

口袋公园在保护城市蝴蝶多样性方面的价值

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摘要:【目的】蝴蝶具有重要的美学和生态价值,是研究城市生物多样性的指标。本研究重点关注城市口袋公园的价值,口袋公园包括向公众开放的各种微型绿地和小型公园。尽管受到面积大小的限制,其对维持城市蝴蝶的多样性仍至关重要。我们的目的是明确以下几个问题:1)有多少种蝴蝶生活在口袋公园中,2)限制口袋公园为不同城市适应性的蝴蝶提供栖息地的因素分别有哪些,以及3)口袋公园为不同城市适应性的蝴蝶分别提供哪种类型的生境?【方法】于2020年7-9月在北京市城市公园和口袋公园进行蝴蝶和植被调查。同时,从食物和隐蔽所两个角度选取了7个环境指标进行分析,包括口袋公园面积、树冠覆盖率、游客活动强度、管护强度、水体有无、寄主植物和蜜源植物的有无。利用Mann-Whitney检验首先将口袋公园蝴蝶多样性与同一时期北京市城市公园的蝴蝶调查结果进行了对比,并根据各种蝴蝶对城市环境的适应程度,使用层次聚类将城市公园和口袋公园的蝴蝶分别划分为城市优势种、城市常见种、城市少见种和口袋公园优势种、口袋公园常见种和口袋公园少见种。然后,利用逻辑斯蒂回归和泊松回归分别对口袋公园中全部蝴蝶以及分别的三组蝴蝶建立了广义线性模型,通过赤池信息准则,选择AIC值最小的模型作为最佳模型,并分析各种环境因子对城市适应性不同的蝴蝶的影响。【结果】在口袋公园共记录4科16种1104只蝴蝶,在城市公园共记录5科20种2748只蝴蝶。Mann-Whitney检验表明,口袋公园的蝴蝶多样性显著低于城市公园,其植被组成也更均质。聚类分析表明,口袋公园可以为所有城市优势种和城市常见种以及部分城市少见种蝴蝶提供栖息地。根据广义线性回归的结果,限制城市适应性不同的蝴蝶利用口袋公园的主要因素不同。当对全部物种进行回归时,管护强度、口袋公园面积和蜜源植物是显著因素。游客活动强度和寄主植物的存在是影响优势种的主要指标,但两者均不显著。食源(寄主和蜜源植物)和管护强度是影响常见种的主要因素,且管护强度影响显著。然而,即使在最粗放的管护条件下,也只有当口袋公园可以同时提供寄主植物和蜜源植物时,在其中观测到常见种的概率才大于50%。蜜源植物、管护强度和口袋公园面积主要影响常见种,但只有面积的影响显著。此外,在我们的研究中,所有少见种出现的可能性均低于50%,并且在三组中,只有少见种对口袋公园的面积敏感。【结论】1)北京市大部分蝴蝶(76%以上)均可利用口袋公园;2)三类蝴蝶的对口袋公园的需求及其适应性各不相同;3)口袋公园为优势种和常见种提供源生境和汇生境,为城市中的大多数蝴蝶提供踏脚石和廊道。此外,我们建议:1)在城市规划过程中,为了保护蝴蝶的生物多样性,应识别棕地和各类小块绿地,并在生境网络建设中考虑口袋公园的价值;保留口袋公园中林下的自然植被,以提供更多的寄主植物,在林缘或园路两侧栽植开花植物,从而为蝴蝶提供蜜源,同时为居民提供优美的游憩环境。2)后续研究还需考虑外部环境的影响,并深入对比不同绿地类型的蝴蝶群落特征。

关键词:寄主植物;蜜源植物;管护强度;源生境;汇生境;踏脚石

The Value of Pocket Parks in Preserving Urban Butterfly Diversity

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【Objective】 Butterflies, valued for their aesthetic and ecological value, are key subjects in urban biodiversity research. Our study focused on the often-overlooked roles of pocket parks, which are micro-green spaces and small amusement parks open to the public. Despite their limited size, pocket parks are vital in maintaining the diversity of urban butterflies. We aimed to determine 1) how many butterfly species live in pocket parks, 2) the limiting variables for the ability of pocket parks to provide habitats for butterflies with different urban adaptabilities; and 3) the roles pocket parks play in this process when they provide habitats for butterflies with different adaptabilities. **【Method】** We conducted surveys of butterflies and vegetation in urban parks and pocket parks in 2020, from July to September in Beijing, China. We also selected seven environmental variables from food resources and shelter and recorded them at the same time. These include pocket park area, canopy coverage, tourist intensity, management intensity, water body, host plants and nectar plants. The last three were binary data, the first two were continuous data and the intensity of tourist and management were ordered data. Firstly, we contrasted pocket park's butterfly diversity and the Jaccard index of vegetation with urban parks by using the Mann-Whitney tests. Next, using hierarchical clustering, we classified butterflies from urban parks and pocket parks into urban exploiters, urban adapters, urban avoiders and pocket park exploiters, pocket park adapters, pocket park avoiders based on how well they adapted to environments, respectively. Finally, we used Logistic regression and Poisson regression to build generalised linear models for all species and each of the three groups from pocket parks separately, allowing us to investigate the differences in the effects of variables from food resources and shelters on various butterfly groups in pocket parks. Using the Akaike information criterion, we adopted the one with the lowest AIC value as the final model. **【Result】** We finally recorded 1104 butterflies from four families and 16 species from pocket parks, and 2748 from five families and 20 species from urban parks. The Mann-Whitney tests showed that the butterfly diversity in pocket parks was lower than in urban parks and the former's vegetation composition was more homogenous. The hierarchical clustering analysis showed that pocket parks can provide habitats for all urban exploiters and urban adapters, and some urban avoiders. According to the results of generalised regressions, the primary restrictions differ depending on the group. Management intensity, pocket park area and nectar plants were significant variables for all species. The tourist intensity and host plants were variables that affected the presence of exploiters, but both were insignificant. Food variables (host and nectar plants) and management intensity were the most influential variables for the adapters, with the latter being significant. However, even at the lowest level of management intensity, the probability of the presence of adapters was greater than 0.5 only when both the host and nectar plants were in a pocket park at the same time. Nectar plants, management intensity, and pocket park area influenced the presence of avoiders and area was the only

y significant variable. Moreover, the likelihood of all avoiders appearing in our study was not greater than 0.5, and of the three groups, only the avoiders were sensitive to the size of the pocket park. 【Conclusion】 These results showed that 1) pocket parks provide habitats for most of the butterfly species (more than 76%) in Beijing, 2) the needs and adaptations of the three communities were distinct, and 3) pocket parks have roles as source and sink habitats for exploiters and adapters and as stepping stones and corridors for most butterfly species inhabiting cities. According to the results, we suggested that 1) in the process of urban planning, for butterfly biodiversity conservation, green wastelands and brownfields should be identified and pocket parks should be considered in habitat network construction, 2) in the process of pocket park management, spontaneous vegetation inside the forest should be reserved to provide more host plants and cultivate flowering plants at the edge of the forest or along the path to provide more nectar plants for butterflies and recreational environment for residents and 3) more research should be done by considering external environment impacts and comparing butterfly community characteristics across green space types.

Keywords: host plant; management intensity; nectar plant; sink habitat; source habitat; stepping stones.