$$\frac{dx}{dt} = \left(\alpha_x \left(k_1 + \frac{(1-k_1)z}{z+k_2}\right) - \beta_x \left(k_3 + \frac{(1-k_3)z}{z+k_4}\right) - m_1 \left(1 - \frac{z}{z_0}\right)\right) x$$

$$\frac{dy}{dt} = m_1 \left(1 - \frac{z}{z_0}\right) x + \left(\alpha_y \left(1 - d\frac{z}{z_0}\right) - \beta_y\right) y$$

$$\frac{dz}{dt} = \frac{z_0 - z}{\tau}$$

$$\frac{dy}{dt} = \left(\left(\frac{(1-k_0)z}{z_0}\right) - \left(\frac{(1-k_0)z}{z_0}\right)\right) x + \left(\frac{(1-k_0)z}{z_0}\right) x + \left(\frac{(1-k_0)z}{z$$

$$\frac{dv}{dt} = \left(\alpha_x \left(k_1 + \frac{(1 - k_1)z}{z + k_2}\right) - \beta_x \left(k_3 + \frac{(1 - k_3)z}{z + k_4}\right) - m_1 \left(1 - \frac{z}{z_0}\right)\right) x$$

$$\left(k_1 + \frac{(1-k_1)z}{z+k_2}\right) - \beta_x \left(k_3 + \frac{(1-k_3)z}{z+k_4}\right) - \beta_x \left(k_3 + \frac{(1-k_3)z}{z+k_4}\right)$$

$$\begin{pmatrix} x & z + k_2 \end{pmatrix} \qquad \begin{pmatrix} z + k_4 \end{pmatrix}$$

 $+ m_1 \left(1 - \frac{z}{z_0} \right) x + \left(\alpha_y \left(1 - d \frac{z}{z_0} \right) - \beta_y \right) y$