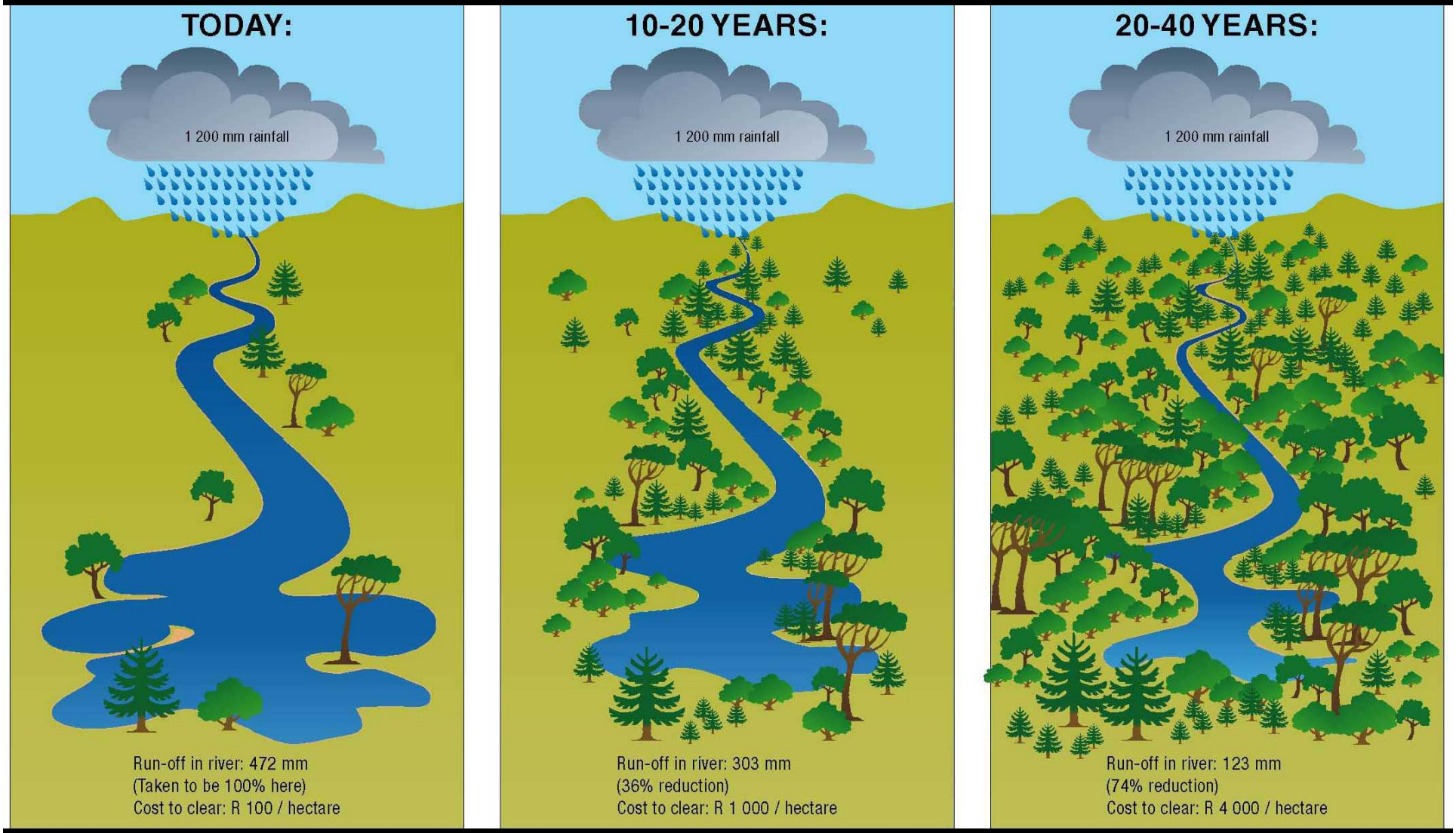
20 yrs


Invaded area
Proposed 20 - year clearing strategy
2000 Level of funding
Growth of invasions without *Working for Water*
(millions of hectares)
25
20
15
10
5
0
WFW begins
WFW now here
1980
1990
2000
2010
2020
2030


Historical and Proposed Funding
Historic Funding
Proposed 20-year Strategy
Rands in millions
600
400
200
1980
1990
2000
2010
2020
2030
Year

Areas of high water yield. Source: National Spatial Biodiversity Assessment (Driver *et al*. 2004).




TODAY:
1 200 mm rainfall
Run-off in river: 472 mm
(Taken to be 100% here)
Cost to clear: R 100 / hectare
10-20 YEARS:
1 200 mm rainfall
Run-off in river: 303 mm
(36% reduction)
Cost to clear: R 1 000 / hectare
20-40 YEARS:
1 200 mm rainfall
Run-off in river: 123 mm
(74% reduction)
Cost to clear: R 4 000 / hectare

Water Management Options

- We have been able to demonstrate that the returns on investment for water yield is greater through clearing water-consumptive invasives, compared to building dams.
- Our water law also prioritizes water for ecosystem functioning, where our work has exceptional returns on investment.

The Impact of Invasive Alien Plants in the Mountain Catchment Areas and Riparian Zones on Total Surface Water Yield

- Current level of infestation
  - Reduction in Yield = 695 Mm^3/a
  - Percent of Registered Use = 4.1 %
- Future level of infestation
  - Reduction in Yield = 2,724 Mm^3/a
  - Percent of Registered Use = 16.1 %

The Hermanus Role Model

- Hermanus – coastal town short of water
- Introduced water conservation programme
- Demand-management, water pricing & invasives
- Dropped water-use by 32%
- Raised revenue from water sales by > 20%
- Greater equity
- Investment by residents in clearing invasives, to protect existing water supply, and to create jobs

Mainstreaming Benefits

- In 1997, only 16 of 120 in a project were women.
- Nine of 16 had unintended pregnancies in first year.
- Introduced sexual and reproductive health initiative.
- Dropped unintended pregnancies by 90% in 1st year.
- Now 100% success – no unintended pregnancies.
- Opportunity to address HIV, STDs, abuse of women.
- Now 73 women (plus female manager) out of 123.
- Difficult to put this in economic terms. But it sells.

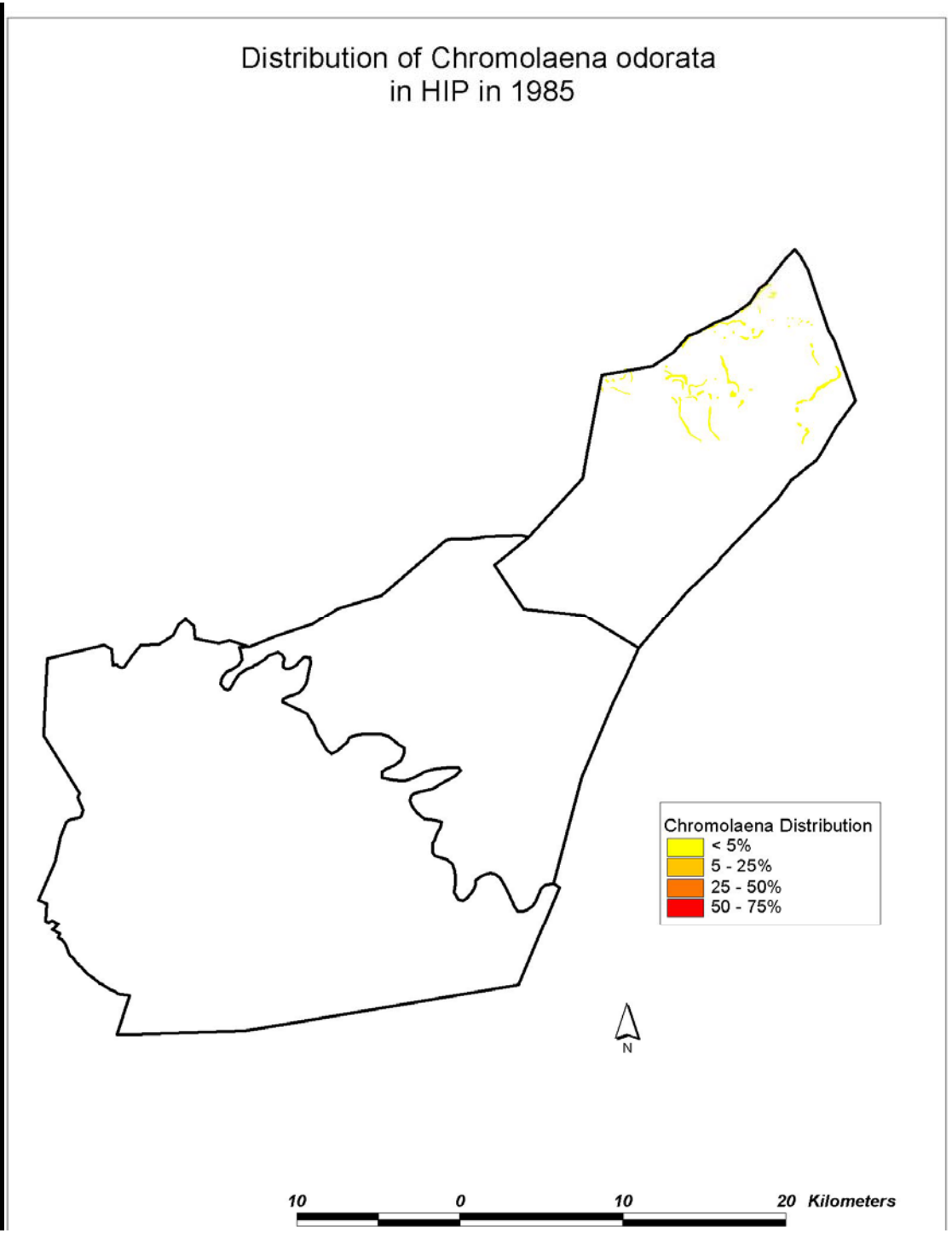
Mainstreaming and Economic Benefits

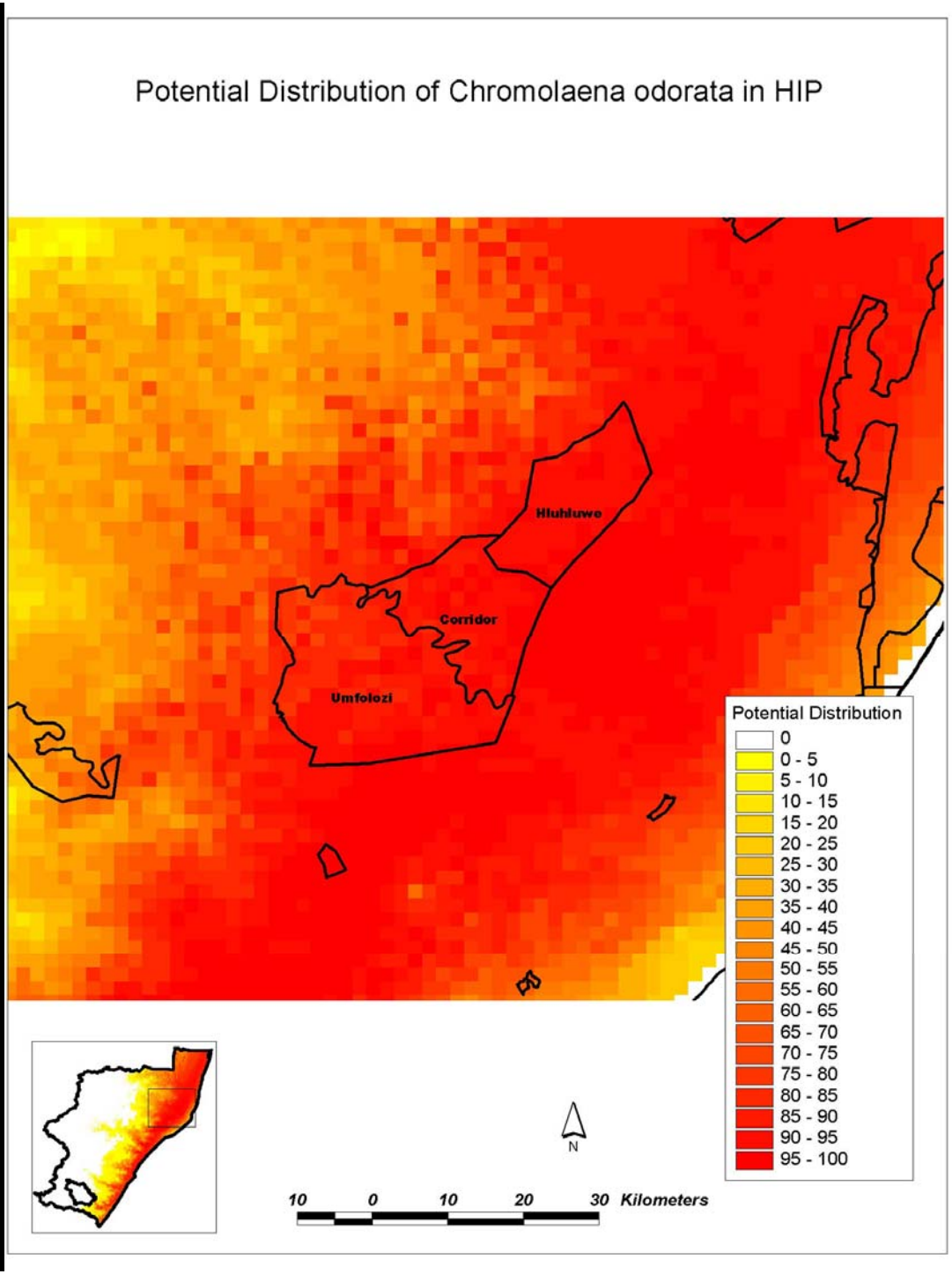
- Status of women
- Child care
- Human health management (eg, HIV/AIDS, TB)
- Political stability (eg, projects in Bulwer, Richmond)
- Land reform management (eg, Dukuduku forest)
- Equity – who benefits and who pays, distribution of resources
- Tourism benefits
- Water quality benefits (thermal, light, eutrophication, siltation)
- Functioning of estuaries (and resilience to invasion)
- Dignity, social stability
- Coffins project

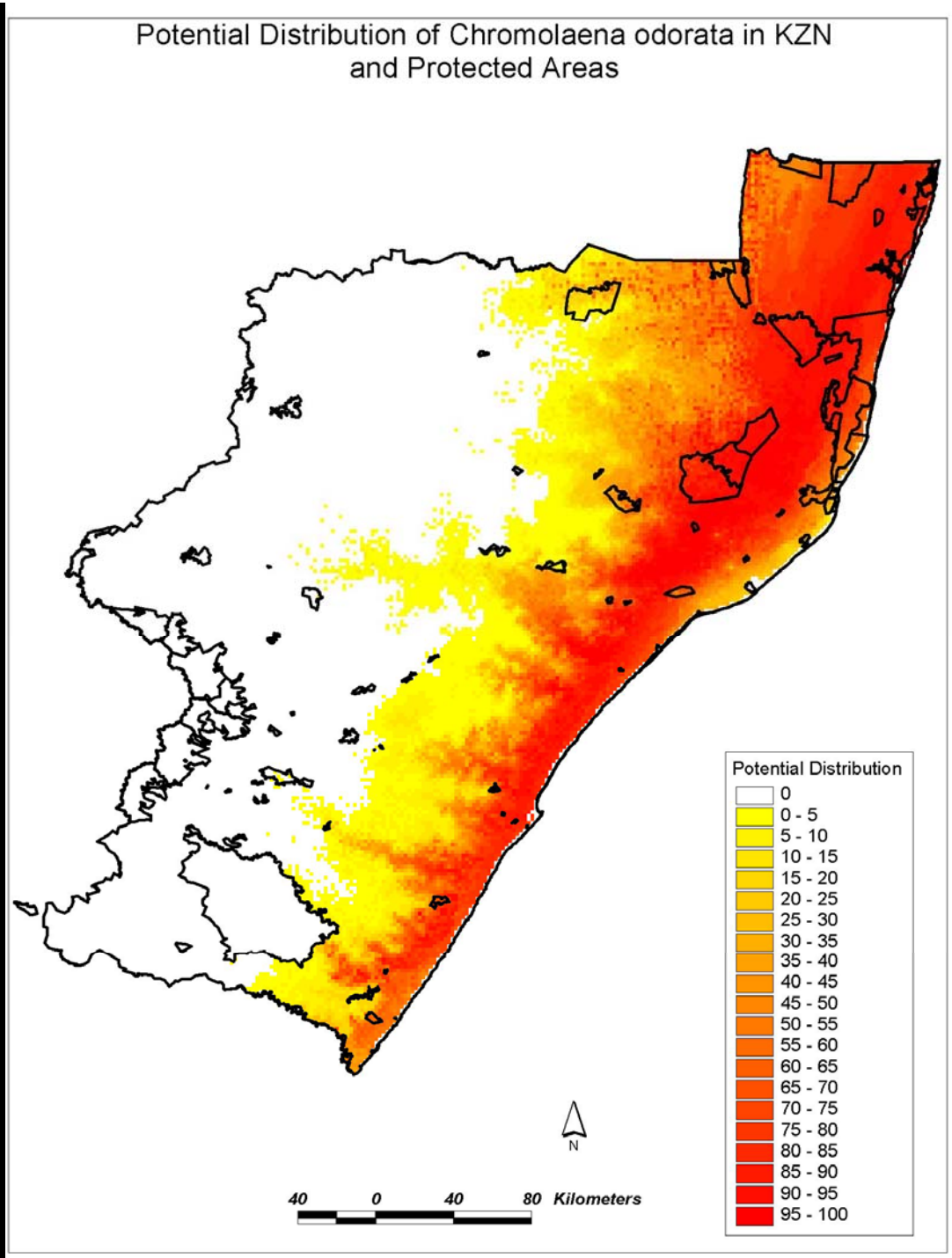
Mainstreaming Fire-management

- Have sold the *Working on Fire* programme on the basis of impact on life and livelihoods.
- Fires in Mpumalanga 2001cost the economy over US$500 million. Estimate was that the cost could have been 2-3 times as high, were it not for fire-fighting of WfW and WoF.
- Recent fires in same area now – damage a fraction of the cost, because of prevention work as well as enhanced response by WoF.
- Most marketable programme running in SA.
- Resource economics on WoF still to be done.

The Hluhluwe-Imfolozi Park – A Role Model Intervention that has Opened Doors well beyond Tourism Revenue


Distribution of Chromolaena odorata
in HIP in 1985
Chromolaena Distribution
< 5%
5 - 25%
25 - 50%
50 - 75%
N
10
0
10
20 Kilometers


Potential Distribution of Chromolaena odorata in HIP
Hluhluwe
Corridor
Umfolozi
Potential Distribution
0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 75
75 - 80
80 - 85
85 - 90
90 - 95
95 - 100
N
10 0 10 20 30 Kilometers


Potential Distribution of Chromolaena odorata in KZN
and Protected Areas
Potential Distribution
0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 75
75 - 80
80 - 85
85 - 90
90 - 95
95 - 100
N
40 0 40 80 Kilometers

Value-added Options

In the Eastern Cape, invasive Australian Acacias were cleared from coastal dune systems and replaced by indigenous thatch reeds. Some of this is now mature and could be worth between R60,000 and R120,000 per hectare harvestable on a four to six year cycle.)

Economic Arguments

- Data on invasive species, spread & threats usually poor
- Strategic alignment with Governmental priorities poor
- Level playing fields a long way off
- Discounting – dams/power stations vs. conservation
- Externalities (social costs and social benefits)
- Opportunity costs
- Cumulative impacts
- Synergistic impacts
- Difficult to put value on loss of human life, extinction
- We grossly under-estimate the impacts of invasives

Human Health Links

- More people understand risks and costs associated with human health invasives
- Excellent science capacities
- Extraordinary response to SARS
- Partnerships can add mutual benefits

- Have used economic impacts strategically
- The risks to the rich and those to the poor interesting in global terms – response to HIV/AIDS vs SARS
- Who benefits and who pays a pivotal argument

Economic benefits and costs of bio-control

- By 1998, bio-control had reduced the cost of clearing SA of IAPs by 19.8% (US$ 276 million)
- If fully implemented, further saving of US$816 million

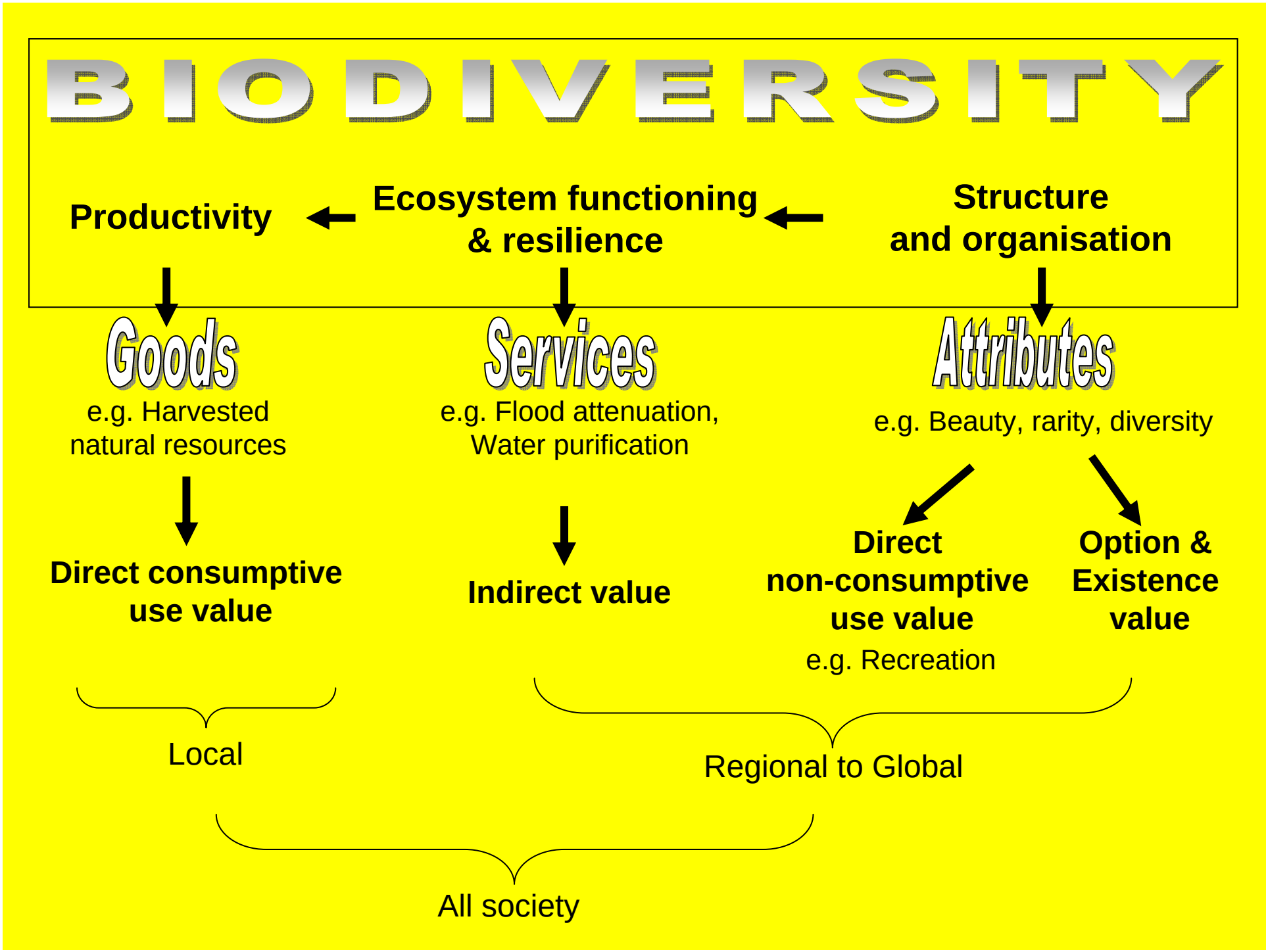
Species	Benefit : cost ratio
Red sesbania	45 : 1
Lantana	34 : 1
Long-leaved wattle	1 465 : 1
Golden wattle	4 333 : 1
Silky hakea	611 : 1

Payment for Ecological Services

- PES systems provide incentives and finance for conservation of ecosystems that yield valuable services
- In PES systems around the world, it has been found that most examples are for a few main commodities, particularly carbon, water, productive potential, biodiversity and landscape beauty, with markets for carbon sequestration and hydrological services being the dominant ones.

- Marketing the hydrological and climate regulation functions of ecosystem restoration projects has got many advantages.
- They are well understood by the broad populous, they are the easiest to execute and it is more likely to find willing-buyer & willing-seller combinations for these projects.
- The positive externalities of these projects, such as biodiversity conservation, protection of endemism, nutrient recycling, etc. are therefore “un-priced” coincidental benefits.
- Should they, however, be clearly identified could sell the restoration activity at a premium over projects where these positive externalities are not clearly identified or not present.
- In this way hydrological and climate regulation restoration programmes becomes an umbrella for the bundling of various ecosystem services.

- If we allow man-made capital to depreciate, economic productivity declines
- >> If we allow natural capital to degrade, it also impacts on economic production


BIODIVERSITY
Productivity
Ecosystem functioning & resilience
Structure and organisation
Goods
Services
Attributes
e.g. Harvested natural resources
e.g. Flood attenuation, Water purification
e.g. Beauty, rarity, diversity
Direct consumptive use value
Indirect value
Direct non-consumptive use value
e.g. Recreation
Option & Existence value
Local
Regional to Global
All society

For what it's worth…..

The Annual Value of the Cape Floristic Region:

- **Harvesting of natural products**
  - Fynbos R76 m
  - Forests R2 m
  - Marine R1 323 m
- **Tourism**
  - Ecotourism R130 m
  - Adventure R1 656 m
  - Passive nature-based R5 657 m
- **Services**
  - Pollination & honey R594 m
  - Water production etc *not included*
- **Existence value**
  - Fynbos R153 m
  - Coast R29 m

All values in 2000 rands

Impacts of fynbos invaders

Loss of species

Change in productivity

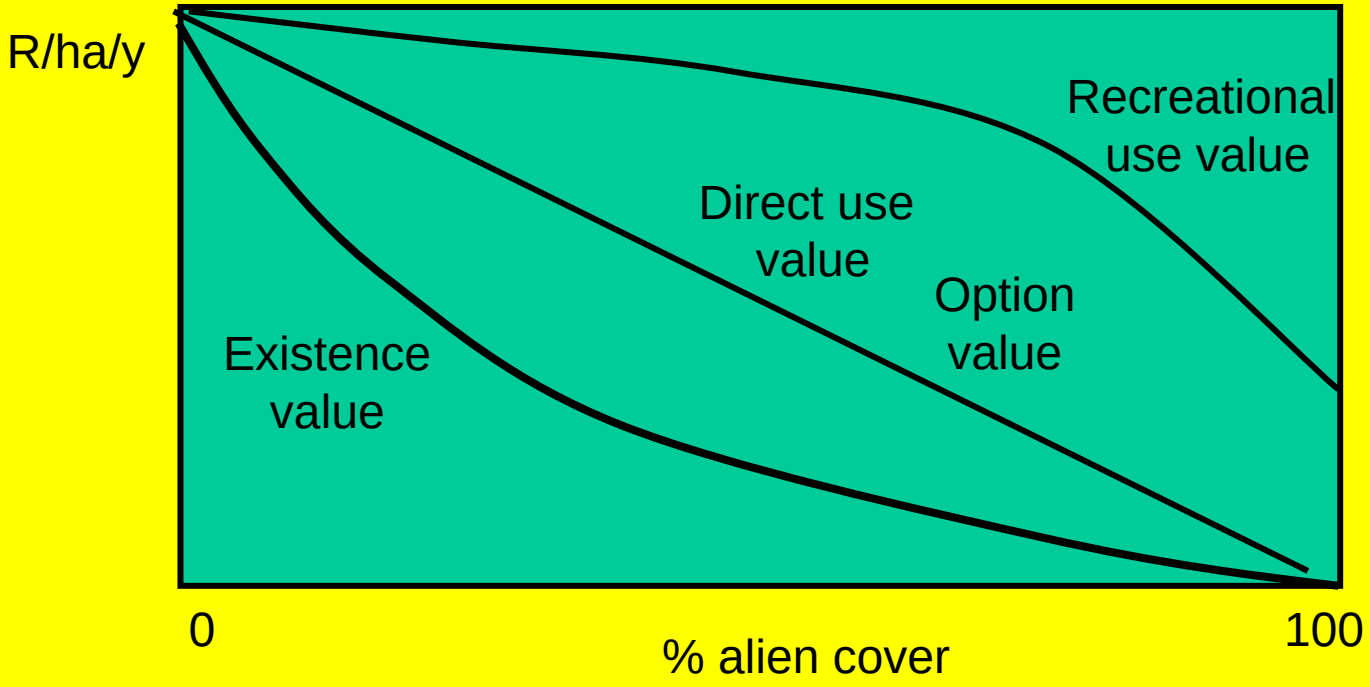
Decreased stream flow

Increased fire intensity

Soil losses

Degree of infestation vs value

- Largely unknown at this stage
- Types of relationships likely to differ for different types of value



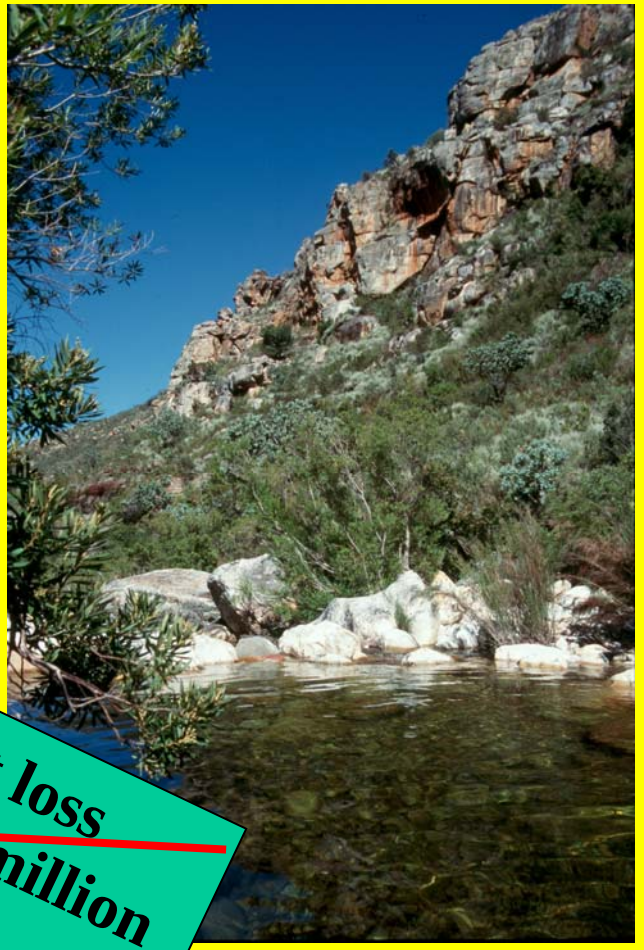
How much has already been lost?

Direct losses

- **Harvesting of natural products**
  - R20 million (24%)
- **Tourism**
  - R6 million (<0.1%)
- **Services**
  - Pollination & honey R194 million (23%)
  - Water R475 million
- **Existence value**
  - R9 million (17%)

Direct gains

- **Natural products**
  - R20 million



Net loss > R700 million p.a.

All values in 2000 Rands

- This does not include losses due to change in downstream aquatic ecosystems
  - Nursery and fishery values
  - Recreational value
  - Existence value

Strategic Use of Economics

1. Proper assessment very difficult
2. Tendency for decisions to be made on financial rather than economic considerations
3. Informed decisions difficult – eg, externalities, discounting – and implementation seldom what is predicted
4. Seldom undertake retrospective analysis – use as weapon
5. Must analyze benefits as well, especially mainstreaming
6. Advocacy (marketing) more important than it should be
7. Popularist externalities a challenge (eg, animal rights)
8. Fairness a challenge – eg, land-users having to clear land
9. Political horizons undermine importance of sustainability
10. For all these difficulties, it is essential to try to understand the returns on investment, and for IAS it will pay dividends