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The physical factors as limiting factors

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Water

A physiological necessity for all protoplasm, water, from the ecological viewpoint, is chiefly a limiting factor in land environments or in water environments in which the amount is subject to great fluctuation. Rainfall, humidity, the evaporating power of the air ,and available surface water supply are the principle factors measured. Rainfall is largely determined geography and pattern of the large air movements or weather system. In temperate climates , rainfall tend to be more evenly distributed throughout the year , with many exceptions. The following tabulation gives a rough approximation of the climax biotic communities that may be expected with different of rainfall distributed in temperate latitudes:

0----- 10 inches per year = Desert

10 ------ 30 inches per year = Grassland or Savanna

30 ------ 50 inches per year = Dry forest

Over 50 inches per year = Wet forest

In generally, rainfall tends to be unevenly distributed over the seasons in the tropic and sub tropics. In the tropics, this seasonal rhythm in moisture regulates the seasonal activities (especially reproduction) of organisms in much the same manner as the seasonal rhythm of temperature and light regulates temperate zone organisms.

Maintenance of water balance for terrestrial animals

Living cells, both plant and animal, contain about 75 to 95 percent water. Water is essential for virtually all biochemical reactions within the body, and it functions as a medium for excreting metabolic wastes and for dissipating excess heat through evaporative cooling.

Maintaining this balance between the uptake and loss of water with the surrounding environment is referred to as **an organism's water balance** .

Terrestrial animals have three major ways of gaining water and solutes: by

1- **Drinking,**
2- **Eating and**
3- **By producing metabolic water in the process of respiration.**

They lose water and solutes through **urine, feces, evaporation from the skin, and from the moist air they exhale.**

Some birds and reptiles have **a Salt gland**, and all birds and reptiles have **a Cloaca** , a common receptacle for the digestive, urinary, and reproductive tracts. They reabsorb water from the cloaca back into the body.

Mammals have kidneys capable of producing urine with high ion concentrations. In arid environments, animals and plants, face a severe problem of water balance. They can solve the problem in either of two ways: **by evading the drought or by avoiding its effects**. Animals of semiarid and desert regions may evade drought by leaving the area during the dry season and moving to

areas where permanent water is available. Many birds use this strategy.

During hot, dry periods the frog (Scaphiopus couchi) of the southern deserts of the United States remains belowground in a state of dormancy and emerges when the rains return. Some invertebrates inhabiting ponds that dry up in summer, such as the flatworm develop hardened casings and remain in them for the dry period. Other aquatic or semiaquatic animals retreat deep into the soil until they reach the level of groundwater. Many insects undergo diapause, a stage of stopped development in their life cycle from which they emerge when conditions improve. Other animals remain active during the dry season but reduce respiratory water loss.

Some small desert mammals reduce water loss by remaining in burrows by day and emerging by night. Many desert mammals, from kangaroos to camels, extract water from the food they eat—either directly from the moisture content of the plants or from metabolic water produced during respiration—and produce highly concentrated urine and dry feces. Some desert mammals can tolerate a certain degree of dehydration. Desert rabbits may withstand water losses of up to 50 percent and camels of up to 27 percent of their body weight.

Atmospheric gases

Except for the large variations in water vapor, the atmosphere of the major part of the biosphere is remarkably homeostatic. The situation in aquatic environments is different from that in the atmospheric environment because amounts of oxygen ,carbon

dioxide ,and other atmospheric gases dissolved in water and thus available to organisms are quite variable from time to time and place to place .Oxygen is an a limiting factor ,especially in lakes and waters with a heavy load of organic material. Temperature and dissolved salts greatly affect the ability of water to hold oxygen, the solubility of oxygen being increased by low temperatures and decreased by high salinities.

The oxygen supply in water comes chiefly from two sources, by diffusion from the air and from photosynthesis by aquatic plants. Carbon dioxide, like oxygen may be present in water in highly variable amounts ,but its behavior in water is rather different and its ecology is not as well known.

Furthermore, unlike oxygen, carbon dioxide enters into chemical combination with water to form H2CO3 which in turn reacts with available limestone's to form carbonates CO3 and bicarbonate HCO3.These compounds not only provide a source of nutrients but also act as buffer, helping to keep the hydrogen ion concentration of aquatic environments near the neutral point.

Biogenic Salts

Dissolved salts are necessary to life may be termed biogenic salts. Phosphorus and nitrogen are the most important ecologically, although, potassium, calcium sulfur ,and magnesium merit high consideration , Calcium is needed in especially large quantities by the mollusks and the vertebrates, and magnesium is a necessary constituent of chlorophyll. Elements and their compounds needed in relatively large amounts are often known as **macronutrients** .In recent years great interest has developed in the study of elements

and there compounds which are necessary for the operation of living system ,but which are required only in extremely minute quantities. These elements are generally called **trace elements** or **micronutrients**. Eyster (1964) lists ten micronutrients that are definitely known to be essential to plants. These are Iron, manganese, copper, zinc, boron, silicon ,molybdenum, chlorine, vanadium and cobalt. These elements can be arranged in three groups as follows :

Those required for photosynthesis :Mn, Fe, Cl, Zn and V.

Those required for nitrogen metabolism Mo, B, Co and Fe .

Those required for other metabolic functions: Mn, B,Co,Cu and Si.

Currents and Pressure

The atmospheric and hydrospheric media in which organisms live are not often completely still for any period of time .Currents in water not only greatly influence the concentration of gases and nutrients ,but act directly as a limiting factor.Thus ,the difference between a stream and small pond community may be due to the big difference in the current factor. On land ,wind exerts a limiting effect on the activities and distribution of organisms in the same manner .Hurricanes transport animals and plants for great distances and the wind may be change the composition of the forest communities. In dry regions ,wind is an especially important

limiting factor for plant , since it increases the rate of water loss by transpiration. Barometric pressure has not been shown to be an important direct limiting factor for organisms, although some animals appear able to detect differences .In water the pressure increases one atmospheric pressure for every 10 meters. In the deepest part of ocean the pressure reaches 1000 atmospheric pressure. Many animals can tolerate wide changes in pressure ,especially if the body does not contain free air or gas.

Ecological indicators

We have seen ,specific factors often determine rather precisely what kinds of organisms will be present ,we can turn the situation and determine the kind of physical environment from the organisms present. It is found that certain species of micro-organisms , plant and animals have one or more specific requirements and they become very much limited in their distribution . Thus, the occurrence of such species in a particular area indicates

special habitat conditions, and such species are called bio indicators or ecological indicators.

Some of the important considerations which should be taken when dealing with ecological indicators follow:

1- **In general, steno species make much better indicators than eury species.**
2- **Large species usually make better indicators than small species**
3- **The species were selected should be abundant in field.**

4- Numerical relationships between species, populations, and whole communities often provide more reliable indicators than single species.