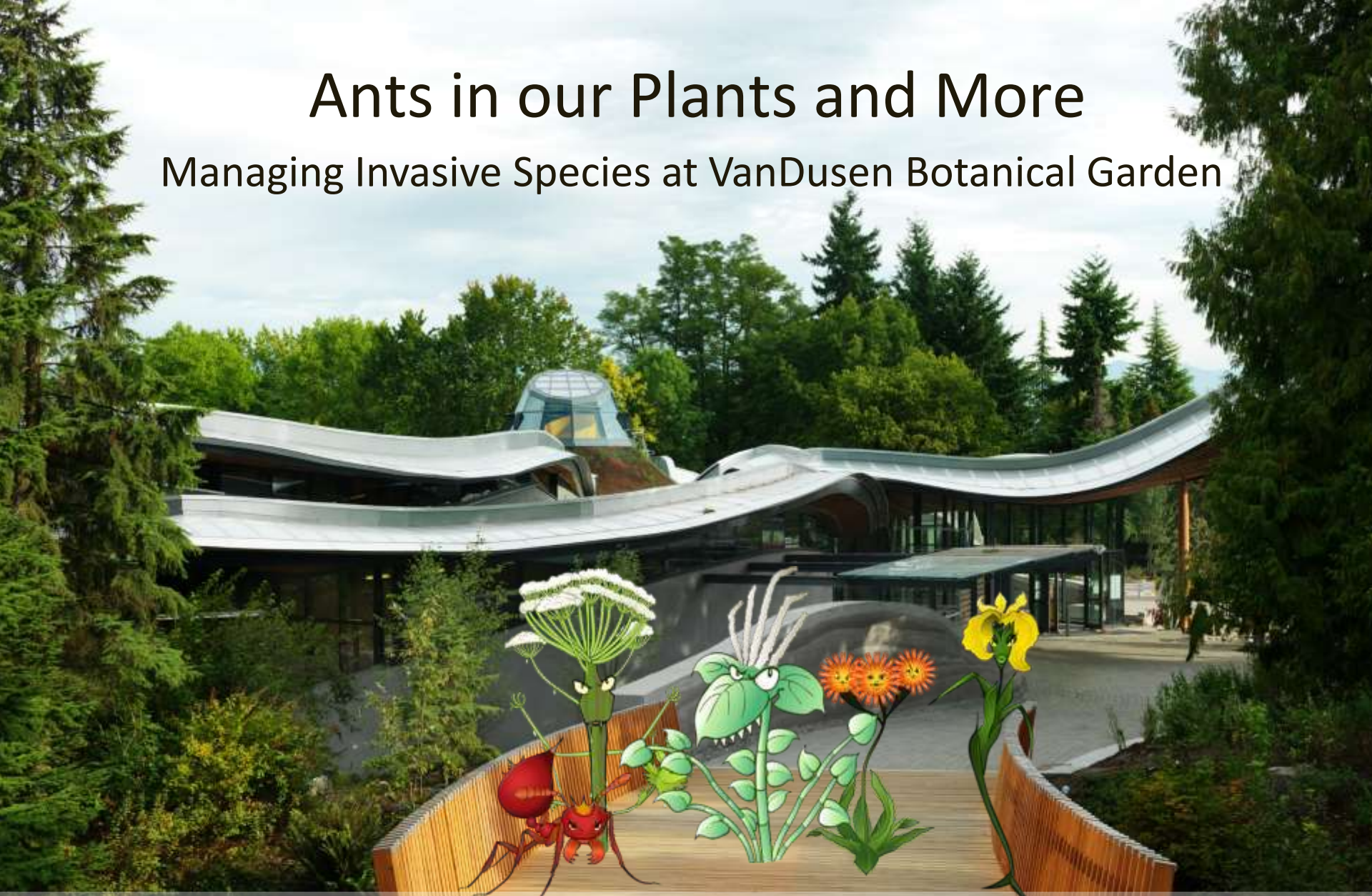
Ants in our Plants and More

Managing Invasive Species at VanDusen Botanical Garden



Cynthia Sayre, Curator of Collections
cynthia.sayre@vancouver.ca
ISCMV Fall Forum 2023

VanDusen BOTANICAL GARDEN | Bloedel CONSERVATORY | Vancouver Botanical Gardens Association | VANCOUVER BOARD OF PARKS AND RECREATION

VanDusen Botanical Garden

- We are located on the unceded and ancestral territories of the xʷməθkʷəy̓əm (Musqueam), sḵwx̱wú7mesh (Squamish) and səlilwətaɬ (Tsleil-Waututh) Nations, in the heart of Vancouver.
- Jointly operated by the Vancouver Park Board and Vancouver Botanical Gardens Association (VBGA)

- 55-acre garden opened in 1975
- 70 curated collections; over 7,500 taxa
- 218 wild origin accns; 552 species at risk
- Remnant trees from second growth coastal western hemlock forest
- 40+ staff; 7 full-time gardeners; seasonal help
- Bloedel Conservatory of tropical plants

Mission

To inspire a deeper understanding of plants and a passion for biodiversity, and to encourage generations to conserve, protect and enhance the natural world.

- **Reconciliation & Decolonization:** in all our programs and practices
- **Education**: adult, youth and family programs, citizen science, youth bursaries and graduate student fellowships with SFU
- **Scientific Research**: partnerships with Botanic Gardens Conservation International, UBC, SFU, TRU, Vancouver Avian Research & government
- **Plant Conservation**: *ex situ* conservation of Magnolias as a member of the international multisite Plant Collections Network of 17 institutions

'Ksan story poles

Magnolia conservation

INVADERS

at VanDusen Botanical Garden

Used with permission by www.alienbusters.ca

How do they get here?

PATHWAYS OF INVASION

Horticulture – acknowledging our role

- Horticulture is responsible for most invasive species introductions
- **Accessioned collections:** English ivy, English holly, Scot's broom, periwinkle, orange hawkweed, giant hogweed, yellow flag iris, lamium,
- Plant and seed sales; donated plants, contaminated soils, mulch, leaf

Accidental, natural and unknown pathways

- Himalayan blackberry, lesser celandine, floating heart, Eurasian milfoil
- European chafer, European fire ants

Intentional

- Abandoned pets: red-eared sliders
- Ornamental: Eurasian carp/koi

How do we manage invasives?

Prevention - Screening Protocols

We screen for invasive plants, European fire ants, Japanese beetle

- Nursery – screen all incoming plants before accessioning
- Events & Film Shoots – screen plants upon arrival at garden
- Annual Plant Sale – audit inventory & screen plants upon arrival
- Seed Collectors – annual audit of seed inventory (**recent success!)**
- Gift shop plant sales

Invasive species management & IPM

- **Sophie Dessureault, IPM Manager for Vancouver Park Board**
- All new invasive species infestations are reported to Sophie
- Sophie assesses, recommends and approves all treatment plans

Prioritizing our Efforts

Removed from the living collections so far…

- Scot's broom, gorse, giant hogweed, purple loosestrife
- In progress: tree of heaven (*Ailanthus*), black locust (*Robinia pseudoacacia*)

Recent EDRR targets

- Japanese knotweed, lesser celandine, *Phragmites australis* ?
- Japanese beetle, European fire ants (new nests), death cap mushroom

Here to stay – prevent further spread!

- English ivy, Himalayan blackberry, false lamium, yellow flag iris, Eurasian milfoil, European chafer beetle

Don't have the resources to tackle

- Aquatic species: red eared sliders, Eurasian carp

A CASE STUDY:

European fire ant (*Myrmica rubra*)

- Established in SE Canada and southern BC
- Found at VanDusen in 2013
- Aggressive, swarm & sting when nest disturbed
- Severe allergic reactions - affect people, pets, wildlife
- Reddish brown with 2 spikes and segmented waist
- Nests of up to 12,000 workers and <u>20 queens</u>!
- Habitat: moist, warm sites; almost anywhere except indoors! Ex. garden beds, turf, under rocks, wood, debris, in soil, mulch, compost
- Spread by colony budding, infested plants, soil, mulch
- Dormant in winter

Impressive fire ant
(*Myrmica specioides*)

- Nearly identical to European fire ant in appearance
- Undergo mating flights, unlike EFA
- Sting but seem less aggressive than EFA
- Safety problem at YVR
- Also present at VanDusen

European & Impressive fire ants at VanDusen – First mapped in 2013

Likely here 15-25 years ago

- **Highest density:** meadow (likely adjacent source)
- **Highest concern**: lawns, high-traffic areas, rental and event locations
- **Limiting factors:** barriers (streams, paths), mode of spread (EFA vs. IFA)

…what's at stake?

- Areas of garden closed to public
- Facilities & Operations impacts: upper service yard, Plant Sale
- Staff injuries, Worksafe BC claim
- Potential spread to adjacent properties
- **Control costs $$$**
- **$200,000 + in potential lost revenues if we don't take action**
  - Admissions, memberships
  - Education programs, summer camps
  - Rentals, special events, Plant Sale

So we developed an EFA Management Plan

- Regular monitoring and mapping of nests
- On-the-ground control (EDRR approach)
- Screening protocols
- Control Trials – Sophie Dessereault, Park Board IPM Manager, past trials with ISCMV, Dr. Rob Higgins, SFU entomology
- Education and outreach – EFA fact sheet, staff and volunteer training, summer camp activities, EFA open house


EUROPEAN FIRE ANTS (EFA)

Control trials – what doesn't work!

Diatomaceous Earth – ineffective in wet climates

Borax bait stations – only weakens colony

Physical traps – ants don't nest in them

Torching – labour intensive, repeat applications needed

Freezing – labour intensive; can't get entire nest

Nematodes – not effective

What works!

Permethrin (AntOut™) Trials

- Collaborative effort between IPM Manager Sophie Dessereault, VanDusen staff, ISCMV
- 0.25% permethrin (no surfactant)
- permethrin is synthetic form of pyrethrin, a plant-based insecticide used in lice treatments

Method

- Identify nest, clear surface of litter and debris
- Working from outside of colony inward, spraying while turning over soil to expose ants
- Repeat as needed
- Pavers may help “lure” colonies in spring & fall

…what works!

Efficacy

- Single treatment effective 90% of time
- 2014 treated areas remain EFA-free
- Re-opened Meditation Garden
- Highly effective for small- to medium-scale infestations

Pollinator considerations

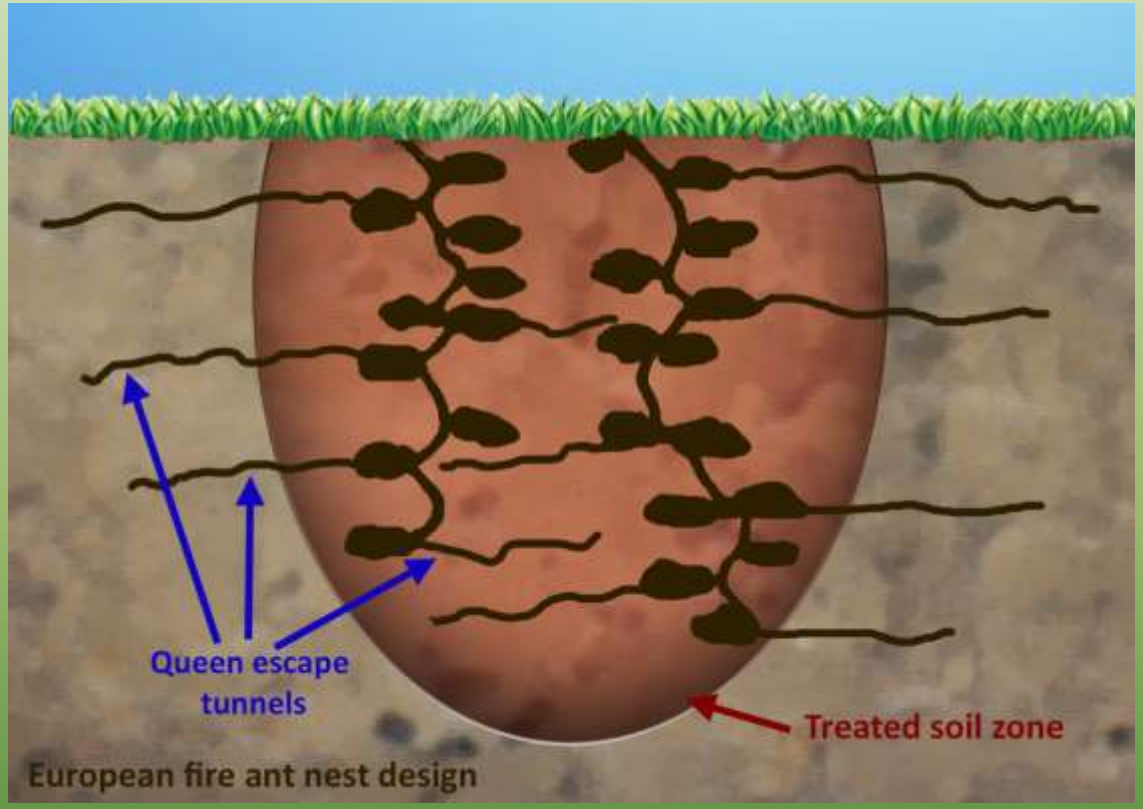
- Affects pollinators only if applied directly to pollinators or the flowers they visit
- Management plans should minimize potential pollinator impacts

NOTE: Check active ingredient!

Gardener Dean McIntosh and EFA Technician Lisa Wong

why does Permethrin work?

It's all in the nest design!



- Queens and some workers hide in **escape tunnels** during disturbance (boiling water, torching, digging, etc.)
- **Residual effect of permethrin (to 40 days) kills queen when it re-emerges!**
- Treatments with no residual effect nearly always miss some queens

Large Scale Control Trial 2015

Theory: clear poly laid over infested soil heats up soil to high enough temperatures to kill or exclude EFA colonies

Methods:

- Treatment period: July 20 - Oct 15 (12 weeks)
- Applied 6 ml clear poly sheeting over 8.8 x 10.4 m area
- In collaboration with Dr. Rob Higgins, Thompson Rivers University

Treatment site

Alma VanDusen Meadow - 0.5 acre
Favourite picnic spot, closed due to EFA

Pre-treatment:

- 2 perennial beds surrounded by turf
- Bordered by a stream (natural barrier) and forest
- EFA nest in roots of clumping grasses and turf
- Nests from 0-18” deep
- Density: ~ 1 nest per 4 m^2

July 20, 2015 - preparing the site: scraping surface vegetation

- 29’ x 34’ (9 x 10m) sheet of 6 mm poly (seams sealed)
- Buried edges 1 foot deep
- Sprayed edges with 0.25% permethrin

Filled in trench

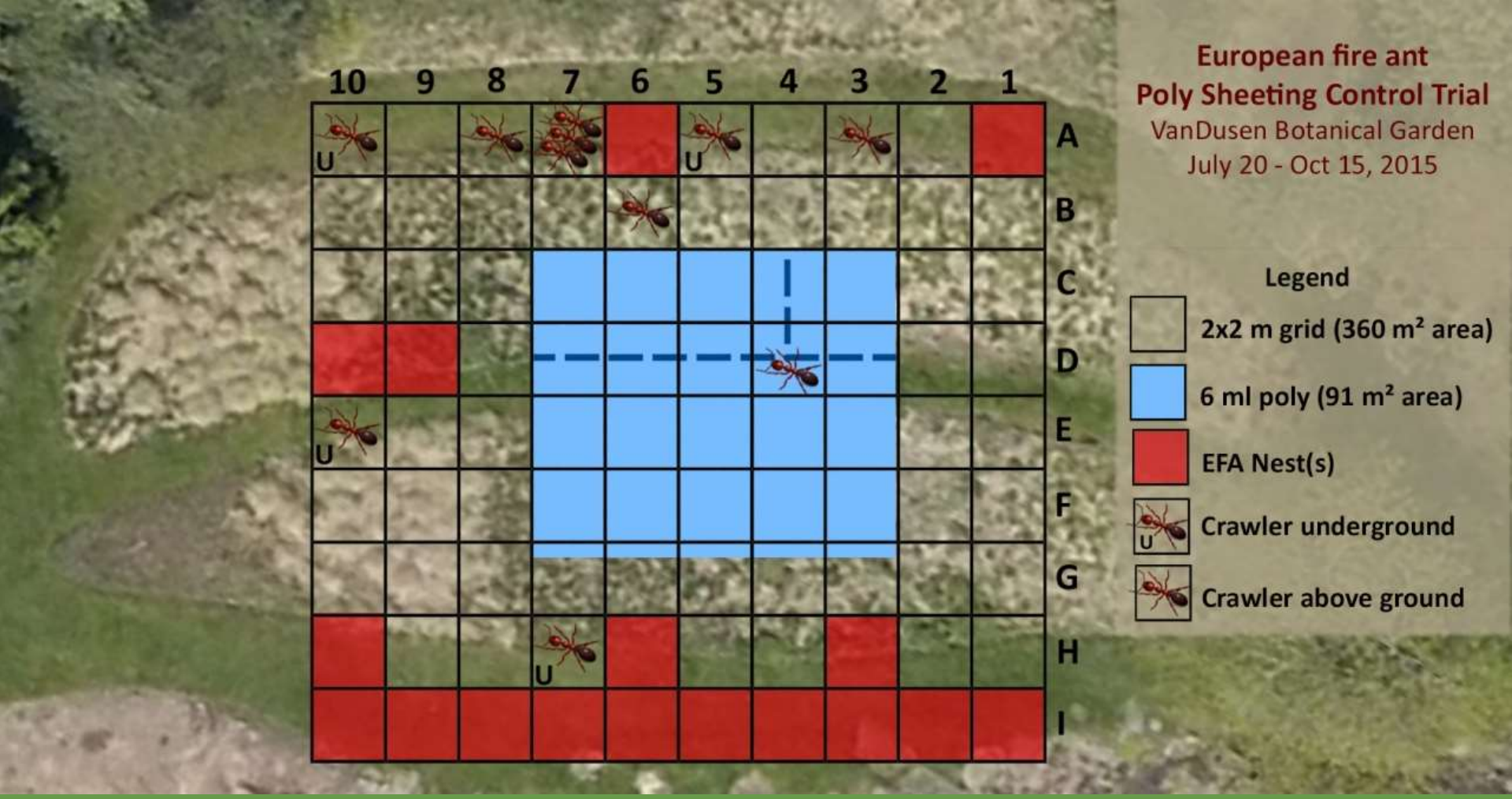
12 temperature sensors buried along transect

Sheeted:	3 just below soil surface
	3 at 10 cm below surface
Unsheeted:	3 just below soil surface
	3 at 10 cm below surface

Observation: in days following installation, EFA depositing **hundreds of dead ants** on and around the poly. WHY? A few theories…

Oct 15 (12 weeks later): Sampling grid laid out (2x2m^2 plots)
Surveyed for EFA presence, marked nests

Results….

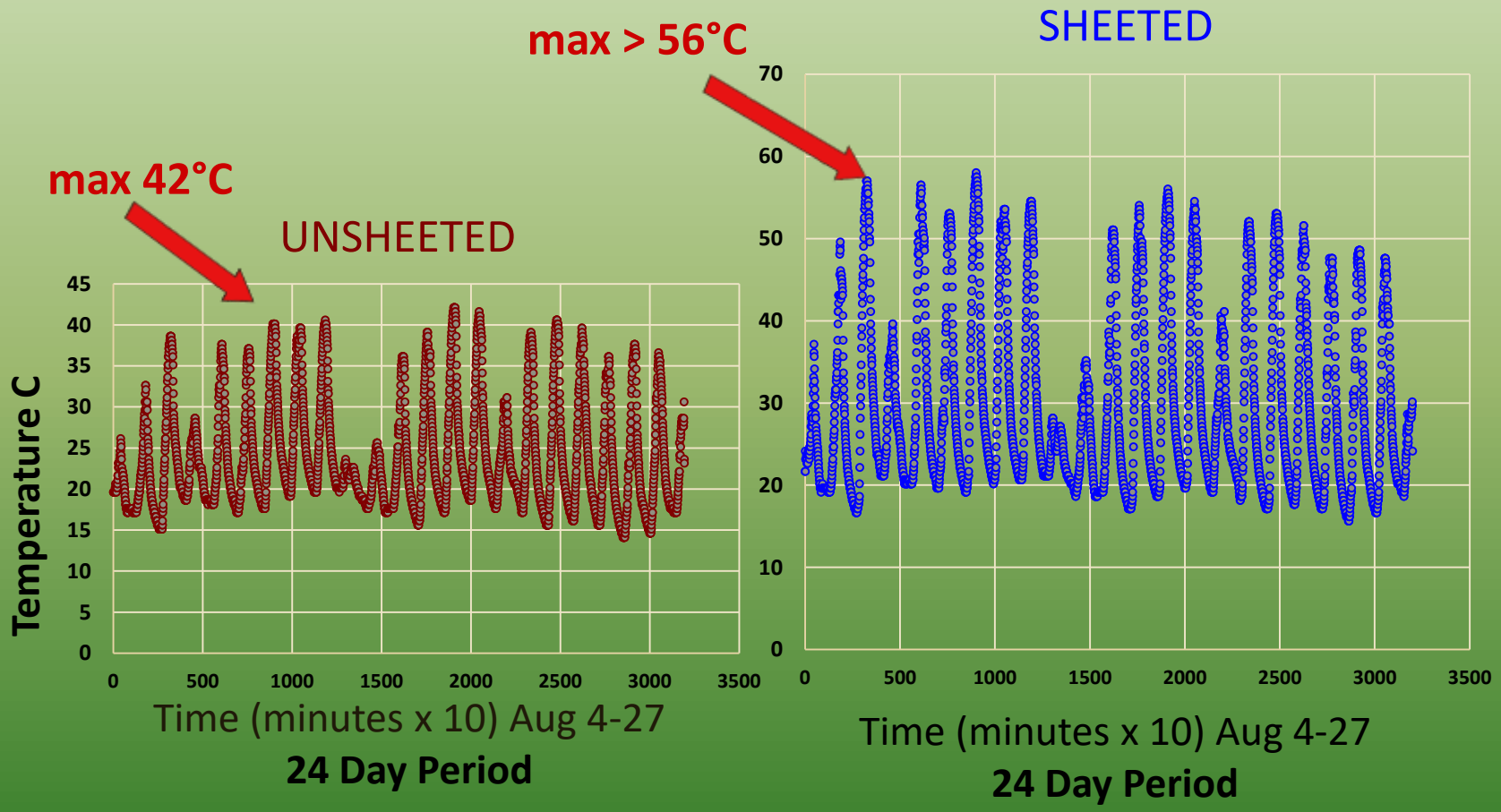


EFA nests in: 0/20 POLY (sheeted) plots – 1 crawler near gaping seam
2/40 SCRAPED (unsheeted) plots – adjacent nests in turf at border
15/30 TURF (undisturbed) plots – few near diatomaceous earth

Crawlers in: 9 plots with crawlers – all but 2 found within 4 m of a nest

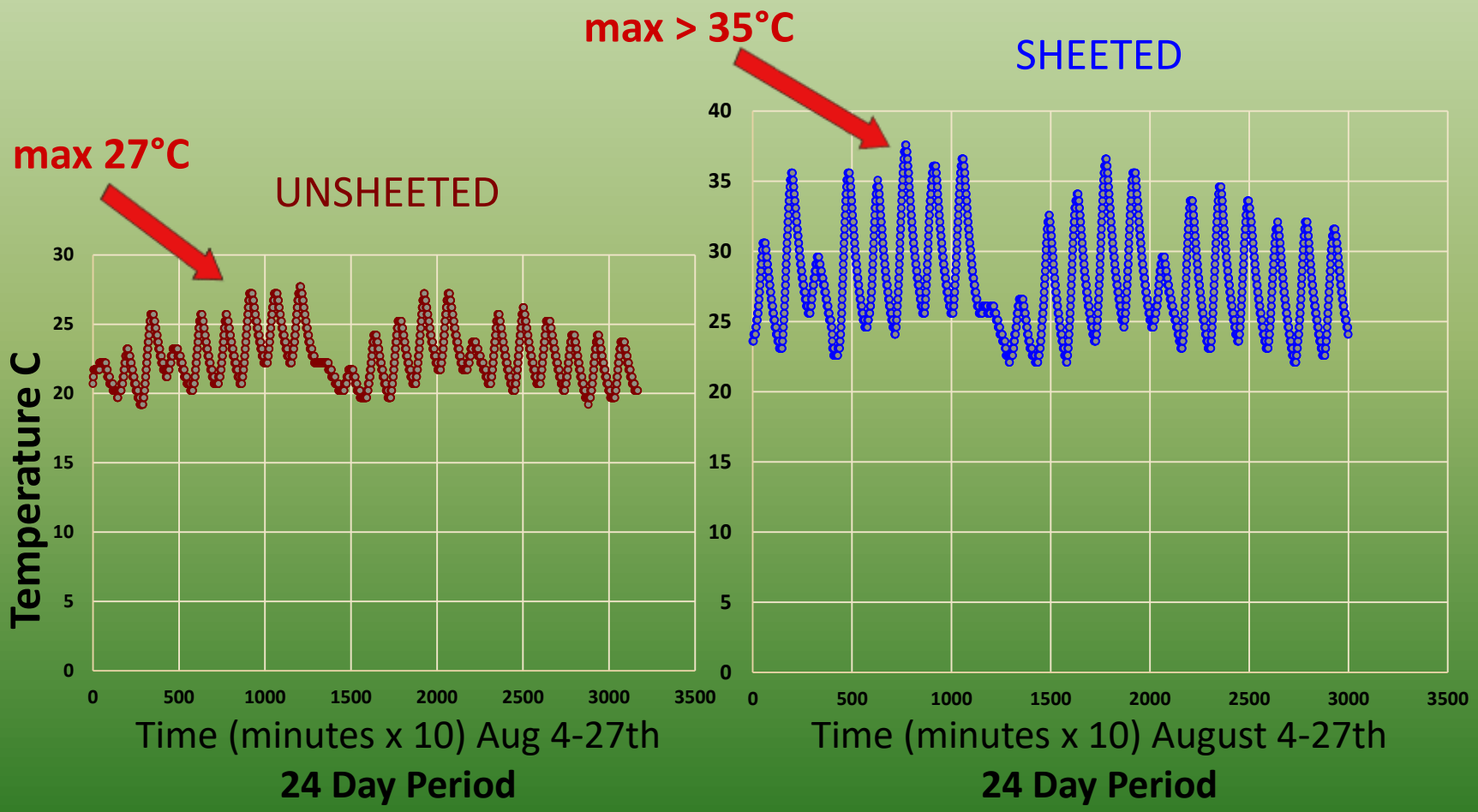
Max Soil Temperature (at surface)

> 15°C increase in treatment plot



Max Soil Temperature (10cm below surface)

8°C increase in treatment plot



Average Daily Soil Temperature

Less difference in average daily temp. than maxiumum temps.

Sine modeled - courtesy of Dr. Robert Higgins, TRU

Sensor	Daily Amplitude x 2 (°C)	Mean Temp °C	Average Daily Amplitude x2 (°C)	Average Temp °C
Sheeted – 10 cm depth				
1	**7.94**	**28.05**	**7.2**	**27.9**
3	**6.7**	**27.87**		
5	**6.86**	**27.89**		
Unsheeted – 10 cm depth				
7	4.44	24.7	4.1	25.2
9	4.5	25.16		
11	3.4	25.77		
Sheeted – at surface				
2	**26.36**	**28.67**	**25.7**	**27.6**
4	**25.54**	**25.56**		
6	**25.34**	**28.7**		
Unsheeted – at surface				
8	16.76	22.4	14.8	23.5
10	17.3	25.7		
12	10.24	22.3		

3.1 °C

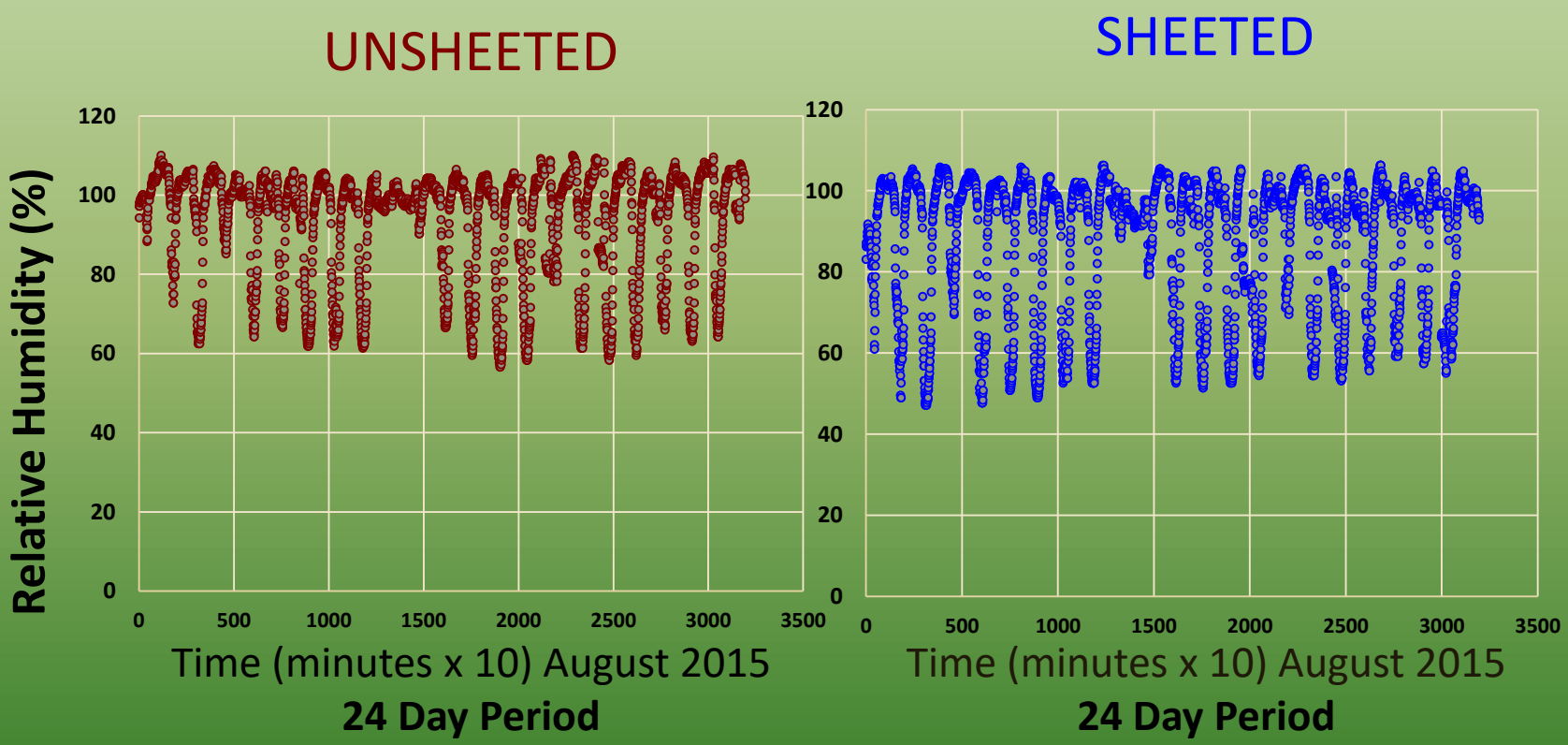
2.7 °C difference

10.9 °C

4.1 °C difference

Soil Relative Humidity (%) at surface

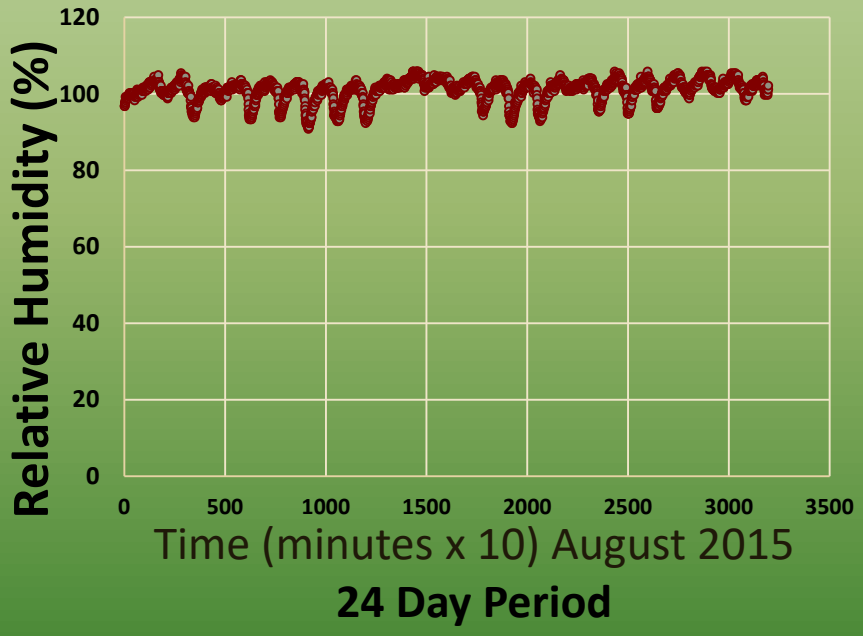
No significant difference between plots



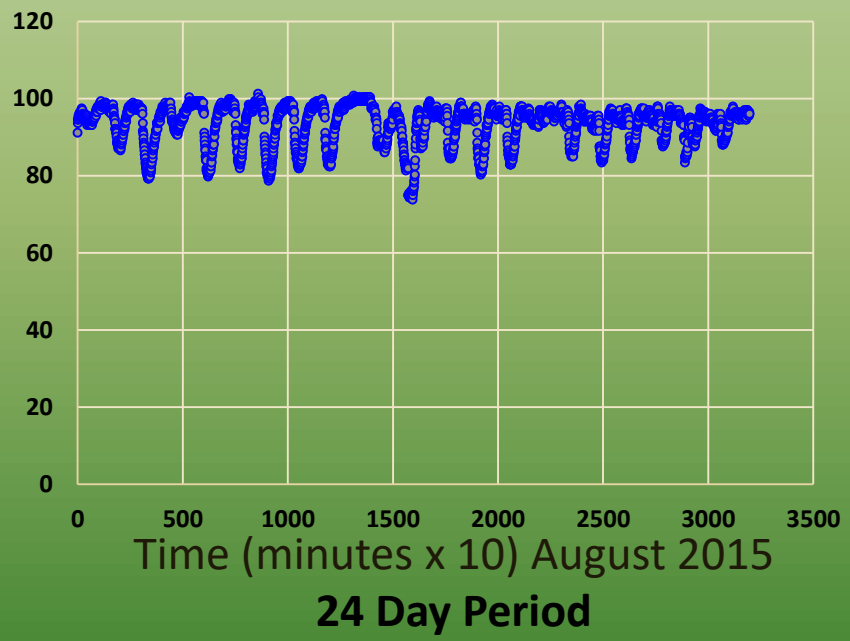
Soil Relative Humidity (%) 10 cm below surface

No significant difference

UNSHEETED



SHEETED



Conclusions

Ants were excluded from **both** poly treatment (sheeted and scraped) and scraped soil (unsheeted and scraped) relative to untreated vegetation

- Cannot conclude poly sheeting alone excluded EFA
- Repeat experiment with replicates and controls to tease out cause and effect
- mark nests to track ant movement

- **Maximum temp regularly above 55°C in poly treatment plot (sheeted) at and below the surface – hot enough to kill EFA!**
- Dr. Rob Higgins' 2016 lab studies on EFA temperature tolerance results:

After 4 hours:
100% survival at 37° C
60% survival at 38° C
0% survival at 39° C
After 1 hour:
0% survival at 40 °C
0% survival at 41° C
0% survival at 42° C

…conclusions

Permethrin method

- Best for small- to medium-scale infestations
- Eradication 90% of the time
- Reduces densities to safe levels with monitoring and maintenance when eradication impossible due to limiting factors (aggressive behaviour increase with density).

Poly sheeting promising as large-scale control option

Nest morphology, habitat highly adaptable: metal pipe, rock crevices, crown of tree fern

Successful control depends on size of infestation, nest density, limiting factors such as large rocks, woody roots, proximity to EFA sources

EFA successes to date

- Over 1,000 nests treated so far with spot treatment
- Quantity of new nest reported declining over time
- Meditation Garden re-opened after successful eradication
- Alma VanDusen Meadow infestation ("ground zero")
  - Population (number of nests) declining year over year
  - Re-opened with new barriers to EFA spread
  - Renovated stream borders: vegetation removal, rock work
  - New 6' wide screenings path and living fence to keep people on path
  - Annual treatment: in late spring, meadow sprayed with permethrin using packpack sprayer, then rototilled to get product into soil
  - Planted with sunflowers to allow annual rototilling
- New screening protocols
- Service yard – safer storage and screening of materials
- Ongoing education and outreach

Thank you

Contact: cynthia.sayre@vancouver.ca

ISCMV
INVASIVE SPECIES COUNCIL OF METRO VANCOUVER

THOMPSON RIVERS UNIVERSITY

isc
Invasive Species Council of British Columbia

BC INTER-MINISTRY INVASIVE SPECIES WORKING GROUP
PROTECTING BC's RESOURCES