Weed Risk Assessment- Galapagos

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What decisions do we mean?

- Someone proposes to introduce a new ornamental plant or crop species. Do you permit it to enter?

- You have 500 introduced plant species in your country, and you know the top 10 invaders. But which of the many plants in people's gardens might become the next problem?

- You have a plant known to be a serious weed on other islands, but it is still only found in small areas in your country. Can it be eradicated completely?

Some principles for Weed Risk Assessment and Weed Management

A process:

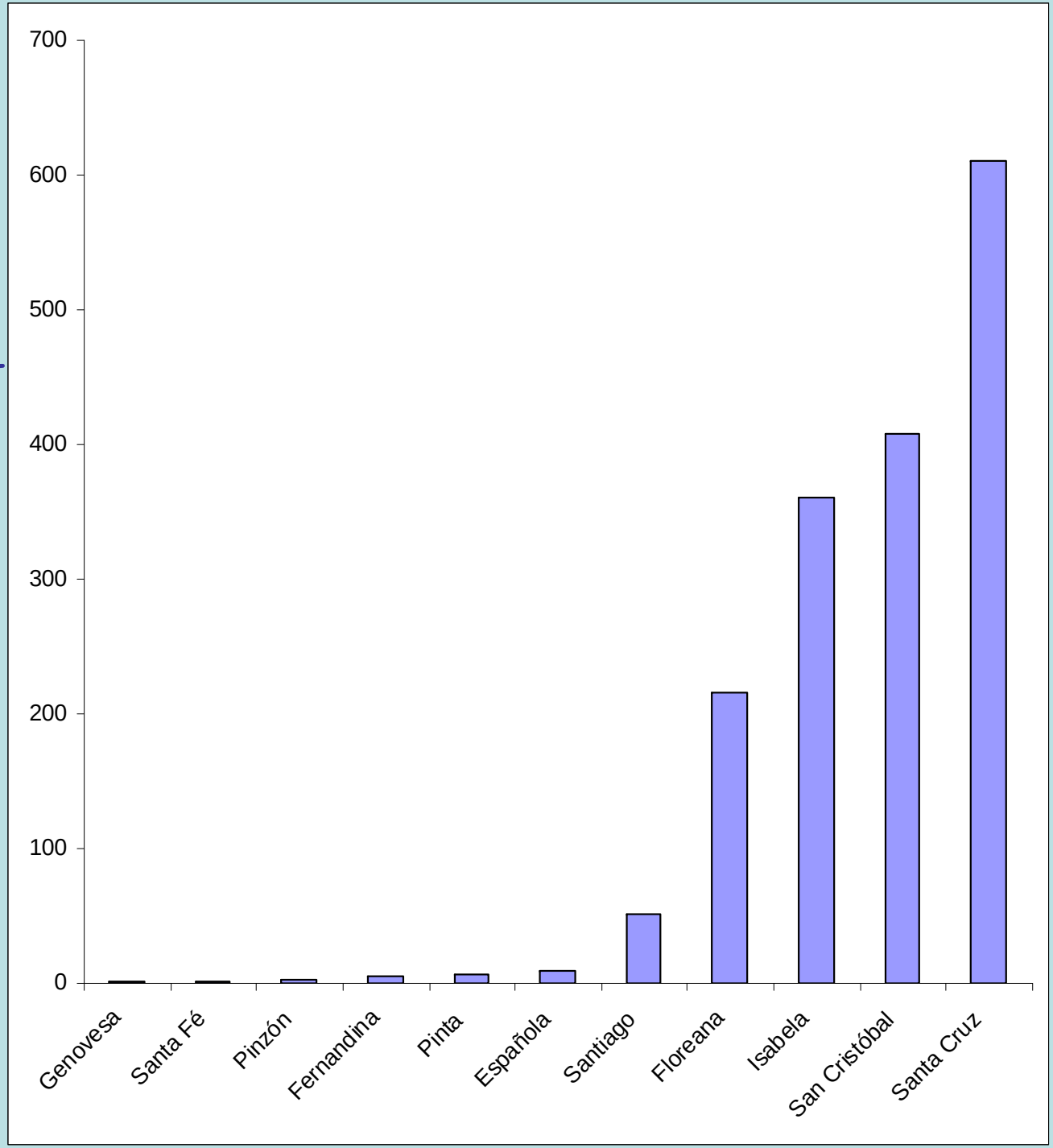
1. Weed inventories

2. Evaluate invasiveness and impact, or risk of it, for each species.

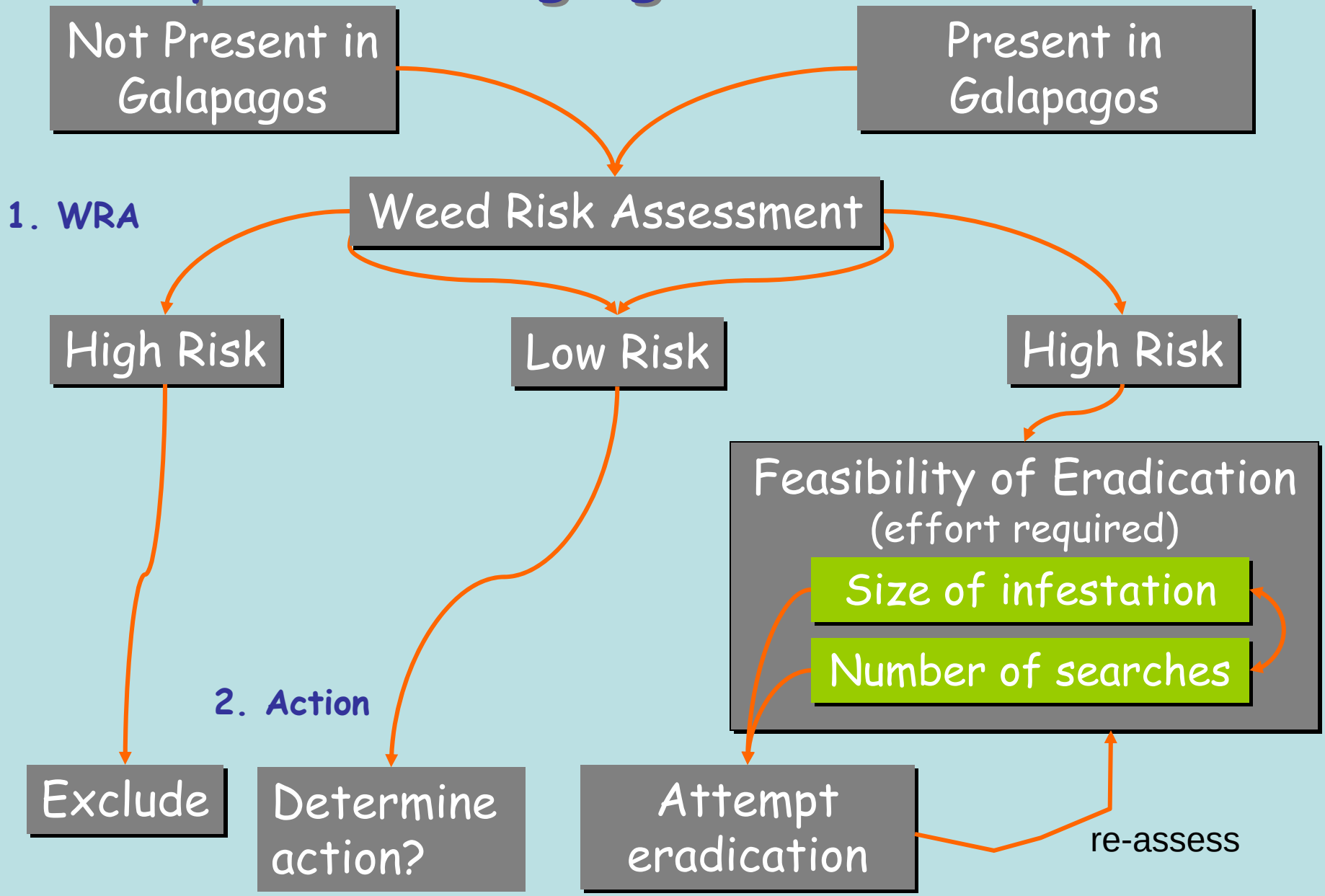
3. Decide if and how to manage each species.

4. Start eradication- reassess feasibility as you go.

Small number of introduced species- good baseline before 450 (2001)
812 total
542 cult.
270 wild
62 NaQ



2 Steps to Managing Plant Introductions



Features of the Galapagos and Galapagos WRAs:

- Environmental focus (but include agricultural, forestry, health etc considerations).
- Intended to permit review of
  all known introduced plants;
  species not yet introduced which could be a risk.
- Produce an **risk index** for each species.
- Classify each species into one of **five** invasiveness impact/risk **categories**.
- Easily adaptable for any island or archipelago.

Changes to questions and in Galapagos section

Naturalization - Viable seed production

Naturalization - Evidence of seedlings produced without human assistance

Naturalization - Evidence of two or more generations of adult plants

Invasiveness - Evidence of long distance propagule dispersal and establishment

Invasiveness - Evidence of establishment in natural ecosystems (with little human disturbance)

Invasiveness - Current status

Already growing wild in the National Park in the arid zone

En la zona húmeda del Parque Nacional

Presente en dos o más islas

Presente en islas no habitadas

Five invasive status categories:

A Transformer:

already a habitat **transformer** in Galapagos (includes hybridizers with endemics).

B Potential transformer:

naturalized in Galapagos and **known** as a habitat transformer elsewhere-or early signs of impact potential.

C Integrator:

naturalized in Galapagos but **integrating** into native vegetation without causing major habitat change (mainly small weeds).

D Potential invader:

not naturalized in Galapagos but a **potential** invader (based on behaviour elsewhere).

E Probably harmless:

only cultivated in Galapagos (**not naturalized**) and **not** known as **an invader** elsewhere.

12 Key Questions that influence the environmental impact categorization:

Behaviour elsewhere:

3.04 Environmental weed that is a transformer in natural areas (elsewhere)

3.05 Other species in same genus are serious invaders elsewhere, or are native or naturalised in Galapagos

Potential environmental impact:

5.04 Smothering growth habit.

5.05 Forms dense thickets, particularly woody perennials.

5.06 Is a tree, woody perennial shrub, grass, geophyte or vine.

6.03 Capable of interspecific hybridization.

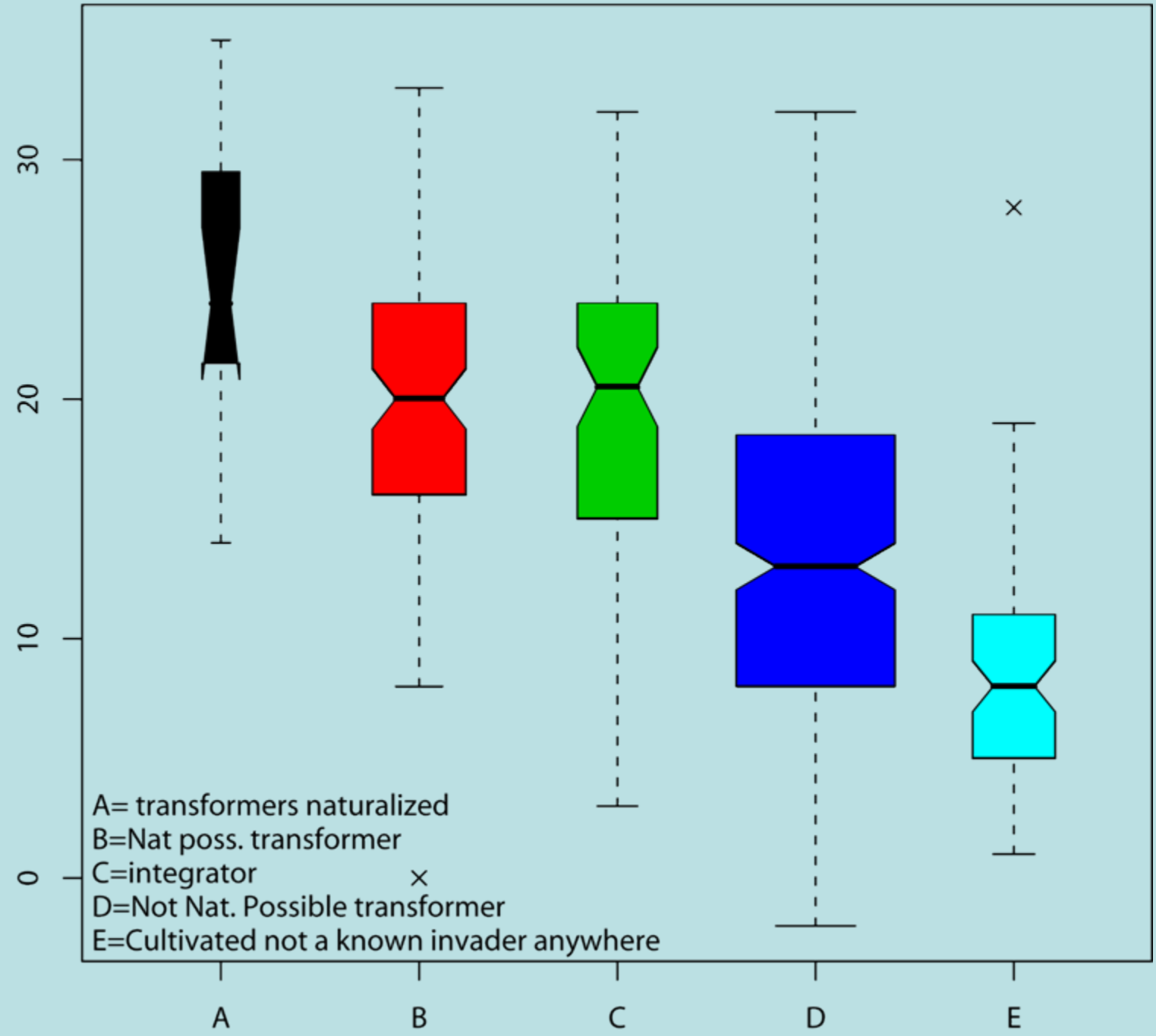
6.04 Endemic congeneric species present in Galapagos.

12 Key Questions that influence the environmental impact categorization:

Present in Galapagos? [Yes or no]

Behaviour in Galapagos:

9.01 Viable seed production
9.02 Evidence of seedlings produced without human assistance
9.03 Evidence of two or more generations of adult plants
9.07 Current invasive status [Don't know, Integrator, Transformer, Potential transformer]

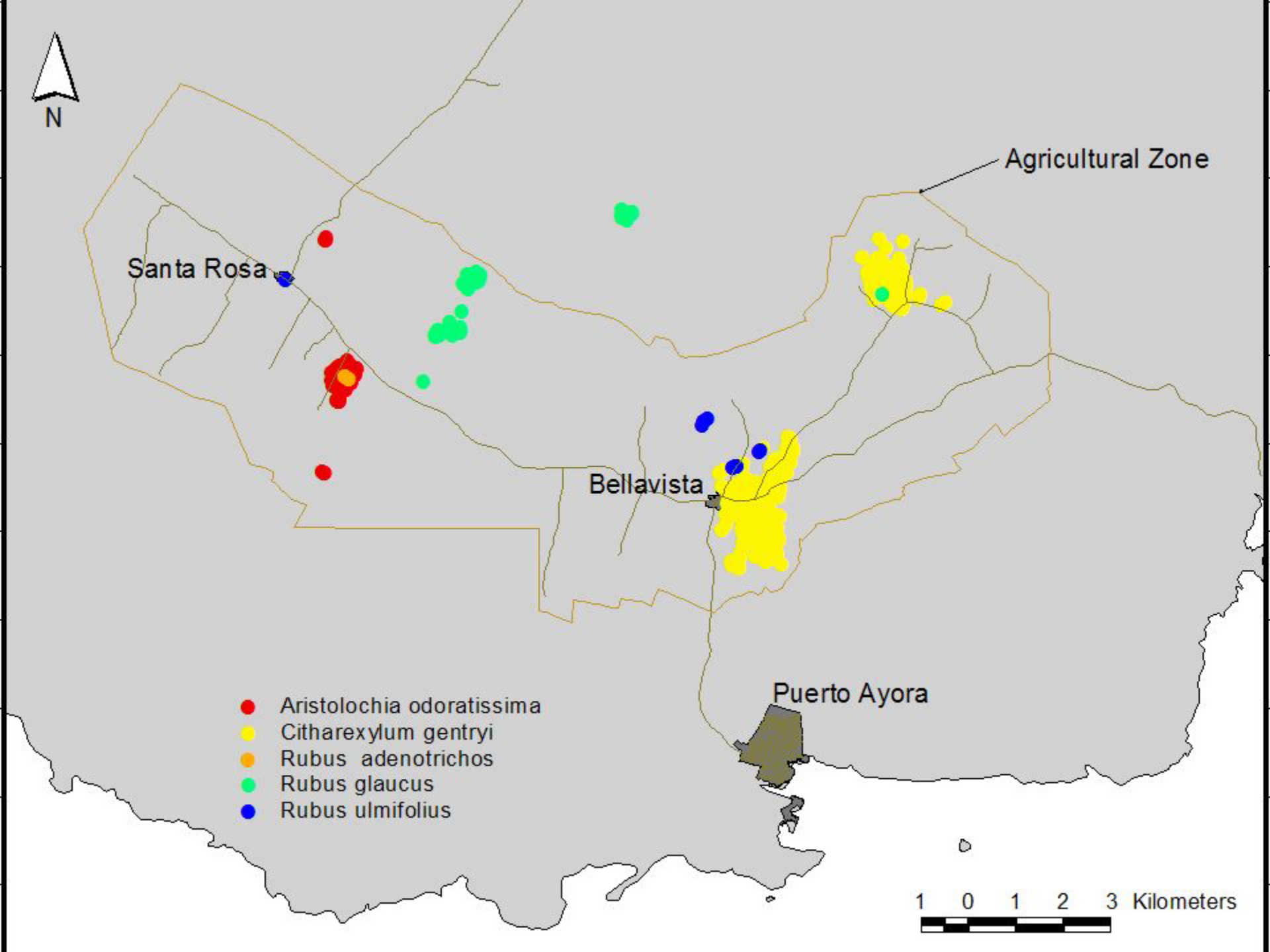

30
20
10
0
A= transformers naturalized
B=Nat poss. transformer
C=integrator
D=Not Nat. Possible transformer
E=Cultivated not a known invader anywhere
A
B
C
D
E

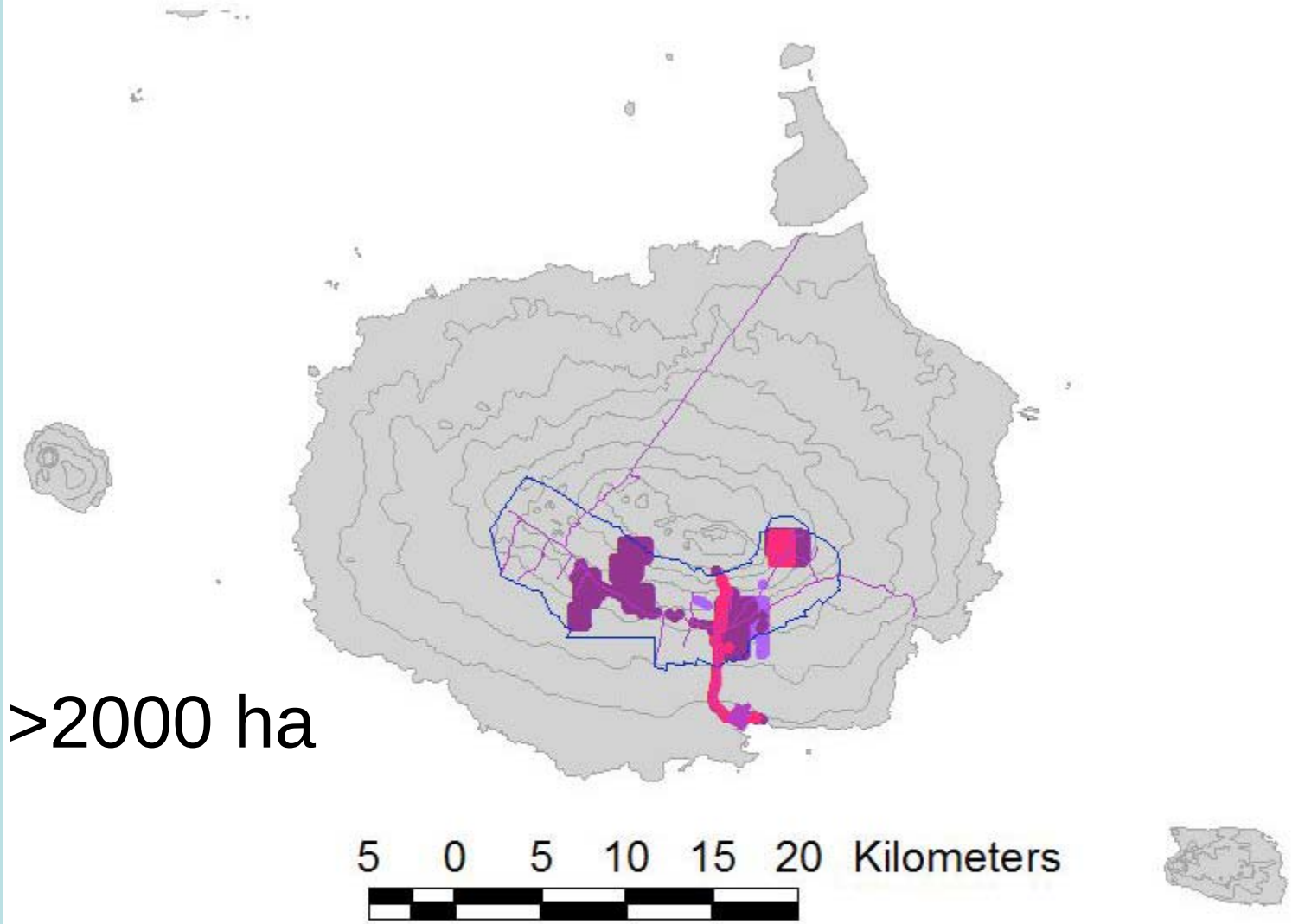
Management options for plants already introduced:

- Do nothing – (E Harmless; C Integrators)

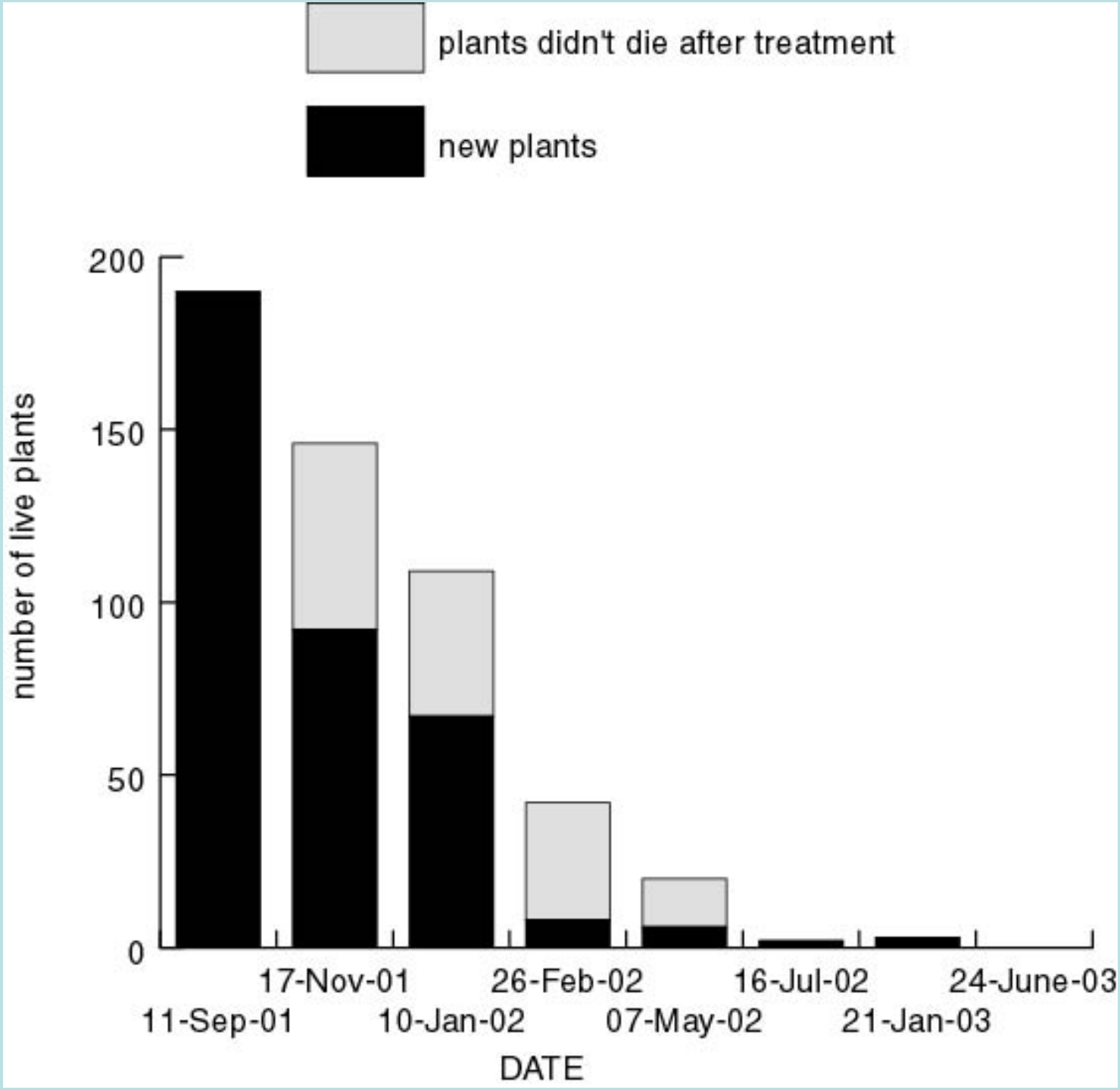
For Transformers, Potential Transformers and Potential Invaders:

- Eradication
- Containment/Exclusion
- Site-specific control
- Biological control


N
Agricultural Zone
Santa Rosa
Bellavista
Puerto Ayora
Aristolochia odoratissima
Citharexylum gentryi
Rubus adenotrichos
Rubus glaucus
Rubus ulmifolius
1 0 1 2 3 Kilometers


>2000 ha
5 0 5 10 15 20 Kilometers


Rubus megalococcus August 2000


plants didn't die after treatment
new plants
number of live plants
200
150
100
50
0
17-Nov-01
26-Feb-02
16-Jul-02
24-June-03
11-Sep-01
10-Jan-02
07-May-02
21-Jan-03
DATE

Weed Eradication Feasibility Analysis

Oscar Cacho & Paul Pheloung
School of Economics
University of New England
AUSTRALIA

Collaboration: Danny Spring, Susie Hester, Dane Panetta, Chris Buddenhagen

ISSUES

a) How can we measure weed detectability?

b) How many search/control missions are required to eradicate an invasion?

c) How intensive should these missions be?

d) What is the probability of eradication in x years if we invest y dollars?

e) How do attributes of the weed and the environment affect all this?

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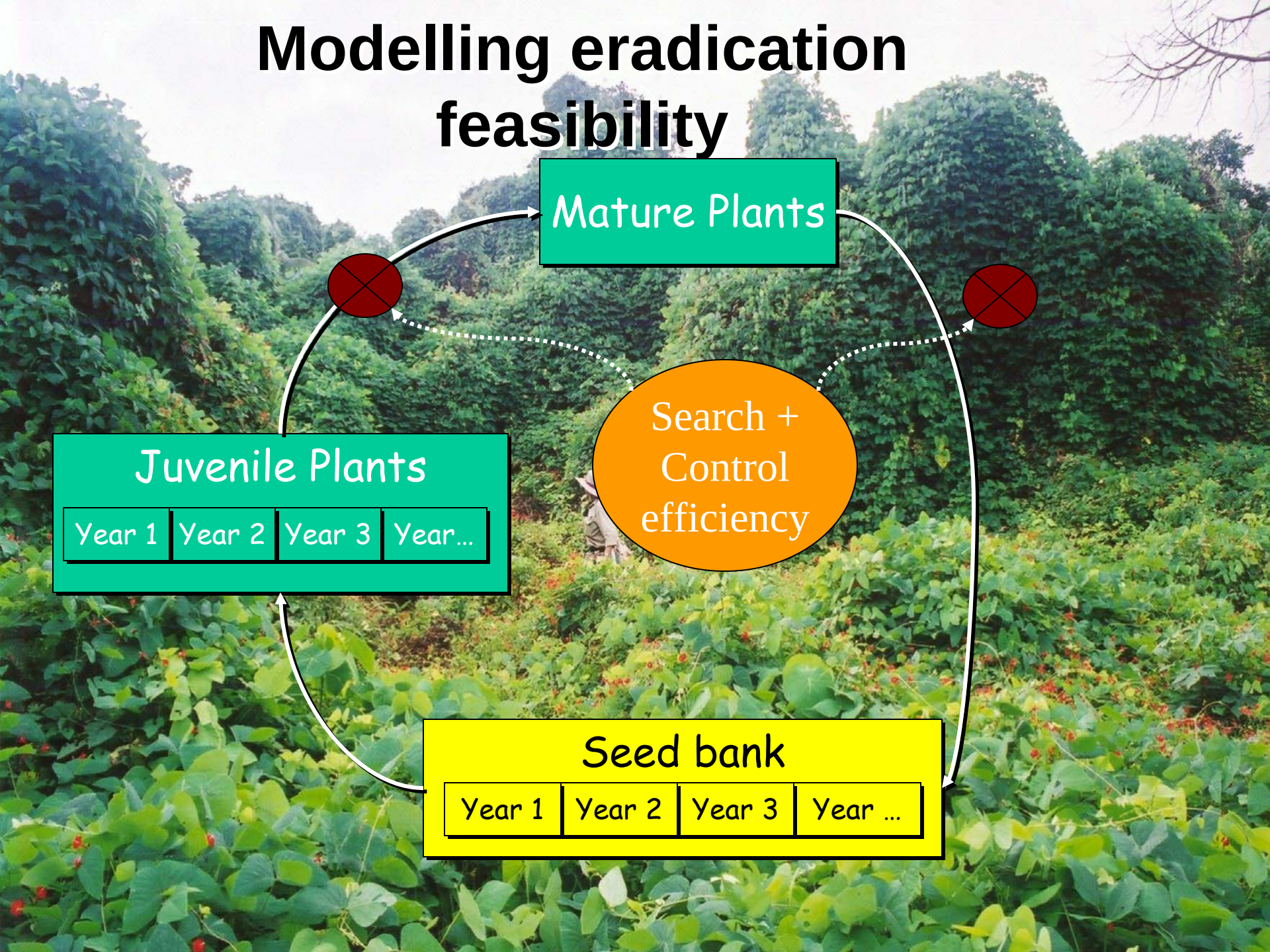
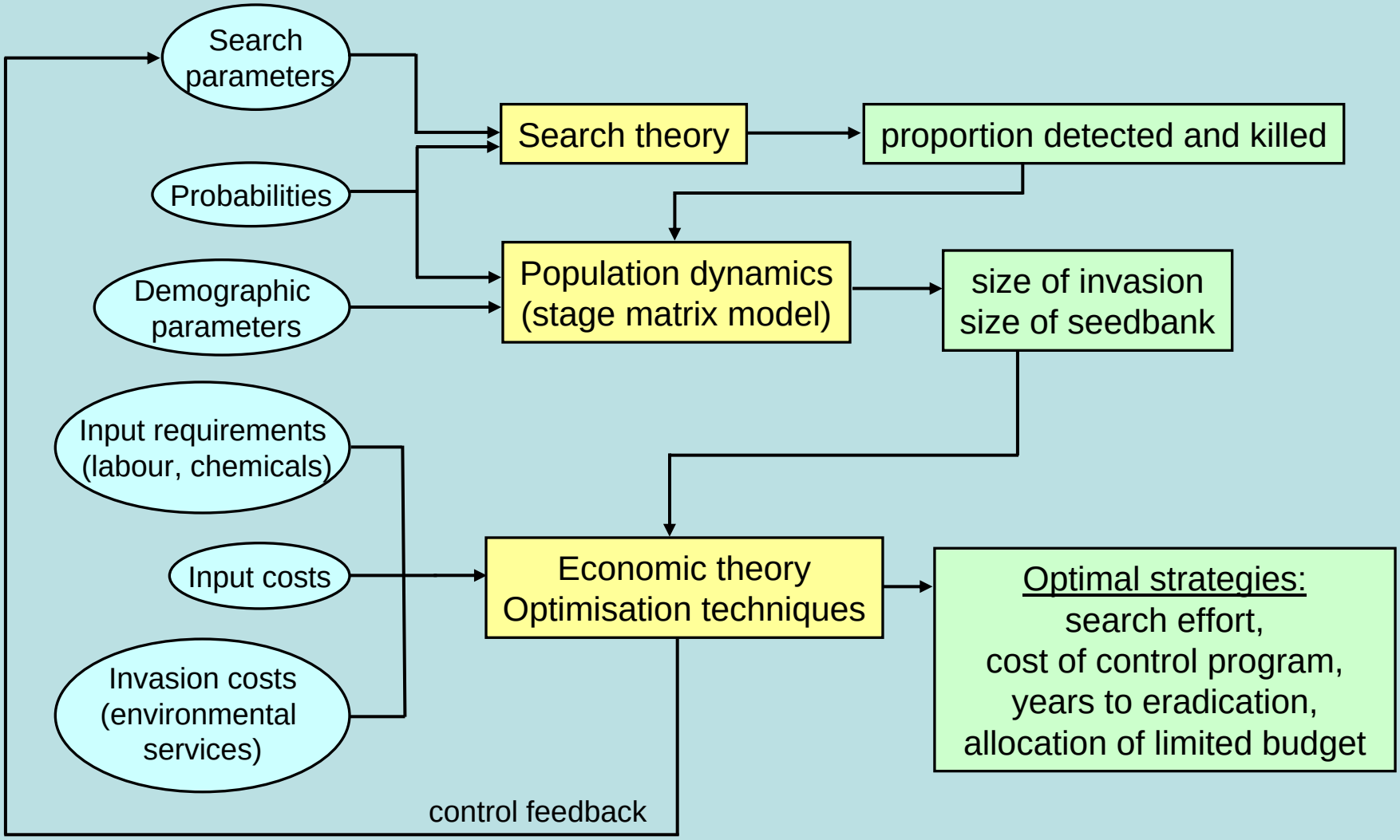
Modelling eradication feasibility



MODELLING STRATEGY



SEARCH THEORY

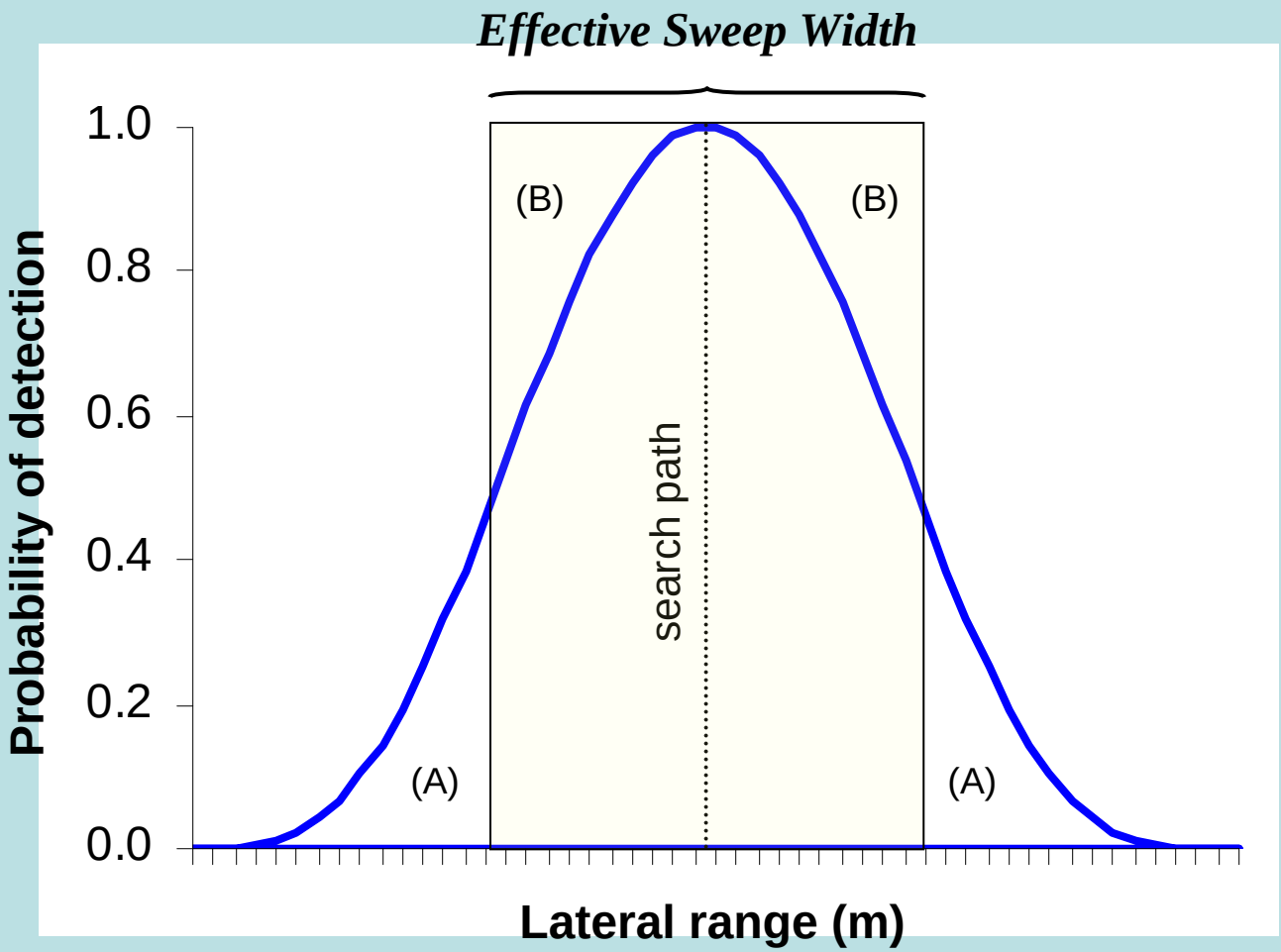
- initially developed to improve success rate in detecting military targets
- relates search effort to probability of detection of an object
- the concepts of *Coverage (c)* and *Effective Sweep Width (R)* are key features of the theory

$$c = \frac{STR}{A}$$

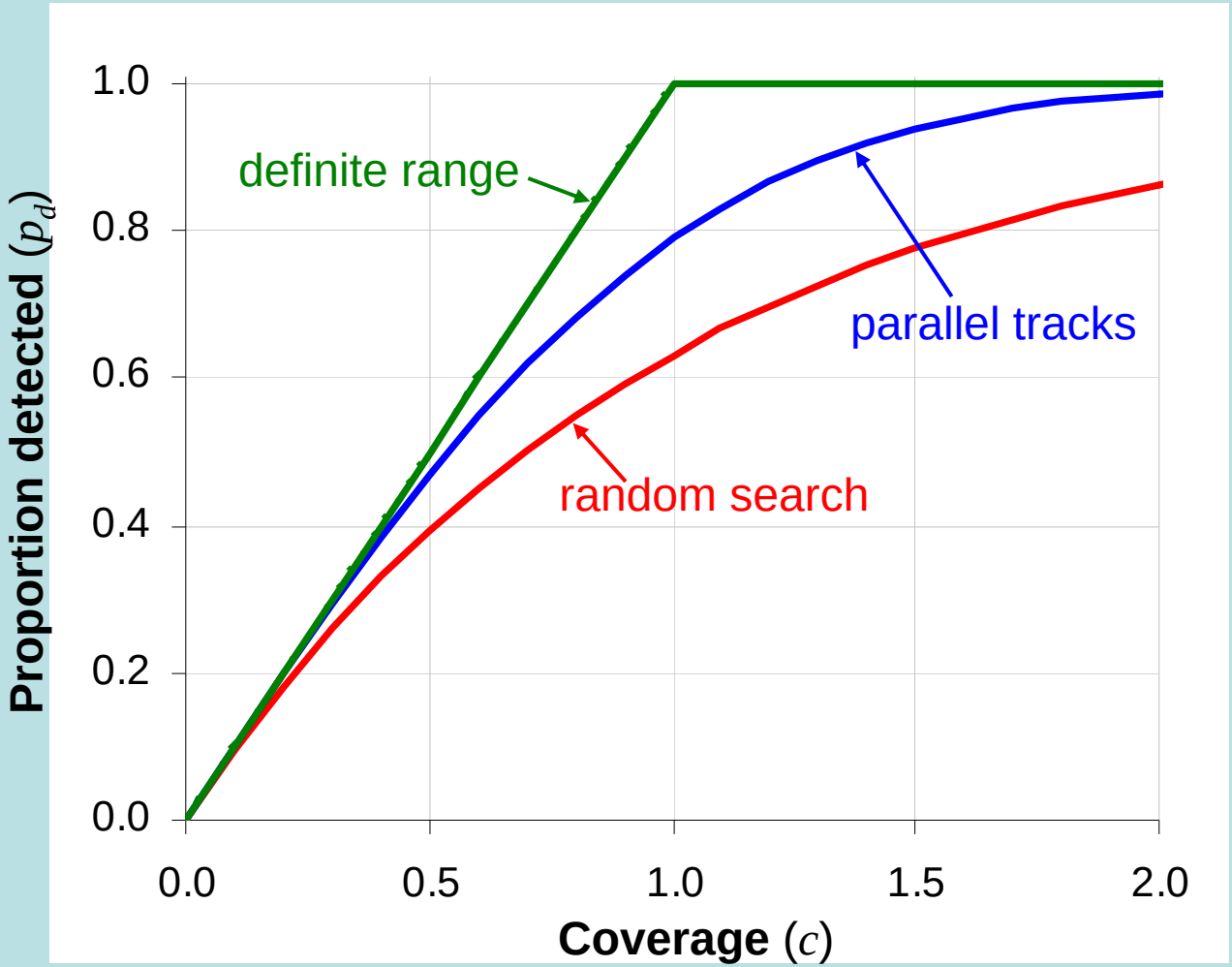
S = search speed (m/h)
T = search time (h)
R = effective sweep width (m)
A = search area (m^2)

R measures the detectability of the object in the given environment

LATERAL RANGE CURVES



PROBABILITY OF DETECTION



PROJECTION MATRIX

$$\mathbf{A} = \begin{pmatrix} 0 & 0 & 0 & 1500 \\ 0.251 & 0.251 & 0 & 0 \\ 0.026 & 0.026 & 0 & 0 \\ 0 & 0 & 0.050 & 0.464 \end{pmatrix}$$

new seeds
seedbank
juveniles
mature

$\lambda = 1.5$

$(\lambda = e^r)$

$$\mathbf{x_t} = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix}$$

$$\mathbf{x_{t+1}} = \mathbf{A}\,\mathbf{x_t}$$

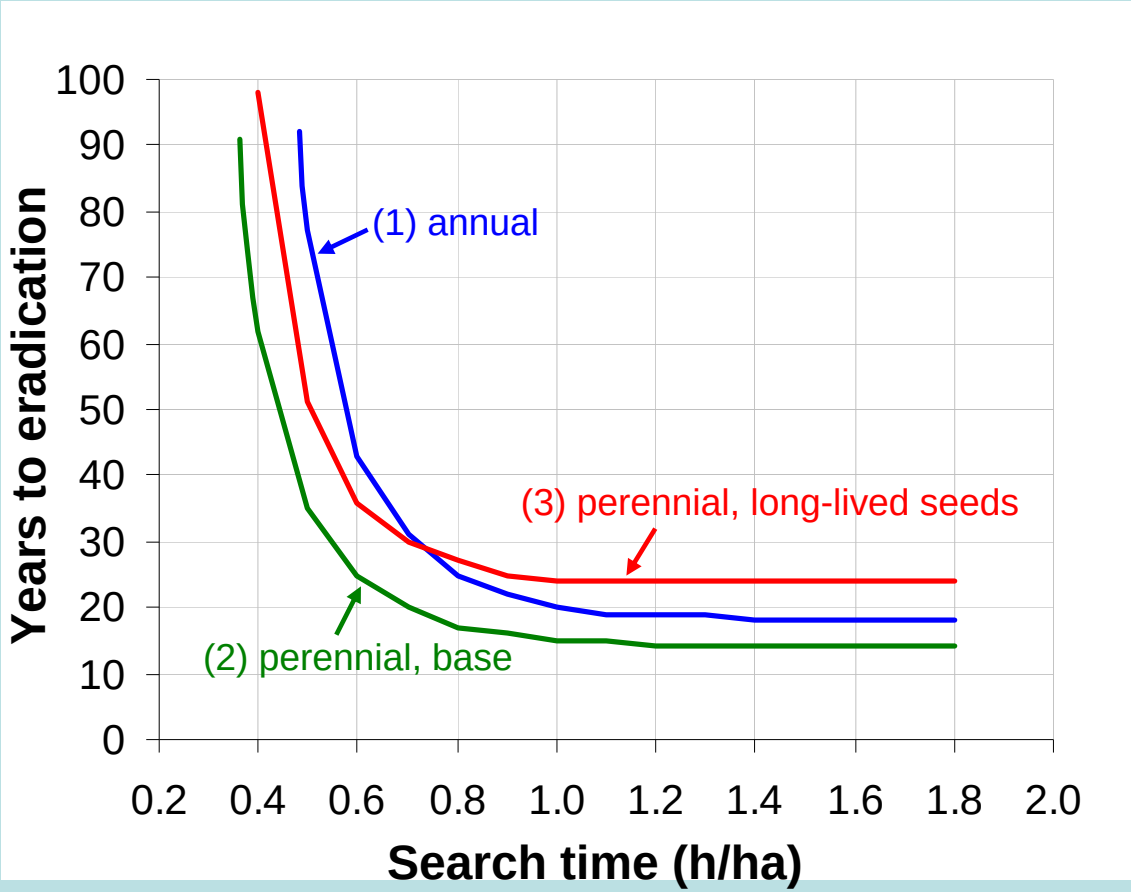
Search parameters

Parameter	Value	Description
T	1.0	Time searching (h/ha)
S	1,000	Speed of search (m/h)
R	20	Perceptual range (m)
K	0.95	Effectiveness of control agent

Biological parameters

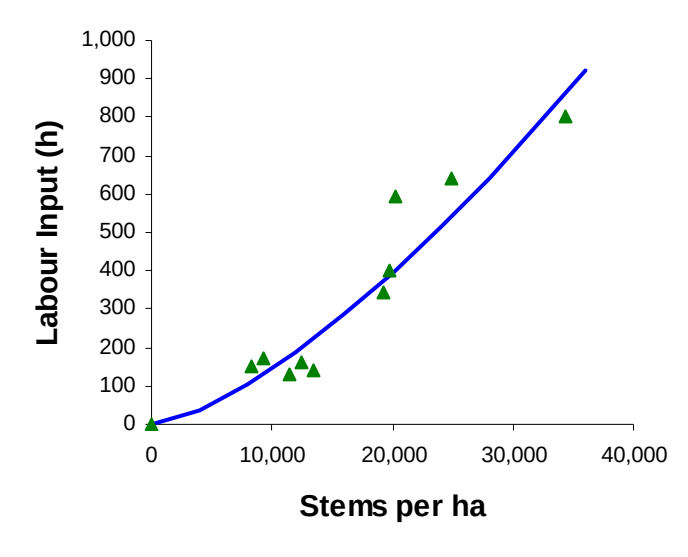
Parameter	Value	Description
f_{31}, f_{32}	0.05	Germination rate
f_{43}	0.02	Juvenile survival
f_{1n}	1,500	Fecundity
M_T	2	Time to maturity (yr)
S_L	5	Seed longevity (yr)
M_S	1.0	Size of adult (m^2)

YEARS TO ERADICATION VS SEARCH EFFORT

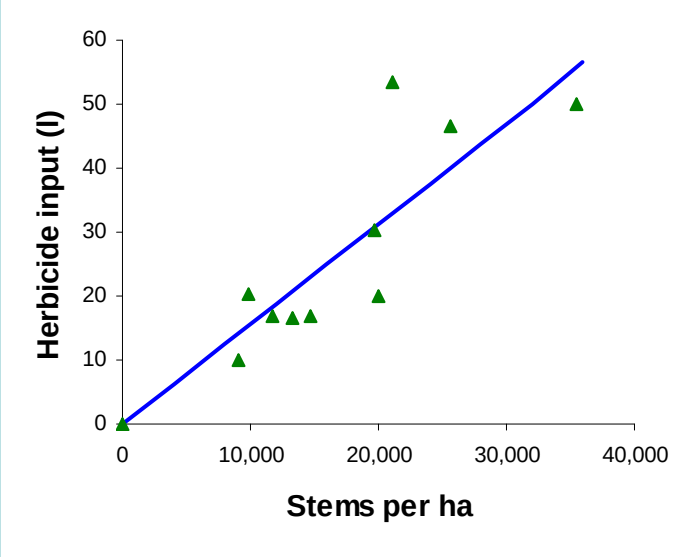


INPUTS FOR WEED CONTROL

Labour



Chemicals



Data from Budenhagen and Yanez (2005)

Measuring detectability

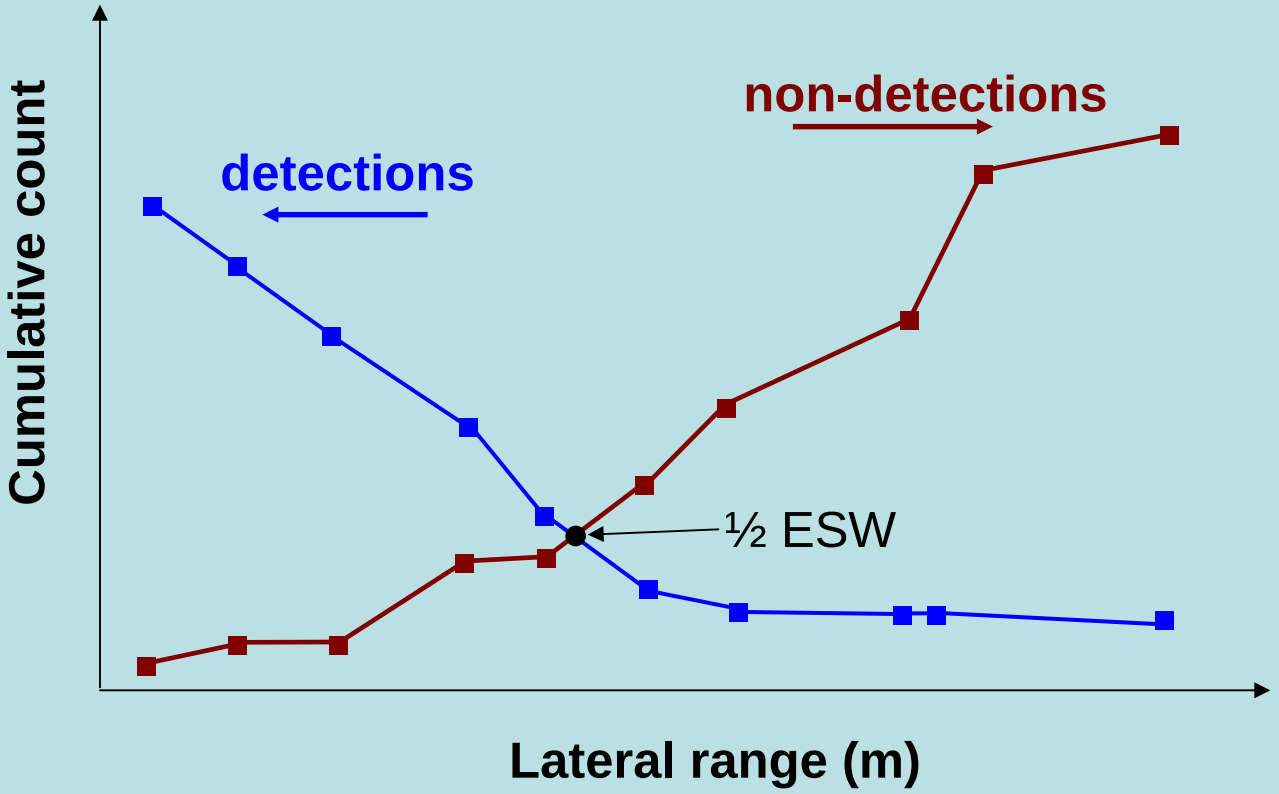
Habitat type	Weed growth form	Visibility[a] (m)
Forest	climbing vine	1-100[b]
	ground creeper	1-7
	shade-tolerant shrub or tree	1-7
Shrubland	vine	1-100[b]
	tree or tall shrub	1-100[b]
Short vegetation	short weed	1-3
	shrub or tree	1-20
Wetland	short weed	1
	shrub	1-30
	tree	1-100[b]
Open habitat	short weed	1-3
	taller weed	1-20

[a] depends on plant age

[b] depends on vantage point

Harris, Brown and Timmins (2001), p.13

Measuring detectability (ESW)



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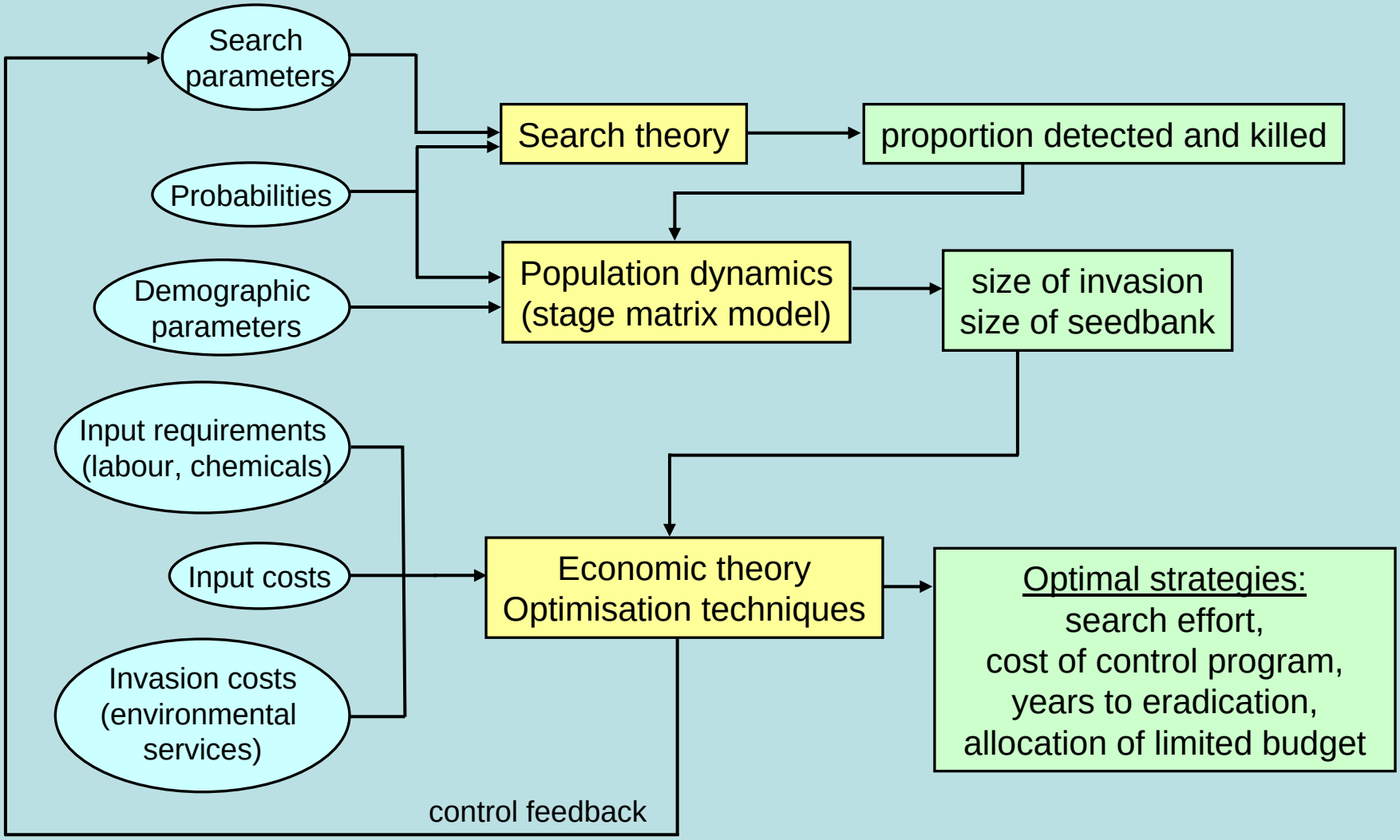


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