Counts ODE

$$
\begin{aligned}
dS_j &= \chi_j(t)(1-\epsilon) - \lambda_b S_j - F_j(t)\frac{S_j}{N_j} \\
dI_j &= \chi_j(t)\epsilon + \lambda_b S_J - \gamma_b I_j - F_j(t)\frac{I_j}{N_j} \\
dR_j &= \gamma_b I_j - F_j(t)\frac{R_j}{N_j}
\end{aligned}
$$

Where ϵ is the proportion of incoming birds entering as infected, $\chi_j(t)$ and $F_j(t)$ are the rates of birds enter and leaving (respectively) species j at time t. //

$$
\begin{aligned}
s &= \frac{S}{N} \\
i &= \frac{I}{N} \\
r &= \frac{R}{N}
\end{aligned}
$$

We apply the following variable transform:

Which yields the following set of differntial equations

$$
\begin{aligned}
ds_j &= \frac{\chi_j(t)(1-\epsilon-s_j)}{N_j} - \lambda_b s_j \\
di_j &= \frac{\chi_j(t)(\epsilon-i_j)}{N_j} + \lambda_b s_j - \gamma_b i_j \\
dr_j &= \gamma_b i_j - \frac{\chi_j(t) r_j}{N_j}
\end{aligned}
$$