

# Spatial pattern of infestation risk and management of brown marmorated stink bugs (BMSB) in field corn and soybean



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# Introduction

## Pest movement patterns and control

- Pest distribution patterns across non-crop to crops influenced by species-specific behavior.
- Pest insect movement into crops can be non-random and directional (Stinner et al. 1983).
- Knowledge about immigration and settlement into crop, used to effectively control insect pests (Nestel et al. 2004).



# BMSB in field corn and soybean

- BMSB a serious pest in mid-Atlantic agronomic row crops.
- Fewer research projects on grain crops and soybean, than speciality crops
- Particularly, few research studies on BMSB movement into field corn and soybean in relation to adjacent non-crop habitat
- Chemical control options widely used



# Objectives

- To characterize BMSB pattern of infestation in field corn and soybean, along non-crop edges.
- To determine the influence of different adjacent non-crop habitats on BMSB population abundance in field corn and soybean fields.
- To determine differences in abundance at different distances from edges of field corn and soybean.
- To devise effective and efficient BMSB control treatment strategies for field corn and soybean.



# Methods – Field sampling

- Adjacent habitat types
  - Corn – Alfalfa, Buildings, Open, Sorghum & Woods
  - Soybean – Buildings, Corn, Open & Woods
- Abundances estimated at 0-50 feet into field corn and soybean
- 2-4 replicate fields / Adj. Hab. based on availability
- 3-4 transects/field
- Sampled 3-5 times



# Methods – Field sampling

- Direct visual counts of BMSB on
  - 10 consecutive corn plants and
  - On all plants within a half of 1m radius plot in soybean (1.55 m<sup>2</sup>)
- Sampled between
  - July – Aug 2012 (Corn)
  - Aug – Sept 2012 (Soybean)
- Corn - Beltsville & Clarksville, MD
- Soybean – Beltsville & Keedysville, MD



Photo: Peter Coffey

# Statistical Analyses

## Characterizing BMSB Infestation Pattern

**Table 1.** Four-step decision path for the ecological i  
optimal fit of all species' distributions into one of th

### Decision-tree rules

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- Significant dispersers (according step 1, see Data a
- $N_{ind} > 0$  at starting point of transect
- Peak numbers at first or second position of transe
- More than 50 % of all individuals caught within 2  
if any is false

∨

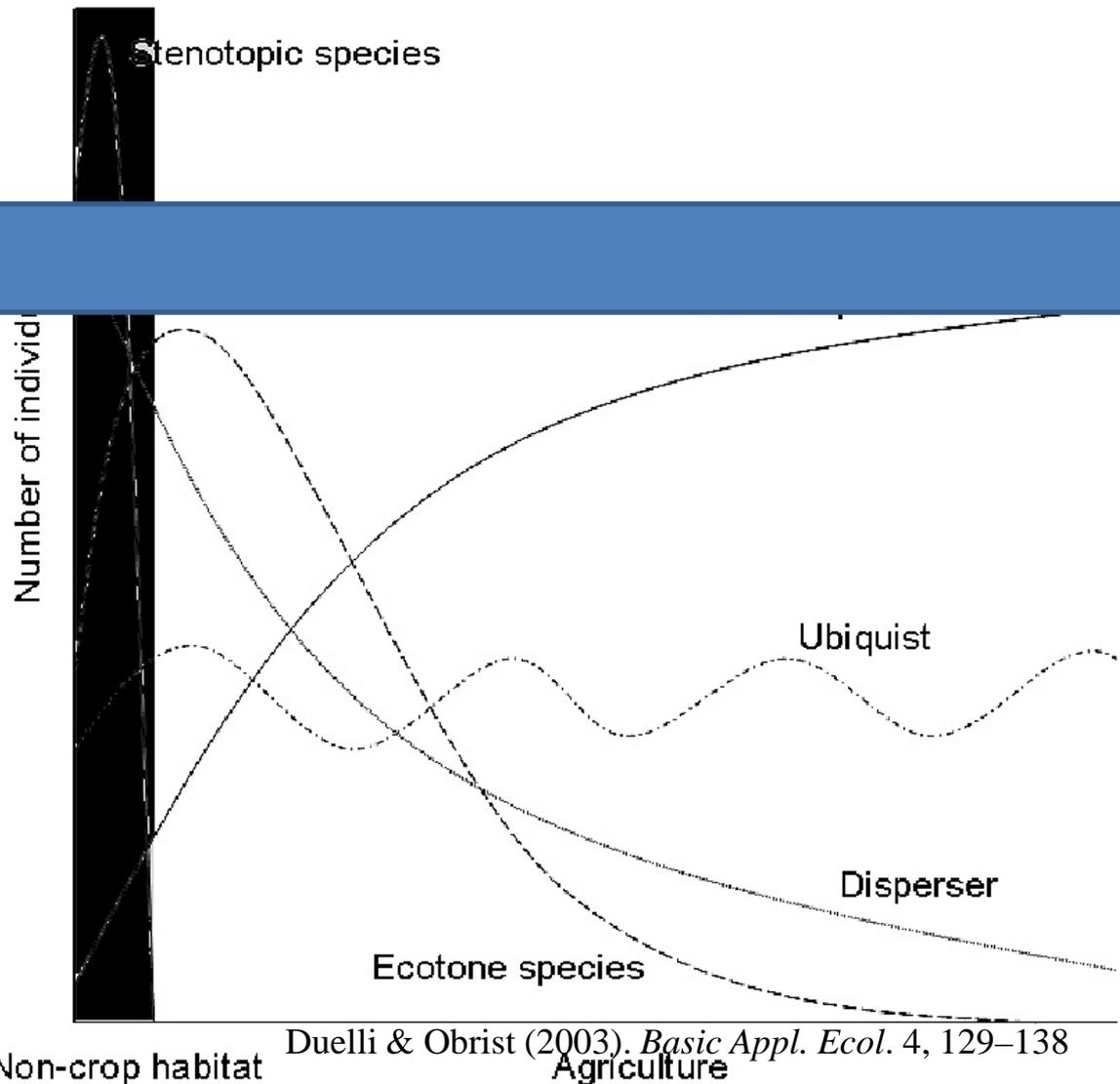
- 66 % of all individuals in the first half of total tran
- 25 % of all individuals in the first quarter of total t
- Peak numbers at first or second position of transe  
if any is false

∨

- Significant dispersers but  $p_2 > 0$  (number of indivi  
if false

∨

>



Modified from Duelli & O'brist  
2003 and Tscharntke *et al.* 2005

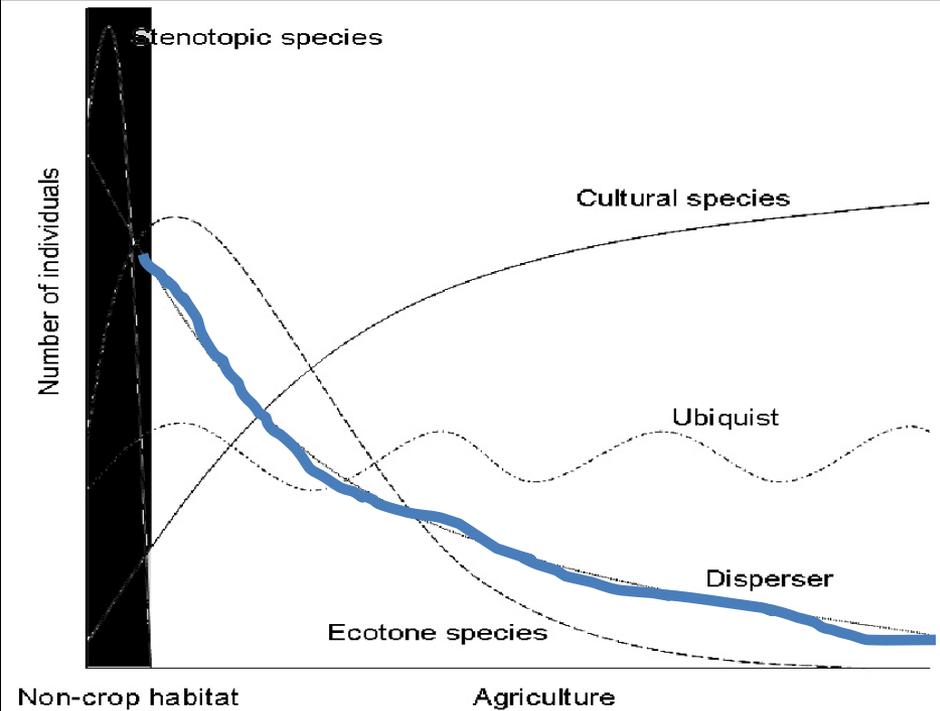
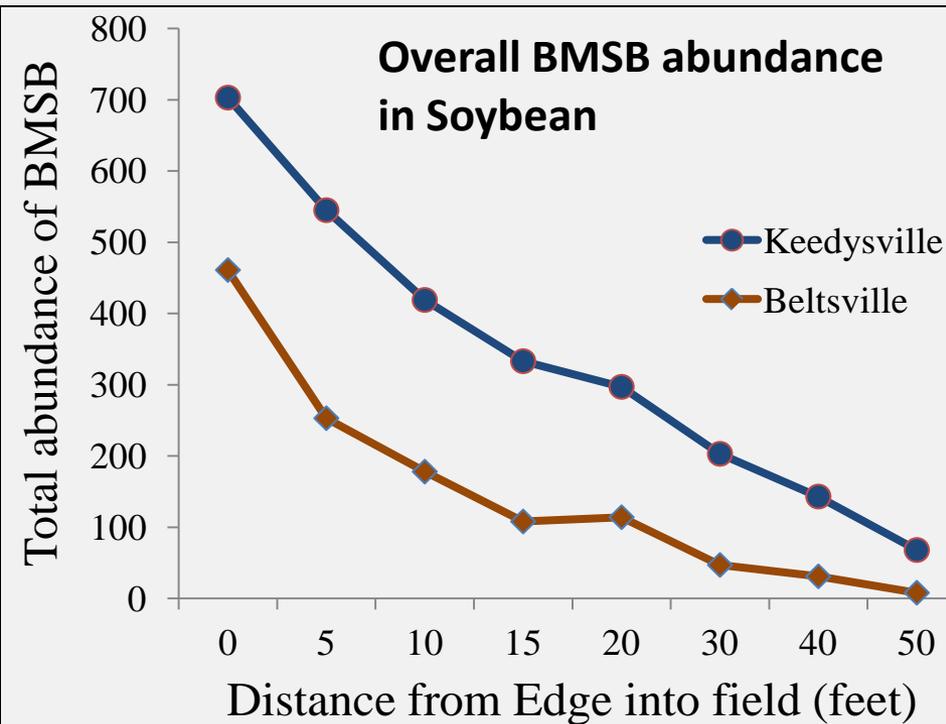
# Statistical Analyses – Adjacent Habitat Influence & Distance from Edge

- Generalized linear mixed models (GLMM)
  - Poisson Distribution
  - Sampling fields as repeated measures
  - Site wise analyses for each crop
  - R package lme4 (v0.999999-0; Bates et al. 2012)
  
- Adjacent Habitat \* Distance from field edge
  - If interaction not significant, then individually tested
  
- Post-hoc Multiple Pair-wise comparisons of group Means (MCP)
  - R package multcomp (v1.2-14; Hothorn et al. 2012)

# Results

## BMSB Infestation Pattern

Data pooled across fields and sampling occasion

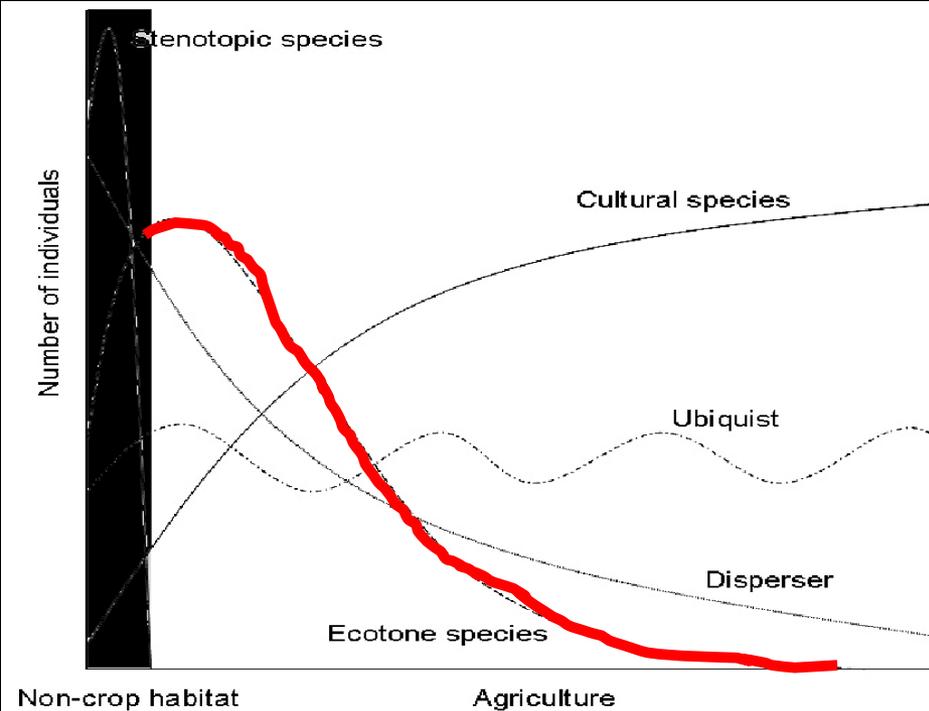
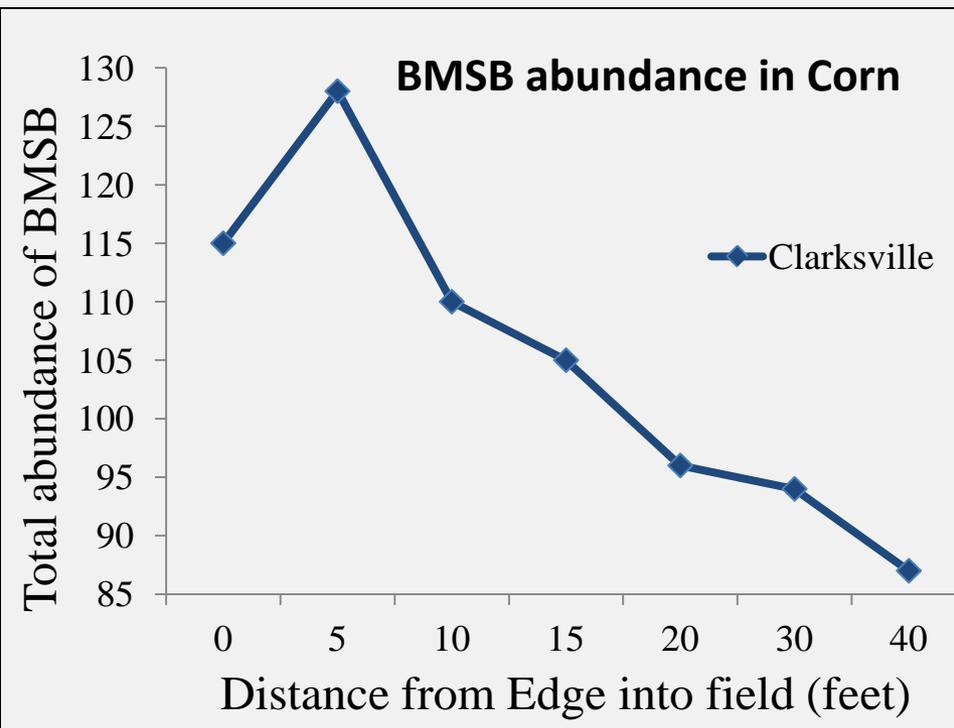


“Species that colonize crops from noncrop habitats” – Duelli & O’brist 2003

**Disperser**

# Results

## BMSB Infestation Pattern



### **Ecotone**

“species that are typically found at the interface of crop and non-crop habitats” – Duelli & O’brist 2003

# Results

## Adjacent Habitat \* Distance

Repeated measures GLMM

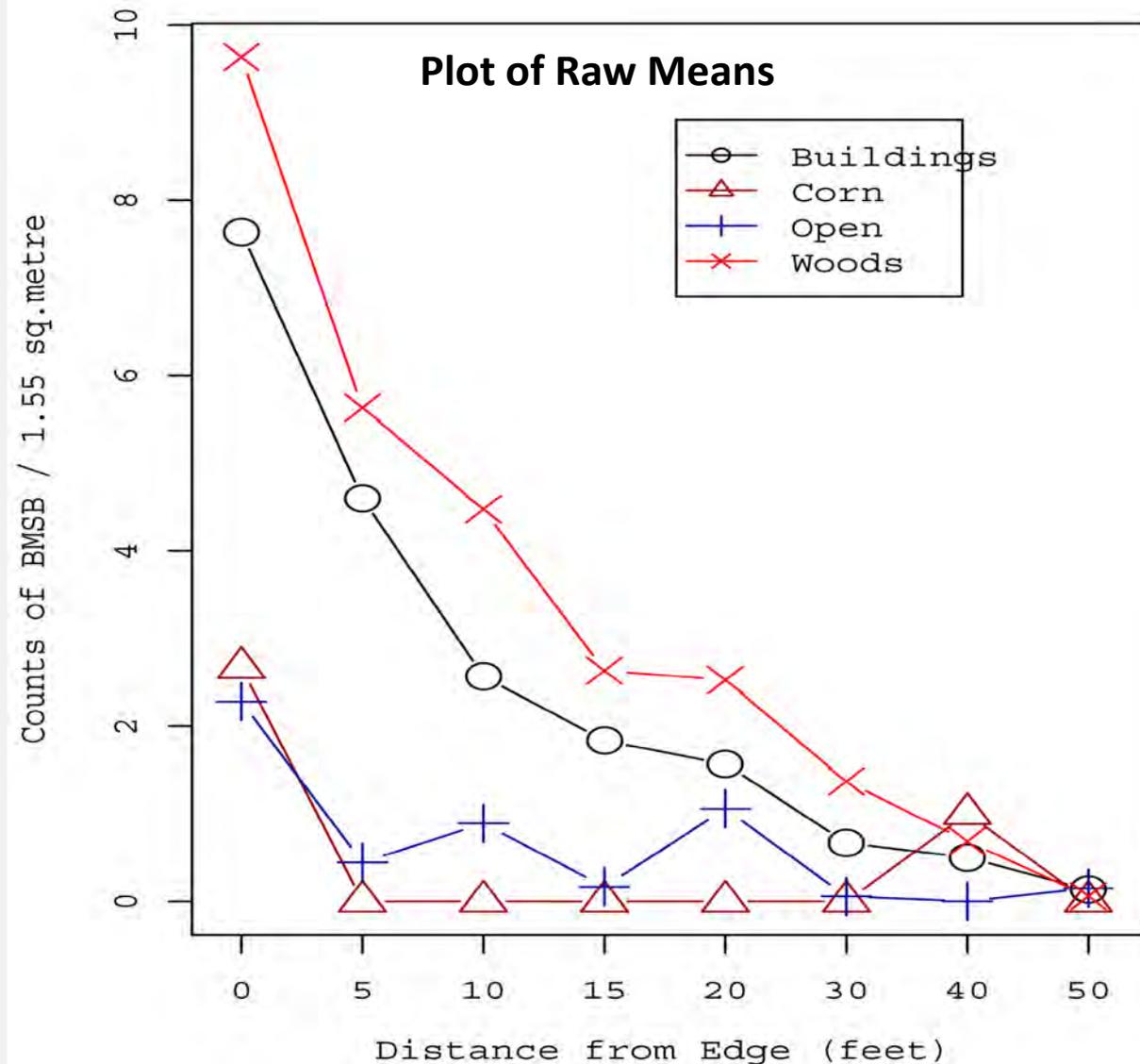
Type III Wald  $X^2$  tests

Adjacent hab:Distance

Wald's  $X^2 = 8.321$ ,

df = 21,  $p = 0.62859$

NS



# Results

Soybean

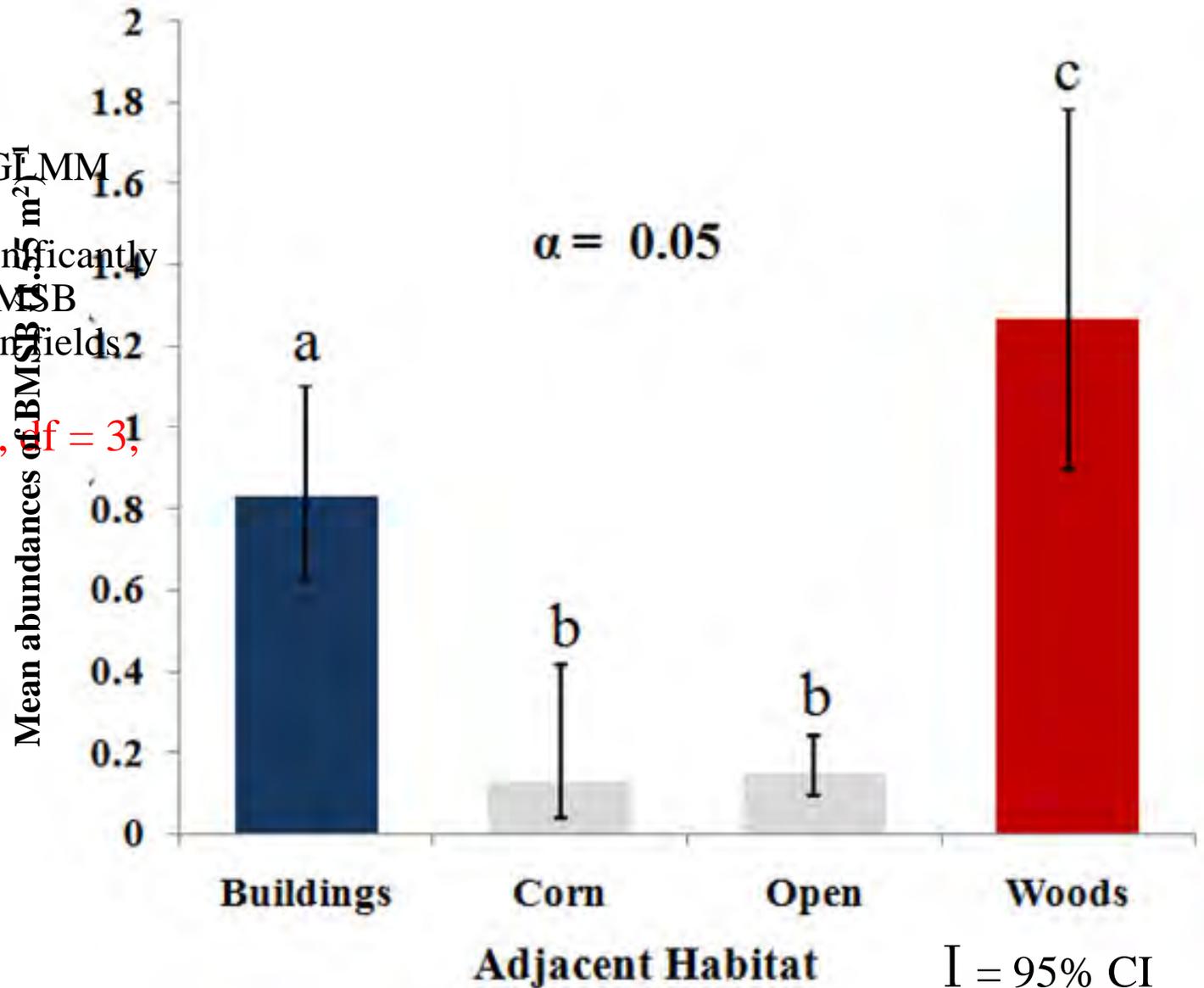
Beltsville

## Adjacent habitat influence

Repeated measures GLMM

Adjacent Habitat Significantly influenced overall BMSB abundance in soybean fields

Wald's  $X^2 = 60.44$ ,  $df = 3$ ,  
 $p = 4.734e-13$ \*\*\*



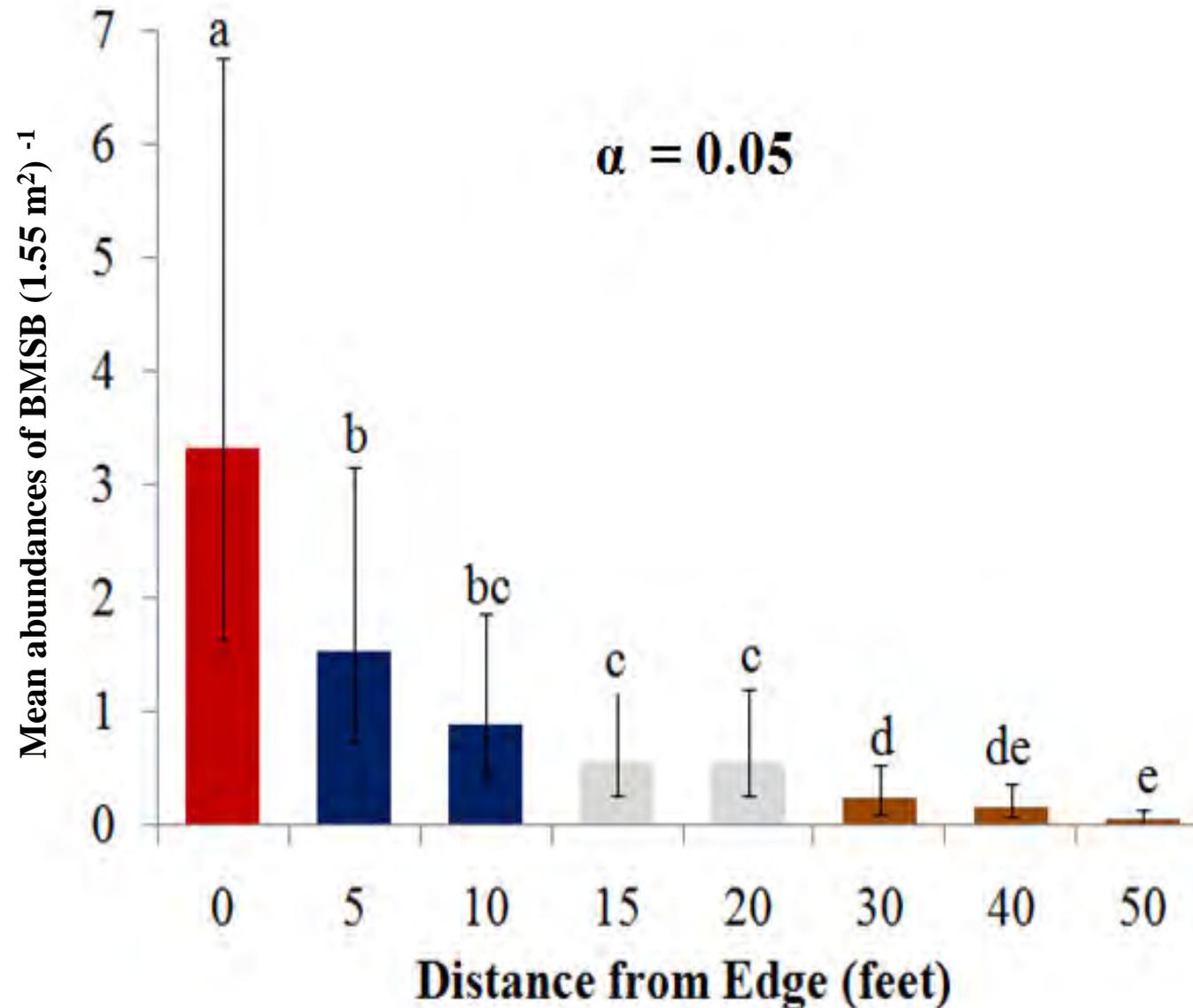
# Results

## Distance from edge influence

Repeated measures C

BMSB abundance significantly vary at different distances from edge

Wald's  $X^2 = 265.5$ ,  $df = 3$ ,  $p = 2.2e-16$  \*\*\*



# Results

## Adjacent Habitat\*Distance

Repeated measures GLMM

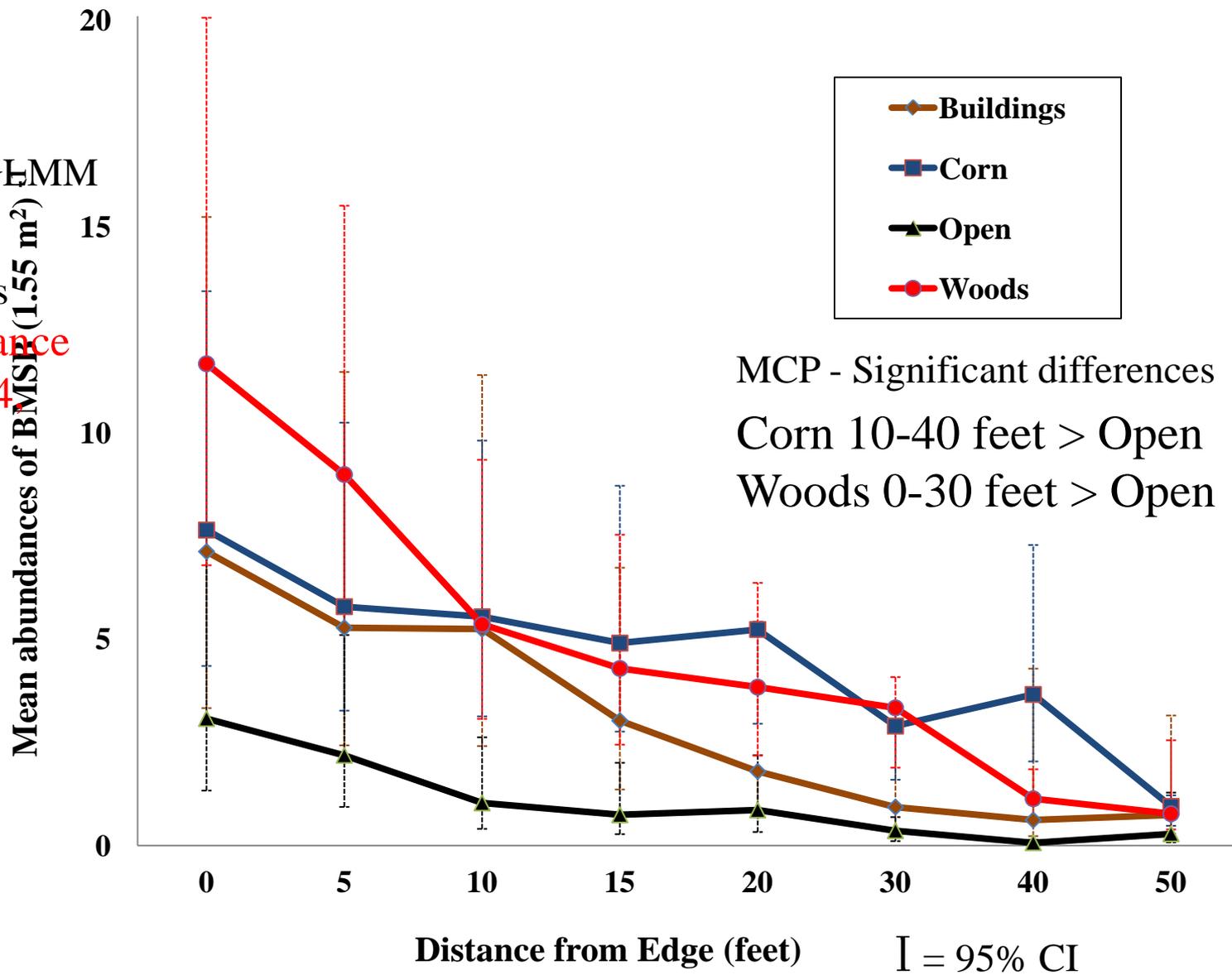
Type III Wald X<sup>2</sup> tests

Adjacent Hab:Distance

Wald's X<sup>2</sup> = 47.6664

df = 21,

p = 0.0007633 \*\*\*



# Results

## Adjacent Habitat\*

## Distance from

Repeated measures GLMM

Type III Wald  $X^2$  tests

Adjacent Hab : Distance

Wald's  $X^2 = 39.2303$ ,  $df = 18$

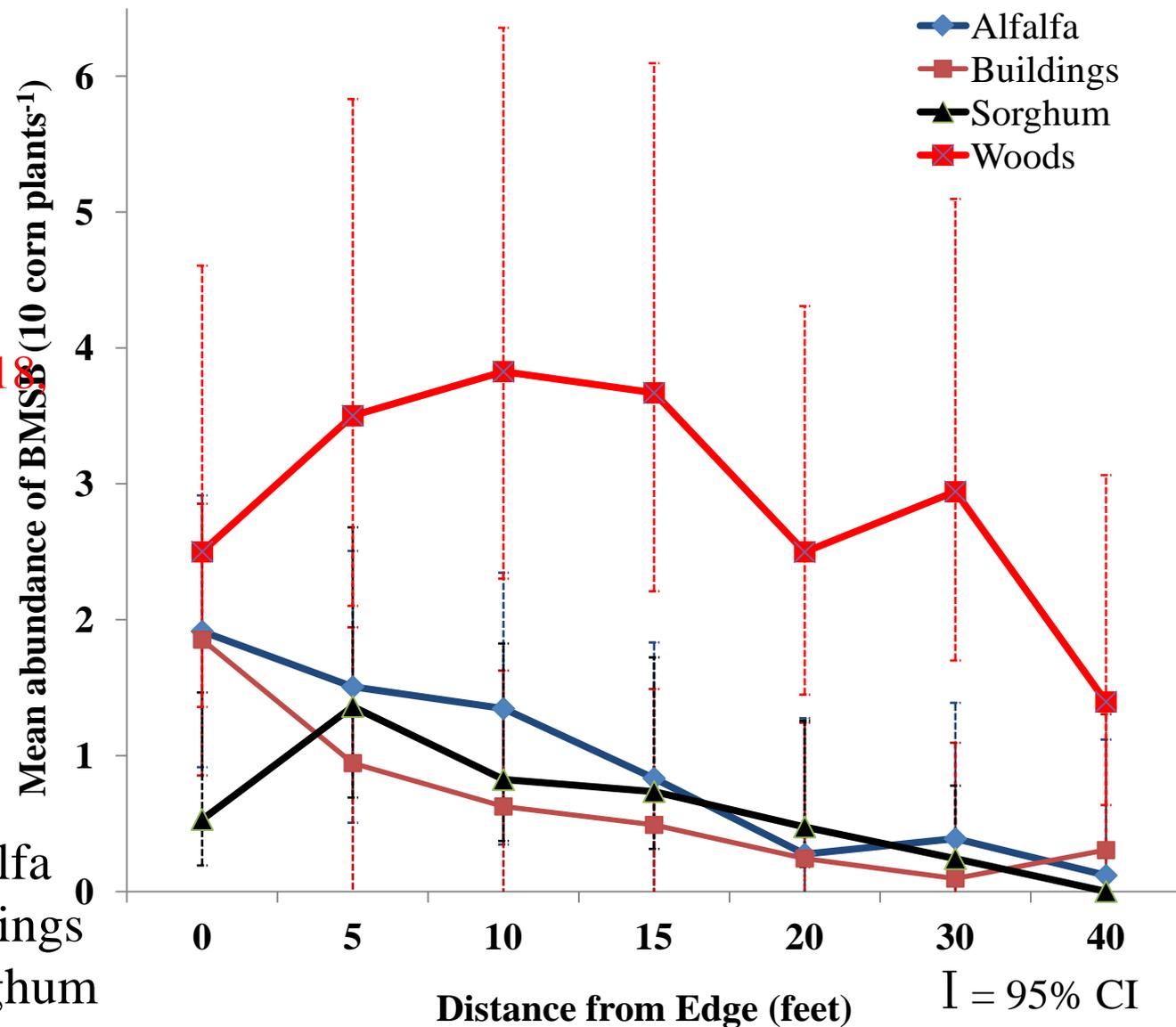
$p = 0.002653$  \*\*

MCP- Significant differences

Woods 10-40 feet > Alfalfa

Woods 5-30 feet > Buildings

Woods 10-30 feet > Sorghum



# Summary and Conclusions

- BMSB infestation pattern
  - Behaviorally classified as ‘Disperser’ – Clumped at the margin
  - Ecotone classification in corn a result of field condition

## In Soybean

- Overall Beltsville abundance lower than past years; Highest along woods, then buildings. Lowest in fields next to open areas
- Overall Keedysville abundance high, and threshold levels
  - While abundance along woods higher, not significant from corn and buildings
  - Lowest in fields next to open areas.
- Abundance adjacent to corn highly variable between sites - signifies local population context.

## In Field Corn

- Overall abundance low.
- Abundance along woods greater than buildings, alfalfa & sorghum.
- Beltsville abundance too low for any meaningful analysis.

# BMSB control strategies

- Chemical treatments can be limited to field edges, up to 40 feet in field and entire field treatment probably not required.
- Prioritize edges along woods, buildings over open areas.
- In certain conditions, fields with edges along open areas probably do not need treatment.
- Probably no treatment required in field corn, if numbers are similar to this year's in most of MD

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