On predator-prey continuous-time games

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We consider a two-player noncooperative continuous-time game played over a season (finite horizon), with players representing the population levels of a predator and of a prey, respectively. The time-dependent decision variables of the players are their summer-phase/diapause ratios, i.e., the portion of individuals being in the summer (active) phase and in diapause (quiescent, passive phase). Unlike in the standard Lotka-Volterra formulation, the players state is defined by both time-varying population size and associated energy. This allows a more realistic description of predator-prey interactions. The goal of each player is to maximize its fitness, a function of both population size and energy. We first investigate a one-player game, the decisions of the predator being fixed. We then look at more general optimal strategies in the two-player game. Such strategies depend on whether a Nash game or a Stackelberg game is played and may be discontinuous. We discuss properties of such strategies and propose extensions to multi-seasonal setups.

Keywords: Predator-prey problems, dynamic noncooperative games

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