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Ecosystem structure: A biotic environmental factors

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Ecosystem structure: A biotic environmental factors

It is well known that ecology includes a broad area of investigation from the individual organism to the biosphere. We begin with the individual organism, examining the processes it uses and constraints it faces in maintaining life under varying environmental conditions. The individual organism forms the basic unit in ecology. The individual senses and responds to the physical environment. But before embarking on our study of other aspects of ecological systems, we examine characteristics of the a biotic (physical and chemical) environment that function to sustain and constrain the patterns of life on our planet. Temperature, light, oxygen concentration, carbon dioxide, wind, speed of water flow etc. exert profound effect on organism living or trying to live in the ecosystem. However, because not all factors are equally important for any living organism we used the term limiting factors which we will discuss below:

Principles of Limiting factors

Ecologists used the term "Limiting Factors" to refer to the all environmental factors that affect an organism's ability to survive in its environment, such as food, light, water, temperature etc. In other words Limiting factors: anything that tends to make it more difficult for a species to live and grow, or reproduce in its environment.

Liebig's Law of the minimum

Liebig's law of the minimum, often simply called Liebig's law or the law of the minimum, is a principle developed by Justus von Liebig. It states that **"Growth of a plant is dependent on the amount of foodstuff which is present in minimum quantity".**

Justus Liebig "father of the fertilizer industry" in 1840 was a pioneer in the study of the effect of various factors on the growth of plant. He found that the yield of crops was often limited not by nutrients needed in large quantities , such as carbon dioxide and water,

since these were often abundant in the environment, but by some raw material, as boron for example, needed in minute quantities but very scarce in the soil.

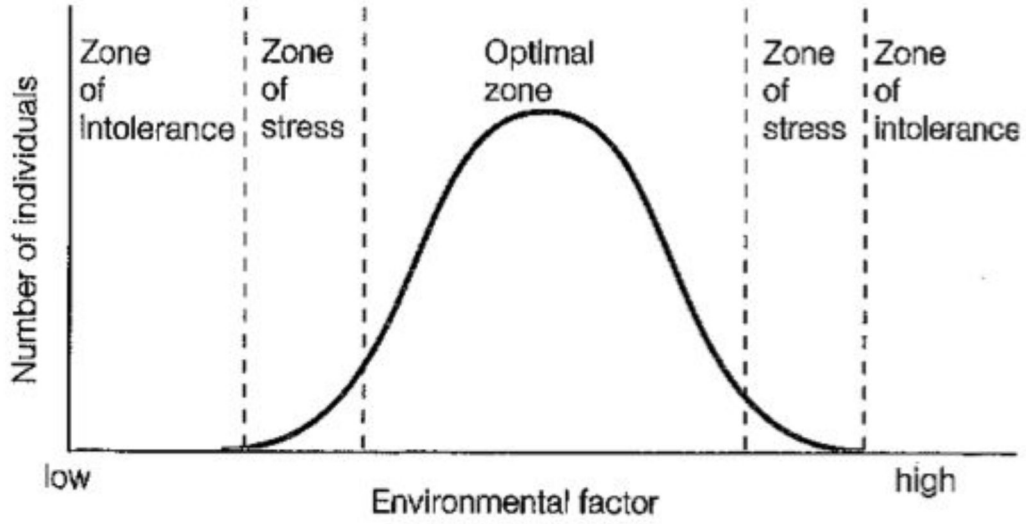
Extensive work since the time of Liebig has shown that two principles must be added to the concept if it is to be useful in practice.

- The first: Liebig's law is strictly applicable only under steady state conditions .
- The second: important consideration is factors interaction.

For explanation, Sometimes organisms are able to substitute, in part at least , a chemically closely related substance fore one that is deficient in the environment. Thus where strontium is abundant, mollusks are able to substitute strontium for calcium to a partial extent in their shells. Other example for factors interaction some plants have been shown to require less zinc when growing in the shade than when growing in full sunlight, therefore, a given amount of zinc in the soil would be less limiting to plants in the shade than under the same conditions in sunlight.

Shelford,s law of tolerance

Shelford's law of tolerance is a principle developed by American zoologist Victor Ernest Shelford in 1911. It states **that an organism's have an ecological maximum and minimum, with a range in between which represents the "limits of tolerance".**



Shelford's law of tolerance. A plot of the number of individuals of a species as a function of some environmental factor (such as temperature) produces a bell-shaped curve that can be divided into various tolerance zones.

In this law not only may too little of something be a limiting factor , as proposed by Liebig, but also too much , as in the case of such factors as heat, light, and water , thus organisms are constrained by both the maximum and minimum extremes of an environmental condition; these extremes represent the limits of tolerance. The concept of the limiting effect of maximum as well as minimum was incorporated in to the law of tolerance by Shelford in 1913.

Some subsidiary principles to the law of tolerance may be stated as follows:

1- Organisms may have a wide range of tolerance for one factor and a narrow range for another.
2- Organisms with wide ranges of tolerance for all factors are likely to be most widely distributed.
3- When conditions are not optimum for a species with respect to one ecological factor, the limits of tolerance may be reduced with respect to other ecological factors. For example when soil nitrogen is limiting, the resistance of grass to drought is reduced . In other words, that more water was required to prevent wilting at low nitrogen levels than at high levels.
4- Very frequently it is discovered that organisms in nature are not actually living at the optimum range with regard to a particular physical factor. In such cases some other factor or factors are found to have greater importance. Certain tropical orchids, for example actually grow better in full sunlight than in shade, provided they are kept cool, in nature they grow only in the shade because they cannot tolerate the heating effect of direct sunlight. In many cases population interactions such as competition, predators, parasites, and so on prevent organisms from taking advantage of optimum physical conditions.
5- The period of reproduction is usually a critical period when environmental factors are most likely to be limiting. The limits of tolerance for reproductive individuals, seeds, eggs, embryos, and larvae are usually narrower than for non reproducing adult plant or animals . For example, adult blue crab and many other marine animals can tolerate brackish

water(fresh water that has a high chloride continent) ,thus individuals are often found for some distance up rivers. The larvae, however cannot live in such waters, there for the species can not reproduce in the river environment.

To express the relative degree of tolerance ,a series of terms have come in to general use in ecology that utilize the prefixes steno meaning narrow and eury meaning wide .

- Stenothermal –eurythermal---refer to temperature
- Stenohaline –euryhaline --refer to salinity
- Stenohydric –euryhydric -----refer to water
- Stenophagic –euryphagic -----refer to food

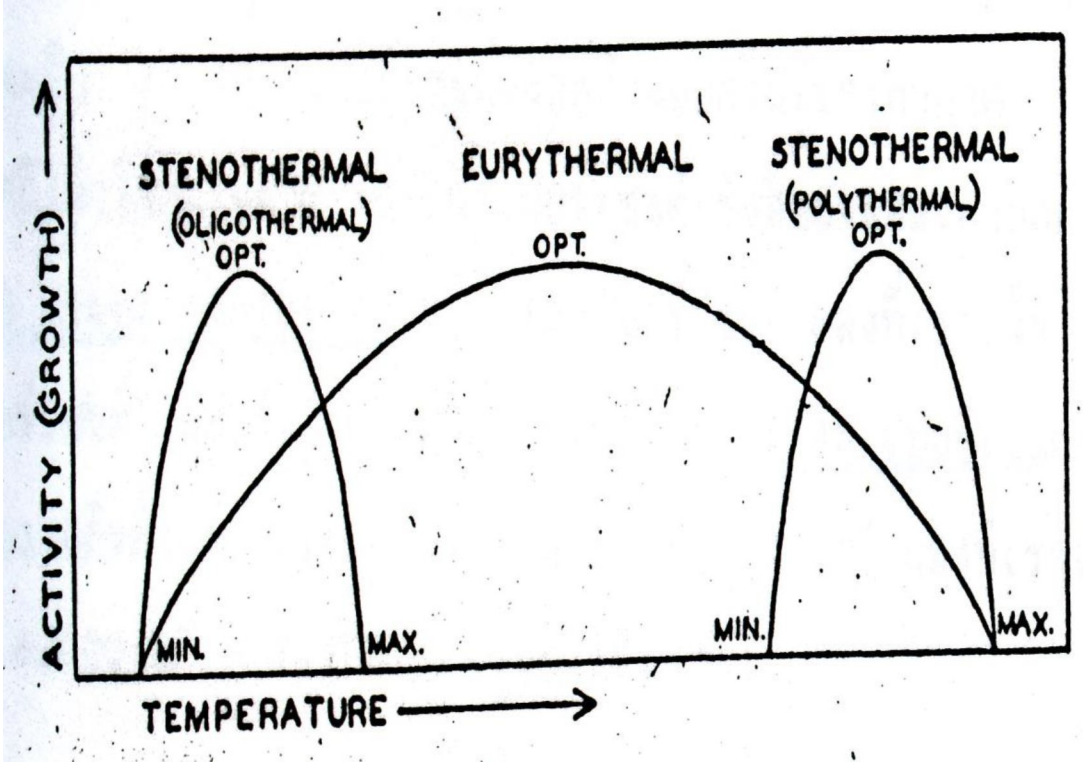


Figure 4: Degree of tolerance