Dynamics of diversity:
Take the "A" train to the realm of biodiversity

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According to one theory, human beings have wiped out animals and plants, the scale of which is comparative with the KT mass extinction at the end of the Cretaceous period, and what is worse, we have very little knowledge on conservation and recovery of biodiversity. Why are large and complex ecosystems, e.g. in tropical rain forests or in coral reefs, formed and maintained stably although even a three dimensional Lotka-Volterra equation connotes instability that causes chaos in some cases? In this talk at the organized session *Take the "A" train to the realm of biodiversity*, theoretical approaches to those problems are briefly reviewed and some results are presented in the light of the dynamics of diversity which is implemented in the evolutionary equation with extinction, invasion and mutation. The first result concerns the effect of extinction on the so-called replicator equations(RE) for a large number of species with complex interspecies interactions[1]. Introducing the "extinction threshold" of the population density into RE, the nature of a series of extinction is characterized by the "extinction dynamics" where the diversity of species, i.e. the dimension of the equation, is a time-dependent variable. The extinction threshold can be interpreted as a disturbance near very small population or a minimal unit of reproduction of species, the reciprocal of which is the permissible population size. We further discuss a new view on mass extinction in association with a mathematical foundation for the paleontologic theory. In the second result, we consider the "neutral mutation" in RE, where a large, complex and stable ecosystem can be evolved[2] in contrast with the prediction by the random matrix theory[3]. The present model shows: (1) speciation accelerated by high diversity of neutral mutants, (2) fixation of mutants realized by a rapid growth of a group of super-symbiotic mutants, (3) highly symbiotic interspecies interactions, (4) strong invasion resistance, (5) a hierarchical structure of taxon, and (6) a typical pattern of relative species abundance widely observed in nature. Several implications are discussed in connection with symbiosis accelerated by natural selection and the speciation via neutral mutations.

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