

Biological control of Pompom weed

The blueprint

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When plants are introduced into a new country, they **may** become invasive



Natural range = diverse



Introduced range = monoculture



Why do only some introduced plants become invasive?

- ☐ High seed load.
- ☐ Vegetative reproduction.
- ☐ Hybrid vigour.
- ☐ Chemical defences.



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- ☐ High seed load.
- ☐ Vegetative reproduction.
- ☐ Hybrid vigour.
- ☐ Chemical defences.
- ☐ NO NATURAL ENEMIES.

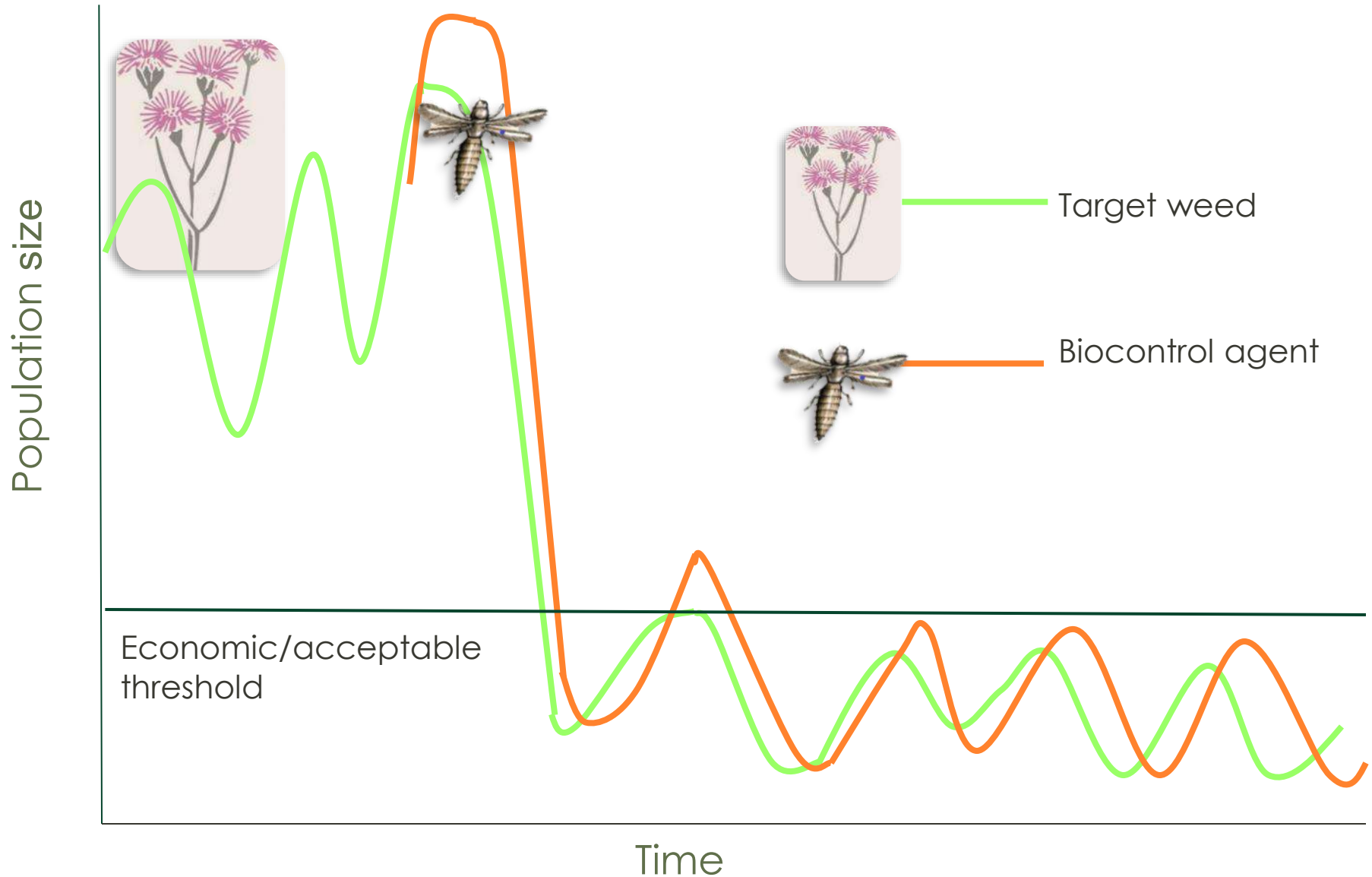


Biological Control

The use of **host-specific** natural enemies to bring about the long-term or sustainable **control** of the target plant.



How does weed biocontrol “work”?



Biocontrol approaches

❑ Classical biocontrol

Agents imported from the weed's country of origin

Agent and the weed have long co-evolved relationship

❑ Neoclassical (new association) biocontrol

Agents are introduced from other countries and feed on plants that are closely related to the weed

Agent and weed have no co-evolved relationship

Weed has no co-evolved defenses to agent



Advantages of biological control

- ❑ Environmentally friendly.
- ❑ Self-perpetuating, permanent.
- ❑ Cost-effective.
- ❑ Can be integrated with other management techniques.
- ❑ Allows the natural vegetation of the area to recover gradually in the shelter of the dying weeds.



Potential natural enemies must be proven host-specific before they can be released



Weeds Research Quarantine Facility at Roodeplaat, Pretoria



Concept of host specificity

Ecological (true) host range

Range of plants that an insect **actually feeds and develops** on under **natural (field)** conditions when **able to choose**.

Determined by field studies in country of origin and is usually much narrower than physiological host range.

Physiological host range

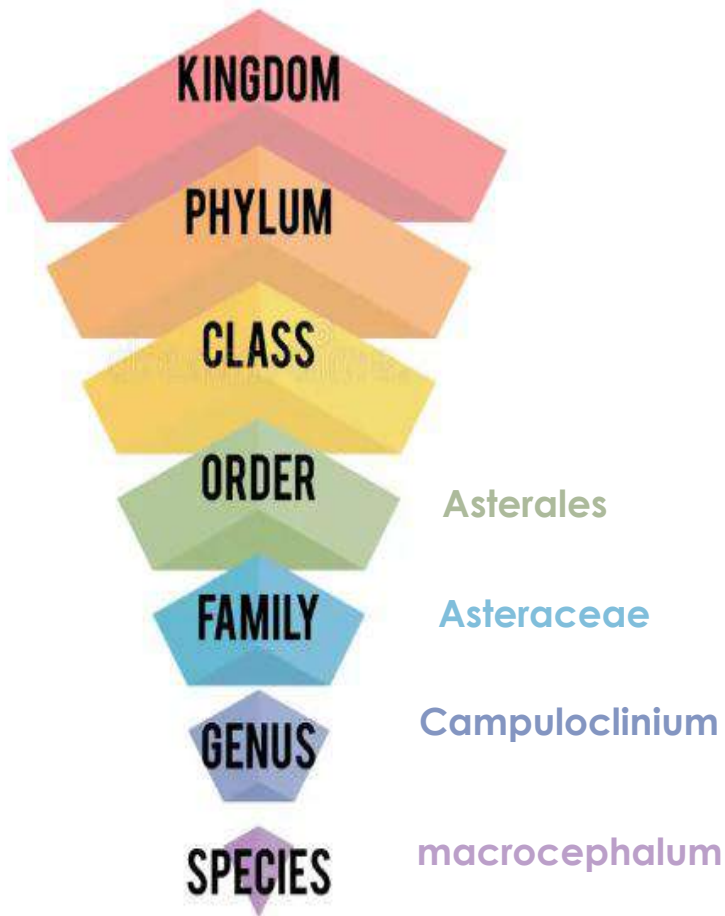
Range of plants that insect is **capable of feeding and developing** on under **artificial (lab)** conditions in **absence of choice**.

Determined by laboratory host-specificity tests.



Concept of host specificity

Plant taxonomy



Concept of host specificity

Monophagous = very narrow host range

1 or 2 host plants **in same genus**

Preferred as agents

(low non-target risk)

Oligophagous = restricted host range

3 or more host plants in **same genus or family**

Suitable as agents if host range is narrow enough

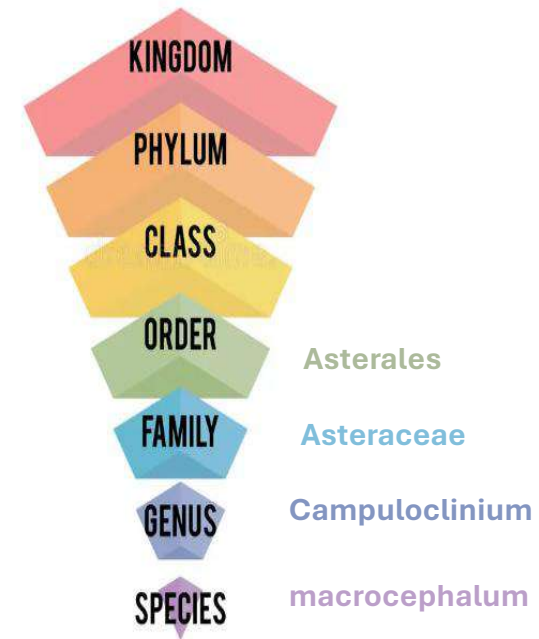
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Polyphagous = wide host range

Many host plants from **different families**

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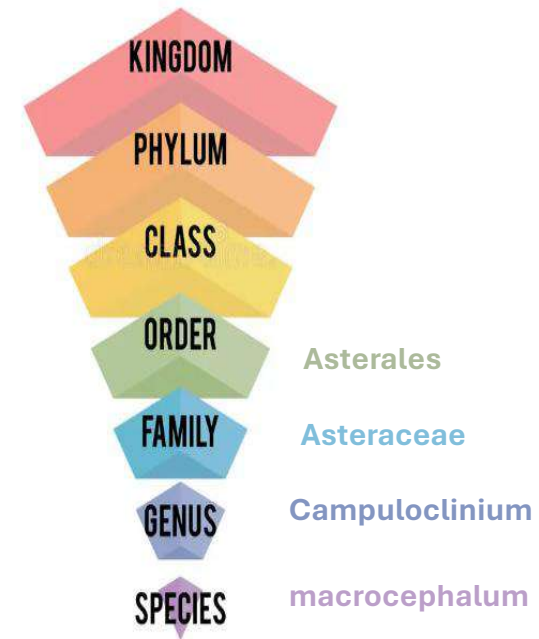
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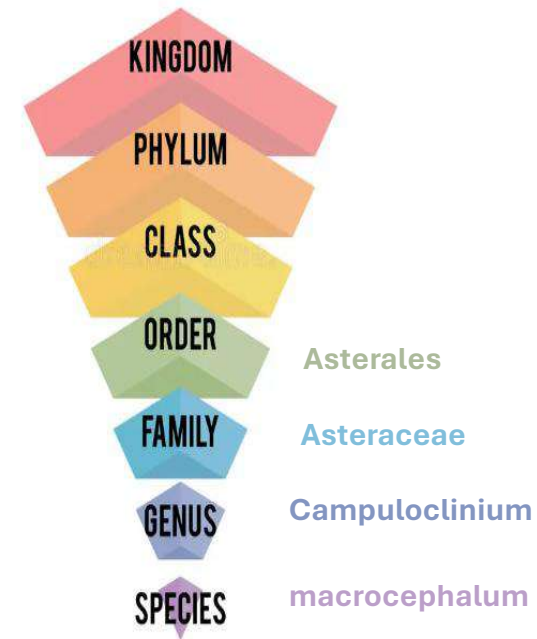
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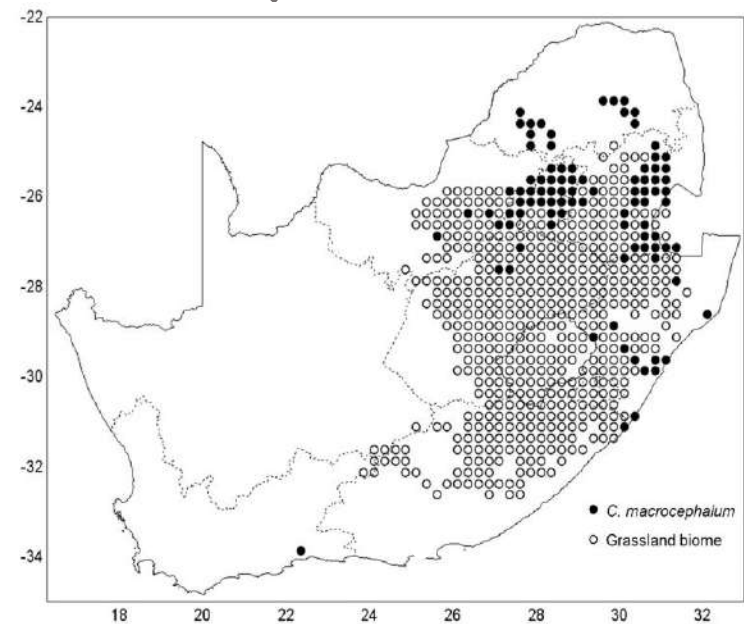
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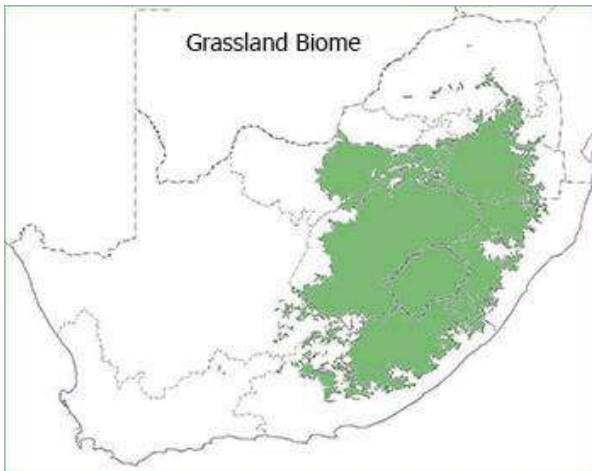
(high non-target risk)



Pompom: Origin and Distribution in RSA



Grassland biome



- Second largest biome (29%) stretching over 8 provinces.
- Species diversity second only to the fynbos.

And yet:

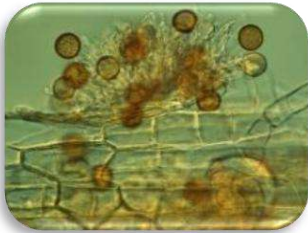
- One of the most threatened biomes.
- 30% transformed beyond repair.
- ONLY 2% is formally conserved.



Pompom: **NOT** a pioneer

- ❑ Long lived perennial.
- ❑ Well developed tuberous root system.
- ❑ Growth point below soil surface.
- ❑ Evolved to establish in a specific niche in grasslands that is being “maintained” because of disturbance.
- ❑ Low basal cover areas at high risk (overgrazing).





- ❑ Seedling growth is reduced by high spore concentrations.
- ❑ Early season introduction of the rust has a higher impact on mature plants.
- ✓ Reduction in the above ground living material
- ✓ Reduction in rootstock growth





First release of the pompom flower-feeding moth, *Cochylis campuloclinium*, in South Africa

The flower-feeding moth, *Cochylis campuloclinium*, was first recorded by the late Dr Stefan Nieser (ARC-PHP) and Fernando Mc Kay (PUEDE) in Argentina in 2003 when surveying for natural enemies of pompom weed, *Campuloclinium macrocephalum*. The moth was later described as a new species in 2006. Following the importation of the moth into quarantine at PHP Roodepols, its host range and impact were assessed. Results from these trials found the moth to be suitably host specific to pompom weed, whilst laboratory impact studies demonstrated that *C. campuloclinium* larvae destroyed a significant number of florets in pompom flower buds (76%) and seeds in mature flowers (54%). Based on the laboratory data, permission for the release of the moth was applied for and granted in October 2015 by the South African regulatory authorities. However, re-importation issues until a new culture landed from Argentina in February 2021. After successfully overwintering in quarantine for parasitoids, the moth culture was reared and the first field release made in January 2022 in the Magaliesberg Biosphere. (This is a rising tribute to the late, Dr Stefan Nieser, long-time member of the Mountaineering Club of South Africa (Magaliesberg) and protector of biodiversity. Planned releases will now follow throughout GP, LP, MP and NW Provinces. Once basic release methods and monitoring studies have been established, the moth will be made available to the public for wider distribution throughout the invasive range of pompom weed.



Adult pompom flower-feeding moth

The first release of the flower-feeding moth, *Cochylis campuloclinium*, together with members of the SA Mountaineering Club in the Magalies Biosphere. A tribute to the late Dr Stefan Nieser (right).

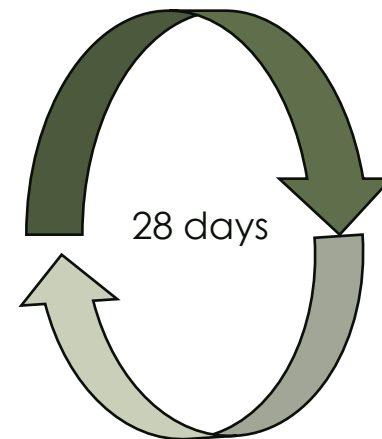
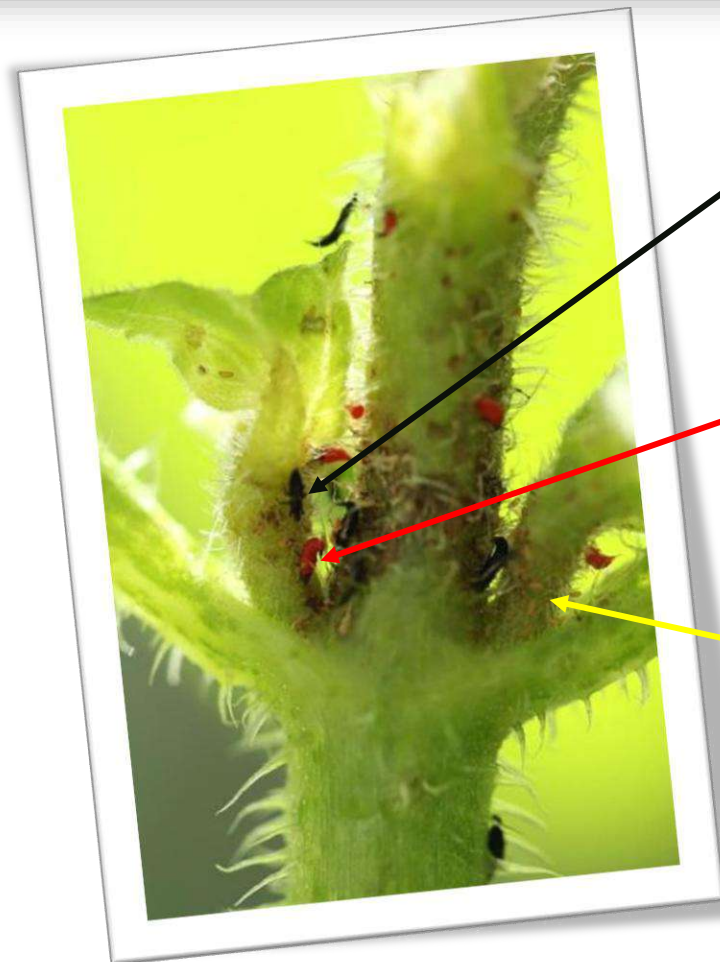


Photos courtesy of Mountain Club members and A. Lubbeke

For any further enquiries

Please contact our researcher, Mc Liemb van der Werfhuizen (M.V.Werfhuizen@arc.agric.za), or our Research Team Manager, Dr. Roger Price (R.Price@arc.agric.za)







Thrips damage: first signs → end of season



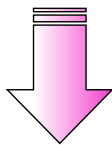
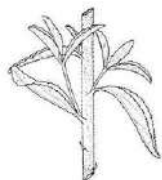
Thrips damage: Early season re-growth following establishment

Challenges

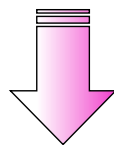
- ❑ Timeous, early season releases.
- ❑ Mass-rearing according to demand/need.
- ❑ Establishment also seems to be limited by:
 - ✓ Overshadowing
 - ✓ Soil clay content
 - ✓ Predation



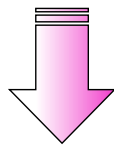
Pompom thrips impact: Plant level



- Plant height (63%)
- Number of leaves



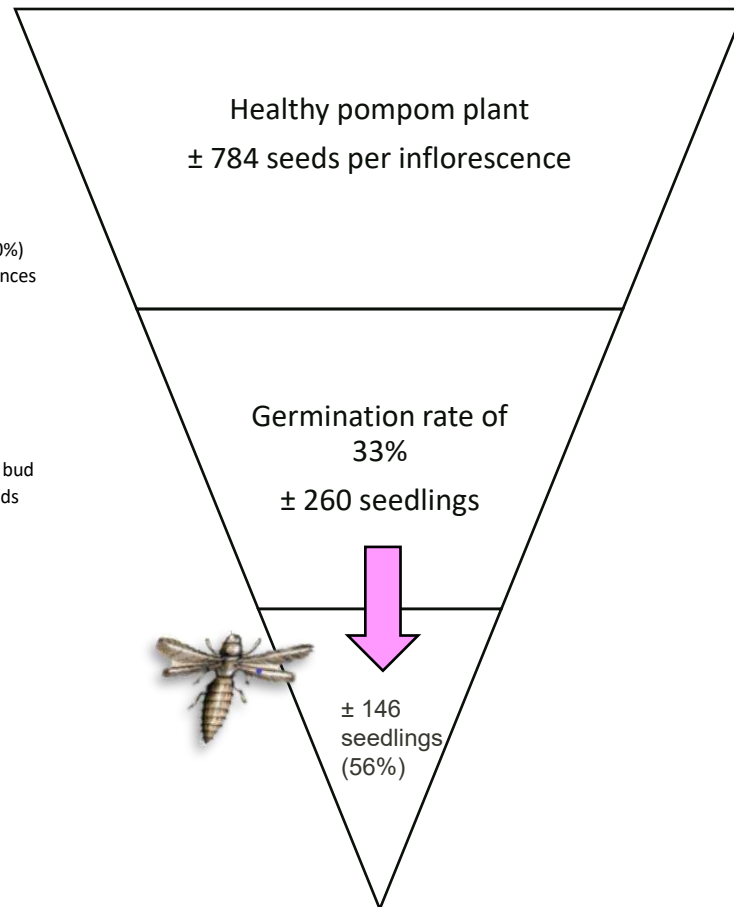
- Number of buds per inflorescence (76-100%)
- Number of inflorescences (50-81%)



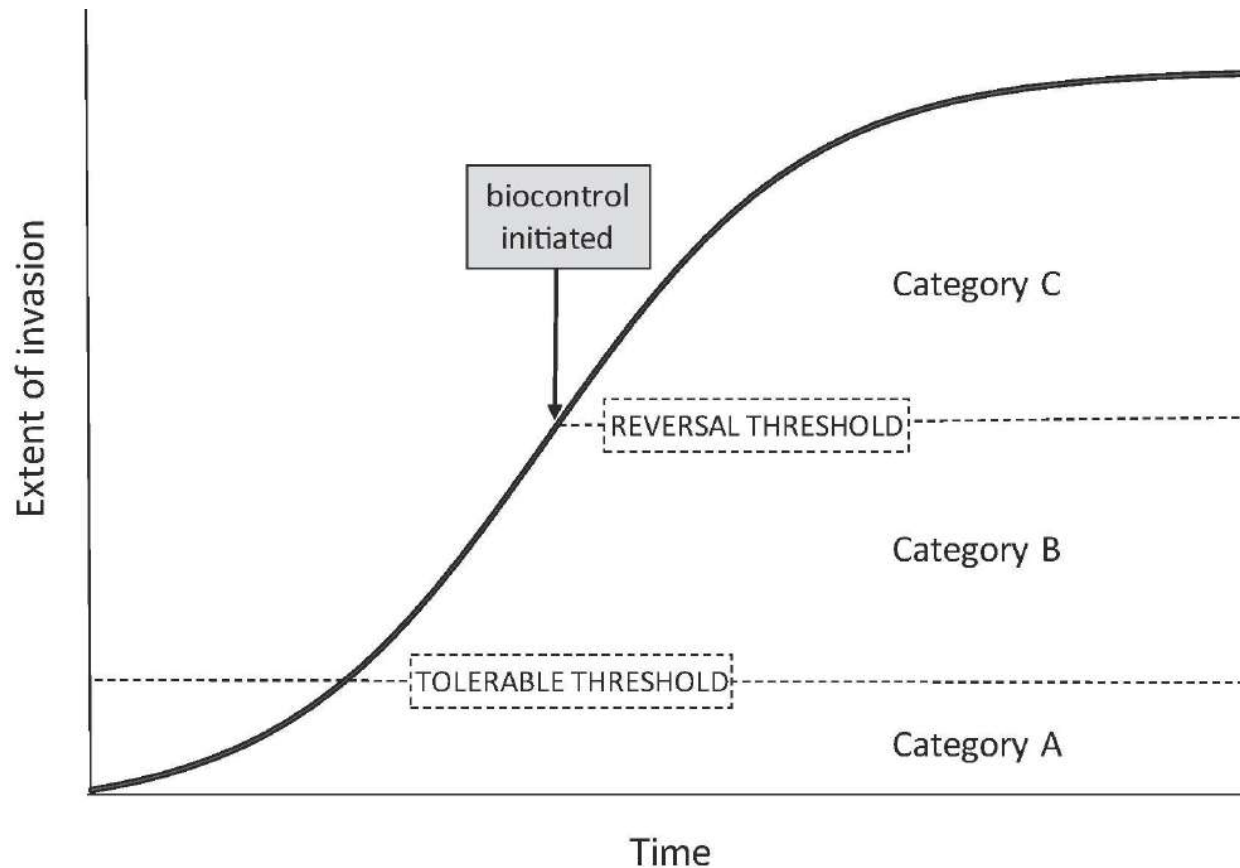
- Number of seeds per bud
- Number of viable seeds



- Chaff



Conceptualising success in biological control



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journal homepage: www.elsevier.com/locate/ybcon



Commentary

Implementing a system in South Africa for categorizing the outcomes of weed biological control

V. Cliff Moran^{a,*}, Costas Zachariades^{b,c}, John H. Hoffmann^a

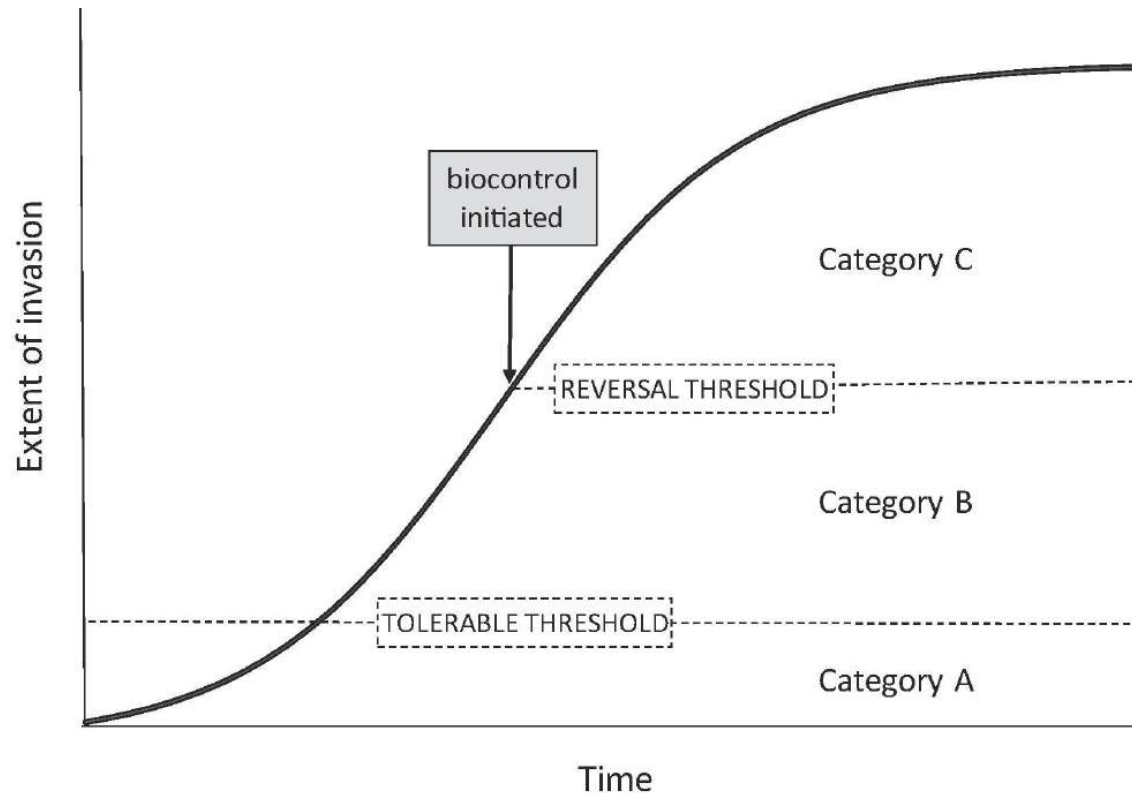
^a Department of Biological Sciences, University of Cape Town, Rondebosch, South Africa

^b Agricultural Research Council Plant Health and Protection, Cedara, South Africa

^c School of Life Sciences, University of KwaZulu-Natal, Scottsville, South Africa

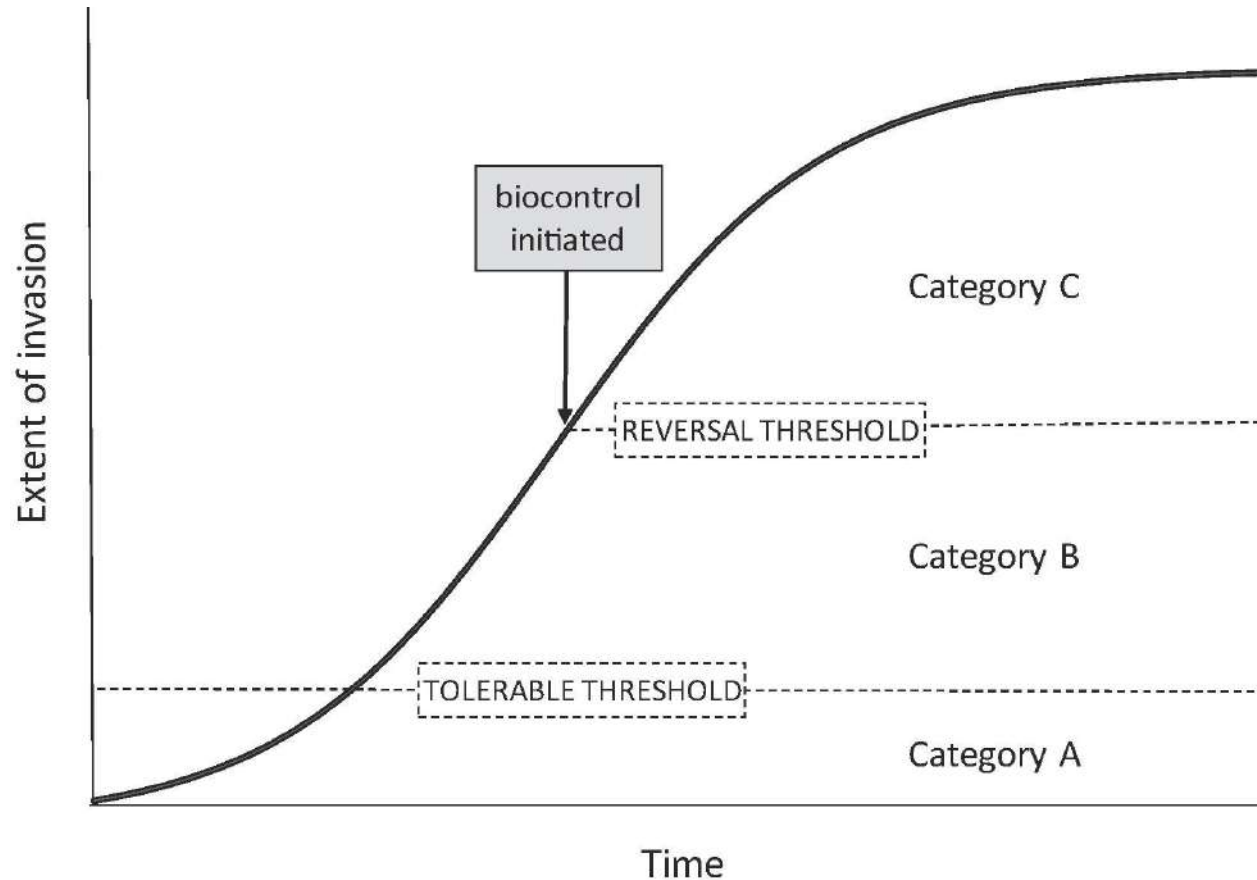


Conceptualising success in biological control



Category C: AIP populations continue to increase over time, possibly at a slower rate than would have occurred without biological control: the changes may be so slight that it is not noticed, and there remains a need for other management interventions, including more biological control effort

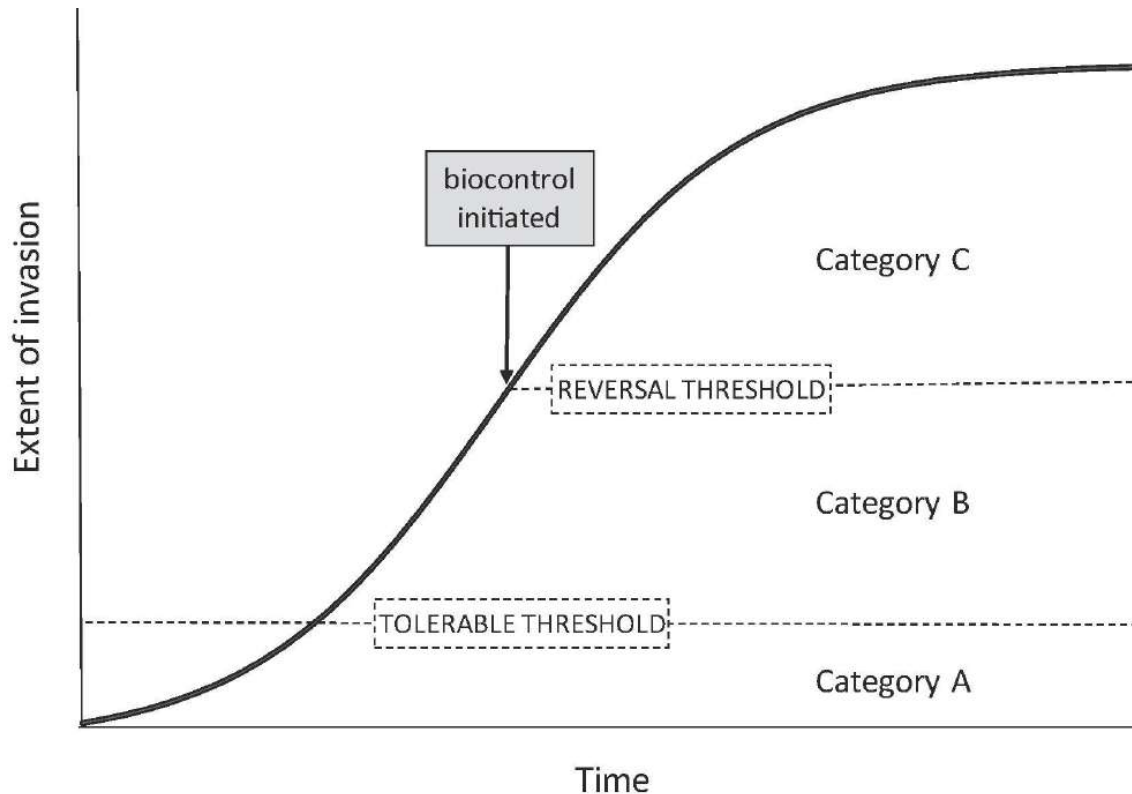
Conceptualising success in biological control



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Category B: the extent of the invasion declines to levels below a 'reversal threshold' but above the 'tolerable threshold'. AIS species are still problematic but much less so than they would have been in the absence of biological control, and management strategies are more likely to succeed.

Conceptualising success in biological control



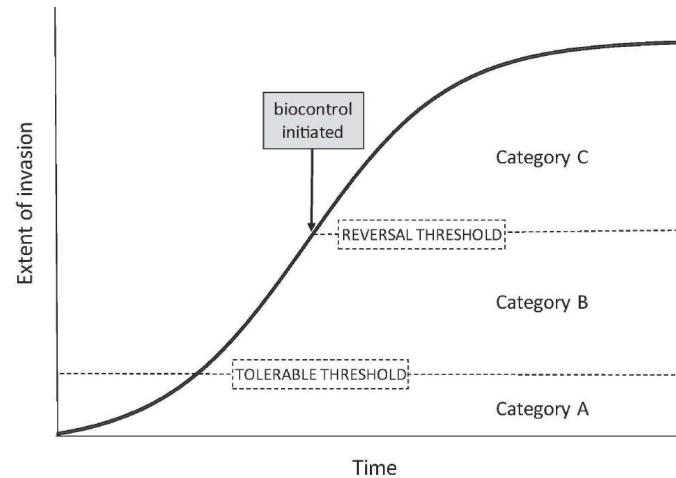
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Category A: relative to the situation prior to biocontrol, plant populations decline to an equilibrium level below a 'tolerable threshold'. The extent and impact of the invasion then becomes trivial or non-existent, often in a 'forever state'.

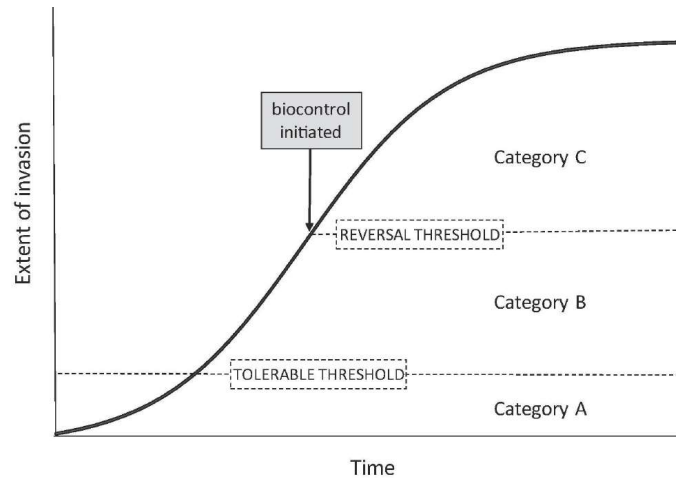
Outcomes of biological control

Weed species	Regions	Habitats	Density	Area	Biomass	Seeds	Years
<i>Opuntia ficus-indica</i> (L.) Mill. (Zimmermann and Moran, 1991)	EC	Coastal	B-	C-	C+	C-	86
<i>Acacia longifolia</i> (Andr.) Willd. (Impson et al., 2011)	All	Drylands	A	A+	A	A	37
<i>Sesbania punicea</i> (Cav.) Benth. (Hoffmann and Moran, 1998)	All	All	A+	A	A+	A+	35



Outcomes of biological control

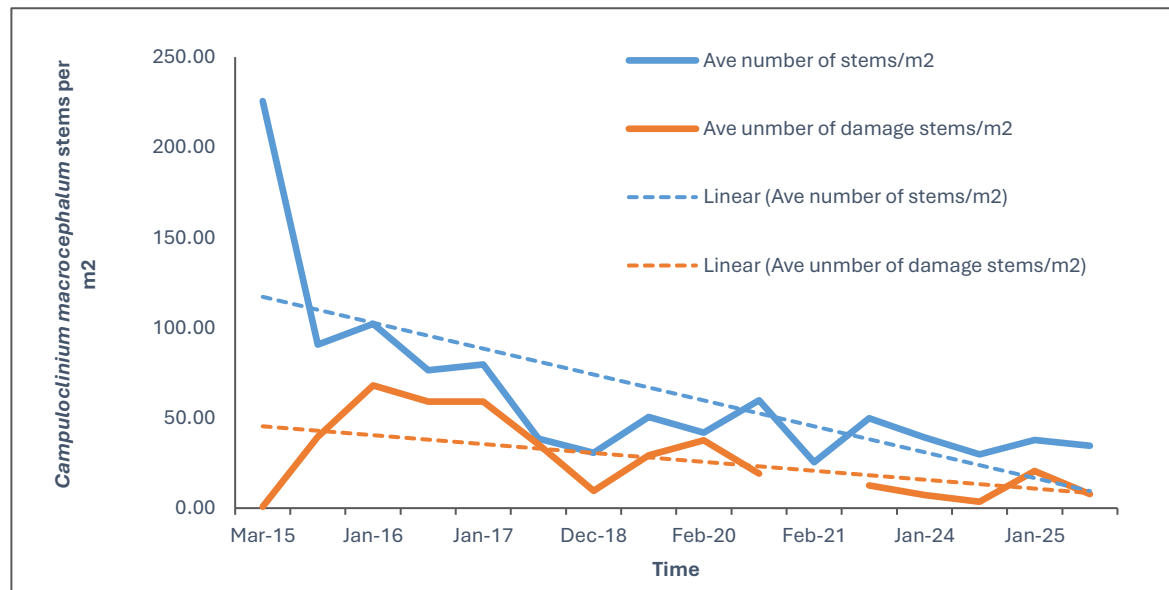
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<i>Campuloclinium macrocephalum</i> (Less.) DC	GP, NW, MP	Drylands	C-	C	C-	B+	11
	All	Riparian	C	C	C	C	



Integrated control

Data collected from long-term monitoring at the Airforce Base Waterkloof suggests a decrease in stem density from ± 226 stems/m² to ± 36 stems/m².

When this stage is reached, the surrounding vegetation may regain its competitive ability.



Decline in the number of *Campuloclinium macrocephalum* stems per square meter following the release of *Liothrips tractabilis* a decade ago.



Integrated control

ECOLOGICAL INTEGRATION APPROACH

- Biological and chemical control used on the same infestation of pompom, within the same season.
- Aim: herbicide to reduce pompom population significantly for biocontrol to delay weed population recovery.





CONTROL

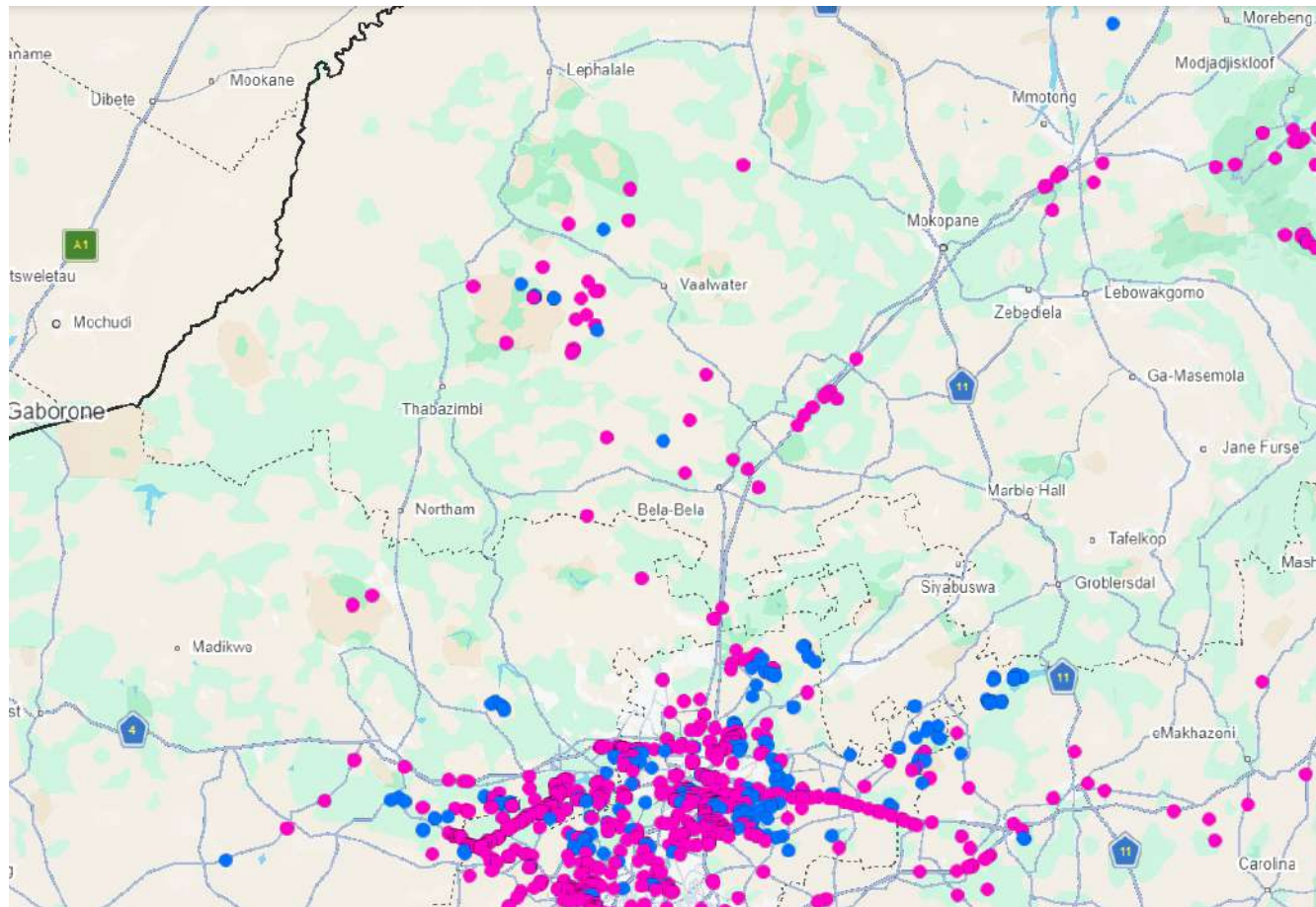
BRUSH-OFF
(metsulfuron)

ACCESS
(picloram)

IMPALA
(trilopyrfluroxy)



Pompom distribution and thrips releases in LP



- *Campuloclinium macrocephalum*
- *Liothrips tractabilis*



Closing remarks

Biocontrol is seldom a solution on its own, and is usually combined with appropriate chemical and/or mechanical control, resulting in “integrated control”.

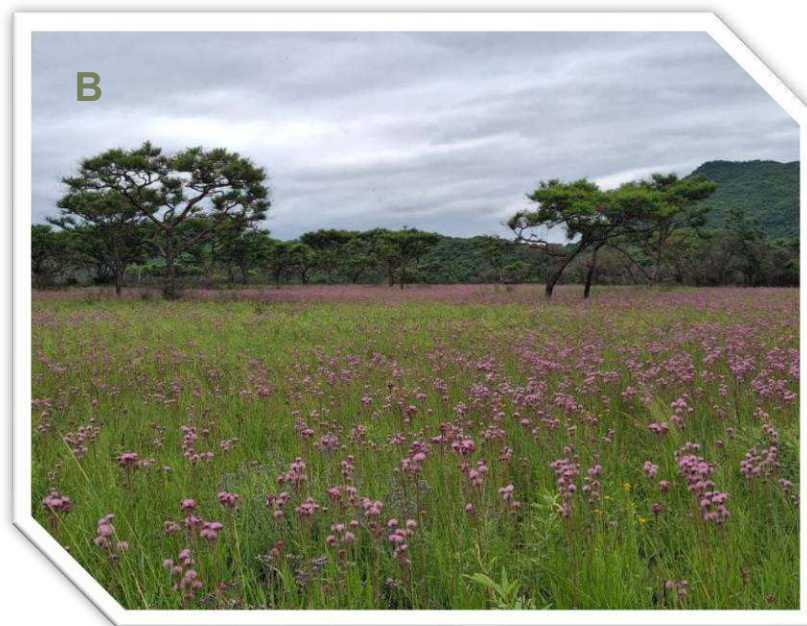
Establish “agent reserves” to protect the agents from clearing and spraying.

Create conditions that favour agents and use the agents optimally.

Clearly define the end goal to recognise success



A success story: 11 years in the making



Thank You



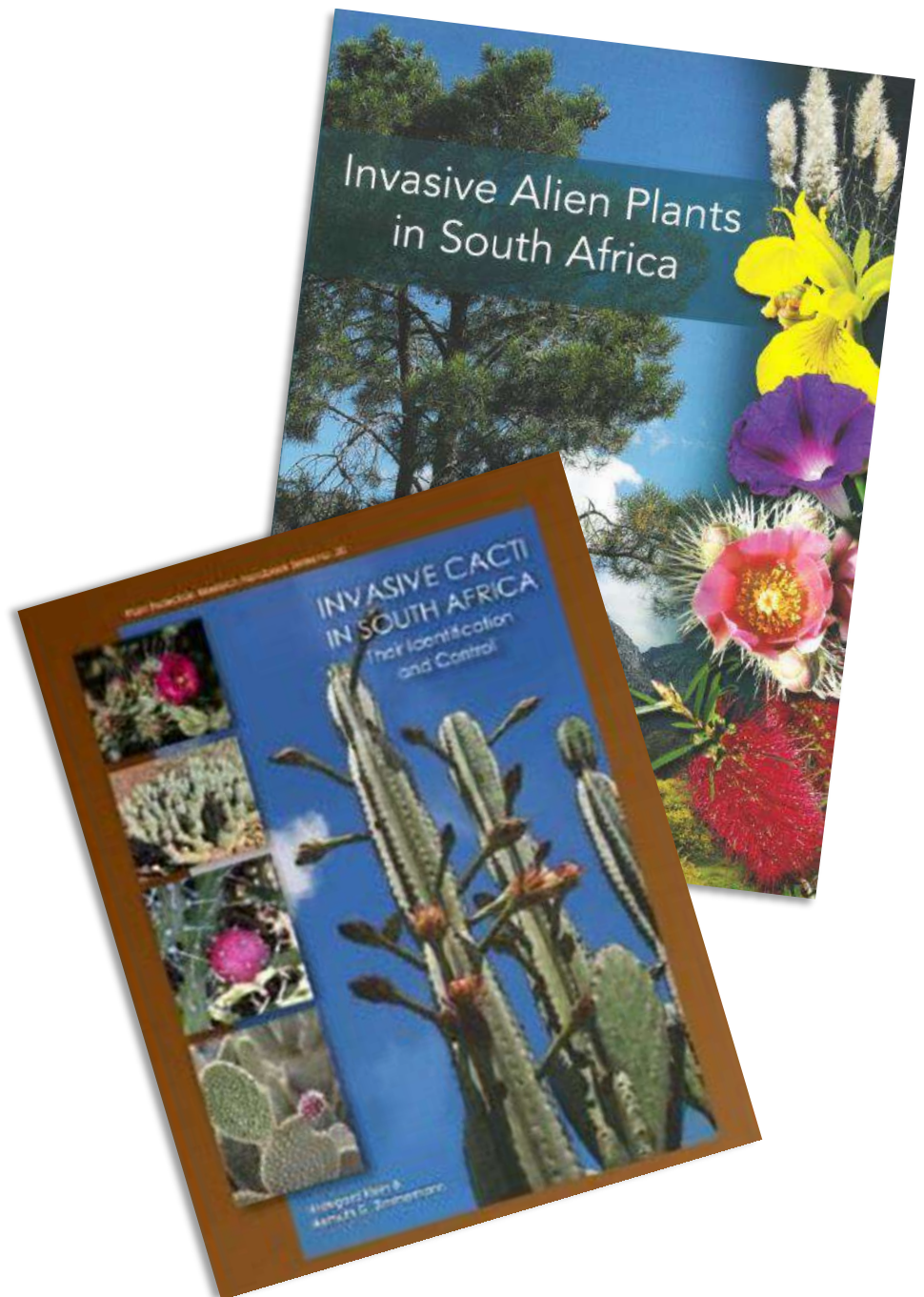
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ARC-PHP CEDARA



HILTON: KZN



Chromolaena odorata



Parthenium hysterophorus



Tradescantia sp.



Arundo donax



ARC-PHP ROODEPLAAT



ROODEPLAAT: GP



Tecoma stans



Cardiospermum grandifolium



Dolichandra unguis-cati



Anredera cordifolia



Cestrum sp.



Lantana camara



Tithonia diversifolia



Campuloclinium macrocephalum



ARC-PHP VREDENBURG



STELLENBOSCH: WC

