

# ECOLOGICAL ADAPTATIONS

## ADAPTATION

- Any **feature of the organism or its parts** which is of definite significance in **allowing** that organism **to exist** under the conditions of its **habitat** is called ***adaptation***.
- The **adjustment** of living organisms to their environment by the aid of special **structures or function**. It is indicated by the fact that different kinds of plants and animals may share a common habitat.

# Habitat

- It is a **place** that **provides** food, shelter and climatic conditions for an organism to **survive, breed, and flourish.**
- The habitat of an organism is a part of the total environment of the region.
- Two species in a habitat may depend on each other for their welfare.

# A habitat has two components:

- ❖ **Physical components** are geographic conditions in the form of temperature, rainfall, seasons, and climate, the water supply and so on.
- ❖ **Biotic components** are in the form of living plants and animals. But there should be a proper balance in between the two types of components.

# Categories of Plants:

Depending upon their water requirements or more specifically upon the quantity of water available in their habitats the plants are divided ecologically into following three categories:

1. Hydrophytes
2. Mesophytes
3. Xerophytes

# **(1) Hydrophytes**

- ❖ **Live partially or wholly submerged in water or in swamps, etc.**

**Categorized into:**

**A) Marine**

**B) Fresh Water**

# **(A) Marine environment**

- **This ecosystem is the largest in terms of surface area of the earth. Unlike land, the ocean is surprisingly uniform habitat.**
- **Three distinctive habitat zones**
  - 1. Inter-tidal**
  - 2. Neritic**
  - 3. Oceanic zones.**

## (a<sub>1</sub>) Inter-tidal zone:

- Area between high tide and low tide levels.
- As water is in a state of continual motion between high and low tides, burrowing organisms such as clams, crabs, snails, etc., are found on sandy stretches.
- On rocky shores algae, barnacles, and Oysters attach themselves to rocky surfaces.

# (a<sub>1</sub>) Neritic zone:

- Extends from the shoreline up to limit of the continental shelf.
- On the **shallow water** of continental shelf, adequate sunlight is available.
- **Nutrients** washed down from the land are **abundant**.
- This zone with **estuaries** accounts for 50% of **productivity of sea**.
- World's **richest fishing grounds** are located on the continental shelves.



## **(a<sub>3</sub>) Oceanic zone:**

- **Wide open ocean beyond the edge of continental shelf.**
- **Though sunlight may be present in surface water, nutrients required for photosynthesis are not adequate.**
- **As productivity is quite low, open oceans are *biological deserts*.**
- **Though a variety of organisms from phytoplankton to large sharks and whales are present, they are **scattered over a large area**.**
- **As food sources are scattered, the larger fishes have powerful swimming ability to cover vast distances in search of food.**

## **(B)Fresh water**

- **Pools, ponds, lakes, streams, rivulets, rivers, and marsh-lands.**
- **Plants are very much the same in all environments of rivers, lakes, etc.**
- **Hydrophytes of even different continents are nearly the same everywhere.**

# Classified ecologically as:

## **(b<sub>1</sub>) Lentic:**

- Refers to the standing water such as in a pond or lake.

## **(b<sub>2</sub>) Lotic:**

- Pertains to running water such as streams and rivers.

## **A) Attached to substrate:**

- a) Emergent hydrophytes, e.g., *Phragmites*, *Glyceria*, *Ludwigia*, *Typha*.
- b) Floating leaved hydrophytes, e.g., *Nymphioides*, *Nymphaea*,
- c) Submerged hydrophytes: *Vallisneria*, *sagittaria*, *Hydrilla*

## **B) Free floating plants:**

- a) Submerged plants: *Urticularia*
- b) Floating plants: *Azolla*

## **C) Amphibious plants: *Eleocharis***

## **D) Marshy plants**

# **Factors Affecting Adaptation:**

- a. Lack of oxygen**
- b. Low temperature**
- c. Lack of light**
- d. Abundance of water, etc.**

# Morphological Adaptations

- Long and spongy petioles have developed.
- Leaves become lengthy, finely divided.
- Dissected leaves can be seen in submerged plants as such leaves offer less resistance to undercurrents.
- Waxy coating on the leaves, e.g., *Nymphaea*. acts as a check on wetting of the upper surface and clogging of the pores.

- Variation (**heterophylly**) in leaves due to the following factors:
  1. Reduction in light intensity;
  2. Changes in living and habitat conditions;
  3. Substantial reduction in transpiration;
  4. Immense hydrostatic pressure on leaves; etc.
- Fruits of several hydrophytes are **indehiscent**.
- May be transported by the water currents from one place to another.

❖ In a large number of aquatic plants, the **propagation** is often by **vegetative means**.

a) Rapid fragmentation, e.g.,  
*Elodea*

b) Runners e.g., *Eichhornia*.)

❖ leaves become thin and linear which are reduced in thickness; **increased surface area to receive diffused light**.



# Anatomical:

- **Mechanical tissues** are greatly reduced
- Plants not subject to wind stress/ strain; do not have to bear the weight of leaves.
- **Turgid parenchyma** tissues provides strength to the plant. The **air** in cavities helps in **buoyancy**.
- External wall of **epidermis is thin**; cells are in a position to absorb the gases and nutrients.
- Function is performed by the roots in land plants.
- **Leaves often don't contain stomata.**
- Hydrophytes excrete **mucilage** serves as a protection against the injury

## **(2) Mesophytes**

- **Plants that normally grow in habitats where water is neither scarce nor abundant.**
- **Pure space in soil is occupied almost equally by water and soil atmosphere.**
- **Mesophytes are grouped, based on light requirements, into the following:**
  - 1.Light Demander: A species that requires abundant light for its best development.**
  - 2.Shade Bearer: A species capable of persisting and developing under the shade.**

# Characteristics of Mesophytes

- **Roots well-developed**
- **Young roots are abundantly covered with hair.**
- **Balanced proportion of mechanical tissues as against their absence in hydrophytes and excessive predominance in xerophytes.**
- **Stems are also well-developed**
- **Leaves are well-developed, usually broad and only moderately thick.**
- **Stomata occur on the surface.**
- **A well-developed vascular system is also present**
- **Osmotic pressure is also lower, as compared to the xerophytes**

# 3) Xerophytes

- **Plants which grow under dry conditions.**
- **Characterized by conditions:**
  - a. **Water supply is lacking**
  - b. **Soil is physically or physiologically dry,**
  - c. **Rate of transpiration is high.**
  - d. **High temperature**
  - e. **Strong sunlight as in deserts**

## Definitions

- **A plant that can subsist in dry situations.**
- **Any plant that can survive in conditions of water deficiency.**

# **Sites of Xerophytic Habitat:**

- **Deserts,**
- **Rock ledges,**
- **Bark of trees,**
- **Polar areas,**
- **Alpine and high lands,**
- **Sandy and gravelly soils,**
- **Sea coasts,**

# Classification of xerophytes:

## A. General

- a) **Ephemeral annuals:** drought escaping plants with a very short life cycle. The shoots are generally longer than the roots.
- b) **Succulent plants:** plants have succulent leaves and stems. *Agave, Aloe, Ceiba parviflora*, etc.
- c) **Non-succulent plants:** can endure periods of permanent wilting. extensive root system is present.

# (A) Adaptations in Xerophytes:

## A) Morphological:

- a) **Modified stem:** Stems of some species become fleshy and are changed into leaf-like structure. *phylloclade*.
- b) **Small leaf size:** Leaf blades, pinnules, etc., are small in size. Reduce transpiration. Sometimes, the leaves are transformed into *phylloclade*. Leaves may become fleshy and hardened, e.g., *agave*, *aloe*,
- c) **Long-root system:** A long-root system to tap the moisture from below strata. In some conditions, a superficial root system may be developed, absorb moisture from the soil surface after a brief shower.
- d) **Curling and rolling:** Fruit stalks and some other parts are curved or rolled inwards.

## **(B) Physiological:**

- i. Respiration: Stomata open after daylight and organic acids are produced. Respiratory quotient (RQ) in most of the species is lower than one and often zero (0).**
- ii. Consumption of CO<sub>2</sub>: Stomata open only during night. Less loss of transpirational moisture.**
- iii. Osmotic pressure: The osmotic pressure is high in xerophytes. Helps:**
  - (a) To check loss of water;**
  - (b) To maintain rigidity of plant;**
  - (c) To continue the process of photosynthesis for longer period.**



## C) Anatomical:

- a) Epidermis is covered with **a thick layer of cuticle.**
- b) **Cork** is produced in greater quantities.
- c) **Mucilage, produced** in some plants, helps to **reduce transpirational loss of water. Lignification acts as a barrier against extreme temperature.**
- d) **Small hairs may develop** .Protect the leaf surface from the sun's rays by providing shade.
- e) Stomata are adapted to reduce loss of moisture
- f) **Development of water storing tissues**

# **HALOPHYTES.**

- **Very specialized category of plants which suffer from water deficiency mainly on account of high content of salt in the soil, mud, or free water, which do not allow water absorption by the plant.**
- **Physically wet but physiologically dry condition.**
- ***Tamarix dioica, Suaeda fruticosa, Avicennia officinalis, Ceriops, Sonneratia,***

# ***Ecological Adaptations in Animals***

***Animals too are subjected to problems of scarcity as well as abundance of water.***

# **(A) Aquatic conditions**

- **Plenty of water in different water bodies poses no problem.**
- **Differences in the values of osmotic concentration of the body fluid of animal and that of the external water medium.**
- **Marine waters - osmotic concentration is greater than the body fluid of fishes.**
- **Fresh water habitats - osmotic concentration of water medium is generally less than that of the body fluid of the animals. Thus, water generally enters inside the body of animals.**

# Main adaptations:

1. Head body and tail are compressed to give an **elongated stream lined body**. Swift passage of the animal in water.
2. Presence of **paired (pectoral and pelvic) and the unpaired (median, dorsal and caudal) fins**. stabilizers or balancers.
3. **Respiration by gills** thus making use of gases dissolved in water.
4. Presence of **air bladders** filled with air that act as an **accessory respiratory** as well as **hydrostatic organ** in many fishes.
5. Presence of lateral line system, helpful in **echolocating** the objects in water.

## **(B) Amphibious conditions –**

- **Stream-lined form of body, neck constriction absent.**
- **Neck becomes short and immobile.**
- **Bones become light and spongy.**
- **External ear disappears. Its presence could have hindered in locomotion in water.**
- **Aquatic mammals, the power of mastication of food is lost.**
- **Aquatic mammals, skin becomes smooth and naked.**

## **(C) Terrestrial conditions**

- **Deficiency of water so have to retain sufficient Water in their bodies.**
- **Animals develop, adaptive features, such as selective food habits, impervious sheathy structures over their bodies, internal lungs or tracheal system, dry excretion, aestivation humidity control, burrowing and nocturnal habits, migration and emigration etc.**

Thank you