Summary: We explore the local dynamics, N-S bifurcation, and hybrid control in a discrete-time Lotka-Volterra predator-prey model in $\mathbb{R}_2^+$. It is shown that $\forall$ parametric values, model has two boundary equilibria: $P_{00}(0, 0)$ and $P_{20}(1, 0)$, and a unique positive equilibrium point: $P_{xy}^+ \left( \frac{d}{c}, \frac{r(c-d)}{bc} \right)$ if $c > d$. We explored the local dynamics along with different topological classifications about equilibria: $P_{00}(0, 0)$, $P_{20}(1, 0)$, and $P_{xy}^+ \left( \frac{d}{c}, \frac{r(c-d)}{bc} \right)$ of the model. It is proved that model cannot undergo any bifurcation about $P_{00}(0, 0)$ and $P_{20}(1, 0)$ but it undergoes an N-S bifurcation when parameters vary in a small neighborhood of $P_{xy}^+ \left( \frac{d}{c}, \frac{r(c-d)}{bc} \right)$ by using a center manifold theorem and bifurcation theory and meanwhile, invariant close curves appears. The appearance of these curves implies that there exist a periodic or quasiperiodic oscillations between predator and prey populations. Further, theoretical results are verified numerically. Finally, the hybrid control strategy is applied to control N-S bifurcation in the discrete-time model.

MSC:

37N35 Dynamical systems in control
37N25 Dynamical systems in biology
39A30 Stability theory for difference equations
39A28 Bifurcation theory for difference equations
39A50 Stochastic difference equations
92D25 Population dynamics (general)

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