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古尔班通古特沙漠南缘地表甲虫物种多样性及其与环境的关系

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Diversity of ground-dwelling beetles within the southern Gurbantunggut Desert and its relationship with environmental factors

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摘要 为了解荒漠地表甲虫的多样性特点及其与环境的关系，明确其环境指示作用，评估沙漠工程对荒漠地表甲虫多样性的影响，作者于2010年5–7月采用陷阱法调查了古尔班通古特沙漠南缘从沙漠腹地到沙漠绿洲交错区不同生境的地表甲虫物种多样性，其中包括沙漠腹地公路防护体系的干扰生境。结果如下：(1)共捕获地表甲虫54,527头，隶属于14科81种，其中拟步甲科和象甲科占绝对优势，数量分别占到93.65%和5.14%；拟步甲科在沙漠腹地的活动密度远大于交错区，而在交错区象甲科种类最多，活动密度也最大；漠王属(*Platyope*)的种类均表现出明显的风沙土的倾向性，而阿苇长足甲(*Adesmia aweiensis*)和光滑胖漠甲(*Trigonoscelis sublaevigata sublaevigata*)则表现出明显的碱化灰漠土的倾向性；(2)不同生境间的丰富度、多样性指数、均匀度指数、优势度指数、活动密度总体上均具有显著性差异(df = 32, $P<0.05$)；(3)分别基于地表甲虫群落与优势类群的生境除趋势对应分析(DCA排序)均表明，沙漠边缘在研究区域中处于中间过渡地位，坡上生境更接近沙漠腹地，垄间更接近交错区；(4)荒漠地表甲虫群落的物种丰富度、多样性指数、均匀度指数、优势度指数与植被盖度、土壤含水量、有机质含量及全N、全P含量均存在显著线性相关($P<0.05$)，其中与土壤含水量的相关性最好，活动密度与所有环境因子的相关性最差，且为负相关；(5)沙漠公路防护体系中的地表甲虫活动密度显著降低，物种丰富度、多样性及均匀性均有所下降，但没有达到显著性水平；主要种的相对重要值也有较大变化。结论如下：荒漠地表甲虫的多样性特点为丰富度低、多样性低、均匀度差，但优势度高、活动密度高，并且这一特点随着生境从荒漠绿洲交错区到沙漠腹地越趋明显；荒漠地表甲虫在科、属与种的水平上均表现了一定的环境指示作用；土壤类型在群落排序中起着主要作用；活动密度与土壤含水量的负相关关系可能是局域尺度下荒漠地表甲虫多样性的一般性规律；工程干扰对沙漠腹地的地表甲虫群落产生了一定的影响，草方格、梭梭(*Haloxylon ammodendron*)、沙拐枣(*Calligonum* sp.)等人工植被可能是导致这一影响的主要因素。

关键词： 荒漠 地表甲虫 物种—多度分析 DCA排序 干扰

Abstract: To study the diversity of ground-dwelling beetle communities and their environmental relation-ships, and to understand their efficacy as habitat indicators and sensitivity to habitat perturbations, we used pitfall traps to investigate patterns of ground-dwelling beetle diversity along ecotones between the desert hinterland and desert-oasis ecotone along a desert edge in the southern Gurbantunggut Desert, including a disturbed habitat by desert highway protecting system. Our main results were as follows: (1) In total, we trapped 54,527 individuals of 81 species, belonging to 14 families, among which Tenebrionidae and Curcu-lionidae were most dominant and accounted for 93.65% and 5.14% of abundance, respectively. Tenebrioni-dae was most abundant in the desert hinterland, while Curculionidae dominated ecotones both in terms of richness and abundance. All *Platyope* spp. showed a preference for aeolian sandy soil, while *Adesmia aweiensis* and *Trigonoscelis sublaevigata sublaevigata* showed a preference for alkaline desert soil. (2) Spe-cies richness, activity density, diversity, dominance, and evenness indices all showed difference among habi-tats (df = 32, $P<0.05$). (3) DCA (detrended correspondence analysis) ordinations of habitats based on ground-dwelling beetle communities or dominant groups showed that desert edge was the transitional area in our study area, and that communities on slopes were more similar to those in desert hinterland while those on interdunes were more similar to those in ecotones. (4) Factors including species richness and diversity, even-ness and dominance indices were linearly correlated ($P<0.05$) with soil water content, nutrient content, total N, and total P content. Among them, the correlation with soil water content was

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the highest, and activity den-sity showed the lowest and negative correlations with all environmental factors. (5) A significant decline in beetle activity density was detected within the highway protecting system ($P<0.05$); species richness, diver-sity index and evenness index all declined in the same area, although the differences were insignificant. The relative importance of main species also changed. Conclusions we can draw based on these results are: These communities show low richness, diversity, and evenness but high dominance and abundance. This becomes more pronounced as one moves from the desert-oasis ecotone to the desert hinterland. Desert ground-dwelling beetles showed certain habitat-indicative value at the family, genus and species levels. Soil type is likely the primary mechanism leading to the observed community ordination results. The negative re-lationship between activity density and soil water content might be a general rule of desert ground-dwelling beetle's distribution at local scales. The desert highway protecting system within our study results has af-fected ground-dwelling beetle communities, and associated artificial plants (straw barrier, *Haloxylon am-modendron* and *Calligonum* sp.) might be the driving factor leading to these changes.

Keywords: desert ground-dwelling beetles species–abundance analysis DCA ordination disturbing

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