

$$\begin{aligned}
\frac{dM_R}{dt} = & sr_M + \alpha_{4A}(M_A + \omega_2 M_1) + sr_{4B} \frac{F_a}{F_a + f_8 I_{10} + s_{4b}} \\
& - k_2 M_R \frac{B_E}{B_E + c_9} - k_3 M_R \frac{I_\gamma}{I_\gamma + f_1 I_4 + s_1} \frac{B_T + \beta F_\alpha}{B_T + \beta F_\alpha + c_8} \\
& - \mu_{MR} M_R
\end{aligned} \tag{1}$$

$$\begin{aligned}
\frac{dM_I}{dt} = & k_2 M_R \frac{B_E}{B_E + c_9} - k_{17} M_I \frac{B_I^2}{B_I^2 + (NM_1)^2} \\
& - k_{14A} M_I \frac{(T_c + \omega_3 T_1)/M_1}{(T_c + \omega_3 T_1)/M_1 + c_4} - k_{14B} M_I \frac{F_\alpha}{F_\alpha + f_9 I_{10} + s_{4B}} \\
& - k_{52} M_I \frac{(T_c(T_1/(T_1 + c_{T1})) + \omega_1 T_1)/M_I}{(T_c(T_1/(T_1 + c_{T1})) + \omega_1 T_1)/M_I + c_{52}} - \mu_{MI} M_I
\end{aligned} \tag{2}$$

$$\frac{dM_A}{dt} = k_3 M_R \frac{I_\gamma}{I_\gamma + f_1 I_4 + s_1} \frac{B_T + \beta F_\alpha}{B_T + \beta F_\alpha + c_8} - k_4 M_A \frac{I_{10}}{I_{10} + s_8} - \mu_{MA} M_A \tag{3}$$

$$\begin{aligned}
\frac{dT_0}{dt} = & \alpha_{1A}(M_A + \omega_2 M_I) + sr_{1B} \frac{F_a}{F_a + f_8 I_{10} + s_{4b2}} + \alpha_2 T_0 \frac{M_A}{M_A + c_{15}} \\
& - k_6 I_{12} T_0 \frac{I_\gamma}{I_\gamma + (f_1 I_4 + f_7 I_{10}) + s_1} - k_7 T_0 \frac{I_4}{I_4 + f_2 I_\gamma + s_2} \\
& - \mu_{T0} T_0
\end{aligned} \tag{4}$$

$$\begin{aligned}
\frac{dT_1}{dt} = & \alpha_{3A}(M_A + \omega_2 M_I) + sr_{3B} \frac{F_a}{F_a + f_8 I_{10} + s_{4b1}} \\
& + k_6 I_{12} T_0 \frac{I_\gamma}{I_\gamma + (f_1 I_4 + f_7 I_{10}) + s_1} - \mu_{T\gamma} \frac{I_\gamma}{I_\gamma + c} T_1 M_A - \mu_{T1} T_1
\end{aligned} \tag{5}$$

$$\begin{aligned}
\frac{dT_2}{dt} = & \alpha_{3A2}(M_A + \omega_2 M_I) + sr_{3B2} \frac{F_a}{F_a + f_8 I_{10} + s_{4b1}} \\
& + k_7 T_0 \frac{I_4}{I_4 + f_2 I_\gamma + s_2} - \mu_{T2} T_2
\end{aligned} \tag{6}$$

$$\begin{aligned}
\frac{dT_{80}}{dt} = & \alpha_{1A}(M_A + \omega_2 M_I) + sr_{1B} \frac{F_a}{F_a + f_8 I_{10} + s_{4b2}} + \alpha_2 T_{80} \frac{M_A}{M_A + c_{15}} \\
& - k_6 I_{12} T_{80} \frac{I_\gamma}{I_\gamma + (f_1 I_4 + f_7 I_{10}) + s_1} \\
& - \mu_{T80} T_{80}
\end{aligned} \tag{7}$$

$$\begin{aligned} \frac{dT_8}{dt} = & m * \alpha_{3Ac}(M_A + \omega_2 M_I) + m * sr_{3Bc} \frac{F_a}{F_a + f_8 I_{10} + s_{4b1}} \\ & + m * k_6 I_{12} T_{80} \frac{I_\gamma}{I_\gamma + (f_1 I_4 + f_7 I_{10}) + s_1} - \mu_{Tc\gamma} \frac{I_\gamma}{I_\gamma + c_c} T_8 M_A \\ & - \mu_{T8} T_8 \end{aligned} \quad (8)$$

$$\begin{aligned} \frac{dT_c}{dt} = & m * \alpha_{3Ac}(M_A + \omega_2 M_I) + m * sr_{3Bc} \frac{F_a}{F_a + f_8 I_{10} + s_{4b1}} \\ & + m * k_6 I_{12} T_{80} \frac{I_\gamma}{I_\gamma + (f_1 I_4 + f_7 I_{10}) + s_1} - \mu_{Tc\gamma} \frac{I_\gamma}{I_\gamma + c_c} T_c M_A \\ & - \mu_{Tc} T_c \end{aligned} \quad (9)$$

$$\begin{aligned} \frac{dF_\alpha}{dt} = & \alpha_{30} M_I + \alpha_{30} M_A \frac{I_\gamma + \beta_2 B_T}{I_\gamma + \beta_2 B_T + (f_1 I_4 + f_7 I_{10}) + s_{10}} \\ & + \alpha_{32} T_1 + \alpha_{33} (T_c + T_8) - \mu_{F\alpha} F_\alpha \end{aligned} \quad (10)$$

$$\begin{aligned} \frac{dI_\gamma}{dt} = & s_g \frac{B_T}{B_T + c_{10}} \frac{I_{12}}{I_{12} + s_7} + \alpha_{5A} T_1 \frac{M_A}{M_A + c_{5A}} + \alpha_{5B} T_8 \frac{M_A}{M_A + c_{5B}} \\ & + \alpha_{5c} M_I + \alpha_7 T_0 \frac{I_{12}}{I_{12} + f_4 I_{10} + s_4} + \alpha_7 T_{80} \frac{I_{12}}{I_{12} + f_4 I_{10} + s_4} \\ & - \mu_{I\gamma} I_\gamma \end{aligned} \quad (11)$$

$$\frac{dI_{12}}{dt} = s_{12} \frac{B_T}{B_T + c_{230}} + \alpha_{23} M_R \frac{B_T}{B_T + c_{23}} + \alpha_8 M_A \frac{s}{s + I_{10}} - \mu_{I12} I_{12} \quad (12)$$

$$\frac{dI_{10}}{dt} = \delta_7 M_A \frac{s_6}{I_{10} + f_6 I_\gamma + s_6} + \alpha_{16} T_1 + \alpha_{17} T_2 + \alpha_{18} (T_8 + T_c) - \mu_{I10} I_{10} \quad (13)$$

$$\frac{dI_4}{dt} = \alpha_{11} T_0 + \alpha_{12} T_2 - \mu_{I4} I_4 \quad (14)$$

$$\frac{dI_4}{dt} = \alpha_{11} T_0 + \alpha_{12} T_2 - \mu_{I4} I_4 \quad (15)$$

$$\begin{aligned} \frac{dB_I}{dt} = & \alpha_{19} B_I \left(1 - \frac{B_I^2}{B_I^2 + (NM_1)^2} \right) + k_2 \frac{N}{2} M_R \frac{B_E}{B_E + c_9} \\ & - k_{17} N M_I \frac{B_I^2}{B_I^2 + (NM_1)^2} - k_{14A} N M_I \frac{(T_c + \omega_3 T_1)/M_1}{(T_c + \omega_3 T_1)/M_1 + c_4} \\ & - k_{14B} N M_I \frac{F_\alpha}{F_\alpha + f_9 I_{10} + s_{4b}} \\ & - k_{52} N * M_I \frac{(T_c(T_1/(T_1 + c_{T1})) + \omega_1 T_1)/M_I}{(T_c(T_1/(T_1 + c_{T1})) + \omega_1 T_1)/M_I + c_{52}} - \mu_I B_I \end{aligned} \quad (16)$$

$$\begin{aligned}
\frac{dB_E}{dt} = & \alpha_{20}B_E + \mu_I B_I - k_{15}M_A B_E - k_{18}M_R B_E + k_{17}N M_I \frac{B_I^2}{B_I^2 + (NM_1)^2} \\
& - k_2 \frac{N}{2} M_R \frac{B_E}{B_E + c_9} + k_{14A} N * N_{frac} M_I \frac{(T_c + \omega_3 T_1)/M_1}{(T_c + \omega_3 T_1)/M_1 + c_4} \\
& + k_{14B} N * N_{frac} M_I \frac{F_\alpha}{F_\alpha + f_9 I_{10} + s_{4b}}
\end{aligned} \tag{17}$$