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A DYNAMICAL MODEL FOR SYMPATRIC SPECIATION IN AN ECOLOGICAL NICHE

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The speciation phenomenon is the process used by the evolution to allow the populations to become distinct species [1]. The speciation is the primary cause of the complexity of the ecological network. The biologists have classified four modes to explain the speciation process based on the extent to which speciating populations are isolated from one another: allopatric, peripatric, parapatric, and sympatric [2]. Sympatric speciation concerns the rise of a new species from a surviving ancestral species while both continue to inhabit the same ecological niche or geographical region. In sympatric speciation, reproductive isolation evolves within a population in a ecological niche without the aid of geographic barriers Different models have been proposed for alternative modes of sympatric speciation. The most popular was first put forward by John Maynard Smith in 1966 [3]: Maynard Smith suggested that in a given population homozygous individuals may, under particular environmental conditions, have a greater fitness than those with alleles heterozygous for a certain trait. Then, under the mechanism of natural selection the homozygous individuals would be favored over heterozygous one, eventually leading to speciation in the population [4]. In this framework we assume an effective description of the speciation process based on a dynamical model for the populations in an ecological system [5] [6]. Our basic assumptions is the existence of an ancestral population in an ecological niche with finite resources that can express two phenotypes. In presence of particular environmental conditions one of the phenotypes has the propensity to separate from the original population in the reproduction process: i.e. the sexual segregation of the new population is explained by a fitness advantage from a evolutionary point of view. Thene new individual may give rise to a new species in the ecosystem according to the sympatric speciation. Due to the finite resources in the niche the populations are continuously competing each other and their number fluctuates according to the changes of the environmental conditions. The effect of natural selection is introduced in the model by a pointwise stochastic perturbations of the environmental conditions that increase the struggle for life of the populations in the niche. We study the dynamical properties of th system and we prove the existence of a threshold values

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in the environmental stress in order to observe the speciation process. The analytical arguments are illustrated by numerical results and we also discuss some biological implication of the model and the validation problem using empirical data.

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