The mechanism of negative feedback on selection for environment-altering species from a standpoint of the competition theory

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[Introduction]

Environmental conditions (pH, temperature, salinity, etc.) affect the growth and adaptation of organisms and organisms also alter their environmental conditions via various processes (e.g. emission or fixation of greenhouse gasses, consumption of nutrients). Although each process has been well established, interactions between environmental conditions and environment-affecting species have been poorly unknown. In this study, the possibility of regulative feedback between temperature (a representative of environmental conditions) and hypothetical plankton with temperature-altering trait was examined.

[Chemostat feedback model]

We considered a chemostat model which described the behavior of two temperature-affecting species competing for one nutrient (2:1 model) or two nutrients (2:2 model) (Seto & Akagi, submitted). In this model, temperature and nutrients can influence growth of their populations and the population of two competing species, one of which can increase and the other of which can decrease temperature, is formulated. Using numerical simulations, the long term outocome of the competition and change of temperature were explored against increasing preset temperatures. As a result of simulations, a domain was found where temperature was maintained at a constant, if there was a 'trade-off' in their ability to utilize nutrients.

[Conclusion]

Although the analysis of the two models revealed the different dynamics of the regulative property, the simulations of both the model gave similar outcomes: the regulation of temperature and coexistence of the two species. The finding of the regulative property in these models supports the idea of biotic homeostasis much strongly than our previous models do (Akagi, 2006; Seto & Akagi, 2005). This may imply that actual environmental conditions can be automatically stabilized by resource competition among species in natural ecosystems.

[References]

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