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Rich dynamics in a non-local population model over three patches

We consider a system of nonlinear delay differential equations that describes the mature population of a species with age-structure that lives over three patches. We analyze existence of nonnegative homogeneous equilibria, stability and Hopf bifurcation from the equilibria. In particular, by employing both the standard Hopf bifurcation theory and the symmetric bifurcation theory of functional differential equations, we obtain very rich dynamics for the system, such as transient oscillations, phase-locked oscillations, mirror-reflecting waves and standing waves. In the standard Hopf bifurcation case, we also derive formulas for determining the stability and the direction of the Hopf bifurcation.