Stability and attractivity for Nicholson systems with time-dependent delays

Diogo Caetano, Teresa Faria

Lisbon, Portugal

We consider a class of n-dimensional Nicholson system with constant coefficients and multiple time-varying delays of the form

$$N_i'(t) = -d_i N_i(t) + \sum_{j=1, j\neq i}^{n} a_{ij} N_j(t) + \sum_{k=1}^{m} \beta_{ik} N_i(t-\tau_{ik}(t)) e^{-c_i N_i(t-\tau_{ik}(t))},\ i = 1, \dots, n,\ t \geq 0, \quad (1)$$

where $d_i > 0, c_i > 0, a_{ij} \geq 0, \beta_{ik} \geq 0$ with $\beta_i := \sum_{k=1}^{m} \beta_{ik} > 0$, and $\tau_{ik} : [0, \infty) \to [0, \infty)$ are continuous and bounded, for $i, j = 1, \dots, n$, $k = 1, \dots, m$.

Sufficient conditions on the coefficients are given for the existence and absolute global exponential stability of a unique positive equilibrium N^*, generalizing and improving known results for autonomous systems. Moreover, a delay-dependent condition is established for the positive equilibrium N^* to be a global attractor of all positive solutions, and some corollaries which do not require the a priori knowledge of N^* are derived.

Acknowledgement

The research was supported by Fundação Calouste Gulbenkian under project 'Estímulo à Investigação' (D. Caetano) and Fundação para a Ciência e a Tecnologia under project UID/MAT/04561/2013 (D. Caetano and T. Faria).

2010 Mathematics Subject Classification: 34K20, 34K25, 92D25.

References

[1] T. Faria, G. Röst, Persistence, permanence and global stability for an n-dimensional Nicholson system, *J. Dyn. Diff. Equ.*, **26** (2014), 723–744.

[2] R. Jia, Z. Long, M. Yang, Delay-dependent criteria on the global attractivity of Nicholson's blowflies model with patch structure, *Math. Meth. Appl. Sci.* **40** (2017), 4222–4232.

[3] H. A. El-Morshedy, A. Ruiz-Herrera, Geometric methods of global attraction in systems of delay differential equations, *J. Differential Equations* (to appear).