Ecological Amplitude

(Notes)

Ecological amplitude was recognized by **Shelford** (1937) as the **Law of Tolerance**. It is *the* ***degree of adaptation of a living organism to the change in its environment***. It is expressed quantitatively as *the range of environmental changes within which a given species is capable of carrying on its normal vital activities*.

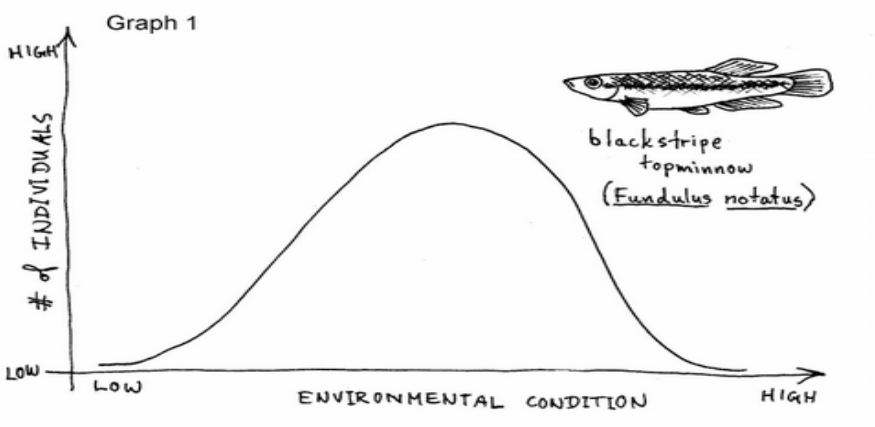
In fact, the **ecological amplitude** (or ecological valence) indicates *organism's range of tolerance to environmental factors*. As per UN Glossary Database (1997), the *ecological amplitude is the* ***limits or range of environmental conditions, within which an organism can live and function***.

Species differ in their environmental requirements. They also differ in respect of their **tolerance** to environmental fluctuations. The **range of tolerance** of a species diagrammatically forms a **bell-shaped** curve.

Wide *ecological amplitude* suggests that a plant or animal can survive in a comparatively large range of environmental conditions, while *narrow ecological amplitude* implies *specific requirements* of the organism from the environment.

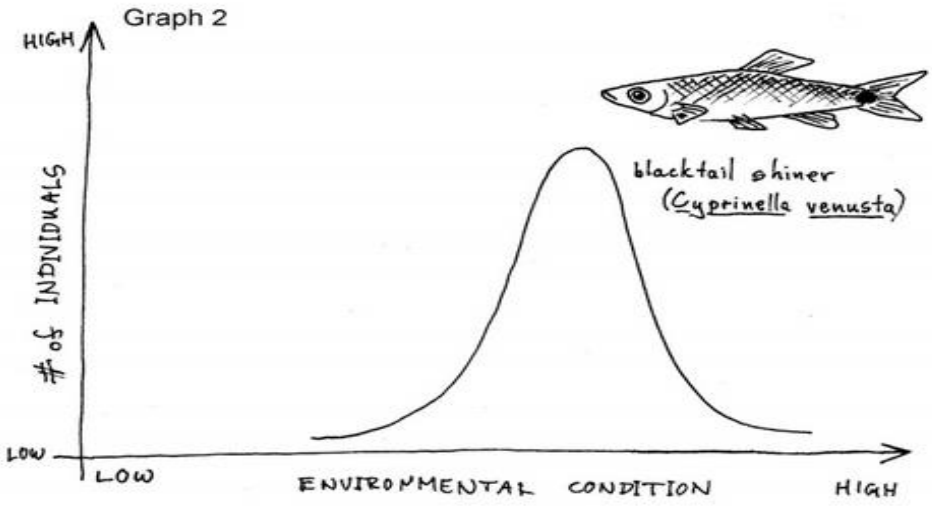
Wide tolerance range

(black-strip Topminnow – a fish)



Animals or plants with **narrow** *ecological amplitudes* are most likely to be considered *threatened* or *endangered* or a candidate of one of these categories. When changes in environmental factors occur, which are beyond the **tolerance limit** of any plant or animal inhabiting the local site, these plants and animals will be replaced over time; this is known as the process of **succession**.

Narrow tolerance range
(black-tail Shiner - a fish)



Each species has a set of environmental conditions within which it can **best** survive and reproduce. In such conditions, the concerned species is considered to be *best adapted* one. Different physical and **abiotic** (non-living) factors (e.g. temperature, humidity, soil chemistry, pH, salinity and oxygen levels) influence the environment of the species.

Tolerance range: Just as species have geographic ranges, they also have tolerance ranges for the **abiotic** *environmental conditions*. In other words, they can tolerate (or survive) within a certain range of a particular environment factor, but cannot survive if there is too much or *too little* effect of the environmental factor. For example, the **polar bears** survive very well in low temperatures, but would die of overheating in the tropics.

On the other hand, a **giraffe** does very well in the scorching heat of the African Savanna, but would quickly freeze to death in hot Arctic regions. This example points out the important aspect of **tolerance range**. In fact, different types of organisms may have different *tolerance range* for the *same factor*.

All organisms (microbes, fungi, plants, and animals, including humans) have *tolerance range*. Humans still freeze to death, die from heat stroke, drown, suffocate, and die from exposure to acid or lack of fresh water to drink. Truly, beyond the tolerance range, we cannot and do not survive, indicating *narrow range of tolerance*. Similarly, a **goldfish** can tolerate water **temperature range** of **2**^{o}C to **34**^{o}C, but it would die of cold or heat at temperatures below **2**^{o}C and above **34**^{o}C, indicating *narrow range of tolerance*.

Also, the tolerance range of a **single individual** may change over time; for example, individuals of a certain species of *salmon fish* starts life in a freshwater stream; it migrates out to the open ocean, and then comes back to its home stream to reproduce. The salmon fish tolerates huge changes in the salinity (salt content of water) of the various kinds of water it passes through during its journey, and also experiences many changes in water temperature, indicating **wide range** of tolerance to salt water.

Even for the same species, *tolerance range* of any environmental factor may vary from season to season. For example, in mid winter, a fish may be able to live in a temperature range of **0**^{o}C to **24**^{o}C, but in summer, the same fish may have a tolerance range of **15**^{o}C to **33**^{o}C. Such *adjustment* in **ecological response** is known as **acclimation**, which helps the organism to survive in changing environments. Lacking this capability, the organism has to migrate to other areas or it will die in unfavourable season. Birds and certain fishes show such adaptations.