



# Structural Overwintering Research Update

BEN CHAMBERS

COMMITTEE:

TOM KUHAR

TRACY LESKEY

ANNIE PEARCE

GEORG REICHARD

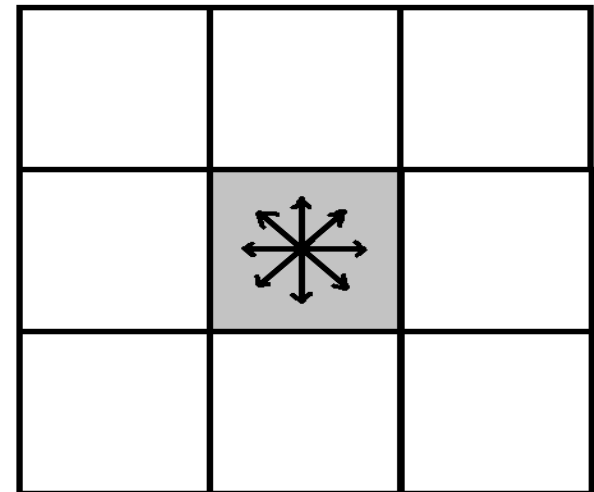
# Efforts to Understand Home Invasion

- ▶ Movement direction on building exteriors
- ▶ Phototaxis
- ▶ Gravitaxis
- ▶ Gap sizes
- ▶ Effects of dead conspecifics
- ▶ Thermal effects
- ▶ Experiences of professionals




# BMSB Movement on Building Exteriors


- ▶ Through September and October, BMSB movement on building exteriors was recorded
- ▶ One data point taken per insect, repeat observations limited by time or by specimen collection
- ▶ Data taken from 12 buildings, but largely from one single-story house



# Summed Movement Directions

- ▶ 269 measurements
- ▶ 66% with upward component

39	104	35
26		34
10	15	6

14%	39%	13%
10%		13%
4%	6%	2%

# Gravitaxis

- ▶ Repeat of nymph experiment (Acebes-Doria et al, 2016)
  - ▶ 30 Overwintering adults
  - ▶ Darkness
  - ▶ Release at midpoint of vertical wooden dowel
- ▶ They go up.  $\chi^2 = 13.3$ ,  $p = 0.0003$
- ▶ No sex effect ( $p = 0.1416$ )

	Up	Down
Female	11	4
Male	14	1
Total	25	5



# Phototaxis

- ▶ Based on nymph experiment (Acebes-Doria et al, 2016)
- ▶ Point-source in darkness
- ▶ Soft white & daylight bulbs
- ▶ Horizontal dowel
- ▶ Stages
  - ▶ Shelter-seeking
  - ▶ Already overwintering
  - ▶ Late overwintering
- ▶ Final data collection pending, but about 1/3 move away



# Minimum Gap Sizes Navigable

- ▶ BMSB groups were placed in boxes with apertures in the lids
- ▶ Boxes were laser-cut from 1/8 in hardboard
- ▶ Apertures were either slits or holes
  - ▶ Single slits 152 mm (6 in) by 5mm, 4mm, or 3mm in center
  - ▶ Four holes near corners, 10mm, 9mm, 8mm, or 7mm diameter
- ▶ Boxes were heated to encourage movement out of the boxes into net cages
- ▶ Bugs were given 5 hours to exit





# Minimum Gap Sizes Navigable

- ▶ Each box contained 30 male and 30 female BMSB collected during overwintering site selection behavior
- ▶ Each aperture type and size received 2 trials, for n=120 bugs per treatment
- ▶ Bug pronotum width and height measured with digital caliper
- ▶ Height measurements were taken at the point where bugs lost the ability to move their legs



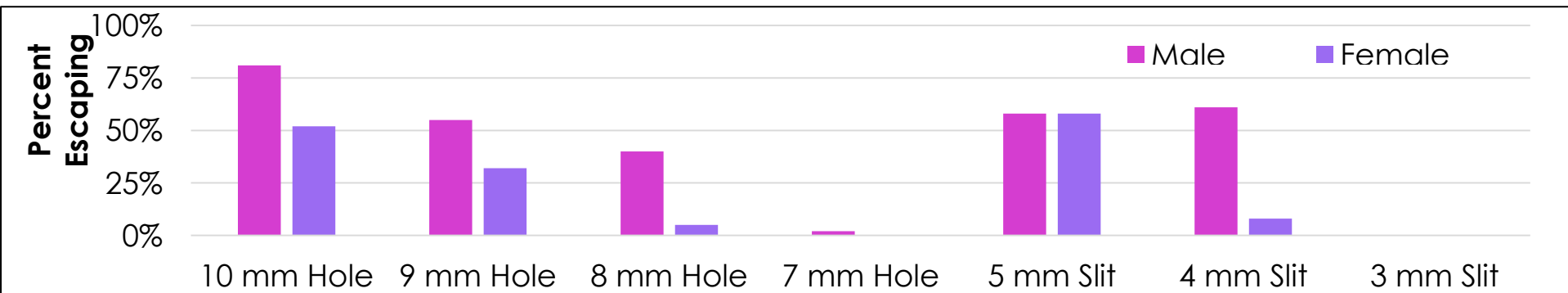


# Gap Size Test Subjects

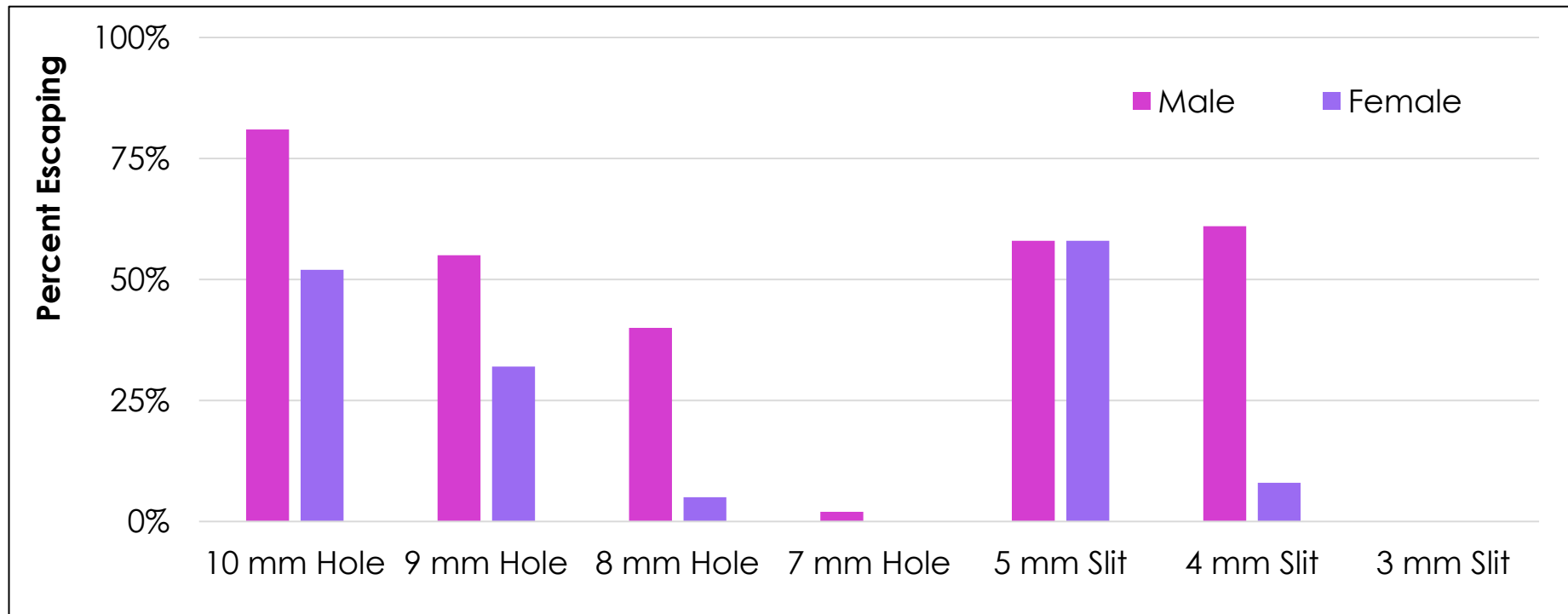
	Male	Female
Number of Individuals	465	465
Pronotum Average Width (mm)	7.47	8.33
Pronotum Maximum Width (mm)	8.25	9.43
Pronotum Minimum Width (mm)	6.00	7.04
Height Average (mm)	3.50	4.04
Height Maximum (mm)	4.00	4.60
Height Minimum (mm)	2.41	2.99

# Gap Size Results

- ▶ Slit Gaps
  - ▶ Height predicts escape
  - ▶ No escapes from 3mm gap boxes
- ▶ Round Hole Gaps
  - ▶ Pronotum width predicts escape
  - ▶ While 10% of males in 7mm trial had pronotum less than 7mm wide, only one escaped in the allotted time



# Gap Size Results



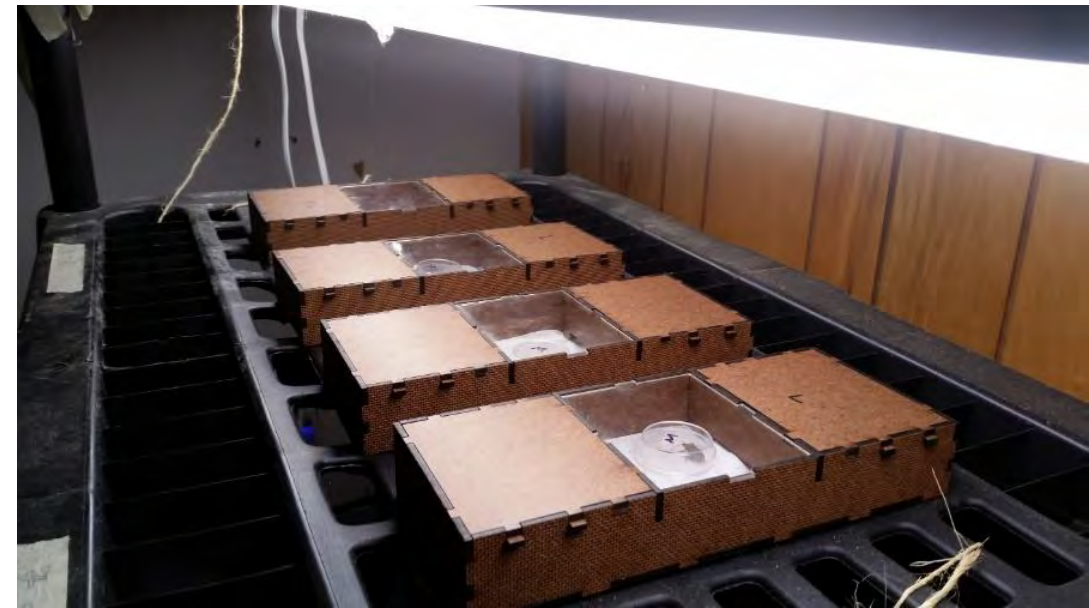
# Tightness and Depth

- ▶ Preferred degree of tightness in refuge
  - ▶ Sloped refuge
- ▶ Preferred depth in refuge
  - ▶ Constant height refuge



# Dead Conspecifics – Non-tactile

- ▶ BMSB individuals released into choice box with two refuges for 4 hours.
- ▶ Each box allowed choice between empty refuge and full refuge
- ▶ Refuges contained an entry chamber and a screened off chamber





# Dead Conspecifics – Non-tactile

- ▶ Year old dead – No difference
- ▶ Live bugs – No difference
- ▶ Recently dead bugs – Empty preferred ( $p < 0.0263$ )



# Dead Conspecifics – Tactile, Single

- ▶ Builds upon Toyama et al. (2006) aggregation study
  - ▶ Overwintering bugs tend to aggregate if they touch with antennae
- ▶ Dead BMSB placed in corner of box
- ▶ Live diapausing BMSB are placed in the box with dead BMSB, and allowed to settle
- ▶ Location distribution analyzed





# Dead Conspecifics – Tactile, Group

- ▶ Groups of 10 dead BMSB and/or dental cotton
- ▶ Individual bugs placed in dishes
  - ▶ Darkness
  - ▶ 24 hours

	Bugs Only	Cotton Only	Bugs and Cotton
Touching Dead Bugs	20	N/A	15
Touching Cotton	N/A	15	8
Touching Nothing	10	15	7



# Conspecific Necrophagy

- ▶ Box elder bug methodology (Norris & Brown 2004)
  - ▶ Individual bugs in dishes
  - ▶ Dead bugs replaced every two weeks
  - ▶ Water refreshed as needed
- ▶ Much higher survivorship than box elder bugs

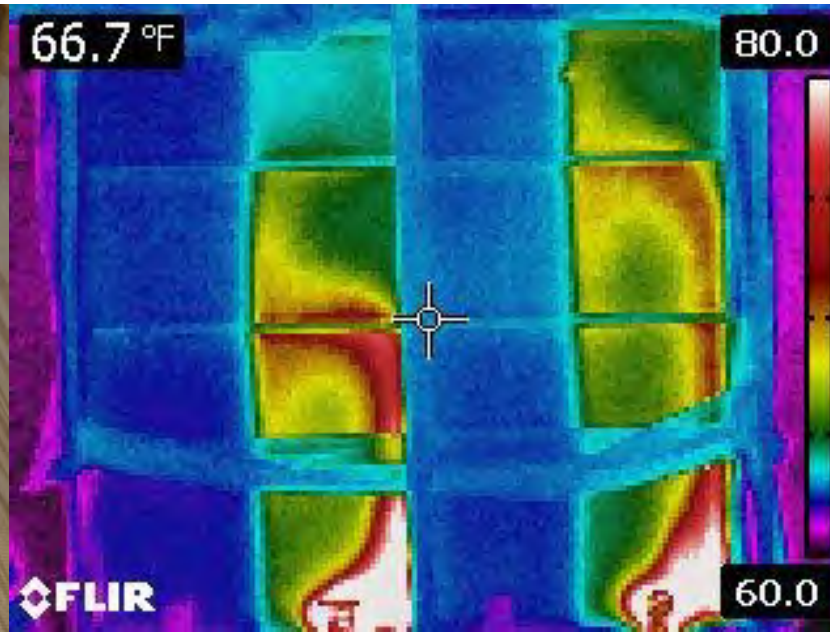
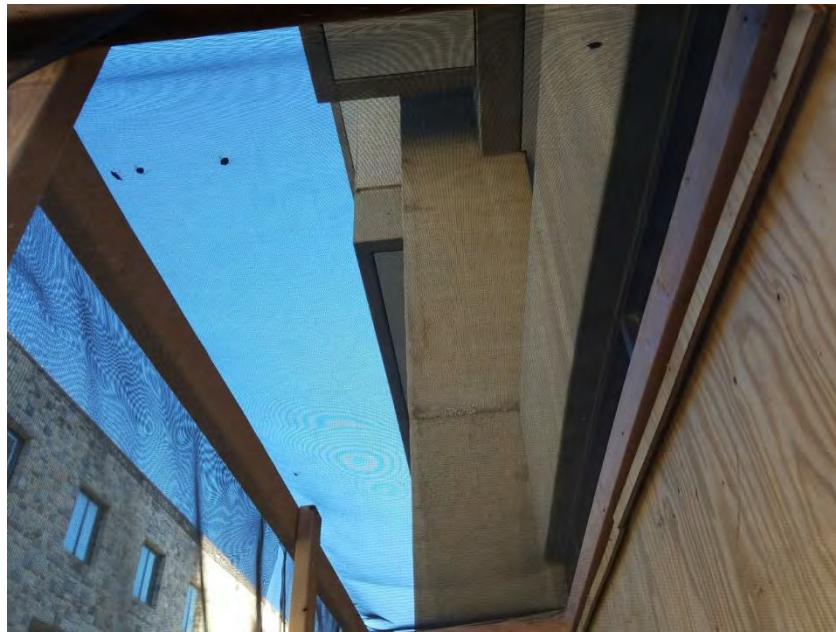
Treatment	Dead (of 36)	Mortality
Control	4	11%
Dead Bugs	8	22%
Dental Cotton with Water	7	19%
Dead Bugs and Water	6	17%





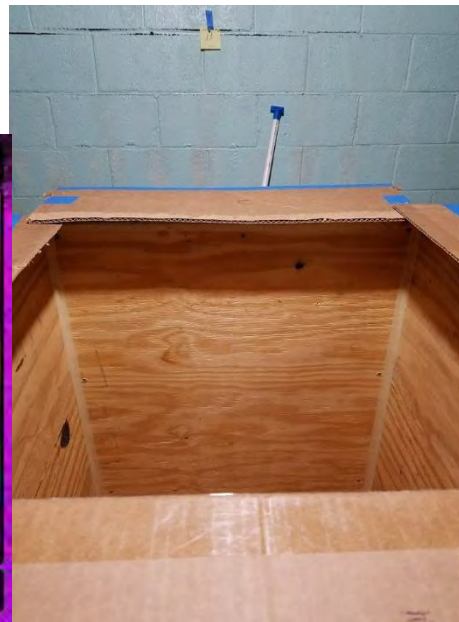
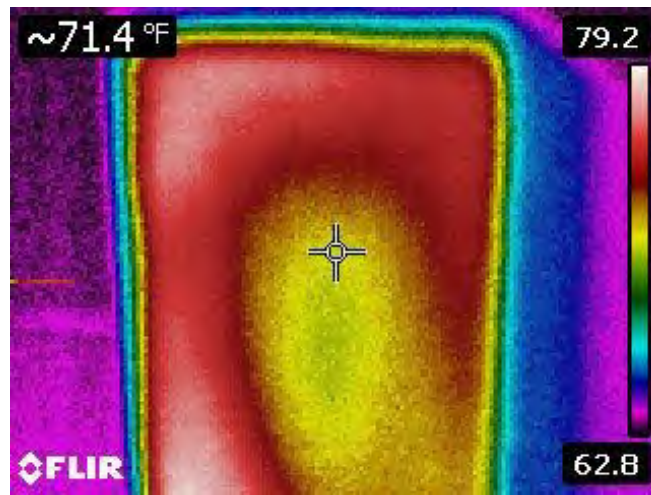
# Thermal Contrast in Exterior Walls

- ▶ First attempt: Outdoor wall section in screen
- ▶ Bugs all went to the screens



# Thermal Contrast, Forced Choice

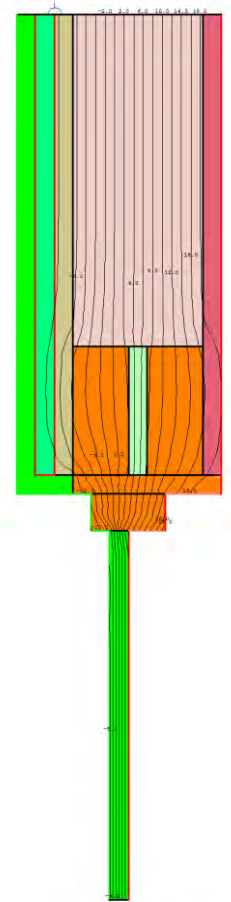
- ▶ Heated wall cavities form a box
- ▶ Bugs released at bottom
- ▶ First wall and movement recorded
- ▶ Overhangs important





# Thermal Models

- ▶ Models of common wall configurations and gaps
- ▶ Estimates of temperature lows and averages
- ▶ Comparison with winter survival rates
- ▶ Methodology for estimating survival at depths



# Survey

- ▶ Virginia Pest Management Association
- ▶ Collect
  - ▶ Structural elements seeing BMSB infestation
  - ▶ Structural elements being treated
  - ▶ Anecdotes



Questions?

