

Poster-#(poster number, leave blank):

Effect of the habitat fragmentation on the persistence of native species against an alien invasion

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Habitat fragmentation could be a threat to biodiversity. Understanding the ecological dynamics in a fragmented habitat is crucial, for example, for the conservation of a species inhabiting there. The influence of habitat fragmentation on ecosystem stability has been debated among ecologists [1]. In this work, we consider the influence of habitat fragmentation on a competition population dynamics. We introduce the influence of habitat fragmentation on the resource limiting the reproduction of the population inhabiting there, making use of the resource dynamics with MacArthur's ideas [2], and the quasi-stationary state approximation about it. Hence in our modeling, the population is affected by habitat fragmentation through the resource availability influenced by it. We focus on the persistence of a native species under the invasion of an alien species competing for the resource in the habitat of the native species. The population dynamics of our model is given by

$$\begin{aligned}\frac{dN_i}{dt} &= \alpha_N \{-R_N^c + f_i(N_i, A_i)\} N_i - m_N N_i + \frac{p_i}{P_n} m_N \sum_{j=1}^n N_j \\ \frac{dA_i}{dt} &= \alpha_A \{-R_A^c + f_i(N_i, A_i)\} A_i - m_A A_i + \frac{p_i}{P_n} m_A \sum_{j=1}^n A_j - m_0 A_i + \frac{p_i}{P_n} M_0 A_0\end{aligned}$$

with $f_i(N_i, A_i) := p_i \frac{\lambda}{\gamma} - \frac{\beta_N}{\gamma} N_i - \frac{\beta_A}{\gamma} A_i$, where N_i is the population size of the native species in patch i , and A_i that of the alien species. The influence of habitat fragmentation on the resource availability at patch i is indexed by the positive parameter p_i , and $P_n = \sum_{j=1}^n p_j$ with the total number of patches n in the habitat. The parameter P_n reflects the influence of habitat fragmentation on the resource availability over the whole habitat. Parameters λ and γ are the intrinsic renewal rate and decay rate for the resource. We use the subscript N (resp. A) to refer to the parameter concerning the native species (resp. alien species). β is the coefficient of the resource consumption by the species, and R^c is the least resource value needed for the reproduction. Positive parameter α is the conversion coefficient of the resource consumption to the reproduction. Migration between patches is introduced by the parameters m_N and m_A . The specific parameter M_0 is the invasion rate of the alien population in the habitat of the native species from the original habitat of the alien species, where it has a stationary population size A_0 . The parameter m_0 means the return rate of alien individual to its original habitat.

We will show some interesting results on our model, especially for the specific case where the habitat is fragmented into a number of equivalent patches, that is, on the above model with $p_i = P_n/n$. We will try to discuss a theoretical possibility that there could be a habitat fragmentation such that it works advantageously for the persistence of native species under exploitative competition with an alien species.

References

- [1] L. Fahrig et al., Is habitat fragmentation bad for biodiversity?, *Biological Conservation*, **230**, 179-186 (2019)
- [2] R.H. MacArthur, *Geographical Ecology: Patterns in the Distribution of Species*, Chapter 2, Harper & Row New York (1972)