Spatial and Temporal Patterns of Stored-Product Insect Flight Activity in a Kansas Landscape

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ABSTRACT

Immigration of stored-product insects into food processing and storage facilities can be an important source of infestation. Although large numbers of stored-product insects can be captured outside food facilities, the sources of these insects and seasonal patterns to their flight activity are not well understood. Potential offsite sources include other food facilities, grain elevators, residential areas, farm fields and storage bins, and non-anthropogenic resources. In this study, seasonal patterns of outside flight activity were evaluated in a variety of habitat types in Kansas (e.g., outside grain storage and processing facilities, residential areas, agricultural fields, woodlands, native prairie) using pheromone traps. Traps were baited with lures for *Plodia interpunctella*, *Trogoderma variabile*, *Rhyzopertha dominica*, *Lasioderma serricorne*, and *Sitotroga cerealella*. Traps were placed outside for monthly one-week sampling periods, over most of a two year period. Temporal and spatial patterns of trap capture were determined for different pest species and habitat types. This information can be used to develop hypotheses about important source populations and recommendations about periods of time when facilities are susceptible to pest immigration.

INTRODUCTION

- Stored-product insects are associated with human stored food and can cause economic damage to raw grain and processed commodities in food processing and storage structures.
- Product infestation can result from persistence within structures, infested product introduced into structures, or active immigration by insects originating from other locations.
- There is limited information available on stored product pest populations outside of food facilities and a need for information on population structure and behavior at these larger spatial scales.
- Immigration from other locations may be important because many species can be captured outside of structures, have a wide host range, and are capable of long distance flight.
- These observations leads to the questions: where do these immigrants originate from, when is a structure most susceptible to immigration, and over what spatial scales are they capable of moving and potentially interconnecting subpopulations?
- To begin to address these questions, we measured seasonal patterns in flight activity outdoors in five different habitat types in a Kansas landscape.

MATERIALS AND METHODS

- Outdoor monitoring was conducted in the area in and around Manhattan, Kansas for one-week periods on an approximately monthly basis from June to November in 2002 and April to December in 2003.
- Delta traps (Scentry Biologicals, Billings MT) baited with pheromone lures (Trece, Adair OK) were placed in one of five general habitat types.
- Trap locations each year and descriptions of the habitat types are shown in Figure 1.
- Locations of all traps were recorded using a handheld GPS unit and mapped onto a land cover map of the area (Kansas Applied Remote Sensing, 1993).
- After a seven day monitoring period traps were returned to lab and the number of each species captured was determined. Data for three of the most prevalant species is presented here: *Plodia interpunctella*, *Trogoderma variabile*, and *Rhyzopertha dominica*.
- Spatial interpolation was done using the inverse distance weighted method with a fixed radius of one mile and a power of two using ArcView GIS software Release 3.2 (ESRI, Redlands, CA).

Figure 1. Land cover map of study area with trap locations and descriptions of the five habitats monitored

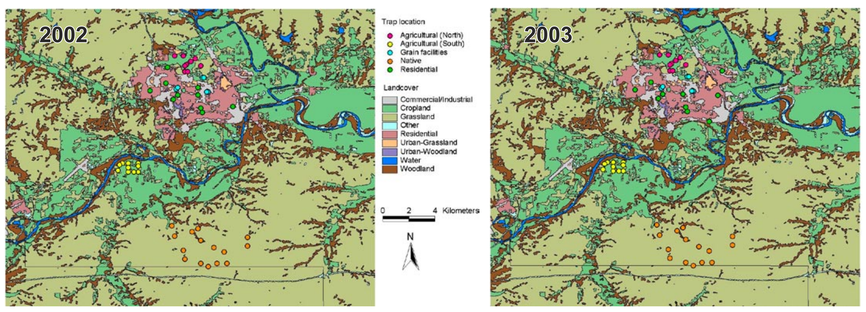
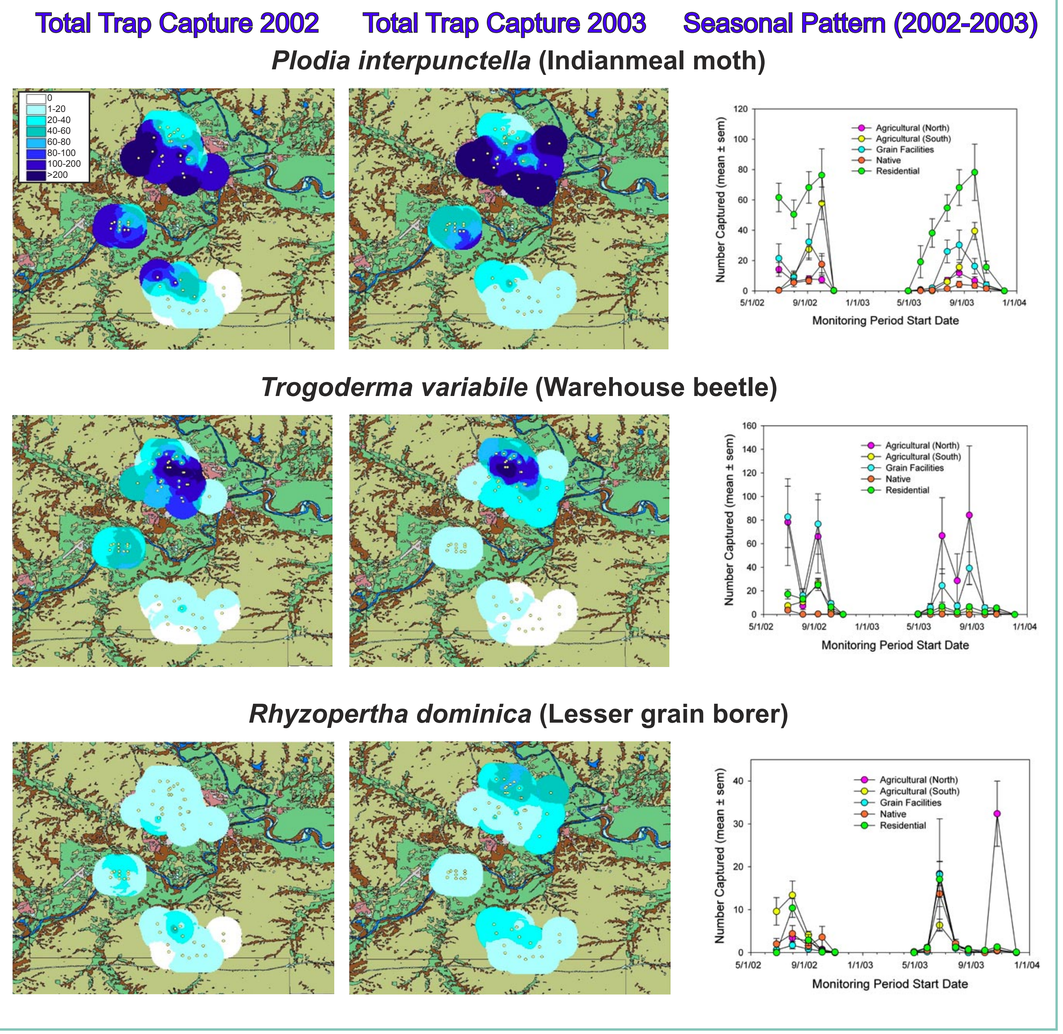


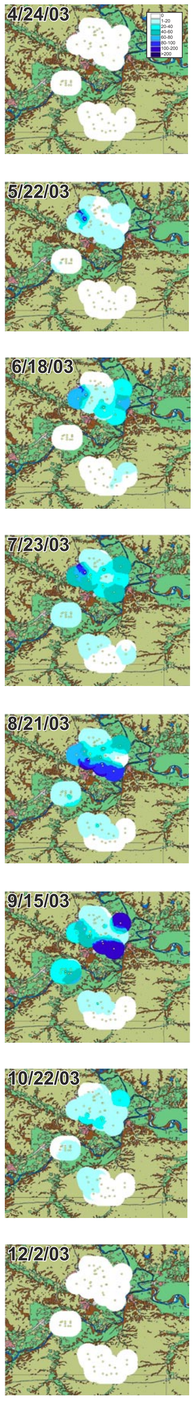
Figure 2. Spatial distribution of total trap captures for three species of stored product insects and the seasonal patterns of trap capture for each species in the different habitat types.



RESULTS AND DISCUSSION

- *Plodia interpunctella* trap captures were highest in the residential area and captures started earlier there in the spring and levels increased steadily to a high point in September or October (Figure 2). Temporal trends in the spatial data, illustrated using 2003 data in Figure 3, suggest that populations may originate in residential areas in the spring and spread into the other habitats. Food storage and processing facilities may be suceptible to moths immigrating from residential areas. Residential areas may provide many relatively small resource patches (e.g., stored bird seed and pet foods) both indoors and outdoors that facilitate population increase and overwintering.
- *Trogoderma variabile* was most prevalant in the traps near grain facilities and the adjacent Agricultural (North) area, and was rarely captured in the Native habitat (Figure 2). An earlier study also found this species to be captured in higher numbers near a food processing facility than further away. This suggests that this species is more closely associated with food facilities, and perhaps has less capability for long distance population spread than *P. interpunctella*.
- *Rhyzopertha dominica* was captured in lower numbers than the other species. The agricultural areas and Native area tended to have the highest number captured (Figure 2). This species is primarily considered a whole grain pest, but because of its capacity for long distance flight it may be widely dispersed across agricultural and native landscapes.
- Differences in distribution and seasonal patterns of flight activity among the species suggest fundamental differences in their behavior and ecology. Understanding these factors will improve the implementing of IPM programs in food facilities. Given the levels of flight activity outdoors, immigration may be an underappreciated source of infestation.

Figure 3. Seasonal changes in *P. interpunctella* spatial distribution - 2003



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