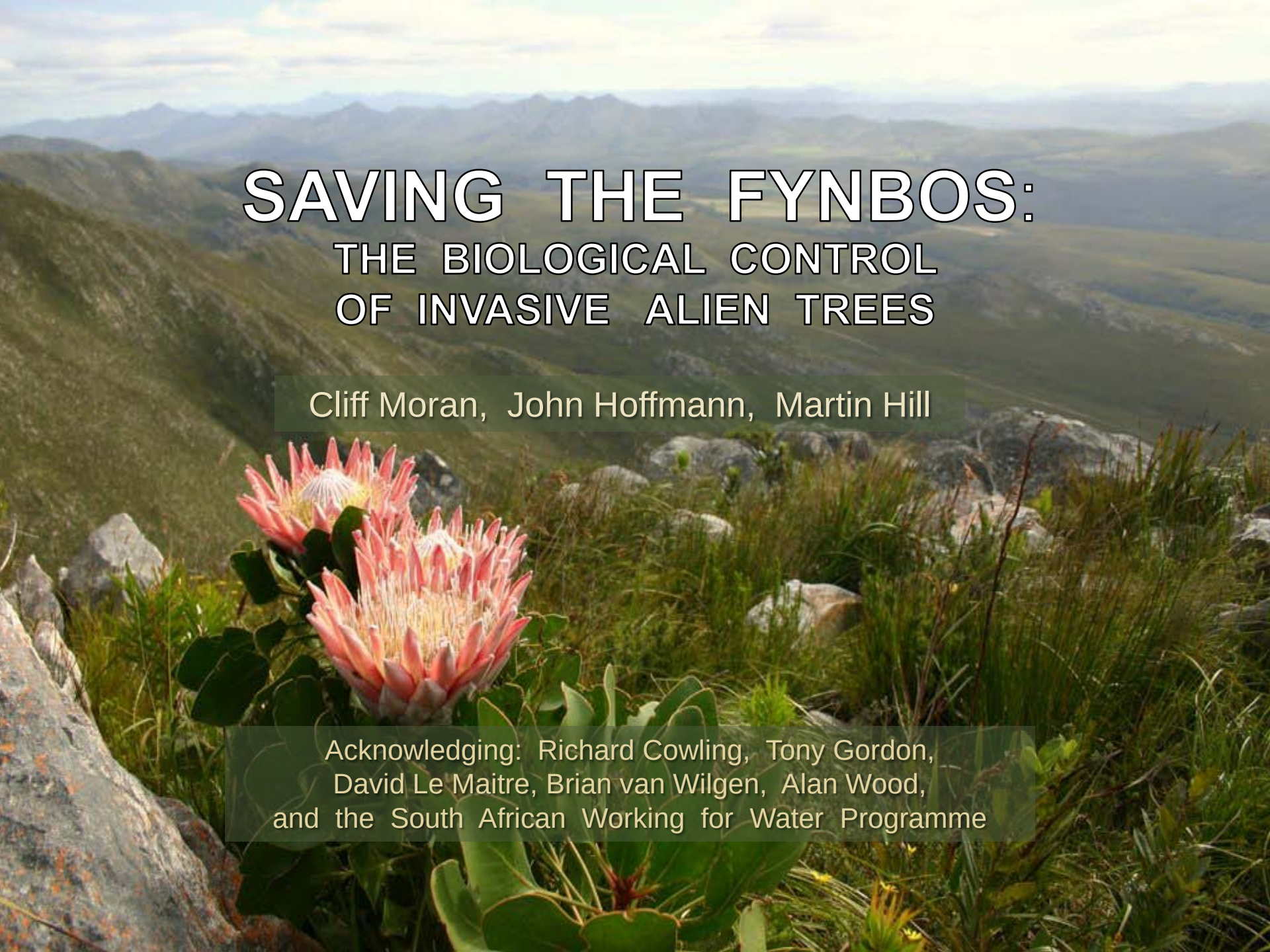


SAVING THE FYNBOS:
THE BIOLOGICAL CONTROL OF INVASIVE ALIEN TREES

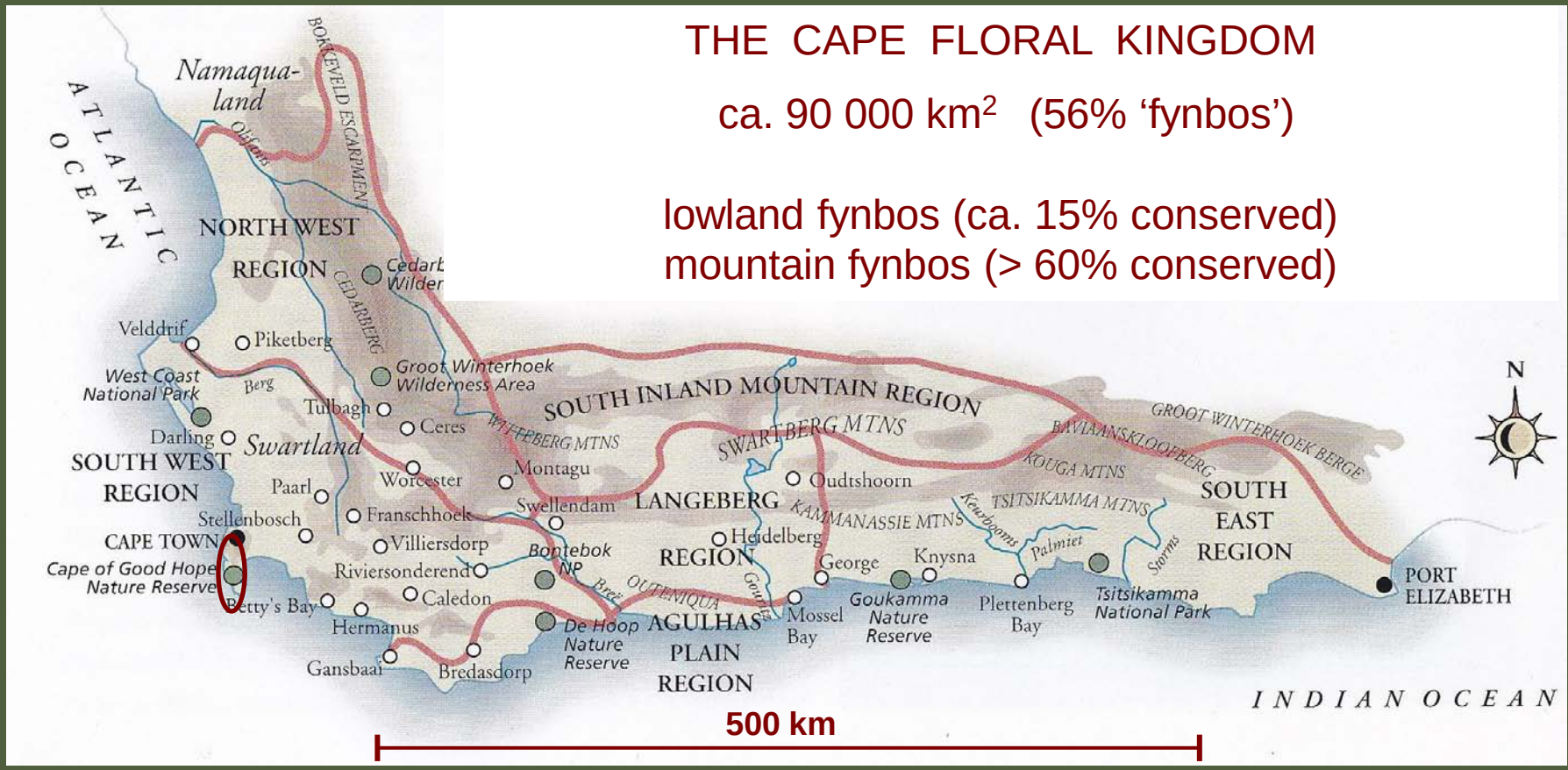
Cliff Moran, John Hoffmann, Martin Hill

Acknowledging: Richard Cowling, Tony Gordon, David Le Maitre, Brian van Wilgen, Alan Wood, and the South African Working for Water Programme

THE CAPE FLORAL KINGDOM

ca. 90 000 km^2 (56% 'fynbos')

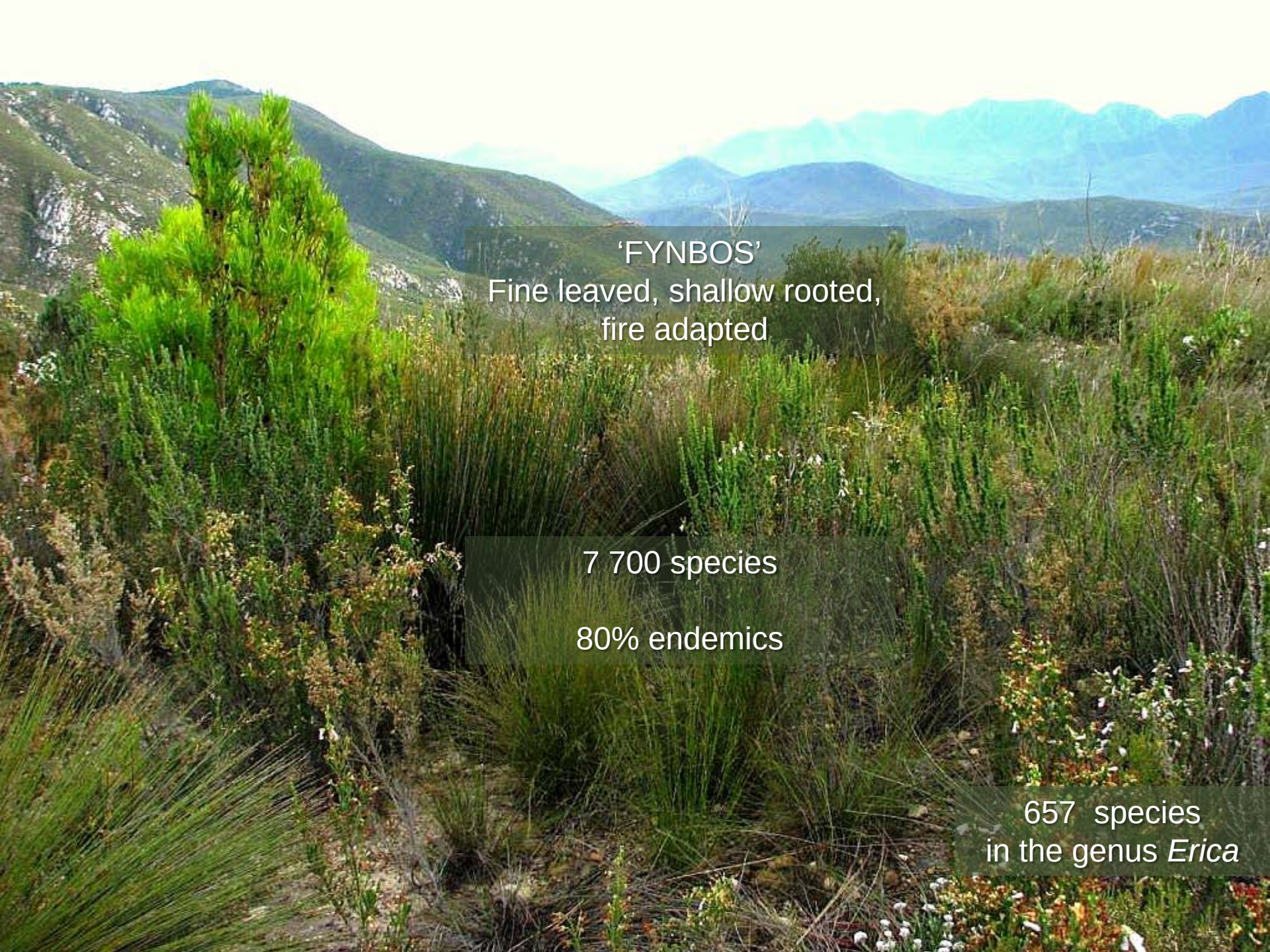
lowland fynbos (ca. 15% conserved)
mountain fynbos (> 60% conserved)



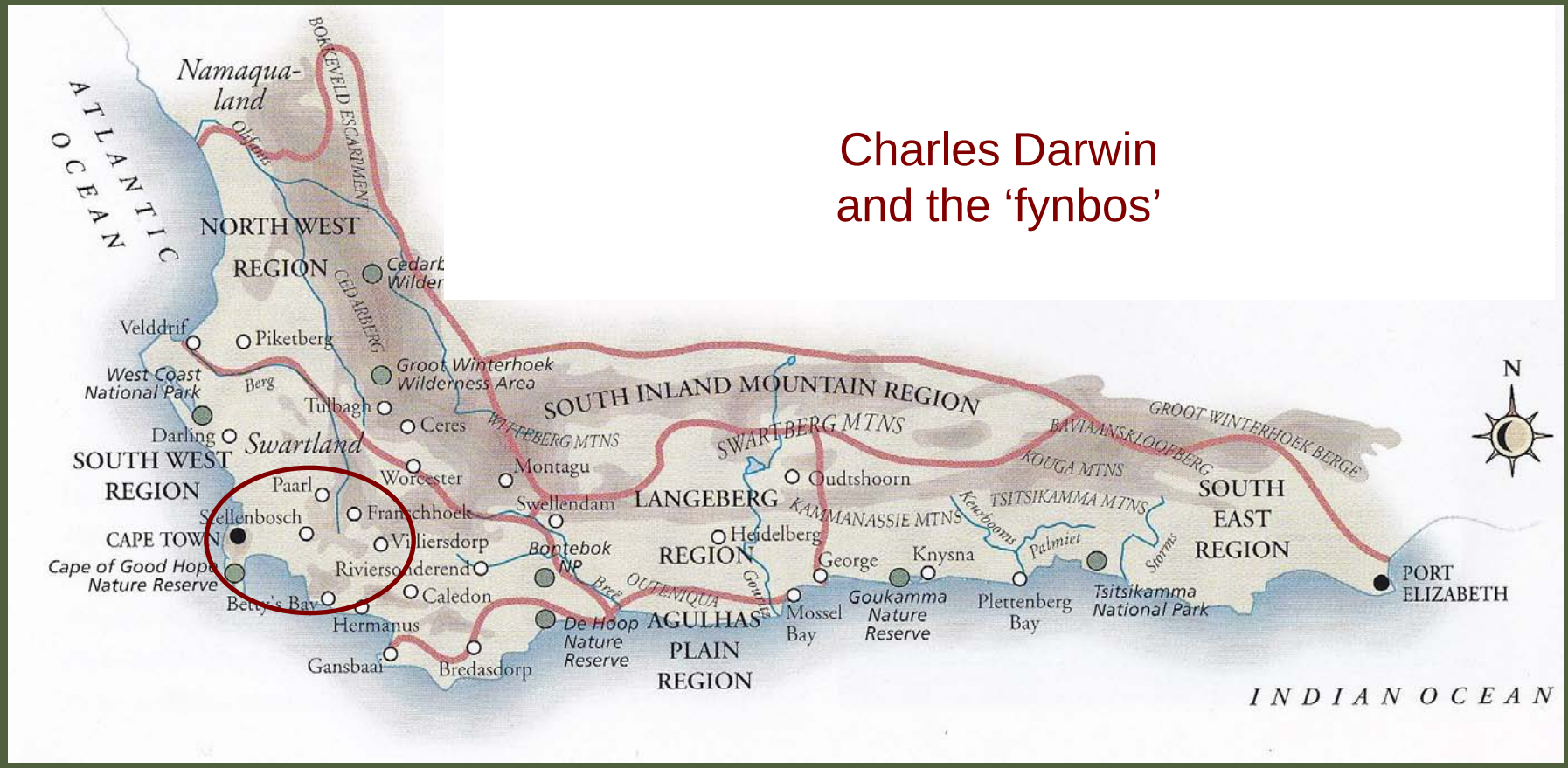
9 003 plant species in the CFK

on 0.3% of land area of Africa
ca. 23% of flora of the continent


Cape peninsula
2 285 plant species


‘FYNBOS’
Fine leaved, shallow rooted,
fire adapted
7 700 species
80% endemics
657 species
in the genus *Erica*

Charles Darwin and the ‘fynbos’

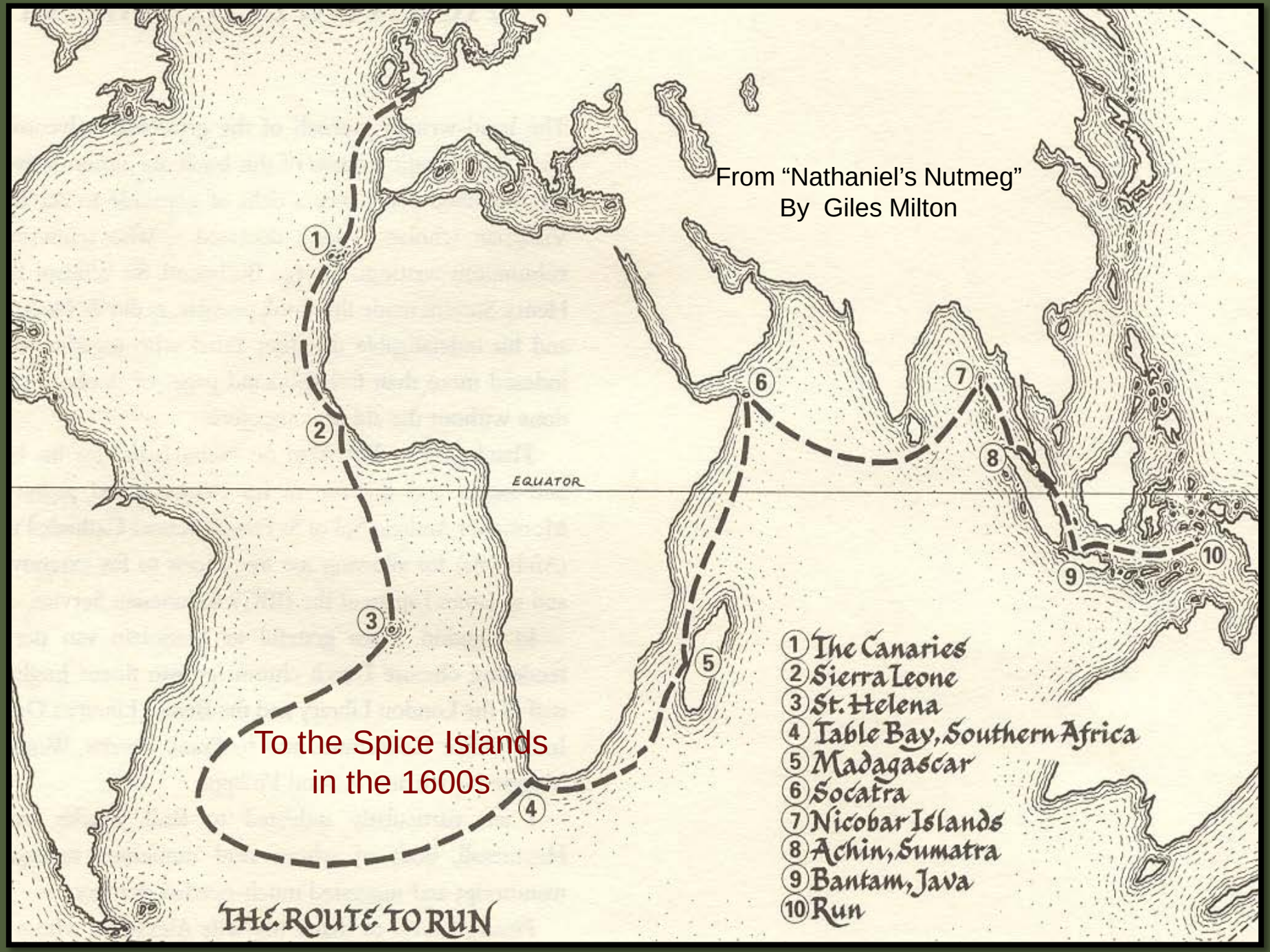


CHARLES DARWIN ON THE FYNBOS,

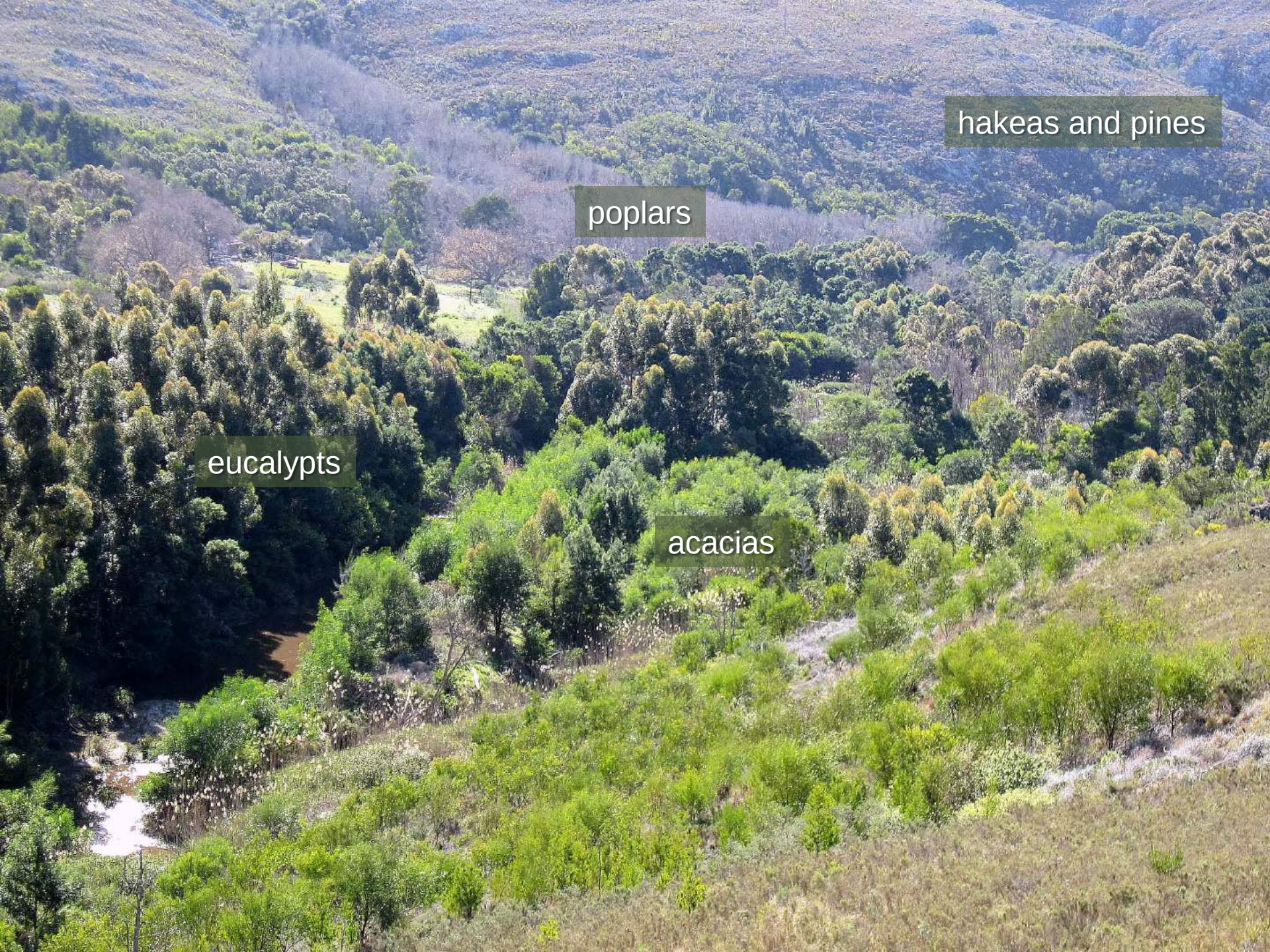
FROM HIS DIARY OF 1836

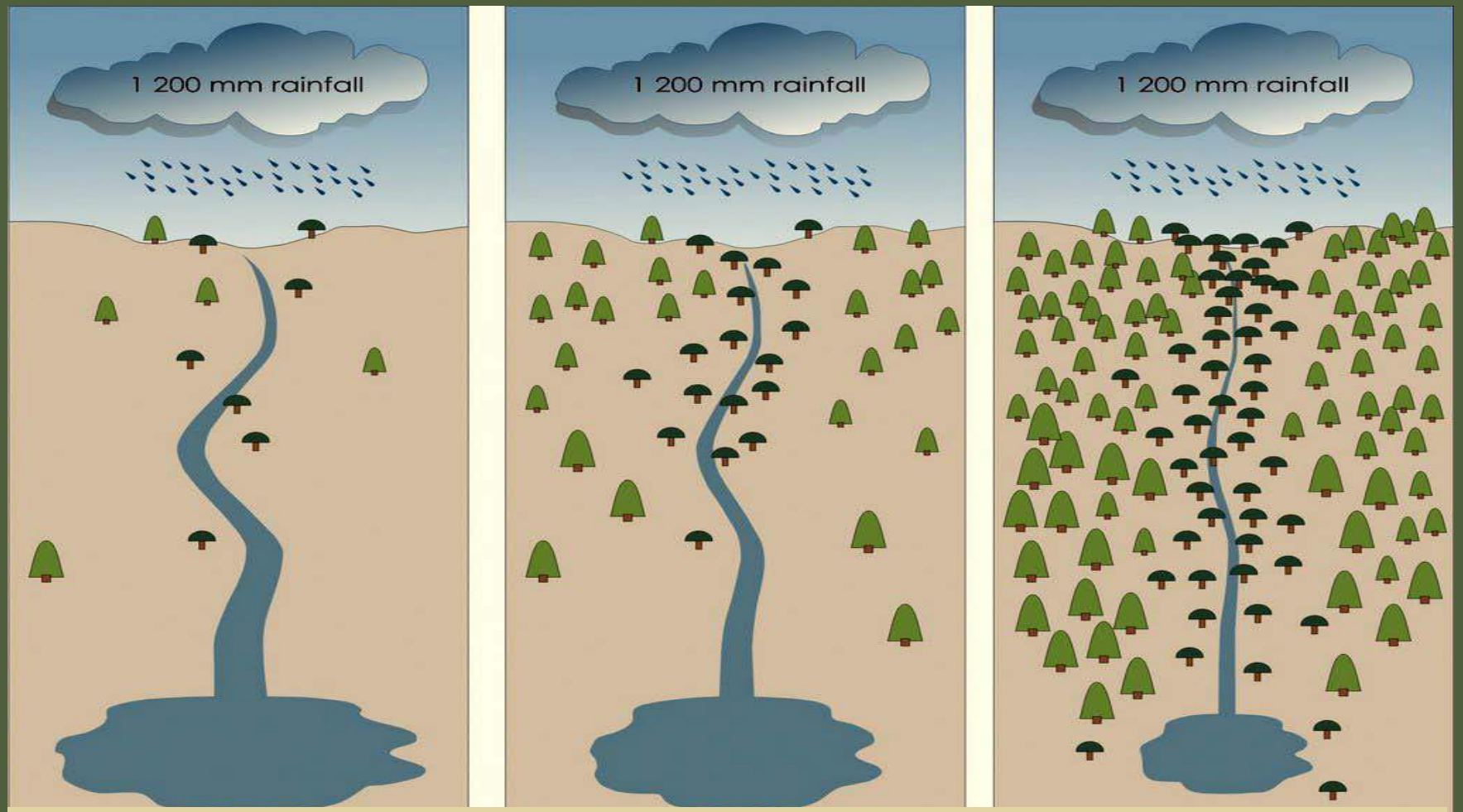
JUNE 6th ....

There was not even a tree to break the monotonous uniformity of the sandstone hills: I never saw a much less interesting country .....


From “Nathaniel’s Nutmeg”
By Giles Milton
EQUATOR
To the Spice Islands
in the 1600s
1 The Canaries
2 Sierra Leone
3 St. Helena
4 Table Bay, Southern Africa
5 Madagascar
6 Socatra
7 Nicobar Islands
8 Achin, Sumatra
9 Bantam, Java
10 Run
THE ROUTE TO RUN


hakeas
eucalypts
pines
acacias


hakeas and pines
poplars
eucalypts
acacias



INVASIVE PLANTS DECREASE
SOUTH AFRICA'S WATER SUPPLIES BY ABOUT 7%

Run-off decreased by 74%
68-fold increase in costs of clearing

WORKING FOR WATER PROGRAMME

WfW accepts that there is no possibility of fulfilling its mandate of increasing water supplies and protecting biodiversity without biological control as a component of its management strategies.

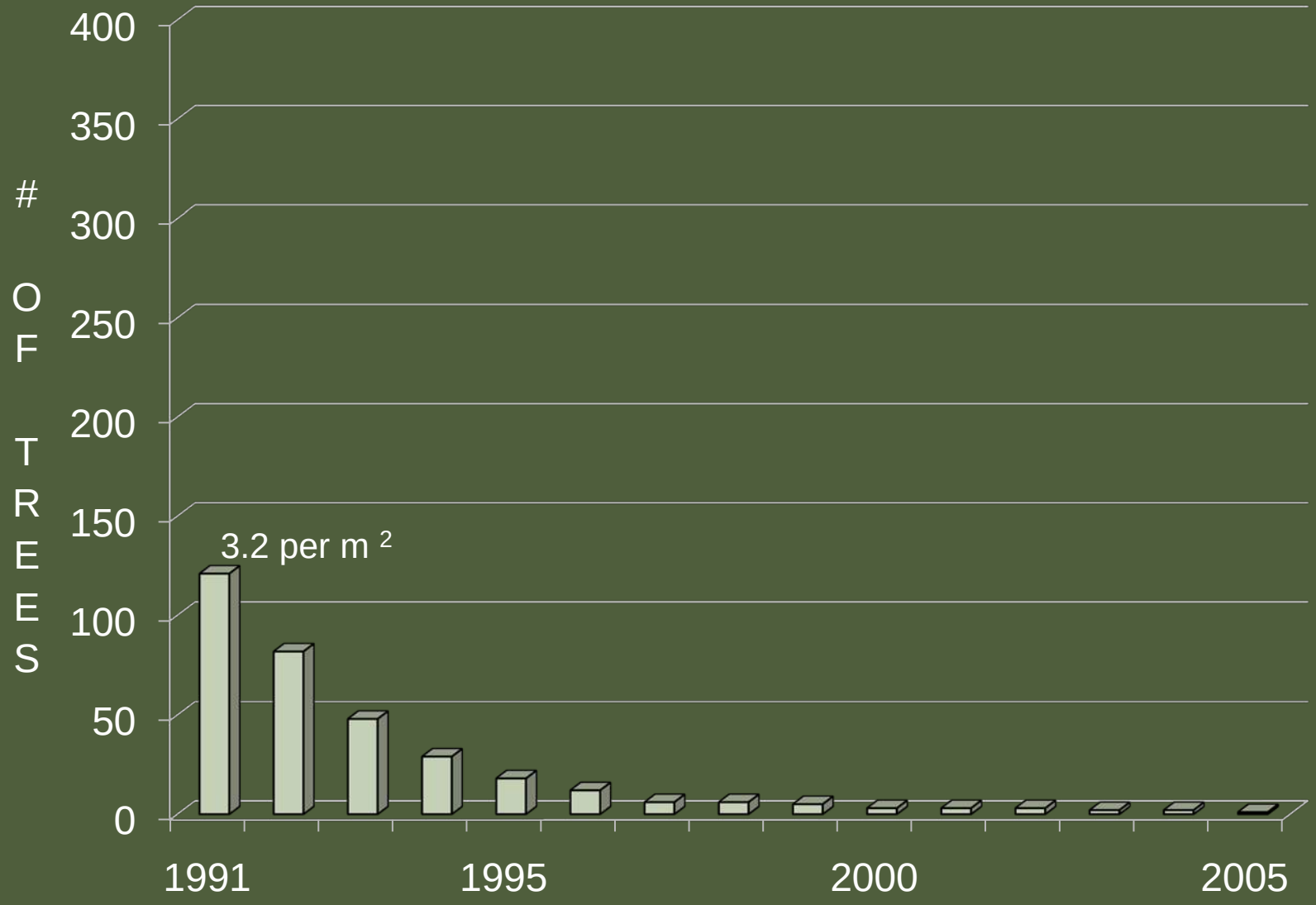
13 SPECIES OF INVASIVE ALIEN TREES IN THE FYNBOS TARGETED FOR BIOLOGICAL CONTROL. TWO EXAMPLES :

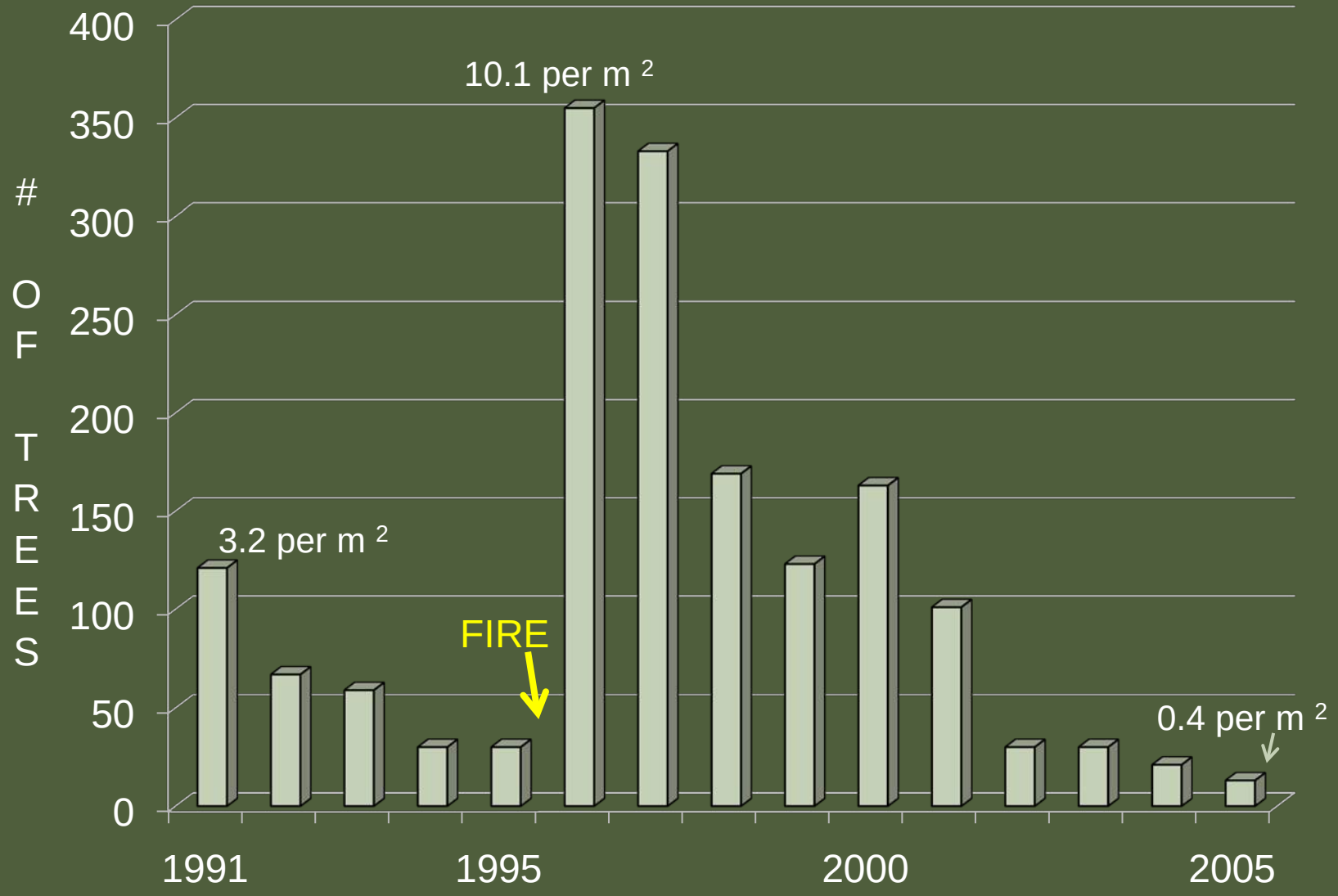
Both ex Australia imported in the 1830s	
Transformer species	
Long-lived > 50 years	
Of no commercial importance	
ACACIA SALIGNA	*HAKEA SERICEA*
Mimosaceae	Proteaceae
Invades lowland fynbos	Invades mountain fynbos
Seeds in pods	Seeds in fruits
Soil seed-banks	Serontinous
Fire adapted	Fire adapted


ACACIA SALIGNA

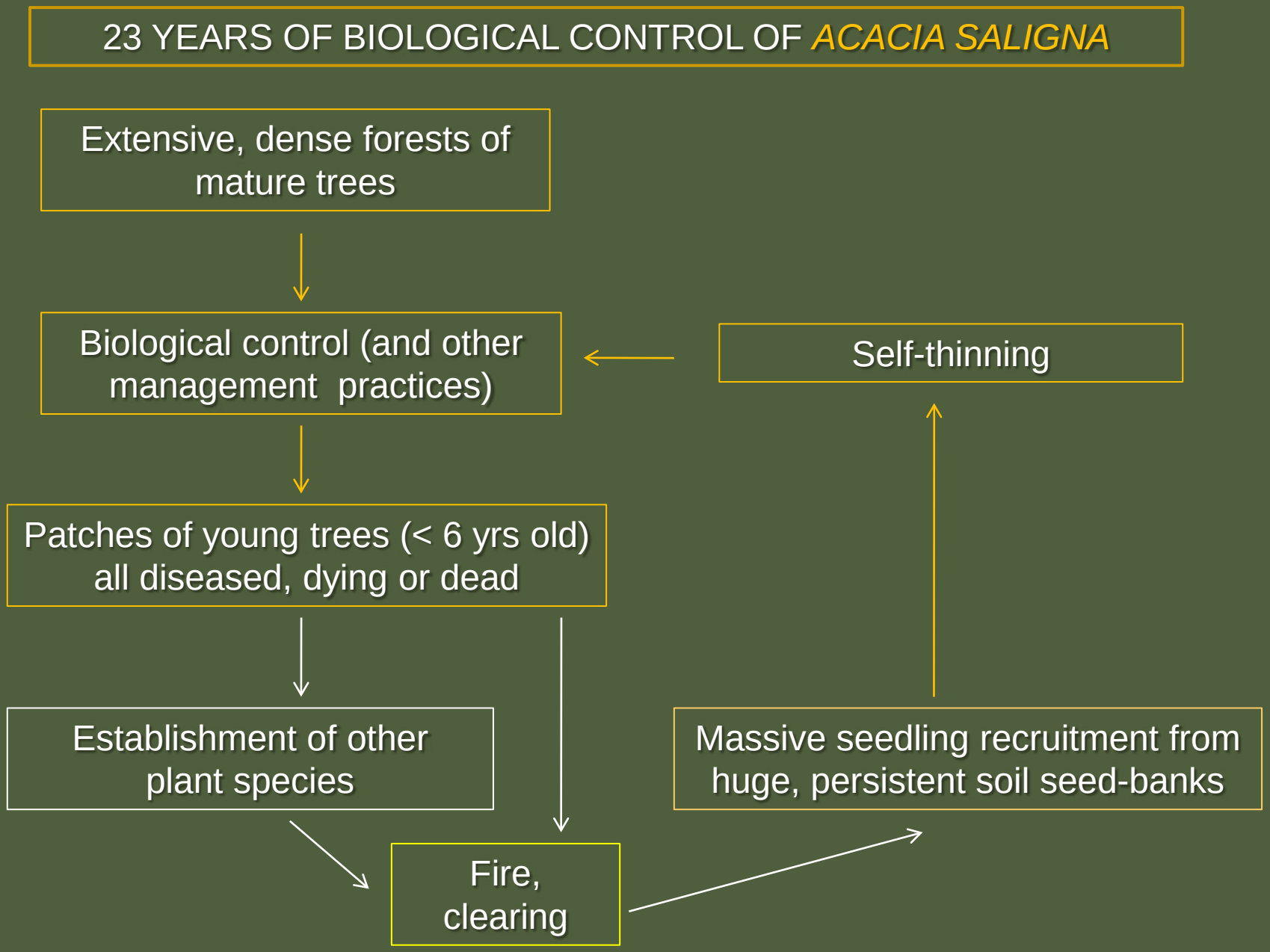
Uromycladium tepperianum

'U. tepp.'
Released in 1987


400
350
300
250
200
150
100
50
0
OF TREES
3.2 per m 2
1991
1995
2000
2005


400
350
300
250
200
150
100
50
0
OF TREES
10.1 per m 2
3.2 per m 2
FIRE
0.4 per m 2
1991
1995
2000
2005


ca. 80% pod reduction


23 YEARS OF BIOLOGICAL CONTROL OF *ACACIA SALIGNA*
Extensive, dense forests of mature trees
Biological control (and other management practices)
Self-thinning
Patches of young trees (< 6 yrs old) all diseased, dying or dead
Establishment of other plant species
Massive seedling recruitment from huge, persistent soil seed-banks
Fire, clearing


HAKEA SERICEA

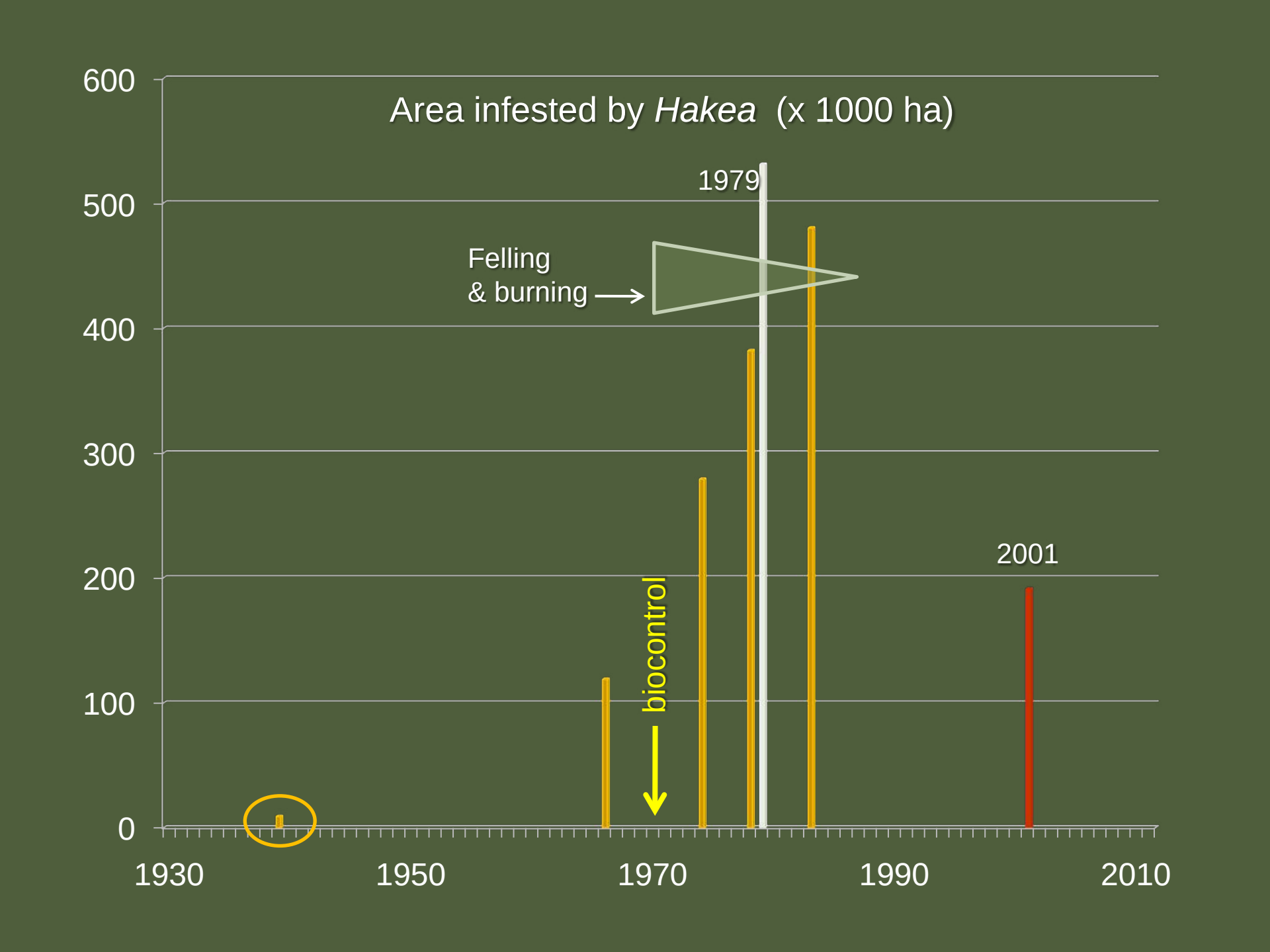

25 mm

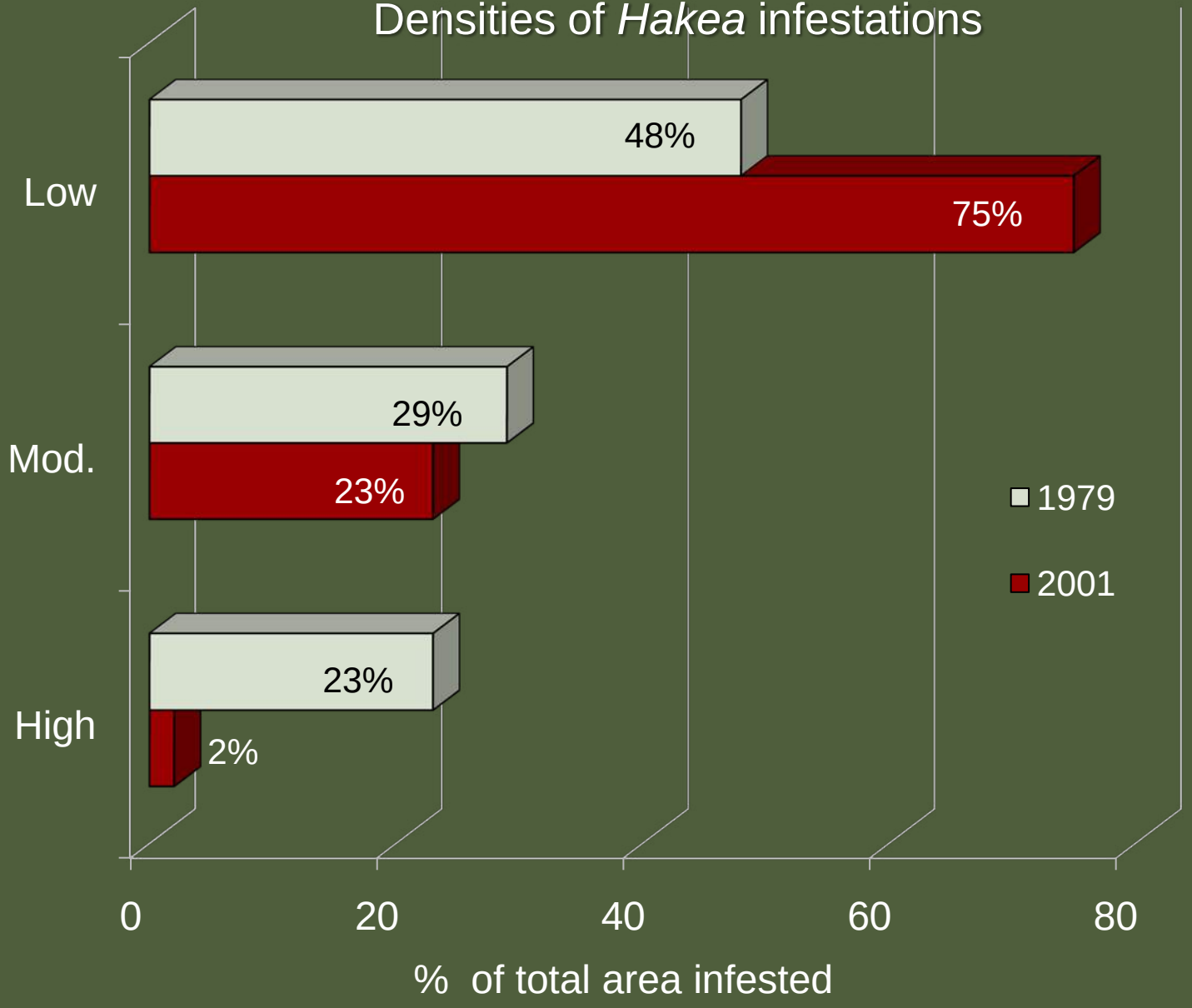
First releases in 1970

Carposina autologa
ca. 65% seed destruction

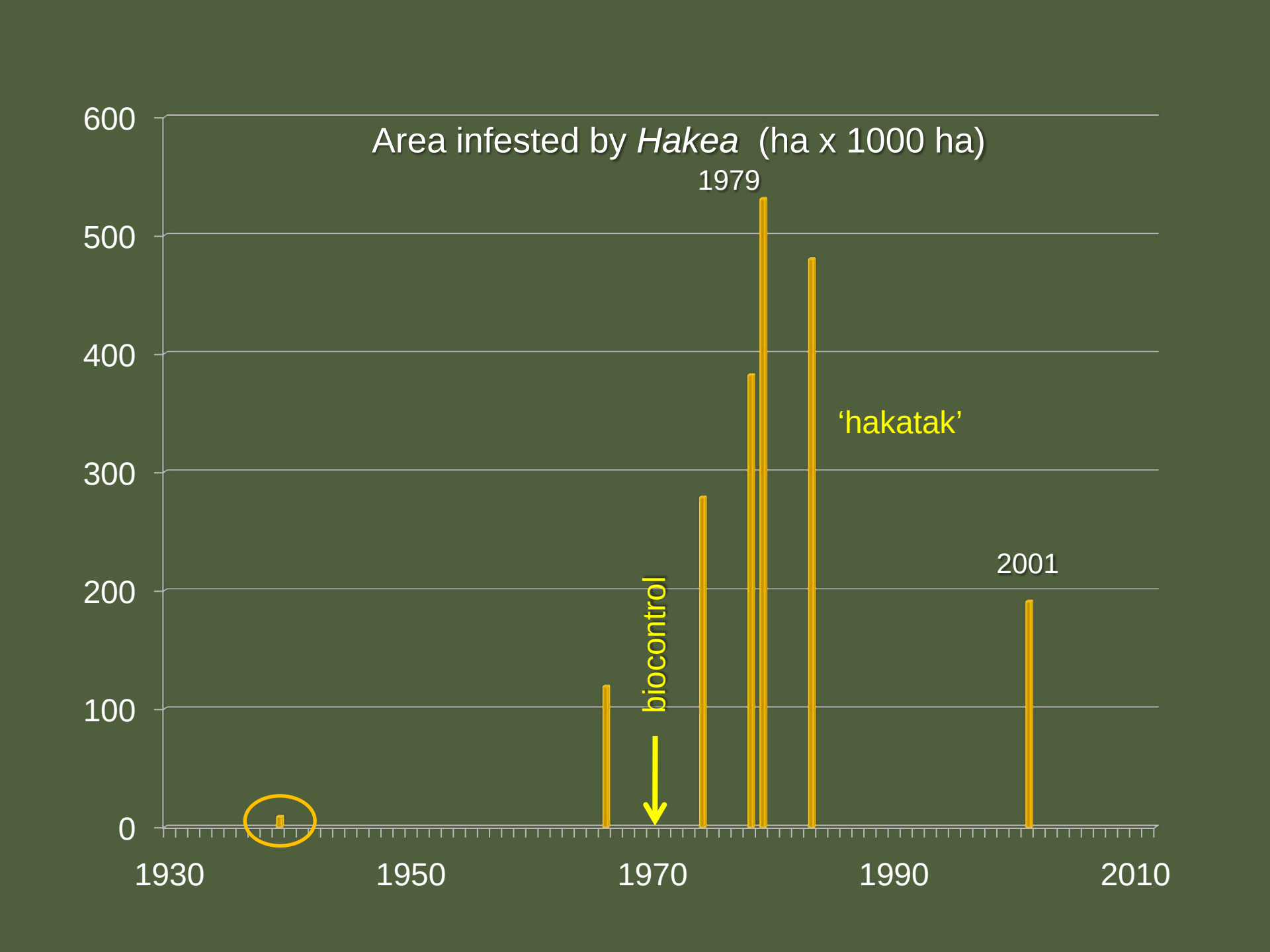
Overall,
95% seed reduction

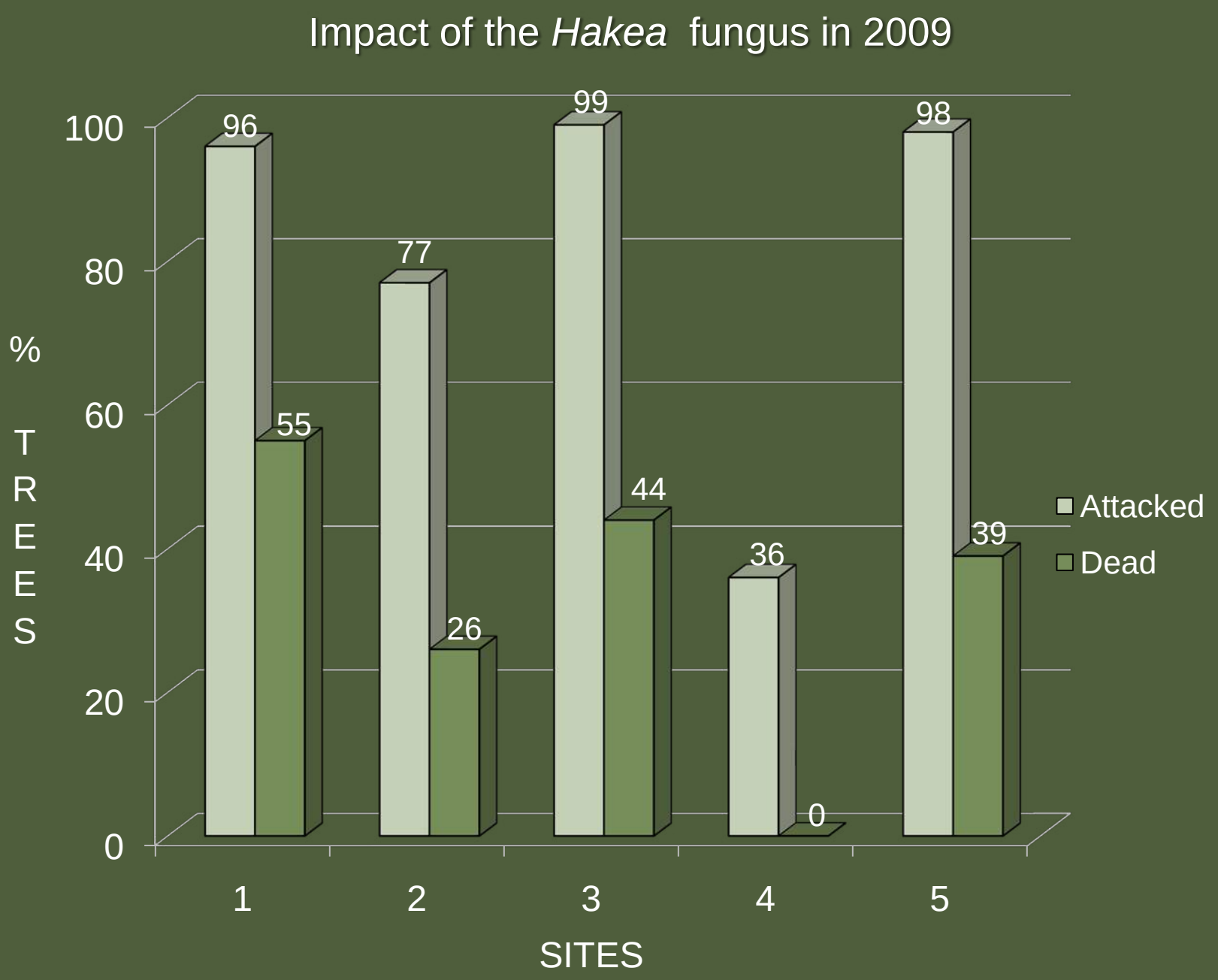
Erytenna consputa
ca. 86% seed destruction


Area infested by *Hakea* (x 1000 ha)
600
500
400
300
200
100
0
1930
1950
1970
1990
2010
1979
Felling
& burning
biocontrol
2001


Densities of *Hakea* infestations
Low
Mod.
High
48%
75%
29%
23%
23%
2%
1979
2001
0
20
40
60
80
% of total area infested


Indigenous fungus
Colletotrichum *acutatum*
(First noted in 1960)


Area infested by *Hakea* (ha x 1000 ha)
600
500
400
300
200
100
0
1930
1950
1970
1990
2010
1979
'hakatak'
2001
biocontrol


Impact of the *Hakea* fungus in 2009
100
80
60
40
20
0
% TREES
96
55
77
26
99
44
36
0
98
39
Attacked
Dead
1
2
3
4
5
SITES

Reduced seed loads because of biocontrol agents

Fungus-induced mortality

Fruit dehiscence and seed release

Granivory

AFTER FIRE

early in summer : long period before winter rains

granivores active

little or no seedling recruitment

late in summer : short period before winter rains

low levels of granivory

mass germination and seedling recruitment

Aphanasium australe - stem borer
Released in 2001

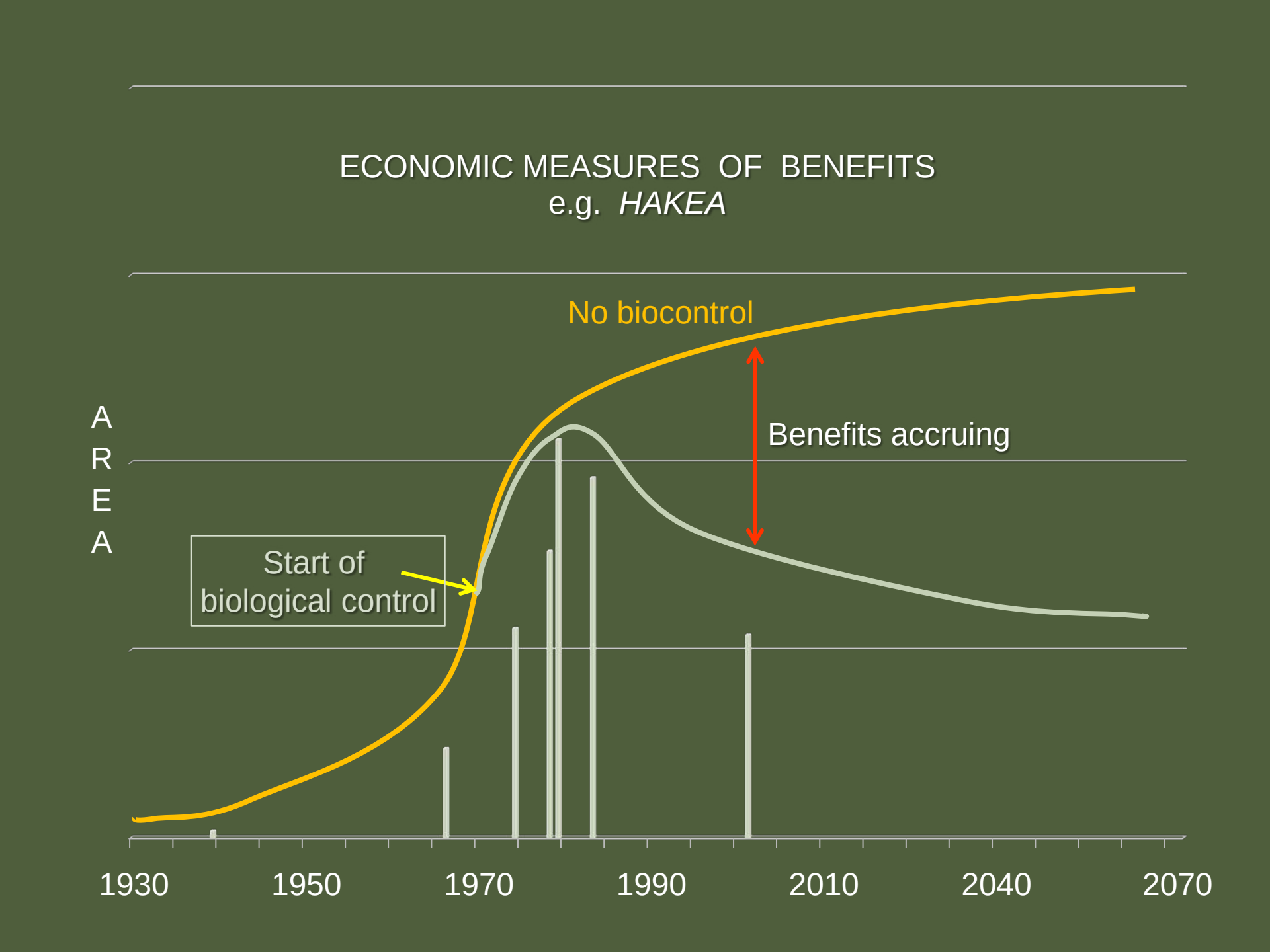
BIOLOGICAL CONTROL AND ‘SAVING THE FYNBOS’

Reduction in range and densities of mature *Acacia saligna* and *Hakea sericea* trees	No new infestations Less frequent, cheaper controls Increased stream flow Fewer, cooler, less damaging fires Potential for recovery of fynbos

BIOLOGICAL CONTROL AND ‘SAVING THE FYNBOS’

Approximately 95% seed reduction	Much reduced rate of spread, fewer ‘nascent foci’ Provides strong rationale for prioritizing and removing isolated trees Reduced aggressiveness/ competitiveness Reductions in seedling and sapling densities after fire Decreases in costs of clearing and follow-up Diminishing seed-banks/loads

OVERALL - SUBSTANTIAL CONTRIBUTIONS TO CONSERVATION AND THE PRESERVATION OF BIODIVERSITY


ECONOMIC MEASURES OF BENEFITS
e.g. HAKEA
No biocontrol
Benefits accruing
AREA
Start of biological control
1930
1950
1970
1990
2010
2040
2070

BIOLOGICAL CONTROL OF INVASIVE ALIEN TREES

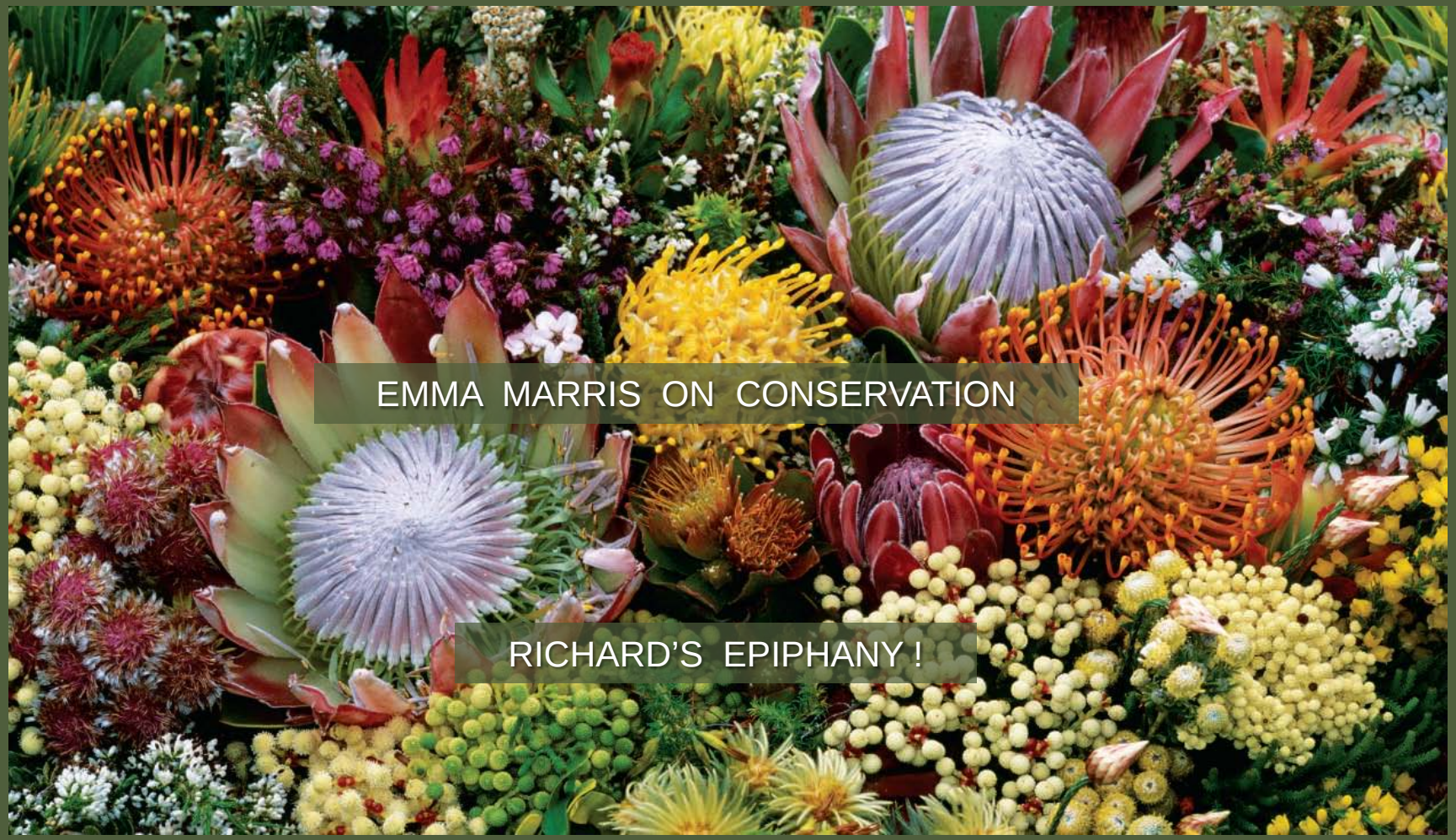
ANNUAL SAVINGS IN THE FYNBOS BIOME (US $ millions – 2008 values)

	Water	Grazing	Biodiversity	Total
Current estimated annual value of ecosystem service	1442	132	680	2254
Value of annual benefits due to biological control	93	26	195	314
% annual savings due to biological control	6.5%	8.1%	28.7%	13.9%

Research costs of biological control = US $ 5.1 million

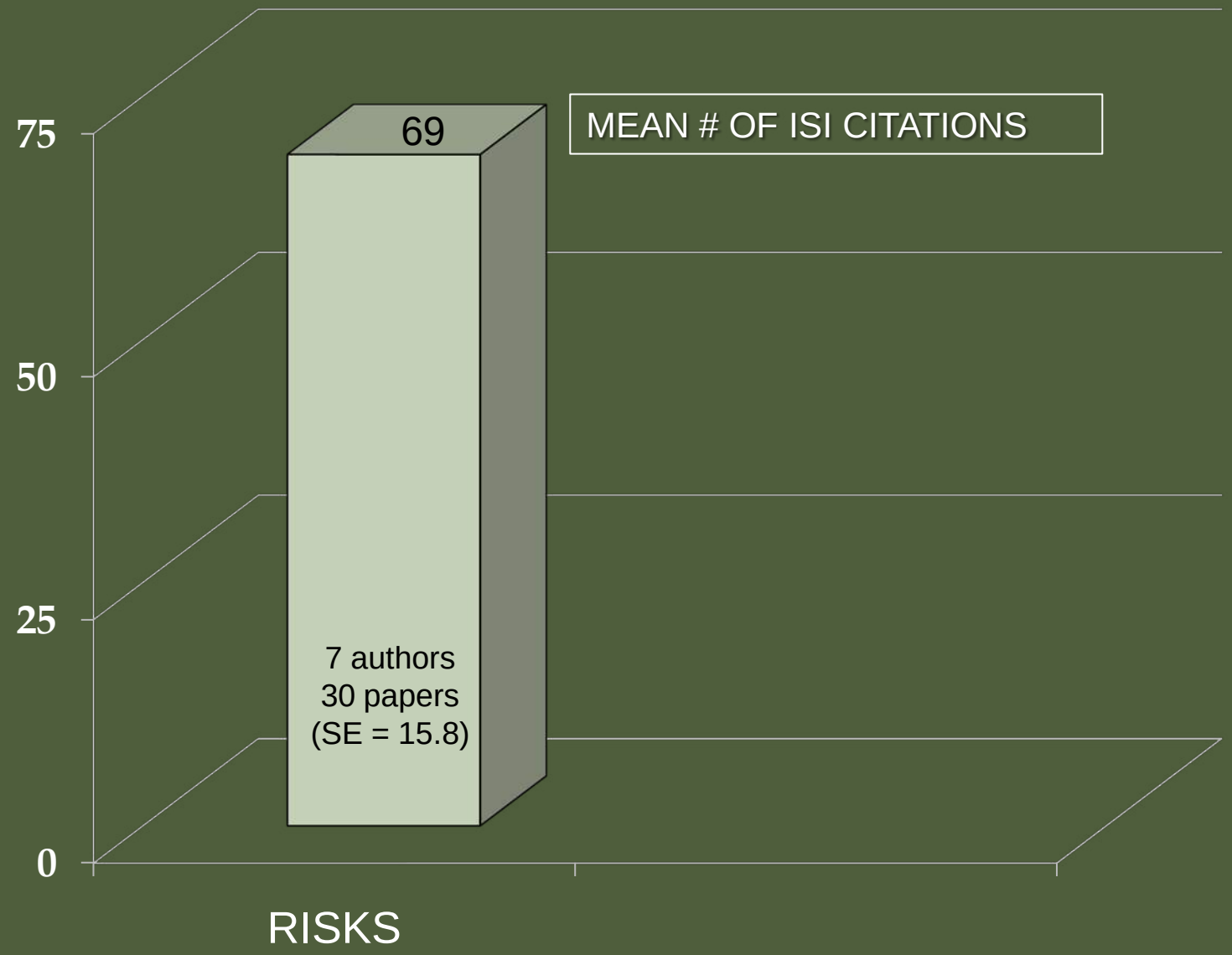
Benefit : costs = 768 : 1

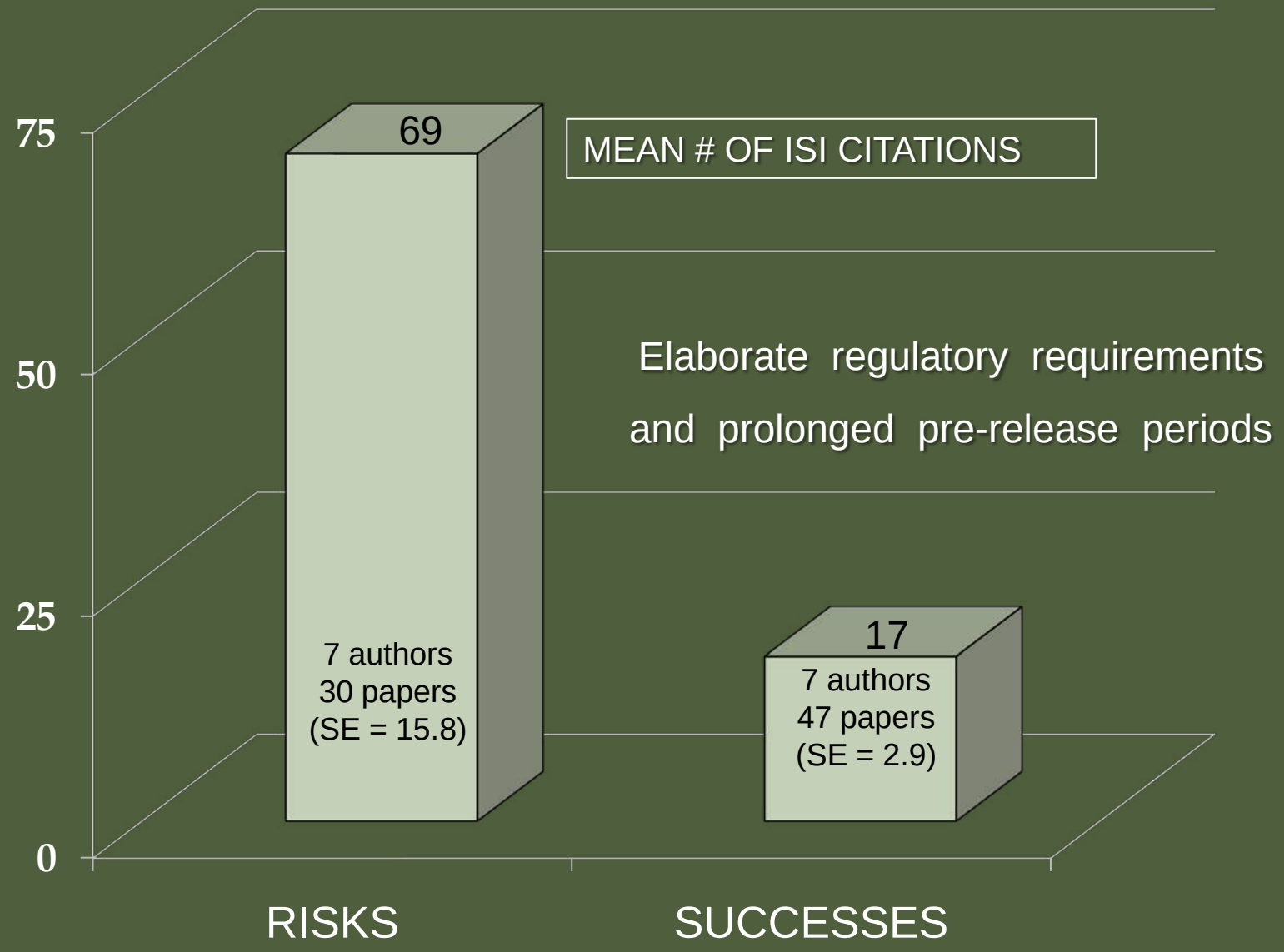
TAKING STOCK



GET INTO THE "MESSY, SLUSHY STUFF" OF REAL-LIFE CONSERVATION.

"IN THE BLOODY BUSINESS OF CONSERVATION BIOLOGY
THE LONGER YOU PAUSE .... THE MORE SPECIES WILL BECOME EXTINCT"


75
50
25
0
69
MEAN # OF ISI CITATIONS
7 authors
30 papers
(SE = 15.8)
RISKS


75
50
25
0
69
MEAN # OF ISI CITATIONS
Elaborate regulatory requirements
and prolonged pre-release periods
7 authors
30 papers
(SE = 15.8)
17
7 authors
47 papers
(SE = 2.9)
RISKS
SUCCESSES

BIOCONTROL FOR NATURE – THE WAY FORWARD?

EVALUATION

OPTIMIZATION

INTEGRATION

RESTORATION AND REHABILITATION

ADVOCACY

THIS CONFERENCE -

THE CATALYST IN THE RENAISSANCE OF OUR SCIENCE ?