ALLEN CAREER INSTITUTE
KOTA (RAJASTHAN)
path to success

PRE-MEDICAL

BOTANY

ENTHUSIAST | LEADER | ACHIEVER

STUDY MATERIAL

Demography

ENGLISH MEDIUM

Copyright Statement

DEMOGRAPHY

01. INTRODUCTION

Scientific study of human population is called demography.
Population is defined as the total number of individual of a species present in a particular area at a given time.
The population have specific character different from the character of individual.

02. CHARACTERS OF POPULATION

(1) POPULATION DENSITY (POPULATION SIZE)

It is measured as total number of individual present in unit area or unit volume.
The size of a population for any species is not a static parameter. It keeps changing in time depending on various factor including food availability, predation pressure and reduced weather.
For human population density is officially counted in first four month of 1^{st} year of each decade is called census.

- For human population density is calculated as number of person living in per square km area.
- The tiger census in our national park and tiger reserves is often based on pug marks and fecal pellets.

Note :
Ecological effects of any factors on a population are generally reflected in its size which may be expressed in numbers, biomass, percent cover etc. depending on the species.

(2) BIRTH RATE / FERTILITY / NATALITY

Birth rate is defined as total number of birth in a population with respect to total number of individual of the population in a year.
Birth rate is represented as per capita birth rate

$$\text{Per capita birth rate (b)} = \frac{\text{Total number of birth}}{\text{Initial population}}$$

Q. If in a pond there are 20 lotus plant last year and through reproduction 8 new plant are added, then the birth rate during the year is calculated as :	**Solution :** $b = \frac{\text{Total birth}}{\text{Initial population}}$ $= \frac{8}{20}$ b = 0.4 offspring per lotus per year.

- Birth rate varies from region to region
- Developed country have lower birth rate.
- Developing or poor country have higher birth rate than developed country
- Higher fertility in developing world is partially explained by large number of hand needed to perform work.

Note :
Biotic potential (Reproductive potential or potential ability) → The term biotic potential was first used by **Chapmann**.
Under most favourable environmental conditions the maximum reproductive capacity of an species is known as biotic potential.

Vitality – Capacity of normal growth and reproduction for survival of a species. It depends upon weight of plant, stem height, root length, leaf number etc.

(3) DEATH RATE / MORTALITY

- Death rate is defined as total number of death in a population with respect to total number of individual of the population in a year.
- Death rate is represented as per capita death rate

$$d = \frac{\text{Total number of death}}{\text{Initial population}}$$

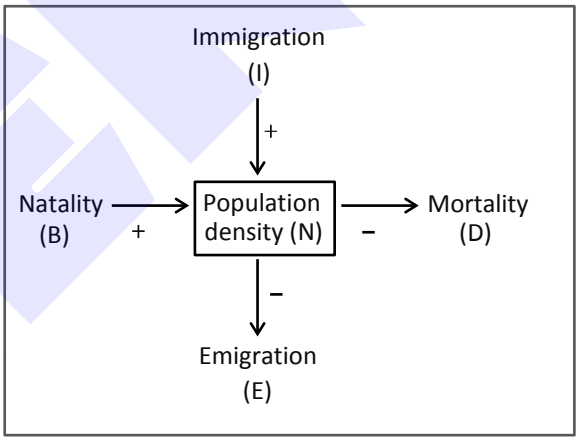
Q. If 4 individuals in a laboratory population of 40 fruit fly died during week. The death rate is calculated as:	**Solution :** $d = \frac{\text{Total number of death}}{\text{Initial population}} = \frac{4}{40}$ d = 0.1 individual per fruit fly per week.

(4) GROWTH RATE

Intrinsic growth rate (r) = b – d

$$\text{Growth rate} = \frac{\Delta N}{\Delta t}$$

$$\text{Percent growth rate} = \frac{\left(\frac{\Delta N}{\Delta t}\right)}{N_0} \times 100$$



Note : Natality, Mortality, Immigration and Emigration are the basic process responsible for fluctuation in population size under normal conditions, Natality and Mortality are the most important factors influencing population size than other two factor i.e., Immigration and Emigration.

$$N_{t+1} = N_t + [(B + I) – (D + E)]$$

(5) AGE-SEX STRUCTURES

The age structure of a given population refers to the proportion of individuals of different age. This is important aspect because **many functional aspect of individuals are related to age**. (Like Reproduction)

Age structure of a population can be depicted in the form of a pyramid diagram.

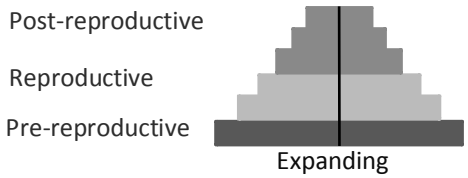
Diagram is particularly important in **understanding future growth.**

Population has 3 age groups.

- Pre-Reproductive individuals – < 15 yr
- Reproductive individuals – 15 – 44 yr
- Post-Reproductive individuals – > 45 yr

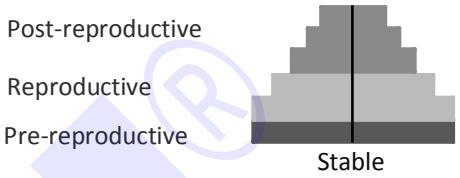
(A) Expanding population :

A **higher number of pre-reproductive** individuals, moderate number of reproductive individuals and fewer post reproductive individuals will form young population it shows **rapid growth.**



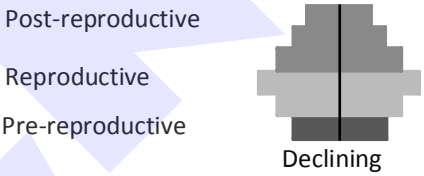
(B) Stable population :

An **equal number** of pre reproductive and reproductive individuals will constitute a mature population or **stable population.**



(C) Declining population :

Fewer number of pre reproductive individuals as compared to reproductive ones will make population aged. It shows **negative growth.**



Note : Developed countries have a steeper pyramid which represent nearly a stable population.

03. POPULATION GROWTH MODELS / CURVE

There are two type of growth curve

(1) EXPONENTIAL GROWTH (GEOMETRIC GROWTH CURVE OR J-SHAPED CURVE)

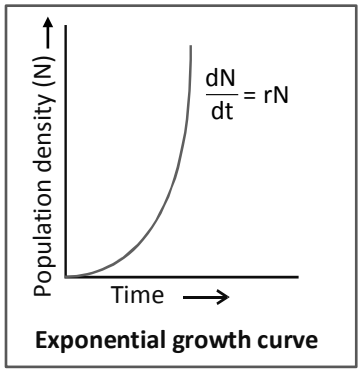
Any species growing exponentially under unlimited resource conditions can reach enormous population densities in a short time. If in a population of size "N", the birth rates are represented as b and death rates as d, then the increase in N during a unit time period t $\left(\frac{dN}{dt}\right)$ will be.

$\frac{dN}{dt} = (b - d) \times N$ Let (b – d) = r, then

$\boxed{\frac{dN}{dt} = rN}$ r = intrinsic rate of Natural increase or Fitness or growth rate.

The integral form of the exponential growth equation as :-

$$N_t = N_0 e^{rt}$$



where : N_t = Population density after time t

N_0 = Population density at time zero

r = intrinsic rate of natural increase

The magnitude of r-values for the Norway rat is 0.015 and for the flour beetle it is 0.12. In 1981, the r-value for human population in India was 0.0205.

e = the base of natural logarithims (2.71828)

(2) LOGISTIC GROWTH CURVE (SIGMOID CURVE / S-SHAPED)

Since resources for growth for most animal population are finite and become limiting sooner or later, the logistic growth model is considered more realistic.

The S-shape sigmoid growth form is represented by the **Verhulst - Pearl logistic growth** equation :-

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

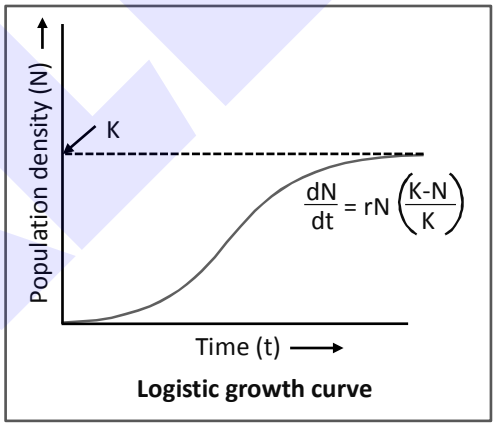
where : $\frac{dN}{dt}$ = Rate of change in population size

r = Intrinsic rate of natural increase

N = Popultation size at time t

K = Carrying capacity

$\left(\frac{K-N}{K}\right)$ = Environmental resistance

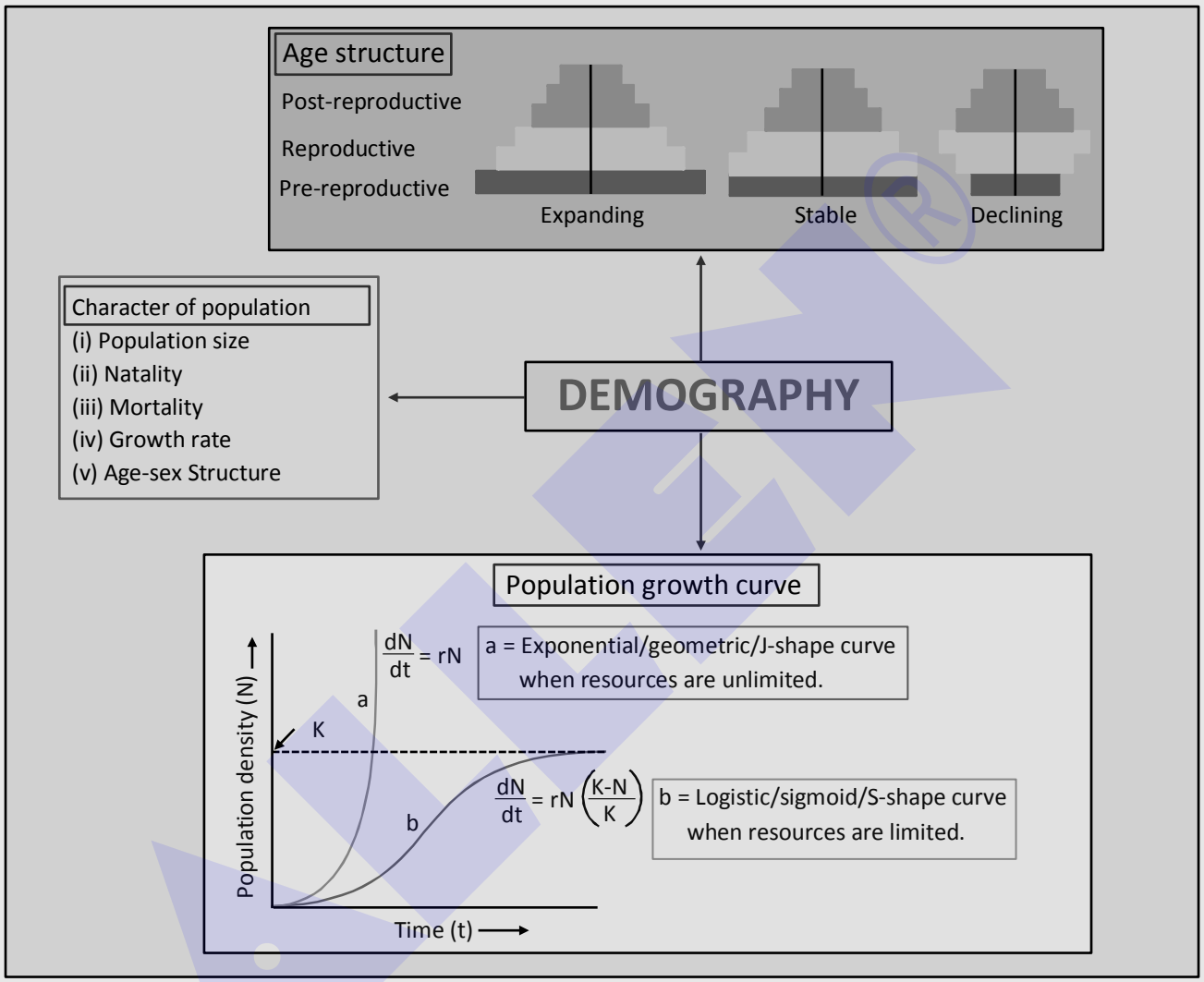


Logistic growth curve

04. LIFE HISTORY VARIATION

- Population evolve different strategy to maximise their reproductive fitness.
- Some organism breed only once in their life time like **Pacific salmon fish, Bamboo** etc.
- Some produce small sized offspring like **Oyster, Pelagic fishes** etc. maximise their fitness by producing large number of offspring.
- Some organism breed many times in their life and produces a small number of large sized offspring **(Birds, Mammals)**.

ESSENCE


Age structure
Post-reproductive
Reproductive
Pre-reproductive
Expanding
Stable
Declining
Character of population
(i) Population size
(ii) Natality
(iii) Mortality
(iv) Growth rate
(v) Age-sex Structure
DEMOGRAPHY
Population growth curve
Population density (N)
Time (t)
a
b
K
dN/dt = rN
a = Exponential/geometric/J-shape curve when resources are unlimited.
dN/dt = rN (K-N/K)
b = Logistic/sigmoid/S-shape curve when resources are limited.