M1 BBS - EM8BBSEM

Simulation de Systèmes Biologiques

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Mutualism (symbiosis)

We consider the same ordinary differential equation model for two competitors, *i.e.*

$$\frac{\mathrm{d}N_1}{\mathrm{d}t} = r_1 N_1 \left(1 - \frac{N_1}{K_1} + b_{12}\frac{N_2}{K_1}\right), \tag{3.40}$$

$$\frac{\mathrm{d}N_2}{\mathrm{d}t} = r_2 N_2 \left(1 - \frac{N_2}{K_2} + b_{21}\frac{N_1}{K_2}\right), \tag{3.41}$$

where K_1, K_2, r_1, r_2, b_{12}, b_{21} are positive constants or, after non-dimensionalisation,

$$u_1' = u_1(1 - u_1 + \alpha_{12}u_2) \stackrel{def}{=} f_1(u_1, u_2), \tag{3.42}$$

$$u_2' = \rho u_2(1 - u_2 + \alpha_{21}u_1) \stackrel{def}{=} f_2(u_1, u_2). \tag{3.43}$$

Analyze the system in the usual way, draw phase portraits.

In symbiosis, the straight line nullclines will have positive gradients leading to the following two possible behaviours shown in Figure 3.4.

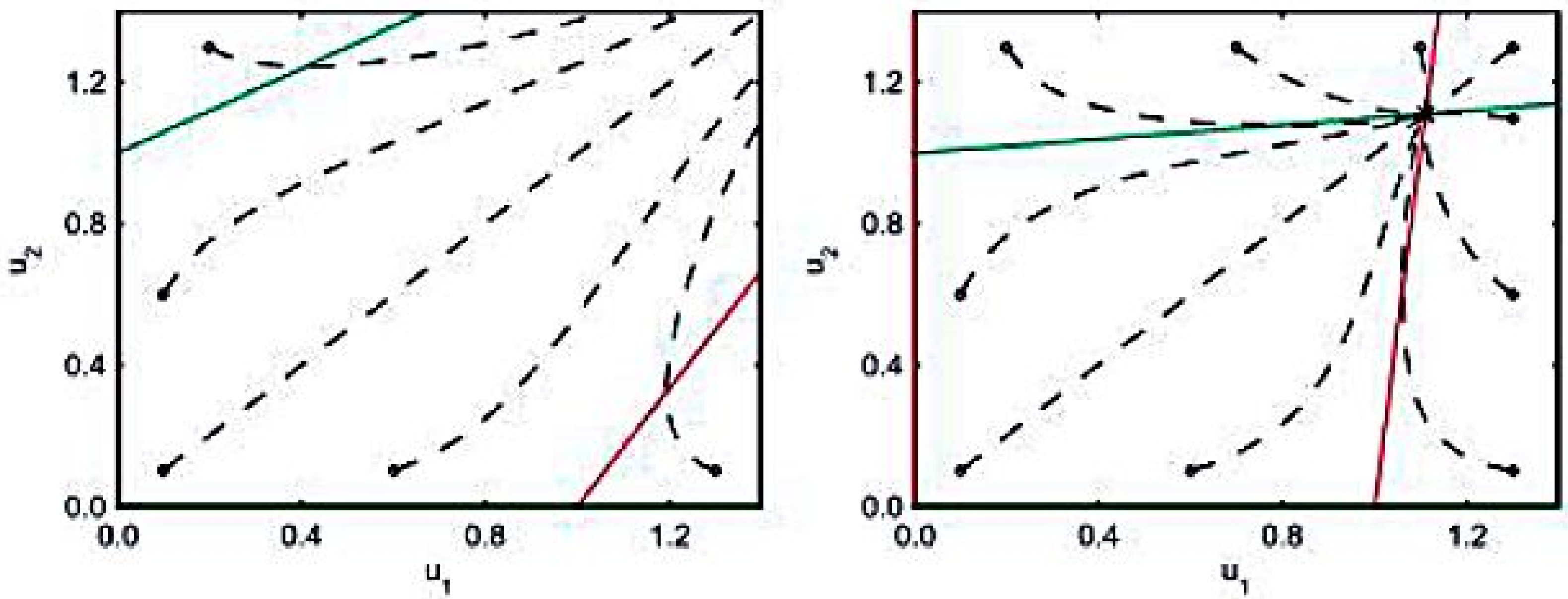

Figure 3.4: Dynamics of the non-dimensional symbiotic system. The left-hand figure shows population explosion ($\alpha_{12} = 0.6 = \alpha_{21}$) whilst the right-hand figure shows population coexistence ($\alpha_{12} = 0.1 = \alpha_{21}$). The stable steady states are marked with $*$'s and $\rho = 1.0$ in all cases. The red lines indicate $f_1 \equiv 0$ whilst the green lines indicate $f_2 \equiv 0$.

Et maintenant : les projets…