Segregation phenomena for some population models with three species

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Abstract

We are concerned with the following population model;

$$\begin{cases} u_t = d_1\Delta u + u(a - u - kv) & \text{in} \quad \Omega \times (0,\infty), \\ v_t = d_2\Delta v + v(b - lu - v + mv) & \text{in} \quad \Omega \times (0,\infty), \\ w_t = d_3\Delta u + dw(1 - nv - w) & \text{in} \quad \Omega \times (0,\infty), \\ \dfrac{\partial u}{\partial \nu} = \dfrac{\partial v}{\partial \nu} = \dfrac{\partial w}{\partial \nu} = 0 & \text{on} \quad \partial\Omega \times (0,\infty) \end{cases}$$

where $d_i (i = 1, 2, 3)$, a, b, k, l, m, n and d are positive number. In special, d is a positive parameter. $\Omega \subset \mathbf{R^N}$ is a bounded domain with smooth boundary with $N \geqq 1$. Now u, v and w denotes each population density in Ω. We also put $u(x,0) = u_0(x), v(x,0) = v_0(x), w(x,0) = w_0(x)$ as non-negative initial function in Ω.
Under some special conditions on the coefficient, we can obtain a positive constant equilibrium point $\mathbf{u_p} = (\mathbf{u_*}, \mathbf{v_*}, \mathbf{w_*})$. By using usual bifurcation argument, we can constract Turing and Hopf bifurcation from u_p for some $d > 0$. Moreover, we can show some segregation phenomena by using Mathematica.

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