

## Chapt. 52 – Population Ecology

**Population** – a group of individuals of a single species that simultaneously occupy the same general area

**Static population patterns** – properties of a population that can be assessed with a measurement or estimate at a single point in time (a “snapshot”)

**Dynamic population patterns** – properties of a population that can only be assessed with measurements or estimates taken at two or more points in time

### Static population patterns

**Geographic range** – a population’s global distribution [Fig. 50.2]

**Population size** – the total number of individuals in a population [Fig. 50.2]

**Density** – the number of individuals per area [Fig. 50.2]

**Dispersion** – the pattern of spacing among individuals [Fig. 52.3]

**Random** – nearest neighbors are as near as predicted if all individuals were randomly placed within the focal boundaries

**Clumped** (a.k.a. **aggregated**) – nearest neighbors are nearer, on average, than a random dispersion pattern would predict

**Uniform** (a.k.a. **regular**) – nearest neighbors are farther away, on average, than a random dispersion pattern would predict

### Dynamic population patterns

Geographic range, population size, density, dispersion can all change through time

Consider population size; a population can grow, decline, or otherwise fluctuate [Fig. 52.19]

### Demography

The study of **vital statistics** that affect population size

**Life table** – an age-specific summary of **survival** [Table 52.1]

**Life tables** are often constructed by following the fate of a **cohort**

**Cohort** – a group of individuals of the same age (or stage)

**Survivorship curve** – a plot of the proportion out of a **cohort** alive at each age [Fig. 52.5]

**3 types: Type I, II or III**

**Reproductive table** (a.k.a., **fertility schedule**) – age-specific **reproductive rates** [Table 52.2]

**Age structure** – the relative number of individuals of each age in a population [Fig. 52.25]

Each population has its own characteristic **vital rates** (**demographic parameters**)

The values of **vital rates** depend on the traits of the focal organisms...

For example... Coconut palms and kiwis produce a few, big offspring with high survivorship probabilities

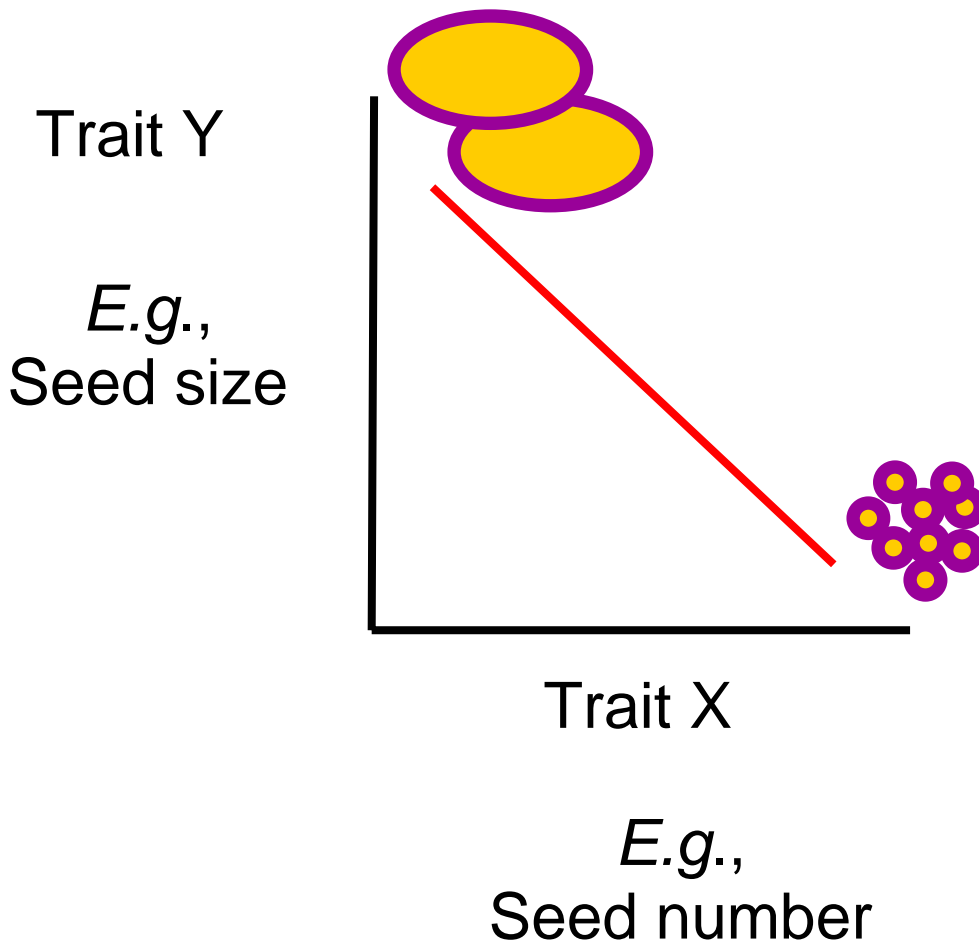
Dandelions and salmon produce many, tiny offspring with low survivorship probabilities

The traits that affect an organism's vital rates, as well as the values of the vital rates themselves, comprise an organism's **life history**

Fitness costs and benefits shape **life-history strategies**

Fitness costs and benefits are often balanced around **life-history trade-offs**

**Life-history trade-off**, *e.g.*, seed size vs. seed number:



**Life-history trade-off**, *e.g.*, number of lifetime reproductive episodes vs. number of offspring per reproductive episode

**Semelparity** – A single reproductive bout per lifetime

**Iteroparity** – Multiple reproductive bouts per lifetime

**Life-history trade-off**, *e.g.*, current year reproduction vs. subsequent survival [Fig. 52.7]

Changes in **population size (N)**

The following four processes can change the size of a population [Fig. 52.2]:

1. **Birth**
2. **Death**
3. **Immigration**
4. **Emigration**

In a population closed to immigration and emigration:

$$\Delta N / \Delta t = B - D$$

$\Delta N / \Delta t$  = the change in N for a given change in time

**B** = the number of **births**

**D** = the number of **deaths**

We can also write the equation in terms of *per capita* birth and death rates:

$$\Delta N / \Delta t = bN - dN$$

$\Delta N / \Delta t$  = the change in N for a given change in time

**b** = the *per capita* **birth rate**

**d** = the *per capita* **death rate**

We can substitute **r = (b - d)** to give:

$$\Delta N / \Delta t = rN$$

**r** = *per capita* **growth rate**

If  $r > 0$ , population grows

If  $r < 0$ , population declines

If  $r = 0$ , population size remains the same

[See example in PowerPoint]

A population with **unlimited resources** would achieve its **maximum growth rate**:

$$\Delta N / \Delta t = r_{\max}N$$

This is known as **exponential growth**

Exponential growth is unlimited [Fig. 52.12, blue curve; Fig. 52.9]

Real-world populations never continue growing exponentially indefinitely...  
[Fig. 52.12, black and red curves]

Because many factors limit maximum population sizes, especially **resources**

**Carrying capacity (K)** is the ceiling population size set by **limited resources**

**Logistic population growth** describes a population that grows to **carrying capacity**

Examples of near-logistic growth [Figs. 52.13a,b]

The logistic equation incorporates a term that slows population change near K [Fig. 52.11]

$$\Delta N / \Delta t = r_{\max}N (K-N/K)$$

**Density-dependent population change** will tend to stabilize population size

**Density-dependent population change** requires at least one **density-dependent vital rate**  
[Figs. 52.14, 52.15]

**Fluctuations** in population size are common in nature [Fig. 52.13c]

Some populations follow **boom-and-bust cycles** [Fig. 52.21]

Global human population trends are frightening [Fig. 52.22]

How long do we have until disaster strikes? The human ecological footprint continues to grow... [Fig. 52.27]