

Are invasive grasses good targets for biological control?: A case-study of two invasive *Sporobolus* sp. in Australia



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Biological control

- Cost-effective, and environmentally-friendly

Family	# Weedy species ³	Total species	% Weeds	# Species with BC	(ratio # weeds: # weeds with BC)
Asteraceae	2373	22 750	10.4	31	1 in 76
Poaceae	2176	9 500	22.9	1	1 in 2176
Fabaceae	2147	18 000	11.9	19	1 in 113



Grasses – poor targets?

- ‘Poor targets’ for biological control
 - Lack of host-specific agents
 - Closely related economic crops
 - Simple plant architecture
 - Lack of secondary defensive compounds
 - Early surveys found no host-specific agents
 - Natural enemies have little/no impact on host
 - Co-evolved to tolerate large mammalian herbivory
 - Able to compensate for tissue loss



Recent advances

- Large herbivore assemblages
 - *Phragmites australis* – 160 species
 - *Spartina alterniflora* – 24 species
 - *Calamagrostis epigejos* – 10 endophagous species
- Secondary compounds not NB
 - Host-specificity maybe driven by silification
- Host-specificity testing
 - Methods developed
 - Confidence in safety assessments



BC of *Arundo donax*

- Host-specific agents
 - Three agents accepted, two released
- Damaging agents
 - 22% reduction in standing biomass in USA
 - Estimated saving of \$4.4 million per/year
 - In its native range, *R. donacis* reduced standing biomass by 50%



Tetramesa romana



Rhizaspidiotus donacis

Grass BC is possible!!!!



Sporobolus BC

- Five *Sporobolus* species are weeds in Australia
 - *S. pyramidalis* →
 - *S. natalensis* →
 - *S. africanus*
 - *S. fertilis*
 - *S. jacquemontii*
- Environmental and economic consequences
 - Decrease carrying capacity by 10-80%
 - Losses of A\$ 60 million per year
 - Occupy half of suitable exotic habitat



Sporobolus BC

- *Tetramesa* sp. (Eurytomidae)
 - Originally thought to be damaging, which was later reversed
 - Lab culture couldn't be established (parasitism, diapause)
 - No host-specificity testing was performed
- *Ustilago sporoboli-indici*
 - Not suitably host-specific
 - Already present in Australia
- Lack of specificity and predicted impact = project terminated (2002/2003)



Aims

- Are grasses good targets for biological control?
 1. Are there host-specific agents available?
 2. Are candidates agent predicted to establish, be damaging and control the target weed?



Climate
matching

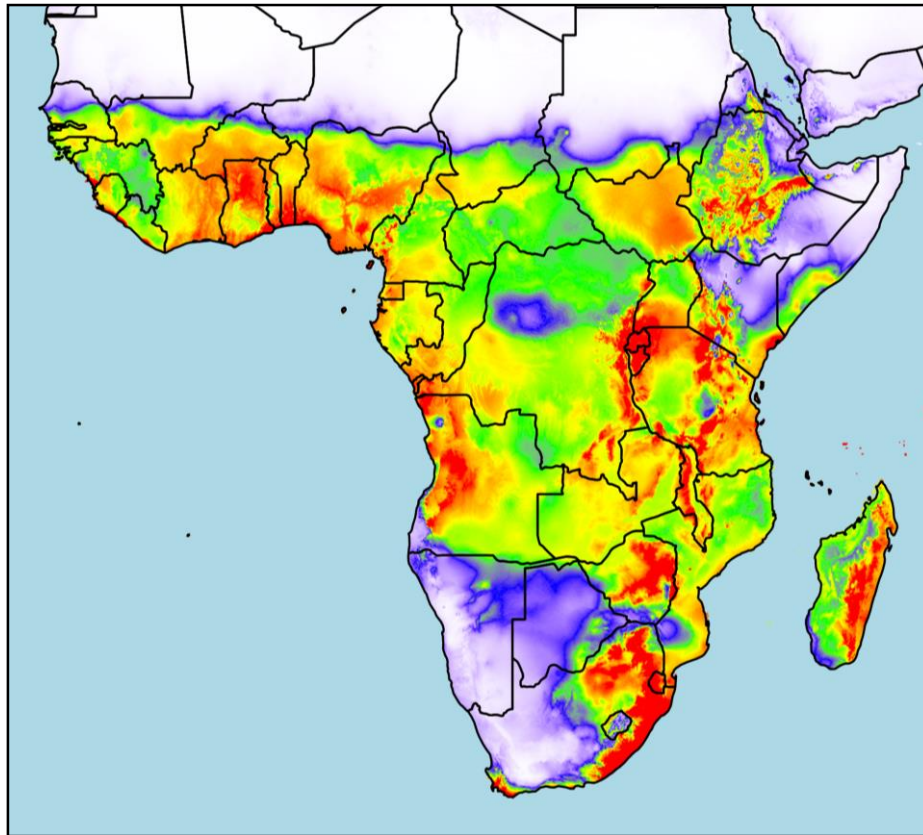


Quantitative
phytophagous
surveys

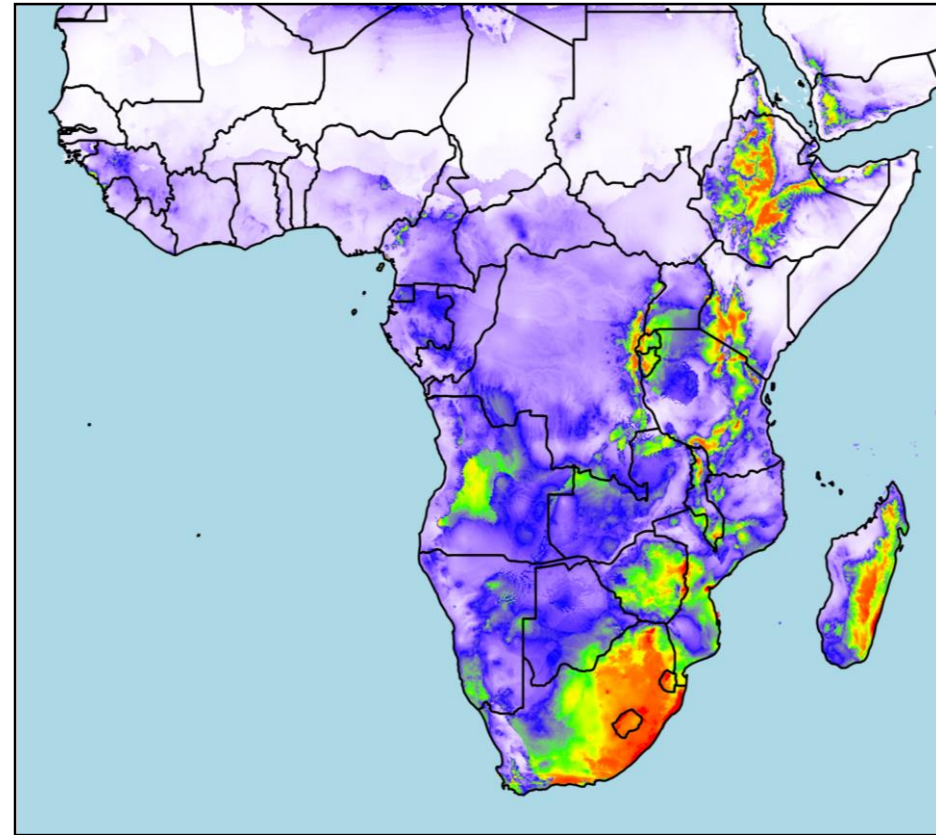


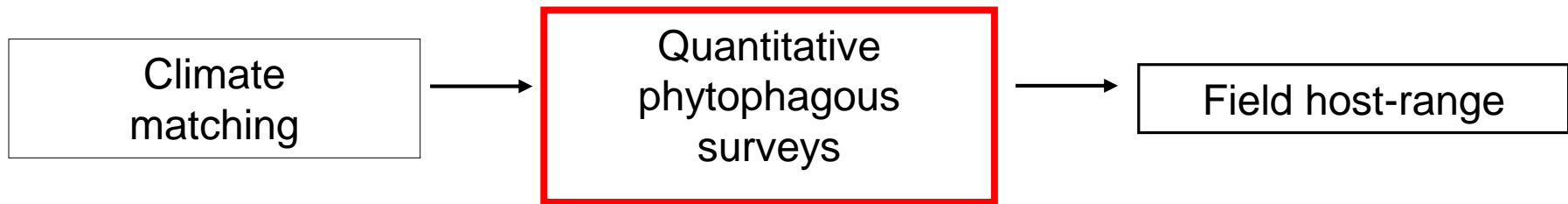
Field host-range

S. pyramidalis



S. natalensis



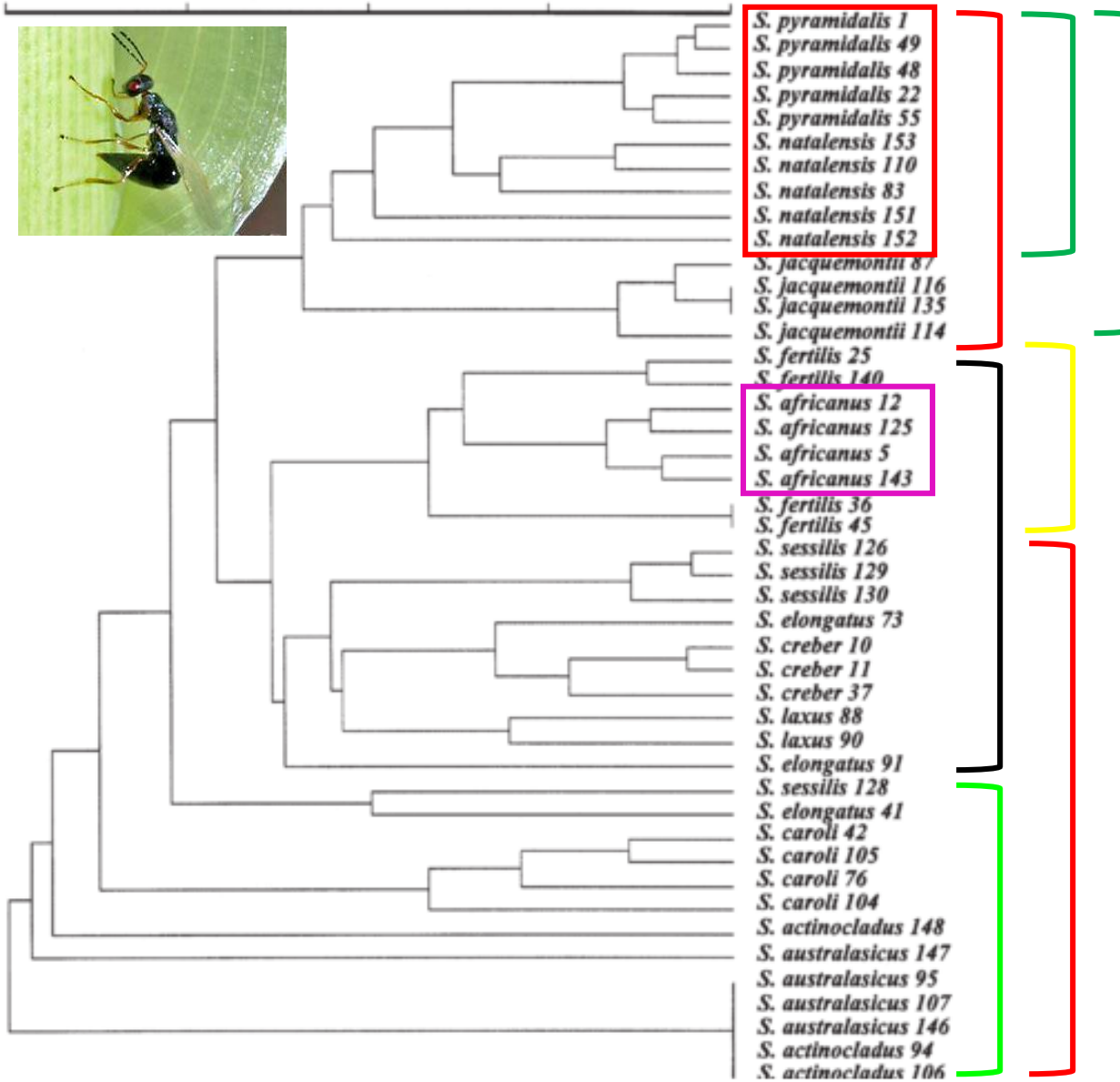


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- Prioritise candidate agents by:
 - Host-specificity
 - Damage
 - Abundance
 - Feeding guild
 - Stringent specificity requirements for *Sporobolus* BC
 - Expensive to do host-spec
 - Pre-release screening = NB!



Field host-range

0.00 0.25 0.50 0.75 1.00



- S. pyramidalis* 1
- S. pyramidalis* 49
- S. pyramidalis* 48
- S. pyramidalis* 22
- S. pyramidalis* 55
- S. natalensis* 153
- S. natalensis* 110
- S. natalensis* 83
- S. natalensis* 151
- S. natalensis* 152
- S. jacquemontii* 87
- S. jacquemontii* 116
- S. jacquemontii* 135
- S. jacquemontii* 114
- S. fertilis* 25
- S. fertilis* 140
- S. africanus* 12
- S. africanus* 125
- S. africanus* 5
- S. africanus* 143
- S. fertilis* 36
- S. fertilis* 45
- S. sessilis* 126
- S. sessilis* 129
- S. sessilis* 130
- S. elongatus* 73
- S. creber* 10
- S. creber* 11
- S. creber* 37
- S. laxus* 88
- S. laxus* 90
- S. elongatus* 91
- S. sessilis* 128
- S. elongatus* 41
- S. caroli* 42
- S. caroli* 105
- S. caroli* 76
- S. caroli* 104
- S. actinocladus* 148
- S. australasicus* 147
- S. australasicus* 95
- S. australasicus* 107
- S. australasicus* 146
- S. actinocladus* 94
- S. actinocladus* 106

High priority Invasive

Low priority REJECT

Native and Invasive

REJECT

Native





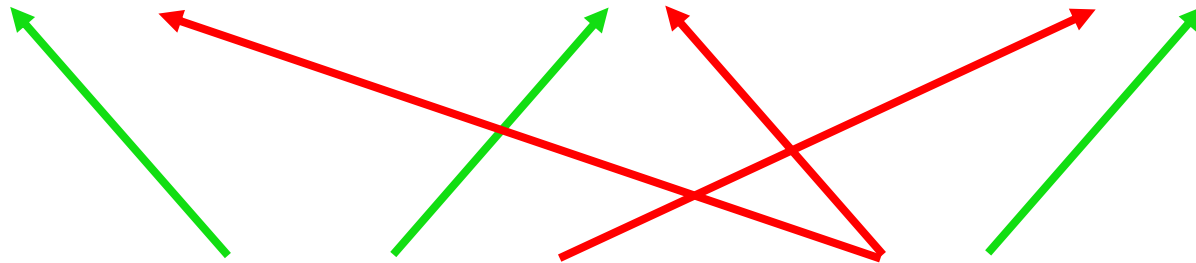
S. pyramidalis



S. natalensis



S. africanus



Tetramesa sp. 1



Tetramesa sp. 2



Outcomes

- Send best candidate(s) to Australia
 - Traditional host-specificity testing, if required
 - Pre-screened from field host-range
 - Efficient allocation of resources
 - Climatically compatible
- Grass BC – *Arundo donax* success
 - Good possibility that *Sporobolus* grasses will have host-specific and damaging agents



Grass BC in SA

- Hopefully more BC of invasive grasses (incl. SA)
- *Arundo donax* – gateway programme?
 - What comes next?



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