

SCUDEM CHALLENGE C: Populační model Bělásek zelný vs parazitické vosičky

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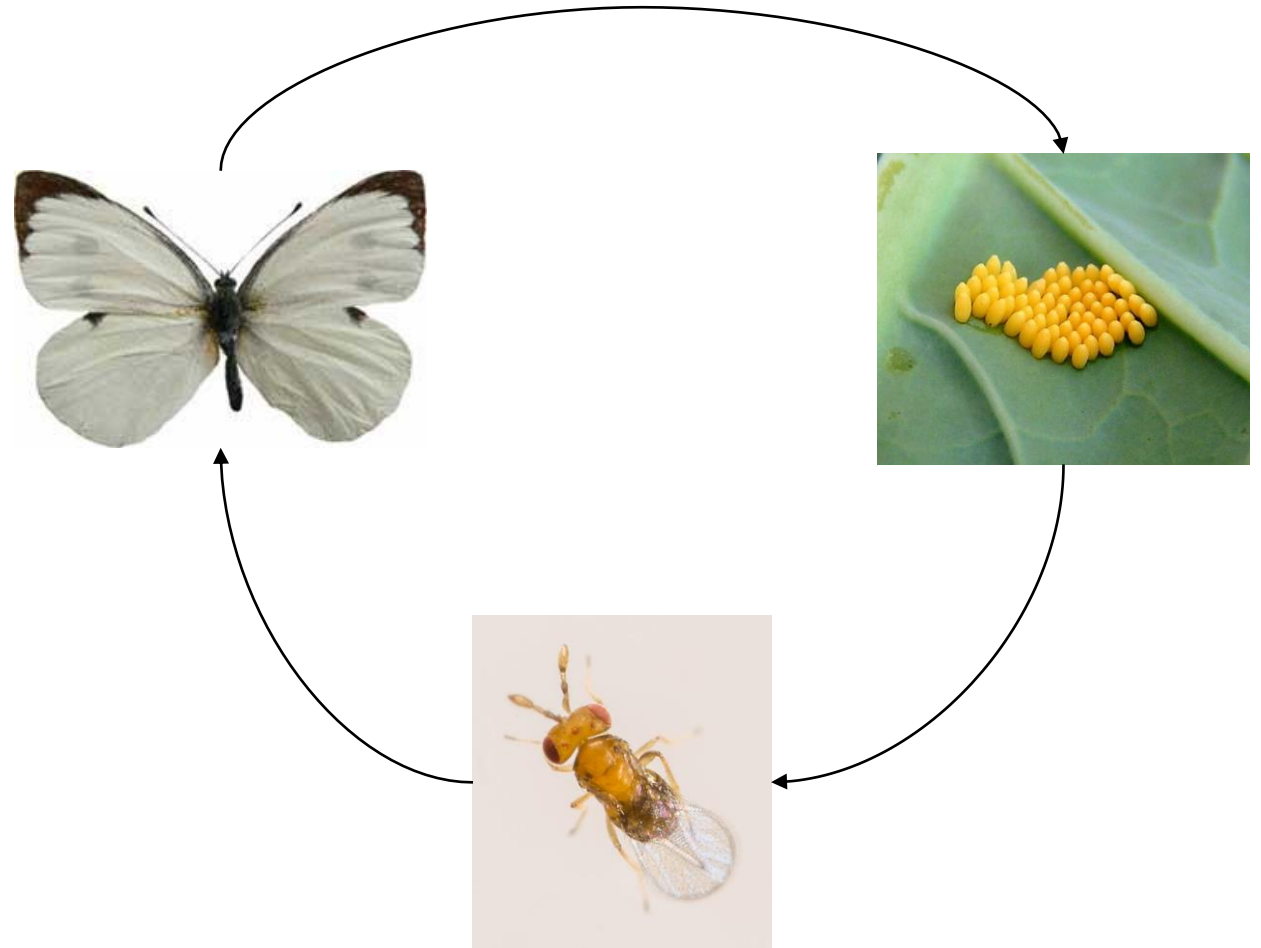
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Popis problému



- A. Bělásci zelní
 - a. Monogamie
 - b. Rozdělení v populaci
 - c. Feromony
- B. Vosičky
 - a. Vliv feromonů



Předpoklady modelu

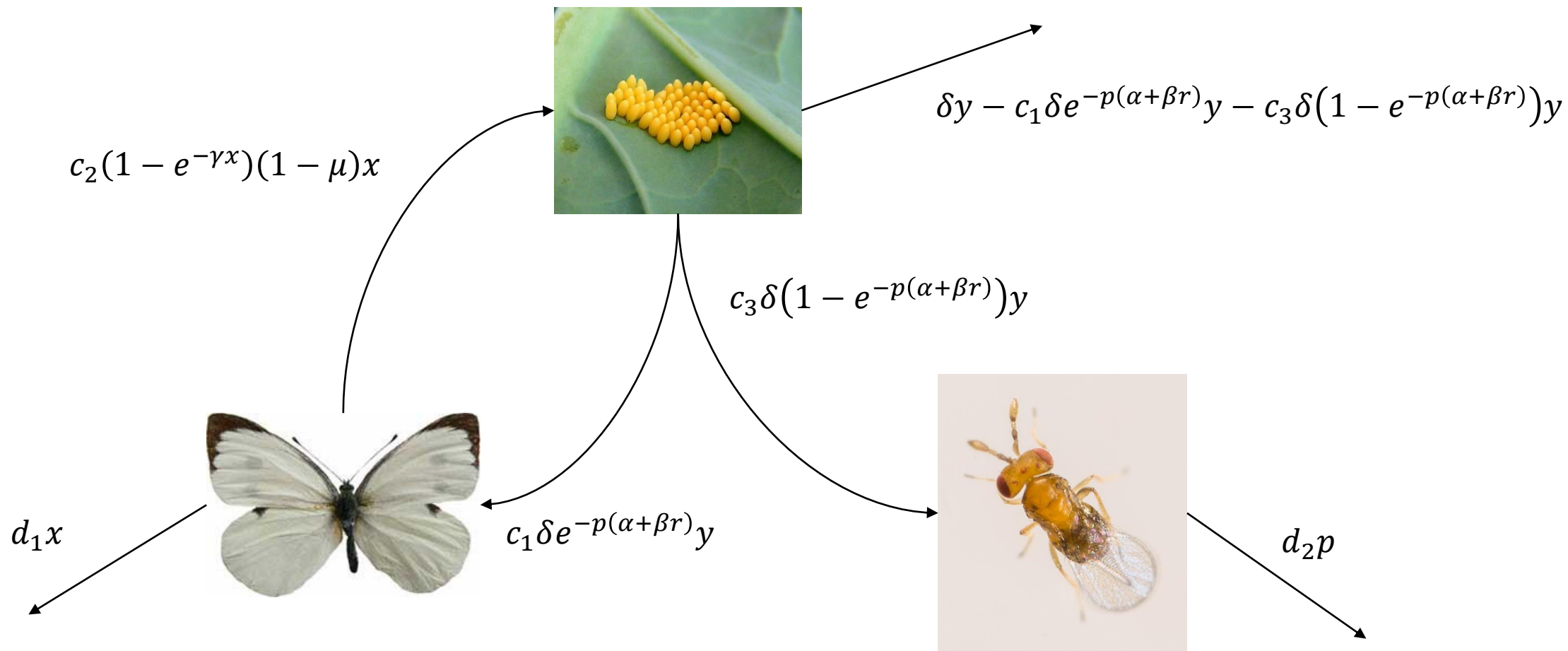


- A. Uzavřenost systému
- B. Spojitost modelu
- C. Zjednodušení vývoje
- D. Interakce mezi bělásky, vajíčky a vosičkami
- E. Afrodiziakum samic
- F. Anti-afrodiziakum samečků
- G. Pouze jeden druh vosiček

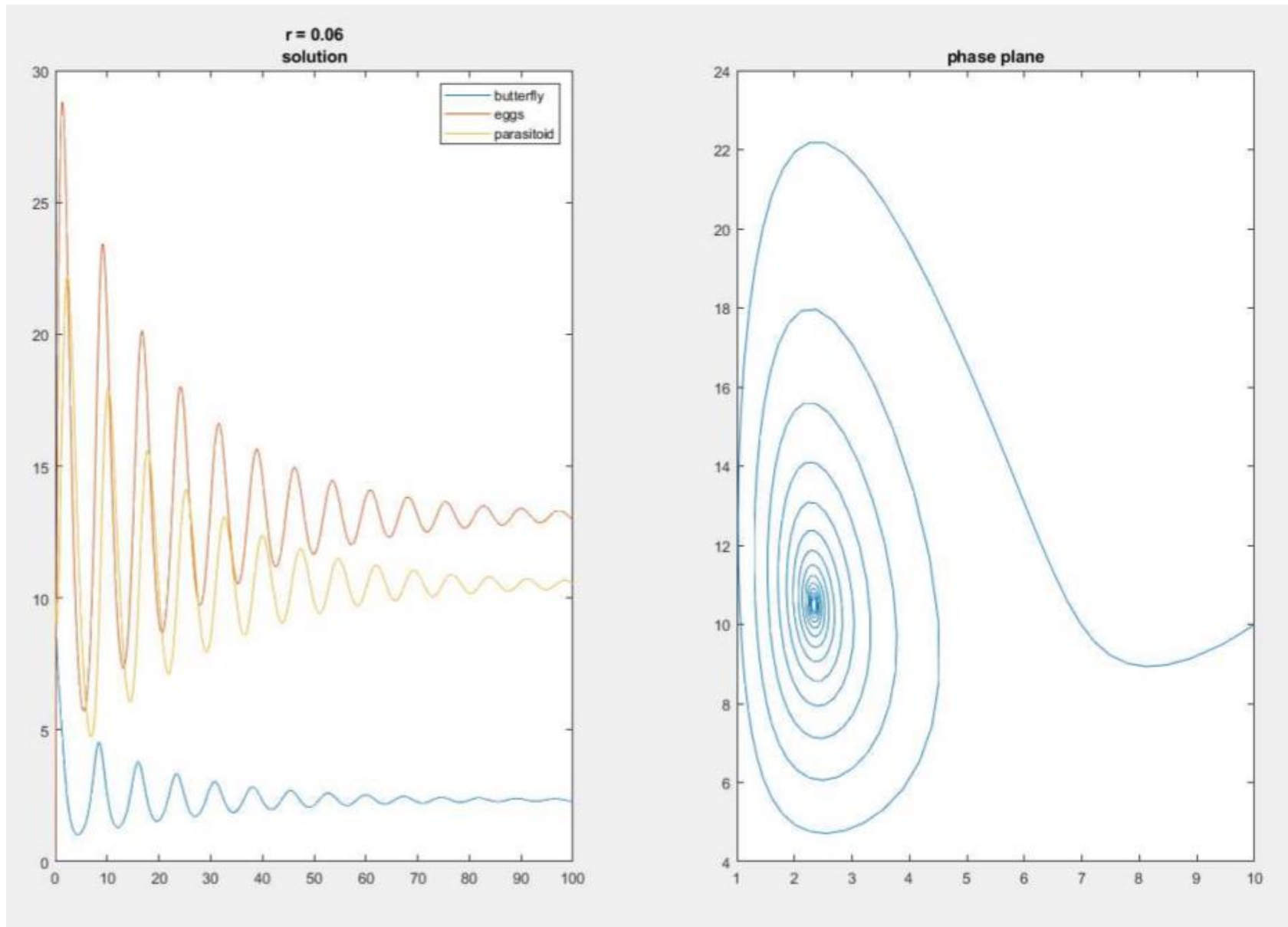


$$\begin{aligned}\dot{x} &= c_1 \delta e^{-p(\alpha+\beta r)} y - d_1 x \\ \dot{y} &= c_2 (1 - e^{-\gamma x}) (1 - \mu) x - \delta y \\ \dot{p} &= c_3 \delta (1 - e^{-p(\alpha+\beta r)}) y - d_2 p\end{aligned}$$

Vizualizace modelu

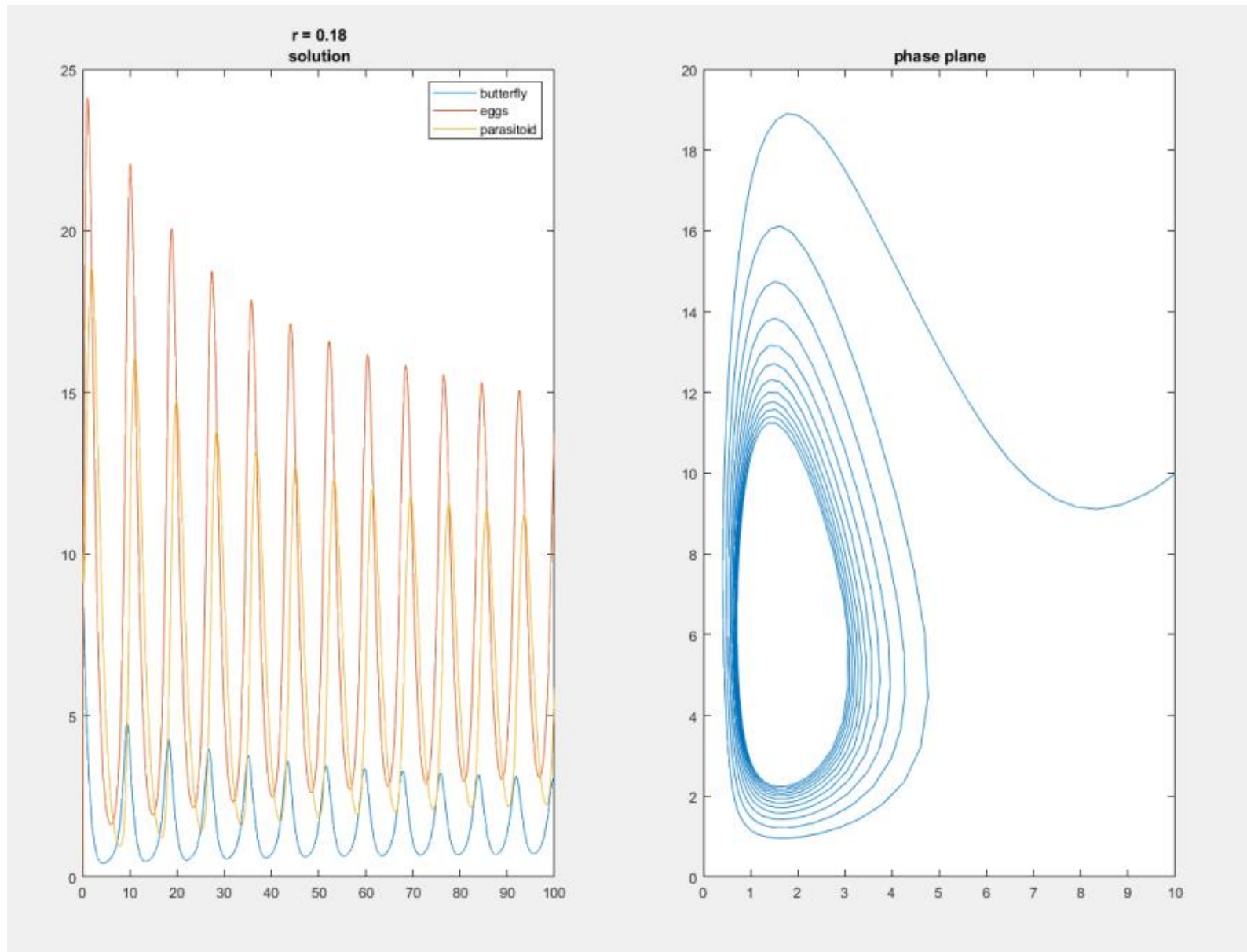


$$x(0) = 10 ; y(0) = 0 ; p(0) = 10$$



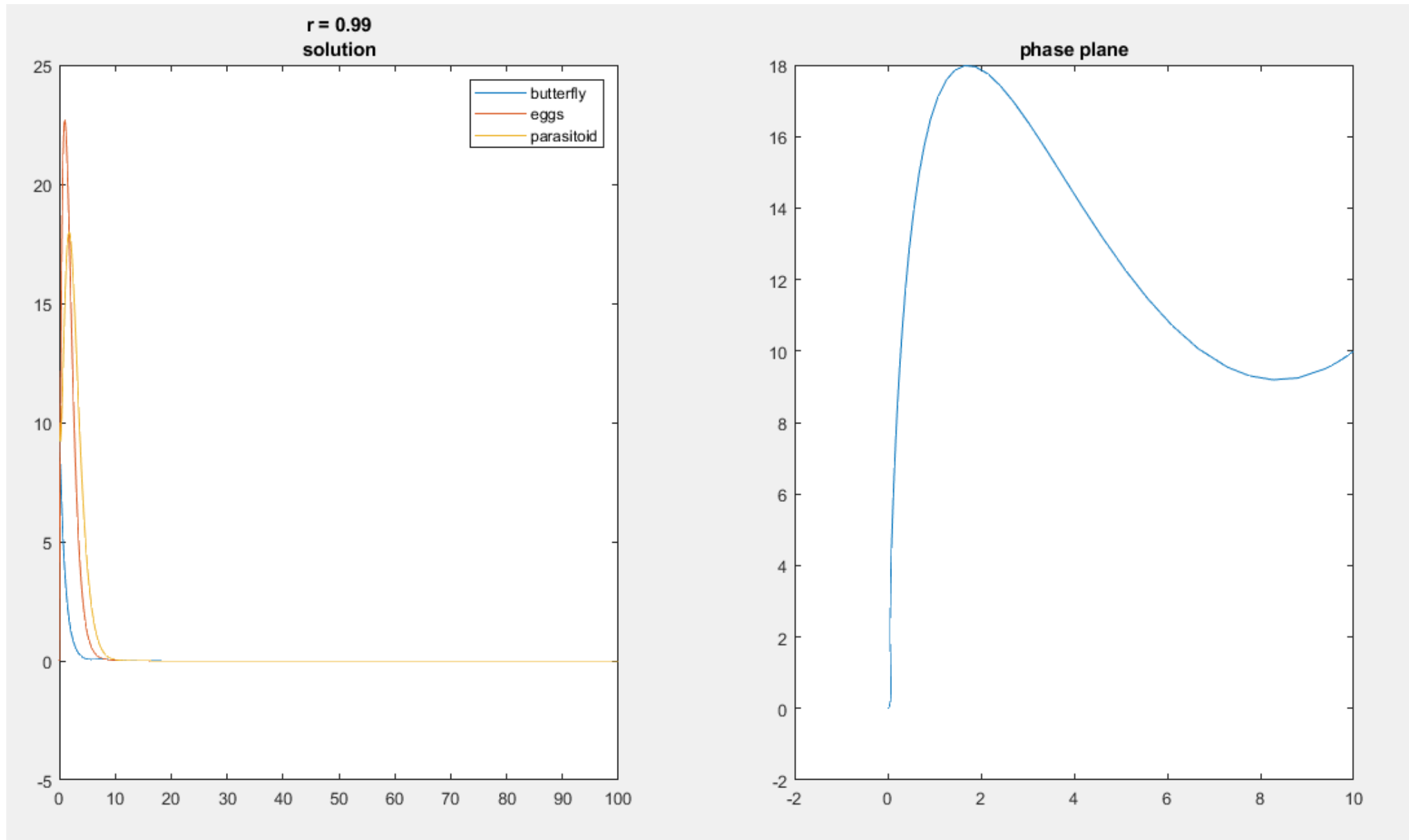
$$c_1 = 0.9 ; c_2 = 20 ; c_3 = 1 ; d_1 = 1 ; d_2 = 1 ; \delta = 1 ; \alpha = 0.1 ; \beta = 0.9 ; \gamma = 1 ; \mu = 0.69$$

$$x(0) = 10 ; y(0) = 0 ; p(0) = 10$$



$$c_1 = 0.9 ; c_2 = 20 ; c_3 = 1 ; d_1 = 1 ; d_2 = 1 ; \delta = 1 ; \alpha = 0.1 ; \beta = 0.9 ; \gamma = 1 ; \mu = 0.69$$

$$x(0) = 10 ; y(0) = 0 ; p(0) = 10$$



$$c_1 = 0.9 ; c_2 = 20 ; c_3 = 1 ; d_1 = 1 ; d_2 = 1 ; \delta = 1 ; \alpha = 0.1 ; \beta = 0.9 ; \gamma = 1 ; \mu = 0.69$$

Sestavený model 1. modifikace



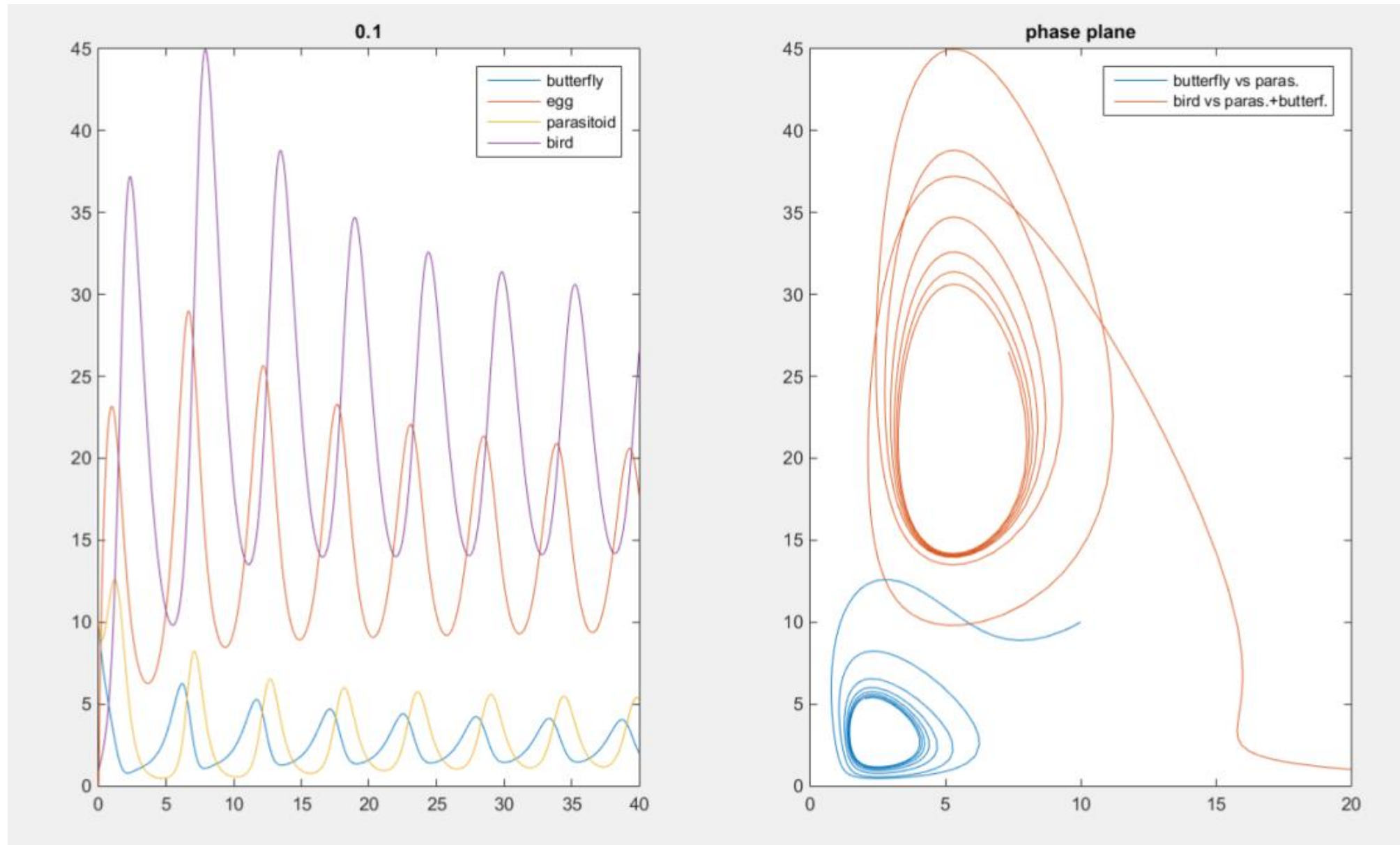
$$\dot{x} = c_1 \delta e^{-p(\alpha + \beta r)} y - d_1 x - k_3 x b$$

$$\dot{y} = c_2 (1 - e^{-\gamma x}) (1 - \mu) x - \delta y$$

$$\dot{p} = c_3 \delta (1 - e^{-p(\alpha + \beta r)}) y - d_2 p - k_4 p b$$

$$\dot{b} = k_1 p b + k_2 x b - d_3 b$$

$$x(0) = 10 ; y(0) = 0 ; p(0) = 10 ; b(0) = 1$$



$$c_1 = 0.9 ; c_2 = 20 ; c_3 = d_1 = d_2 = \delta = \gamma = 1 ; \alpha = 0.1 ; \beta = 0.9 ; \mu = 0.69 ; k_1 = 0.19 ; k_2 = 0.188 ; k_3 = 0.1 ; k_4 = 0.05$$

2. otázka



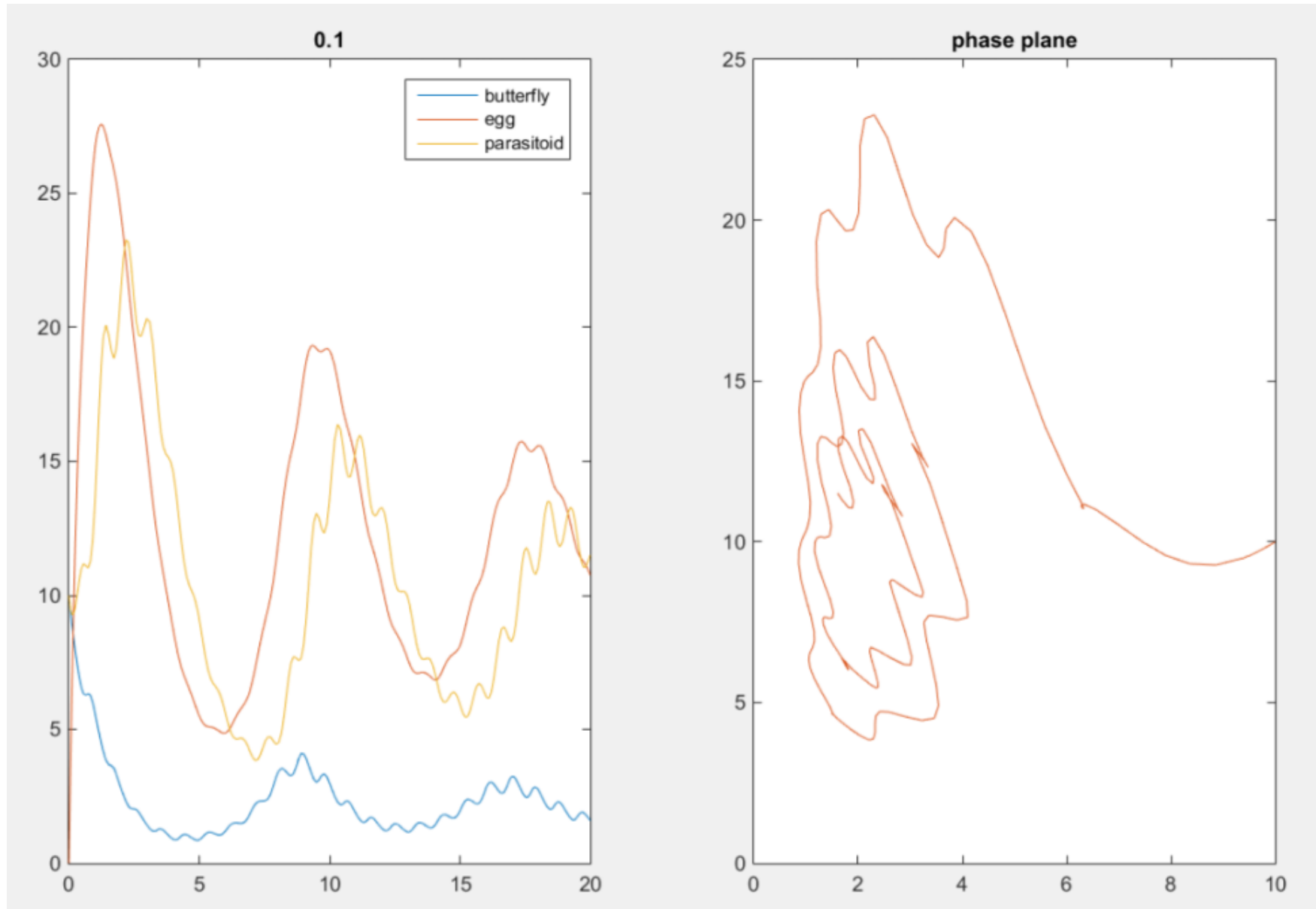
A. Samička se bude snažit najít partnera, který nepoužívá feromon

Sestavený model 3. modifikace



$$\begin{aligned}\dot{x} &= c_1 \delta e^{-p(\alpha+\beta r)} (1+0.5 \sin \omega t) y - d_1 x \\ \dot{y} &= c_2 (1 - e^{-\gamma x}) (1 - \mu) x - \delta y \\ \dot{p} &= c_3 \delta (1 - e^{-p(\alpha+\beta r)} (1+0.5 \sin \omega t)) y - d_2 p\end{aligned}$$

$$x(0) = 10 ; y(0) = 0 ; p(0) = 10$$



$$c_1 = 0.9 ; c_2 = 20 ; c_3 = 1 ; d_1 = 1 ; d_2 = 1 ; \delta = 1 ; \alpha = 0.1 ; \beta = 0.9 ; \gamma = 1 ; \mu = 0.69 ; \omega = 7$$



- A. http://motyli.net/pieridae.php?lepidoptera=pieris_brassicae
- B. <https://bugguide.net/node/view/1147652>
- C. <https://temata.rozhlas.cz/rychly-jako-motyl-7863231Z>