

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



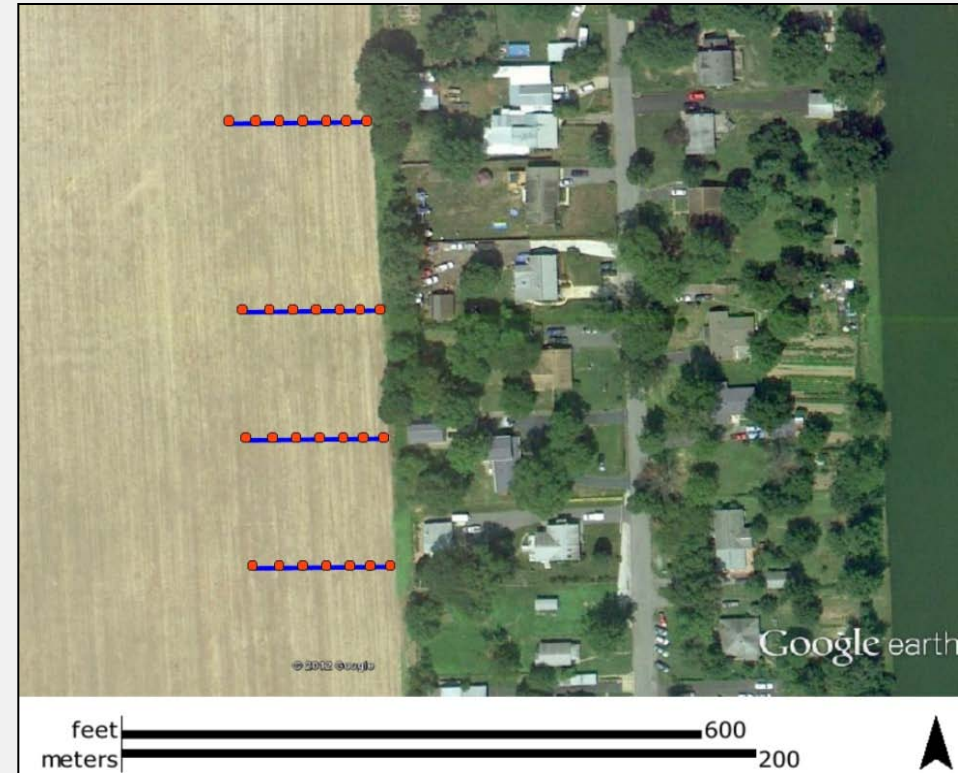
Objectives

- 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 m²)
- 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

V

- 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

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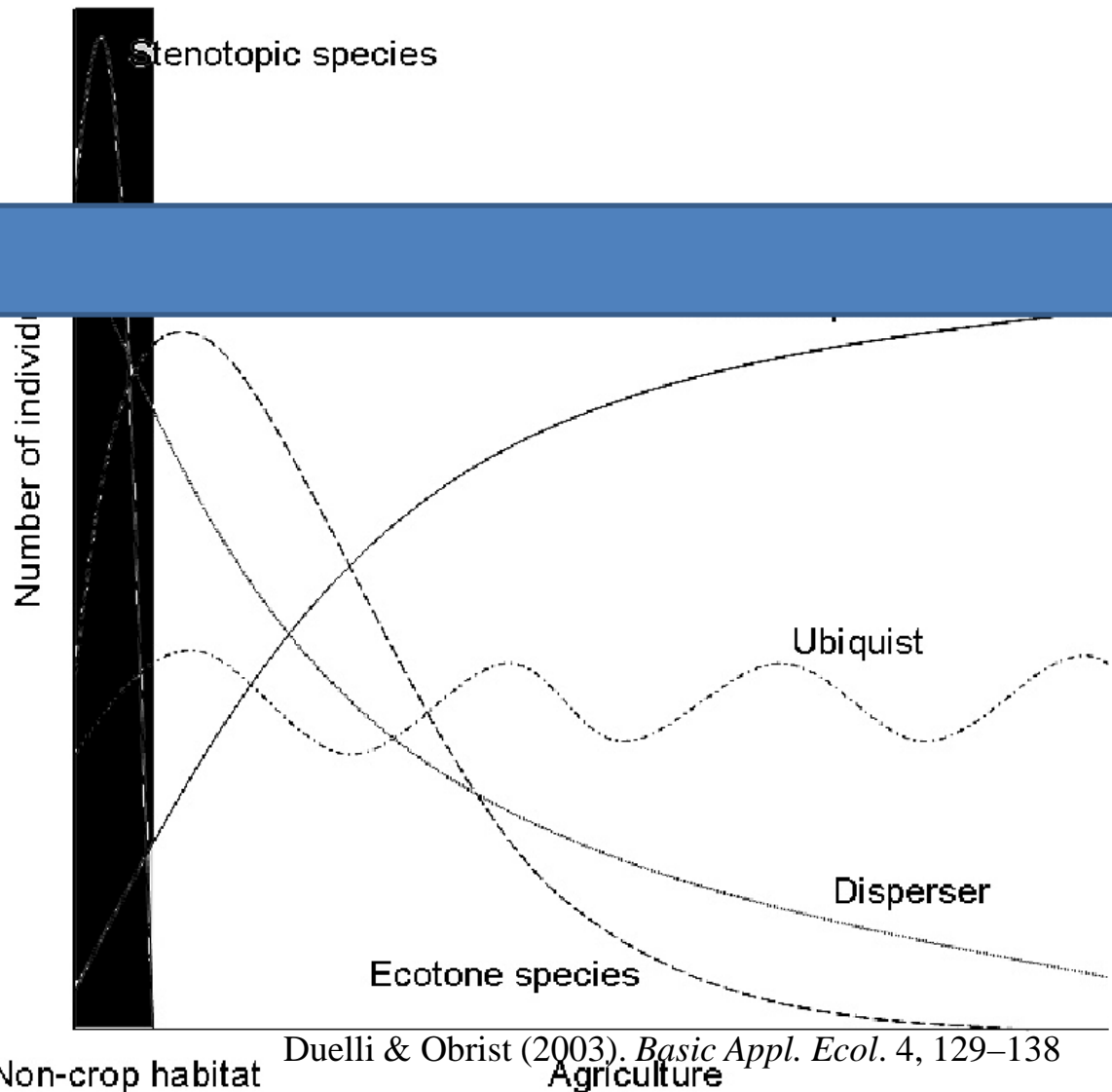
- 66 % of all individuals in the first half of total tran
- 25 % of all individuals in the first quarter of total t
- Peak numbers at first or second position of transe
if any is false

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

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Duelli & Obrist (2003). *Basic Appl. Ecol.* 4, 129–138

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)

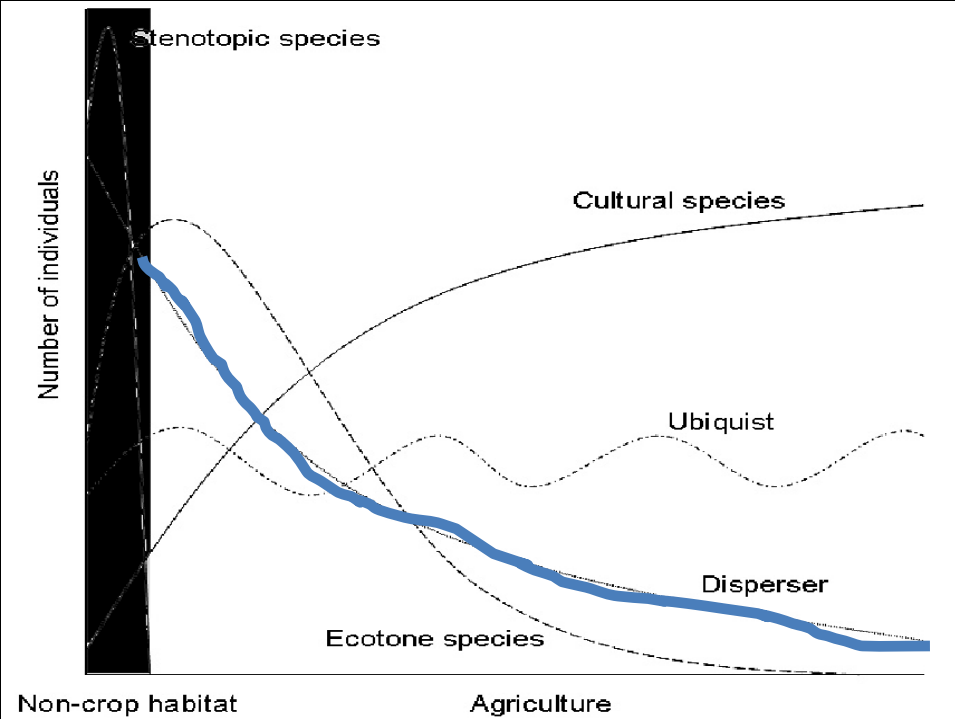
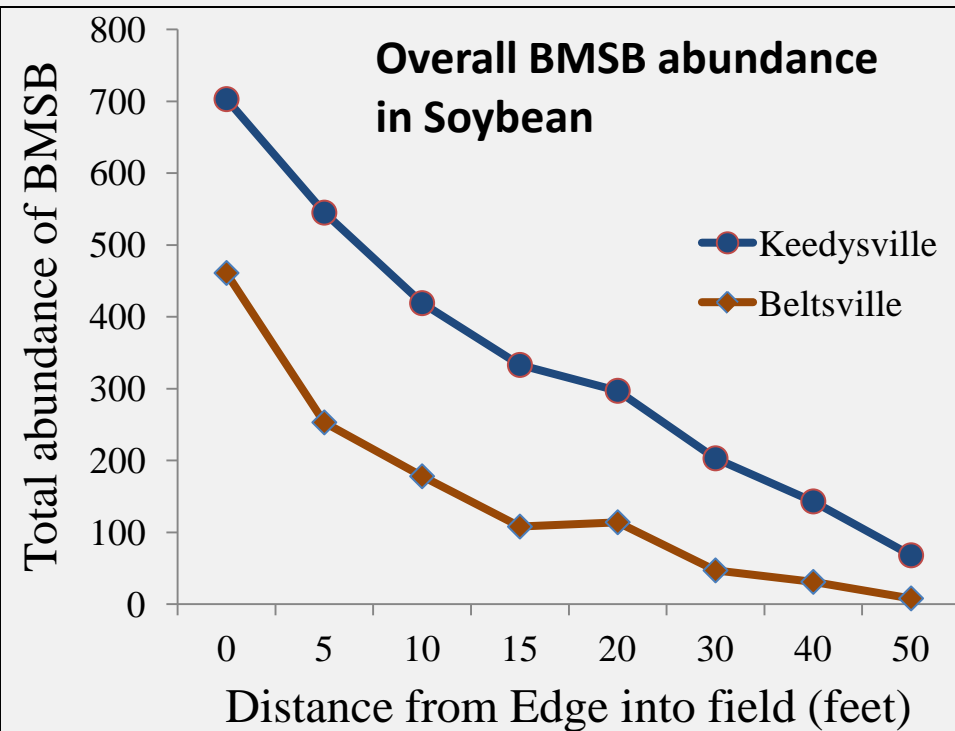
- Adjacent Habitat * Distance from field edge
 - If interaction not significant, then individually tested

- 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

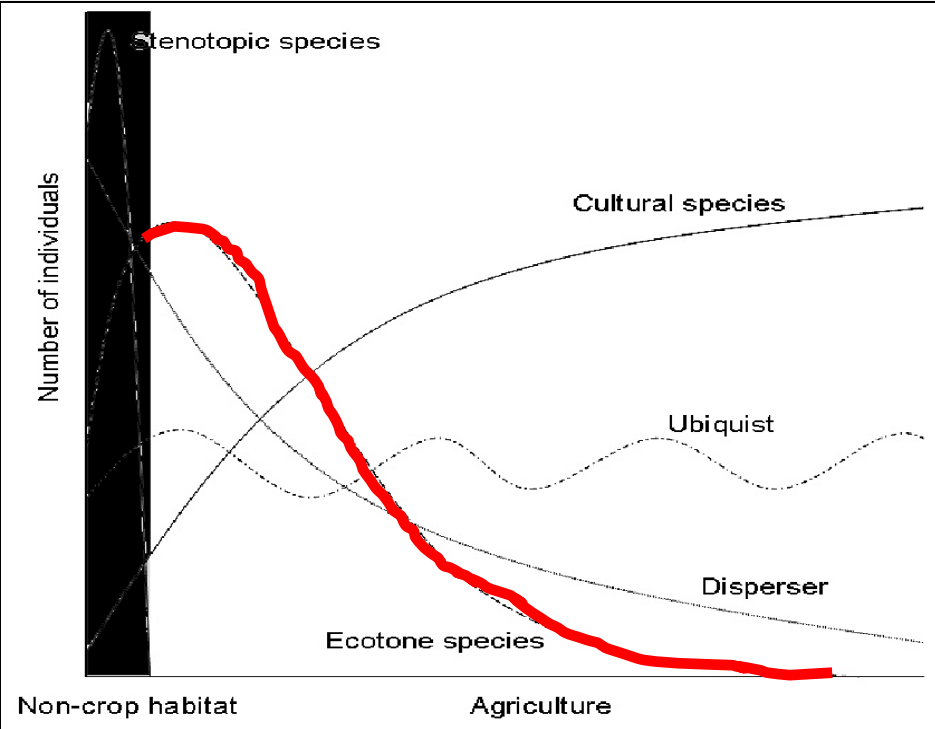
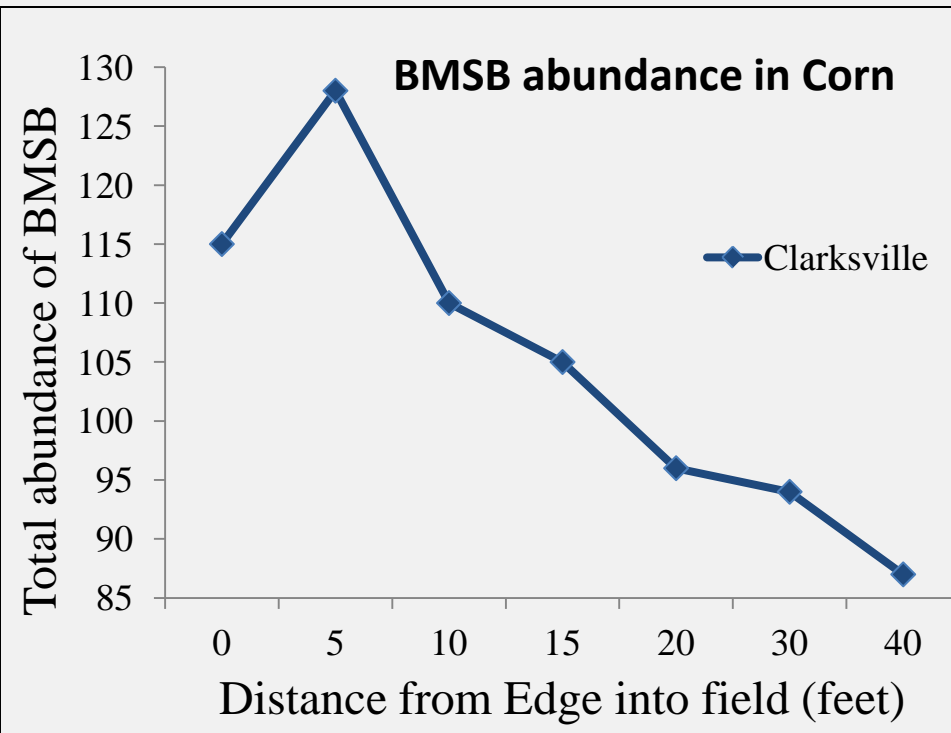


“Species that colonize crops from noncrop habitats” – Duelli & O’brist 2003

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

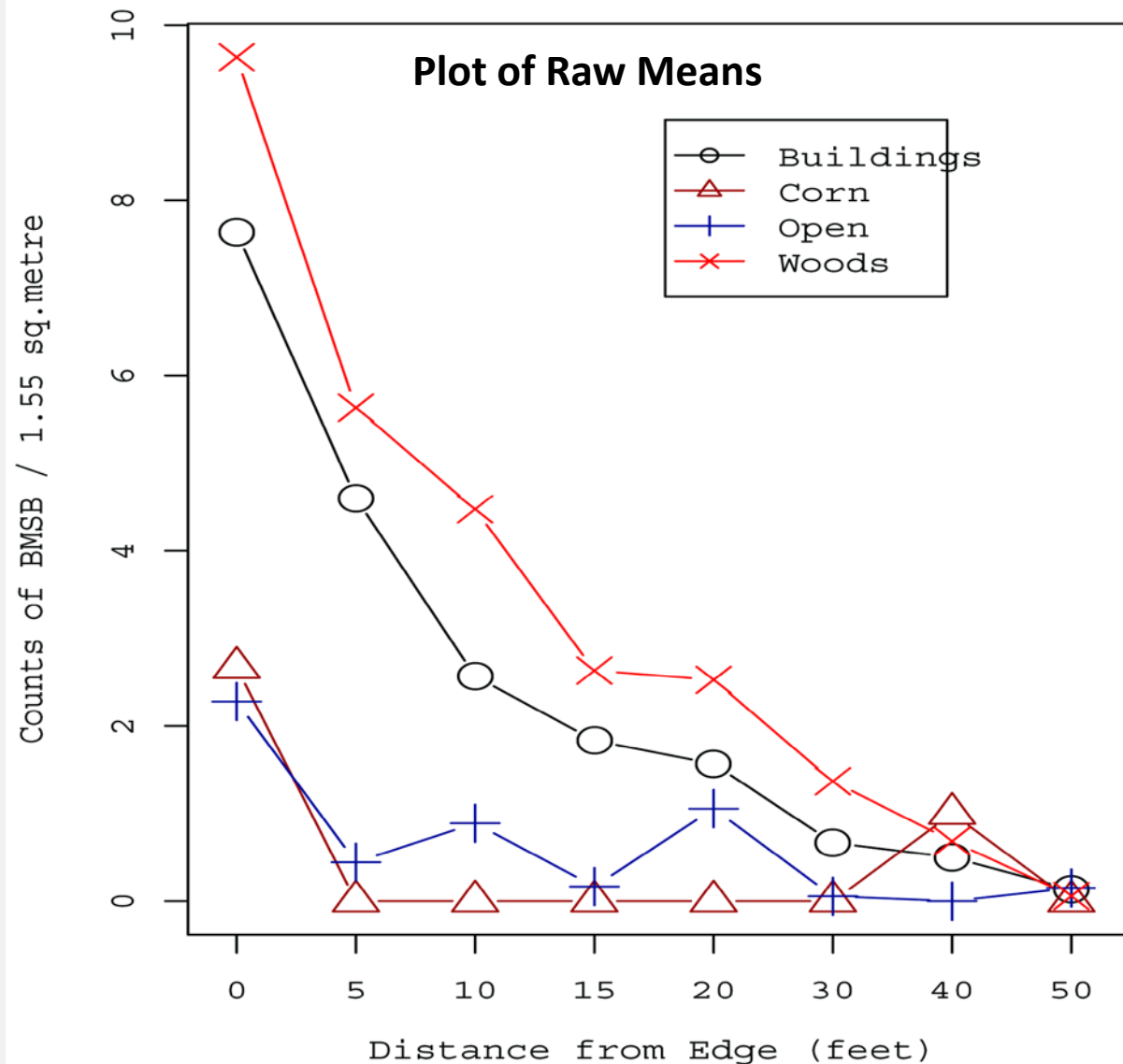
Type III Wald X^2 tests

Adjacent hab:Distance

Wald's $X^2 = 8.321$,

$df = 21$, $p = 0.62859$

NS



Results

Soybean

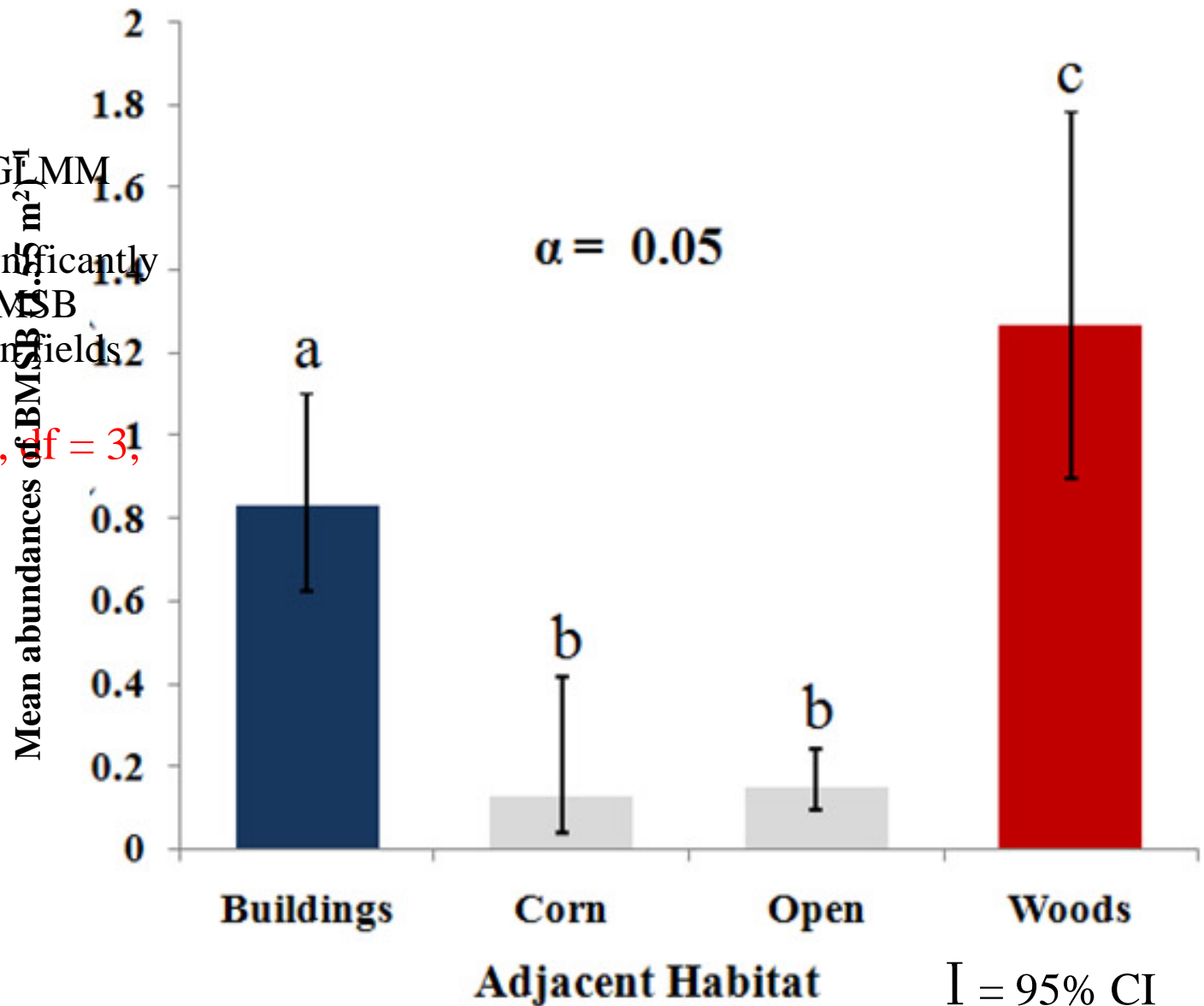
Beltsville

Adjacent habitat influence

Repeated measures GLMM

Adjacent Habitat Significantly influenced overall BMSB abundance in soybean fields

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



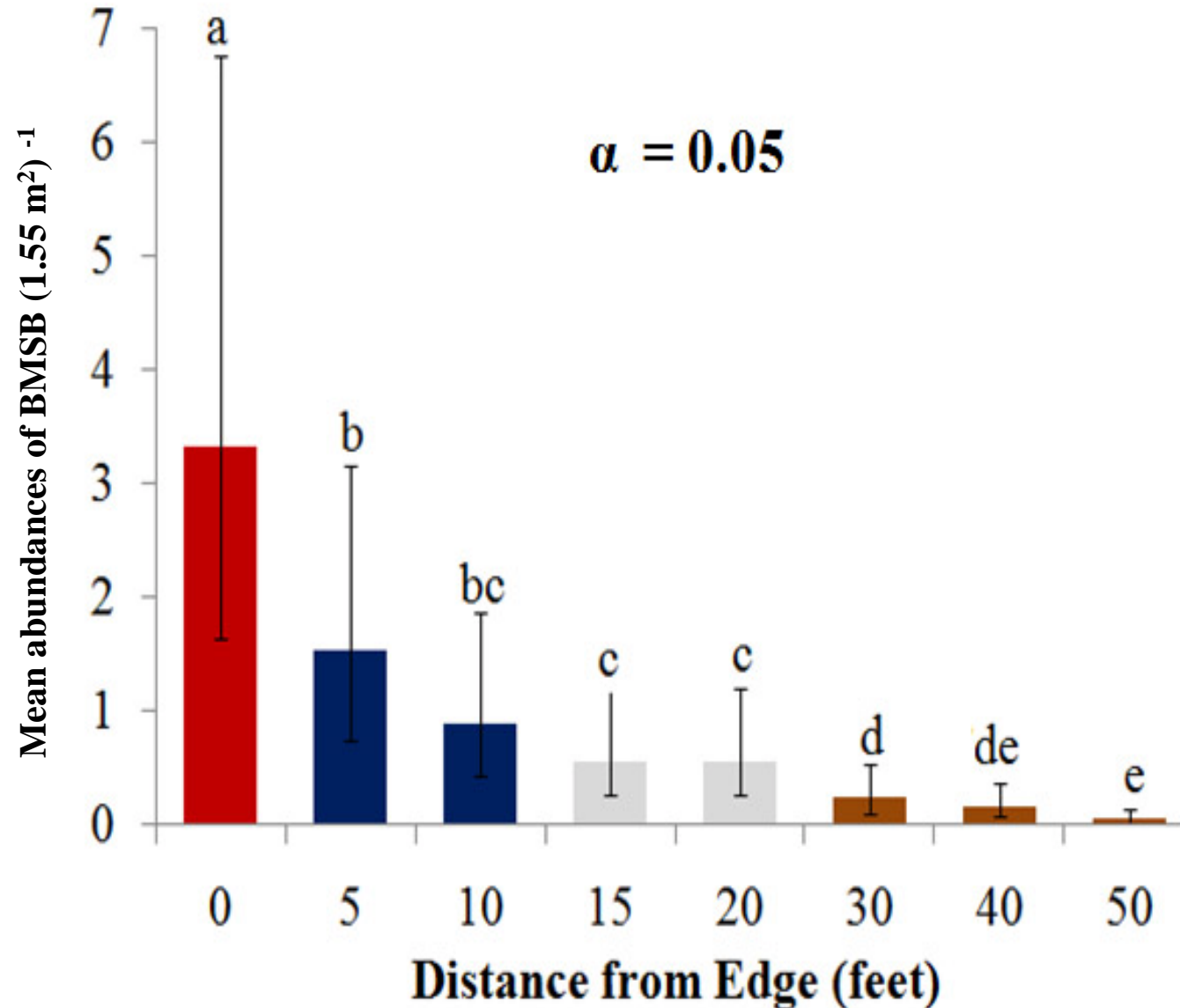
Results

Distance from edge influence

Repeated measures C

BMSB abundance significantly vary at different distances from edge

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



Results

Adjacent Habitat*Distance

Repeated measures GLMM

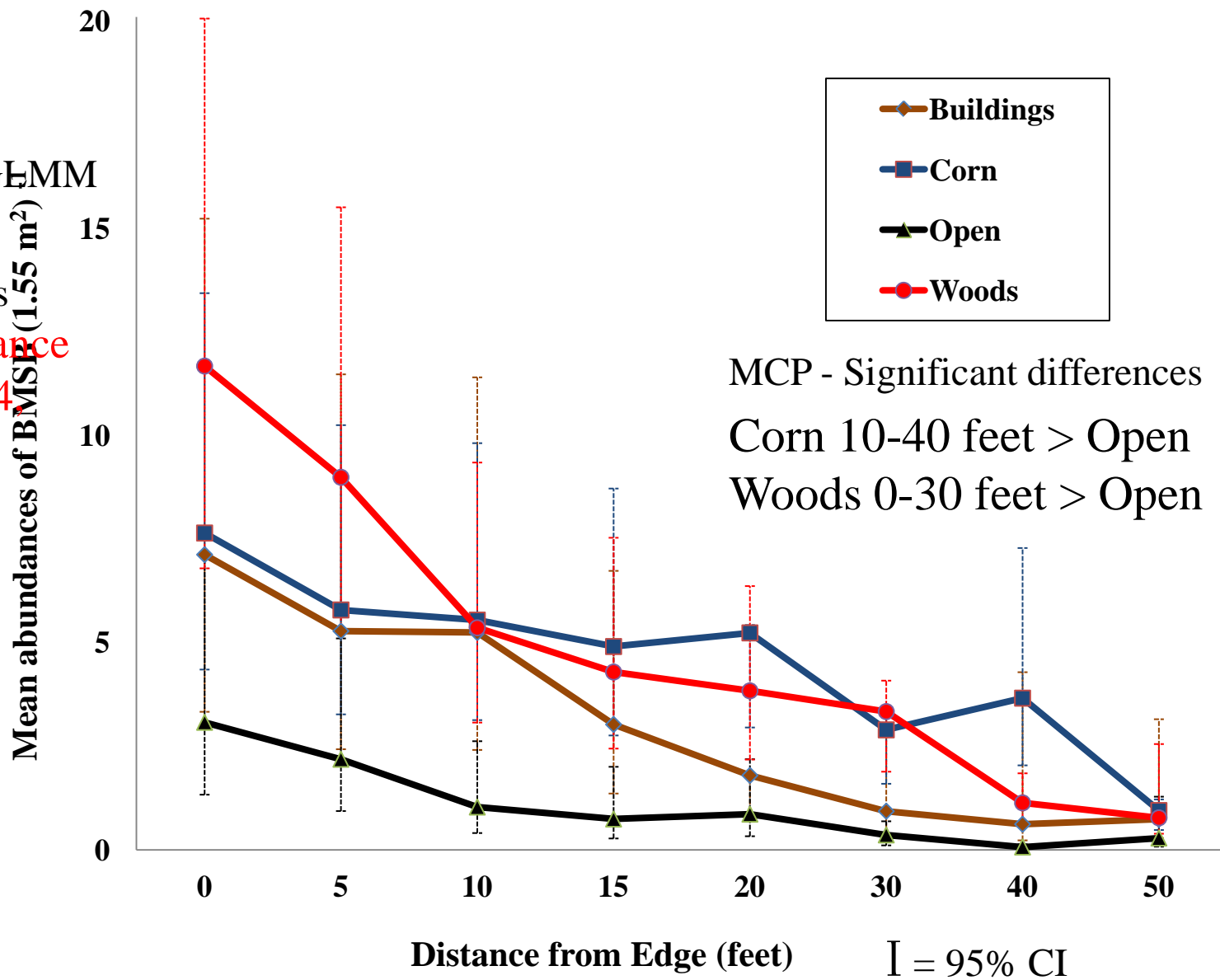
Type III Wald X² tests

Adjacent Hab:Distance

Wald's X² = 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 $X^2 = 39.2303$, $df = 18$

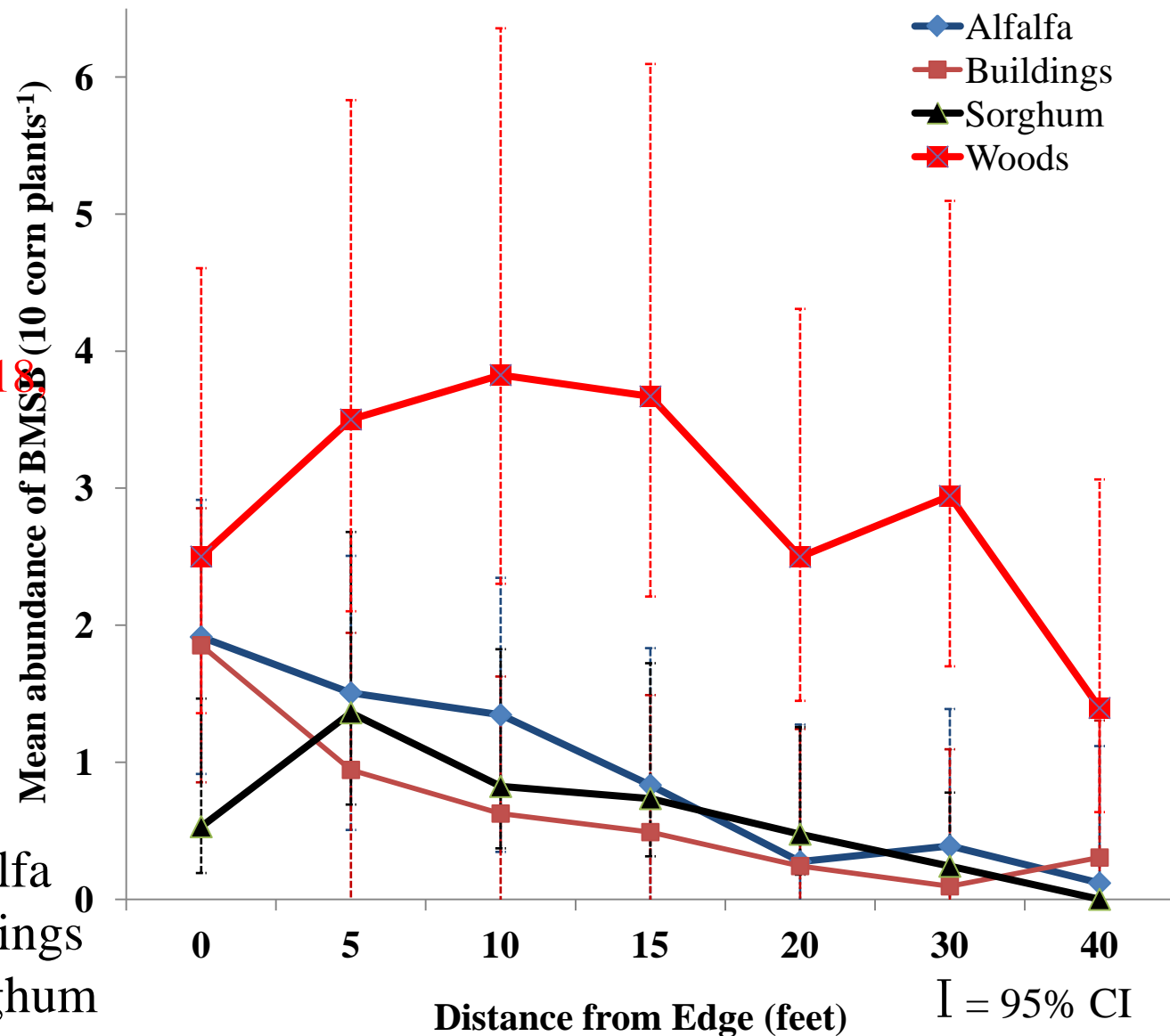
$p = 0.002653$ **

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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