

# Long term sampling reveals previously unobserved trends in predatory coccinellid populations in an agricultural landscape.



**KBS LTER**  
Kellogg Biological Station  
Long-term Ecological Research

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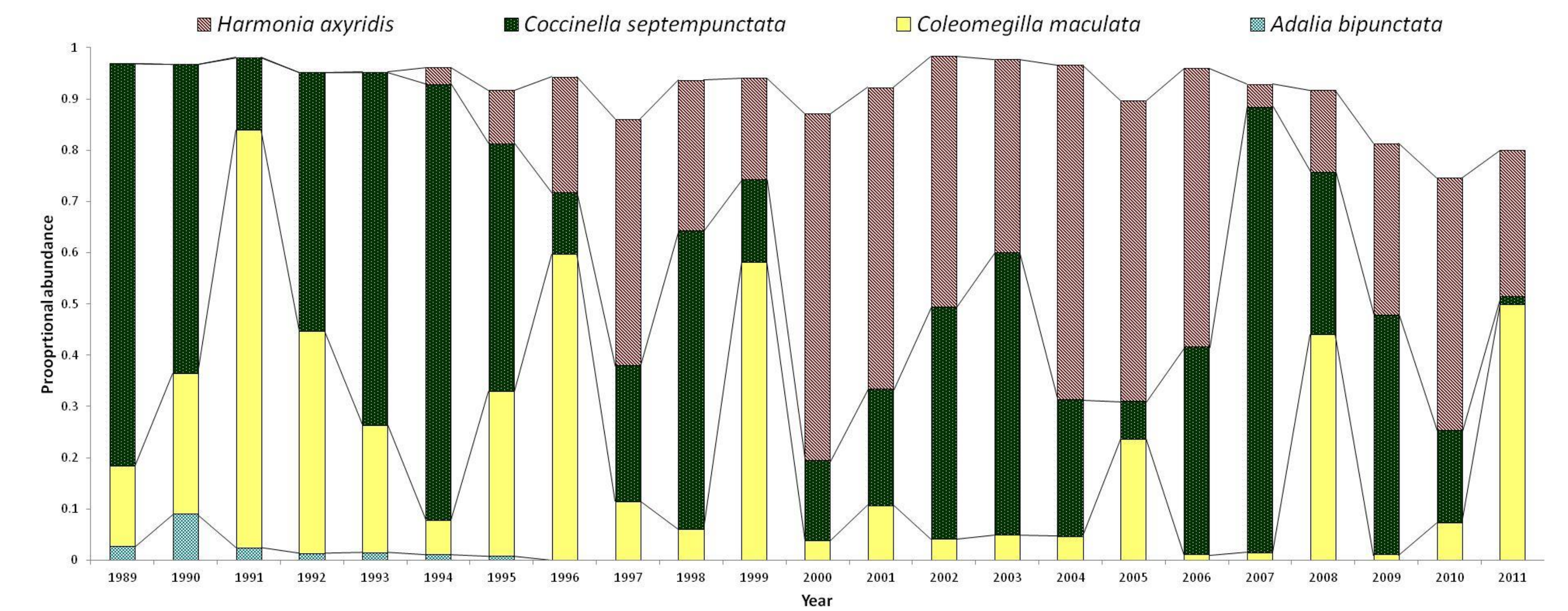


## Background

Predatory Coccinellidae (ladybeetles) are a charismatic and economically important guild.<sup>1</sup> Historically, this guild has been subjected to multiple invasions of exotic ladybeetles.<sup>2</sup> Here we use long-term records of ladybeetle captures to examine changes in community composition, abundance, habitat use, and biocontrol function of coccinellid communities in response to invasions.

Each growing season since 1989, coccinellid populations have been monitored weekly in a variety of habitats at the Kellogg Biological Station (KBS) in southwestern Michigan. Coccinellid captures on yellow sticky traps were recorded from main site treatments: in annual crops of maize, soybean, wheat (in three year rotation), perennial crops alfalfa, poplar, and early successional (ES) vegetation and adjacent unmanaged forest plots: coniferous (CF), deciduous (DF) and successional forest). Thirteen species of predatory coccinellid occur with regularity on traps: this poster documents summaries of captures by year and habitat, and models for seasonality for four of these species; the three species that dominate captures in KBS surveys and one species that was formerly dominant in the surveyed ecosystems.

*Coleomegilla maculata* is a native species whose diet includes both pollen and smaller invertebrates.<sup>3</sup> *Harmonia axyridis* is an introduced species which was first recorded at KBS in 1994 and has undergone periodic abundance associated with outbreaks of soybean aphid (*Aphis glycines*).<sup>4</sup> *Adalia bipunctata*, a native species, was formerly very common in agroecosystems in central North America, but has been in decline since the 1980s.<sup>2</sup> *Coccinella septempunctata* was introduced from Europe in the 1980s, and is considered among the most successful invasive ladybeetles.<sup>5</sup>



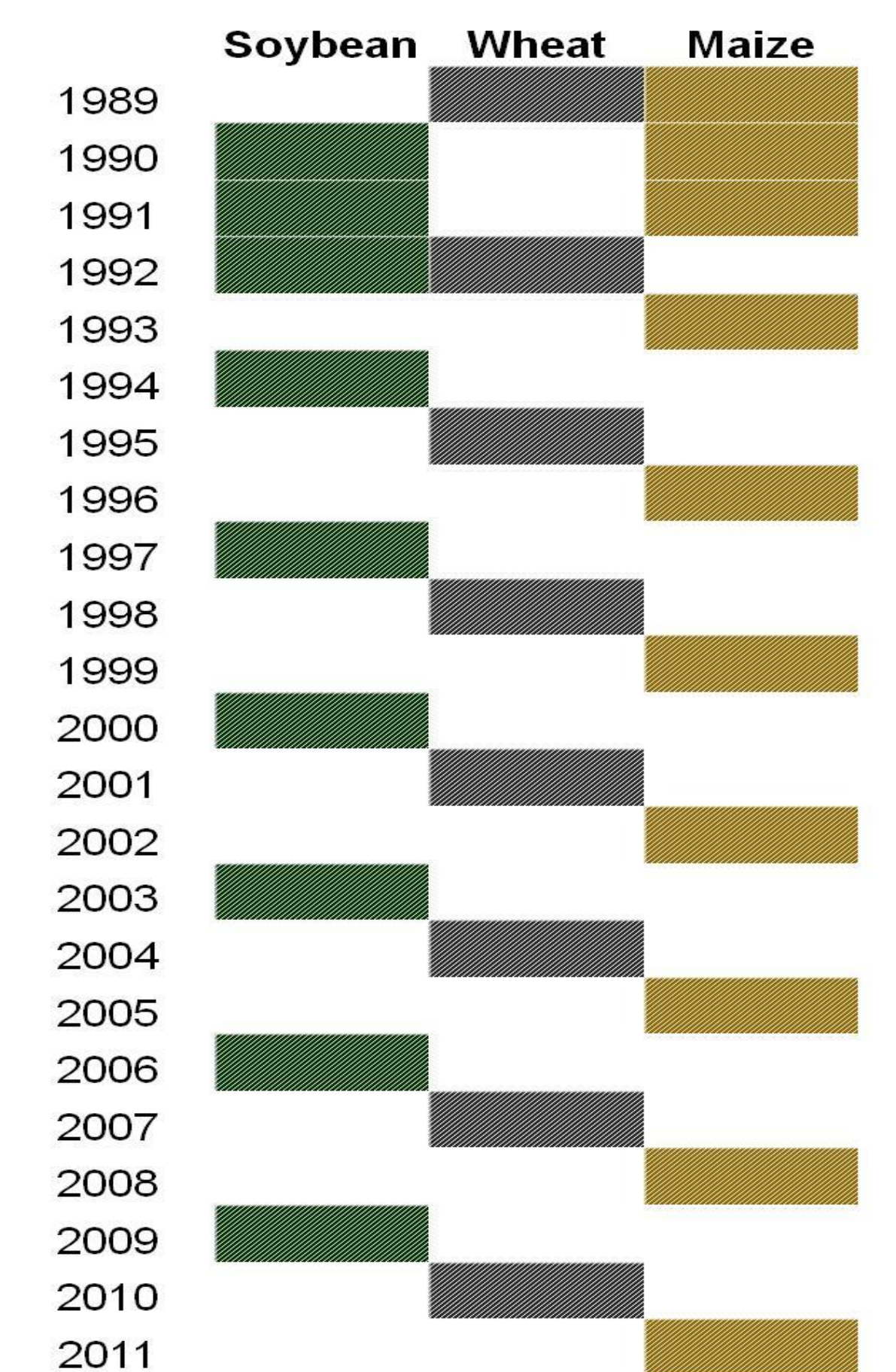
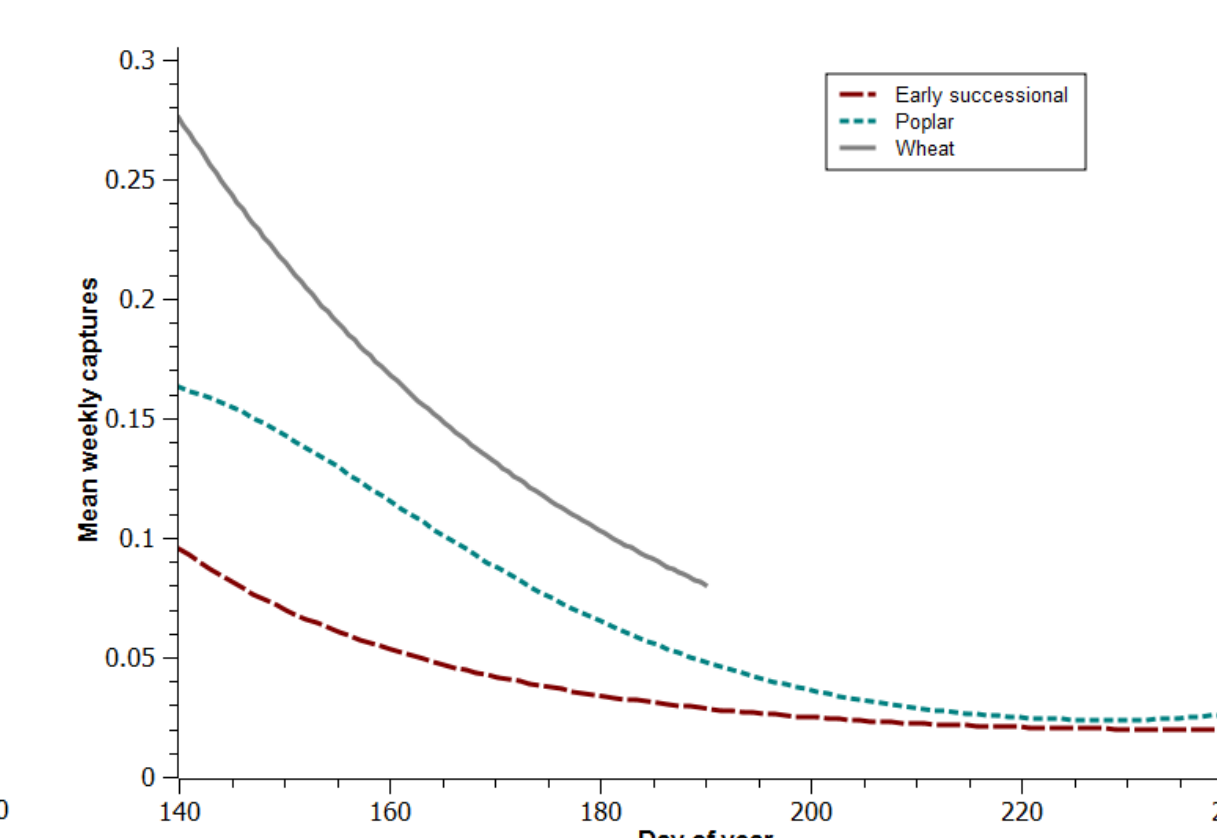
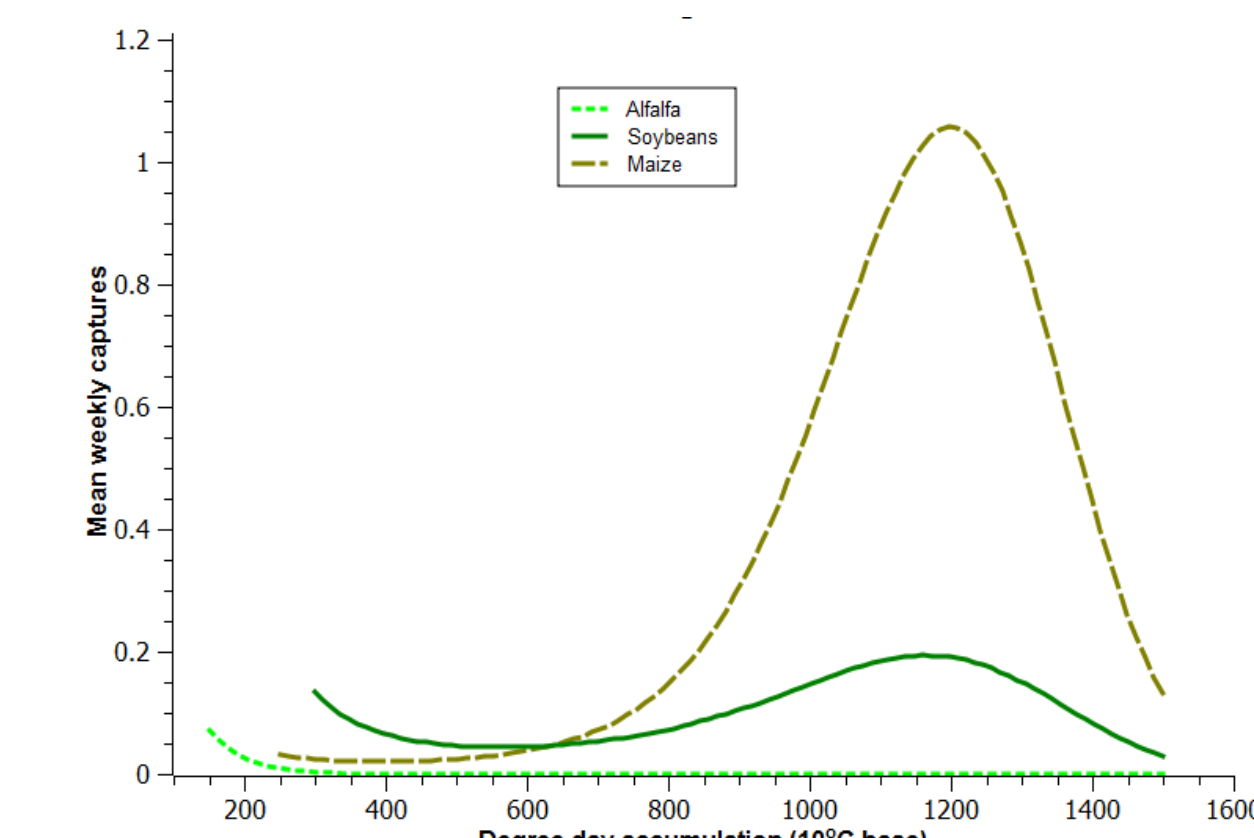
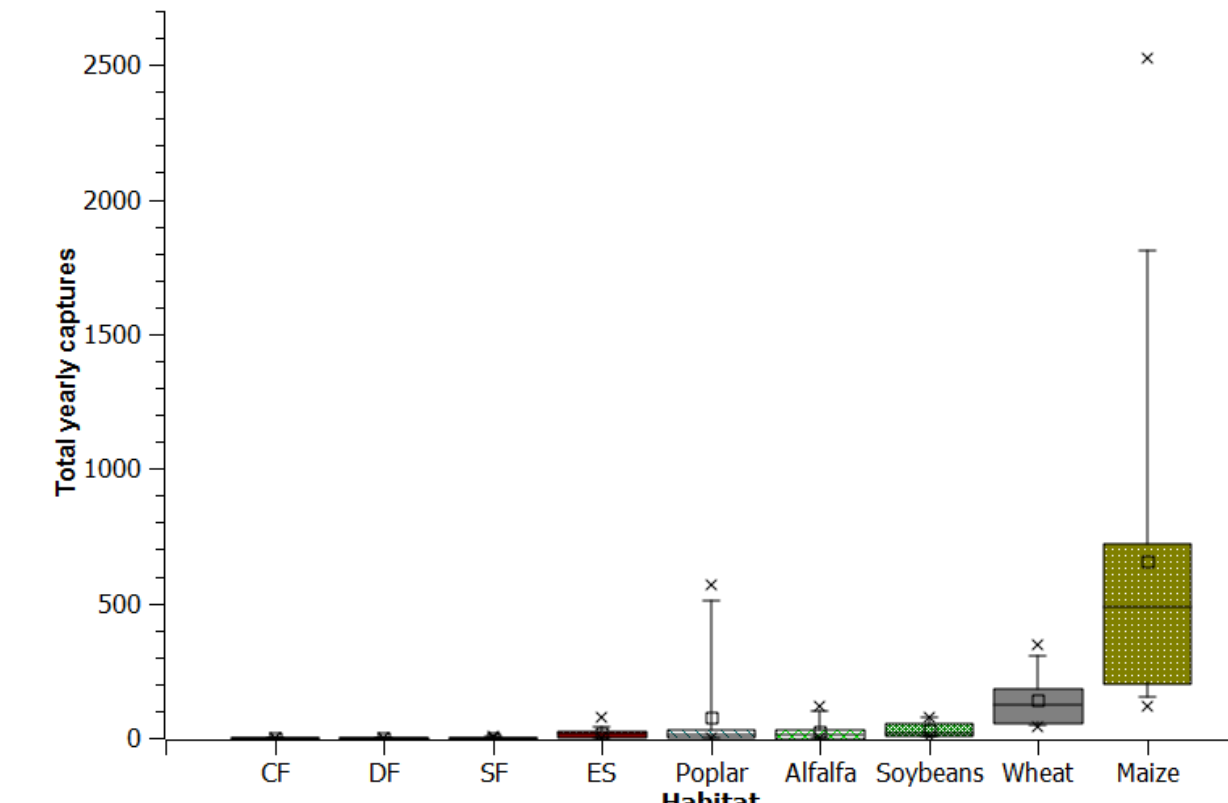
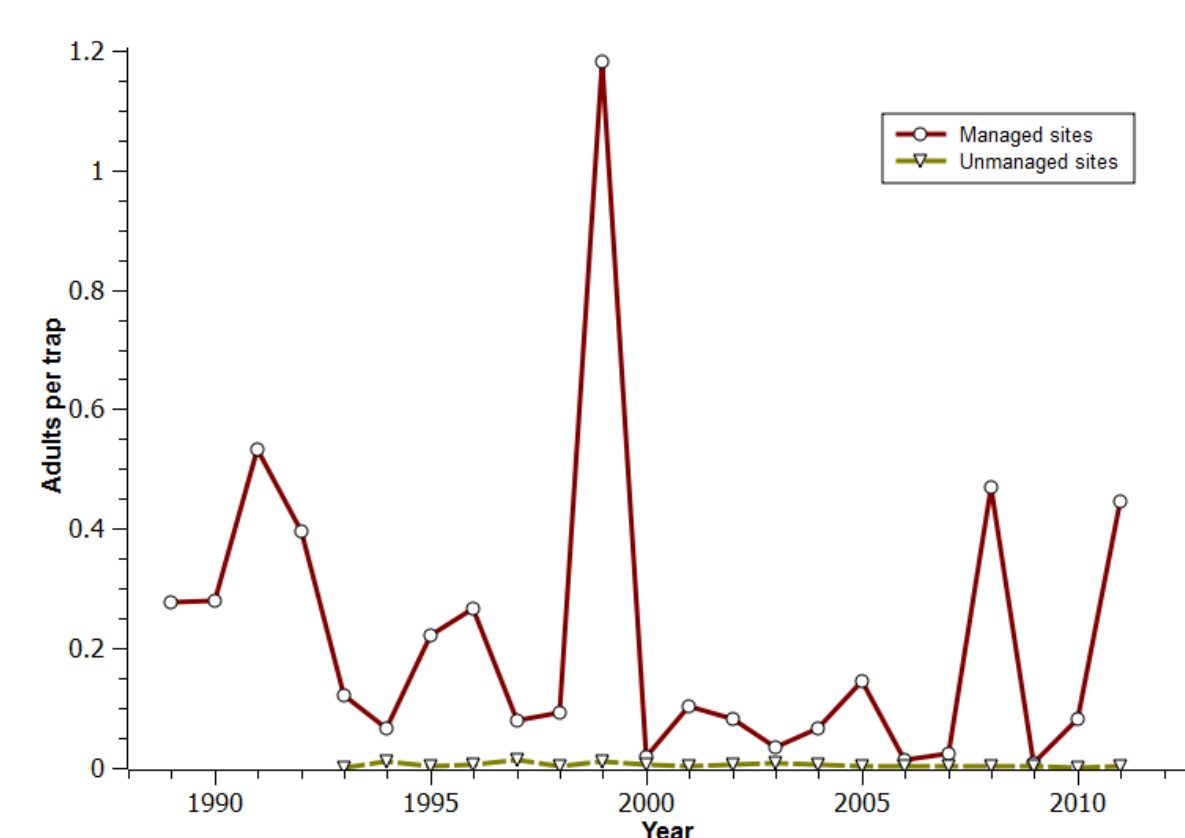
Proportional captures of four dominant coccinellid species summed across all habitats at Kellogg Biological Station, 1989 to 2011. These species have represented ~95% of the individuals captured for most years surveyed, though recently, the introduced *Hippodamia variegata* and *Propylea quatuordecimpunctata* represent an increasing proportion (up to 18%) of captures. *Adalia bipunctata*, a formerly dominant species, has been in decline since before the initiation of this survey, and has not been observed at this site at all since 2008.

## Captures by year

## Captures by habitat

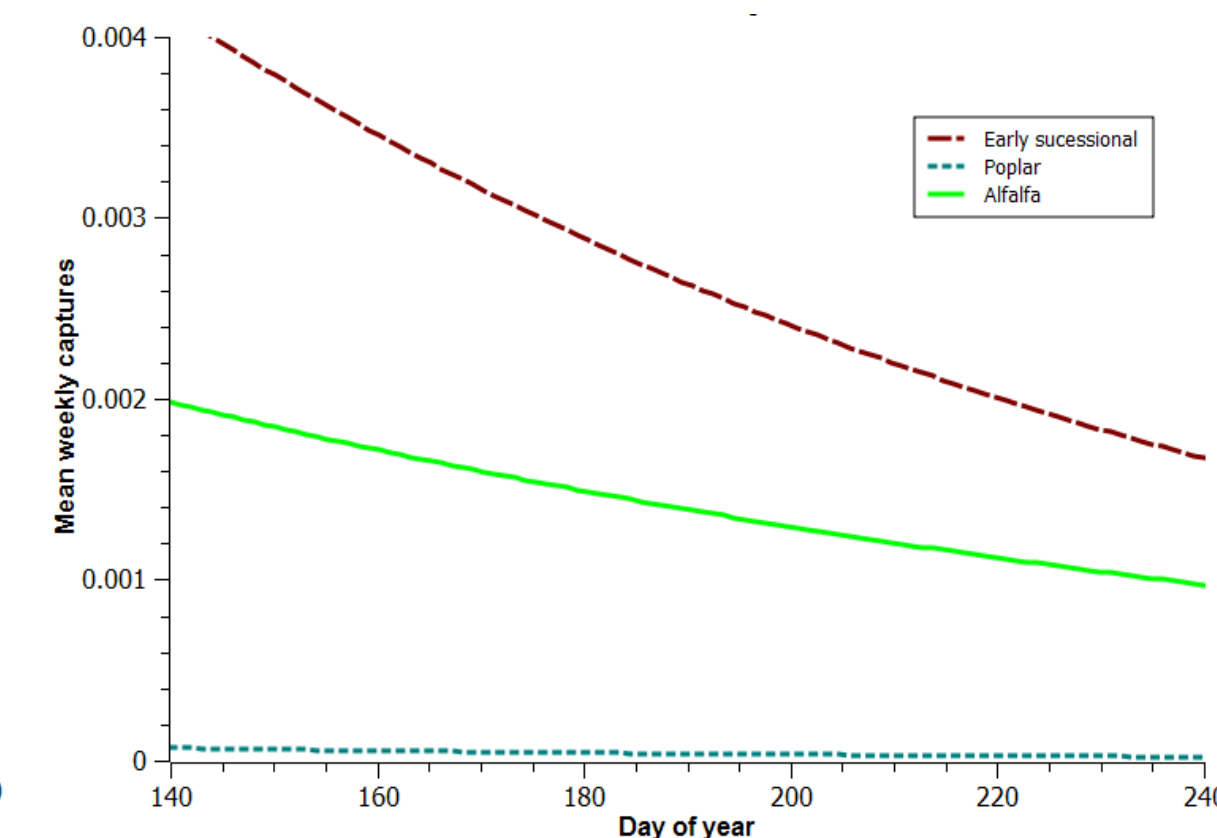
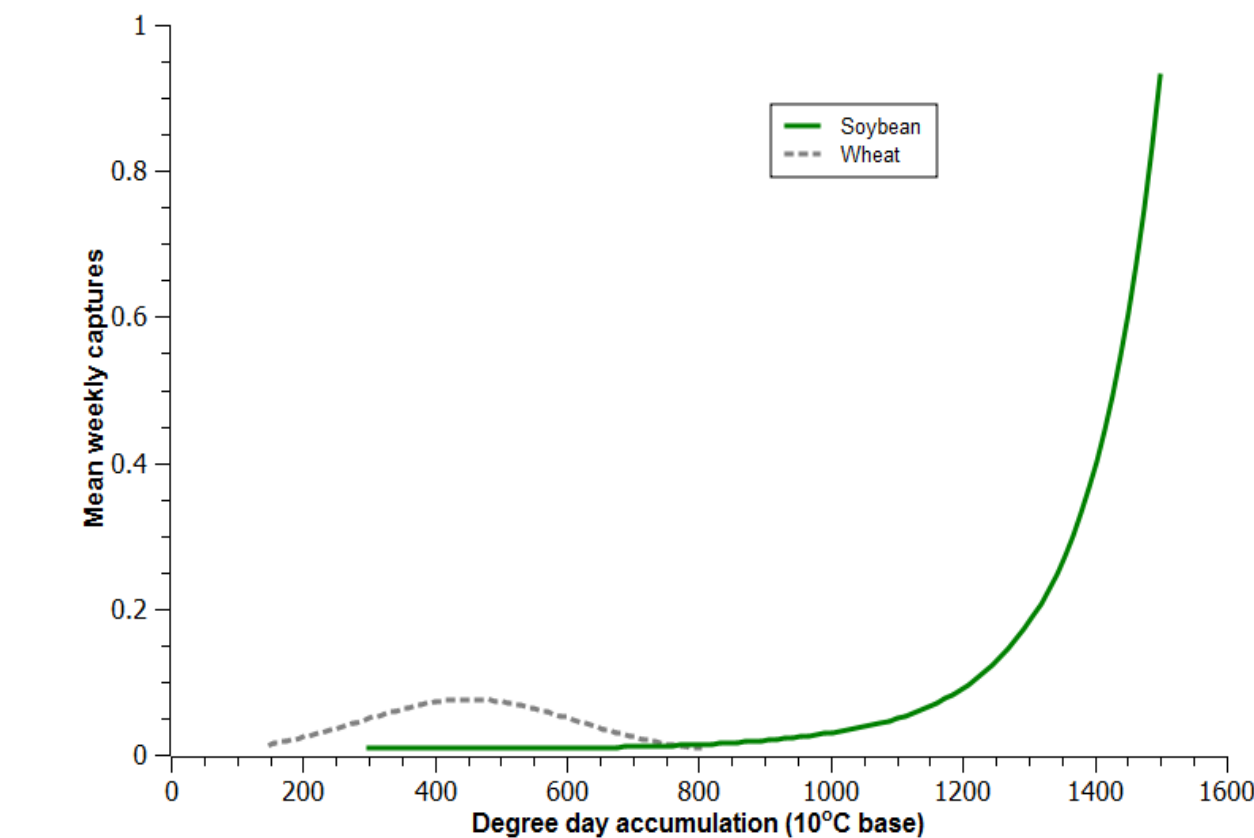
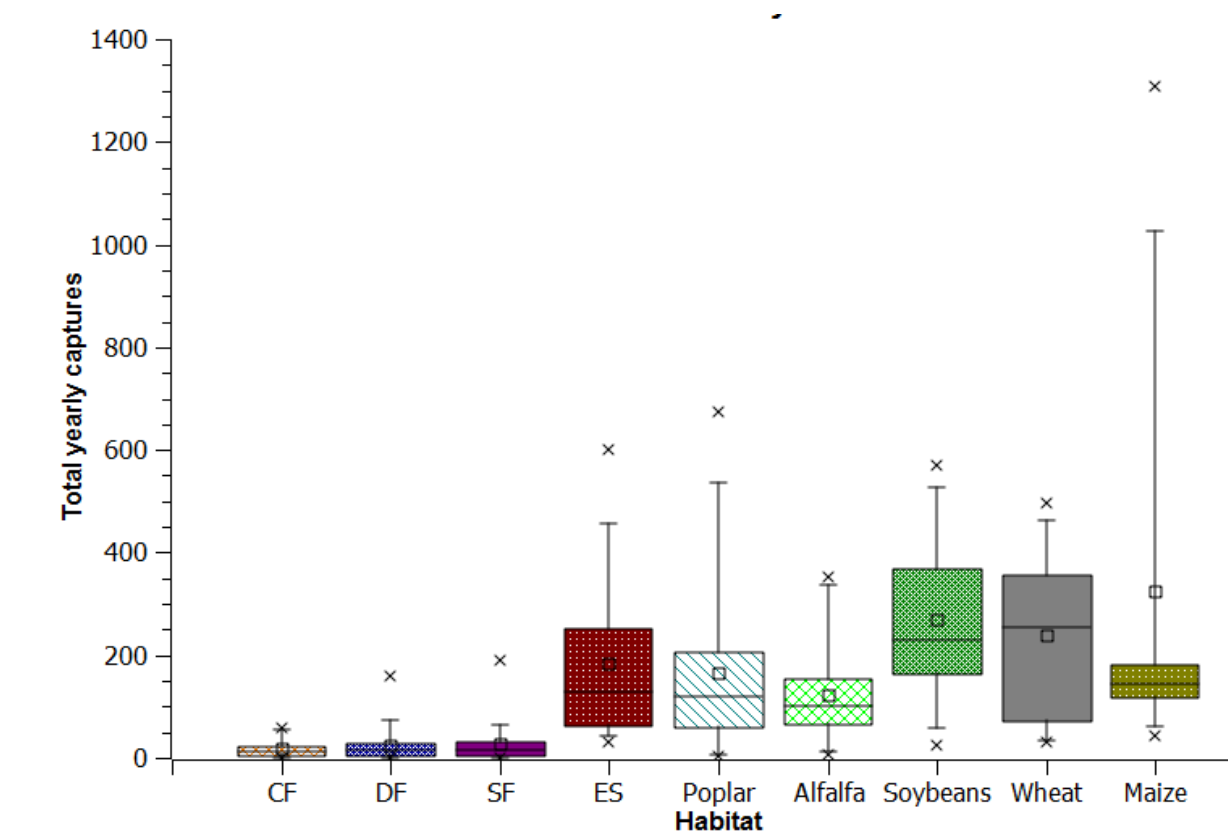
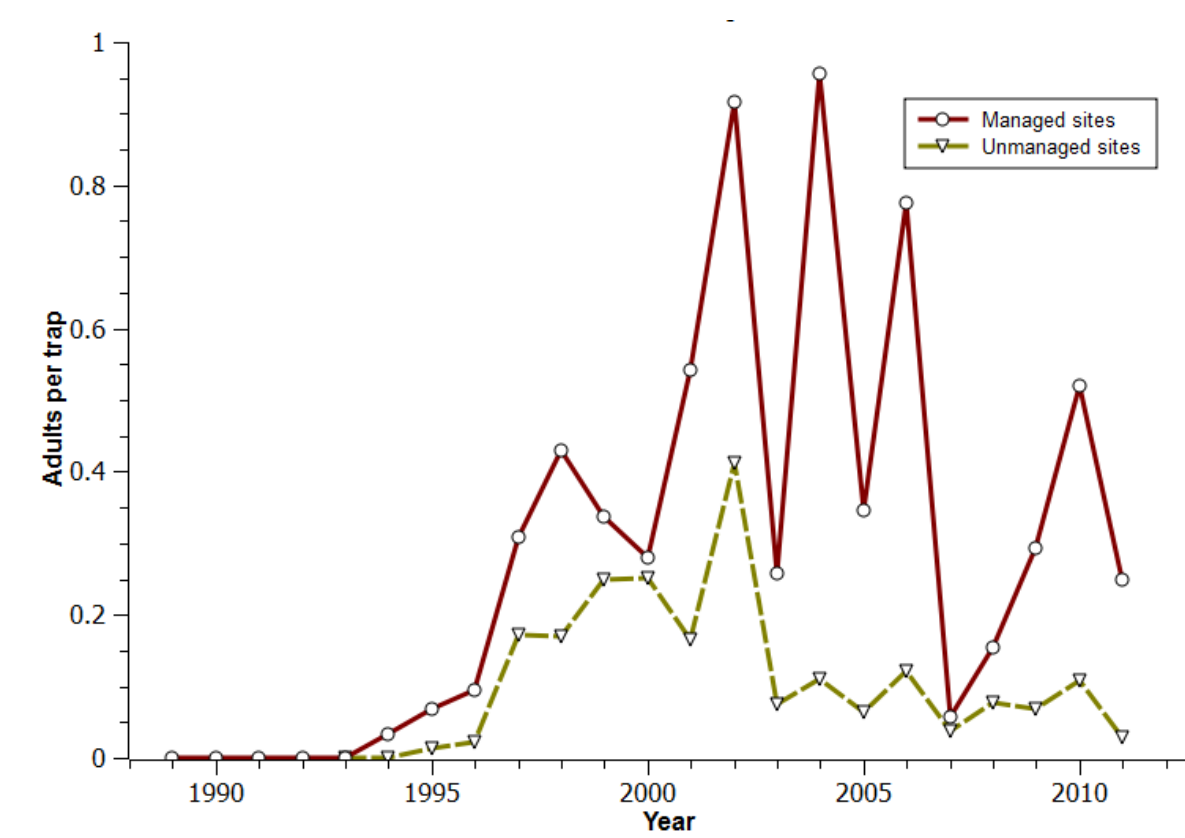
## Seasonality by habitat

### *Coleomegilla maculata*

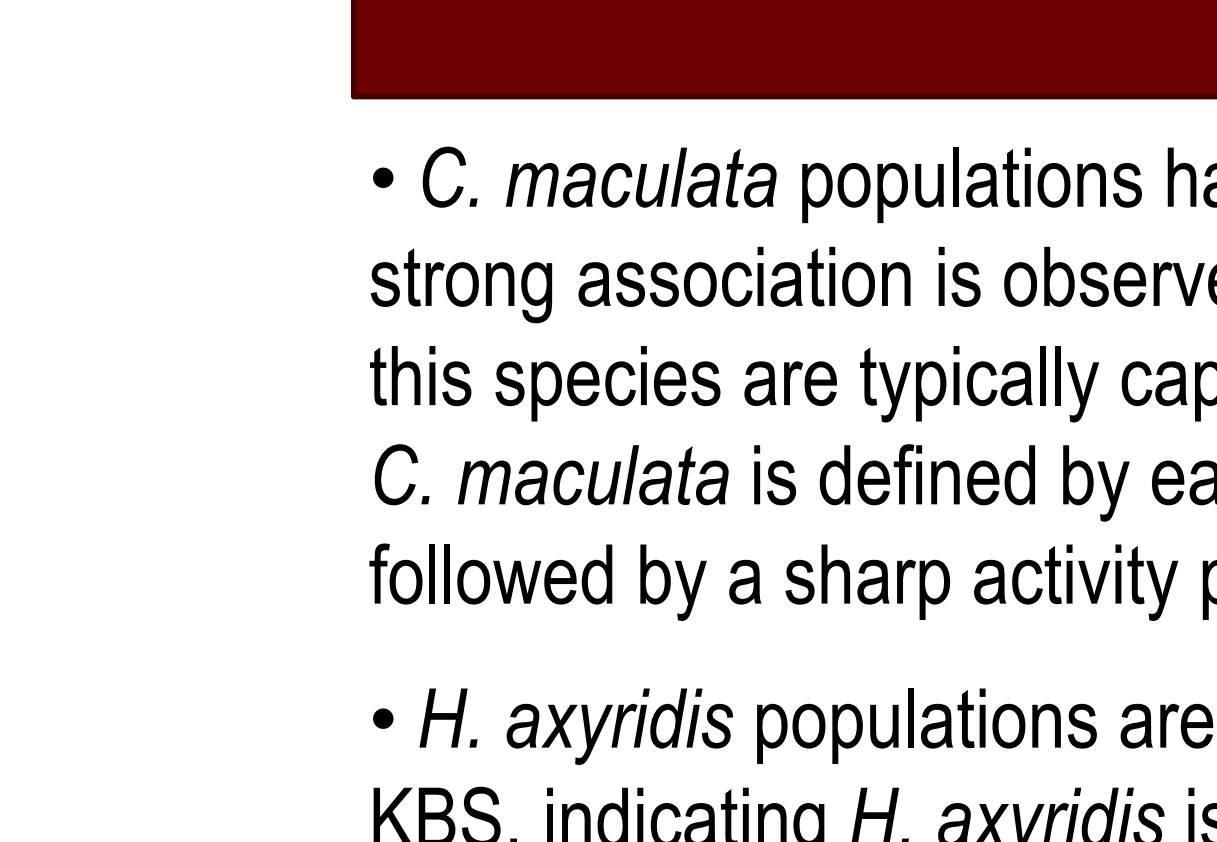
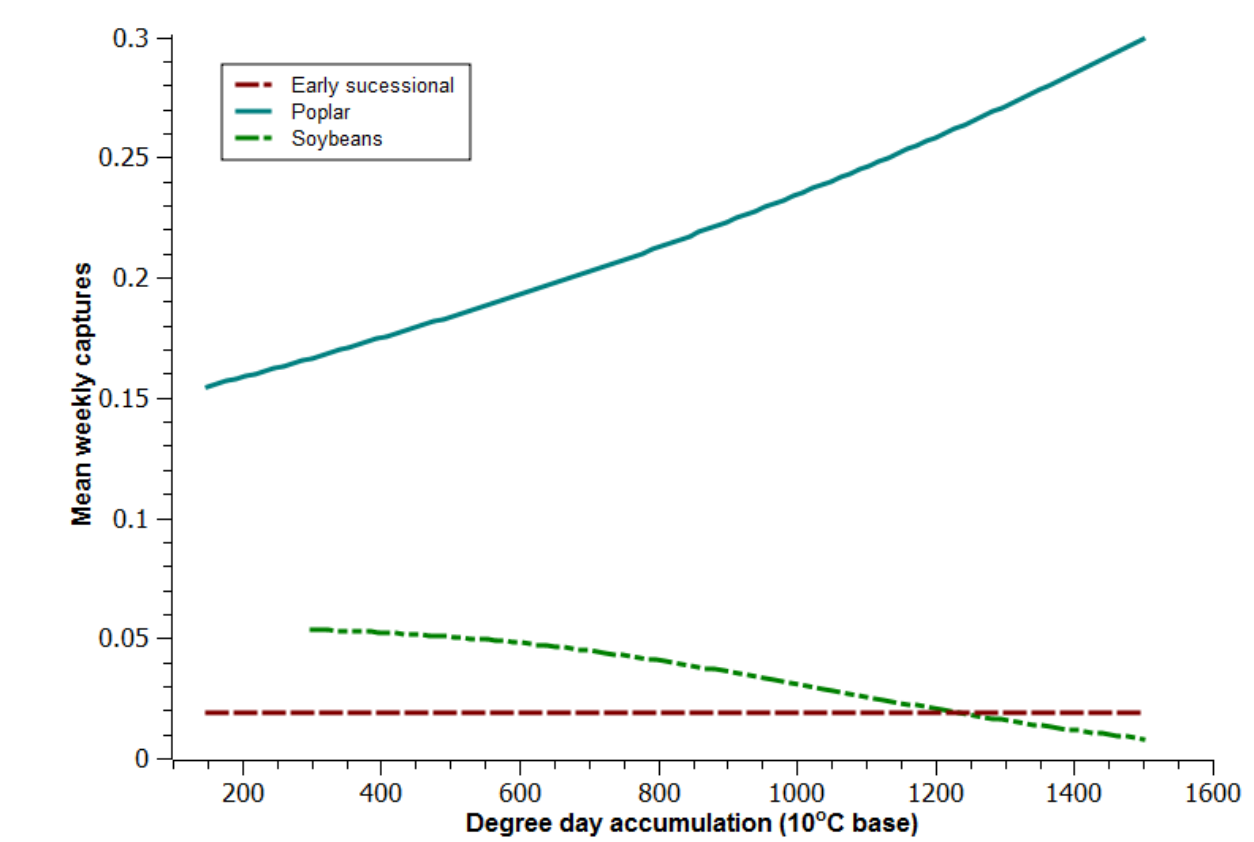
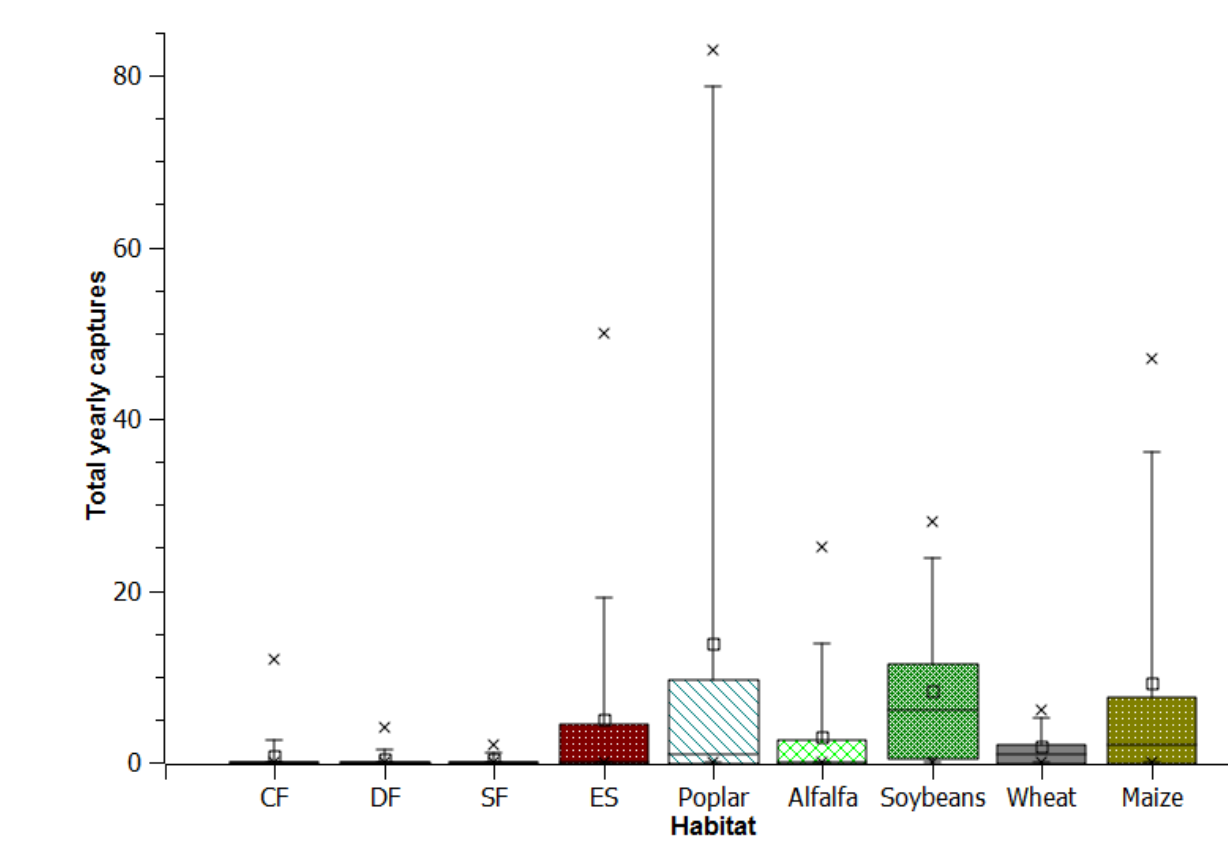
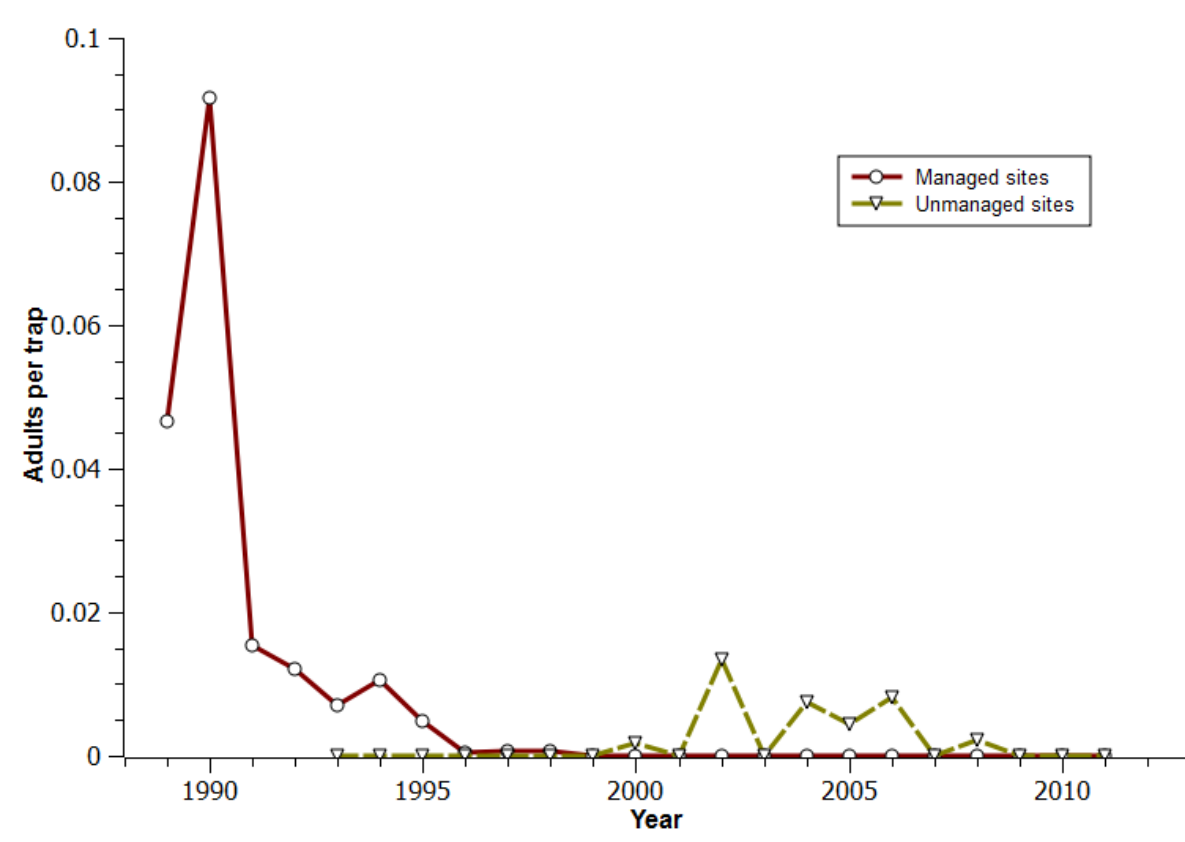


Presence (shaded) of given annual crop species at KBS in the main cropping experiment by year. In the first four years of the study, two crop species were planted per year, after that, all field crop plots were planted to the same species in a three year rotation

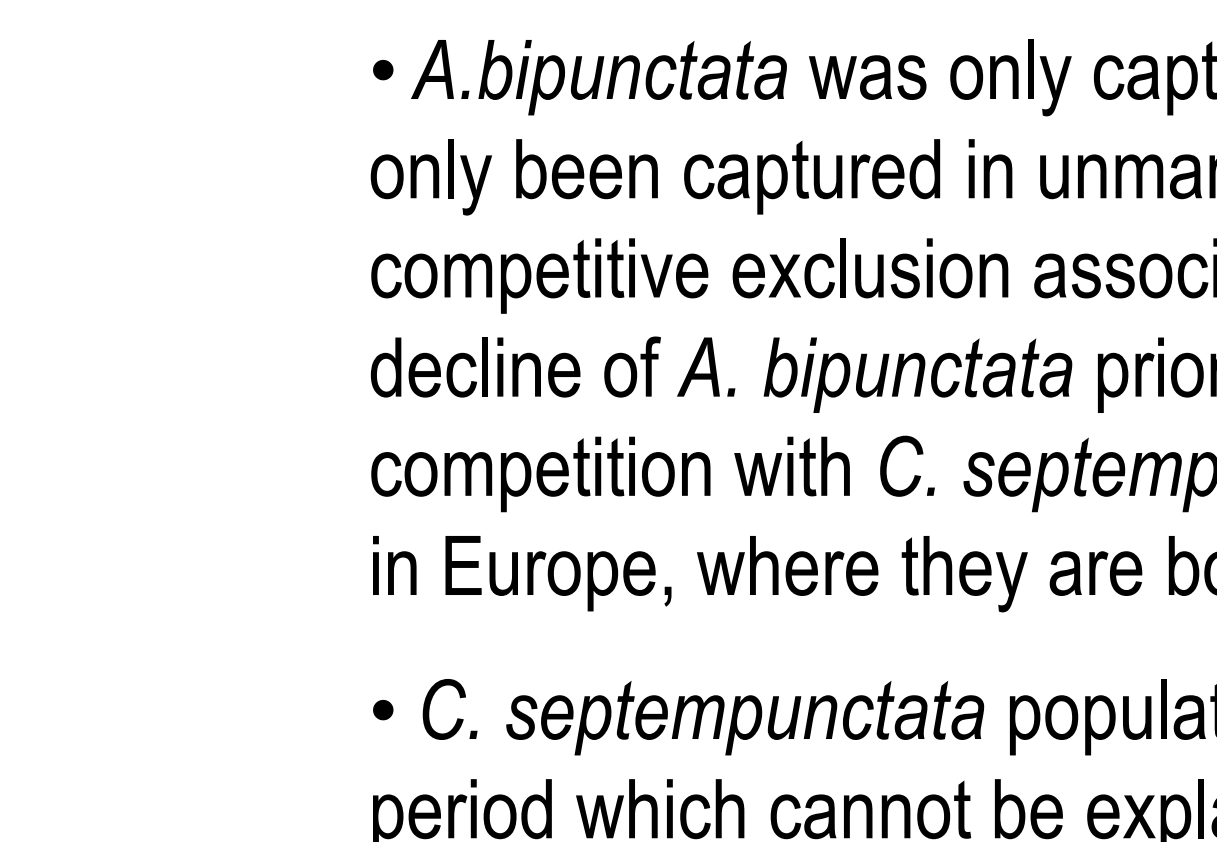
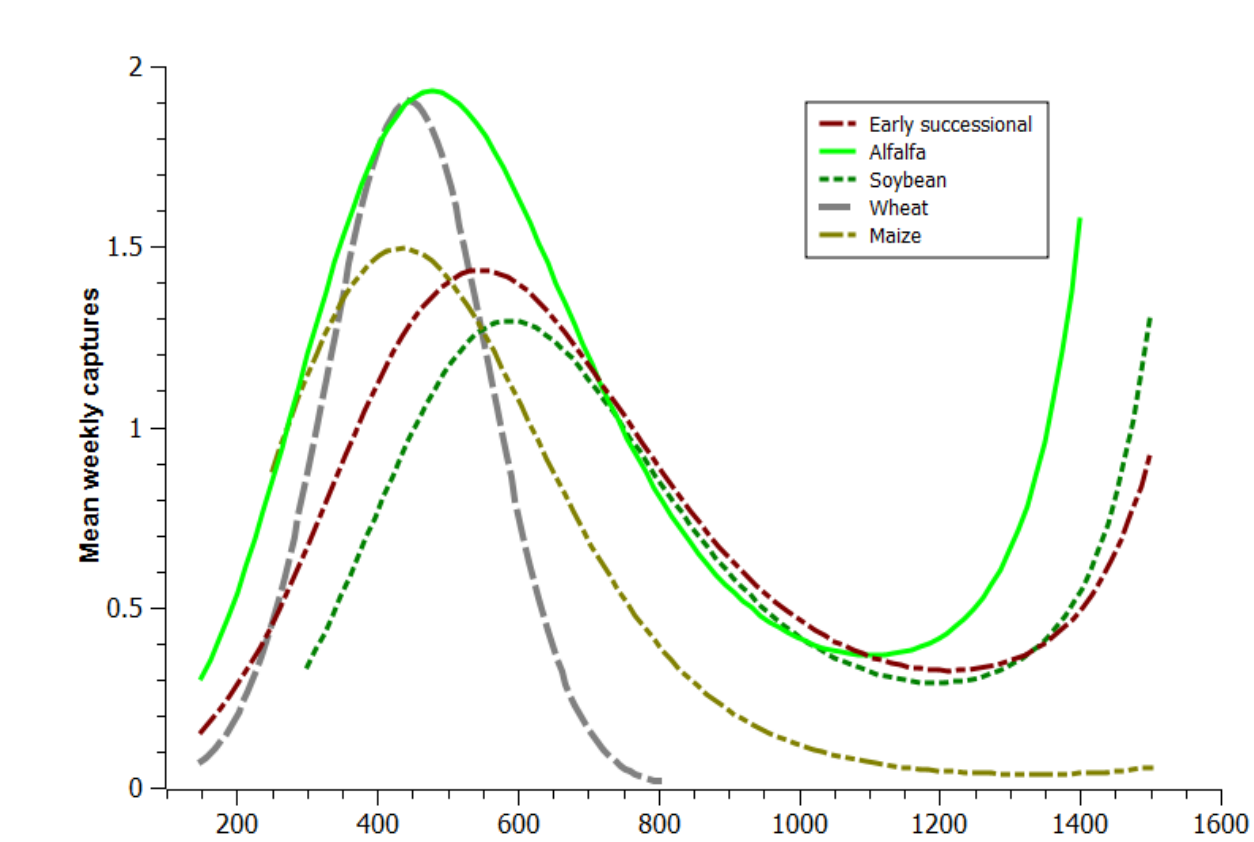
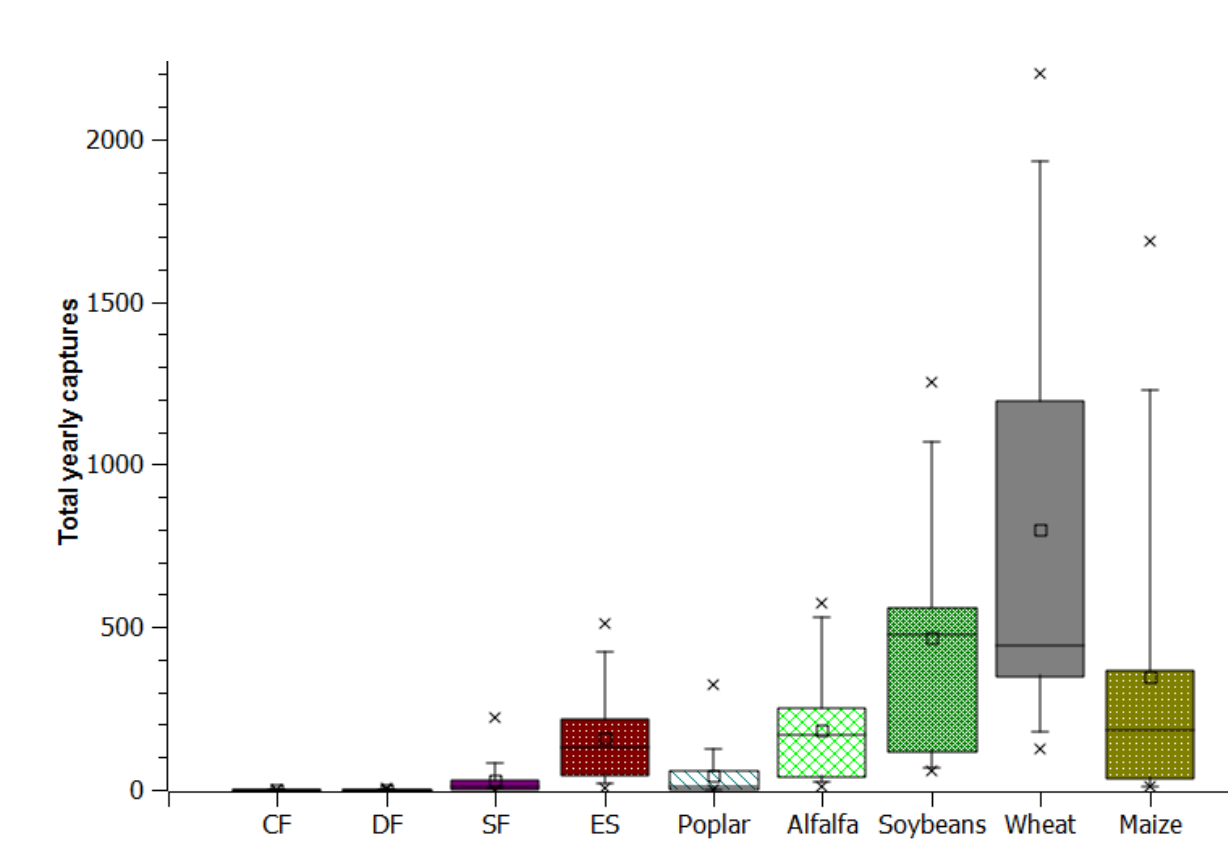
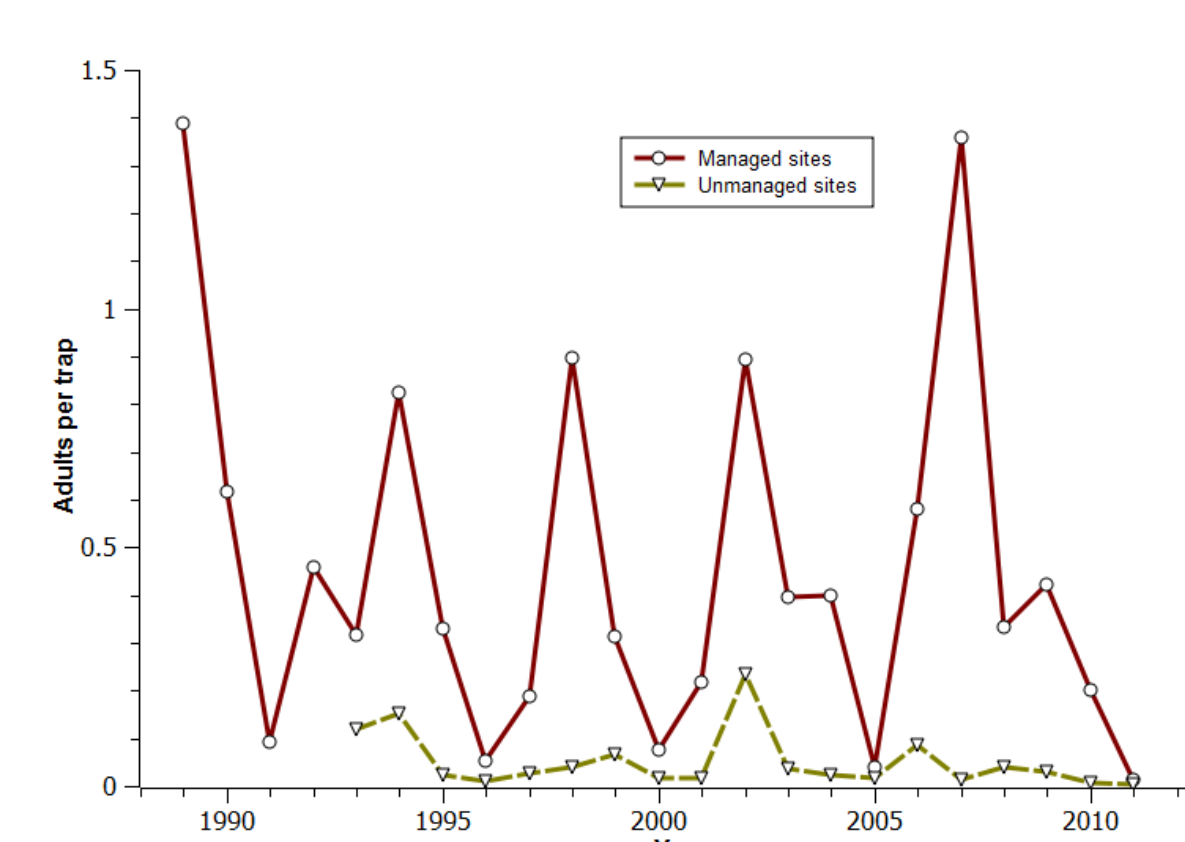
### *Harmonia axyridis*



### *Adalia bipunctata*



### *Coccinella septempunctata*



Average adults per trap by year in managed (KBS main site) and unmanaged (KBS unmanaged forest plots) sites for each species of coccinellid. Abundance peaks for *C. maculata* and *H. axyridis* are largely related to variations in the availability of preferred food at the site (maize pollen and soybean aphid, respectively), but the cyclical abundance of *C. septempunctata* is unexplained. *A. bipunctata* underwent an apparent shift in habitat use, and has only been captured in unmanaged plots since 1999.

Box plots of total yearly captures by habitat for each species of coccinellid. In general, fewer coccinellids are captured in unmanaged forests (CF, DF and SF) adjacent to the KBS main site

Seasonality regression models for each species, by crop, by either degree day accumulation (DDA) or day of year (DOY). Models assumed a negative binomial or Poisson distribution, where appropriate, and sample year was treated as a factor in the model, and held constant for these plots. AIC was used to select model structure with best performance, and only models with significant parameters are reported. Most models selected used DDA as the independent variable but in some habitats for both *C. maculata* and *H. axyridis*, DOY was a better predictor of seasonality.

## Discussion

• *C. maculata* populations have largely remained consistent over the study period. A strong association is observed between *C. maculata* and maize, and more individuals of this species are typically captured at KBS in years when maize is planted. Seasonality of *C. maculata* is defined by early activity, declining over the season in several habitats followed by a sharp activity peak associated with maize beginning in mid summer.

• *H. axyridis* populations are variable, and adults are routinely captured in all habitats at KBS, indicating *H. axyridis* is a generalist and opportunist. Seasonality of this species varies with habitat and abundance of soybean aphid.

• *A. bipunctata* was only captured in main site habitats until 1999, but since this date, has only been captured in unmanaged forest sites. This shift in habitat use may be a result of competitive exclusion associated with the introduction of *H. axyridis*.<sup>2</sup> Although the decline of *A. bipunctata* prior to the arrival of *H. axyridis* is usually attributed to competition with *C. septempunctata*,<sup>2</sup> it should be noted that both these species co-occur in Europe, where they are both considered natives.<sup>6</sup>

• *C. septempunctata* populations undergo oscillations in abundance with a 4-5 year period which cannot be explained by crop rotation or fluctuations in populations of any one prey species. This species is most frequently captured in managed habitats, and exhibits similar seasonal patterns in all crops where it is frequently captured.

• Future work will examine abundance trends, habitat use and seasonality of other species present at this site, as well as biocontrol potential of the guild over time.

## References

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