# Appendix

In this appendix, we show how the logistic growth equation can be obtained from the population dynamics equation used in our paper (Eq. 1 of the article) by expressing the rate constatnts $k_E$ and $\gamma$ as linear functions of $N$.

When considering $k_E$ and $\gamma$ as functions of the expected population, we can use for both the Taylor expansion around $N_{eq}$ truncated to the first order terms to obtain

$$k_E = k_E^0 + \eta(N - N_{eq}) \tag{A-1}$$

$$\gamma = \gamma^0 + \beta(N - N_{eq}) \tag{A-2}$$

with $k_E^0, \gamma^0$ the rate constant values at $N = N_{eq}$ and $\eta, \beta \geq 0$ the corresponding first derivatives, providing

$$
\begin{aligned}
\dot{N} &= \frac{k}{4} N^2 - \Big[k_E^0 + \eta(N - N_{eq})\Big] N - \Big[\gamma^0 + \beta(N - N_{eq})\Big] (N - N_{eq}) \\
&= -\Big[\eta + \beta - \frac{k}{4}\Big] N^2 \quad + \quad \Big[N_{eq}\eta + 2N_{eq}\beta - k_E^0 - \gamma^0\Big] N + N_{eq}(\gamma^0 - N_{eq}\beta) \qquad \text{(A-3)}
\end{aligned}
$$

By assuming $N_{eq}(\gamma^0 - N_{eq}\beta) = 0$ and hence $\gamma^0 = N_{eq}\beta$, we can retrieve the logistic equation

$$
\begin{aligned}
\dot{N} &= -\Big[\eta + \beta - \frac{k}{4}\Big] N^2 + \Big[N_{eq}(\eta + \beta) - k_E^0\Big] N \\
&= N\Big[N_{eq}(\eta + \beta) - k_E^0\Big]\Big[1 - \frac{(\eta + \beta - k/4)N}{N_{eq}(\eta + \beta) - k_E^0}\Big] \\
&= Nr\Big(1 - \frac{N}{K_C}\Big) \qquad \text{(A-4)}
\end{aligned}
$$

where

$$
\begin{aligned}
r &= N_{eq}(\eta + \beta) - k_E^0 \qquad \text{(A-5)} \\
K_C &= \frac{N_{eq}(\eta + \beta) - k_E^0}{\eta + \beta - k/4} \qquad \text{(A-6)}
\end{aligned}
$$

with $r, K_C > 0$ and thus $\eta + \beta > k/4,\ N_{eq}(\eta + \beta) > k_E^0$.

Once realizing that from Eq. A-3 $N_{eq} = 4k_E^0/k$, we readily obtain $K_C = 4k_E^0/k$ showing that the carrying capacity $K_C$ corresponds to the equilibrium population $N_{eq}$. It should be noted that the condition $\gamma^0 = N_{eq}\beta$ (necessary to retrieve the logistic equation) implies that for $\beta = 0$ no migration term is present.