

S1 Text: Derivation of survival equations

The instantaneous, stage specific survival can be written as:

$$S_i(t) = e^{-\int_{t-\tau_i(t)}^t \mu_i(t) dt} \quad (\text{Equation A})$$

where $i = \{J, A\}$, J and A denote juvenile and adult mosquito populations, respectively, $\mu_i(t)$ is the stage-specific mortality and τ_i is the stage-specific development time. First, the derivative of Equation A is taken to give:

$$\frac{dS_i(t)}{dt} = S_i(t) \left[\frac{d}{dt} \left(-\int_{t-\tau_i(t)}^t \mu_i(t) dt \right) \right] \quad (\text{Equation B})$$

which is further evaluated as:

$$\frac{dS_i(t)}{dt} = S_i(t) \left[\frac{d}{dt} (t - \tau_i(t)) \mu_i(t - \tau_i(t)) - \frac{dt}{dt} \mu_i(t) \right] \quad (\text{Equation C})$$

and subsequently as:

$$\frac{dS_i(t)}{dt} = S_i(t) \left[\left(1 - \frac{d\tau_i(t)}{dt} \right) \mu_i(t - \tau_i(t)) - \mu_i(t) \right] \quad (\text{Equation D})$$

Since $\frac{d\tau_i(t)}{dt} = 1 - \left(\frac{g_i(t)}{g_i(t - \tau_i(t))} \right)$, then this can be substituted into Equation D to give:

$$\frac{dS_i(t)}{dt} = S_i(t) \left[\left(1 - 1 + \frac{g_i(t)}{g_i(t - \tau_i(t))} \right) \mu_i(t - \tau_i(t)) - \mu_i(t) \right] \quad (\text{Equation E})$$

which simplifies to

$$\frac{dS_i(t)}{dt} = S_i(t) \left[\frac{g_i(t) \mu_i(t - \tau_i(t))}{g_i(t - \tau_i(t))} - \mu_i(t) \right]. \quad (\text{Equation F})$$