POPULATION ECOLOGY

- **Population**
  - **Ecological**
    - **Group of organisms** **or individuals of the same species occupying a particular space at a particular time**
  - **Genetic**
    - **A group of organisms or individuals of the same species forming a breeding unit with random mating**

Populations...

- **Mono specific (individual of same sp.)**
  - no. of animals of a species inhabiting a common geographic area

- **Poly specific (individual of several sp.)**
  - **an assemblage or collective group** of organism (plant or animal) of several closely related sp. occupying a definite area

BIOLOGICAL ATTRIBUTES/ CHARACTERISTICS OF POPULATION STRUCTURE (COMPONENTS)

- **Determined by the numerical relationship among the ages and sexes of individuals within it**

- **Density, Age and sex structure, population growth.**

1. DENSITY

No. of animals/ unit area

- Crude density : no. Of individual/ unit of total area

- Ecological density : no...../ unit of area it actually occupies

- Density: the size of a population in relation to a definite unit of space is its density.

  – Density varies with seasons, weather conditions, and food supply.

  – Density is determined by energy flow, resources availability and utilization, physiological stress, dispersal and productivity of a population
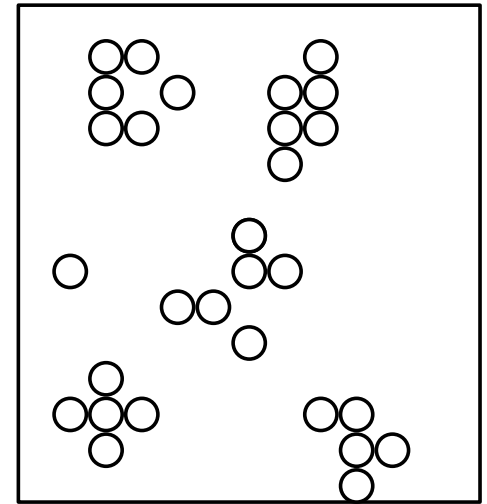
- Dispersion
  - Density & stress
  - **<u>Spatial dispersion</u>**
  - Pattern of dispersion results from responses by plants and animals to habitat differences, daily and seasonal weather and environmental changes, reproductive pattern and social behaviour.
  - **<u>Temporal dispersion</u>**
    - Daily changes in light and dark, humidity and temperature, seasons, lunar cycle and tidal cycles.
    - Seasonal changes: migration of birds, blooming of wild flowers
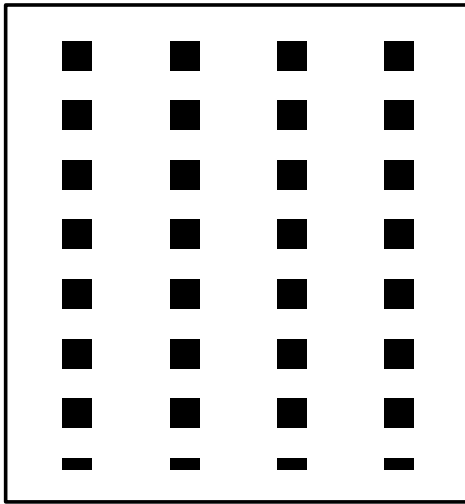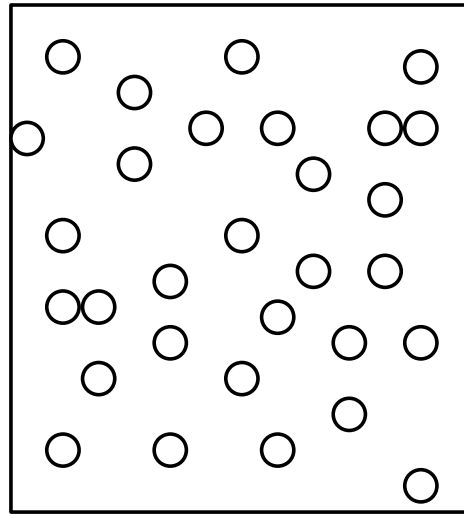
Uniform   **Random**   **Clumped**

Pattern of distribution

- **Dispersal movement**
  - **Causes**: Insufficient resources, deteriorating habitats, alleviation of inbreeding.
  - **Benefits**: Improve potential fitness, colonization of new area, expansion of species range, spread of genes.
  - Types:
    - **Emigration**: one way movement, out of a habitat.
    - **Immigration**: one way movement, into another habitat.
    - **Migration**: dispersal with a return to the place of origin.

2. SEX RATIO

- **It is expressed by convention as males per 100 females**

- **computing sex ratio :**

raw data 3 males, 7 females $\quad \dfrac{3}{7} = \dfrac{x}{100}$
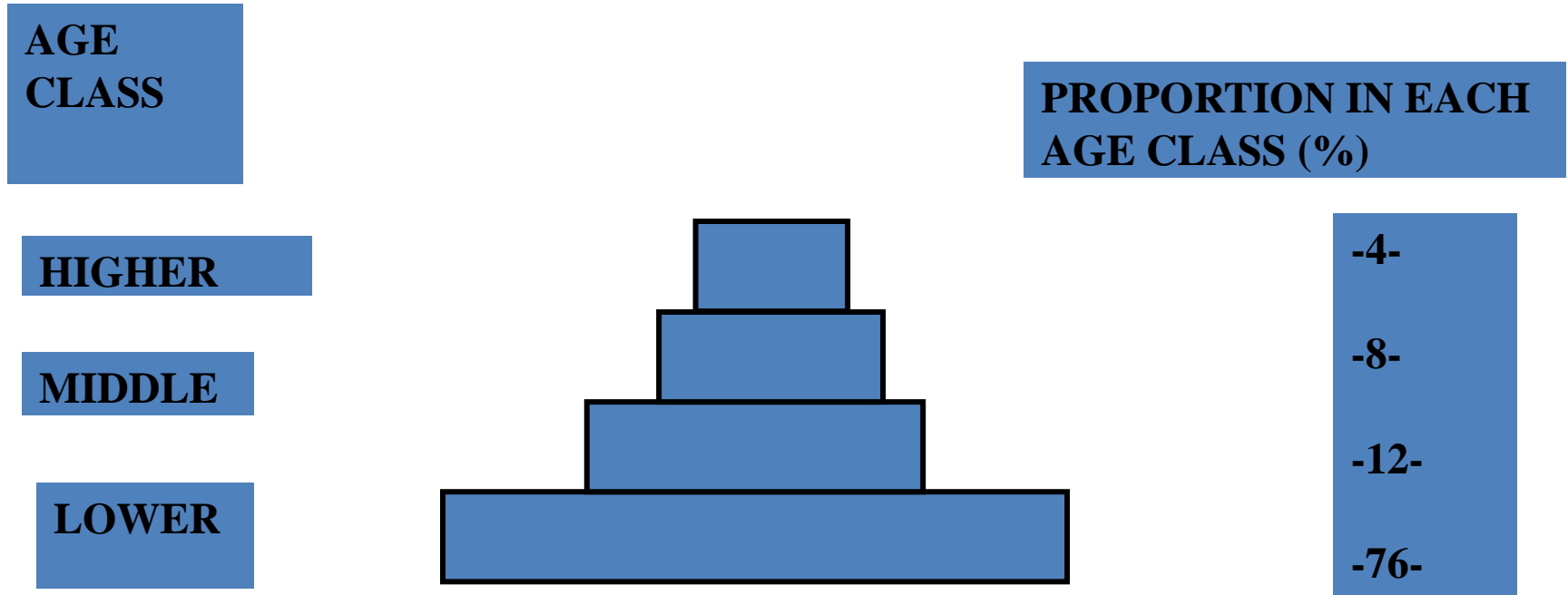
x = 43

sex ratio - 43:100

- Sex ratio of 100:100 at birth is the general rule among most sp. of vertebrates

- Monogamous sp.

- Polygamous sp.
  - Polyandry 1 female, many males
  - Polygyny 1male, many females

- Rate of reproduction is a function of the no. of breeding age females which are present in the population

- Management implication:increase females in a habitat and population will increase
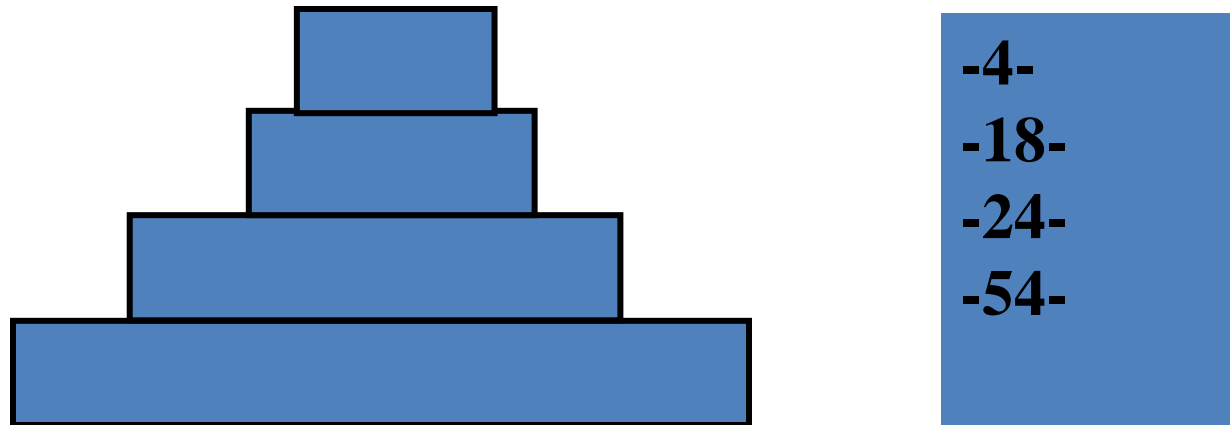
3. AGE RATIO'S

- ## Age determination in the field
  - Age of wild animals is determined by body size, weight, hair, feather colour and texture, stage of feather, moult, changes in anatomical structures, teeth, horns, antlers, eye lenses, ear lobes

- ## Age classification
  - Young, sub-adult, adult
  - Pre-reproductive; Reproductive and post-reproductive stages

- ## Age ratio suggests pop' productivity, vulnerability and hunting pressure

- *Three types of indication on pop' growth age pyramid*
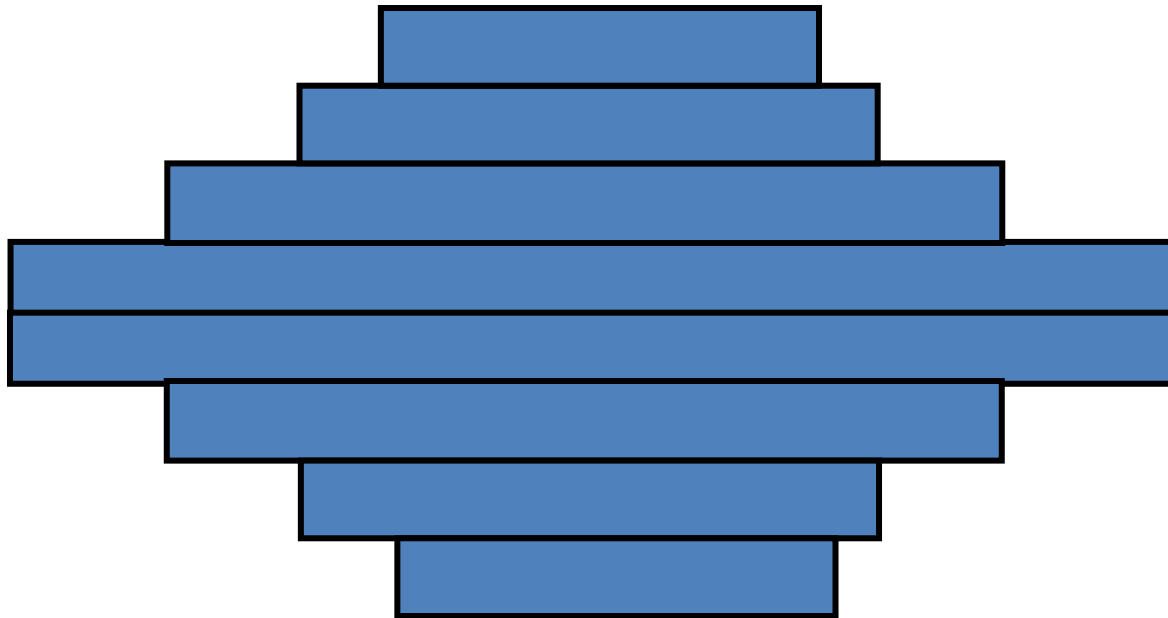
A. EXPANDING OR INCREASING POP'

AGE CLASS

HIGHER

MIDDLE

LOWER

PROPORTION IN EACH AGE CLASS (%)

-4-

-8-

-12-

-76-

B. STABLE POP

-4-

-18-

-24-

-54-

- NARROW BASE AND TAPERS LESS SHARPLY

C.   DECLINING POP'

4.   NATALITY

- **The production of new individuals in a population**

- **Individuals produced per unit of time (natality rate) or per unit time per breeding individual (specific natality rate) in a pop'**

NET REPRODUCTION RATE:

- No of young surviving till some pre-specified age

- It is the total young born minus the death in the 1st year of life (or some specified time)

Fertility:

- Pop' ability to produce viable sex cells

Fecundity:

Potential ability of an organism to
  conceive or produce viable zygotes

Natality:

The ability to produce viable off
  spring

ECOLOGICAL BIRTH RATE

OR

REALIZED NATALITY

Is the actual no of new individuals which are added to a pop' in a unit time

IT IS EXPRESSED AS:

$$M = \frac{N}{t}$$

WHERE N= NO OF INDIVIDUAL ADDED OVER 't' TIME

NATALITY IS DEPENDENT ON

1.Clutch /litter size

   a) Genetic build up of the species

   litter size

   -Sambar-1 ;   Chital-1-3 ;   Tiger-   1-
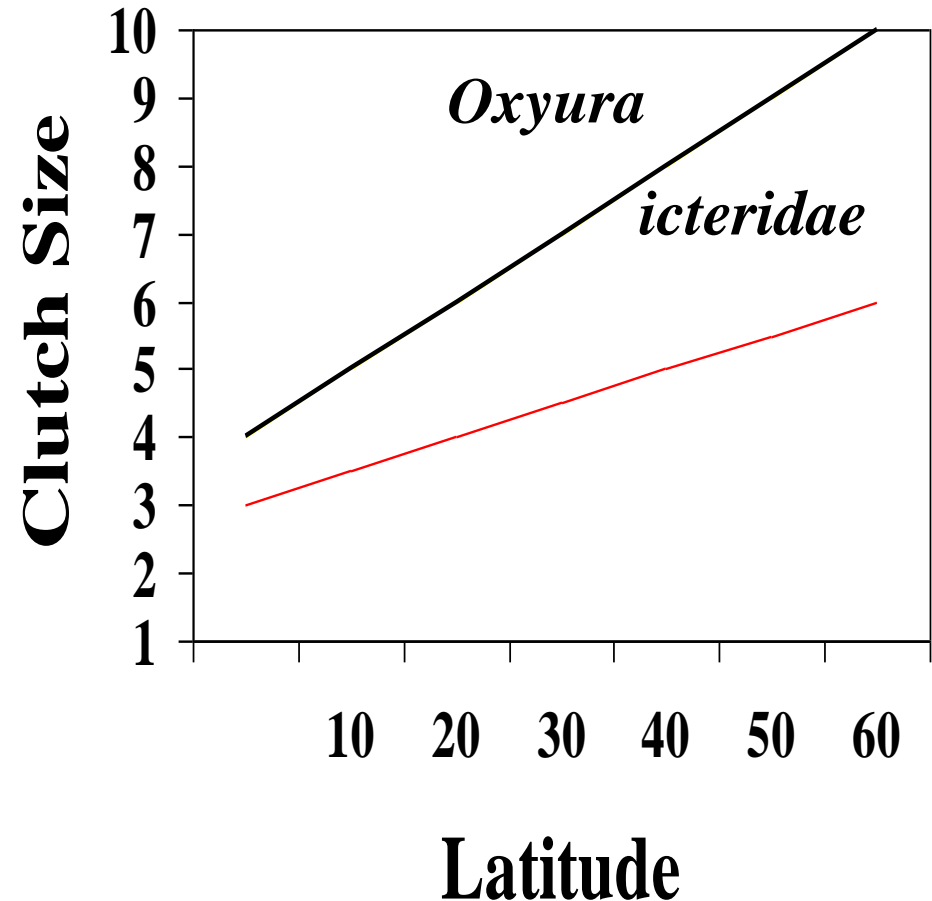   4 ;   Elephant- 1-2

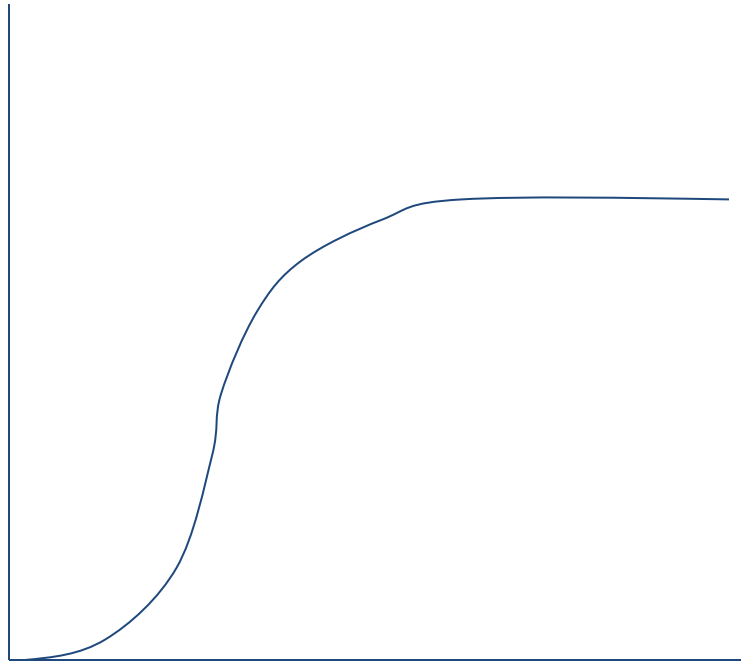## b) Environmental factors

Robins

clutch size in Europe:

- **4-5 eggs**

clutch size in Scandinavia

- **6-8 eggs**

POPULATION SIZE (N) (y-axis)

Time (t) (x-axis)

Allocation of energy to

- egg production
- Avoidance of Predators
- Competitive ability (*Cody 1966*)

Temperate areas→ Climatic catastrophes→ Pop below carrying capacity

Tropical areas → stable climates→ Pop near carrying capacity→ more energy in competition

2. Parental care
3. Length of breeding season and no. Of clutches or litter/year

4. Breeding age

5. Sex ratio and mating habit

6. Density

7. Potential natality

MORTALITY

No of individuals which die per unit of time

<u>**Potential or minimum mortality:**</u>

- no. of deaths occurring per unit of time under ideal natural condition

<u>**Realized mortality**</u> :

actual no of individuals which die per unit of time

DECIMATING FACTORS

A) Predation

- killing of any animal by other animal

- natural balance in ecosystem

- generalized predators

  leopard, tiger, lion, owl

- specialized predators

  cheetah, clouded leopard, fishing eagles

  sp. dependent on the abundance of   special prey

PREDATION DEPENDS ON

a. Species specific predatory behaviour

b. Prey species richness

c. Prey species biomass

d. Cover

e. Density and quality of alternate food to predator

f. Prey defenses: protective colouration, alertness swiftness, high reproductive rates

g. Predators ability :speed, strength in claws and teeth, smell, vision

PREDATION SUCCESS

- 7% in wolves

- Tiger - one in 20 attempts

PREY - PREDATOR RELATIONSHIP

Prey pop' high - predators increase; Increased predation - prey pop' falls

Low prey pop' - predators decrease

- **Social intolerance in predators when pop' high**

Energy and time budgeting is essential for a predator to survive depredation

a. **Mutual depredation**

   - predators fight and kill each other

b. **Chance depredation**

   - sudden encounter

B)   Disease and Parasites

- **Small population : often more vulnerable (inbreeding depression)**
- **Domestic or wild animals   may   serve as reservoirs or vectors**

  Rinderpest - Mudumalai Gaur pop. almost eliminated – 1968

  Periyar - 1974

- **Frequency of disease is density dependent**

C)   POISONING

- Plants produce toxic alkaloid
- Animals evolve metabolic mechanism to combat
- Introduction of toxic by man to control predators: extinction of wolf in USA
- Petroleum spills
- Persistent pesticide
- Lead poisoning in avifauna

D) Accidents

  fire, flash floods, fall, highway collision

E) Weather

  hail storm, cyclone

F) Starvation

G) Stress

H) HUNTING

- Major cause of mortality of some pop'
- Man a master predator
- Many species exterminated
- Large scale extermination of large mammal pop' in India
- Sport hunting in india
  banned by wlp act in 1972
- Poaching
- Impact of hunting on animal pop' removal of 'surplus' 'spillover'

EVOLUTIONARY STRATEGIES

K-selected species

- Species high on the food chain

- Few effective enemies

- Stable environments- climax vegetation

- Less energy devoted for reproduction and care of young

- **Usually large body size**

- **Can reach high levels of abundance-energy devoted to intraspecific interactions: territoriality, aggresion, cannabalism, specialisation**

- **Population live near carrying capacity(k)**

r-SELECTED SPECIES

- **Low on the food chain**

- **Occupy marginal or early succession habitats where resources are temporarily abundant**

- **Rapid rate of reproduction**

- Generalist species

- High dispersal ability

- Small size: energy devoted to reproduction; Less on intra-specific conflicts

- Rodents, quails, flocking birds (starlings, quellas, sparrows)

- Explosive populations

SOME OF THE CORRELATES OF r - AND K-SELECTION

	r - Selection	K - Selection
Climate	Variable and/or unpredictable : uncertain	Fairly constant and/or predictable: more certain
Mortality	Non-directed, density-independent	More directed, density-dependent

Population size	**Variable in time, non-equilibrium; usually well below carrying capacity of environment; unsaturated communities or portions thereof: ecological vacuums; re-colonisation each year**	**Fairly constant in time, equilibrium; at or near carrying capacity of the environment; saturated communities; no re-colonisation necessary**
Intra- and interspecific competition	**Variable, often lax**	**Usually keen**

Selection favours	1. Rapid development 2. High r_{max} 3. Early reproduction 4. Small body size 5. Semelparity :single reproduction	1. Slower development, greater competitive ability 2. Lower r_{max} 3. Delayed reproduction 4. Larger body size 5. Iteroparity : :repeated reproductions
Length of life	Short, usually less than I year	Longer, usually more than I year
Leads to	Productivity	efficiency

Thank you