

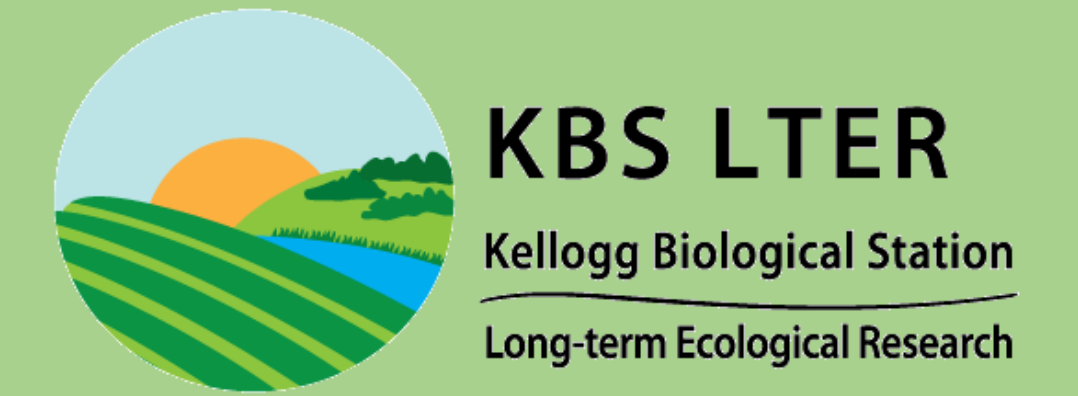


Adapting to changing methodology in a long-term experiment

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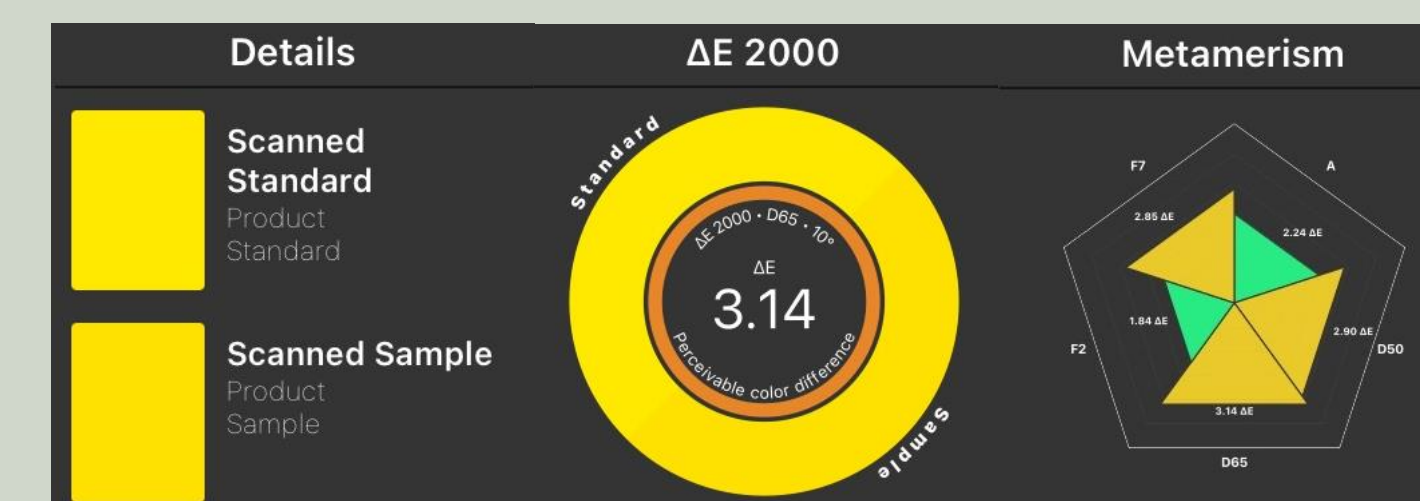
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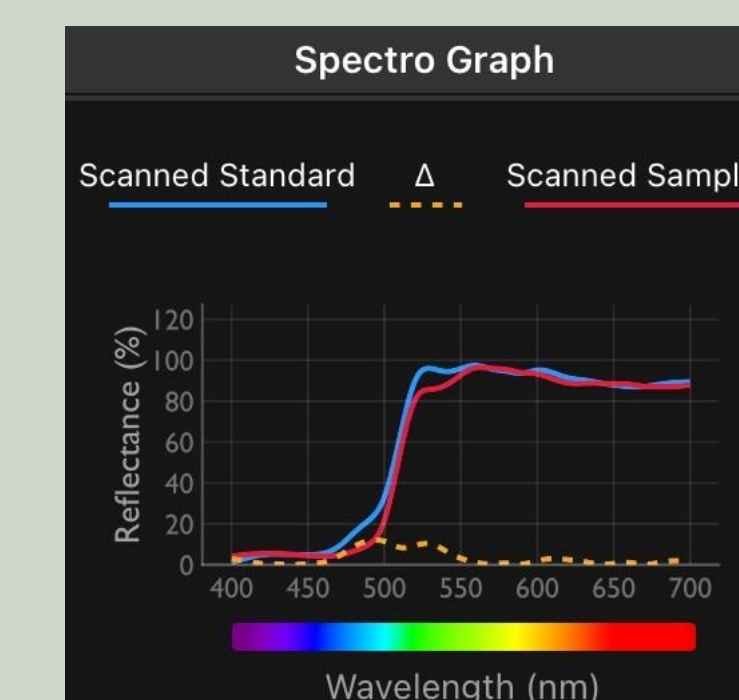
Introduction

Long-term experiments are important for ecological monitoring but come with unique challenges. Due to the length of time they span, a project can see changes of personnel or funding, and even changes to sampling protocols due to availability of materials. Yet, some measurements are not robust to even slight changes, for instance insect monitoring is notoriously sensitive to changes in protocol. At the Kellogg Biological Station Long-Term Ecological Research Station (KBS LTER), one of many NSF-funded long-term research stations, an over 30-year old project recently experienced a supply-chain-induced change in insect sampling methodology. Since 1989, lady beetles have been sampled weekly over the growing season using yellow sticky cards. In 2021 the manufacturer discontinued the card and a similar one was identified to replace the former standard but had noticeable differences. In 2021 we conducted a field study which paired the old cards with the new cards to examine if this change would impact the observed biodiversity patterns at the site, while otherwise maintaining identical protocol. The study was conducted with standard protocol in 2020 using entirely old cards and in 2022 using entirely new cards.



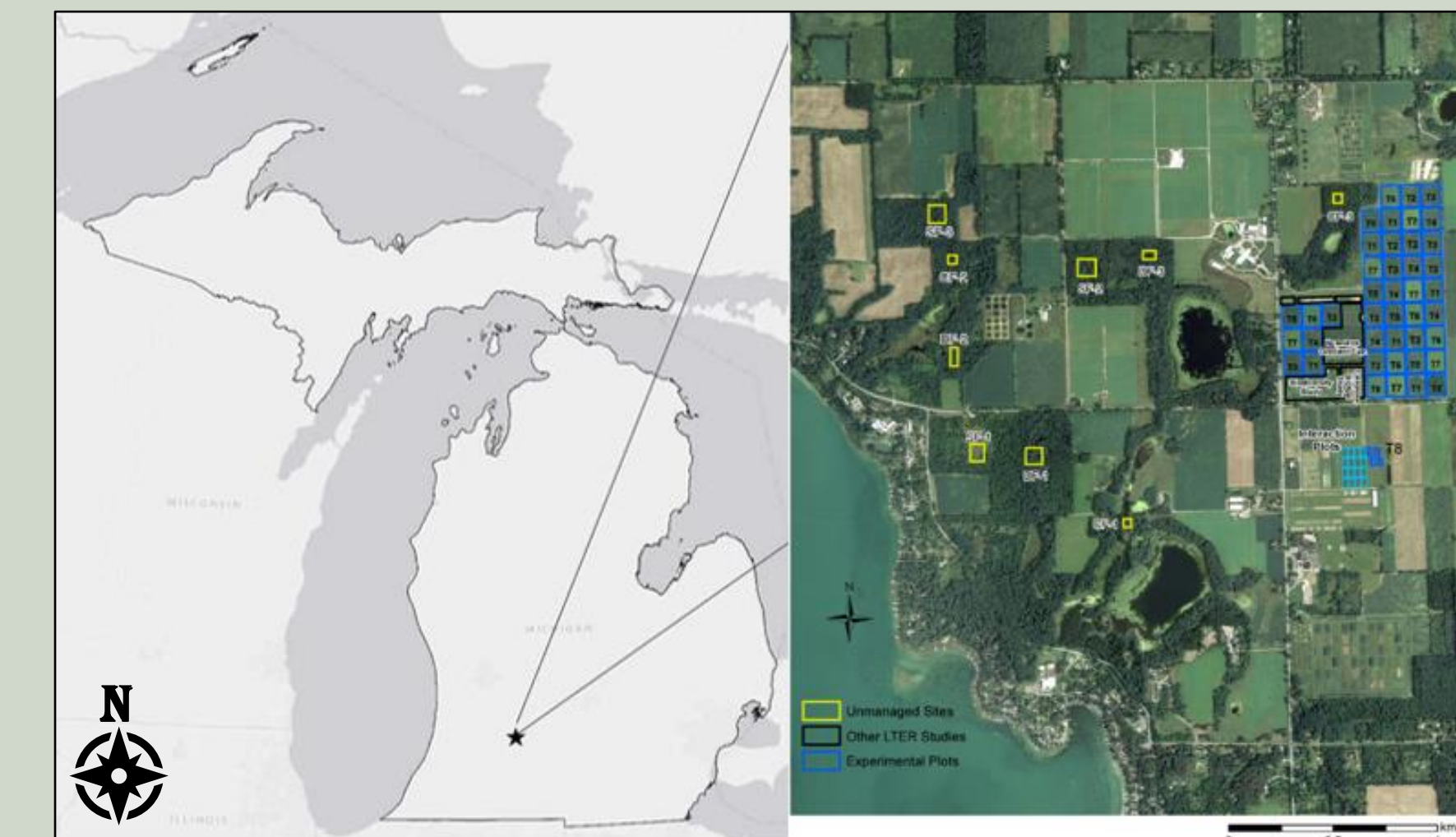
Colors of the two yellow sticky cards were perceptibly different under three of the five light types, including daylight, when scanned with a spectrophotometer (Spectro 1 by Variable).

Scanned standard = old card (Zoecon; #FFE900), scanned sample = new card (Trécé; #FFE000).



Yellow sticky cards had similar but not identical spectral reflectance. Solid blue = old card, solid red = new card, dashed orange = difference between card types.

Materials and methods



Location of KBS LTER and experimental sites: Main cropping system (blue), forested sites (yellow). Figure adapted from Abraha et al. 2021 and Hsun-Yi Hsieh 2018.



Sticky card types: old sticky card used since 1989 (left) and new sticky card implemented in 2021 (right).

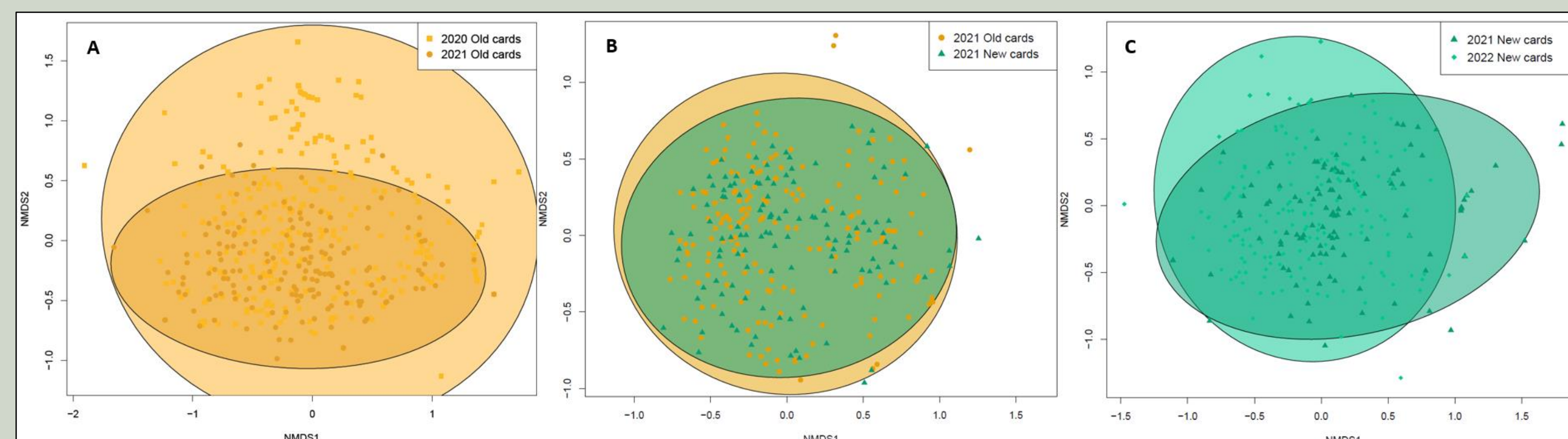


Aerial view of the KBS LTER main cropping system experiment. Credit: K. Kahmark

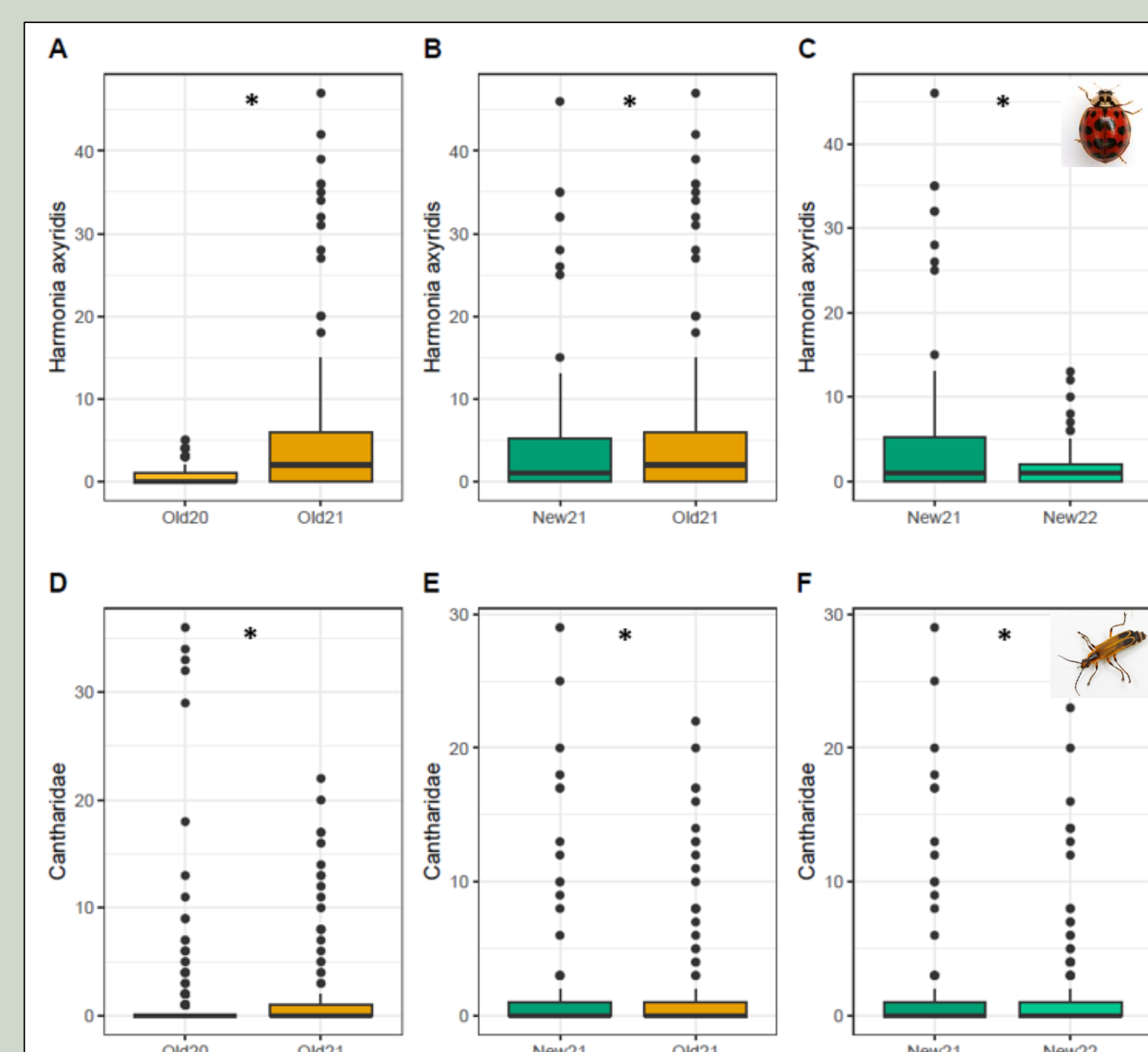


Yellow sticky card deployed at the KBS LTER in a corn treatment. Credit: KBS LTER

Results



Non-metric multidimensional scaling representing insect communities by (A, stress = 0.18) old cards in between years: 2020 and 2021, (B, stress = 0.23) new and old cards within year: 2021, and (C, stress = 0.23) new cards between years: 2021 and 2022. Community composition differed for between year comparisons, but not within year.



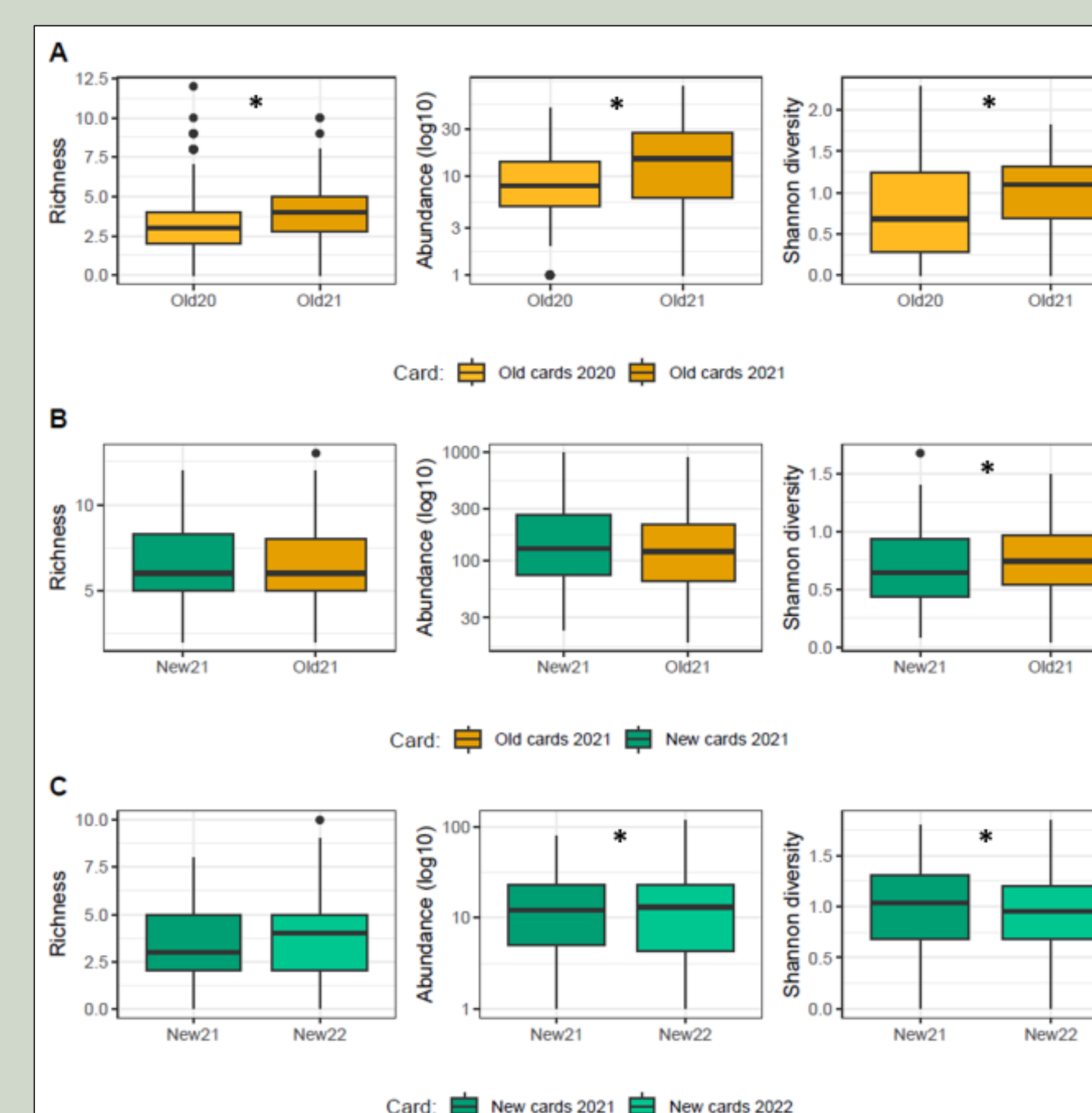
Boxplots for *Harmonia axyridis* and *Cantharidae* (solider beetles) comparing counts between old cards between years: 2020 and 2021, new and old cards within year: 2021, and new cards between years: 2021 and 2022.

Asterisk (*) represents significant difference ($p < 0.05$).

These taxa were the only two in the study that showed a statistical difference for all comparisons. Solider beetle credit: Patrick Coin



The most abundant lady beetle species collected during 2020-2023 sampling. *Coccinella septempunctata* (left) and *Harmonia axyridis* (right). Credit: Francisco Welter-Schultes and Mike Quinn.



Boxplots displaying richness, abundance (log 10), Shannon diversity for comparisons between (A) old cards between years: 2020 and 2021, (B) new and old cards within year: 2021, and (C) new cards between years: 2021 and 2022. Asterisk (*) represents significant difference ($p < 0.05$).

Discussion

- Within year sticky card comparison:
 - No difference in insect community composition.
 - No difference in richness or abundance, but diversity was statistically different between old and new cards.
 - 38% of total taxa identified (26% of core taxa) were statistically different between old and new cards.
- Between year comparison:
 - Difference for old and new card community composition between years.
 - Difference in richness, abundance, and diversity for old cards between 2020 and 2021.
 - No difference in richness, but abundance and diversity were statistically different between new cards between 2021 and 2022.
 - 53% of taxa on old cards and 37% of taxa on new cards between years were statistically different.
- Within year variation between old and new cards was not greater than between year variation on the same card types.

Acknowledgements

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