

黑河上游祁连山区青海云杉生长状况及其潜在分布区的模拟

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摘要 根据Hutchinson的n维超体积概念以及物种与资源利用之间的关系, 构建了青海云杉(*Picea crassifolia*)在三维环境资源空间中的生物-地理模型, 并利用该模型模拟了青海云杉的潜在分布及其对环境资源的利用状况。结果表明: 青海云杉在生长季平均气温、多年平均降水量及太阳直接辐射三维环境资源空间上的最佳配置为9 °C、360 mm和 $1.9 \times 10^3 \text{ kW} \cdot \text{h} \cdot \text{m}^{-2}$; 用三元方程式的拟合结果在大范围上预测了青海云杉的潜在分布区, 并给出了其在对应地理位置上的生长状况。

关键词: 基础生态位 青海云杉 潜在分布 资源利用

Abstract: *Aims* Study of the spatial distributions of species is important to biogeography. Studies can provide the foundation for ecological conservation and restoration. Therefore, our objective is to estimate Qinghai spruce's (*Picea crassifolia*) potential distribution and assess its growth status in the upper reaches of the Heihe River in the Qilian Mountains of China.

Methods We built a biogeographical model of Qinghai spruce in environmental resource space at three dimensions based on concepts of Hutchinson's n-dimensional hypervolume and relationships between species and resource utilization. The model requires data on species distribution and environmental variables important in the growth of the species. Data on the distribution of Qinghai spruce were obtained using Landsat TM data with supervised classification and decision-trees technology. The three most important environmental variables, i.e., mean growing season air temperature, mean annual precipitation and solar radiation, were spatialized with GIS technology.

Important findings The optimal combination of the three environmental variables (mean growing season air temperature, mean annual precipitation and solar radiation) in the area of Qinghai spruce distribution is 9 °C, 360 mm and $1.9 \times 10^3 \text{ kW} \cdot \text{h} \cdot \text{m}^{-2}$, respectively. The model is built to estimate Qinghai spruce's potential distribution in a large area and to assess the species' growth status at corresponding geographical positions.

Our model provides a universal function that incorporates multiple environmental variables to estimate the species' potential distribution and growth status in other regions.

Keywords: fundamental niche, *Picea crassifolia*, potential distribution, resource utilization

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