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Abstract: In this work we investigate the population dynamics of cooperative hunting extending the McCann and Yodzis model for a three-species food chain system with a predator, a prey, and a resource species. The new model considers that a given fraction sigma of predators cooperates in prey's hunting, while the rest of the population 1-sigma hunts without cooperation. We use the theory of symbolic dynamics to study the topological entropy and the parameter space ordering of the kneading sequences associated with one-dimensional maps that reproduce significant aspects of the dynamics of the species under several degrees of cooperative hunting. Our model also allows us to investigate the so-called deterministic extinction via chaotic crisis and transient chaos in the framework of cooperative hunting. The symbolic sequences allow us to identify a critical boundary in the parameter spaces (K, C-0) and (K, sigma) which separates two scenarios: (i) all-species coexistence and (ii) predator's extinction via chaotic crisis. We show that the crisis value of the carrying capacity K-c decreases at increasing sigma, indicating that predator's populations with high degree of cooperative hunting are more sensitive to the chaotic crises. We also show that the control method of Dhamala and Lai [Phys. Rev. E 59, 1646 (1999)] can sustain the chaotic behavior after the crisis for systems with cooperative hunting. We finally analyze and quantify the inner structure of the target regions obtained with this control method for wider parameter values beyond the crisis, showing a power law dependence of the extinction transients on such critical parameters. (C) 2009 American Institute of Physics. [doi: 10.1063/1.3243924]

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