Evaluation of mating disruption for eradication of an invasive moth (Lepidoptera: Tortricidae)

Ecki Brockerhoff, Max Suckling, Mark Kimberley, Tara Strand, Brian Richardson, Graham Coker, David Cowan, David Lance, Aijun Zhang

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(for Andrea Battisti, with some extra slides)

“Mating disruption” – “green” eradication technology

Challenge

- Eradication desirable response to incursion of “invasive” species
- Can be successful, suitable eradication technology necessary
- Insecticides controversial, especially in urban environments

Mating disruption principles

- Female moths attract males, species-specific ‘sex pheromone’
- Many pheromone compounds are available
- “Disruption” of attraction (confusion), males can’t find females

Advantages

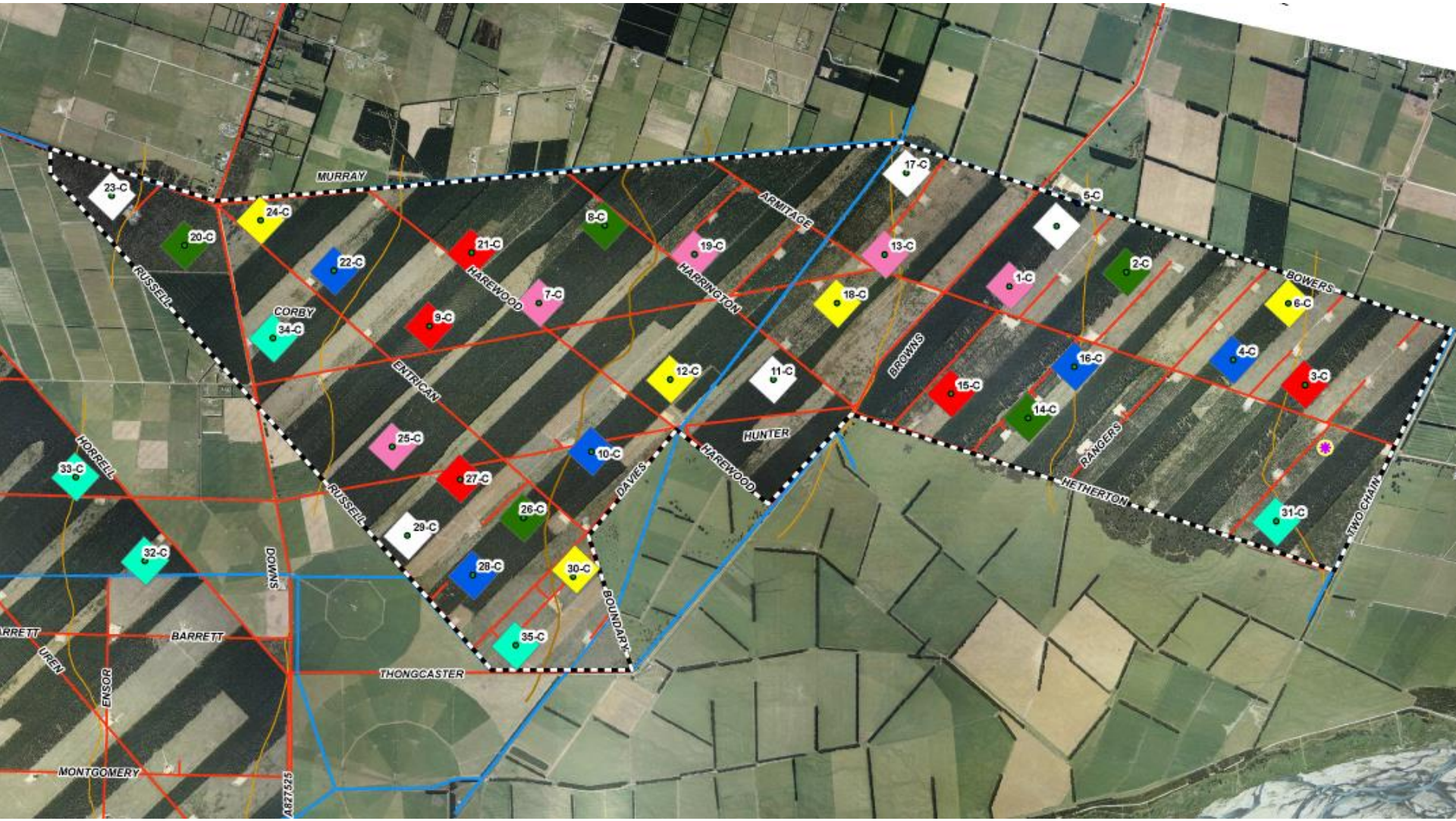
- “Green technology”
- Use at very low doses (here: 40 grams per ha)
- No or low toxicity (*c.f.* insecticides); low non-target effects

But… need to achieve sufficient aerial concentration (in the air)

Epiphyas postvittana (light brown apple moth, "LBAM") in California

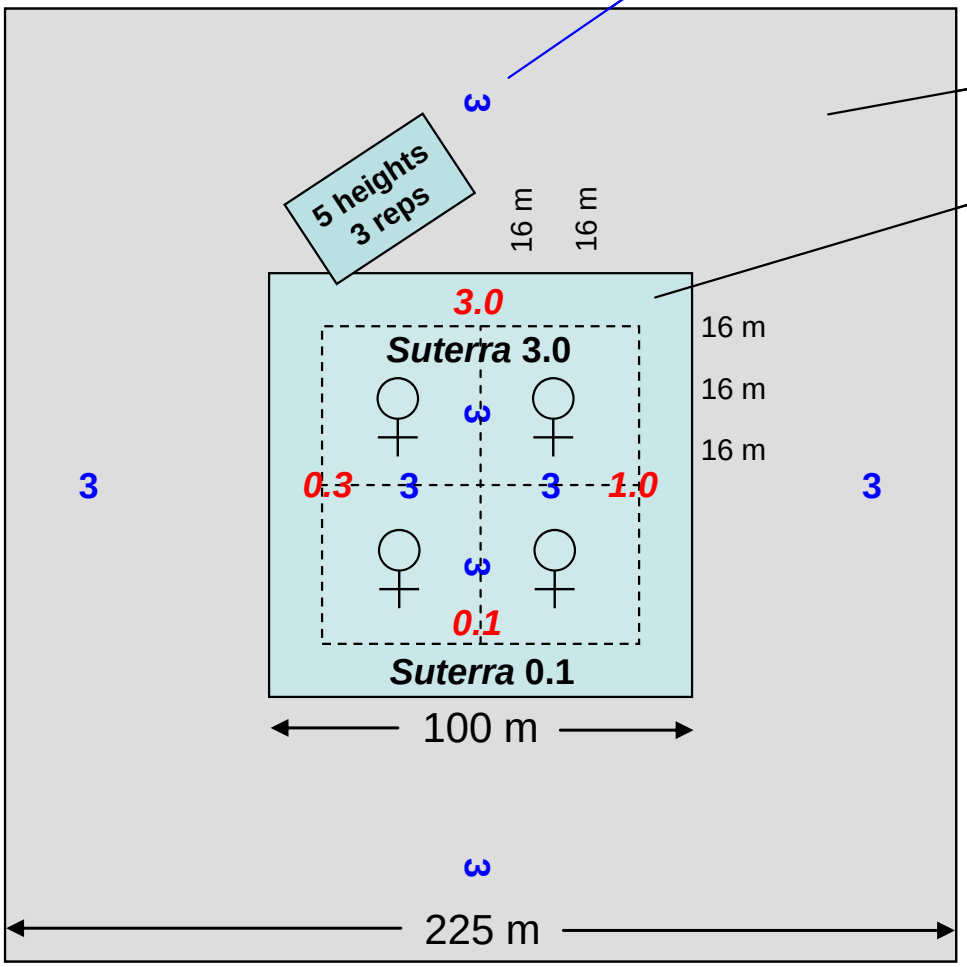
- LBAM native to Australia
- Established in NZ, Hawaii, UK
- 2007: San Francisco (200 x 80 km)
- USDA Response: Eradication
- Sensitive urban area, opposition to insecticide application
- Mating disruption by aerial application of sex pheromones
- Trials in New Zealand to test formulations

Trial area, 5 ha plots, *Pinus radiata* (Eyrewell Forest)



5 treatments plus control plots, 5 replicates

Plot layout, treatment and core areas, trap locations



Key

4 x ♀ virgin female

Transects
10 x 3 HortResearch **3 mg**

Dose response

1 x 0.1 *Suterra 0.1 mg*	**S0.1**
1 x 3 *Suterra 3.0 mg*	**S3.0**
1 x 0.1 HortResearch 0.1 mg	**H0.1**
1 x 0.3 HortResearch 0.3 mg	**H0.3**
1 x 1 HortResearch 1.0 mg	**H1.0**
1 x 3 HortResearch 3.0 mg	**H3.0**

Vertical transects, 5 heights to 17 m
3 x 5 HortResearch **3 mg**


14-3

Vertical transect traps

(Near centre, edge, outside)
Older stands:
- 17 m
- 13 m
- 9 m
- 5 m
- 1.5 m (standard)

Younger stands:
- 4 m
- 1.5 m (standard)

Anemometers (wind speed)
Stand structure

- Tree height 2-30 m
- Stocking 800-350 stems / ha
- Leaf area 2-5 m^2/m^2

Trapping periods, treatments

- 802 traps total, weekly trap checks (26 km walking),
- 2 pre-treatment periods, 12 + 4 weeks post treatment

Treatments (5 replicates (plots) per treatment):

- Untreated control (5 x in blocks, plus 5 x further away)
- LBAM **Twist ties** (Shin Etsu) (ground application, standard)
- **Disrupt** Bioflake LBAM (Hercon Environmental) (aerial)
- **Splat** LBAM (ISCA Technologies, Inc.) (aerial)
- **Checkmate** LBAM-F (Suterra LLC) (aerial)
- **NoMate** LBAM MEC (Scentry Biologicals, Inc.) (aerial)

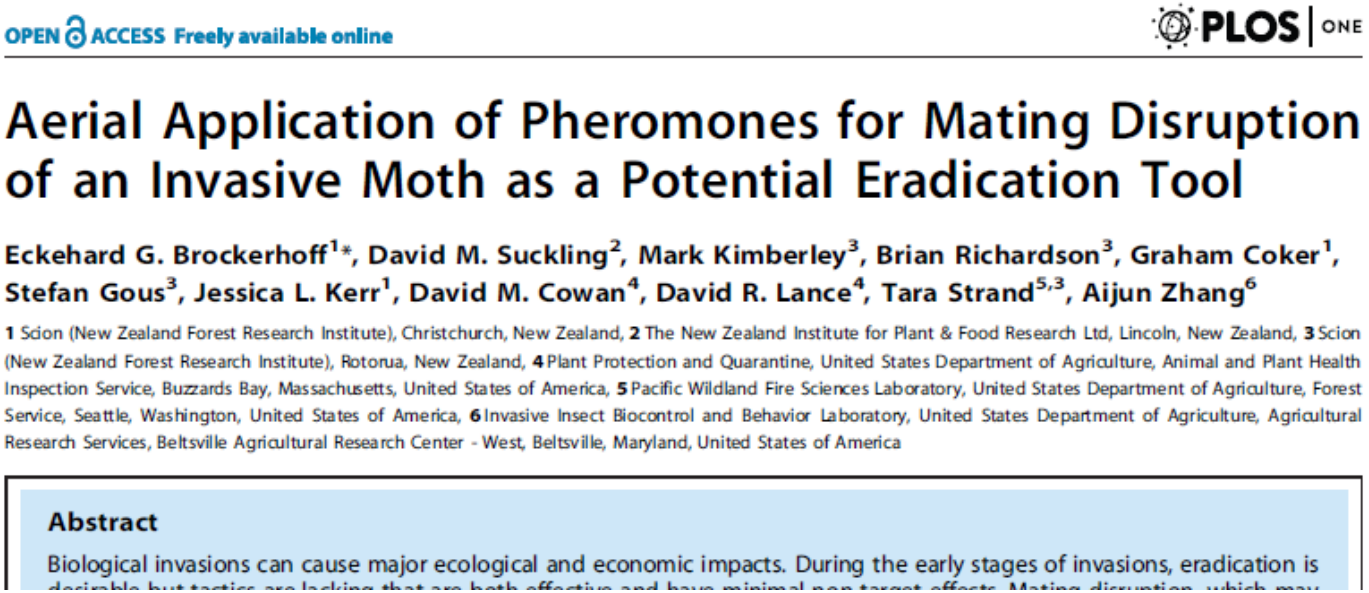
Application rate: ca. 40 g a.i. per ha


55
Eyrewell Forest
matariki

Results, analysis

- Caught 24,941 LBAM total
- ANCOVA (covariate: log trap catch per plot before treatment)
- Mean catch per week
- % suppression / % presence of LBAM, compared with control

Brockerhoff et al. (2012) PLOS ONE, e43767



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Aerial Application of Pheromones for Mating Disruption of an Invasive Moth as a Potential Eradication Tool

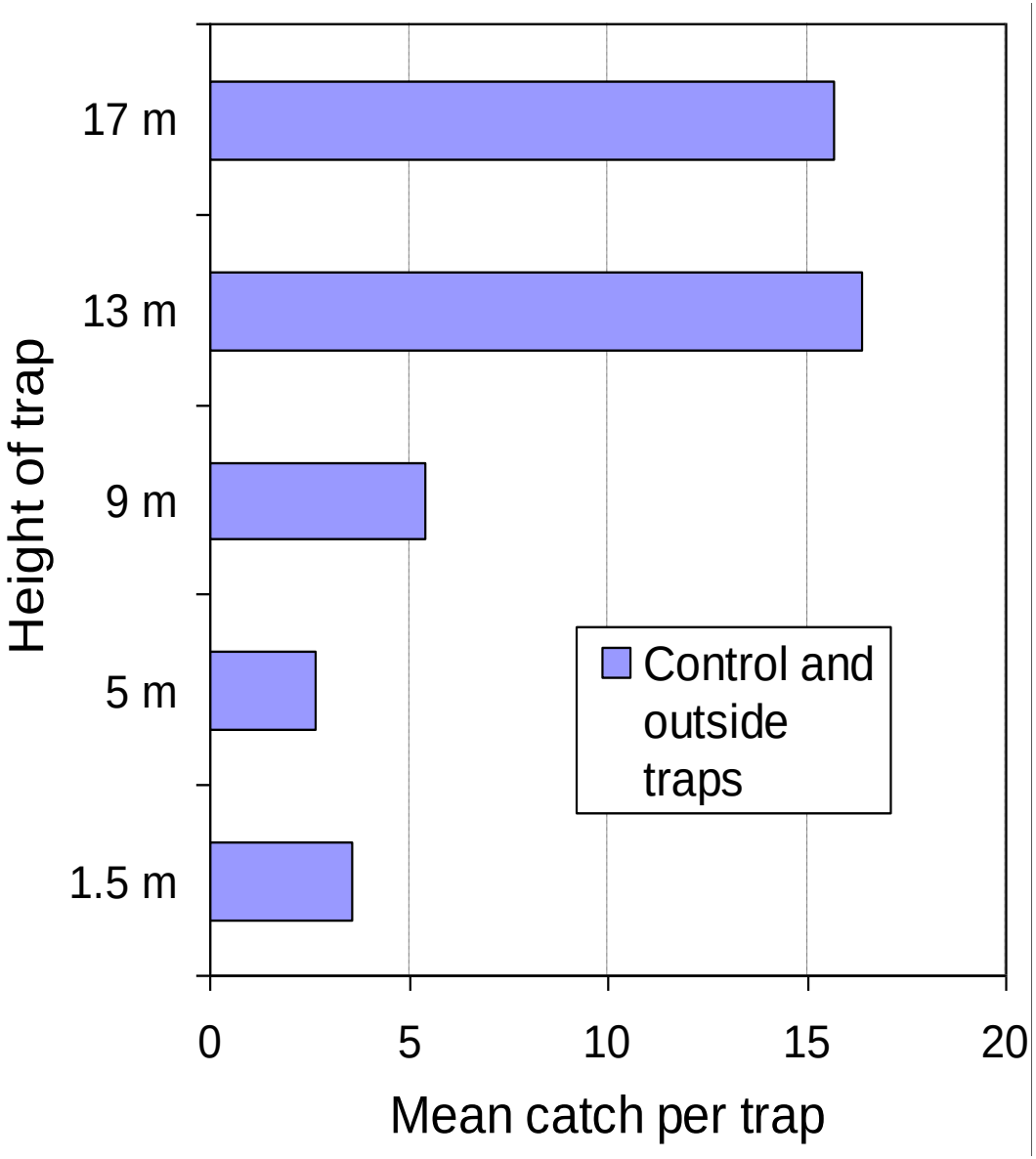
Eckehard G. Brockerhoff[1]*, David M. Suckling[2], Mark Kimberley[3], Brian Richardson[3], Graham Coker[1], Stefan Gous[3], Jessica L. Kerr[1], David M. Cowan[4], David R. Lance[4], Tara Strand[5,3], Aijun Zhang[6]

1 Scion (New Zealand Forest Research Institute), Christchurch, New Zealand, **2** The New Zealand Institute for Plant & Food Research Ltd, Lincoln, New Zealand, **3** Scion (New Zealand Forest Research Institute), Rotorua, New Zealand, **4** Plant Protection and Quarantine, United States Department of Agriculture, Animal and Plant Health Inspection Service, Buzzards Bay, Massachusetts, United States of America, **5** Pacific Wildland Fire Sciences Laboratory, United States Department of Agriculture, Forest Service, Seattle, Washington, United States of America, **6** Invasive Insect Biocontrol and Behavior Laboratory, United States Department of Agriculture, Agricultural Research Services, Beltsville Agricultural Research Center - West, Beltsville, Maryland, United States of America

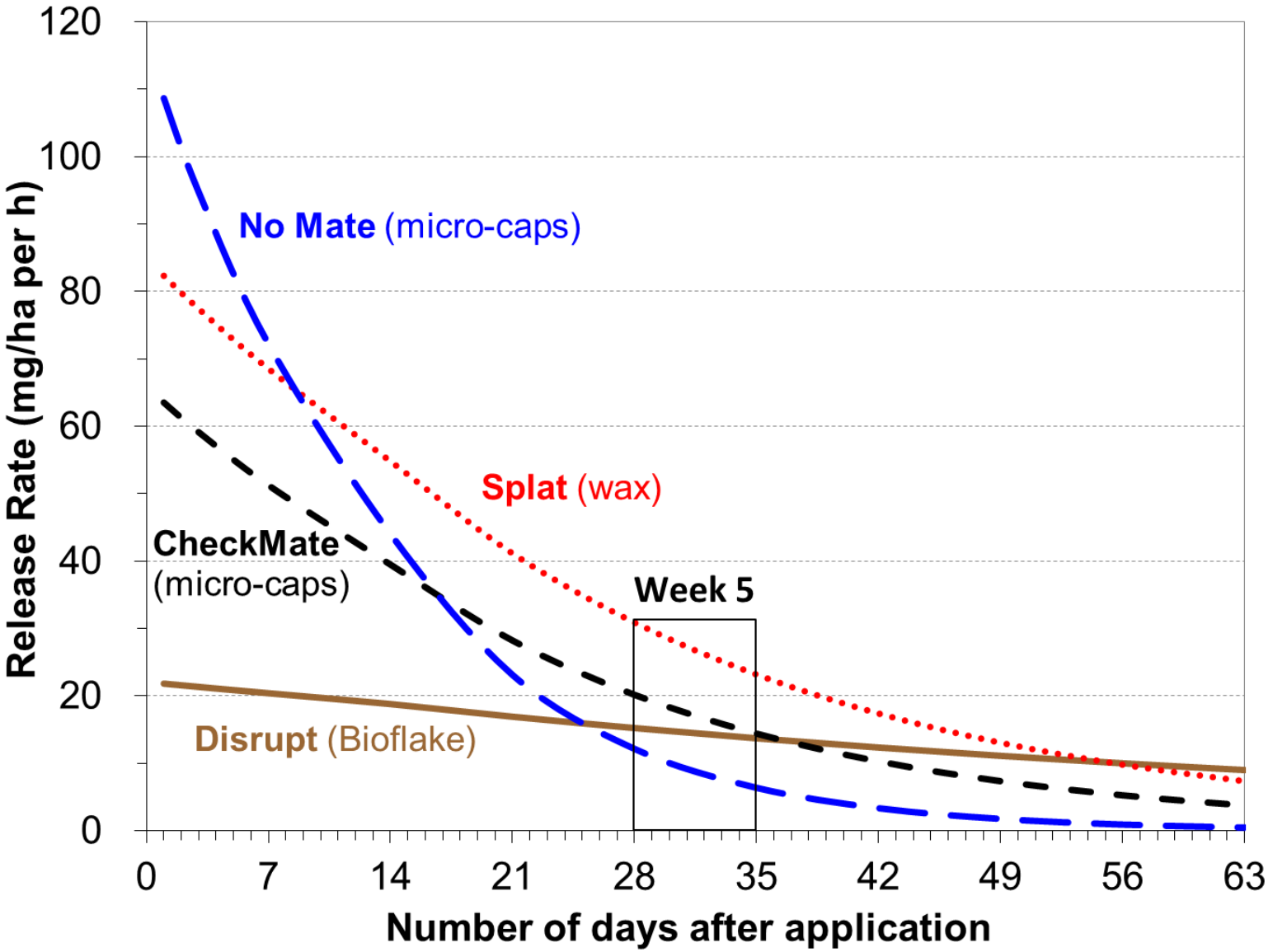
Abstract

Biological invasions can cause major ecological and economic impacts. During the early stages of invasions, eradication is

Vertical transect trap catches



Pheromone Release Rate (mg per ha per hour, time series)



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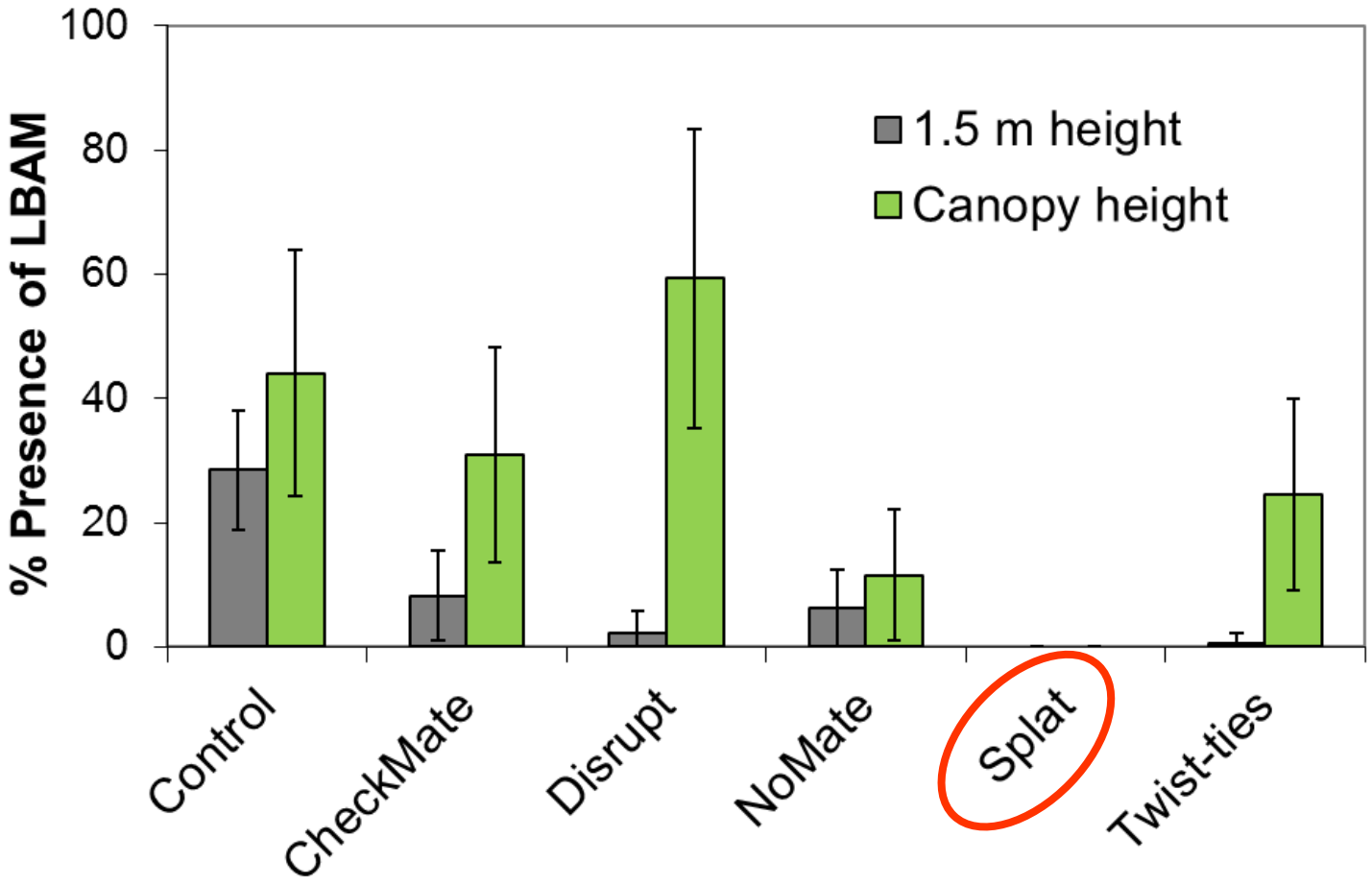
% presence of LBAM catches (1.5 m / canopy), weeks 1-5



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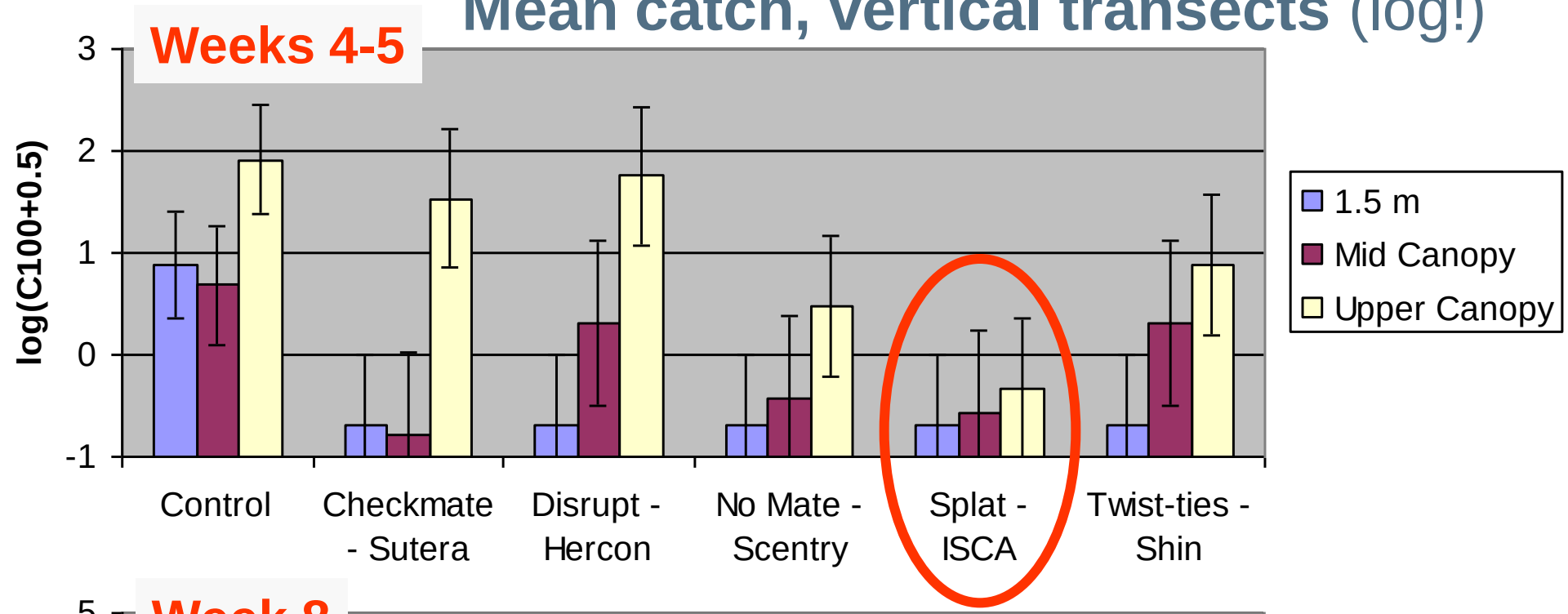
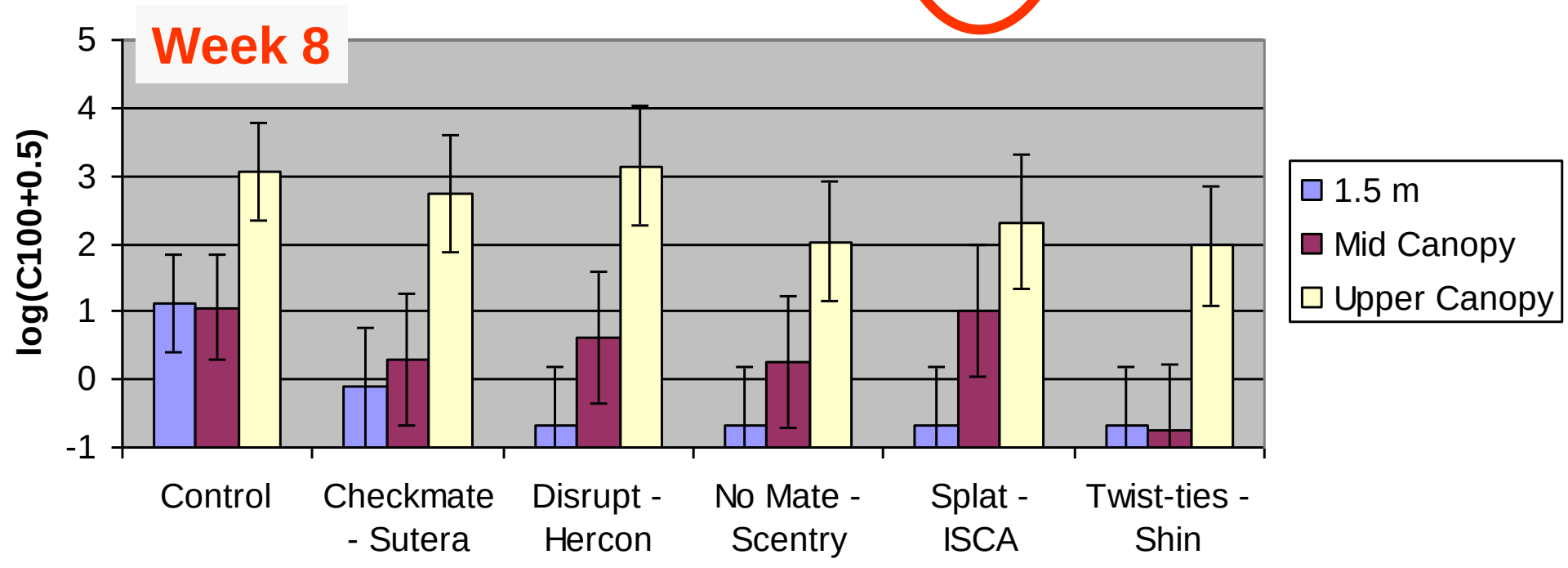
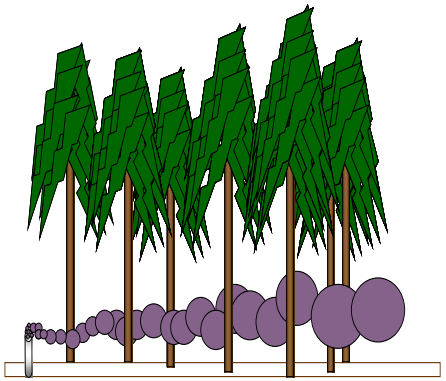
Mean catch, vertical transects (log!)

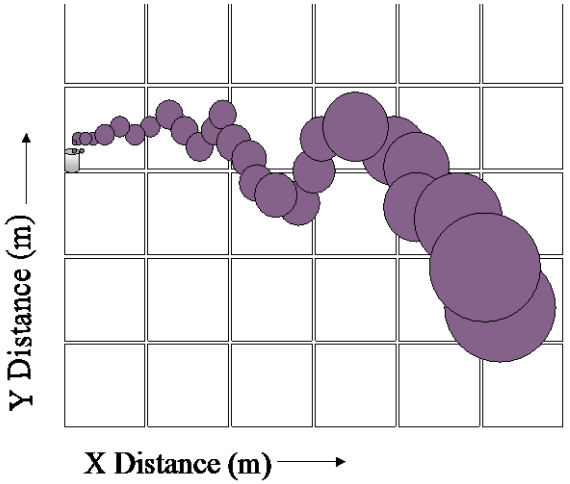




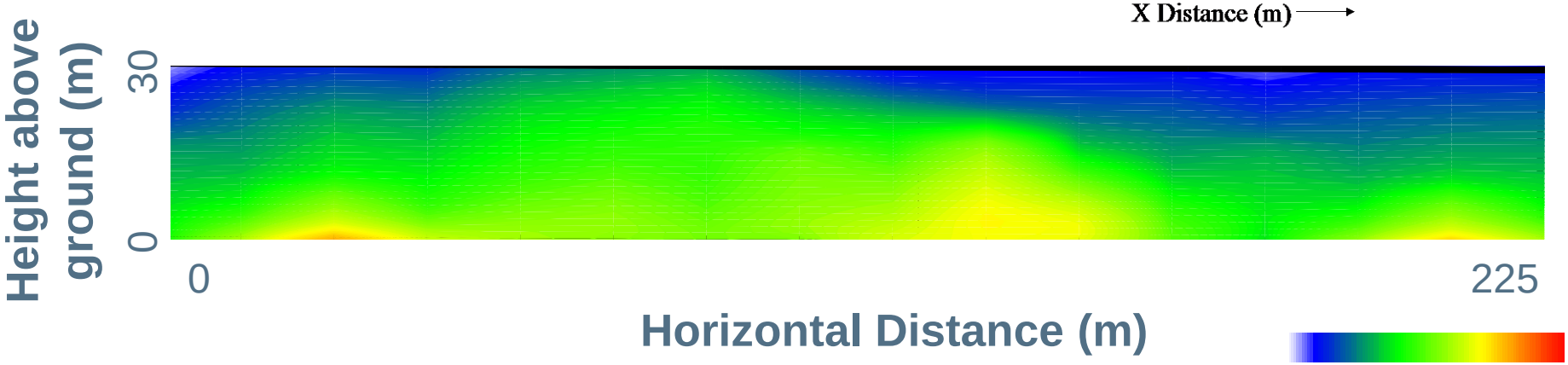
3D Pheromone Puff Release and Transport Model

- Puffs emitted every 1 second
- Advected downwind, meteorological data collected in the field
- Gaussian dispersion
- Using measured turbulence data





Aerial concentration model output



Strand, Brockerhoff, et al. (in prep.)

Conclusions

- Mating disruption by aerial application is possible.
- Some formulations achieve near complete shutdown, despite the small plots (5 ha).
- Effects expected to be better for area-wide application.
- Mating disruption in the upper canopy is important.
- Modelling useful for understanding effects of release rates (from formulations) and atmospheric conditions.
- Findings are applicable to other target species.

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