2: Population ecology:…………………………………………..Pages 20-31

2-1: Structure of single species populations:……………. Lecture 7

A population is a group of interacting individuals set in a frame that is defined in respect to both time and space . Populations are fundamental units in ecology , as are tissues in biology . Whereas , tissues are composed of cells in functional groups , populations are composed of individuals in functional groups . Populations are major components of communities in an ecosystem, just as tissues are major components of organs in an organism. Thus , it should be thought that populations have a structural organization and a functional role . The structure of a population is definable in terms of numbers (density) , spatial distribution , age structure (age groups) and sex ratios . Its functional role is definable in terms of patterns of population growth and population fluctuations through birth rates (natality) , death rates (mortality) , emigration and immigration . In both structural and functional terms these are statistical properties which individual organism don't have , thus it can be said that populations are more than the sum of their individuals . They represent a higher level of biological organization , a level which has its own specific properties not found at the level of individual organism .

Population sizes (Population densities):

Population sizes may vary from a few individuals to millions of individuals . Population estimates are one of the most important aspects of population structure . Methods of population estimates include direct counts if possible or indirect counts by sampling if direct counts are impossible . Indirect counts include two main methods :

1 . Capture – mark – recapture method (Lincolin Index):

The method depends upon the ratio of marked to unmarked animals in subsequent trapping runs , as follows :

$$\frac{P}{M1} = \frac{T2}{M2}$$

Where P : unknown population

M1: marked individuals in first run ; M2: marked individuals in second run

T2 : total number of individuals in second run

2 . Kelker ratio method:

This method is based on a change in sex ratio before and after a known number of one sex has been harvested , as follows :

$$\frac{S1}{P1} = \frac{S1-S2}{H}$$

Where S1 : Sex ratio before hunting ; P1 : total number of desired sex before hunting

S2 : Sex ratio after hunting ; S1 - S2 : the change in sex ratio due to hunt

Thus , total population (P) equals P1 plus total number of young individuals and those of other sex in population .

Spatial distribution:

Most plants and animals in natural environments show a clumped – nonrandom pattern of spatial distribution . Hence , it is more common for populations to belong to this type of distribution . The reasons for such distribution might be attributable to the heterogeneity of the environment (the distribution of food , shelter….etc.) , or to the social behavior of the species . Other types of spatial distribution include clumped – random , nonclumped – random and nonclumped – regular .These distributions are probably exceptions to the general rule (clumped – nonrandom distribution) and they are most likely attributable to homogeneous environment , absence of social behavior of species or to artificial nature of the environment in each type .

Sex ratios:

In most vertebrate populations primary sex ratios at hatching or birth approach 50% male and 50% female . However , the secondary sex ratios or adult sex ratios of many vertebrates show greater deviations . In most mammal populations adult females outnumber adult males 2 – 3 : 1 . Hence , apparently males have higher mortality rates throughout life than females . In some bird populations , the reverse is true , and females have higher mortality rates than males , particularly during the nesting season .Thus , males may outnumber females 4 – 5 : 1 .

Age structures:

There are three basic types of age structure of populations . The exact shape and proportions of age classes in each type , are a function of natality , mortality and population turnover (Fig . 12) . :

A - a declining population ; with a low percentage of young individuals in the population
B - a stable population ; with a larger percentage of young individuals than adults
C - an increasing population ; with a very large percentage of young individuals

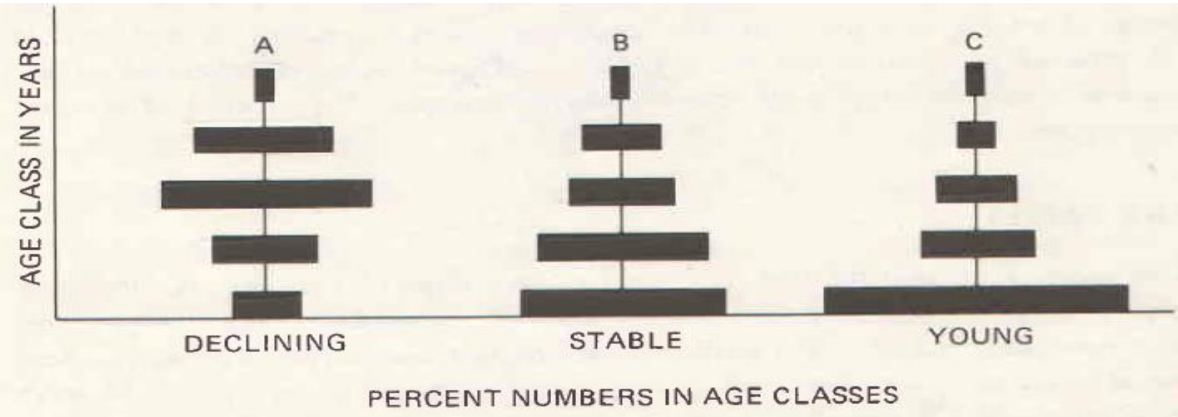

Fig . 12 : Basic types of age structure of populations

Populations usually show different age structures in different habitats , for example , Rhesus monkey populations in India (Fig . 13) . In roadside habitats and villages , where juvenile individuals (1 – 3 years of age) are trapped for export for use in scientific research throughout the world , there is an unnatural shortage of individuals in this age group . However , in temples , where rhesus monkeys are protected for religious reasons , and in forests where they can escape trapping more successfully , the age structure shows relatively stable type . By comparison , this population shows young type of age structures with a broad base of infants and juveniles , when it has been feed and protected by a governmental research programs , in Cayo Santiago island (Puerto Rico) .

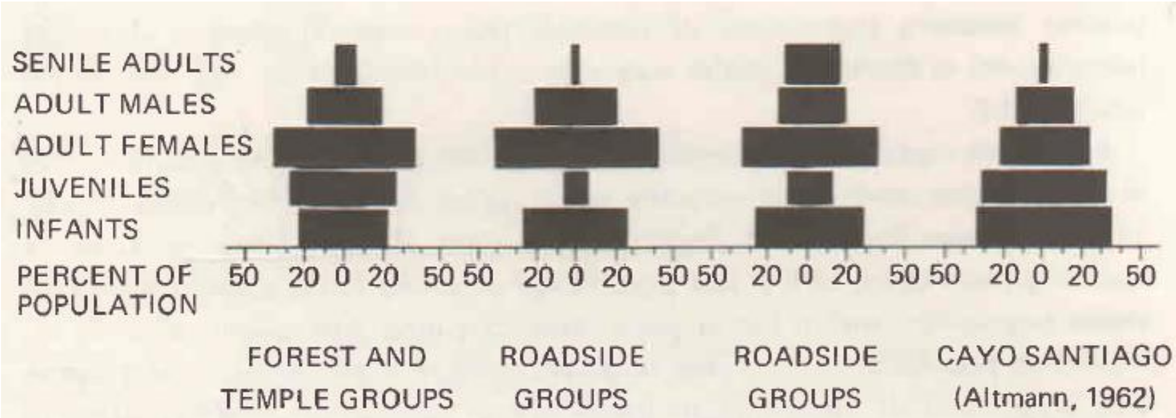

Fig . 13 : Age structures of Rhesus monkey populations

Life tables:

Life tables represent tabular data on age structures of populations , and they also provide valuable information on mortality rates and longevity patterns. **The essential data of a life table may be of two basic types :**

1 . Census data on a population with accurate counts of the numbers of individuals in each age group .

2 . Mortality data on the number of individuals of each age group dying in a given period of years .

From such data , survivorship and longevity can be calculated . Thus , insurance companies use life table statistics on human populations to estimate the probability of death each age group and to establish rates for life insurance .