A Population Dynamics Model of Two Parasite Species Competing for the Common Host with Different Parasitism Stages 共通の宿主について競争関係にある寄生者 2 種の寄生対象生育段階が異なる場合の個体群動態モデル

Akshat GOYAL and Hiromi SENO

東北大学大学院情報科学研究科情報基礎科学専攻 Department of Computer and Mathematical Sciences, Graduate School of Information Sciences, Tohoku University, Sendai, Japan

goyal.akshat.r3@dc.tohoku.ac.jp

Today numerous species are experiencing habitat shifts potentially driven by climate change. Invasion of an alien parasite species into a native host-parasite system could lead to substantial ecological consequences. In this work we consider the following discrete time model on the competition dynamics between two parasite populations sharing the common host:

$$H_{n+1} = e^{-a_1 P_n} \frac{r_0}{1 + e^{-a_2 Q_n} H_n / \beta} e^{-a_2 Q_n} H_n;$$

$$P_{n+1} = \rho_1 (1 - e^{-a_1 P_n}) \frac{r_0}{1 + e^{-a_2 Q_n} H_n / \beta} e^{-a_2 Q_n} H_n;$$

$$Q_{n+1} = \rho_2 (1 - e^{-a_2 Q_n}) H_n,$$

where H_n , P_n and Q_n are the host, and two parasite populations respectively at time step n. Parameters a_1 and a_2 are the coefficients for the successful parasitism by parasite species P and Q respectively. r_0 is the supremum for the expected number of host's offsprings produced by an adult host. β is the coefficient of the strength of intraspecific density effect on the host reproduction. The larger β means the weaker sensitivity of host reproduction to the density effect. In the other sense, it indexes the strength of host's intraspecific competition. Its larger value means the weaker intraspecific competition affecting the reproduction rate. ρ_1 and ρ_2 are the expected number of parasite offsprings born per parasitized host by P and Q respectively. We here assume that the parasite species P and Q attempt to parasitize the host at different life stages, at juvenile stage and adult stage respectively.

We examine a scenario where a native host-parasite system is invaded by an alien parasite. By analyzing the above model, we will try to discuss how the difference of parasitism stage could be related to the consequence of the competition, especially with respect to the invasion success/failure of alien parasite (P or Q).