

Population Dynamics & Harvest

Logistic growth:

$$N_{t+1} = N_t + N_t * r$$

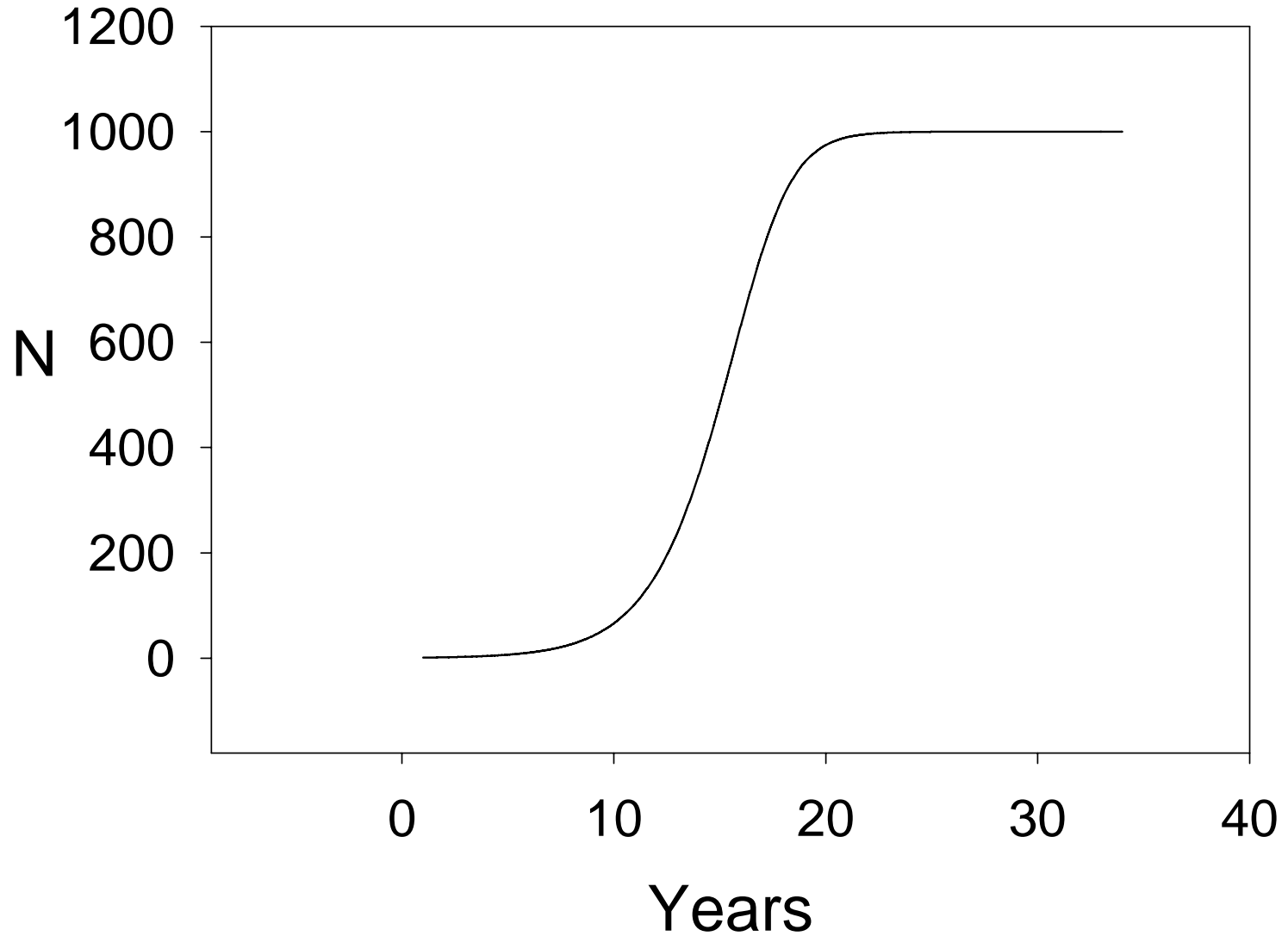
With density dependence:

$$N_{t+1} = N_t + N_t * r(1 - [N_t / K])$$

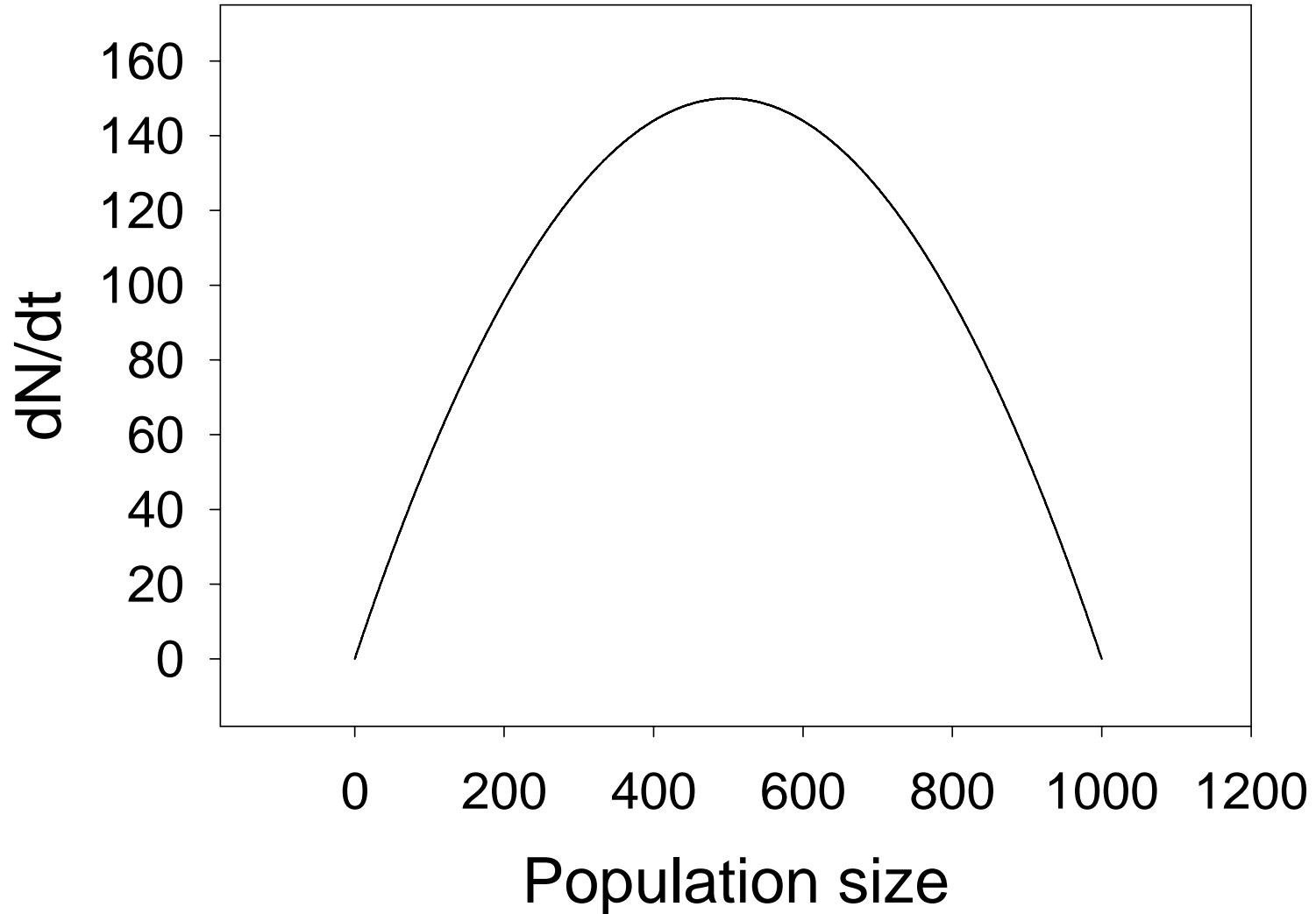
Assume: $r = 0.6$, $K = 1000$

$$N_{t+1} = N_t + N_t * 0.6(1 - [N_t / 1000])$$

$$N_{t+1} = N_t + N_t * 0.6(1 - N_t / 1000)$$



$$dN/dt = N + r(1 - N/1000)$$



What is the MSY?

Formula:

$$\mathbf{MSY = \frac{1}{2} r * \frac{1}{2}K}$$

where: **r** is the intrinsic growth rate
 K is carrying capacity

What is the MSY?

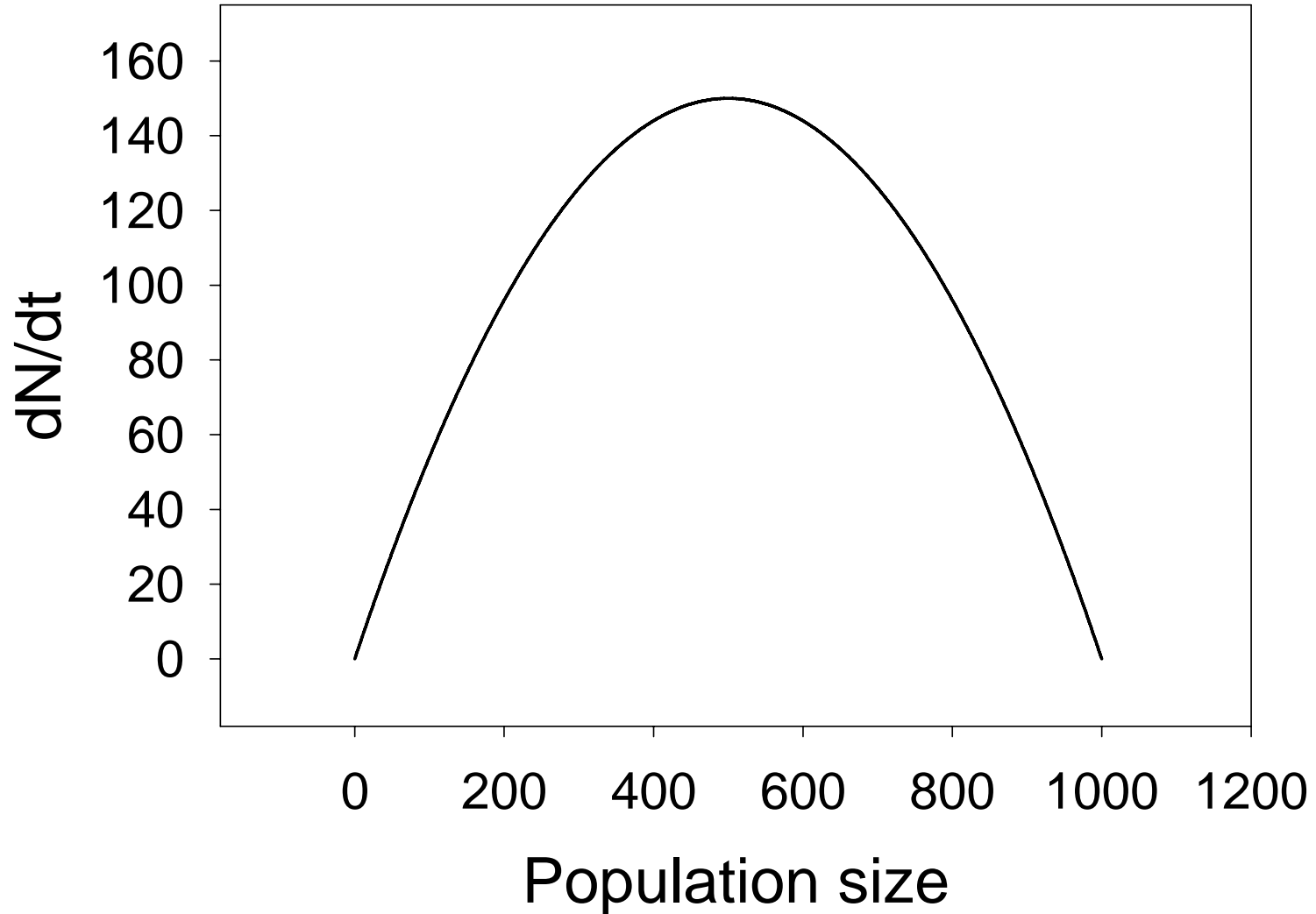
Formula:

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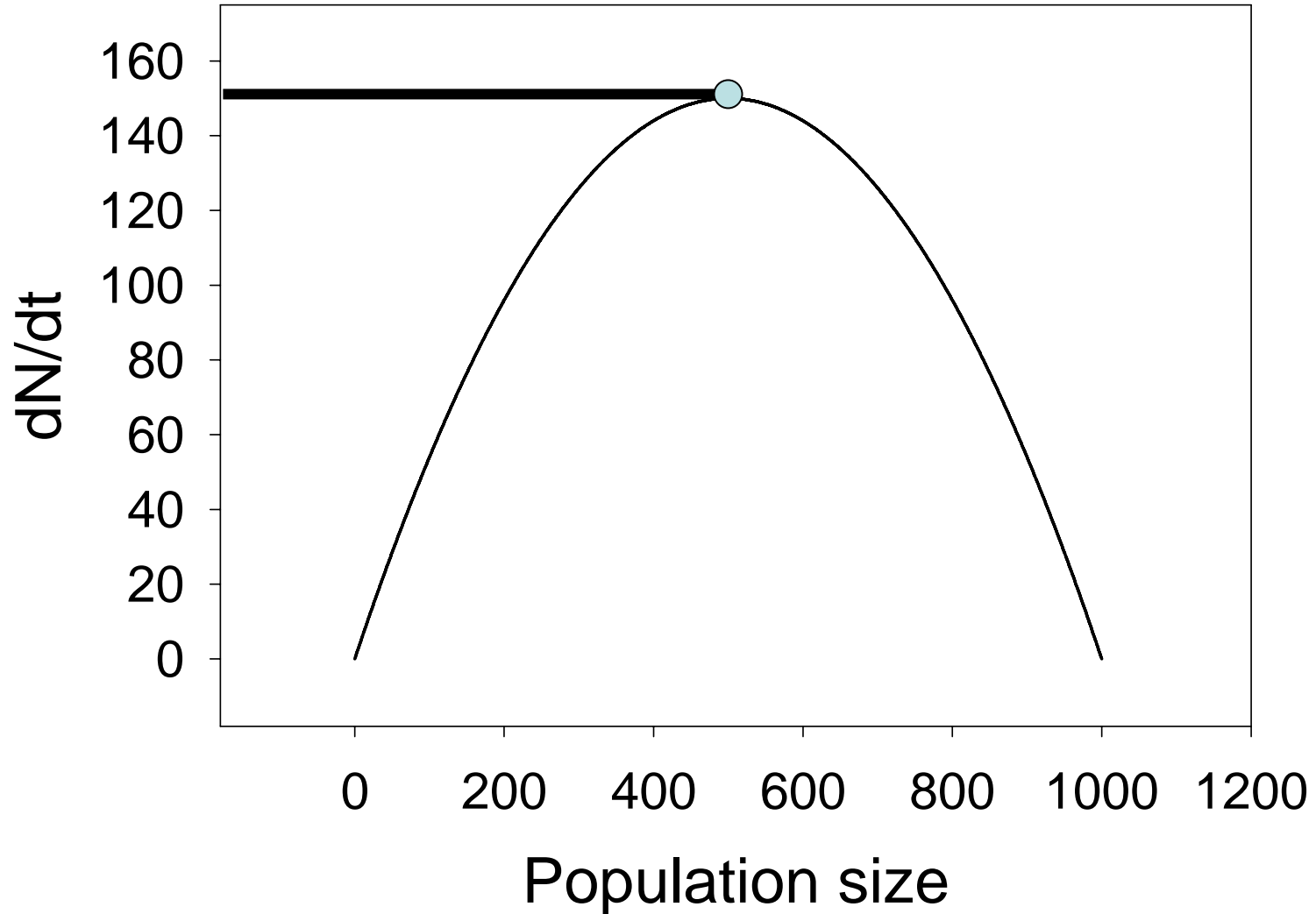
where: **r** is the intrinsic growth rate
 K is carrying capacity

$$\begin{aligned}\mathbf{MSY} &= (\mathbf{\frac{1}{2} * 0.6}) * (\mathbf{\frac{1}{2} * 1000}) \\ &= \mathbf{0.3 * 500} \\ &= \mathbf{150}\end{aligned}$$

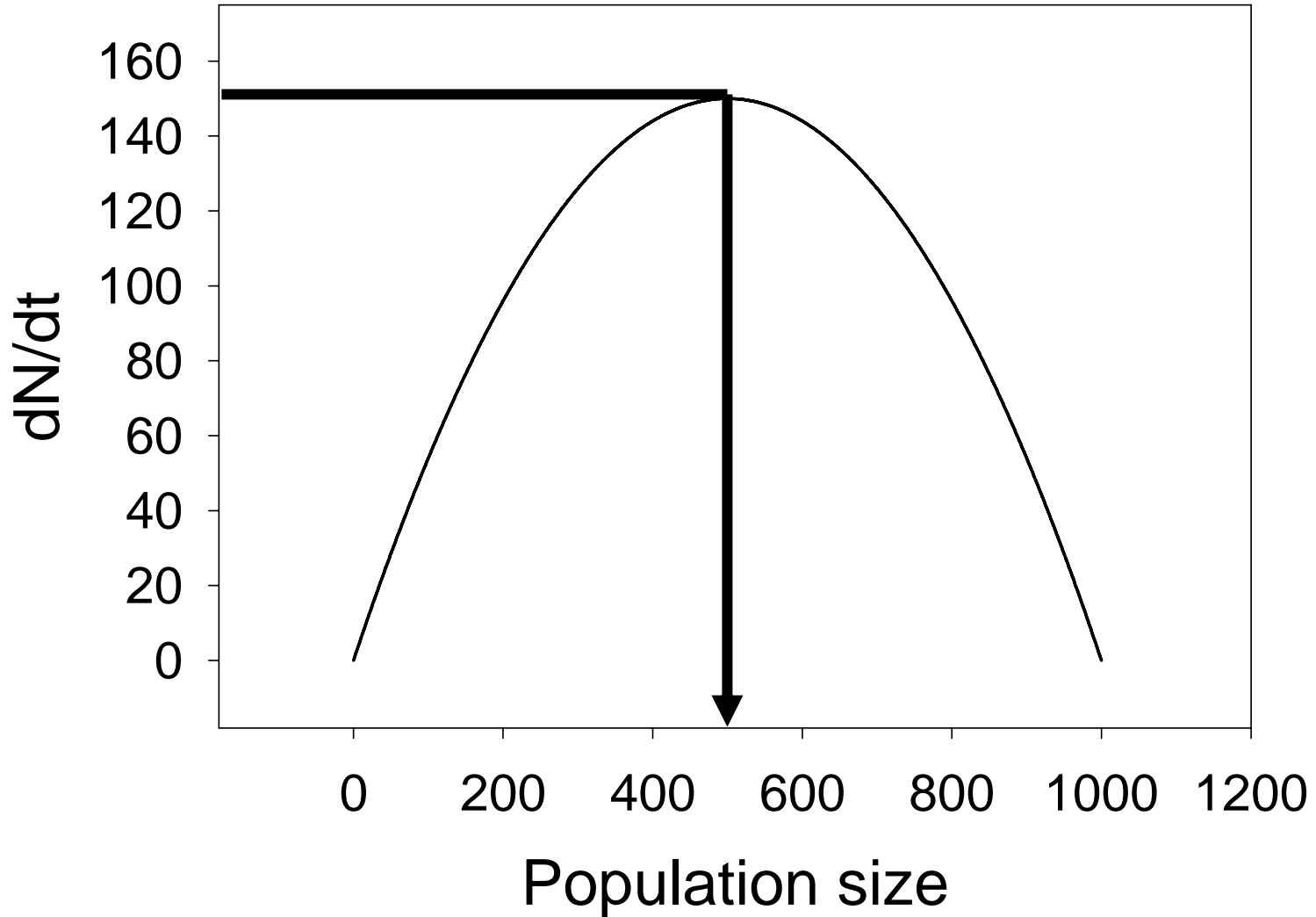
$$dN/dt = N + r(1 - N/1000)$$



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$$\frac{dN}{dt} = N + r(1 - N/1000)$$



What is the MSY?

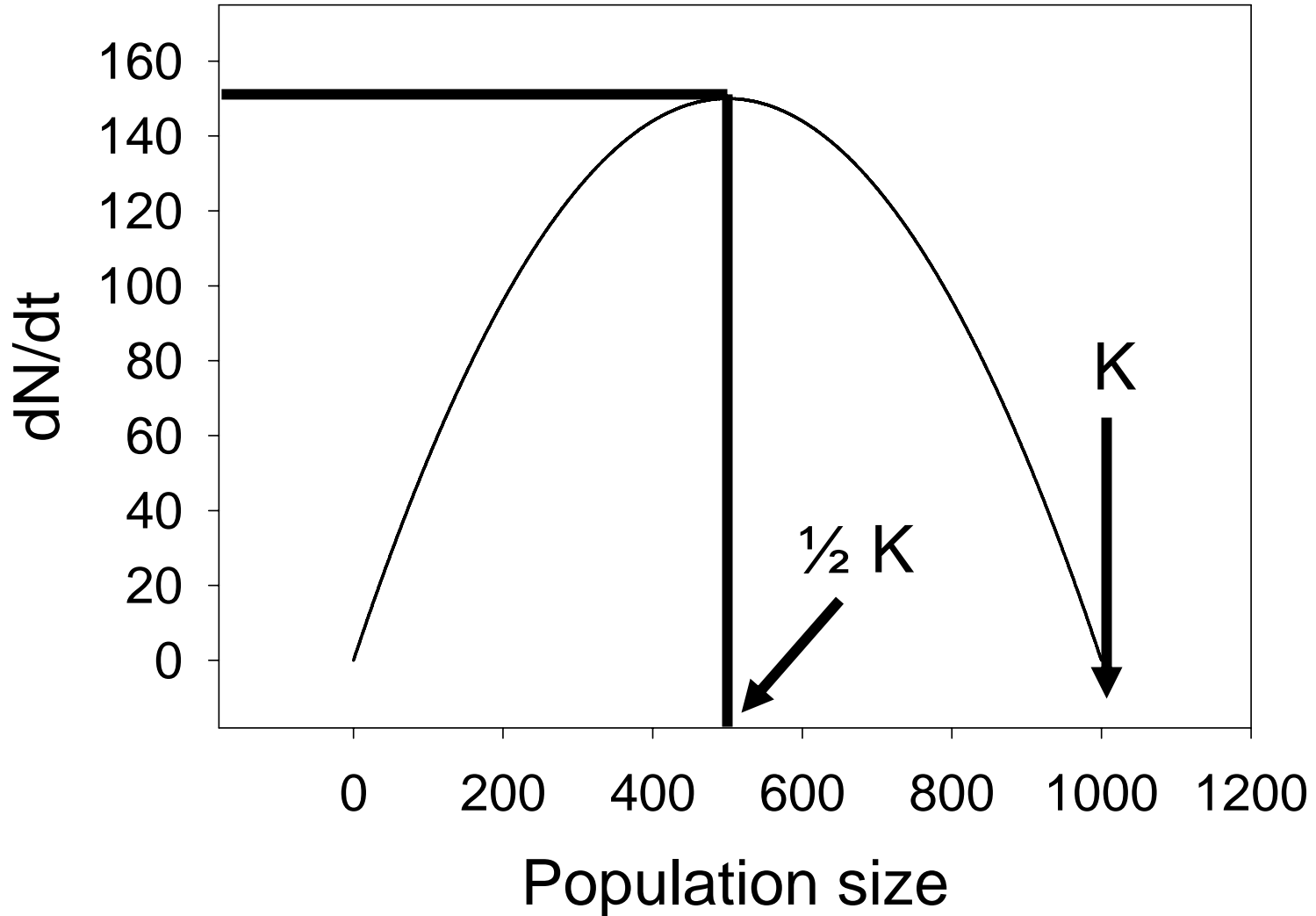
Formula:

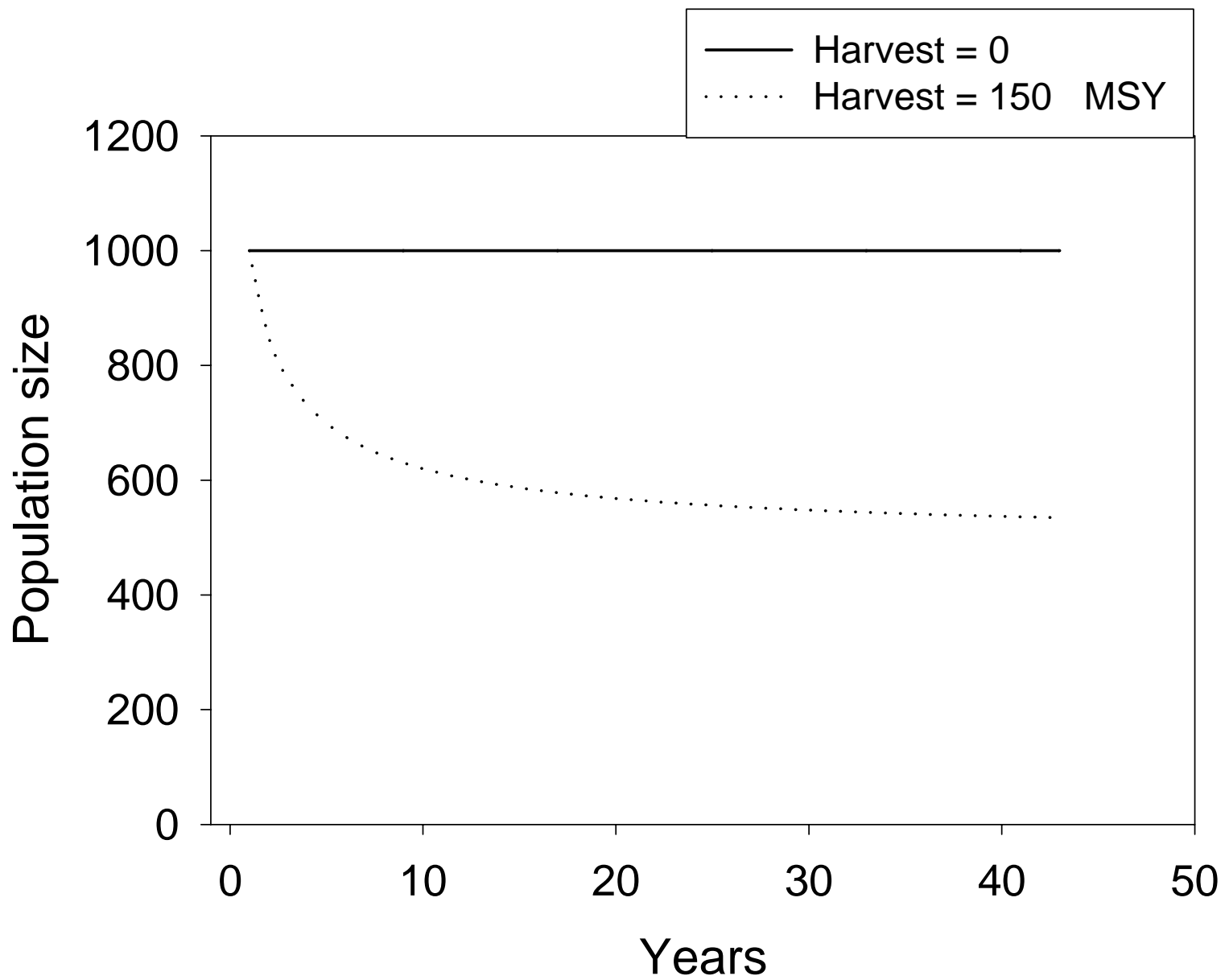
$$\mathbf{MSY = \frac{1}{2} r * \frac{1}{2}K}$$

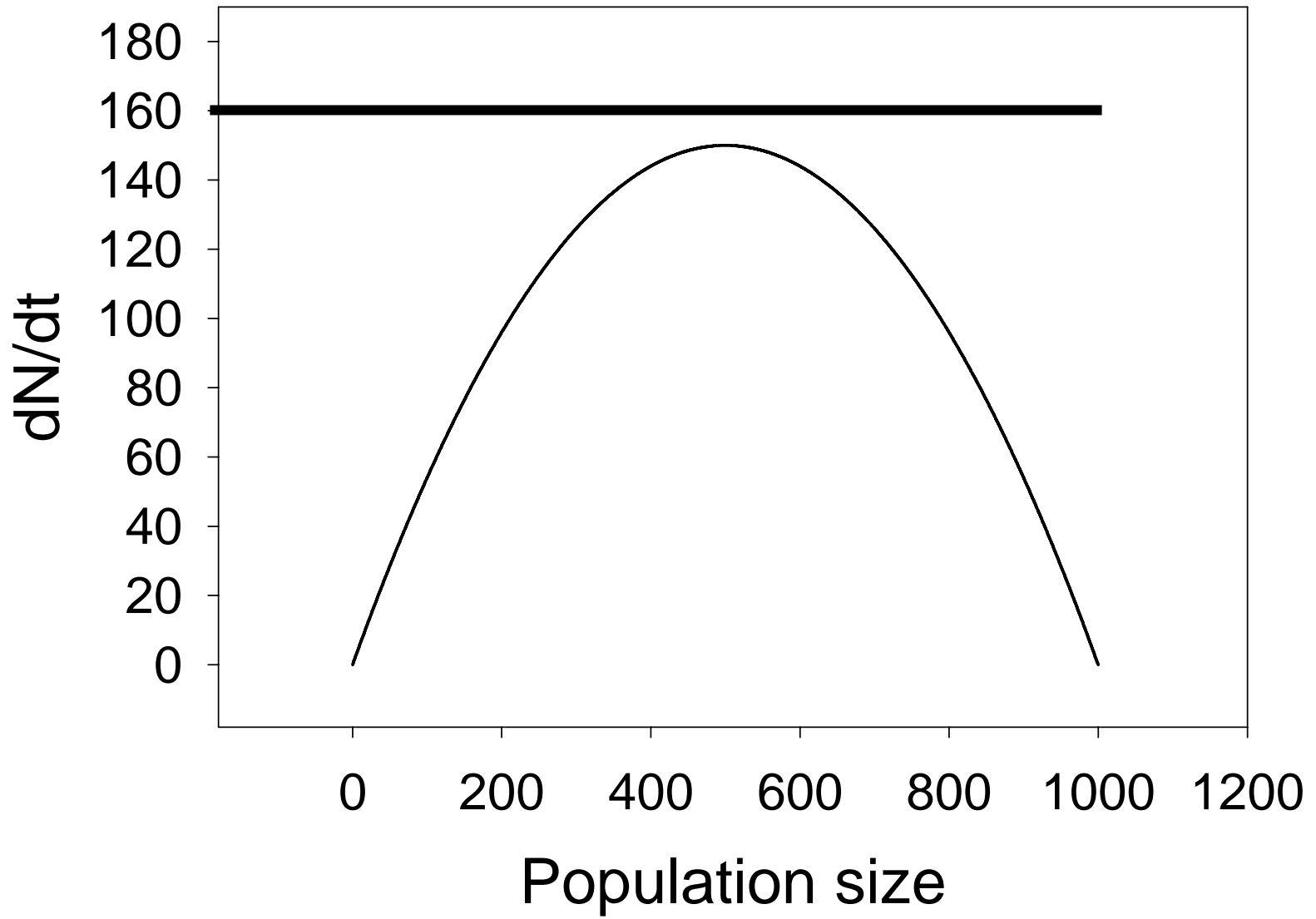
Graphical depiction:

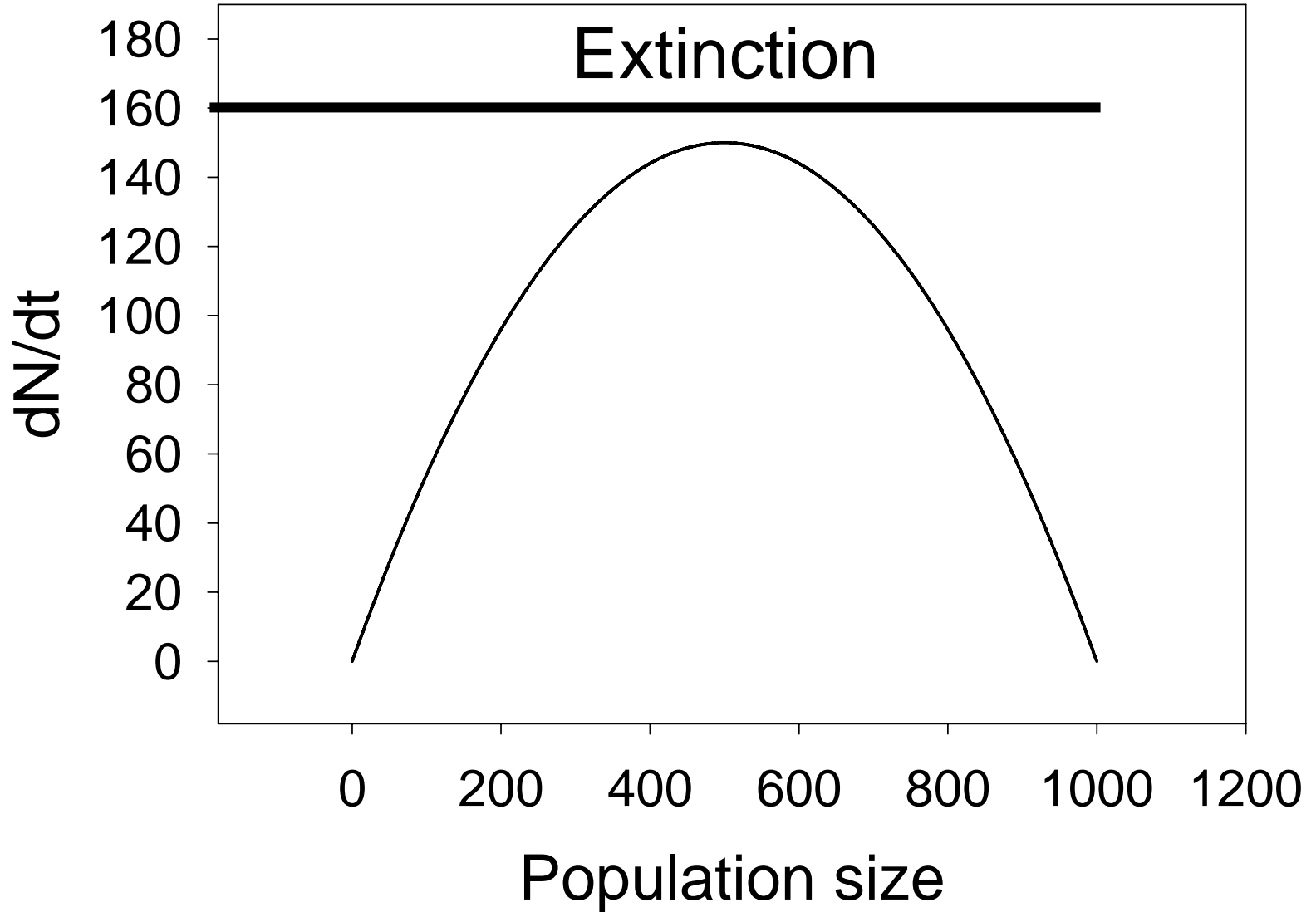
MSY = the recruitment that results when the population is at $\frac{1}{2} K$.

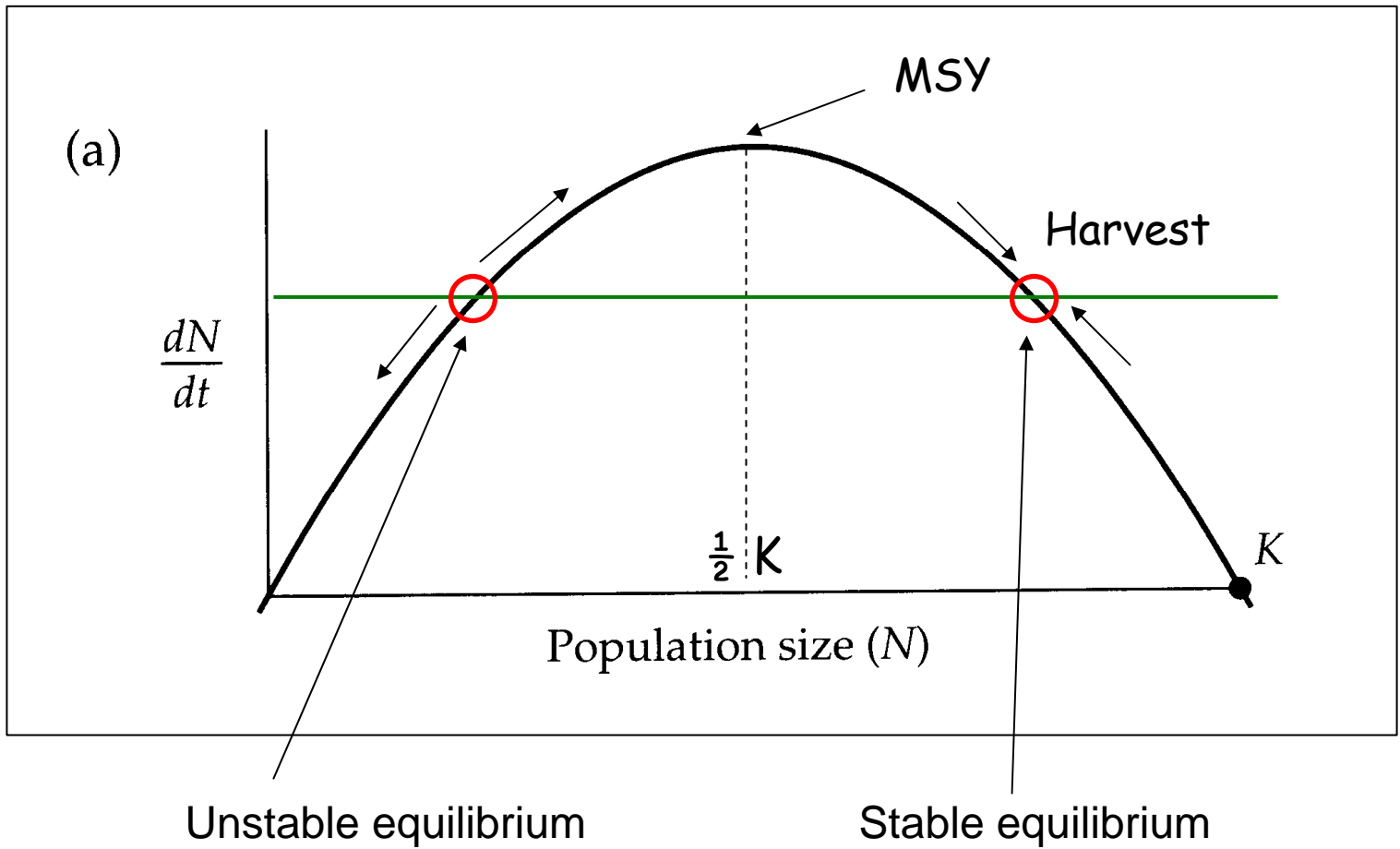
$$\frac{dN}{dt} = N + r(1 - N/1000)$$

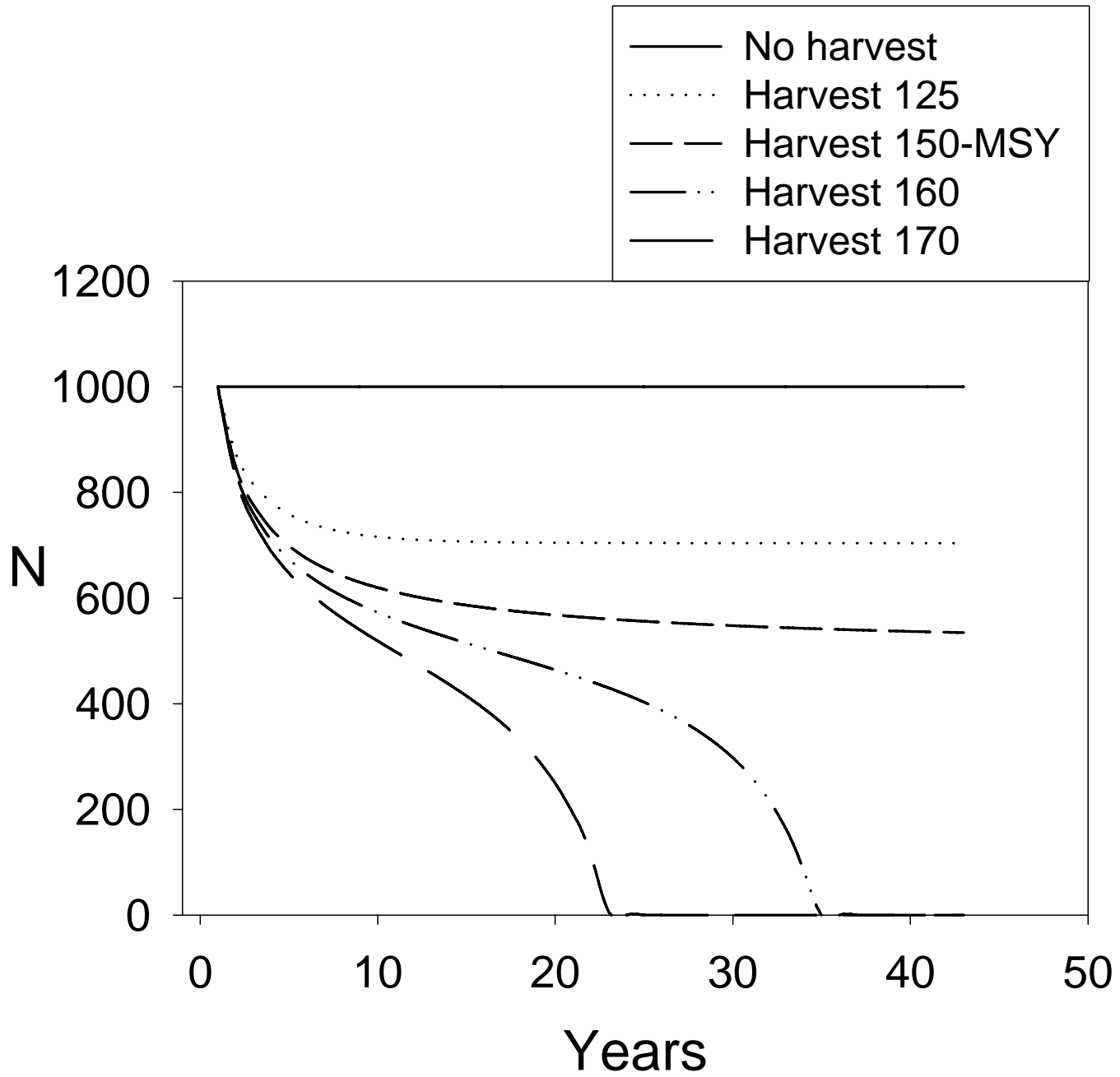












Maximum sustained yield

Assumptions:

- Constant birth and death rates (no stochasticity) and no immigration or emigration
- Constant K
- No age structure or reproductive variance
- Constant sex ratio
- Relationship between density and rate of increase is linear
- The effect of density on rate of increase is instantaneous

- What happens if birth or death rates are less than what we think they are?
- What happens if K or sex ratio fluctuates?
- Do managers have complete control of harvest?

Problems with assumptions

- Each individual added probably does not cause a decrement of r
- K varied seasonally or with climate
- Reproductive success has high variance
- Much immigration and emigration
- Allee effect
- Time lags