Beyond site-specific assembly rules: species traits predict occurrence of Lepidoptera in restored Tallgrass prairies

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ABSTRACT: Restoration ecologists are increasingly turning to the development of models to predict how species move from a regional species pool into a restored community. Two untested assumptions of these models, however, are that ecologists have an understanding for which traits are predictors of species distribution and that such traits predictably interact to determine the community membership. The goals of this study were to sample the regional species pool of Lepidoptera and to determine whether combinations of species traits predispose species toward becoming members of the actual species pool within restored prairies. In 2004, we sampled 259 moth species from 13 Tallgrass prairie remnants and restored in central Iowa. Species most frequently filtered from the regional species pool into prairies were those that (1) had long flight periods and were multivoltine (2) displayed a feeding preference for legumes but not the Asteraceae or other forb families, and (3) were regionally abundant but relatively small in body size.

Sampling Design
Moths sampled with standard bucket traps
Meteorological restrictions on sampling
8 total trap nights per site (104 samples)

Statistical Analysis
- Principle components analysis (PCA) to generate independent combinations of species traits (accommodate intercorrelations)
- Logistic regression using PCA axes as predictor variables

Results
- Total Species Richness: 269
- Total Abundance: 4,323 individuals
- Four PCA axes explained at least 10% of the variation in moth species traits (total variance explained = 82%)

Regression Parameters Analysis
- Logistic Regression indicated that all four PCA trait combinations were critical for determining how species were filtered from the regional pool into local communities.

Frequency of Moth Occurrence Increased For:
- PCA1: Multivoltine species with long flight periods (also known to feed on Fabaceae)
- PCA2: Species NOT considered reliant on Asteraceae (among most diverse forb families in Tall grass prairies)
- PCA3: Regionally abundant species of smaller or modal body size
- PCA4: Species NOT restricted to a small subset of host plants, regardless of the identity of those host plants (legume feeders tend to also be host plant generalists)

Implications for Restoration
- As long as plant communities and establishment rates are similar among a set of sites, species with greater windows for colonization will occur more frequently among sites
- Combines significant effects of regional abundance, flight duration, and volitism
- Restorations may initially lack high β-diversity
- Increasing “functional” connectivity among restored sites may hold considerable promise for speeding up time to faunal recovery in prairies (Summerville et al. 2005)
- Each managed system is unlikely to ever attain the same set of species, and given the apparent prevalence of rarity in moth communities, species composition within sites may exhibit high interannual variability

Study Goals/Hypothesis
Goal: sample regional species pool of moths in restored / remnant prairies in central Iowa and determine whether particular combinations of traits increase frequency of moth species occurrence

- H1: Increased flight periods and volitism will increase frequency of occurrence
- H2: Increased regional abundance (small species) will increase frequency of occurrence
- H3: Forb specialization on asters will decrease frequency of occurrence

Interpretations of PCA
PCA1: Multivoltine, long flight period, well established feeding on Fabaceae (inc. soybean, vetch, and clovers)
PCA2: Restricted to forb families as host plants; especially Asteraceae
PCA3: Species load positively if small in size and regionally abundant
PCA4: Species load positively if host plant generalists (feed on > 10 plant families, including Fabaceae)

Study Sites
- In 2004, we sampled 13 prairie sites in central Iowa
- 5 prairie remnants
- 5 prairie restorations between 7 and 10 years old
- 3 prairie restorations planted ≤ 1 year ago

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