

POPULATION BIOLOGY / ECOLOGY III

Abstracts

DIFFERENCES IN GENERALIST AND SPECIALIST RESPONSES: BACK TO FIRST PRINCIPLES

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The idea that generalist predators should stabilize prey population dynamics while specialist predators should destabilize prey dynamics is based on an unrealistic assumption that predator diet breadth can be dichotomized and such dichotomy leads to equally distinctive types of functional and numerical responses. Not surprisingly, few empirical tests of the disparity in generalist and specialist responses have been successful. We generated predictions regarding differences in responses between predators with dissimilar diet breadth but identical types of functional and numerical responses. We then tested our predictions by fitting response curves to published data for coyote (a generalist) and lynx (a specialist) relative to hare density. Supporting our predictions, the coyote exhibited lower kill rates and higher density at any specific hare density relative to that of lynx. Stability analysis demonstrates that our predictions can lead to differences in system stability as proposed by classic theory; systems with predators characterized by relatively broad diets are more likely to have stable point attractors and may have greater ecological resilience. Thus, the theory that generalists drive stability and specialists drive instability can be supported in a relative sense without dichotomizing predator diet breadth or invoking associations between diet breadth and specific response types.

Key words: Diet breadth; population dynamics; predator response; stability

COMPARATIVE PERFORMANCE OF LANDSCAPE-LEVEL HABITAT MODELS FOR NORTHERN BOBWHITE IN ILLINOIS.

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In the past three decades, populations of northern bobwhite quail (*Colinus virginianus*) have declined considerably in Illinois and throughout their range. Principal causes of population decline appear to be loss and alteration of habitat due to modern agricultural practices and rural development. Landscape-level habitat modeling can be an efficient method of assessing present amount and distribution of habitat. Two competing bobwhite habitat models have been developed for the state of Illinois. One model categorized 24% (35,000 km²) of Illinois as potentially suitable habitat whereas the other categorized 49% (71,294 km²) of Illinois as potentially suitable habitat. We compare the performance of the two models by testing their habitat categorizations against quail presence/absence data collected within 390 randomly located 250 ha-sample units stratified by model categorization (suitable/unsuitable) and

physiographic region. Presence/absence data stem from a mail survey of landowners within sample units. We present comparisons of regional performance variation between the two models throughout Illinois' historic quail range. Also, land use and habitat management data collected in the survey and its potential influence on model performance will be discussed. The goal of this study is to recommend an accurate habitat model for agency use and to help focus upland management activities and concerns to landscapes where they will be the most cost-effective and produce the greatest benefit to quail abundance.

Keywords: *northern bobwhite, habitat modeling, performance evaluation, landowner survey.*

EFFECTS OF ASYNCHRONOUS HATCHING AND POPULATION DENSITY ON LIFE-HISTORY TRAITS OF *MELANOPLUS SANGUINIPES*

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Many grasshopper species in temperate regions exhibit asynchronous hatching. This is partly due to the ability of grasshoppers to produce multiple pods throughout a season, and to differences in oviposition site, such as temperature and soil moisture, that influence hatching date. I conducted a manipulative field experiment in western Montana to determine what effects asynchronous hatching has on important life-history traits (survivorship, body size, fecundity) of *Melanoplus sanguinipes*. Second and third instar *M. sanguinipes* nymphs were stocked into enclosures at 10 densities, that reflect the range of grasshopper densities observed at my site. After three weeks, half of the enclosures were restocked with second and third instar *M. sanguinipes* nymphs to simulate asynchronous hatching, while the other half of the enclosures received no additional grasshoppers, simulating synchronous hatching. Survival, reproduction, and female body size exhibited density dependence in both hatching treatments, indicating that intraspecific competition is important at my site. Survivorship was higher in the asynchronous hatching treatment than the synchronous treatment ($P < 0.05$, ANOVA), and was apparently driven by females, which out-competed males. Though survival was higher in the asynchronous treatment, body size was higher in the synchronous treatment at low densities for females, and across all densities for males. There was no difference in reproduction between hatching treatments ($P > 0.05$, ANOVA), which was probably influenced by the similarity in female body size between hatching treatments at moderate to high densities.

Keywords: *grasshopper, asynchronous hatching, life-history, density dependence*

BIOLOGICAL CONTROL OF THE SOUTHERN PINE BEETLE USING THE CHECKERED BEETLE *Thanasimus dubius*

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The southern pine beetle, *Dendroctonus frontalis* (Coleoptera: Scolytidae), is known to be a major pest of pine forests throughout the southern US, inflicting considerable economic damages during outbreaks. A common predator of bark beetles, *Thanasimus dubius* (Coleoptera: Cleridae), has recently been suggested to have a prevalent role on the dynamics of this pest. This predator has been shown to affect prey survival in both the larvae and adult stages, but further tests using this predator as a biological control agent are required to ascertain its impact on prey dynamics. It might be used in a biological control program by treating infested trees with *T. dubius* eggs.

Newly hatched predator larvae were set at several densities on log bolts taken from pine trees infested by *D. frontalis*. In order to assess the potential impact of *T. dubius* larvae on prey survival, the number of adult southern pine beetles emerging from the pine log and the number of exit holes were measured. To produce enough predators for such a study, the method previously developed to rear *T. dubius* larvae on an artificial diet was improved by adding preservatives in the larvae diet, which reduces the overall number of feedings. Yet, to insure this method is safe considering survival and reproduction of predators, a study to measure potential effects of preservatives and delay feeding time on predator performance (larvae and adult mortality, female fecundity) was conducted.

Key Words: *rearing, preservative, predator performance, biological control*

FOOD LIMITATION AND COMPLEX DYNAMICS IN HERBIVOROUS INSECTS

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Despite a vast body of work on consumer-resource interactions, plant-herbivore theory has received little attention. Traditional consumer-resource theory (predator-prey and host-parasitoid models) use biological assumptions which make them unsuitable for plant-herbivore systems. As a result, the expected dynamics of food-limited herbivores remain virtually unknown. Population outbreaks are common in herbivorous insects, but in most cases, we cannot identify the factor driving these dynamics. To determine whether food limitation can drive realistic population dynamics in herbivores, I consider a series of simple and general population dynamic models which relate the abundance of a host-plant to the abundance of its herbivore. These models show that complex dynamics, such as outbreaks, can be accurately predicted by changes in plant abundance alone. This novel result demonstrates that neither inducible defenses nor higher trophic levels, such as predators, parasitoids, or pathogens, need be present for herbivore outbreaks to occur.

Keywords: *herbivory, insect outbreak, consumer-resource model, population dynamics*

FOREST MATRIX PERMEABILITY TO BUTTERFLY MOVEMENT IN A FRAGMENTED PRAIRIE LANDSCAPE IN SOUTH-CENTRAL OHIO

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The composition of the matrix (non-habitat) surrounding suitable habitat patches is known to influence movement patterns and the spatial structuring of a species. Depending on the composition of the matrix, a habitat patch may be isolated from other suitable habitat patches, or the matrix may allow for easy dispersal from patch to patch. Other factors such as the distance between patches and the type of edge (hard vs. soft) surrounding a patch will also influence dispersal patterns and the spatial structuring within a patch. Using three species of butterfly, we have attempted to quantify the permeability of the matrix and the habitat edge to movement between habitat patches in a naturally fragmented system. The Lynx prairie system in Adams County, OH consists of nine (9) remnant prairie patches of variable sizes, variable distances between patches, and variable matrix composition between patches. Matrix composition ranged from herbaceous vegetation to oak forest. Mark-recapture methods were used to assess the movement patterns of the great-spangled fritillary (*Speyeria cybele*, Lepidoptera: Nymphalidae),

the pearl crescent (*Phycoides tharos*, Lepidoptera: Nymphalidae), and the pipevine swallowtail (*Battus philenor*, Lepidoptera: Papilionidae). Direct observation was used to determine the target species' behavior at a patch's edge. Great-spangled fritillaries exhibited the most movement between patches with 66% of recaptures found in a different patch than the one where they were initially marked. Pearl crescents rarely left the patch where they were first marked (71% of recaptures). Great-spangled fritillaries crossed any type of edge and moved through any type of matrix, while pearl crescents rarely approached or crossed a patch's edge. Insufficient recaptures of the pipevine swallowtail did not allow for movement analysis, but the type of edge was not a barrier to movement in this species. Based on observed movement patterns, the population of the great-spangled fritillary in the Lynx system appears to be exhibiting metapopulation dynamics, while each patch is an individual population of pearl crescents. This study is important to land managers because in order to manage species properly, it must be known how much suitable habitat is necessary for a given species.

Keywords: landscape ecology, Lepidoptera, matrix, metapopulation