South Africa's Working for Water Programme

Guy Preston
Namibia Scientific Society
29th May 2023

Exponential Growth Experiment

Doubling the wheat grains every day.

The Impact of Invasive Waterweeds on Water Security

Roodeplaat Dam

Water Hyacinth

- Water hyacinth can double the area it invades on a dam in 10 days.
- It increases evaporation levels by over 40%.
- It adds to water quality impacts and costs (and exacerbates risks of toxic algae).
- It causes damage to infrastructure (insert: *hydrilla* impact on a pump, that cost R1.6m).
- It leads to eutrophication (oxygen depletion) and fish deaths – and bad smells.
- It results in a loss of recreational activities (e.g. fishing, rowing, sailing, swimming).
- It worsens diseases problems, such as bilharzia and (in malaria areas) malaria.
- It has caused people and cattle to drown.
- Hartbeestpoort Dam reputedly has up to 12 metres of goo-like sludge at the bottom, from invasives – depleting water-storage capacity.
- Herbicides are often necessary to contain the water hyacinth, with secondary impacts.

2012 Olympic Games: Lightweight Men's Four Final

(The South African gold medallists trained on Roodeplaat Dam.)

The "Four Ts" of Invasive Species

–

Trade, Travel, Transport and Tourism



These invasive species may be:

- **Plants** – such as these black wattles (*Acacia mearnsii*) from Australia, coming up like hairs on a dog's back, after a fire which killed the parent plant (the burnt tree in the foreground).
- **Animals** – like these common starlings in the USA. Someone wanted all the birds mentioned in Shakespeare to be introduced into America – with catastrophic impacts, in terms of the starling.
- **Microbes** – like this *Phytophthora*, a fungus-like species whose invasions have been responsible for problems such as potato blight, the rotting of soya beans, sudden oak death, and many others, including needle disease (above) in Chilean plantation of the Monterey pine (*Pinus radiata* – ironically itself an invasive tree in South Africa).

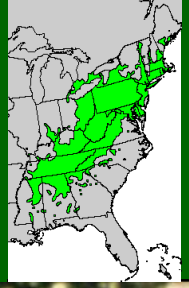
Microbial Invasions

Human Health and Invasions

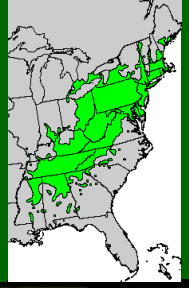
Bio-security alignment with efforts to combat human health invasions is essential – microbial invasions are among the most threatening of all invasive alien species.

COVID-19 is also, of course, an invasive organism

Chestnut trees once formed almost a canopy along eastern USA, running for thousands of kilometres from south to north.



Chestnut blight is just one microbial invasion (e.g. Dutch elm disease, sudden oak death – plus Asian long-horned beetle, etc).



Bovine tuberculosis is a major zoonotic bacterial disease.

The polyphagous shot-hole borer is an invasive beetle which, with its symbiont fungus, is killing a wide variety of plants, roughly half of which are indigenous, and a quarter of which are invasives.

In South Africa, there are 81 (known) breeding host species, and 78 non-breeding host species.

There is no chemical control for the PSHB. Bio-control is being researched.

Animal Invasions

- House crows, from India, kill the young of other birds, spread disease and harass people.
- Zanzibar has over 2 million house crows. The hotel pamphlets list species that are now very hard to find.
- South Africa had invasions in three port cities – Cape Town, Richards Bay and Durban.
- There were 500 birds in Durban in 2005. Left to invade, there would have been more than 250,000 birds in Durban by now. They appear to have been eradicated in Durban and Richards Bay.
- If South Africa fails to eradicate the house crow, we will be a pathway for an invasion up the west coast of Africa, with devastating impacts. We will eradicate them in Cape Town.

Invasive rats spread disease, and have many other negative impacts – and are estimated to eat one-third (1/3) of all grain produced in Africa.

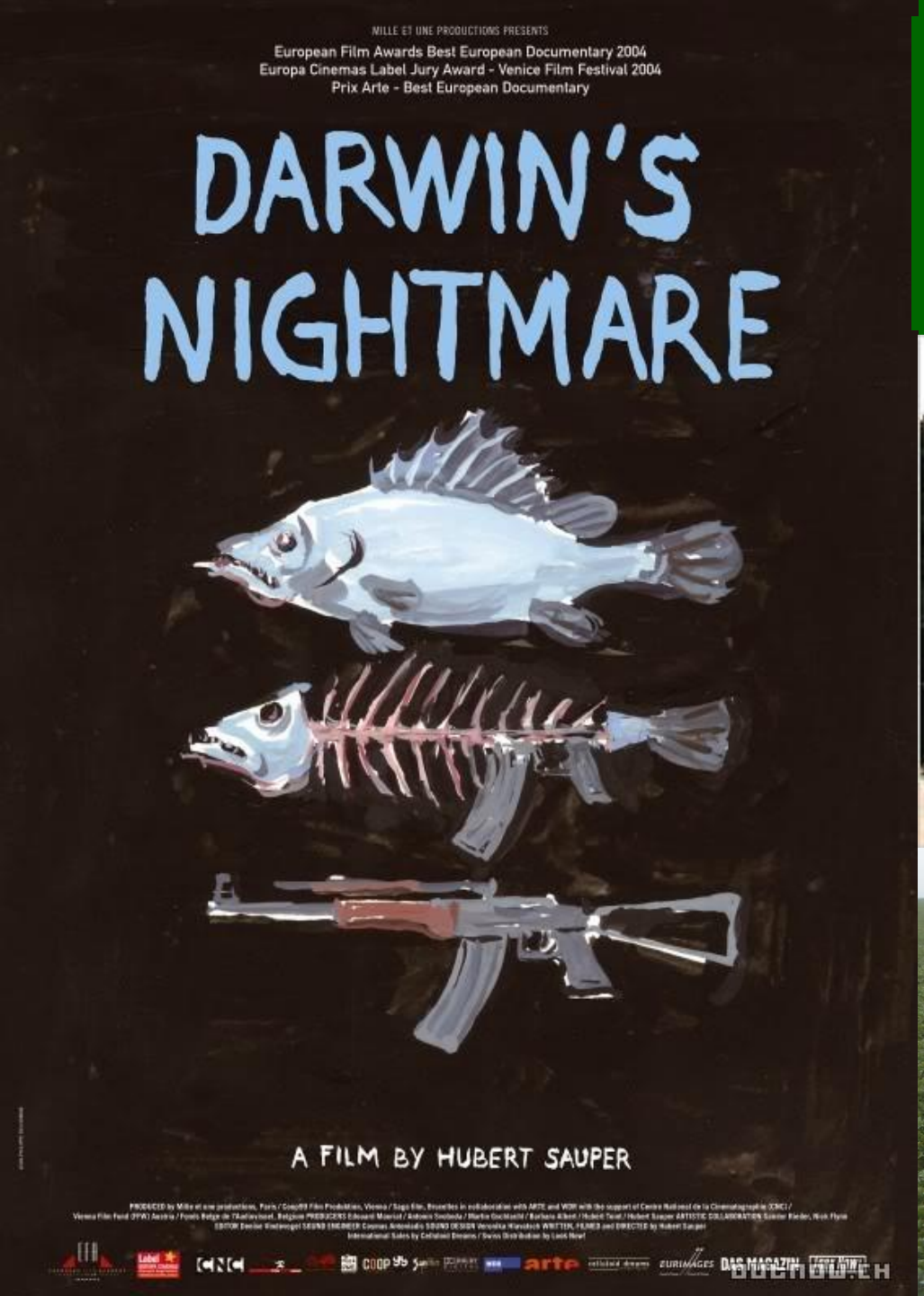
Zebra Mussels are choking the Great Lakes in the USA.

Cauleurpa seaweed is forming a green, marine desert in large parts of the Mediterranean Sea.

Lionfish

First noticed in Florida in 1992.

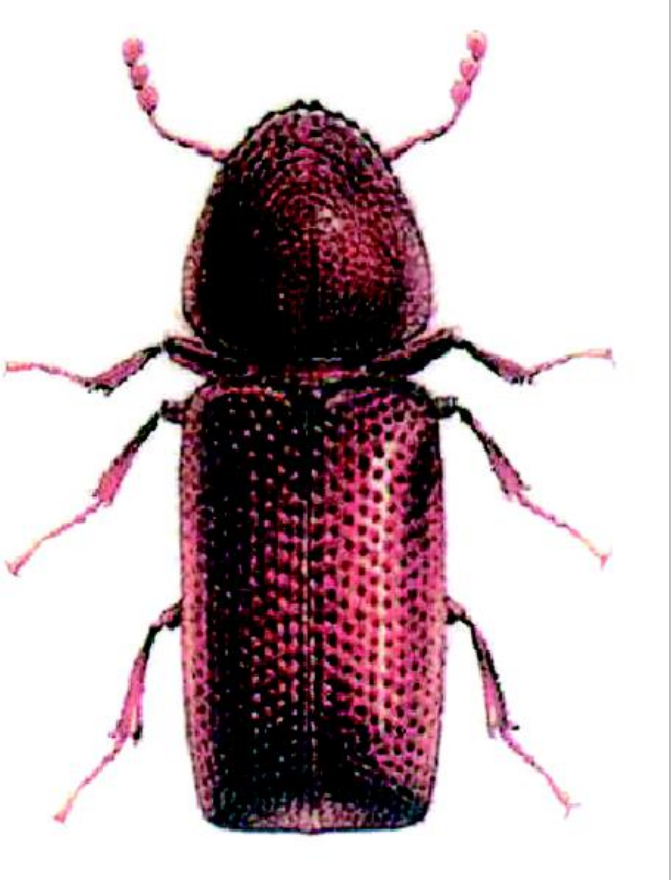
One lionfish can reduce the number of juvenile fish on a patch of reef by 79% in just five weeks.



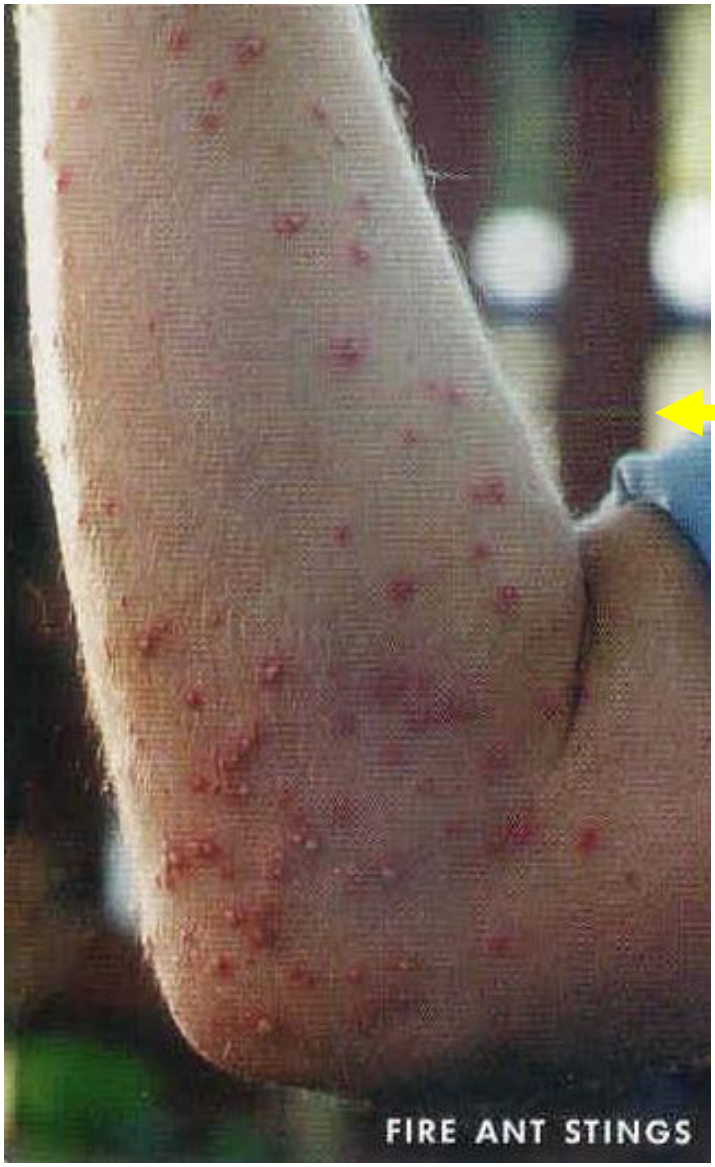
Nile perch was introduced into Lake Victoria. Together with water hyacinth, it has had a devastating impact.

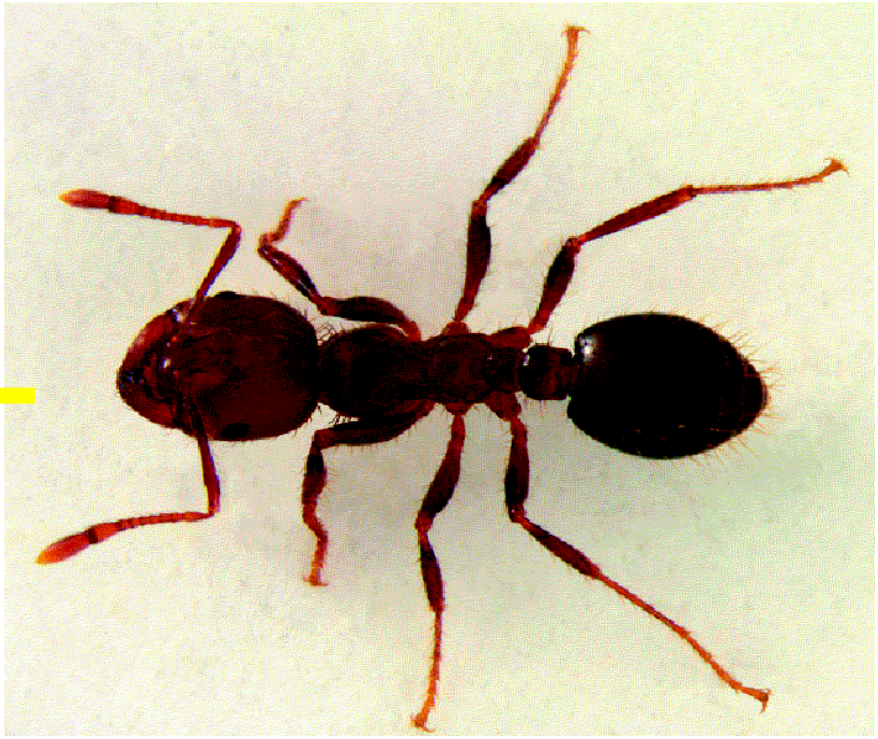
Research at the University of Stellenbosch has shown that over 50% of the endemic species of dragon flies and damselflies are threatened with extinction, owing to invasions by the black wattle (*Acacia mearnsii*).

We had not anticipated such an impact, and doubtless there are others.



Various pest species are impacting on food security. Of particular concern are our pollinators, such as by verroa mites on honey bees





The introduction into South Africa of invasive animals that threaten human life, amongst other impacts – such as the fire ant and various button spiders – appears almost inevitable, given the levels of trade, travel, transport & tourism.

SOUTH AFRICA'S PRINCE EDWARD ISLANDS

Home to 28 species of seabirds, including

- 44% of all Wandering Albatrosses;
- 25% of Sooty Albatrosses;
- 10% of Grey-headed Albatrosses.

Mice threaten 19 species with extirpation.

Mice “Scalping” a Wandering Albatross Chick

Video: Stefan Schoombie

Plant Invasions

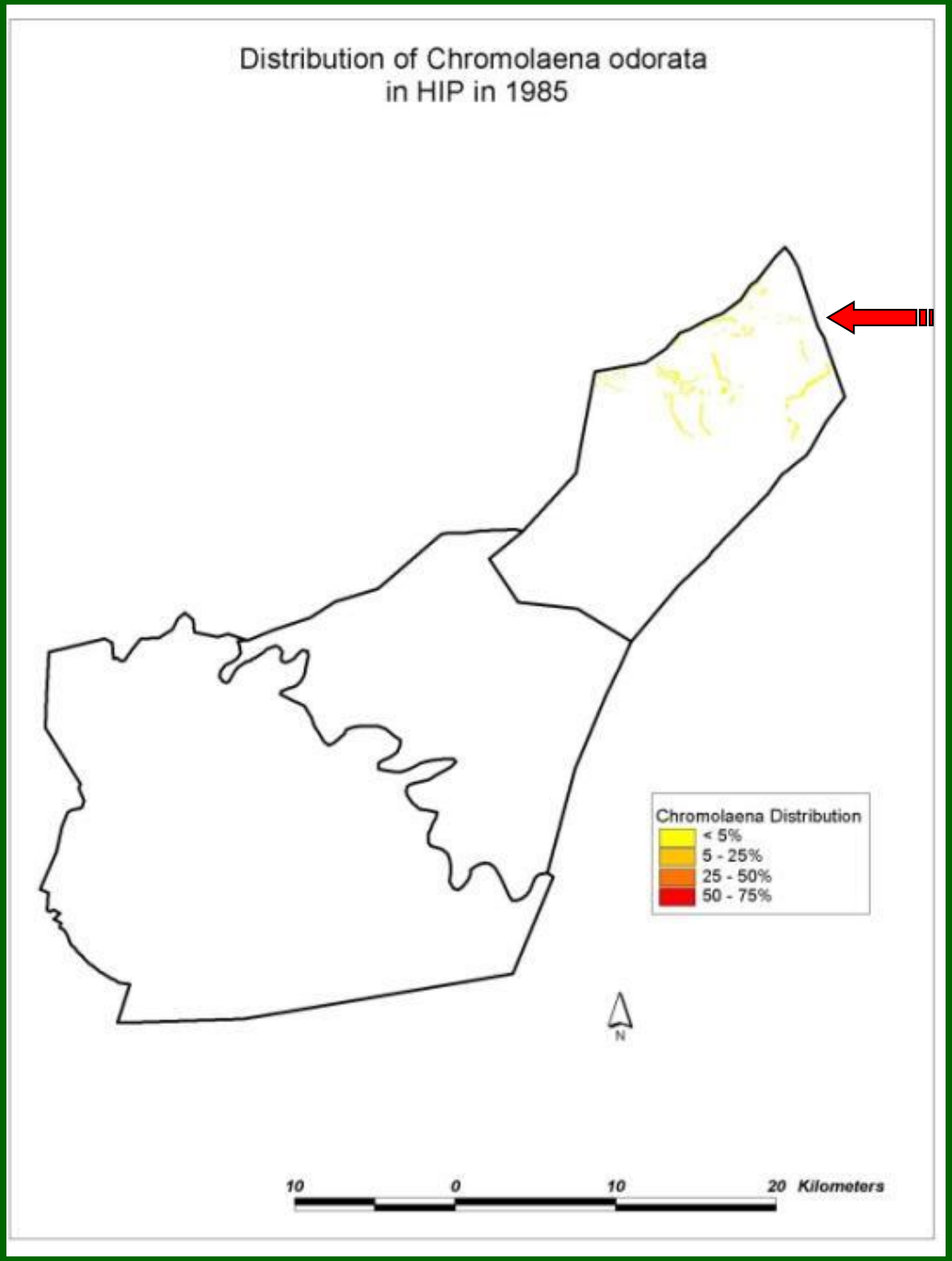
Prior to human arrival, a new species successfully colonized Hawaii once every 25,000 to 50,000 years.

Nowadays a foreign species becomes established in Hawaii about once every 18 days.

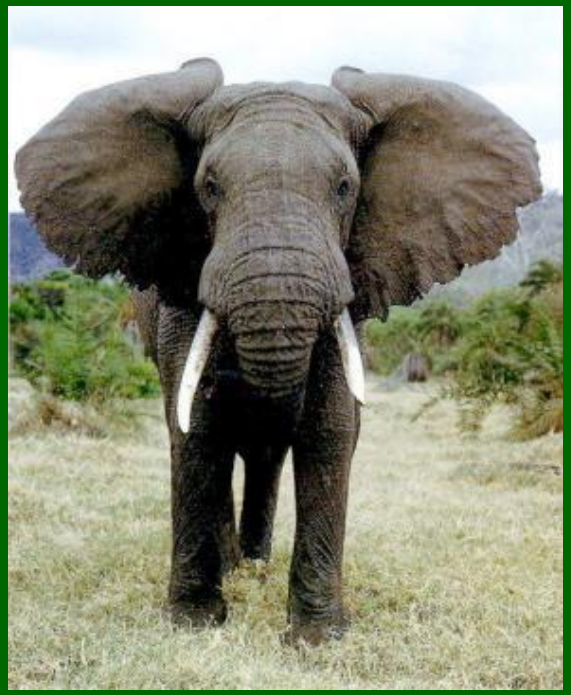
Pat Bily (The Nature Conservancy)

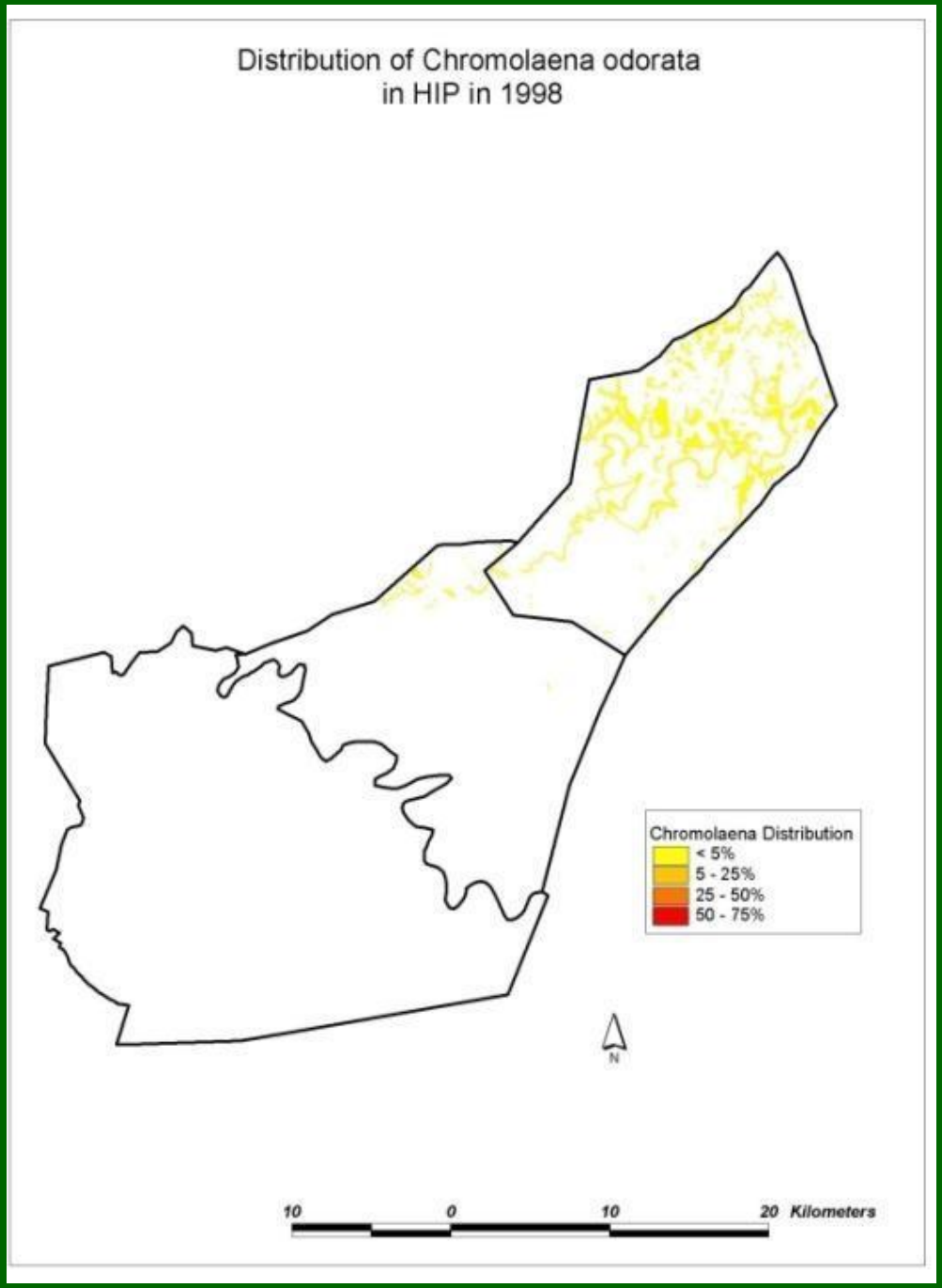
Chromolaena odorata (triffid weed), from Central and South America, is invading the Hluhluwe-Imfolozi Park. Our wild (and domestic) animals do not eat *Chromolaena*.

In South Africa's Hluhluwe-Imfolozi Park, what looks like land with a high carrying capacity for game, is being invaded by *Chromolaena.*

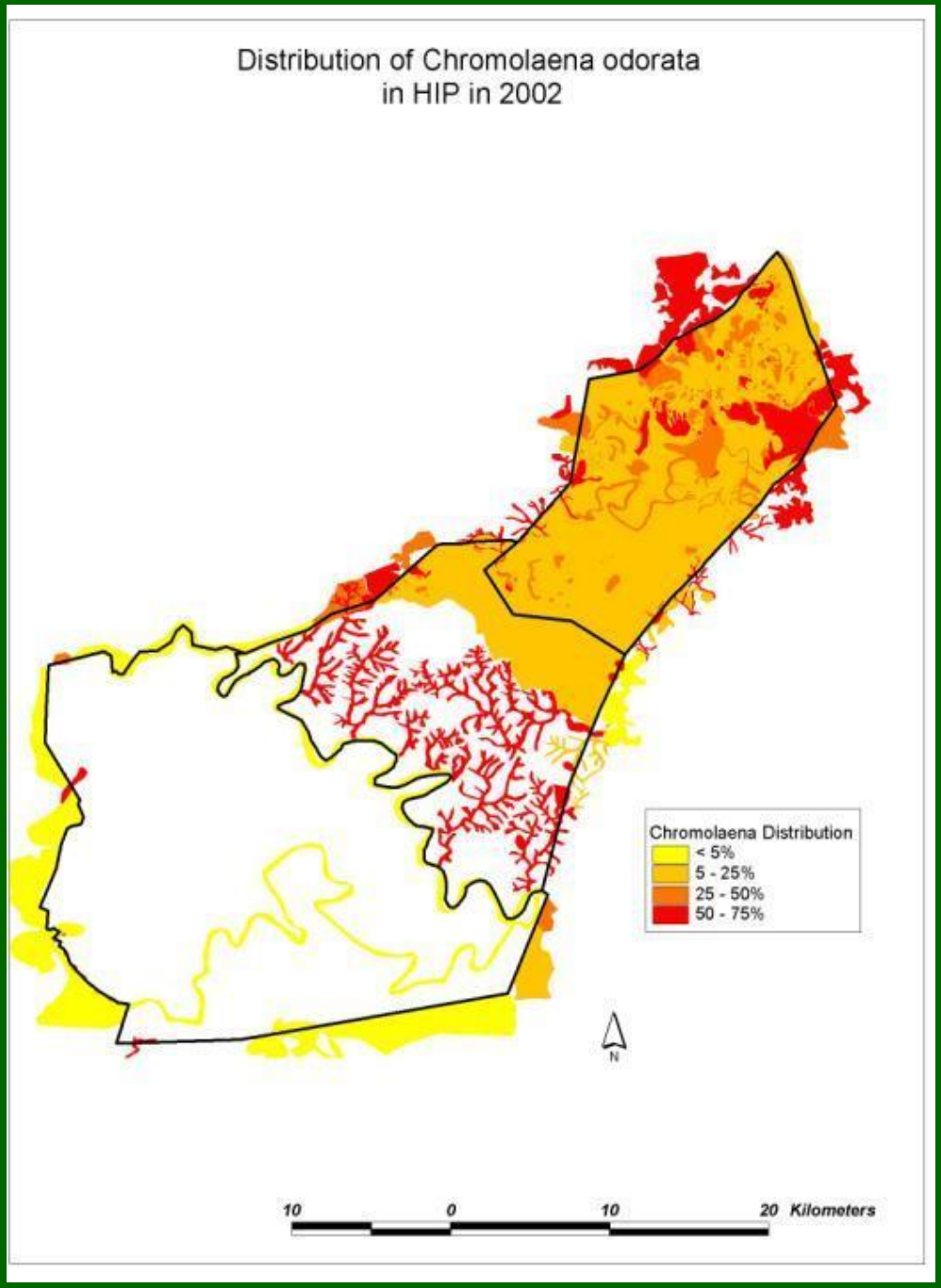


***Chromolaena* was mapped when invading the north-east section of the Hluhluwe-Imfolozi Park in 1985.**

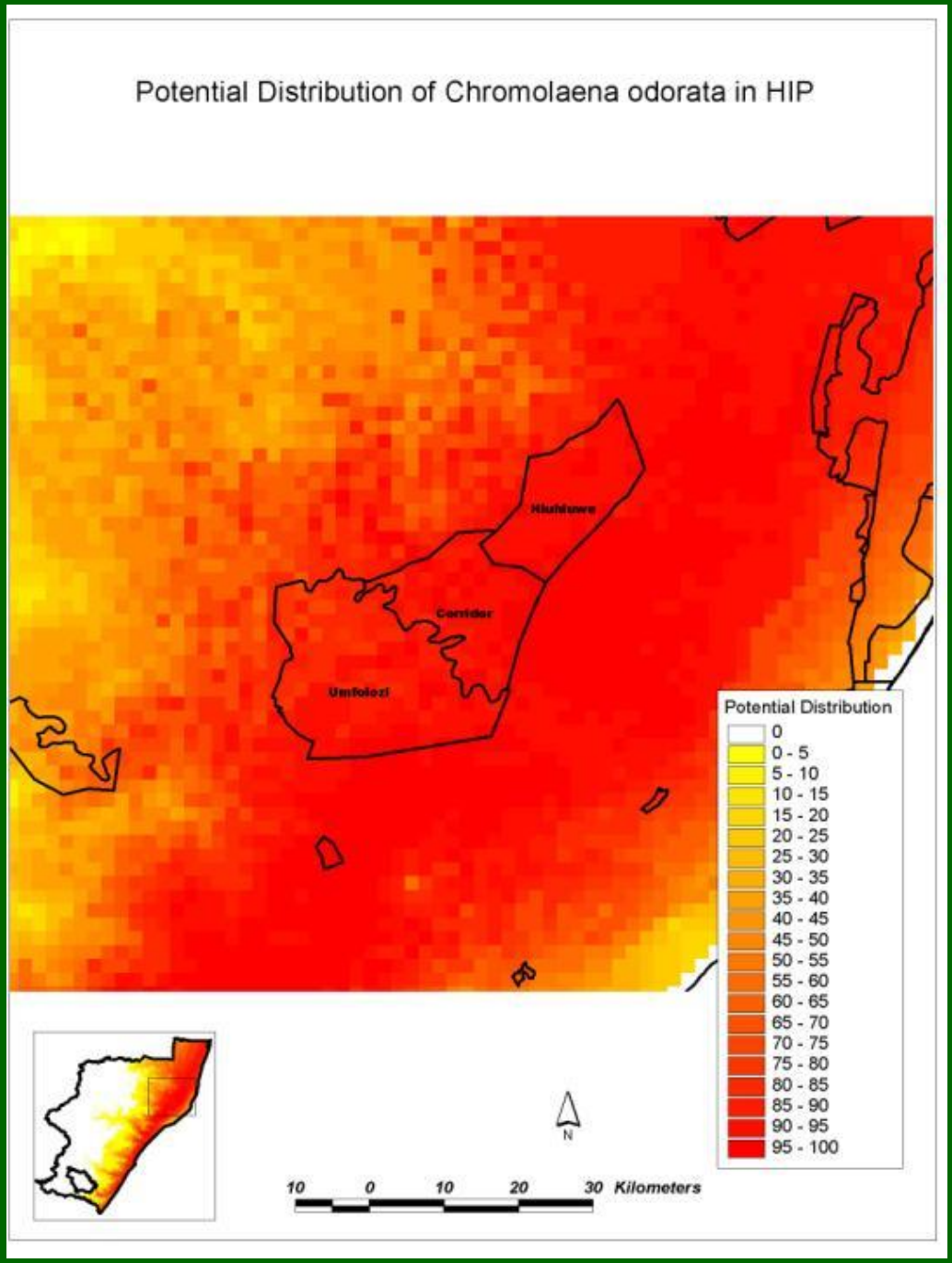




By 1998, the *Chromolaena* was far more widespread in the Park, although still at low densities.



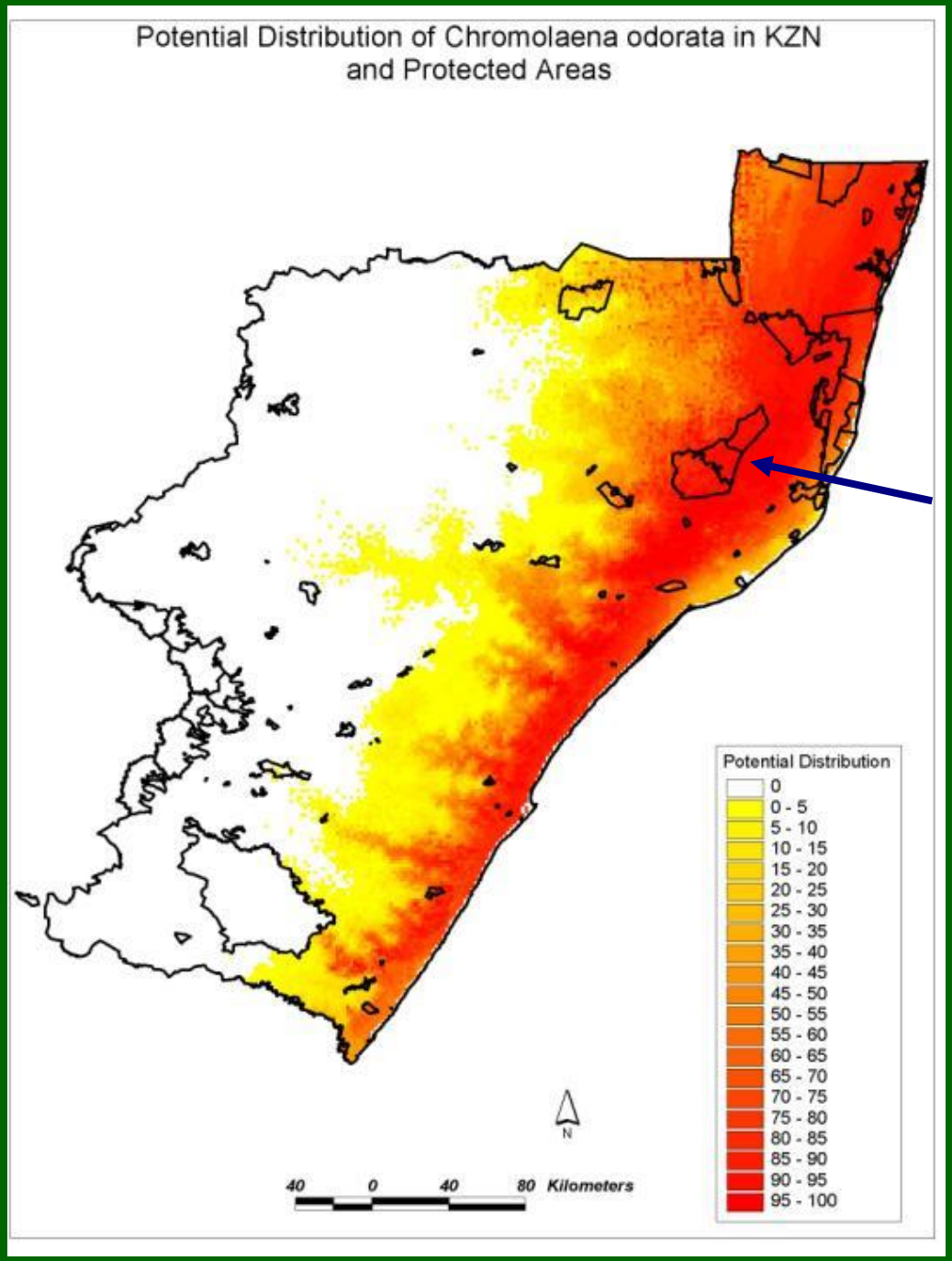
However, by 2002 (just four years' later) the level of invasion had changed dramatically. The *Chromolaena* had spread and grown across much of the Park, and the densities had become far greater as well.



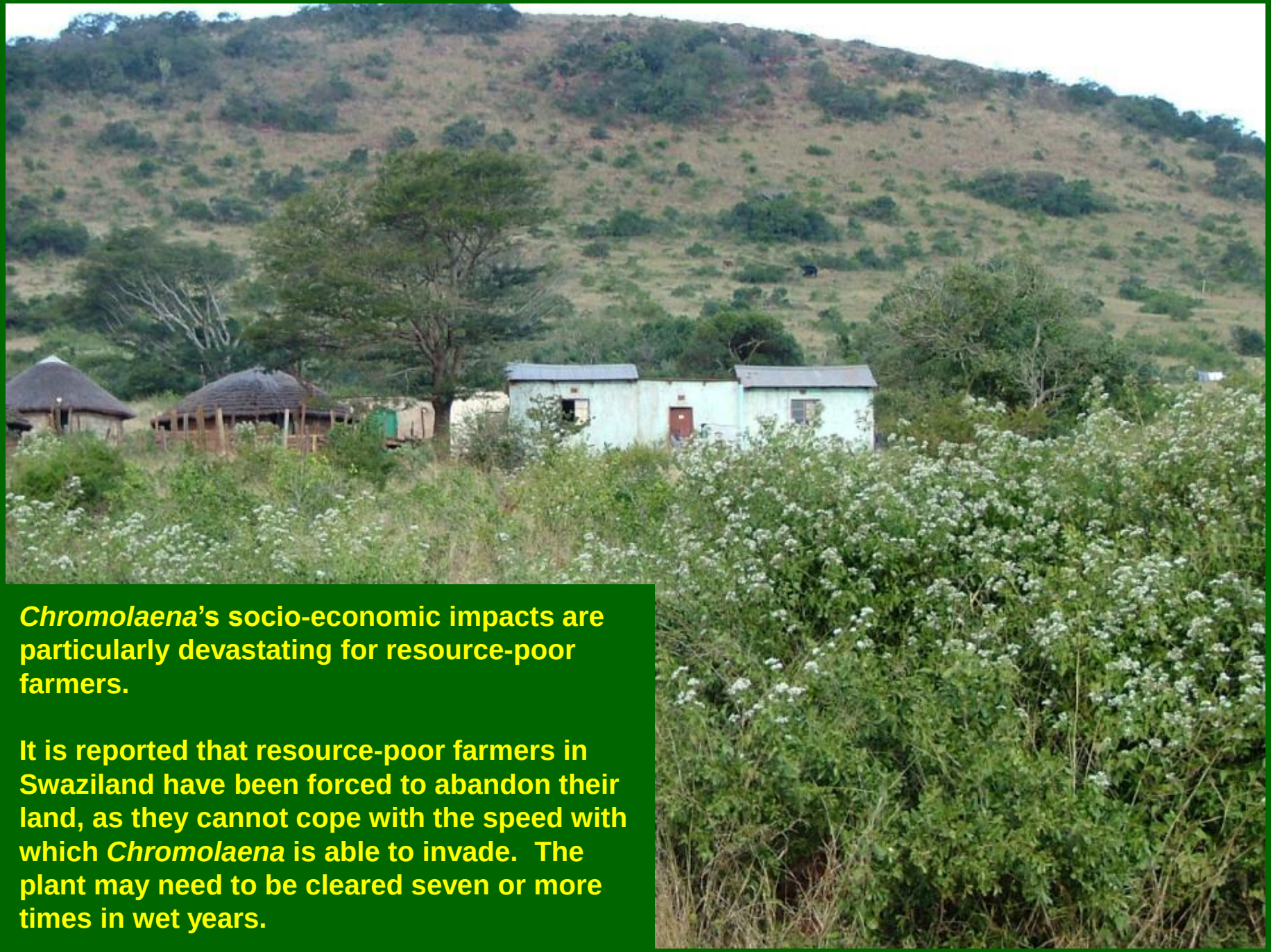
Projected Impacts in 2005

Our 2005 assessment of the invasion by *Chromolaena* was that it could engulf Hluhluwe-Imfolozi Park within ten years. If that was allowed to happen, then the impacts would be predictable:

- Little for animals to eat.
- No animals, no tourists.
- No tourists, no jobs. (Loss of 3,000 jobs.)
- Loss of R100 million p.a. revenue.
- Devastating impact on local economy, in an impoverished part of country.
- The biggest financial impacts would, however, be felt by the broad support industries that benefit from the tourism in the Hluhluwe-Imfolozi Park – and all of the other Parks that would inevitably face the same fate.



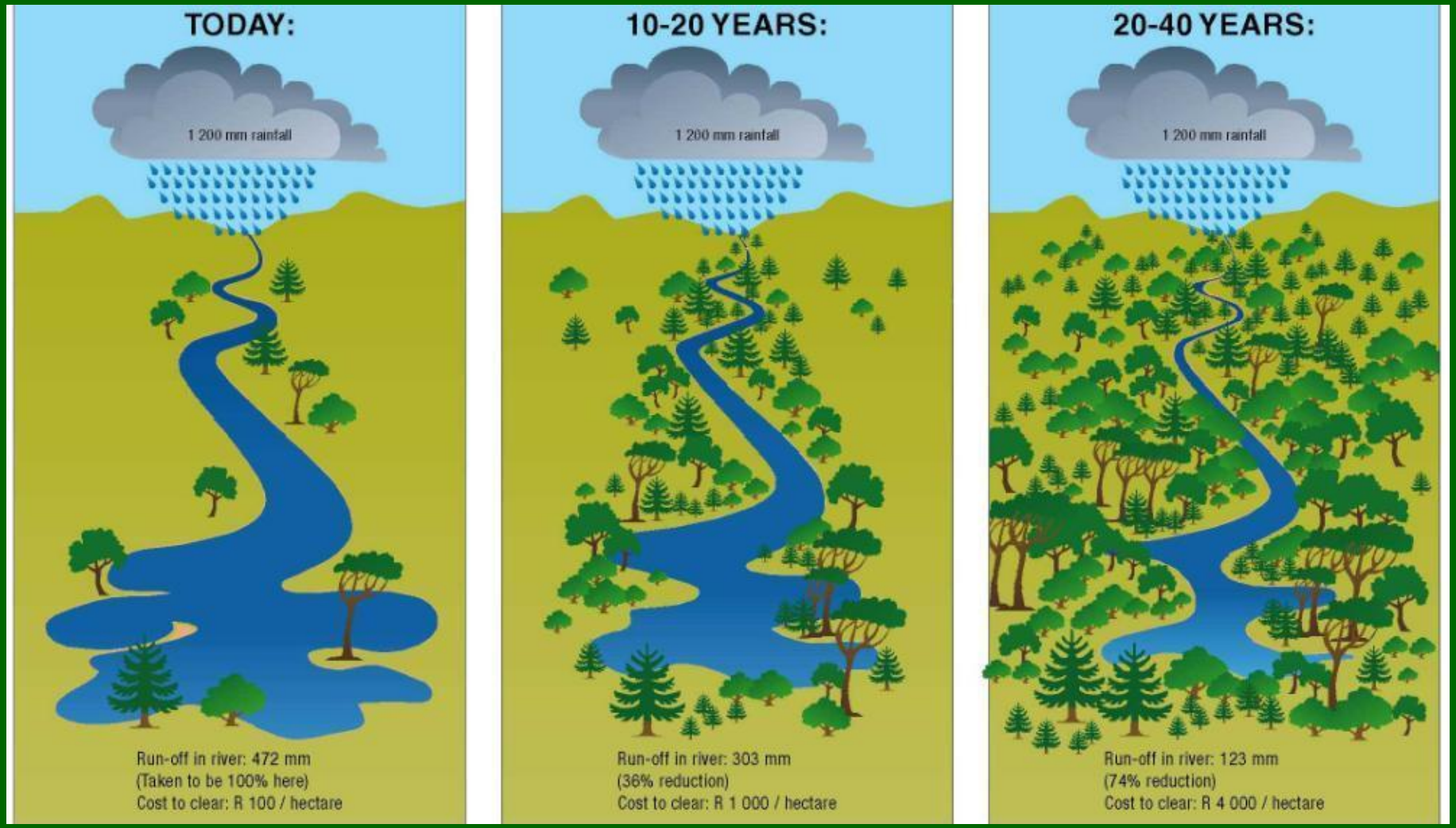
It's not just the Hluhluwe-Imfolozi Park that is being threatened by *Chromolaena*, but all lower-lying areas of KwaZulu-Natal and adjacent provinces in South Africa, as well as Swaziland and Mozambique. This shows the potential spread of the invasive alien plant in KZN.



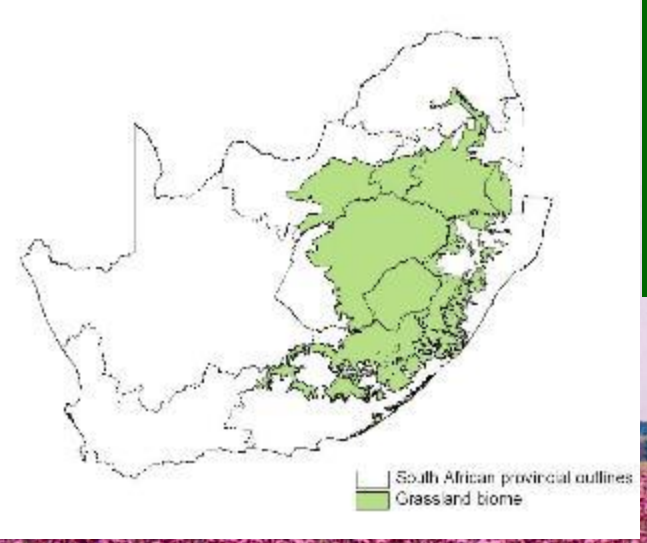
***Chromolaena*'s socio-economic impacts are particularly devastating for resource-poor farmers.**

It is reported that resource-poor farmers in Swaziland have been forced to abandon their land, as they cannot cope with the speed with which *Chromolaena* is able to invade. The plant may need to be cleared seven or more times in wet years.

Recent research has indicated that *Chromolaena odorata* may have impacts on water similar to those of large invasive trees like gums, pines and wattles. It is also known as the “paraffin bush”, for the intensity with which it burns.



Famine weed (*Parthenium hysterophorus*) is one of the worst invasive plants in South Africa. It is spreading into the Hluhluwe-Imfolozi Park by tourist and other vehicles. Here it is being sprayed inside the park, with a wall of famine weed outside the fence.

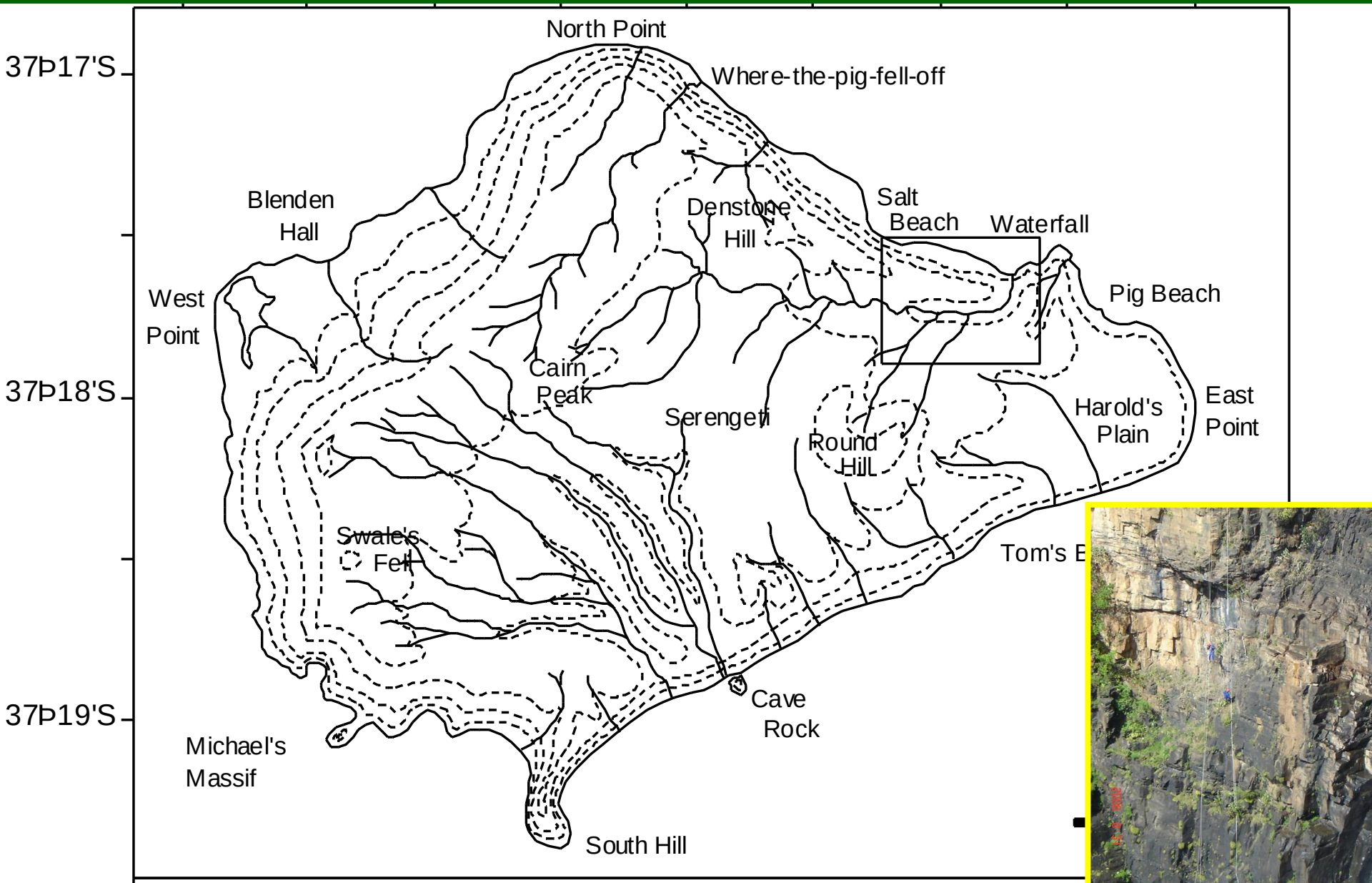


Pom-pom weed (Campuloclinium macrocephalum) is unpalatable for both stock and game. It can invade Southern Africa's grassland biome.

Invasive plants have devastating impacts on water supply, on the productive use of land, on the intensity of wild fires, on soil erosion, on flooding, on disease and many other negative impacts. Their impacts are measured in hundreds of billions of Rands.

Photo: Dr Brian van Wilgen.

High-altitude invasives are a priority. Left alone, they will reach thresholds where it is not possible to control them. It took two workers 12 hours to kill eight invasive New Zealand flax plants on Inaccessible Island, as they had to abseil down 1,000 foot cliffs.

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Pines invading at 900 metres altitude in the Langeberg, Western Cape

On the left, the ring-barking of a lone pine (arrowed) in 2007 led to a shedding of cones, and the plume of new seedlings.

Chemicals versus Suppression

Wattle invasion post a fire. On the right, suppression by grass species had been used, and on the left, spraying with herbicide was used!

Catchment management – and particularly of invasive plants – is the critical intervention to mitigate a “Day Zero” scenario in a changing climate.

Comparison of the Spread and Growth – 2008 vs 2053 (45 years)

Impact	2008	2053
Condensed hectares invaded	390 ha^{-1}	12,279 ha^{-1}
Percentage catchment (non-transformed) invaded	2.73%	90.49%
Cubic meters loss in Mean Annual Runoff	I,899,427 m^3	63,013,989 m^3
Percentage loss of MAR	1.39%	46.16%
Cost to clear (2008 Rands)	R4,129,207	R136,987,546

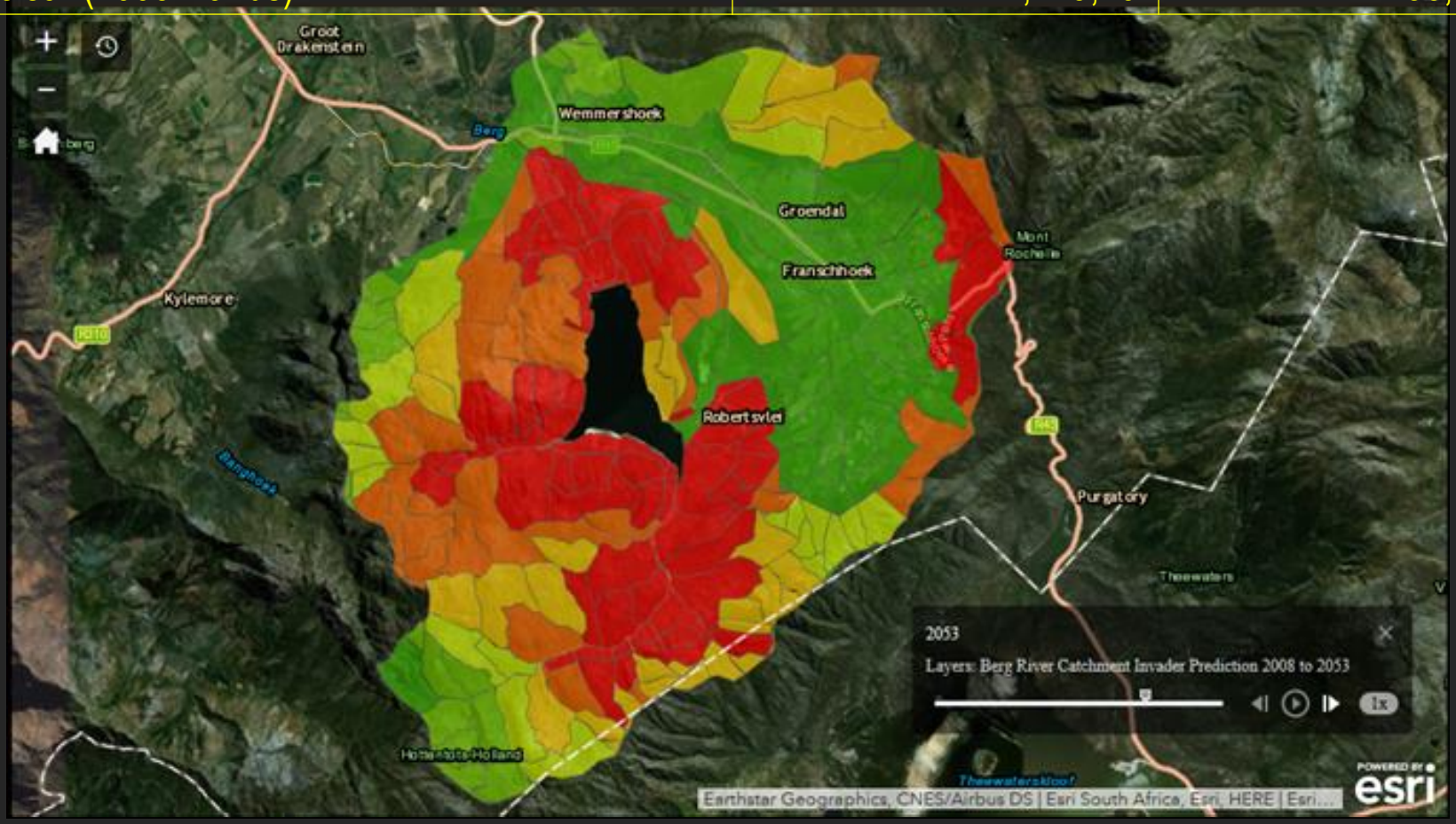



Table Mountain fire in January 2000.
80 structures were destroyed. Every burned house was surrounded by invasive plants.

Four WfW workers died in this vehicle when trying to outrun a wild fire in the Craggs area, in 1999. Nine workers jumped out of the vehicle, and lay in a stream. However, because of the invasions there was little water in the stream, and all suffered major injuries (particularly respiratory problem/singeing of lungs).

In South Africa, invasive species are:

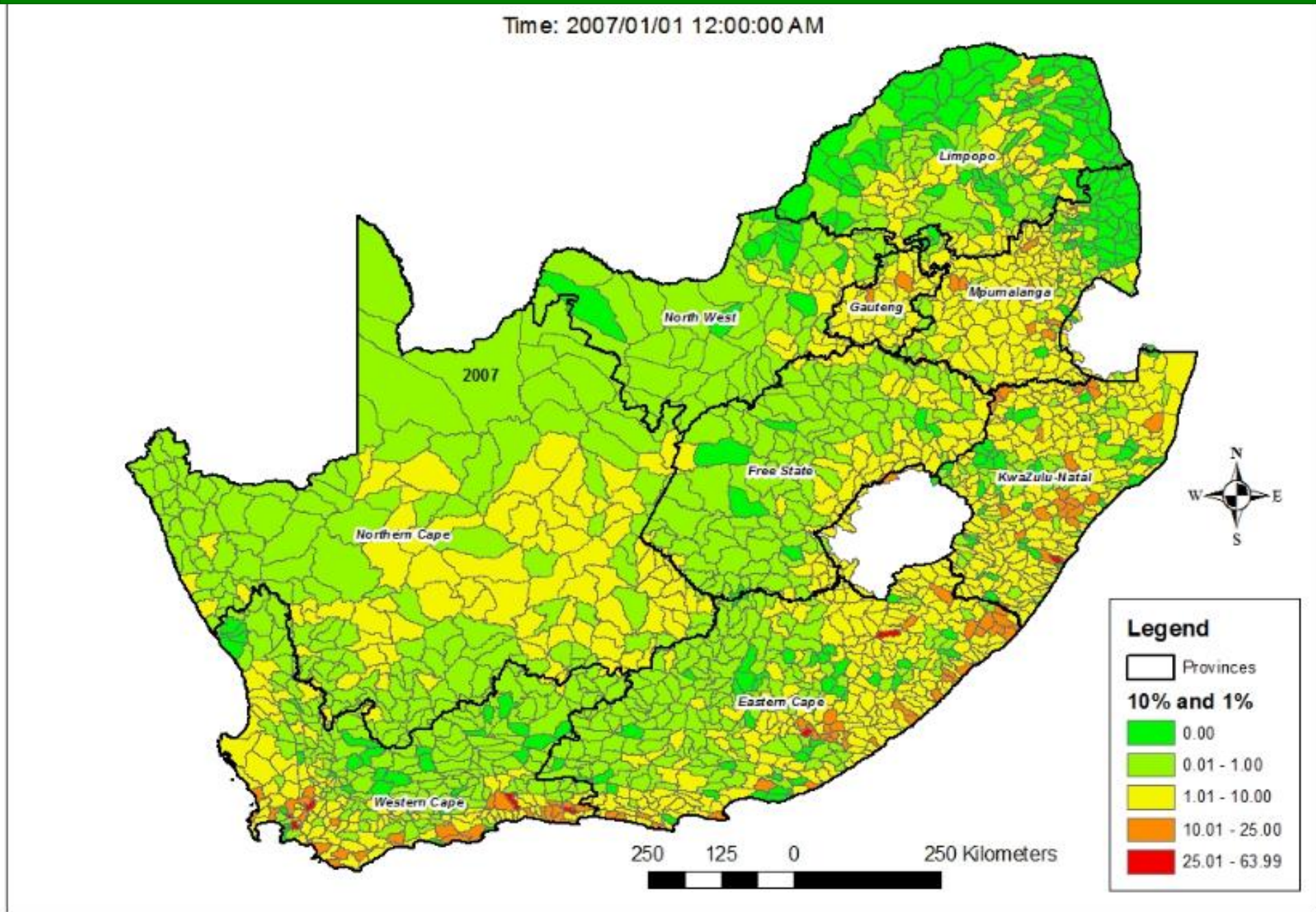
- The single biggest risk to our long-term water security.
- The single biggest risk in terms of catastrophic wild fires.
- The single biggest risk to our biological diversity (the third highest in the world).
- Plus many other impacts: erosion, siltation, sedimentation, disease, water quality, flooding, eutrophication, destruction of wetlands, the ecological functioning of natural systems, productive use of land and water, jobs, and the economy.

THE
WORKING FOR WATER
PROGRAMME

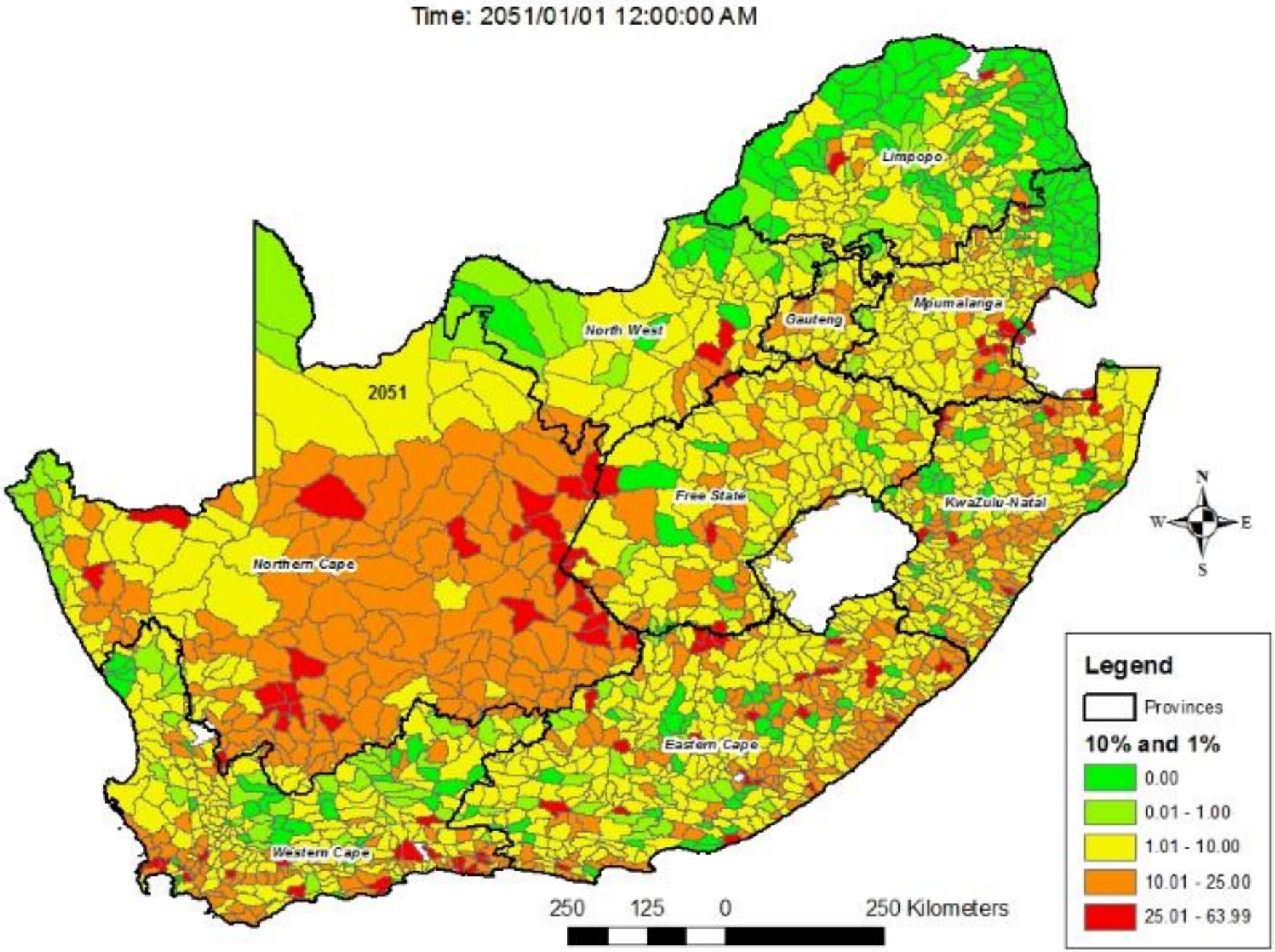
environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

EXPANDED PUBLIC WORKS PROGRAMME
CONTRIBUTING TO A NATION AT WORK

The estimated extent of woody invasives in South Africa in 2007.

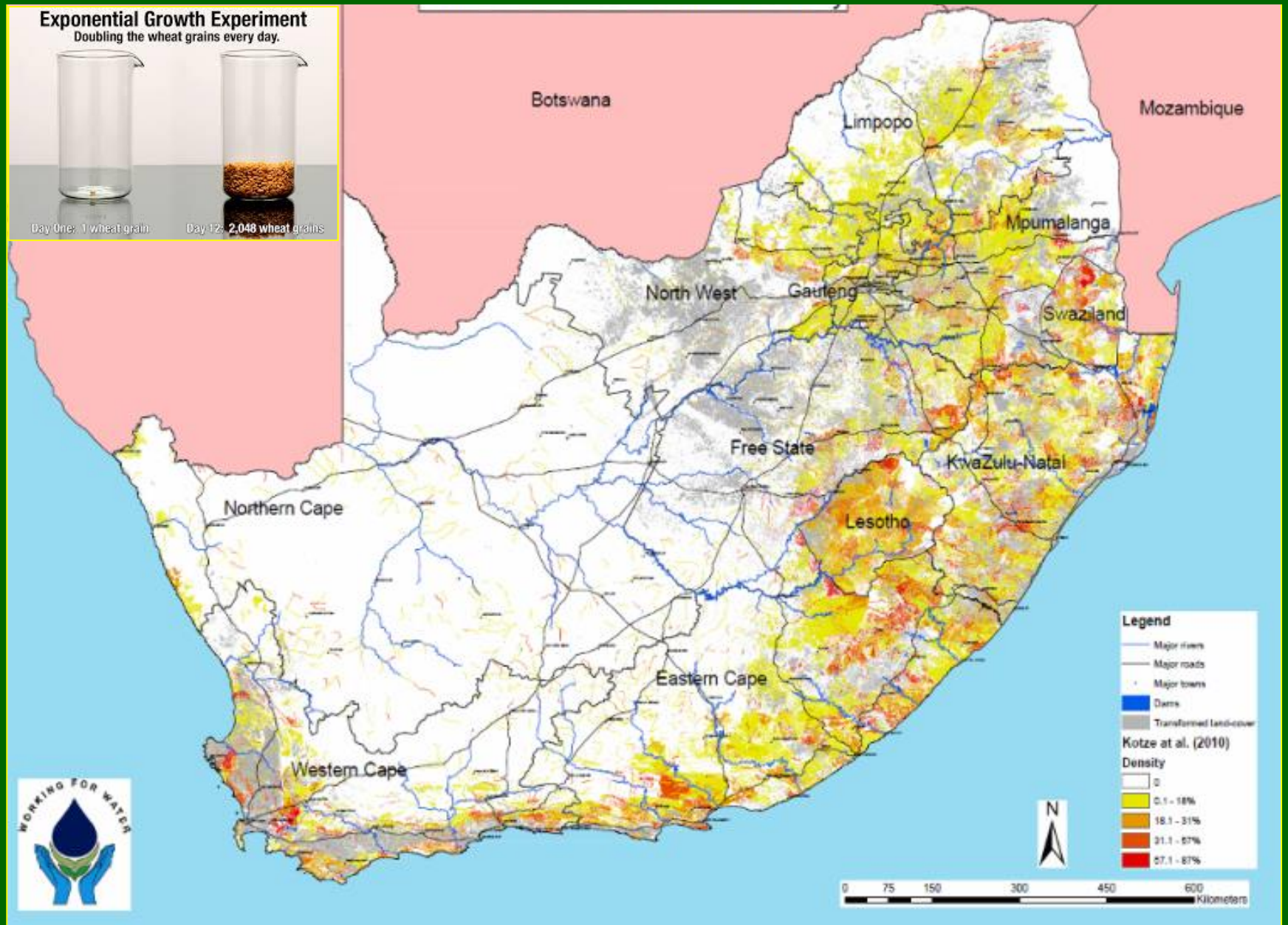


The estimated expansion of invasives in South Africa in 2051, over 44 years.



The *Working for Water* programme was started in October 1995, in response to the impacts of invasive alien species. A forerunner to the Government's Expanded Public Works Programme, it has taken a labour-intensive approach to the control of invasives, providing work for about 50,000 previously unemployed people annually. The costs of invasives have been estimated at hundreds billions of Rands.

Invasives were estimated to have covered over 20 million hectares of land in 2008 (Kotzé, *et al*, 2008).
It is estimated that, on average, they spread and grow at 10% per annum (i.e. doubling in just 7 years).
We are thus still in an early phase of the invasion of our land and water – plus facing all the new invasives.



The Impact of the Clearing of Invasive Alien Plants on the Value of Water, Grazing and Biodiversity

- "Our study showed that reductions in surface water runoff due to current invasions exceeded 3,000 million m^3 (about 7% of the national total)."

- "[T]he potential reductions would be more than eight times greater if invasive alien plants are allowed to spread and occupy the full extent of their potential range."

- "Although an estimated R6.5 billion was lost every year due to invading alien plants, this would have been an estimated additional R41.7 billion had no control been carried out. This indicates a saving of R35.2 billion every year."

- "The net present value of all control operations up to the end of 2011 would be in the order of R453 billion." ["About R400 billion of that relates to water quantity."]

Dr Brian van Wilgen and Dr Willem de Lange (CSIR) [1, 2]

1. *The costs and benefits of biological control of invasive alien plants in South Africa* (B.W. van Wilgen & W.J. De Lange). African Entemology (2010).
2. *An economic assessment of the contribution of biological control to the management of invasive alien plants and to the protection of ecosystem services in South Africa* (Willem J. de Lange & Brian W. van Wilgen). Biological Invasions (2010).

In the early years, we were sometimes wittily referred to as the *Walking on Water* Programme, such was our perceived success.

But behind every successful programme ...


… is a champion

Professor Kader Asmal

Minister of Water Affairs & Forestry

- No gloves;
- no goggles;
- no helmet;
- no boots;
- fancy pants;
- great t-shirt;
- bad stance;
- cutting too high;
- & he took eight swipes to fell the black wattle,

but …

what a Champion!

So What Can Be Done

Key Interventions in an Integrated Programme

Integration of Advocacy, Incentives, Disincentives and Research

Driven by integrity, honesty, courage, curiosity and pragmatism

a. Research.
b. Planning and prioritisation.
c. Advocacy.
d. Legislation (and then enforcement critical).
e. Prevention.
f. Partnerships.
   (Land-user incentives, and contracts. Policy of work on private land.)
g. Early detection and rapid response of emerging species.
h. Biological control.
i. Use of fire.
j. Mechanical control.
k. Physical control.
   (Task-based, light infestations, start with source of invasions, training, branding, heath & safety.)
l. High-altitude clearing.
m. Follow-up.
n. Monitoring and evaluation.
o. Value-added industries (coffins, desks, furniture, pads, wood-plastic, Biomass Insulated Concrete).

THE ALIEN AND INVASIVE SPECIES REGULATIONS, 2014

in terms of the

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT NO. 10 OF 2004)

	Taxa	Listed Invasive Species [s.70(1)]	Prohibited Alien Species [s.67(1)]
List 1:	Terrestrial and Fresh-water Plants	379	238
List 2:	Marine Plants	4	2
List 3:	Mammals	41	18
List 4:	Birds	24	20
List 5:	Reptiles	35	10
List 6:	Amphibians	7	9
List 7:	Fresh-water Fishes	15	110
List 8:	Marine Fishes	0	1
List 9:	Terrestrial Invertebrates	23	131
List 10:	Fresh-water Invertebrates	8	8
List 11:	Marine Invertebrates	16	7
List 12:	Microbial Species	7	7
Total:	**Species/Groups of species**	**559**	**561**

Categories of Listed Invasive Species

Category 1a Listed Invasive Species

- Take immediate steps to combat or eradicate listed invasive species.

Category 1b Listed Invasive Species

- Control the listed invasive species.
- Comply with any Invasive Species Management Programme.

Category 2 Listed Invasive Species

- Require a Permit to carry out a restricted activity within specified area.
- Must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or Permit.
- Specimens that occur outside the Permitted area or conditions are then Category 1b species.

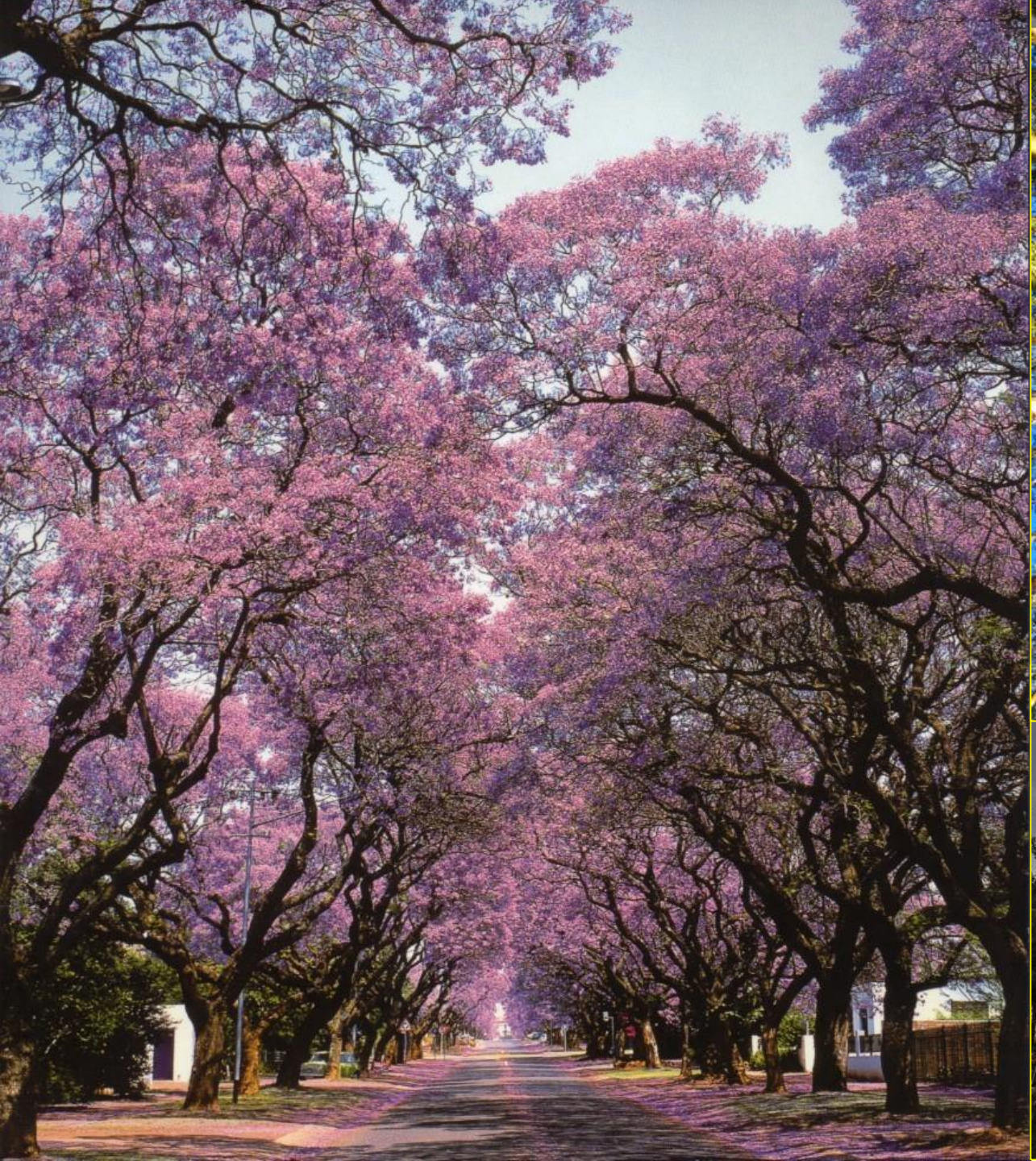
Category 3 Listed Invasive Species

- Subject to exemptions and prohibitions, as specified in the Notice.
- Any Category 3 plant specimen in riparian areas is to be a Category 1b species.
- Comply with any Invasive Species Management Programme.

Some of the laws that we proposed, but are yet to be enforced.

1. Land-users are responsible for the control of invasive plants on their land, and non-compliance can lead to (a) a fine; (b) the state doing the work at the land-owners' costs and risks, or (c) expropriating the land.
2. Those with invasions on land greater than 10 hectares can get support to clear the land, but must sign land-owner contracts to keep it clear (and failure will lead to the state clearing the land at the land-owners' expense).
3. Those utilizing invasive species require a permit, and are accountable for propagule pollution; further, the onus of proof for the origin of species that are invading lies with them.
4. Associations (e.g. game, forestry, nursery, fisheries) may have self-administration rights for the transfer & transport of Category 2 invasive species, but will be held accountable.
5. Those wishing to transfer land may have to have an invasive certificate, similar to a beetle certificate or an electricity certificate, before being allowed to transfer.
6. Those wishing to export live specimens must have a permit from the receiving country, accepting the import into their country.
7. Those wanting to import alien species into the country must take out insurance to cover their control, should they become invasive.

Conflict species like the mallard duck, the Himalayan tahr and the rose-ringed parakeet, although beautiful, do need to be controlled.



Witness (Durban)
18 Apr 2014, p.1

Fight to save trout industry

Groups oppose fish extermination

STEPHEN COAN

THE trout industry is fighting back against a state move to exterminate the fresh water fish, which they say will destroy a R14 billion industry.

"The Department of Environment and Agriculture is trying to destroy the trout industry by making trout an invasive species," charged Gerrie van der Merwe, acting chairperson of TroutSA, speaking in Nottingham Road yesterday.

In February the DEA, using the National Environmental Management: Biodiversity Act, named 332 species they propose listing as invasive aliens. One of them was trout.

The intention is to declare trout as invasive in all nature reserves, all mountain catchment reserves and all so-called fish sanctuary areas. This means they have to be eradicated.

Maps of affected areas recently released by the department include most of the trout fishing locations in KwaZulu-Natal, from the northern to the southern Drakensberg, thus impacting on trout fishing operations based around Nottingham Road and Underberg.

TroutSA was formed in December to respond to this threat and has combined with the Federation of South African Fly Fishers (Fosaf) to present a number of "road shows" highlighting the issue in trout fishing areas around South Africa and to garner support for the legal battles that might lie ahead.

Yesterday they made a presentation at the Nottingham Road Hotel. Those attending included hatchery owners, tackle dealers, farmers and fisher folk.

Pietermaritzburg lawyer Ilan Lax, Fosaf's national chairperson, together with Durban-based lawyer Ian Cox, a member of the convening committee of TroutSA, have submitted a 68-page document to DEA commenting on the proposed Alien and Invasive Species List and Regulations on behalf of TroutSA and Fosaf.

The heart of the their submission tackles the department on the legality of the laws they intend promulgating, while also taking issue as to whether trout are invasive or not.

Van der Merwe said trout have been in South Africa for 125 years and in the past the DEA and conservation bodies such as Ezemvelo KZN Wildlife were active in the introduction, breeding and conservation of the species.

"Now the department plans to eradicate trout," said Van der Merwe. "This hinges on whether trout are considered invasive or not."

Van der Merwe said there are around 40 trout hatcheries in South Africa and these "underpin a large industry with a big value chain", that "includes stocking trout waters, the hospitality industry and trout-based real estate in such places as Clarens, Rhodes and Dullstroom, as well as fly-fishing farms and estates in the Drakensberg.

Already the proposed legislation, which has been in the offing for the past eight years, has had an impact on property values. At Oak Lane Estate in Mpumalanga, stands valued at R295 000 have dropped to R165 000. At the prestigious Wellsmoore Estate, stand values have dropped from R1,2 million to R800 000.

Lax said the DEA had misread the National Environment Management Act (Nema), the umbrella legislation for the Biodiversity Act. He said there was a failure to appreciate that South African environmental law is anthropocentric in its orientation and implementation. He said Nema took a human rights approach to the environment.

"For a species to be defined invasive, it must be a threat to humans. If you can't show a species is harmful to humans, it is not invasive."

• StephenCoan@witness.co.za

Ian Cox, a member of the convening committee of TroutSA (left), Ilan Lax, Federation of South African Fly Fishers' national chairperson, and Gerrie van der Merwe, acting chairperson of TroutSA, gave a presentation on the threat posed to trout by the proposed legislation on alien and invasive species tabled by the Department of Environment and Agriculture at the Nottingham Road Hotel yesterday.
PHOTO: STEPHEN COAN

How trout add value to South Africa

The Department of Environment and Agriculture via the National Environmental Management: Biodiversity Act intends to declare trout invasive aliens in most of South Africa's premier trout fishing waters.

More than fishing
The trout fishing industry is estimated to be worth over R1,4 billion. Trout is much more than just recreational fishing. There are two principal drivers to this industry: the trout farming and trout processing industries, including the research and development components at Rhodes University and the University of Stellenbosch. Add to this tackle manufacturers, dealers and shops; trout fishing destinations and developments that exist either in whole or in part because many South Africans and foreign trout tourists fish here.

Rural growth
Previously disadvantaged communities in rural areas have long engaged in subsistence trout fishing and are increasingly exploiting the benefits this industry offers.

Interest
The phrase "trout fishing destinations in South Africa" generates 318 million hits on Google, "bass fishing destinations in South Africa" generates 74 500 hits, and "game viewing destinations in South Africa" 89 million hits.

Fishing getaways
The trout fishing industry in South Africa covers everything from day ticket fishing on public, communal and private waters, offering a massive variety of trout fishing getaways, ranging from camping and farm stayaways to luxury lodges that cost tens of thousands of rand a night. Tackle dealers estimate that approximately 100 000 fly rods are sold a year in South Africa.

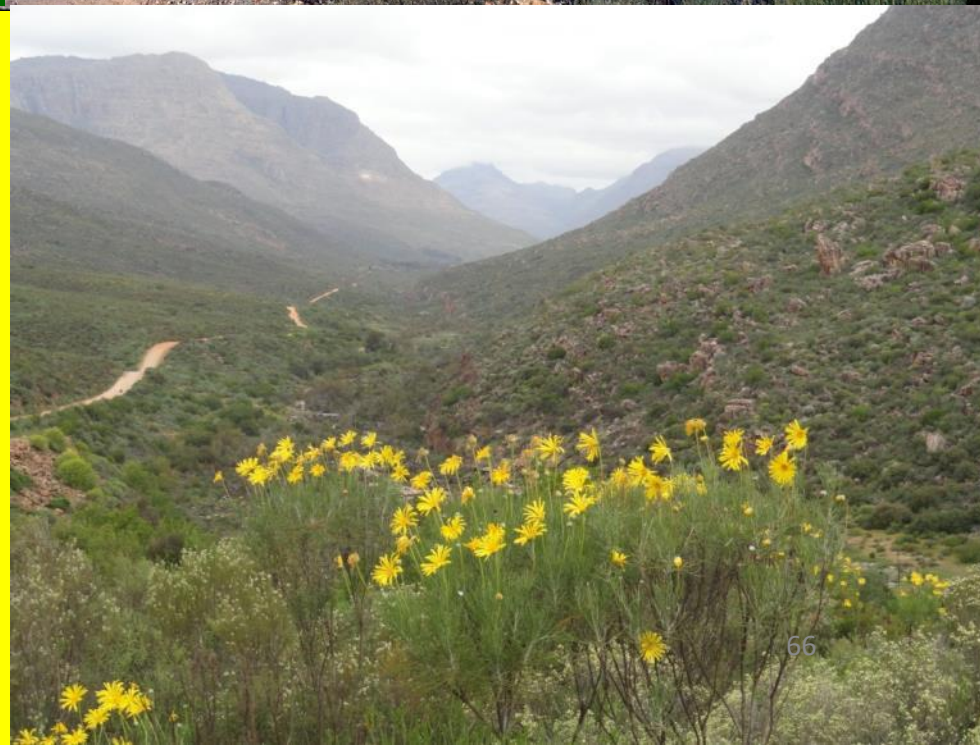
Preferred choice
There are 1,2 million fly anglers in South Africa who fly fish at least once a year, mostly for trout.

HANLIE MALAN, STEPHEN COAN AND ANDRE GOUWS, Graphics24

Vested-interest groups, lobbying for fly-fishing and aquaculture using brown and rainbow trout, arguing disengeniously that it is our intention to eradicate trout and destroy aquaculture.

Invasive Alien Plants and Run-of-River Abstraction, Low-Flows and the Water Reserve

- The pictures to the right show the Jan Dissels River in Clanwilliam in the year 2000 (top) and 2013 (bottom), after clearing of the black wattles by the Working for Water programme..
- Yield from run-of-river abstraction remains central to water security in South Africa, and clearing invasives is essential.
- Without this clearing, releases from dams to meet the environmental water reserve will be considerably higher.



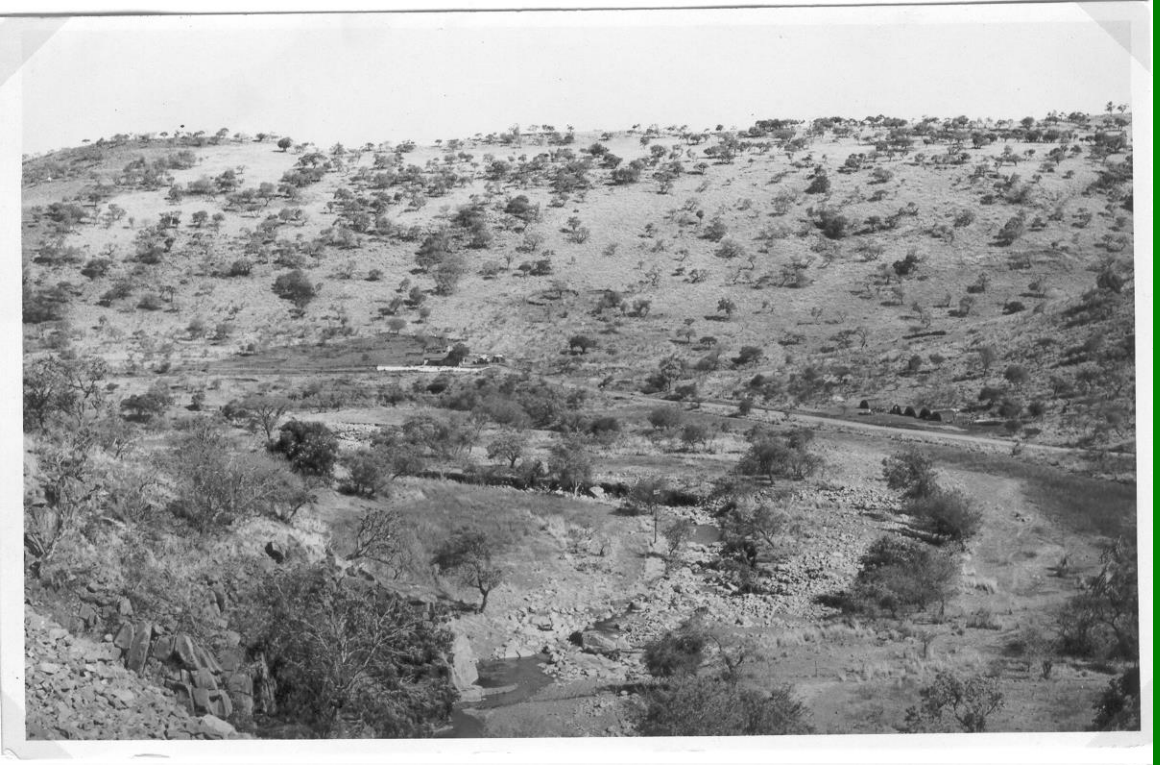
Seventy Species Under Biological Control

Water lettuce Crofton weed	Creeping prickly pear Small round-leaved prickly pear	Leucaena Stink bean
Mistflower Pompom weed	Sweet prickly pear Round-leaved tuna	Mesquite (Prosopis) Red sesbania
Triffid weed Spear thistle	Drooping prickly pear Bur cactus	Parrot's feather Brazilian waterweed
Parthenium Mexican sunflower	Large round-leaved prickly pear Australian pest pear	Hydrilla St John's wort
Red sunflower Madeira vine	Velvet opuntia Serpent cactus	Australian myrtle Giant reed
Cat's claw creeper Yellow bells	Barbados gooseberry (Pereskia) Small-leaf spiderwort	Water hyacinth Rock hakea
Long-spine cactus Queen of the night	Bailey's wattle Rooikrans	Silky hakea Carolina water fern
Chain-fruit cholla Boxing-glove cactus	Silver wattle Green wattle	Red water fern Giant salvinia
Imbricate prickly pear Pencil cactus	Long-leaved wattle Black wattle	Balloon vine Satansbos
Strangler cactus Moon cactus	Australian blackwood Pearl acacia	Bugweed Dense-thorned bitter apple
Devil's rope cactus Spiny snake cactus	Golden wattle Port Jackson willow	Chinese tamarisk Lantana
Dragon fruit Jointed cactus	Mauritius thorn Honey locust	

Research by Dr Barney Kgope, Professor Guy Midgley and a visibly concerned Professor William Bond (below) confirmed a potentially catastrophic link between climate change and habitat modification – and one that will be exacerbated by woody invasive alien plants.

Root and shoot growth of sweet thorn (*Acacia Karroo*) at different parts-per-million of atmospheric carbon dioxide (CO_2).

This will lead to massive impacts on a productive use of land, water security, wild fires, biological diversity, and more.



From pre-industrial
to current CO_2 levels?
Trees have increased
world-wide in savannas

Open savanna, South Africa
1955

Same place, 1998

(from T. Hoffmann, IPC)

Encroachment by sicklebush (*Dichrostachys cinerea)*

Bush encroachment by mopane
(*Colophospermum mopane*)

Bush encroachment by sweet thorn
(*Acacia karroo*)

Value-Added Industries

Making useful products from invasive species
(and ensuring that cherry-picking does not thwart efforts to control invasives)

environmental affairs
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Environmental Affairs
REPUBLIC OF SOUTH AFRICA

THE WORKING FOR WATER PROGRAMME

South African
NATIONAL PARKS

THE JOBS FUND

EXPANDED PUBLIC WORKS PROGRAMME
CONTRIBUTING TO A NATION AT WORK

Through our Eco-Furniture Programme, we have been using invasive biomass for:

Eco-coffins

High-quality furniture (desks, chairs, etc)

Eco-benches

Eco-desks

Toys & games, and crafts

Over 800,000 Learners now have quality school desks through our Eco-Furniture Programme, and many other products are being developed, to take full advantage of the potential utilization of invasive biomass.

Multi-purpose chess tables

Wood-wool erosion blankets & bio-char

A variety of options are still being looked at, such as biodegradable sanitary pads & nappies, and wood-plastic composite products.

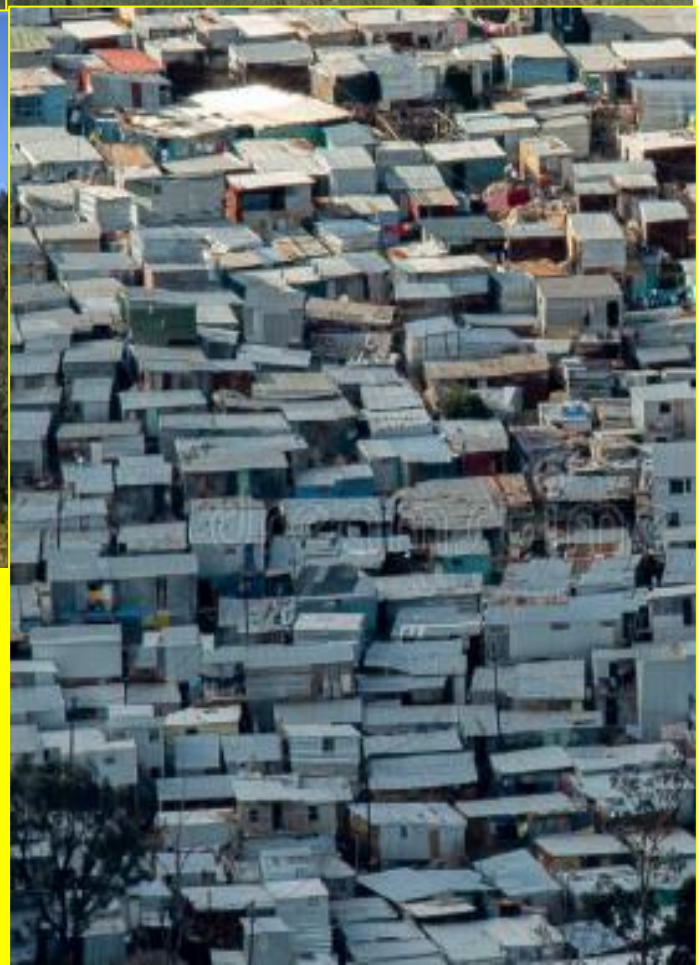
An Emergency Hut was built on Gough Island (which can sleep ten people), with wood-plastic composite cladding, and furniture and fittings from invasive poplars.

Approximately 4,000 people lost everything in a fire that swept through Masiphumelele in Cape Town in 2015 (right).

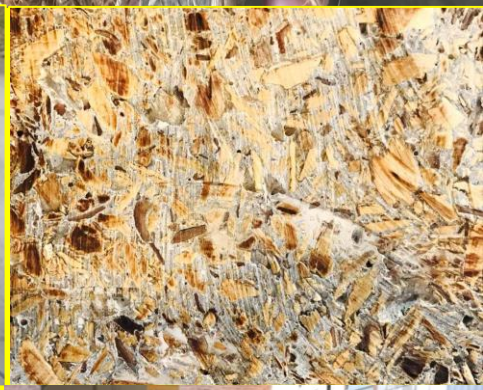
Its happens time and again.

Rather than fighting fires (here through our Working on Fire planes and helicopters), we wanted to prevent them.

We wanted to use invasive biomass (which is a major factor in wild fires) to build fire-proof structures – and to design houses and communities that were safe, dignified and green.



The successful fire-test in Mamelodi, testing woodwool-cement board. A Light House was surrounded by 8 shacks that were then incinerated. One of the shacks was lined with our material, and fire-shutters. Both the treated shack and the Light House were unscathed. The others were burned to the ground. Temperatures reached 1,500^{o}C. We were so confident that we had people in the house during the fire.



Invading alien plants are cleared, chipped and used to replace sand and stone in a strong, **low-cement, bio-based wood-chip cement concrete**. A patented binding agent is mixed with the woodchips (75%) and addatives (including just 15% cement), to make a material stronger than conventional options.

Cross-cut sample of 200mm Light House wall after exposure to 1 100 C furnace for 3 hours, 70% chipped gum trees

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The Agrément certification has been achieved with flying colours – a three-hour fire-rating; three-story load-bearing, and superior properties shown overleaf. It was tested over 3 years to be termite-proof (left).

BIC fares very well in comparison to clay brick, hollow concrete and poured concrete structures:

- It has superior acoustic properties.
- It has excellent thermal properties.
- It has a three-hour fire rating in the Agrément test – the best yet tested.

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Ranked comparison between Biomass Insulated Concrete Wall (130 mm panels and 200 mm in-situ walls) with other wall options, and comparisions of foundation options

WORKING ON FIRE

The ranking of the different products was done with the best performer receiving first position and the worst performer receives maximum points.
The product with the lowest amount of ranking points is the recommended number #1 choice.

Parameters	ROK 225mm thick with Plaster	R1	Hollow Concrete MA Block with Plaster	R2	Traditional Concrete Pour	R3	BIC Panel 130mm thick	R4	BIC In-situ 200mm thick	R5	Recycled Plastic & Fly-ash Blocks (90 mm)	R6
Basic Raw material	Clay, Aggregate, Sand, Charcoal	4	Stone Aggregate, Sand, Cement	5	Stone Aggregate, Sand, Cement	5	Biomass Chips, Cement, Fly ash, Water.	1	Biomass Chips, Cement, Fly ash, Water.	1	Waste polystyrene, Cement, Fly ash, Water.	1
Product Agrémont history	tbd	1	2000	2	2011/403	3	2018/578	5	2018/578	5	2015/477	4
Production Process & setup	Clay mixer & kniers.	1	Mobile or stationary block plants	4	Stationary plant with mobile 12-ton delivery	6	Using ribbon mixer.	1	Using ribbon mixer.	1	Using traditional mixer.	4
Lead time (days)	14	6	7	3	1	1	7	3	1	1	7	3
Requiring Plaster or Paint	Plaster & Paint	4	Plaster & Paint	4	No Plaster, No Paint	1	Skim Plaster & Paint	3	No Plaster with Paint	2	Plaster & Paint	4
Dry Density (kg/m3)	1840-2400	5	1700	4	2240-2400	6	600-1400	3	500-1400	2	375-550	1
Compression Kg/cm2 (Mpa)	51-90 (5.1-9.0Mpa)	3	30-70 (3.0-7.6Mpa)	5	120-140 (12-14Mpa)	1	(5.1-14.0MPa)3111 mix	1	58-90 (5-9.0Mpa)	3	27-58 (2.9-4.2Mpa)	5
Tensile strength kg/m2	22,5	1	21,42	6	20,91	5	22,95	1	22,95	1	tbd	4
Aging	Lose strength with age	5	Yes	5	Yes	1	Gains strength with age (Like conv concrete)	2	Lose strength with age	2	Lose strength with age	2
Usage	Heavy weight structural and non-structural applications	5	Light weight structural and non-structural applications	1	Structural applications only	6	Light weight structural and non-structural applications	1	Light weight structural and non-structural applications	1	Light weight structural and non-structural applications	1
Sound insulation	Excellent 59 STc	2	Good 38 STc	5	Good 36 STc	6	Excellent 66 STc	1	Excellent 49 STc	3	Excellent 40 STc	4
Eco-friendliness	Consumes clay material. Based on sustainable green building. Not pollution-free due to brick firing, Scope 1 emission, consumes fly-ash (and hazardous industrial material)	6	Low energy, no smoke, use stone aggregates, soil erosion, sand rehabilitation, heavy on roads and high transport costs.	4	Low energy, no smoke, use stone aggregates, soil erosion, sand rehabilitation, heavy on roads and high transport costs.	4	Invasive plants biomass (with water, fire, biodiversity & erosion benefits). Based on sustainable green building. Pollution free. No primary energy consumption. Consumes fly-ash (and hazardous industrial material).	1	Invasive plants biomass (with water, fire, biodiversity & erosion benefits). Based on sustainable green building. Pollution free. No primary energy consumption. Consumes fly-ash (and hazardous industrial material).	1	Consumes waste styrene material, as recycled material. Based on sustainable green building. Pollution in carbon footprint (EDR not available). No primary energy consumption. Consumes fly-ash (and hazardous industrial material).	3

- It is a largely straight-forward building option, requiring limited equipment.
- It is more labour-intensive than other options.
- There is virtually no waste on a building site.
- It is the “greenest” building option, including with a negative carbon footprint.
- Instead of mining for aggregate, it turns harmful biomass into a superior aggregate.

Parameters	ROK 225mm thick with Plaster	R1	Hollow Concrete MA Block with Plaster	R2	Traditional Concrete Pour	R3	BIC Panel 130mm thick	R4	BIC In-situ 200mm thick	R5	Recycled Plastic & Fly-ash Blocks (90 mm)	R6
Water saving -(m3/m2.a)	0,028	3	0,034	5	0,032	4	-5,825	2	-5,8	1	0,034	5
Thermal conductivity W.mK	0.6-1.1 (density depending)	4	1.8-2.1 (equivalent thickness and density depending)	6	1.1-1.8 (equivalent thickness and density depending)	5	0.11-0.15 (density depending)	3	0.11-0.18 (density depending)	2	tbd	1
R-value (m2K/W)	(230mm)	1	(Concrete block 6") 1.25	1	(Concrete block 6") 1.25	1	(ABC block 6.5")	1	(ABC block 6.5")	1	(1.109 @ 4")	1
R-value equivalent thickness (m2K/W)	0,30	5	0,104	2	0.8-1.1	2	1,18	2	3,55	1	1,11	2
Fire rating (min)	30-240min (Cracked after 30min)	2	60 (cracked after 20min)	6	78	5	94	2	180 (no crack after 3h)	1	60-120	2
Block size and shape	Any size, shape given by mould 2200x105x73	1	Typical size mould 140x190x390	6	Any size, shape given by mould 100mm	1	Any size, shape given by mould 140x190x390	1	Any size, shape given by mould	1	Size 1200x900x90mm, shape given by mould	5
Water absorption capacity	ROK Brick (without plaster or waterproof rendering) absorbs water at approximately 12-20%.	6	Concrete Block absorb more water than CLC brick	2	Cured Concrete Pour absorb water 2.5%	1	ABC Block (without plaster or waterproof rendering) absorbs water at approximately 0-15%	3	ABC Block (without plaster or waterproof rendering) absorbs water at approximately 0-15%	3	Block (without plaster or waterproof rendering) absorbs water at approximately 0-15%.	3
Labour intensity	Good	4	Fair	5	Fair	6	Excellent	1	Excellent	1	Good	3
Cost / m2 wall	**R841,59**	6	**R464,87**	2	**R613,92**	5	**R470,00**	3	**R430,84**	1	**486.86****	4
Cost / m2 Foundation / Slab	**R850,00**	3	**R850,00**	3	**R850,00**	3	**R665,00**	1	**R665,00**	1	**R850,00**	3
Total Comparison Ranking	**86**	4th	**96**	6th	**87**	5th	**45**	2nd	**38**	1st	**71**	3rd

The comparison is compiled and based on test and data available from reliable sources & work studies during the R&D process.

The Engineering calculations and comparison is independently compiled for WOF by NESconsult and Associates.

NES CONSULT & ASSOCIATES

The BIC Material is also more cost-competitive and labour-intensive

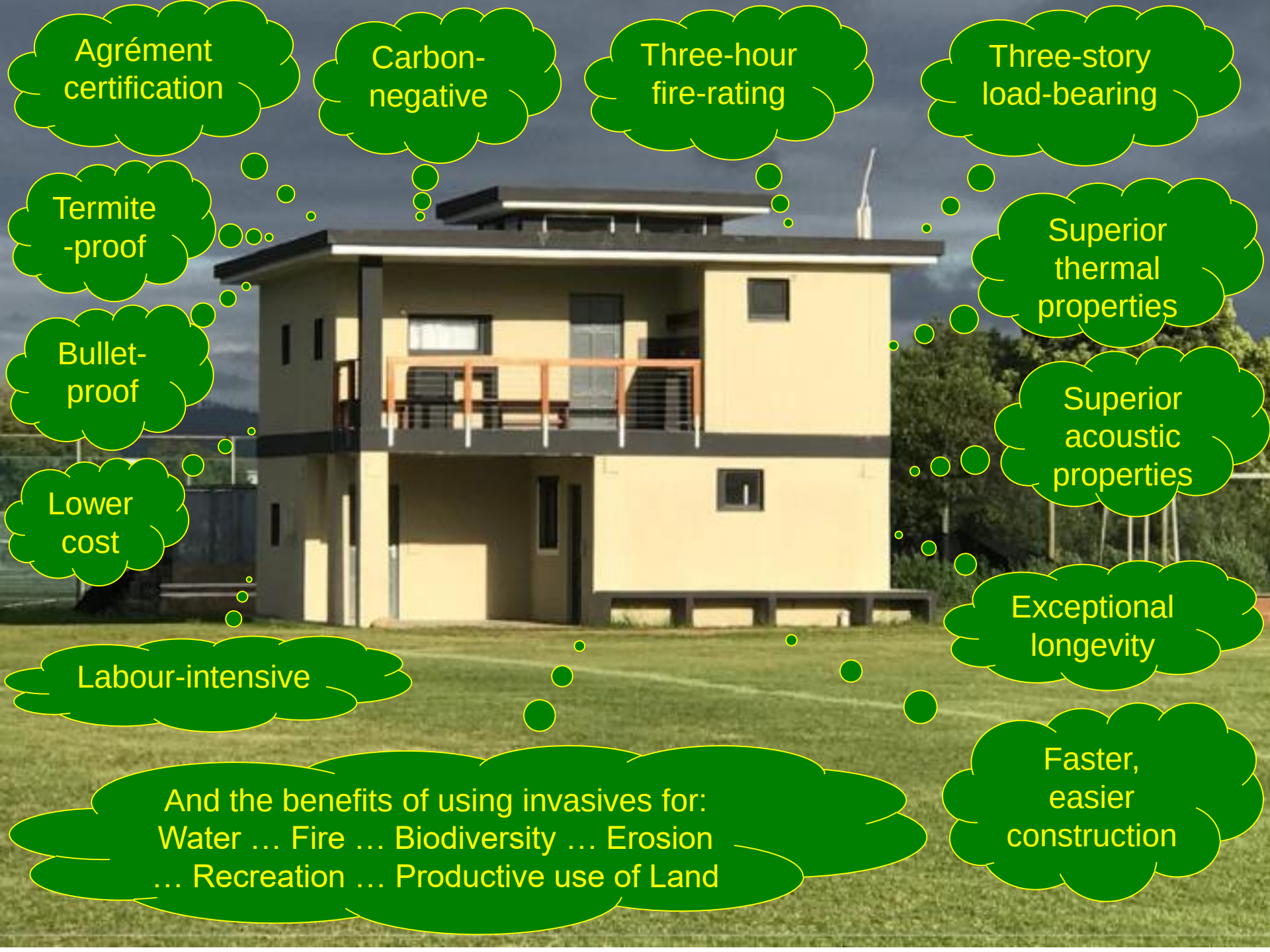
1. A comparison of the costs of a BIC in-situ house and a masonry house is shown below.
2. These are the financial costs. The economic costs are orders of magnitude better. And they matter.
3. The numbers of jobs are also impressively better using the BIC material.

Numbers of person days required for the construction of a Masonry House compared to a BIC In-situ Light House

Floor Area (m^2)	STRUCTURE AND FINISHES	NUMBER OF PERSON HOURS (hours)				Person days / house
		Materials	Site Labour	Total	Person hours Total/m^2	
51 m^2	**MASONRY HOUSE (Reference 1)**	160	1400	1560	30.59	**195**
	Internal water and sanitary fittings					
	Internal electrical reticulation					
	Double-pitched sheeted roof					
	Ceilings					
	Plastered and painted internal & external.					
43 m^2	**BIOMASS INSULATED CONCRETE IN-SITU LIGHT HOUSE (Reference 2)**	529	1530	2059	47.89	**257**
	Internal water and sanitary fittings					**This reflects the 32% more person days without allowing for the smaller size of the BIC House.**
	Internal electrical reticulation					
	Flat roof slab with vertical extension option					
	Down lighters and skimmed ceilings Painted internal & external					
	Note that this is 84% of the size of the Masonry House. If projected to the same size, the BIC may have 42% more person days (not 32%).					

Average Cost per square metre of wall and floors for various materials

Material	ROK 225mm thick with plaster	Hollow concrete block with plaster	Traditional concrete	BIC Panel 130mm thick	**BIC In-situ 200mm thick**	Recycled plastic & fly-ash blocks
Walls (Cost per m^2)	R841.59	R464.87	R613.92	R470.00	**R430.84**	R486.86
Floors (Cost per m^2)	R850.00	R850.00	R850.00	R665.00	**R665.00**	R850.00


Agrément certification
Carbon-negative
Three-hour fire-rating
Three-story load-bearing
Termite-proof
Superior thermal properties
Bullet-proof
Superior acoustic properties
Lower cost
Exceptional longevity
Labour-intensive
Faster, easier construction
And the benefits of using invasives for:
Water … Fire … Biodiversity … Erosion
… Recreation … Productive use of Land

George Rose | Getty Images

A firestorm that began in Napa Valley's Calistoga destroys more than 1,000 homes and businesses in just the northwestern Coffey Park neighborhood as viewed in this aerial photo taken on October 12, 2017, in Santa Rosa, California. State officials are calling the Tubbs Fire the most destructive wildfire in history.

The number of structures destroyed by the 245,000-acre Northern California wildfires climbed to 8,400 and authorities warned Monday the total could continue to go up as crews assess damage in scorched areas.

The devastating wild fires in California, Portugal, Greece, Australia and elsewhere, have been fuelled by gums, pines and other species that are "born to burn". We have a solution to their problem – using their fire-prone trees.

Portugals alien-fuelled fires of June 2017

News › World

Portugal Forest fire: Death toll rises to 72

Reeling from its deadliest forest fire, Portugal finds a villain: eucalyptus trees

It's not just about *Prosopis* species!

Although (if left to invade) they will become considerably worse that they already are, with unaffordable impacts on groundwater, biodiversity and the productive use of land.

Namibia has been less at risk of invasions, historically, than major hubs of trade, tourism, transport and travel. But that is changing, and the risks of new invasive species must be confronted now. Too often we only react when it is almost too late.

Climate change will exacerbate the problems of invasive species.

Their control offers enormous scope for employment that adds real value.

THANK YOU

Leslie Henderson's book on South African invasives:

https://wwfafrica.awsassets.panda.org/downloads/invasive_alien_plants_in_south_africa.pdf

List of species being attacked by the Polyphagous shot-hole borer:

https://www.fabinet.up.ac.za/images/PSHB/PSHB_host_list_v6_20230417.pdf

Alan Woods' book on biological control of hakea species:

https://www.arc.agric.za/arc-ppri/weeds/Pages/Silky-hakea.aspx

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