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Can the Ecological Constraints Model inform us about nesting tactics in a primitively eusocial wasp?

Abstract

The Ecological Constraints Model (ECM) has successfully identified a variety of factors that can explain the evolution and expression of cooperative breeding. As a part of the ECM, density has been implicated in the expression cooperative breeding. In this study, I asked whether density could explain the proportion of haplometrotic and pleometrotic foundresses in the eusocial paper wasp, Mischocyttarus mexicanus. M. mexicanus is particularly appropriate to address this issue because nests are initiated throughout the year and multiple nests are initiated in the same tree (Sabal palmetto), making discrete estimates of density in a natural environment possible. During an 18-month census, I found that solitary females were negatively correlated with density. This pattern was then examined experimentally by adding or removing palm fronds from S. palmetto and then forcing nest reinitiation. The percentage of solitary females decreased when fronds were removed (high-density treatment), increased when fronds were added (low-density treatment), and remained unchanged in the control treatment. The percentage of all females emigrating from a tree and the average number of females per pleometrotic nests were the same for each treatment (Not shown). Together these data suggest that solitary females joined social nest in poor environments, which is consistent with of the ECM.

Research Highlights

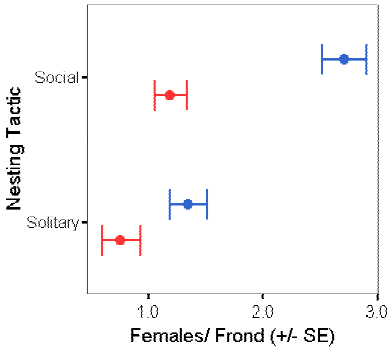
- Ecological Constraints Model (ECM)
  - Animal should behave cooperatively in poor environments
  - Altruism ↑ with ↑ density
- Mischocyttarus mexicanus nesting tactics

Solitary Nesting

Social Nesting

  - Evidence of Altruism
    - Reproductive Skew
    - Division of Labor
- Does density affect M. mexicanus nesting tactic?
  - 93 % of nest initiated on empty palm frond
  - Aggression is common and more intense among non-nestmates

- Field Observation
  - 18 month bi-weekly census
  - 244 new nests sampled



Nesting tactic & density correlated negatively

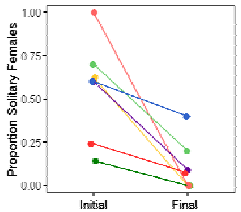
- Field Experiment – Methods
  - Top-down view of sabal palm modifications

- Day 1
  - Grouped trees
  - Census
  - Nests removed

- Day 14
  - Census

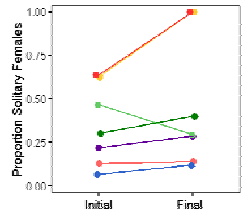
- Field Experiment – Results
  - Lines represent change in individual trees

High Density



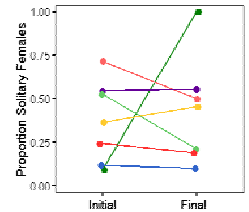
45 % fewer solitary females

Low Density



11 % more solitary females

Control



Mixed response

Impact

- Summary
  - Field Observation
    - Nesting Tactic was negatively correlated with density
  - Field Experiment
    - Density affected nesting tactic
- Are these observations consistent with the ECM?
  - Yes; females bred cooperatively in poor, dense environments

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