

Logistic Growth, Continuous Time

Instantaneous Feedback via Self-regulation

Temporal Variation in Carrying Capacity

Form of Environmental Variation:

All Individuals at time t Experience $K(t)$

$$\frac{dN(t)}{dt} = r N_t \left(1 - \frac{N_t}{K(t)} \right)$$

$K(t)$: Random variation, Periodic variation

Not Demographic variation

Random Variation in K

Max density environment supports **changes unpredictably**

Average density < Average K

$$\langle N_t \rangle \approx \langle K \rangle - \left(\frac{1}{2} \right) V[K]$$

$V[K]$: Variance K over time

Greater variance in carrying capacity \Rightarrow

Smaller average population density

Population with larger r : “Tracks” $K(t)$ more closely

Smaller r : Less responsive, Lower Mean $N(t)$

Periodic Variation in K

Max density environment supports changes predictably;

Cycles from milder to harsher environment

Amplitude, Periodicity

Population larger r : Tracks $K(t)$ better

Consider Effect of Body Mass on

Response of Dynamics to Temporal variation in K

Cycle length of $K(t) = c$

$rc \ll 1 \Rightarrow$ Population “averages” fluctuations in K

Environment changes too fast

$rc \gg 1 \Rightarrow$ Population “tracks” fluctuations in K

“Small” organisms: larger r

Generation time shorter, more likely shorter than
period of environmental fluctuation