

## 苜蓿草地生境丧失与破碎化对昆虫物种丧失与群落重建的影响

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### Effects of habitat loss and fragmentation on species loss and colonization of insect communities in experimental alfalfa landscapes

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摘要

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**摘要** 生境破碎化包括生境丧失与破碎化两个相对独立的过程, 为探讨这两个过程各自对生物多样性的影响, 本文利用苜蓿草地实验模型系统(EMS)构建了36个小区研究不同生境丧失与破碎化对昆虫群落及不同类群的影响, 包括18个破碎化小区与18个连续小区, 破碎化小区全部采用1 m×1 m (H=1)破碎, 连续小区苜蓿连片(H=0), 生境丧失采用90%、80%、70%、50%、20%以及0%共6个梯度, 每个小区重复3次, 以0%生境丧失的小区为对照, 采用拍板法、巴氏罐诱集法与扫网法对苜蓿草地昆虫群落进行调查, 对38种昆虫划分为4个类群并进行分析。生境丧失与破碎化后, 两种处理的小区物种丧失及多样性变化没有明显的阈值效应, 但在同等生境丧失程度下的破碎化小区物种数高于连续小区, 生境丧失率为80%与90%的小区中个体数显著低于对照, 而且破碎化小区个体数低于连续小区, 昆虫多样性指数在不同处理的小区间差异不显著; 80%与90%生境丧失的小区内昆虫群落难以恢复, 物种数、个体数与多样性指数均显著低于对照, 破碎化小区昆虫群落恢复更为困难, 表现出明显的阈值效应; 苜蓿草地生境丧失与破碎化后低营养级类群(植食性昆虫)较高营养级类群(捕食性昆虫与寄生性昆虫)易于恢复, 生境丧失与破碎化两个变量对昆虫群落及不同的类群的分布都有显著性影响。这些研究结果为利用农业景观设计来加强害虫生物防治具有重要的意义。

**关键词:** 生境破碎化 苜蓿草地 昆虫多样性 景观格局 阈值

**Abstract:** In agro-ecosystems, habitat loss and fragmentation may alter insect assemblages such as ladybug beetles and aphids, potentially affecting important ecological interactions. We used an experimental model system (EMS) with multiple micro-landscapes in which the habitat loss and habitat fragmentation impacts were distinguishable to test the following hypotheses: (1) Habitat removal results in short-term increases in population density in remaining habitat patches (crowding effect); (2) For the same total habitat area on a landscape, insect density will be higher in landscapes with more but smaller patches and more habitat edge than in less fragmented landscapes; (3) This positive effect of fragmentation on density is larger in landscapes with small inter-patch distances, and these last two effects on colonization should be reduced or disappear over time following habitat removal. This EMS included 18 fragmented and 18 clumped experimental plots. Alfalfa was cut to 1 m×1 m patches in fragmented plots (H=1) and retained the whole patches in continual plots (H=0). Habitat loss was designed to 90%, 80%, 70%, 50%, 20% and 0% respectively. Every plot was 3 times replicated and 0% of habitat loss was CK. Net sweeping, barber traps and clapper boards were used to investigate insect species in experimental alfalfa landscapes. 38 species were divided into 4 groups and diversity and abundance of every group were calculated and the relationship between diversity and habitat loss was analyzed. In our EMS, there was little support for the threshold phenomenon or for general effects of habitat loss and fragmentation, although this conclusion needs to be tempered by the limited duration of the experiment. We observed no threshold in species loss after habitat fragmentation and habitat loss in experimental alfalfa landscapes. The species number in fragmented habitat was higher than that in continual habitat under the same degree of habitat loss. Insect abundance was lower in micro-landscapes with 80 - 90% habitat loss than in CK. As for species, individuals in fragmented habitat were higher than that in continual habitat under the same degree of habitat loss.

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Insect diversity did not differ among variously treated micro-landscapes. It appears that insect colonization is low in micro-landscapes with 80 - 90% habitat loss; species richness, abundance and diversity were all significantly lower than that in CK, especially in fragmented habitats. Herbivorous species appear to colonize more rapidly than predatory species after habitat fragmentation and loss in experimental alfalfa landscapes. Our results did not support our first, but provided some support for the other two hypotheses. We suggest that fragmentation decreased the rate of immigration to patches, resulting in lower population densities in more fragmented landscapes. These results could be used to guide spatial and temporal aspects of the design of agricultural systems in order to enhance natural predator populations in agricultural landscapes and suppress pest population to the greatest extent.

Keywords: [habitat loss](#) [habitat fragmentation](#) [grasslands](#) [insect diversity](#) [landscape structure](#) [threshold](#)

Received 2010-12-03; published 2011-07-20

Fund:

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#### 引用本文:

赵紫华, 王颖, 贺达汉, 张蓉, 朱猛蒙, 董凤林. 苜蓿草地生境丧失与破碎化对昆虫物种丧失与群落重建的影响[J] 生物多样性, 2011, V19(04): 453-462

Zihua Zhao, Ying Wang, Dahan He, Rong Zhang, Mengmeng Zhu, Fenglin Dong. Effects of habitat loss and fragmentation on species loss and colonization of insect communities in experimental alfalfa landscapes[J] Biodiversity Science, 2011, V19(04): 453-462

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