Evaluating effects of habitat patch connectivity and arrangement on population survival in *Peromyscus leucopus*: a simulation study

Ye SUN

Key words: Habitat patch connectivity, network, node, graph theory, metapopulation, population viability analys is, simulation

Habitat fragmentation has become one of the biggest pressure drivers for underlying biodiversity loss. In conservation biology and landscape ecology, ecological network and corridor construction have been widely considered as the main solutions to improve the connectivity of landscape. The key question here is how to quantify and well measure the habitat patch connectivity and network properties, so that we can make a functional habitat network. Previous studies have explored network measures in terms of node degree distribution and the standard deviation of node degree distribution to evaluate the correlations between of these structural connectivity properties and functional connectivity. Most of these studies have focused on how to find the key nodes in many kinds of networks, using graph theory and network analysis. However, little attention has been paid to evaluate how the distribution of node degree in a network influences the population dynamics and survival.

To solve this problem, an individual-based stochastic model was designed to simulate the *Peromyscus leucopus* metapopulation dynamics in habitat graphs that contain distinct node degree distribution. The mean absolute deviation (MAD) was used to quantify the dispersion of node degree in a network. The demographic statistics resulting from the simulations were then analyzed with the MAD value, using statistical measures and graph theory.

Given the results from the simulation and system modeling, the dispersion of node degree distribution within a habitat network is considered to have correlations with metapopulation size. The results are as follows:

1. The MAD of node degree within a network has a significant positive correlations with metapopulation size, which indicates that the dispersion of node degree in a network might have an influence on metapopulation dynamics and survival.
2. The effect of node degree distribution and dispersion on metapopulation size can be strongly influenced by the other network properties. Given the positive correlations between link number and metapopulation size, when there are two habitat networks that have the same MAD, the one that has more links, less isolated nodes or stronger rubustness against destruction and deletion, tend to have bigger metapopulation size.
3. No significant relationship can be seen between the node degree MAD value and metapopulation extinction probability. However, the correlation analysis shows that there exists a significant relationship between metapopulation size and extinction probability, therefore the dispersion of node degree with in a network might influence extinction probability indirectly.

The present `results` underline the importance of assessing degree distribution and arrangement on population survival. The study will contribute to applications to quantify how the arrangement of node degree distribution well enables population survival, which can improve the habitat network designing and management in landscape ecology and conservation biology.