

## Ecology

### *Lesson 15*

## LIMITS ON POPULATIONS

Text Reference, Section 2.10, page 77-80

Studies of undisturbed ecosystems show that the growth of a typical animal population show a sigmoidal, (S shaped), graph; beginning with a very slow initial increase, followed by a period of rapid growth, and eventually the growth rate declines to zero and the population of the organism tends to remain stable over time i.e. attains a steady state and the population growth becomes constant [the carrying capacity is reached → see later notes].

However, the **Biotic Potential** [Definition: the maximum number of offsprings that a species could produce if resources were unlimited], places limits on population.

### **Factors Affecting Biotic Potential**

Biotic potential is affected by 4 main factors:

1. Birth Potential: the maximum number of offspring per birth e.g. whooping crane: 2 eggs per year, but only 1 chick survives.
2. Capacity for Survival: the number of offspring that reach reproductive age, e.g. the sea turtle lays many eggs but majority do not survive.
3. Procreation: the number of times that a species reproduces each year, e.g. humans: 1/year, elk: 1/year.
4. Length of Reproductive Life: the age of sexual maturity and number of years the individual can reproduce, e.g. African elephants: sexual maturity: 15 years and reproduce until 50 years (similar to humans).

### **Limiting Factors**

The abiotic and biotic environmental factors that prevent populations from attaining their biotic potential are:

1. Any resource: e.g. food and water: necessary for nourishment of individuals in the population.
2. Living space: living area for offspring of the population to grow and reproduce.
3. Climate: environmental conditions, such as temperature and precipitation, for growth and development of the population.
4. Competition between organisms for food, space and mates: The extent of interaction of one population species with another population in the same ecosystem population numbers will vary according to the extent of competition.

5. Predation: This is a factor that depends on an adequate number of prey.
6. Diseases and Parasites: This is a factor that usually eliminates the weak and the old, but is also capable of eliminating an entire population.

A species would reach its maximum potential only under ideal conditions such as:

- ▶ the number of offsprings per pregnancy,
- ▶ the probability of offspring surviving until they can reproduce,
- ▶ the frequency of reproduction,
- ▶ the age of first reproduction,
- ▶ unlimited resources,
- ▶ plenty of room,
- ▶ ideal environmental conditions, and
- ▶ no predators, parasites or disease.

## **Carrying Capacity**

Definition: Carrying Capacity is the maximum number of individuals of a species that can be supported over the long period by an ecosystem, i.e. it is the largest population of a species that an environment can support.

As a population approaches carrying capacity, various environmental interactions occur to slow its growth. The carrying capacity of an area is affected by:

- ▶ available nourishment, i.e. materials and energy.
- ▶ competition.
- ▶ population niche
- ▶ population density, (note: an excessive population density that produces overcrowding can result in starvation, disease, increases in aggression among competitors, and extinction of populations.

## **Limits of Tolerance**

The survival and reproduction of an organism depend on the presence of nutrients and the ability of organism to withstand the abiotic factors in the environment; this is determined by two laws:

### I. Laws of the Minimum: (Justes-von-Liebig, 1800's)

The nutrient in least supply is the one that limits growth.

### II Laws of Tolerance (Victor Shelford, 1913)

An organism can survive within a certain range of an abiotic factor; above and below the limit it cannot survive.

(The greater the range of tolerance, the greater the organism's ability to survive)

## **Population Density**

This is the number of individuals per unit area (# / area, e.g. 6 deer / Km).

The different ways in which populations grow are associated with the density of the population.

### Density Dependent and Independent Factors

#### Density Dependent Factors:

Factors that affect a population because of the density of the population, e.g. food supply, water quality, disease, space available (i.e. territory).

#### Density Independent Factors:

Factors that affect members of a population regardless of their density, e.g. fire, flood, sunlight.

### **Homework**

**1. Read Sec. 2.10, pages 77 - 80**

**2. Answer: Understanding Concepts, page 80, # 1 - 4**

**3. Worksheet: Limits on Populations**

**4. Worksheet: Population Terms**

**5. Read Lab: Estimating Populations (Jelly Bean Lab)**

**6. Chapter 2 Review, Page 84 - 85, # 2,3,5,7, 10, 11, 13, 16**