COMMUNITY

The individuals of a species that occupy a particular place represent a population. Every place on Earth - each meadow, each pond, each rock at the edge of the sea — is shared by many coexisting populations. An association of such populations is called a community.

- Characteristics

1) SPECIES DIVERSITY:

Each community is made up of much different organisms - plants, animals, microbes, which differ taxonomically from each other.

2) GROWTH FORM AND STRUCTURE:

community is described in terms of major growth forms as trees, shrubs, herbs, mossess etc. In each growth form as in trees, there may be different kinds of plants as broad-leaved trees, evergreen trees. These different growth forms determine the structural pattern of a community.

3) DOMINANCE:

In each community all the species are not equally important. There are few species which exert a major controlling influence on the community and thus, determine the nature of the community. Such species are known as dominants.

4) SUCCESSION:

Each community has its own developmental history. It develops as a result of a directional change in it with time. This directional change is called succession.

5) TROPHIC STRUCTURE:

Nutritionally, each community, a group of autotrophic plants as well as heterotrophic animals exist as a self sufficient, perfectly balanced assemblage of organisms.

6) COMPOSITION:

Communities may be large or small. Larger ones extend over a large areas such as forests, etc.. others such as deserts are comparatively smaller in dimensions. Very small-sized communities are the groups of micro-organisms in such micro-habitats as leaf surface, litter, soil etc.

7) STRUCTURE:

Structure of the community refers to the recognizable pattern in the spatial arrangement of their members. Thus structurally, a community may be divided horizontally into subcommunities. This horizontal division constitutes the zonation in the community.
Ex (a) different distinct vegetational types on a mountain
(b) stratification of deep ponds and lakes into littoral, limnetic and profundal zone.

ECOLOGICAL SUCCESSION

communities are never stable, but dynamic, changing more or less regularly over time and space. They are never found permanently in complete balance with their component species or with the physical environment.

Variation in climatic and physiographic factors

↓

changing over of Environment

↓

marked changes in the dominants of the existing community

↓

unstable condition arises and thus existing community is sooner or later replaced by another community at the same place.

↓

Process of community replacement occurs and successive communities develop one after another over the same area, until the terminal final community again becomes more or less stable for a period of time.

↓

This phenomena of occurence of relatively definite sequence of communities over a period of time in the same area is called as **ecological succession**.

CAUSES OF SUCCESSION

- Initial or initiating causes
  - a) Climatic – erosion, wind, fire etc. caused by lightning and volcanic activity
  - b) Biotic

These causes produce the bare areas of or destroy the existing populations in an area.

- Ecesis or continuing causes

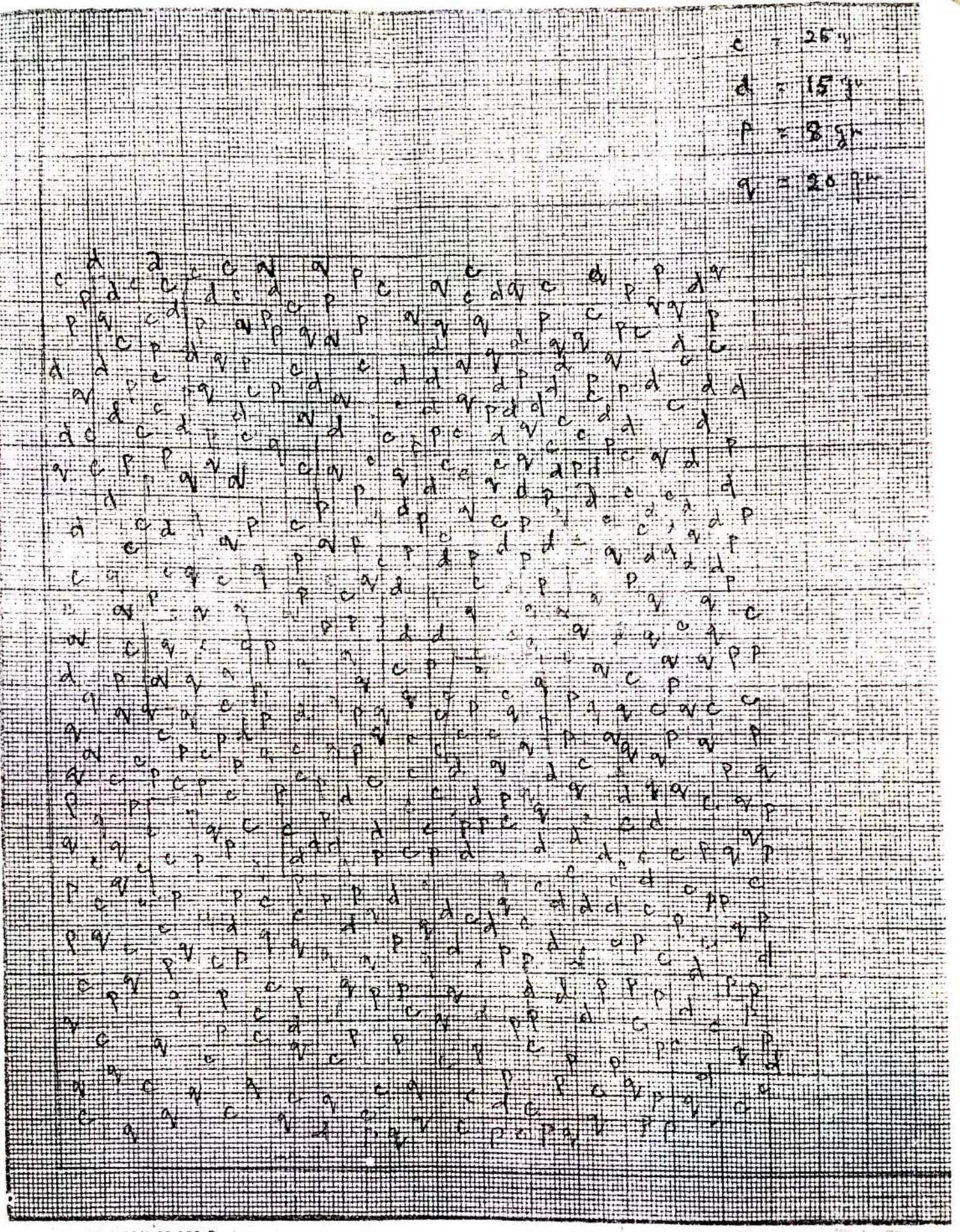
These are the processes as migration, aggregation, competition which cause successive waves of population.

- Stabilising causes

These cause stabilisation of the community.

TRENDS OF SUCCESSION

A continuous change in the kinds of plants and animals
↓
A tending increase in the diversity of species
↓
An increase in the organic matter and biomass supported by the available energy flow.
↓
Decrease in net community production
↓
unstable community
↓
leads to process of succession.



SCUP/127C/98-99/1,00,000 Copies

Eco

Niche concept

Ecological niche concept is an important aspect in ecosystem. The term ecological niche was first introduced by Joseph Grinnell (1917). Ecological niche means micro-habitat. Niche concept leads to the formation of bio diversity when an ecosystem and it helps to provide independent functional activity of a species population within a narrow range of environment. Grinnell mostly thought of Niche in terms of microhabitat or more what he would call as spatial niche. Charles Elton just used the term "niche" in the sense of the "functional status of an organism in its community".

Definition

Ecological niche is the position or status that a given species occupy within the community or in a ecosystem on account of its structural adaptations, physiological response or specific behaviours (Whittaker, 1973)

A niche can be defined for an individual population or a species and represent a response to the physical and biological gradients in the environ. (Bazdx (1987))

Habitat and niche

The word habitat means "it dwells". The word niche means "the small area" the distinction between habitat and niche is an important aspect in ecology.

Habitat refers to the place where an organism or species population lives, for instance a pond is the habitat of zooplankton, phytoplankton and fish. A niche refers to the small portion of the habitat which is occupied by a particular species population. Habitat is the first geographical area which is characterized by various biological species

A habitat is separated from another habitat by diff environmental factors (temp, light, humidity etc) and edaphic factors (soil)

Niche is separated from other niche either a habitat by minor variation of different ecological parameters.

Thus a habitat is divided into many small zones or microhabitat.

Odum suggested that the habitat is the organism's "address" and the niche is its "profession"; (population, community biologically speaking)

~~Odum has compared the habitat to the address and the niche to its profession~~

Kendeigh (1974) considered the niche as a combination of habitat and biotic interactions of a species for its survival and continuance in a community.. for inst., a lake is the habitat of all types of fishes whose niches are different, like there may be surface, column or bottom feeders

From evolutionary pt. of view, niche concept is developed within a habitat to avoid food and space competition.

Niche concept

Ecological ~~nic~~ niche is an adaptive zone within the habitat where a particular species can survive in relation to environment and food. A niche is explained by the frequency to of use of diff parts of resource gradient. The distribution of a species reflects the extent to which each of part of the gradient is used. The concept of niche

is most useful to study the differences betⁿ species and location.

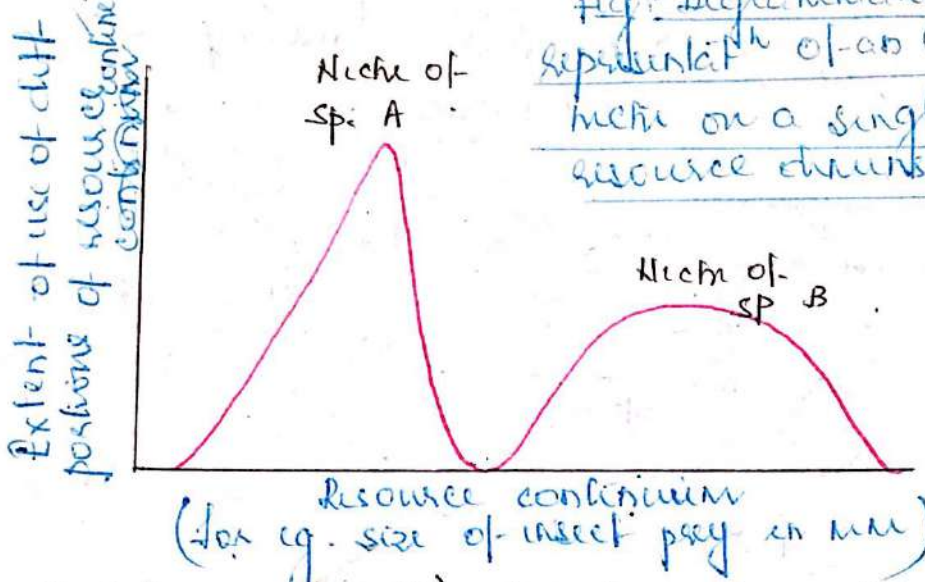


fig:- Diagrammatic representation of an organisms niche on a single resource dimensions.

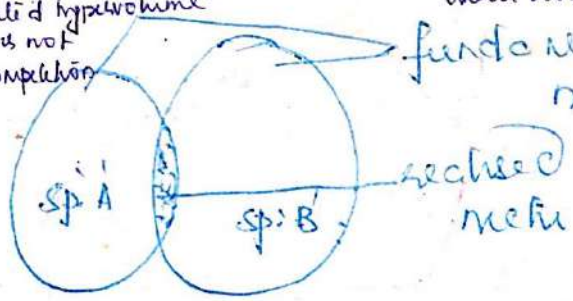
Hutchinson (1957) stated that niche is a multidimensional concept or a hypervolume ~~for~~ within which the environment permits an individual or species to survive indefinitely. An ecological niche is a unique constellation of environmental factors that may be capable of supporting a given form of life. The sea, for inst. does not constitute a single niche occupied by marine animals. They all share an aquatic habitat but may differ widely in temperature tolerance, pressure tolerance, food sources or reaction to salinity.

Thus, a niche can develop in any direction or dimension according to availability of environmental suitability, called the hypervolume or multidimensional concept.

Hutchinson distinguished hypervolume into fundamental and realised niche. The niche which is occupied by uncompetetive population called fundamental niche. If one fundamental niche of a species may cause niche overlap

or another fundamental niche, then a biological competition may arise in the overlapping area. This interacting zone is known as realized niche. realized niche - a smaller hypervolume occupied under biotic constraints

Fundamental niche - the maximum "abstractly inhabited hypervolume" when the species is not constrained by competition with others



Niche concept

Explanation of niche concept.

Niche concept can be explained on the basis of two components :- niche overlap
niche width

i) Niche overlap :- Niche overlap is one of the important component. Many population inhabit niches that obviously overlap, and one of the most fascinating problems in ecology is to determine how great the overlap must be before a condition of equilibrium gives way to one of competition.

Gillen (1984) divided niche overlap on the basis of different degrees.

a) included niche :- When one fundamental niche might be totally included within a second fundamental niche, here an inferior included species could be eliminated but a superior included species would eliminate the other species

from the conflicted space.

3(i)

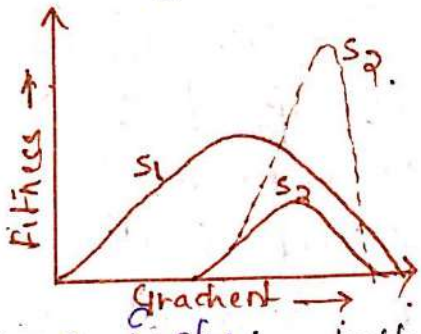


Fig Included niche

b) Overlapping niche :- With partial overlap of fundamental niches, the competitively superior species occupy the shared niche space and each species has an exclusive uncontested refuge. There may be mutual understanding among the different species.

3(ii)

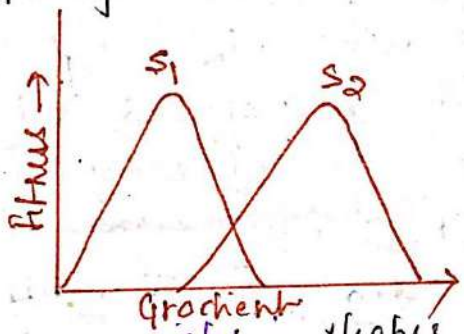


Fig Overlapping niche

c) Abutting niche :- Niches may abute against each other. No direct competitive exclusion can occur. But such niche relations might reflect the avoidance of competition.

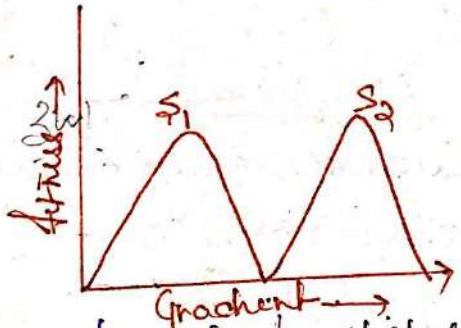


Fig Abutting niche

d) Disjunct niche :- Niches are entirely disjunct, so both species occupy their fundamental niche.

3(iv)

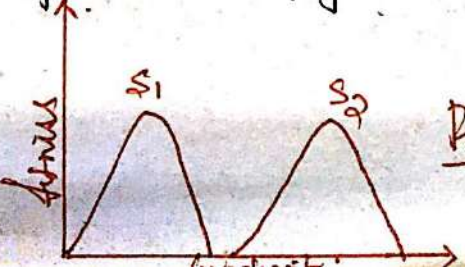


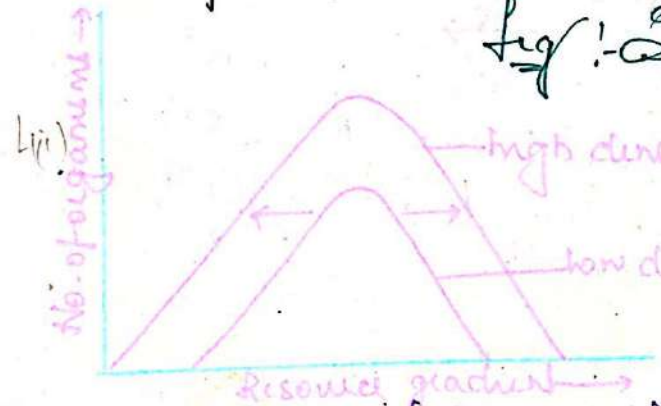
Fig Disjunct niche

ii) Niche width

Niche width is measured by the length of the axis intercepted by a species population. The range of resource that a species can use is termed as its niche width, ~~Hence~~ A niche width usually involve natural selection. A niche width depends upon the nature of competition. Gause (1984) suggested that niche width can be devided into two :-

a) Under intra specific competition :- It is predicted that this restricts the range of resource spectrum used by a species the factors like population growth may cause expansion of ~~the~~ niche width

Fig :- Intra specific competition



b) Under interspecific competition :-

Any ecological abnormalities may cause niche overlap. Niche overlap may cause severe competition among the different species. Thus the area of overlap between niches will be reduced, so niche width is decreased on the basis of competitive exclusion.

4(w)

Fig
Interspecific competition

Possible outcome of niche overlap

Niche overlap may cause the development of following results.

- **Competitive exclusion or Gause's principle (Gause 1934)**

Gause (1934) postulated that no two forms can share exactly the same ecological niche for an indefinite period of time, eventually one will replace the other. This is popularly known as Gause's principle

Competitive exclusion is experimentally demonstrated from the growth curves of laboratory cultures of P. aurelia and P. caudatum. These two species of Paramoecium are found in same ecological conditions of two different ponds. By growing two organisms (two sp. of Paramoecium) in same culture medium under identical conditions of temperature and light. After ten days growth curve of Paramoecium caudatum is gradually diminished. Therefore, it is explained that under same ecological condition, P. aurelia is regarded as the superior species and uses the available food more rapidly the P. caudatum. Results of the experiment are

graphically represented below:-

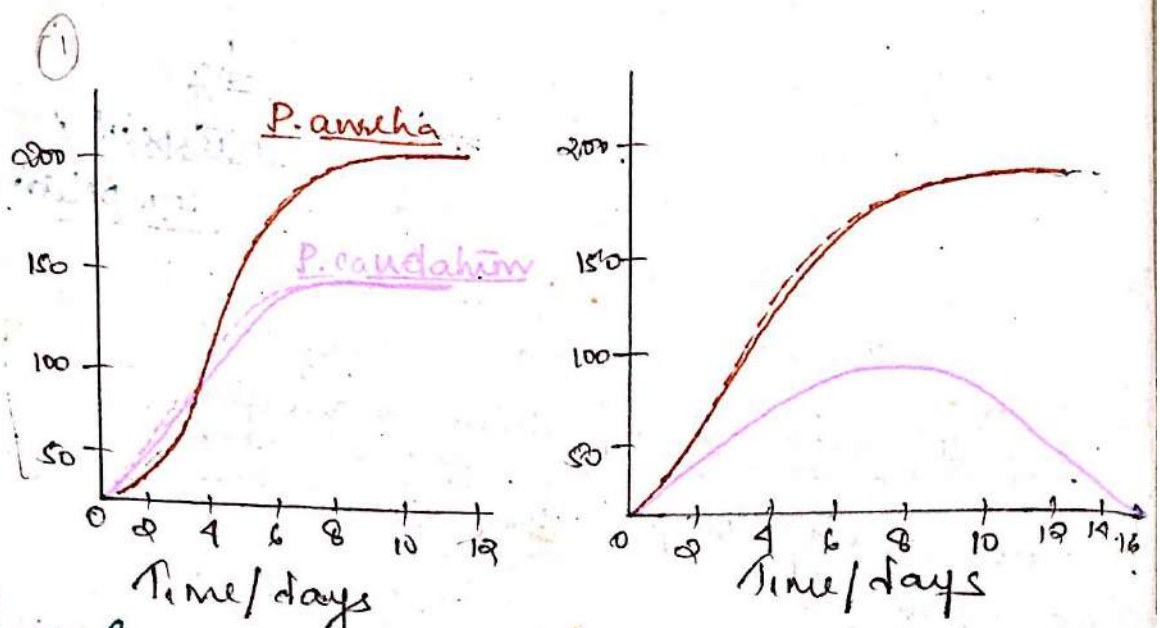


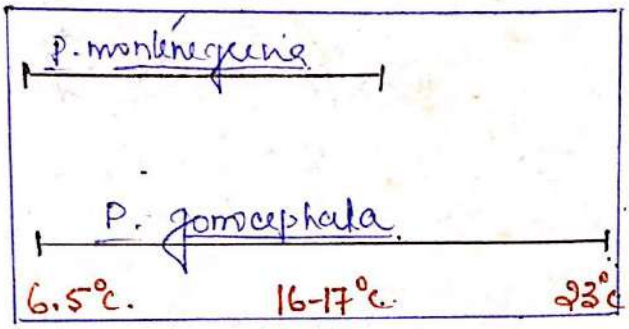
Fig:- Growth curves of laboratory cultures of 2 species of Paramoecium

- **Niche shift**:- Niche shift or displacement is another outcome of niche overlap. To avoid competition, the related species may shift their habitat by mutual understanding to avoid food and space competition.

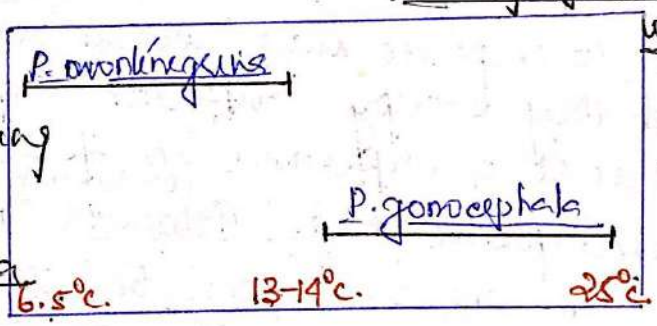
Miller (1967) experimentally demonstrated the concept of niche shift during niche overlap. It is observed that two species of Planaria — P. montenegrina and P. gonocephala are inhabited in different ponds. In allopatric condition, the thermal range of distribution of P. montenegrina is 6.5°C to 17°C. where as P. gonocepala is distributed from 6.5° to 23°C.

When two species are cultured in the same area and show the conception of niche shift to avoid conflict, P. montenegrina is restricted from 6.5°c to 13°c. P. Gonocephala shows thermal range of distribution from 14°c to 25°c. Following schematic representation shows the niche shift of two Planaria species

(5)



In allopatric condition



In sympatric condition

Fig Schematic representation showing the niche shift in two sp of Planaria

Types of niches :-

Ecological niche can be divided into 2 types :-

~~The maximum abstractly inhabited by species when the species is not~~ constrained by competition with others.

(1) Spatial / habitat / place niche :- Sometimes niche concept is based on variations of microhabitat. Oneill (1967) experimentally showed the segregation of different species of millepids to avoid space or competition. Microhabitat of 3 species of millepede on Oak plant is given below schematically.

Microhabitat	Leuctopolydesius serratus	Narceus americanus	Fontaria virginiensis
superficial wood of logs	(66.7%)	4.3%	0
Outer surface of logs beneath the bark	20.8%	(71.4%)	0
under logs, but on the ground surface	4.2%	12.5%	(97.5%)

~~Edaphic hypsothune occupied niche biotic constraints~~

② Trophic / Food niche :- Sometimes, two or more species may live in the same area but they occupy different trophic niches because of differences in food habits (backswimmer) (boatman)
e.g. two aquatic bugs, Notonecta and Corixa live in the same pond but they never compete with each other because of diff food habits. Notonecta is an active carnivore where as corixa feeds on decaying vegetation.

Discussion

The niche concept has an important bearing on the theory of evolution by natural selection. Slatkin & Roche (1974) suggested that ecological niche sp. is dependant upon genetic variability. Krebs (1972) suggested that niche concept is mainly based on different independent adaptive zones. So the ecological niche is significant to study the interactions in between the niche species. According to Gause's principle, it is observed that a niche is occupied by a single species i.e popularly known as "one niche — one species concept".

Short quest.

(1) Gause's principle / competitive exclusion (5)

(2) One niche - one species concept (5)

Practice Problems on Shannon-Wiener Diversity Index

Introduction Questions:

1. What is meant by species abundance?
2. Explain how the biodiversity of an ecosystem relates to the health of that ecosystem.
3. Explain why biodiversity is important to the human population.

Part 1: Example Communities

Complete the tables for the following populations and make a conclusion about the diversity for each community.

Community #1

Species	# found	P_i	$\ln(P_i)$	$P_i \ln(P_i)$
1	40			
2	40			
3	40			
4	40			
5	40			
Total				

Community #2

Species	# found	P_i	$\ln(P_i)$	$P_i \ln(P_i)$
1	1			
2	1			
3	196			
4	1			
5	1			
Total				

Community #3

Species	# found	P_i	$\ln(P_i)$	$P_i \ln(P_i)$
1	84			
2	4			
3	91			
4	34			
5	43			
Total	256			

Part 2:

Following specimens were collected from GARDEN A and GARDEN B. Calculate the Diversity index [Shannon Weiner Index] for two communities and comment on your result.

GARDEN A

Order	Description	No of individuals [n]
Hymenoptera (wasp)	Black	10
Hymenoptera (wasp)	Purple	23
Hymenoptera (bee)	Striped	5
Orthoptera (grasshopper)	green with red legs	24
Orthoptera (grasshopper)	brown with a yellow stripe	3
Lepidoptera (butterfly)	large, blue	16
Lepidoptera (butterfly)	small, blue	8

GARDEN B

Order	Description	No of individuals [n]
Orthoptera (grasshopper)	green with red legs	7
Orthoptera (grasshopper)	brown with a yellow stripe	6
Lepidoptera (butterfly)	large, blue	2
Lepidoptera (butterfly)	small, blue	4
Coleoptera (beetle)	red & blue	14