

天然赤松林树种组成对昆嵛山腮扁叶蜂种群密度的联合影响*

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摘要: 植物多样性与植食性昆虫种群之间关系, 一直是生态学研究的热点问题。许多研究普遍认为, 相比于几个树种组成的混交林, 树种单一的纯林更易受植物性昆虫为害, 但由于寄主特异性和取食方式差异, 致使植食性昆虫对树种多样性响应过程也是不同的。在由几种植物组成的特定植物群落中, 植物之间的联合作用对植食性昆虫产生直接或间接影响。一种植物(关键植物)受到其它相邻植物的影响, 从而增加或降低被植食性昆虫为害的可能性, 即联合抗性或联合易感性。由于相邻植物直接或间接影响关键植物受昆虫为害水平, 相邻植物与关键植物之间亲缘关系远近影响两者的联合作用。关于组成混交林的树种间亲缘关系是否影响林分对植食性昆虫的联合易感性或联合抗性的相关研究较少。本研究以昆嵛山天然赤松(*Pinus densiflora*)林和寡食性食叶昆虫—昆嵛山腮扁叶蜂(*Cephalcia kunyushanica*)为研究对象, 对比树种组成类型、多样性、立地和林分因子对昆嵛山腮扁叶蜂种群密度的影响, 分析了昆嵛山腮扁叶蜂在不同林分类型中种群年度波动变异系数。结果表明: 2009~2011年赤松株虫口密度与立地和林分及树种多样性因素等相关关系不显著; 随机森林分析表明, 林分类型是影响昆嵛山腮扁叶蜂虫口密度最重要的解释变量, 随着赤松与混交亲缘关系越远, 虫口密度越小。不同林分类型中, Shannon指数和赤松株虫口密度存在差异, 但两者变化趋势完全不同。赤松纯林中赤松株虫口密度均为最高, 与赤松一同属混交林没有显著差异, 显著高于赤松一同目和阔叶树种组成的混交林; 赤松纯林和赤松一同属混交林中昆嵛山腮扁叶蜂种群年度波动大于其它两种林分类型。表明相比树种多样性, 树种组成对昆嵛山腮扁叶蜂种群的影响更为重要, 赤松与其亲缘关系较近树种混交, 昆虫种群稳定性较差, 赤松与相邻树种形成对昆嵛山腮扁叶蜂联合易感作用, 而与其它亲缘关系较远的树种混交, 使害虫种群稳定性增强, 进而形成联合抗性作用。本研究结果证实, 开展天然林森林生态系统中植物群落

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水平上联合抗性和联合易感性效应的长期研究,揭示森林植物多样性对害虫种群联合作用机制,探索以经营技术为主的调控病虫害模式,指导森林经营管理,实现我国森林可持续发展,将是未来研究的重点方向。

关键词: 昆崙山腮扁叶蜂; 天然赤松林; 虫口密度; 树种组成; 随机森林; 联合易感性; 联合抗性

Associational impact of species composition in *Pinus densiflora* natural forest on *Cephalcia kunyushanica* larval density

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Abstract: *Cephalcia kunyushanica* is a typical monophagous defoliating insect species. To study the impact factors of *C. kunyushanica* population distribution on each individual Japanese red pine (*Pinus densiflora*), we analyzed the correlation between composition types, diversity of tree species, site factors, stand factors and *C. kunyushanica* larval density, compared larval density, and annual fluctuation of *C. kunyushanica* population and the paired stand with a mixture of same generic (*Pinus*), same order (Pinales, except for *Pinus*) and broadleaf trees species in Kunyu Mountain from 2009 to 2011. We found that there was no significant correlation between population densities of *C. kunyushanica* with different site and stand factors. There were difference between population density of *C. kunyushanica* and tree species Shannon index respectively in various stand types, but the variation trend were totally different. Forest types was the the most important predictor variables from random forests (RF) regression used for predicting larval density of *C. kunyushanica*. The larval density of *C. kunyushanica* was highest in Japanese red pine pure stand and was not significantly different from that in *P. densiflora* mixed with *Pinus* spp., but was significantly higher than that in the stand of Japanese red pine mixed with broadleaf and Pinales spp. tree species in each of the three years. Although larval density of *C. kunyushanica* in pure stand were higher than in mixed stands, tree species composition can be more important

than tree species richness in mixed stand, as herbivores on focal trees were influenced by neighboring trees. Coefficient of annual variation of *C. kunyushanica* population was lower in Japanese red pine mixed with broadleaf trees and *Pinus* spp. than that in the *P. densiflora* mixed with *Pinus* spp. or pure Japanese red pine stand from 2009 to 2010 and 2010 to 2011, suggesting that *C. kunyushanica* population in Japanese red pine mixed with broadleaf tree species is less stable than mixed with *Pinus* spp. or pure Japanese red pine stand. Our results provide that association of Japanese red pine mixed with *Pinus* spp. may actually receive more damage by defoliating insect than the Japanese red pine mixed with *Pinus* spp. and broadleaf trees. the degree to which a focal tree and its neighbor trees are taxonomically related played an important role in likelihood of association resistance and association susceptibility, mixed tree species that have closely genetic relationship to focal tree specie received more larval density and lower stability of *C. kunyushanica* population than genetically distant trees species.

Key Words: *Cephalcia kunyushanica*; *Pinus densiflora* natural forest; larval density; Tree species composition; Random forest; Associational resistance; Associational susceptibility