

## Populations and Communities

Population ecology: considers the evolution, organization, and individual behavior in relation to others.

Population: an interbreeding group of individuals; members of the same species living together in the same place at the same time.

Population characteristics (e.g., size, density, age structure, spacing of individuals) can change over time.

### Population Growth

A. What determines the number or density of individuals in a population?

$$\text{Density} = (\text{birth} + \text{immigration}) - (\text{death} + \text{emigration})$$

B. Population growth models may be used to predict number of individuals at some future time, if present size and intrinsic rate of increase known.

1. **Exponential population growth** – a J-shaped curve; represents an increasingly rapid addition of the number of individuals in a population over time.
2. **Logistic population growth** – a population that begins to grow exponentially, then begins to level off as it approaches the **carrying capacity (K)**; represented by a J-shaped curve.

**Carrying capacity**= the maximal number of individuals in a population that can be sustained by the environment.

Not all populations behave according to these models. Some populations may fluctuate irregularly, especially if they overshoot their carrying capacity and then “crash”. Other populations may exhibit regular patterns or cycles.

### Distribution of Individuals

#### Spatial distribution

Dispersion (Spacing) – the position of members of a population relative to their neighbors.

Three types of spatial patterns are generally recognized:

1. Random
2. Clumped
3. Even

Spatial patterns are scale dependent.

E.g.,

Intraspecific competition: competition among members of a population.

Resource – something that can be drawn upon for support e.g., nutrients, water, sunlight, nest sites.

Within a patch, competition for a limiting resource can cause even distribution patterns, e.g.,

However, also within a patch, competition for a limiting resource can cause clumped distributions,

### Temporal distribution

Species distributions may change over time, especially in response to environmental perturbations/disturbances (e.g., drought, fire, grazing).

Overall, spatial and temporal distributions of tallgrass prairie plants may fall into two categories:

Core/matrix species:

Satellite species:

### **Interspecific Competition**

Many, possibly most, resources are used by more than one species. This can result in several possible outcomes:

## **Mutalism**

Mutualism –

Symbiosis –

Symbiotic mutualism –

    Mycorrhizae –

        Endomycorrhizae

        Ectomycorrhizae

Nonsymbiotic mutualism –

    Pollination –

## **Community Ecology: Structure, Diversity, and Succession**

Community –

**Ecological niche** –

*Fundamental niche* –

*Realized niche* –

    A niche can be  $n$ -dimensional, or form a hypervolume

    Ecological equivalents –

If a community is at the upper limit of all the species that can coexist, it is considered **saturated**; additional species could be added to an **unsaturated** community.

## **Interactions of Species in a Community**

Species in a community can interact directly through predation, competition, or symbiosis.

Indirect effects –

**Community structure or organization** – patterns in which communities are arranged.

1. Species composition – including the number of species present and their relative proportions.

**Species richness** –

**Species diversity** –

– can be quantified through the use of **diversity indices**. E.g., Shannon-Wiener (H') for surveys or Simpson (C) for censuses.

2. Trophic interactions –

3. Temporal changes –

4. Guilds –

Spatial structure can be both vertical and horizontal.

Temporal structure:

A. day-night changes

B. seasonal changes (phenology)

Other Factors Influencing Community Structure:

Habitat size:

**Species area curve** –

Disturbance regime:

**Intermediate disturbance hypothesis** (Connell 1978) –

[Important implications for disturbance regimes in prairie. Note also interactive effects of various disturbances.]

## **Community Change**

Replacement changes –

Replacement can occur in a cyclic pattern; may be related to a particular disturbance regime (e.g., altering abundance of fire-positive and fire-negative species).

Directional change –

**Succession** –

Pioneer community –

Sere or seral stage –

Climax community –

Primary succession –

Examples of primary succession include:

Secondary succession –

Examples of secondary succession include: