学位論文内容の要旨

博士の専攻分野名称：博士（農学）　　氏　名：Xu Menglin

学位論文題名

Validation of landscape planning framework based on an assessment of ecological resistance and ecological risk

（生態学的抵抗力と生態学的リスクの評価に基づく景観計画手法の検証）

Natural disasters and human activities have significant negative impacts on ecosystem stability, leading to the destruction of ecological structures (e.g. forests, grasslands) and making habit fragmented. Furthermore, external potential risks and threats (human aggregation, heavy rainfall, etc.) are still present and have a continuous impact. This paper focuses on the Tianmeng Scenic Spot in China and the eastern coastal areas of Japan as the study areas, its main aims are to assess the ecological connectivity and ecological risk in response to human activities and natural disasters in these regions, explore the main driver indicators and vulnerable areas affecting ecological stability, and then predict the future development trends.

1. Establishing landscape networks based on visual quality and ecological resistance: a case study in Tianmeng scenic spot, China

Forest-based scenic spot has received widespread attention for its landscape aesthetics and ecological values, but the rapid growth of tourism activities led to habitat fragmentation. This study analyzed and evaluated the visual quality and the ecological connectivity of Tianmeng mountain, and combined them to build the sustainable landscape network. In the analysis of ecological resistance surfaces, the very-high resistance areas and high resistance areas (low ecological connectivity) were mostly distributed in the main tourism roads and their buffer areas around the northwest of Tianmeng mountain. 27 short cost and resistance paths were identified respectively using the Minimum Cumulative Resistance (MCR) model to connect high-quality landscape points, respectively. The paths distributed in low resistance areas serve as ecological corridors for wildlife migration and eco-friendly transportation routes, and cannot be developed or constructed as paved roads, others distributed in high resistance areas can be used as convenient transportation options for tourists.

2. Multi-dimensional and multi-temporal landscape ecological risk assessment in the eastern coastal areas of Japan

The eastern coast areas of Japan are threatened by multiple ecological risks due to frequent natural disasters, climate changes, human activities, etc. Taking the eastern coastal areas of Japan as the research object, this study performed the analysis of the spatio-temporal patterns and driving mechanisms of ecological risk from 2009 to 2021 by establishing the ecological risk assessment framework of "Nature-Landscape Pattern-Human Society" (NA-LP-HS). The results showed that the driving risk factors leading to a sharp increase from 2009 to 2015 were earthquake and tsunami disasters and the decrease of vegetation coverage, high-risk areas were distributed in the regions with Sendai Bay as the core radiation; From 2015 to 2021, the decrease of vegetation coverage, the aggravation of rainfall erosion, and debris flow disasters were the main causes of ecological instability, and high-risk areas were concentrated in the urban cluster centered around Tokyo, comprising Tokyo Bay, Sagami Bay, Chiba, and Ibaraki. This study demonstrates the ability of multidimensional ecological risk assessment to identify high-risk areas and driving factors, and provide a visual analysis and decision-making basis for sustainable development.

3. Predictions of vegetation changes in coastal areas with sea level rise in Sendai, Japan

Vegetation coverage is important for the Sendai region as a major driver of risk affecting. Four study sites in Sendai region (Gamou, Arahama, Yuriyage, and Ido) were selected to analyze the relationship between coastal vegetation, coastal zone width, and sea level rise in the context of climate change. The aim was also to predict the distribution state of coastal vegetation from 2030 to 2150. The results revealed that when the coastal zone width was less than 56m, vegetation was almost nonexistent. Among the five scenarios (SSP119, SSP126, SSP245, SSP370, and SSP585) considered for sea level rise, SSP585 exhibited the fastest rate of rise, followed by SSP370, SSP245, SSP126, SSP119 which had the slowest sea level growth rate, representing a greener and more sustainable path. In predicting the vegetation distribution from 2030 to 2150, it was observed that Ido started to experience no plants existing in the SSP585 scenario by 2090. By 2150, except for the Yuriyage, no plants survived in the study area under the SSP585 scenario.