$$r_t = r_0 e^{-\alpha t}$$

$$\frac{dN_t}{dt} = r_0 \ln \frac{K}{N_t} N_t$$

seperating variables:

$$\frac{d \ln N_t}{\ln K - \ln N_t} = r_0 dt$$

thus the solution is:

$$N_t = K e^{-\ln \frac{K}{N_0} e^{-r_0 t}}$$

where:

$$N_0 = \text{the initial population size}$$
$$N_t = \text{the population size at time t}$$
$$r_0 = \text{maximum growth rate } [1/\text{time step}]$$
$$K = \text{carrying capacity}$$