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Ekologi Populasi

Bagian 2: Dinamika populasi

Siti Nurleily Marliana

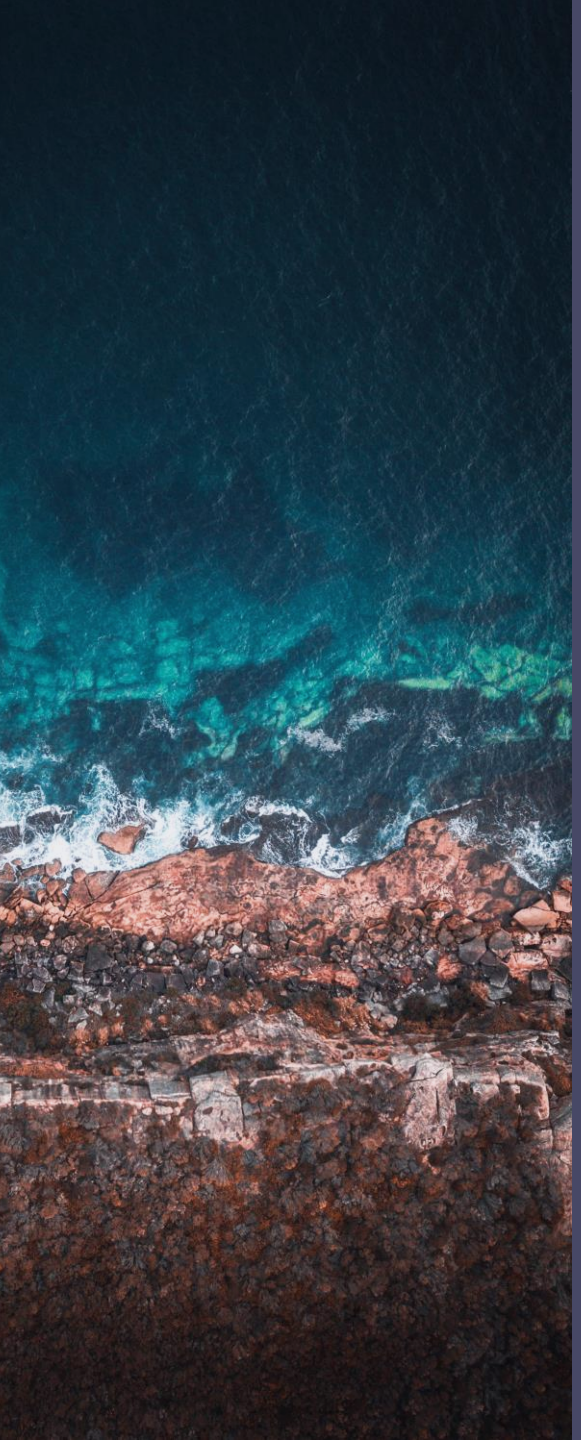
EKOLOGI

01 KONSEP DAN DEFINISI

02 STRUKTUR POPULASI

03 DINAMIKA POPULASI

04 SEJARAH KEHIDUPAN



DINAMIKA POPULASI

Perubahan dalam ukuran dan komposisi populasi.

Mempelajari faktor-faktor penyebabnya:

- Mekanisme yang mengatur ukuran, distribusi, dan struktur umur populasi.

PROSES POPULASI

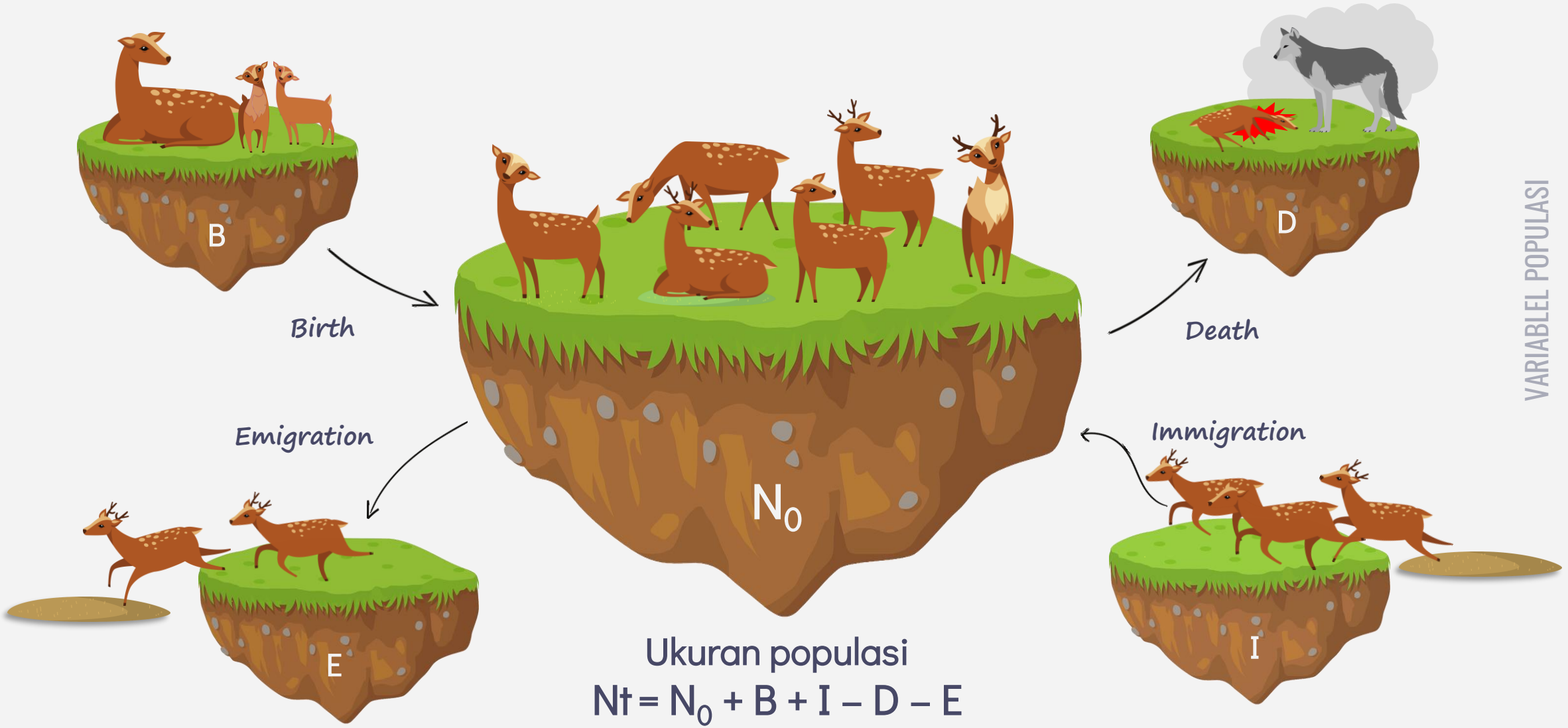
PROSES **POPULASI**

Faktor-faktor yang mempengaruhi karakteristik populasi.

Terdiri dari 4 komponen:

- Kelahiran/natalitas (*birth* = **B**)
- Kematian/mortalitas (*death* = **D**)
- Imigrasi (*immigration* = **I**)
- Emigrasi (*emigration* = **E**)

PROSES POPULASI & UKURAN POPULASI



PERTUMBUHAN UKURAN POPULASI

Ukuran populasi akan:

- Stabil, jika (B + I = D + E)
- Naik, jika (B + I > D + E)
- Turun, jika (B + I < D + E)

REGULASI POPULASI

PEMBATASAN
UKURAN POPULASI

Kelimpahan populasi pada suatu waktu merupakan hasil interaksi yang kompleks antara bentuk **resistensi lingkungan** yang bersifat ***density-independent*** dan ***density-dependent***.

PERTUMBUHAN POPULASI

Kebanyakan organisme punya potensi laju reproduksi tinggi,

- Sesuai dengan potensi biotik.

Kenyataannya, sumber daya tidak selalu tersedia,

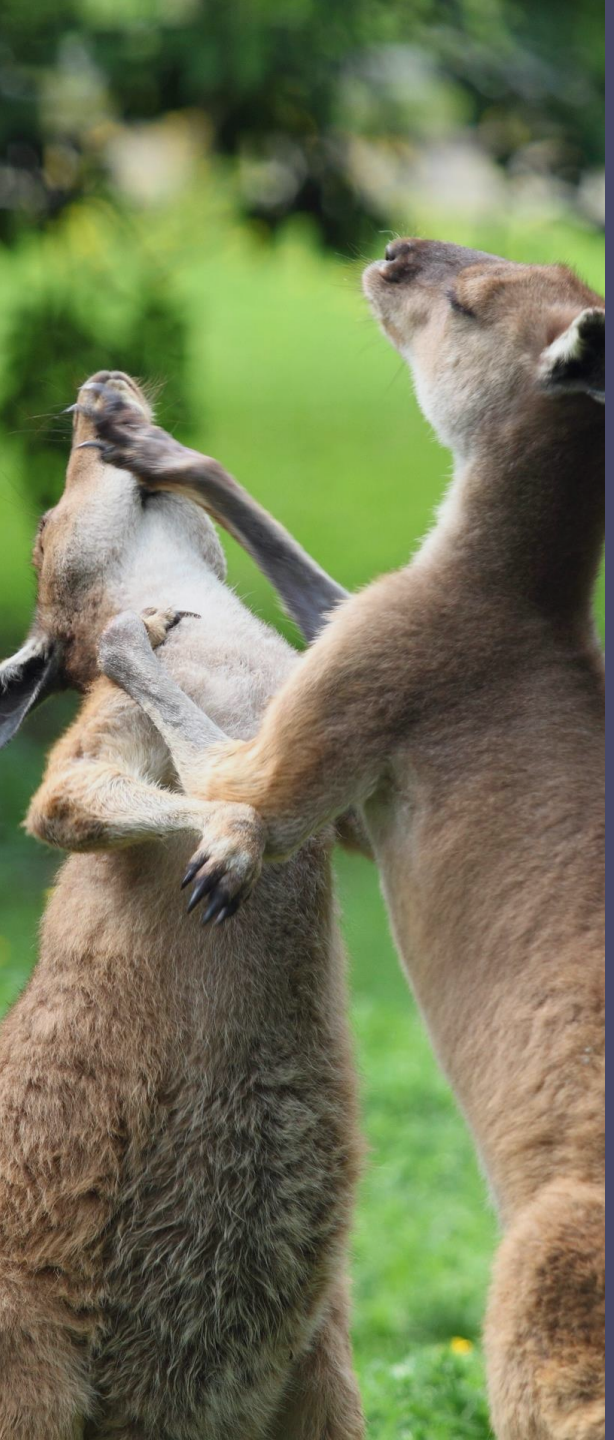
- Menjadi faktor pembatas.

POTENSI **BIOTIK**

Adalah kapasitas reproduksi maksimum suatu populasi bila:

- Sumber daya tak terbatas;
- Kondisi lingkungan ideal.

Tercapainya potensi biotik dihambat oleh **resistensi lingkungan** (*environmental resistance*).



RESISTENSI LINGKUNGAN

Keseluruhan faktor pembatas (biotik dan abiotik) yang bersama-sama menghambat tercapainya potensi biotik suatu organisme.

- Meningkatkan mortalitas
- Menurunkan laju kelahiran.

SIFAT FAKTOR
REGULASI POPULASI

Density-dependent
(tergantung densitas)

Density-independent
(tidak tergantung densitas)

FAKTOR *DENSITY-DEPENDENT*

Faktor pembatas populasi yang tingkat dampaknya tergantung pada densitas populasi.

- Penyakit (karena stress dan *crowding*).
- Predasi, parasitisme, kompetisi.
- Penumpukan limbah (hasil samping metabolisme).

Umumnya berupa faktor biotik.

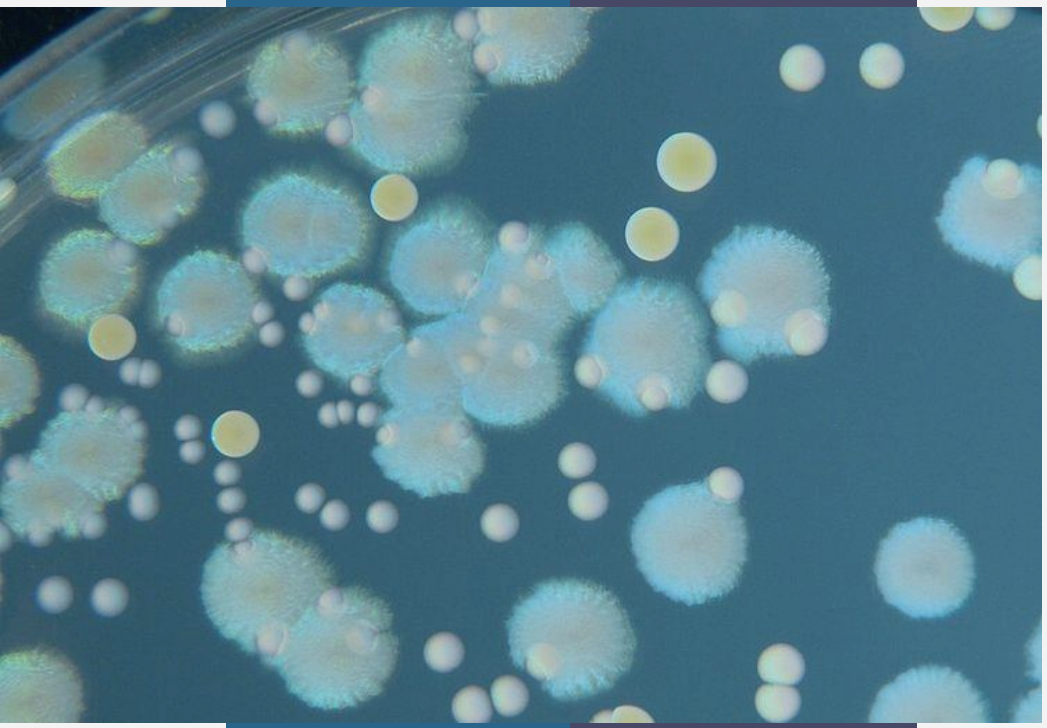
FAKTOR *DENSITY-INDEPENDENT*

Faktor pembatas populasi yang tingkat dampaknya **tidak tergantung** pada densitas populasi.

- Kerusakan habitat
- Bencana alam (banjir, badai, gempa bumi, dll)

Umumnya berupa faktor abiotik.

MODEL PERTUMBUHAN POPULASI



JENIS PERTUMBUHAN POPULASI

Berdasarkan ada-tidaknya faktor pembatas, pertumbuhan populasi dibedakan dua model:

1. Model pertumbuhan **EKSPONENSIAL**
   - Jika tidak ada faktor pembatas pertumbuhan populasi.
2. Model pertumbuhan **LOGISTIK**
   - Jika ada faktor yang membatasi pertumbuhan populasi.

LAJU INTRINSIK
PERTUMBUHAN POPULASI

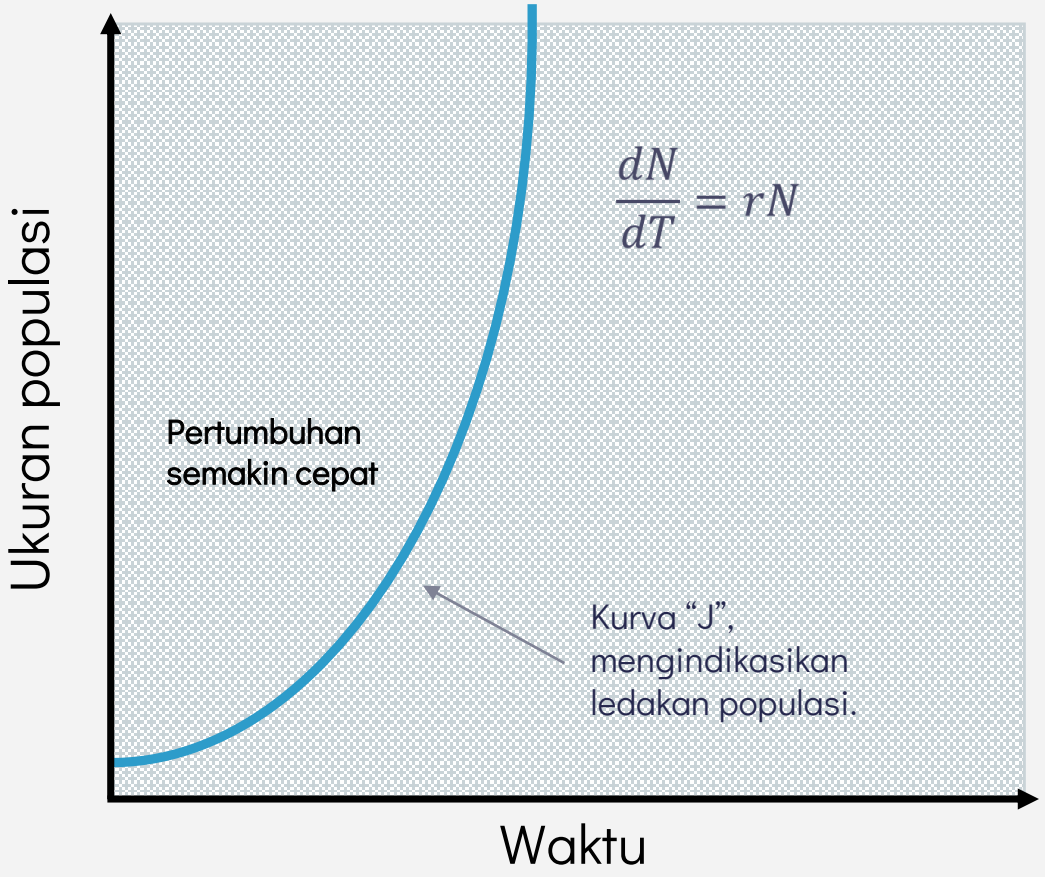
Laju pertumbuhan populasi, apabila tidak ada faktor *density-dependent* yang mempengaruhi.

- Merupakan laju pertumbuhan populasi teoritis maksimum "*r*".

Tergantung pada umur dan kinerja reproduktif.

Lingkungan yang konstan menciptakan populasi yang stabil.

MODEL PERTUMBUHAN **EKSPONENSIAL**



Semakin besar populasi, semakin cepat pertumbuhannya.

- ✓ Asumsi: laju pertumbuhan (B dan D) konstan).

Memprediksi pertumbuhan indefinit.

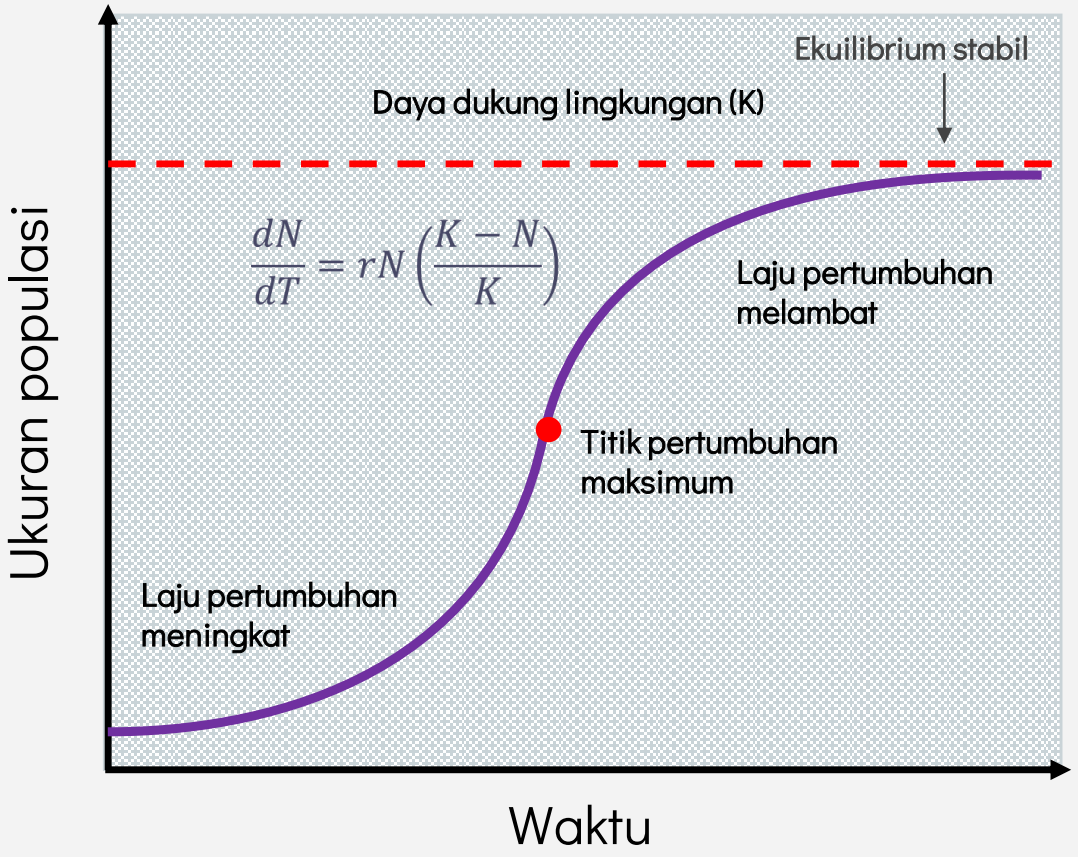
Tidak memperhitungkan faktor pembatas.

$$\frac{dN}{dT} = rN$$

(Persamaan "potensi biotik")

dN/dt : laju pertumbuhan populasi
r : laju intrinsik pertumbuhan populasi
N : jumlah individu anggota populasi

MODEL PERTUMBUHAN **LOGISTIK**



Laju pertumbuhan (B dan D) berubah-ubah, tergantung daya dukung lingkungan.

Ukuran populasi stabil, karena regulasi faktor internal dan eksternal.

Pertumbuhan bersifat *density-dependent.*

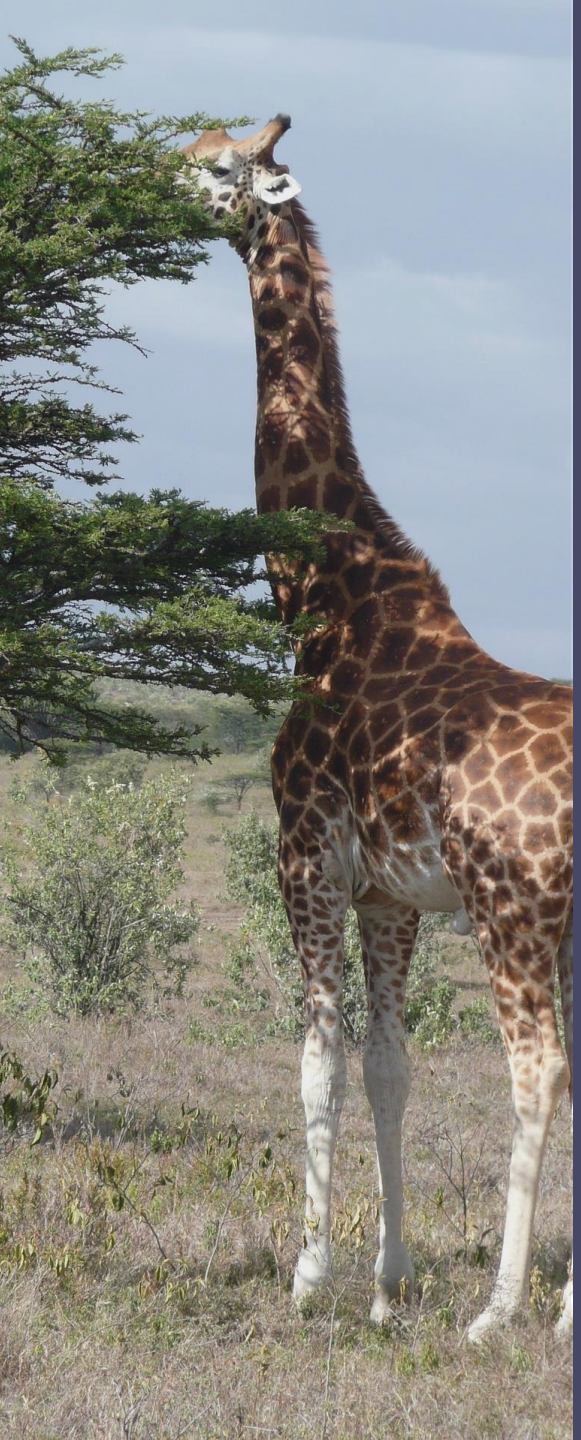
$$\frac{dN}{dT} = rN\left(\frac{K-N}{K}\right)$$

dN/dt	: laju pertumbuhan populasi
r	: laju intrinsik pertumbuhan populasi
N	: jumlah individu anggota populasi
K	: daya dukung lingkungan

FAKTA
PERTUMBUHAN POPULASI

Di alam, pertumbuhan eksponensial jarang terjadi karena adanya faktor pembatas terhadap pertumbuhan.

Faktor pembatas ini berupa daya dukung lingkungan (*carrying capacity* = K).



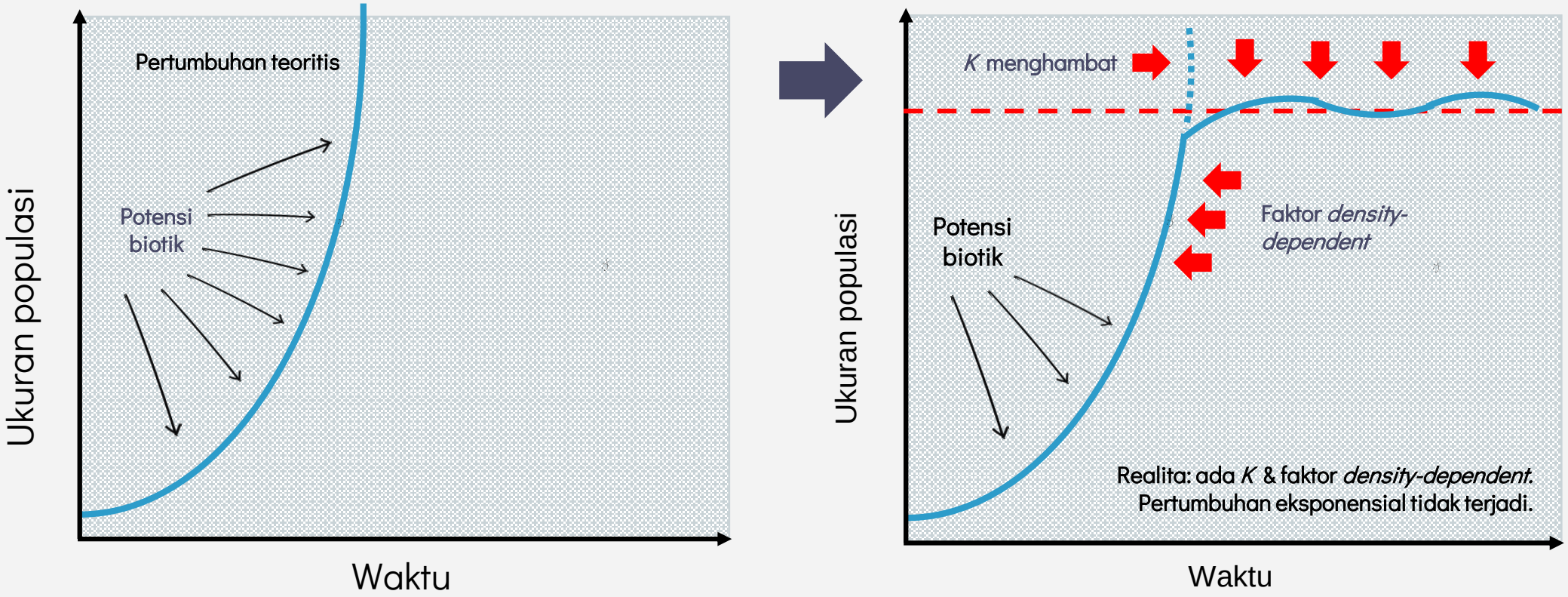
DAYA DUKUNG LINGKUNGAN

"K" adalah jumlah individu maksimum yang dapat didukung ("dihidupi") oleh sumber daya suatu wilayah dalam periode tak terbatas, tanpa menghabiskan atau merusak sumberdaya tersebut.

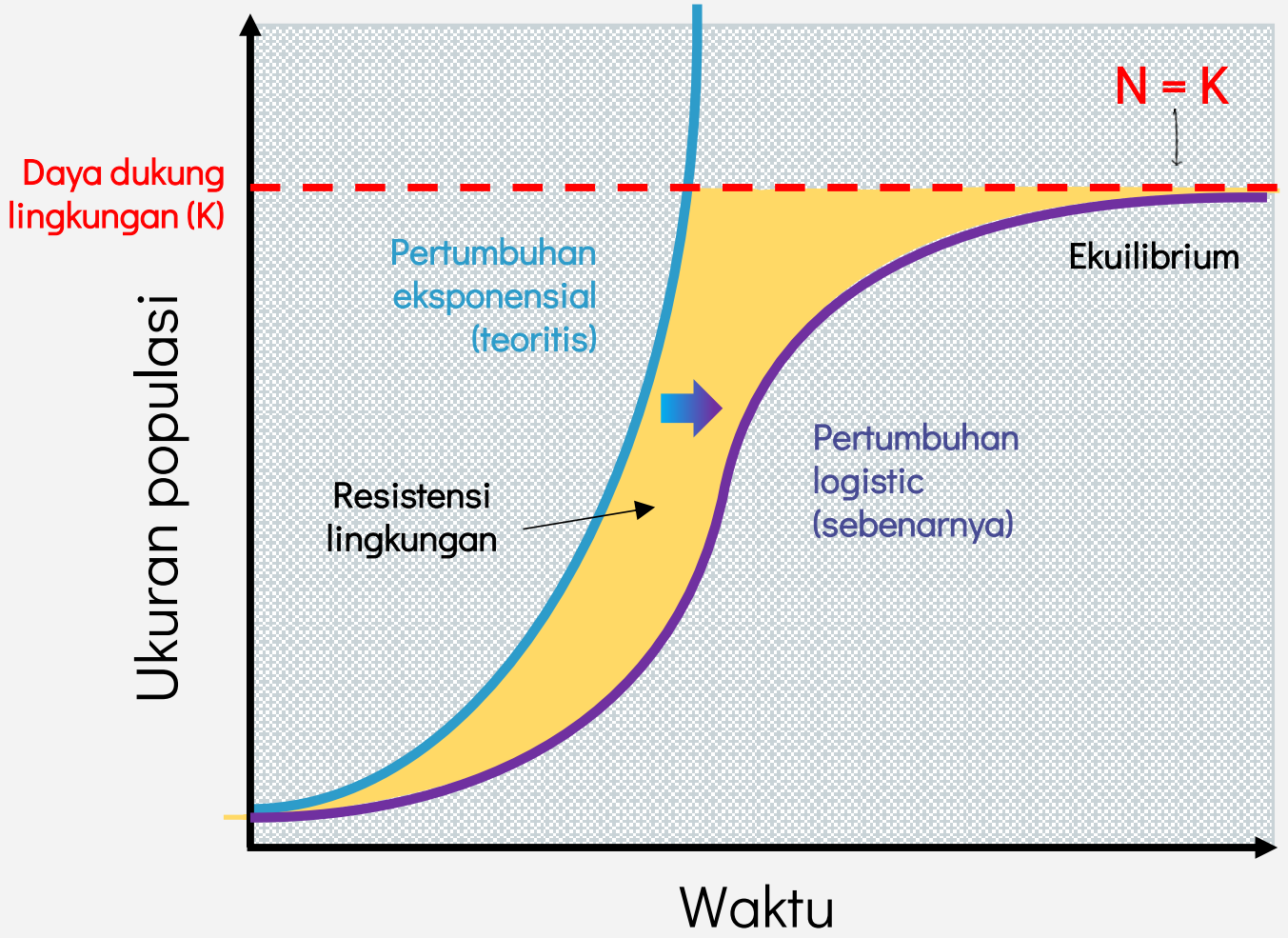
Nilai K bersifat dinamis, bukan statis.

Nilai K berbeda untuk setiap spesies di suatu habitat (karena perbedaan kebutuhan sumber daya).

RESISTENSI LINGKUNGAN



RESISTENSI LINGKUNGAN



KONTROL PERTUMBUHAN POPULASI OLEH K

Dengan peningkatan ukuran populasi, laju pertumbuhan (*r*) menurun hingga N=K, karena:

- Kompetisi antar individu atas sumberdaya meningkat.
- Akumulasi limbah/sisa metabolisme.
- Peningkatan rasio predasi.

OSILASI POPULASI

Naik turunnya populasi di sekitar K disebut osilasi populasi.

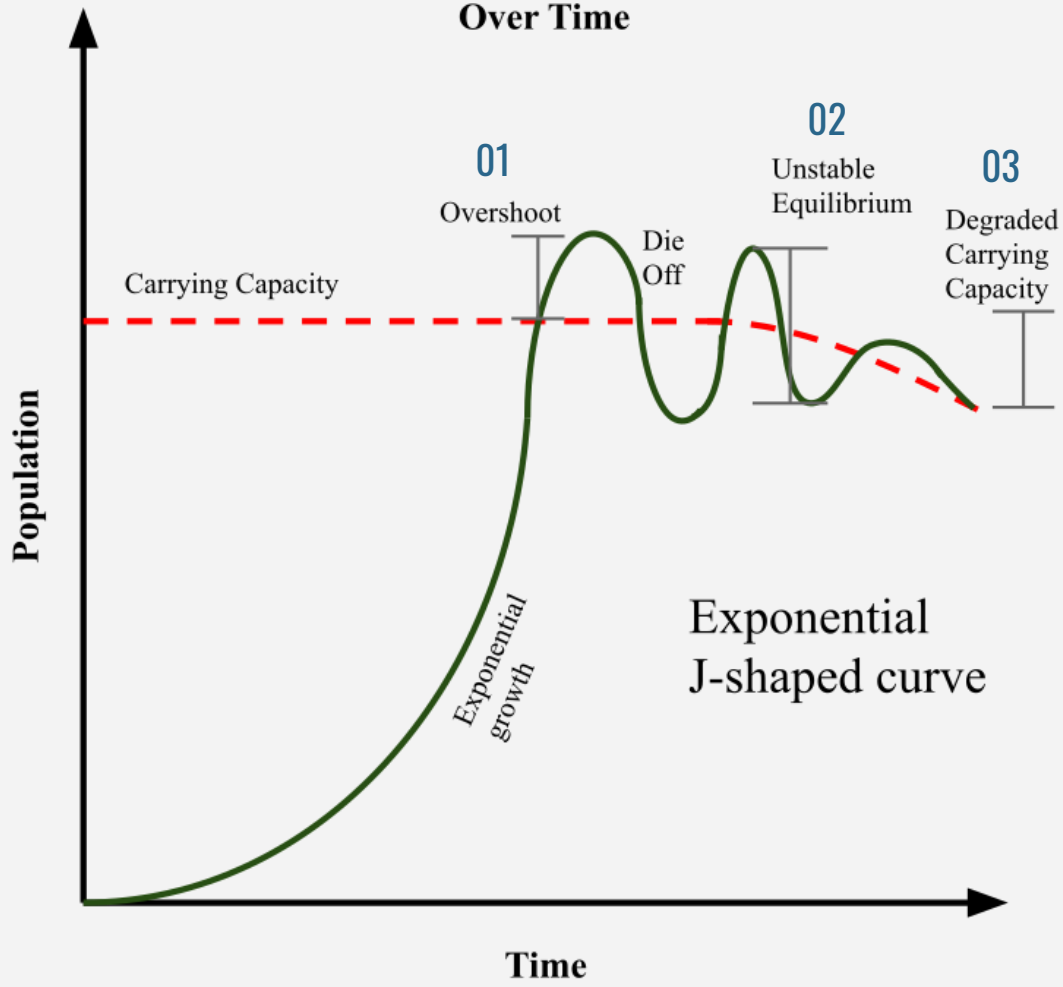
- Ukuran populasi berfluktuasi di sekitar rerata nilai dN/dt = rN(K-N/K)

Efek ukuran populasi:

- Jika ukuran populasi > K, maka D > B, populasi turun.
- Jika ukuran populasi < K, maka B > D, populasi naik lagi dengan cepat.

OSILASI DALAM STABILISASI POPULASI

Figure 1: Exponential Growth of Population Size Over Time



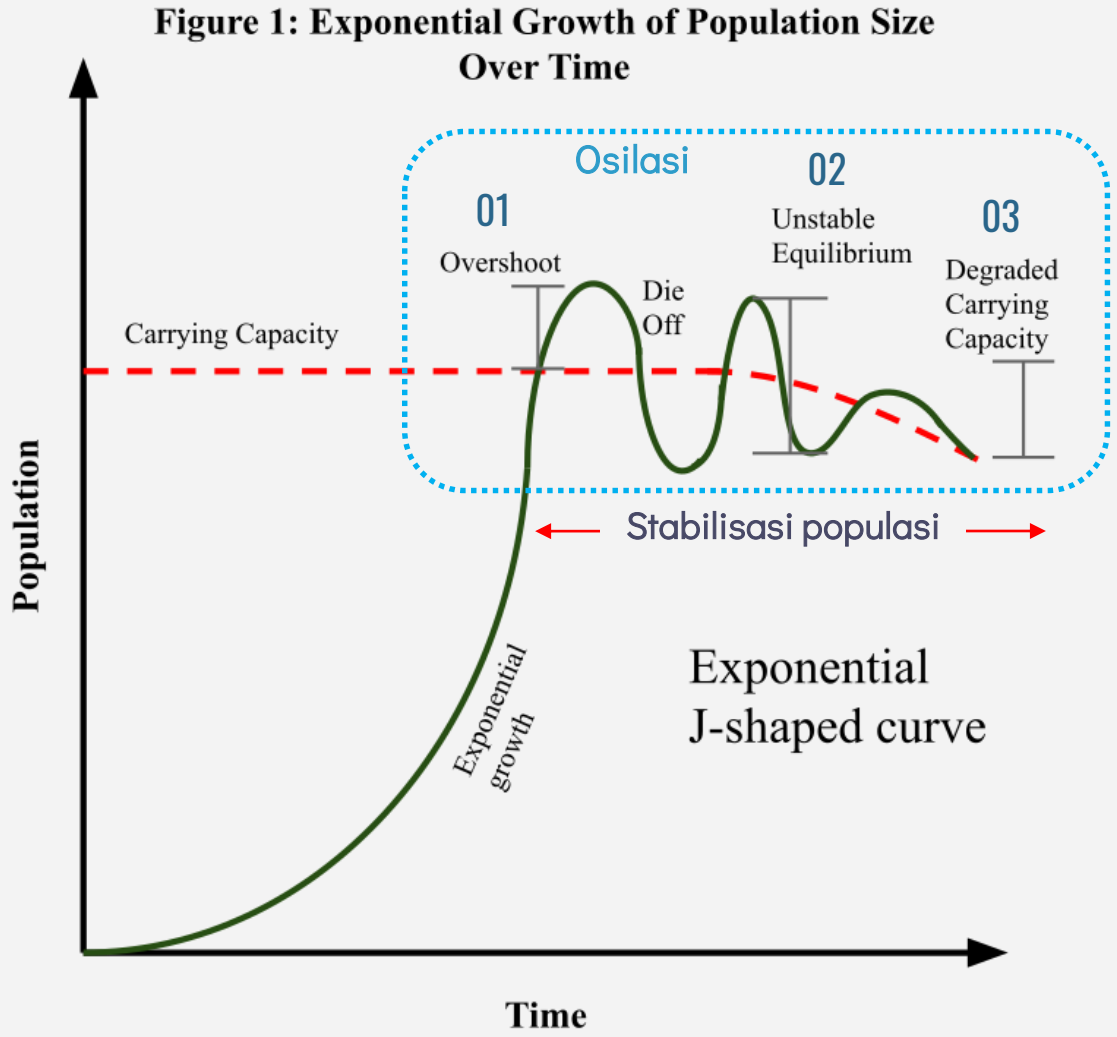
01 Overshoot occurs when the population growth exceeds the carrying capacity, leading to a die off for the individuals in the population

02 Unstable equilibrium is the fluctuation of the population above and below the carrying capacity, changing based on the relationship between natality and mortality

03 Degraded carrying capacity may be due to resource destruction during an overshoot, carrying capacity is not static

[Exponential growth], Nchisick, , https://commons.wikimedia.org/wiki/File:Exponential_Carrying_Capacity.svg, CC BY-SA.

OSILASI DALAM STABILISASI POPULASI



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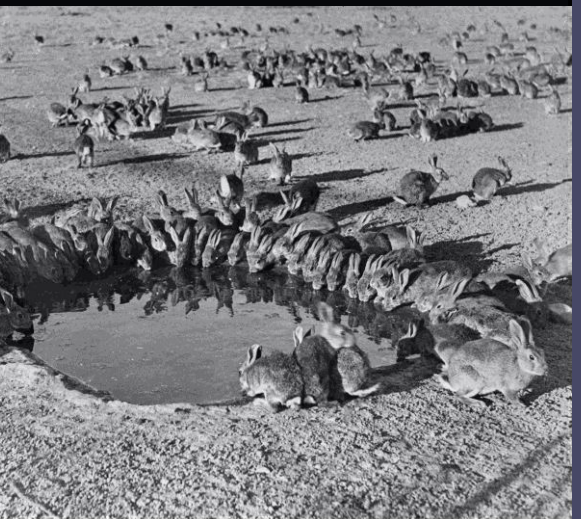
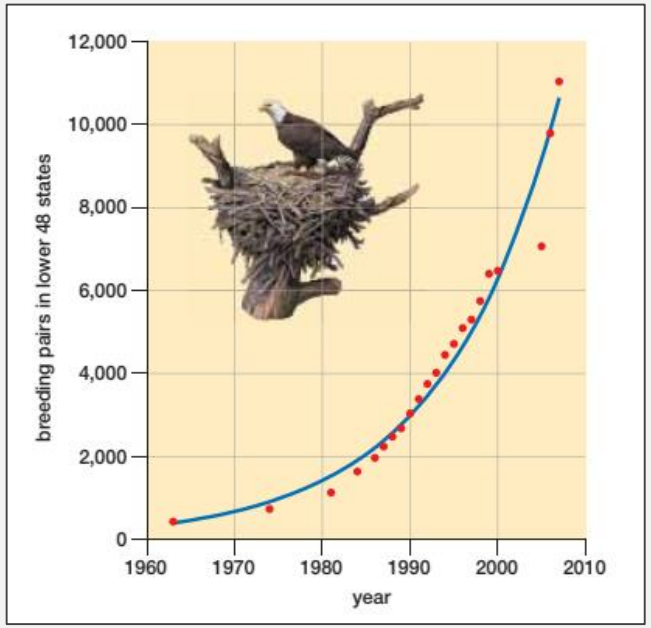
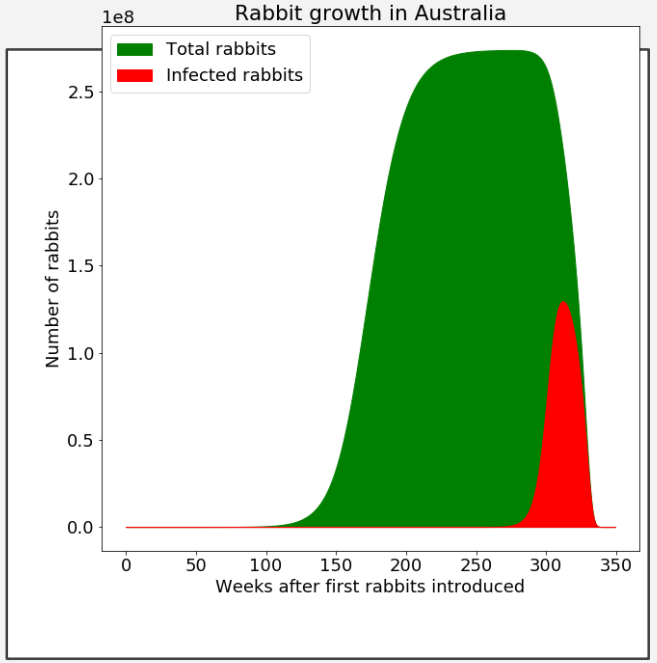


CONTOH
PERTUMBUHAN EKSPONENSIAL



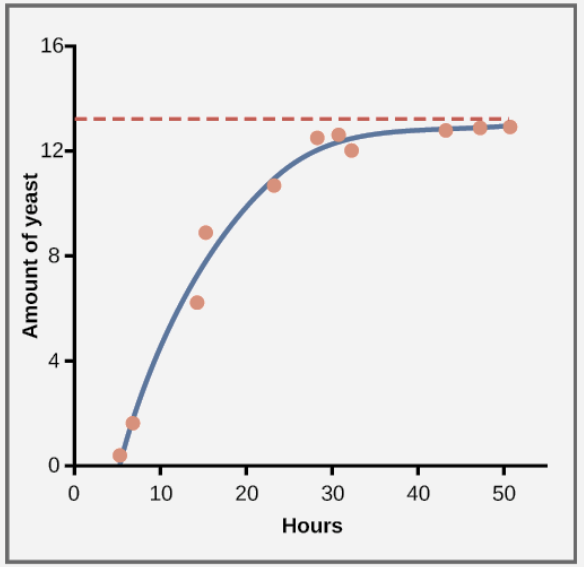
Audesirk et al. (2016), Fig. 27-4, used under a Fair Use rationale.

Populasi *bald eagle* setelah dilindungi.

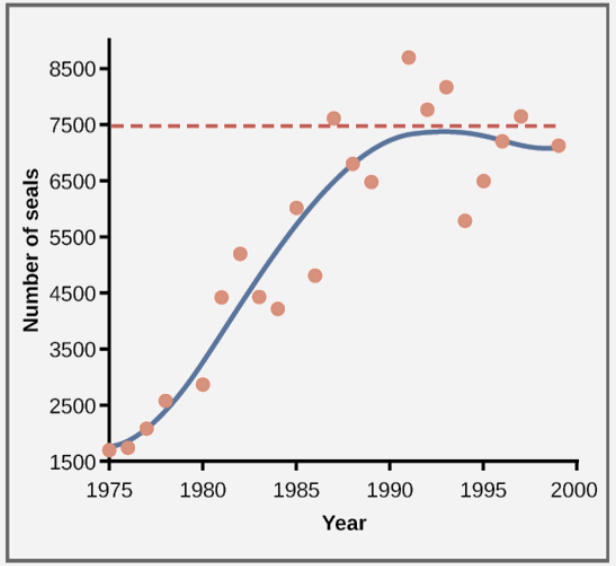


Populasi kelinci introduksi di Australia.

CONTOH
PERTUMBUHAN LOGISTIK

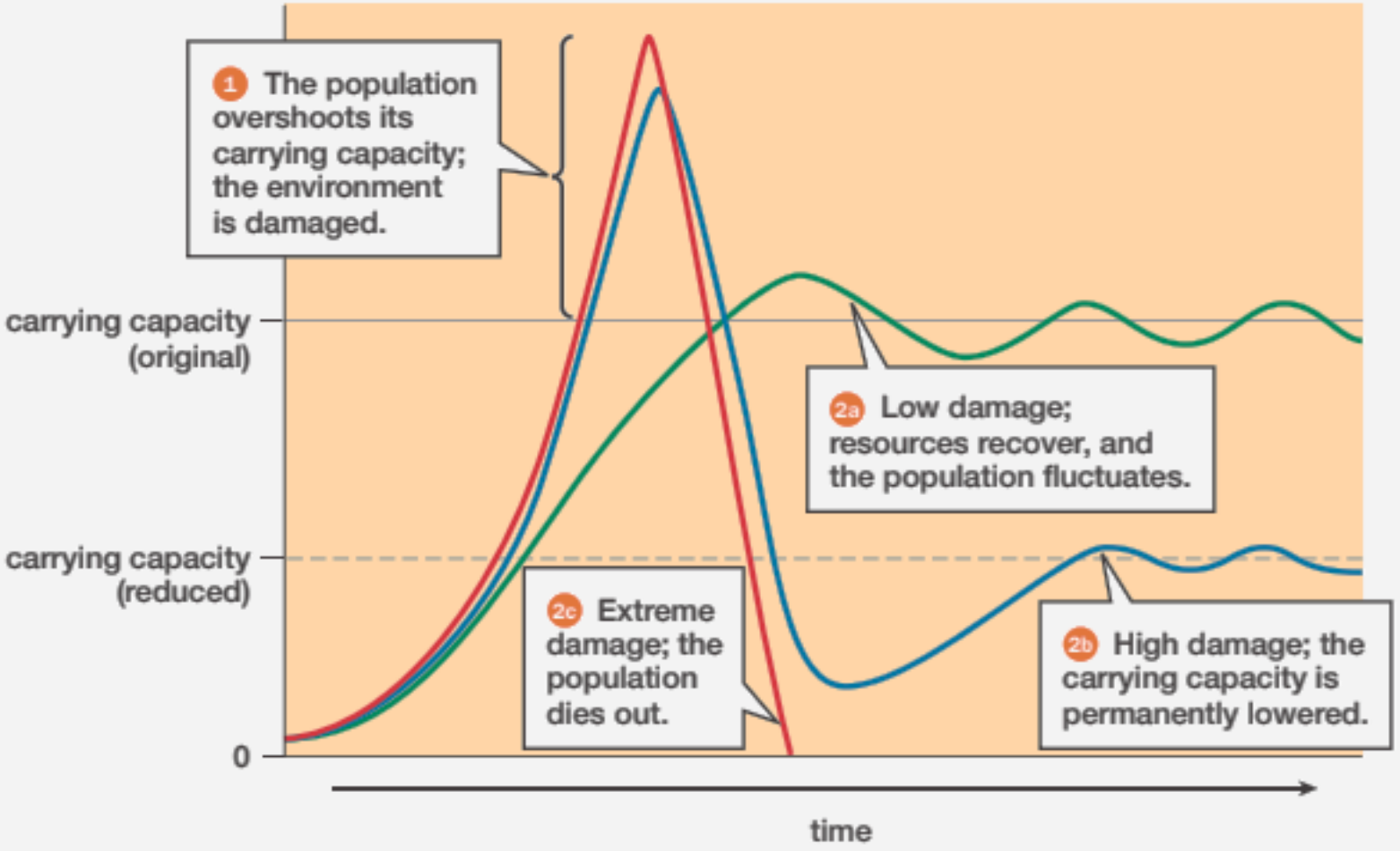


Populasi *yeast* di lab



Populasi anjing laut di alam

KONSEKUENSI TERLAMPAUINYA *K*



Audesirk et al. (2016), Fig. 27-6 "Biology: Life on Earth with Physiology" 11th ed.; used under a Fair Use rationale.

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