Emergence and Robustness of Solitary States and Cluster States in Prey-Predator Model

Poster

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We investigate the possible scenarios for the emergence and robustness of solitary states (SS) in an identically coupled Rosenzweig-MacArthur (RM) prey-predator model, where the coupling is limited to the predator. In SS, one patch splits off and behaves differently from other patches. We also explored cluster state (CS) and synchronized oscillatory state (SOS) in smaller and larger networks of patches. In CS, the patches split into two groups, one with high density (exhibits periodic oscillations) in the prey-predator population and the other maintaining a zero prey density. In contrast, the predator population has a low density and shows periodic oscillations. In addition, we have also examined the two distinct types of solitary states (SS1 and SS2) and the probability of reaching different dynamical states through basin stability measures. We also show the emergence of two Inhomogenous steady states (IHSS), such as solitary death (SD) and cluster death (CLD) state in addition to solitary and cluster states. Further, we show the transition of SS1 to SD and CS to CLD state with varying the number of patches. In addition, we show the robustness and critical value of the dispersal rate required for the occurrence of SS, CS, SD, and CLD states with varying patches from smaller to larger networks. Finally, we also observed that CS and CLD states can be obtained in different ratios, including high and zero prey density patches. However, in larger networks of patches, the CS is a prerequisite for the emergence of a solitary state. We have also determined the stability conditions for solitary and cluster states.

Keywords: Solitary states, Rosenzweig-MacArthur model, Cluster states.