# CSIR NET Life Science Unit 10

## Rules in Ecology

### Ecology

The term Ecology was coined by Ernst Haeckel; it is made up of a combination of two Greek words, *Oikos* which means house and *logos* that means to study, together these denote the relation between organism and their environment. Ecology can thus be summed up as the study of living organisms and their interaction with their environment.

For explaining the interaction of an organism to its environment, several ecologists put forward their logic and principles over the years; collectively these are known as ecological rules. Some of the prominent rules are listed below:

### A. Allen's Rule

This rule was given by Joel Allen in 1877. In this rule, it was explained that the snout, tail ears and legs of mammals are comparatively shorter who reside in cold places with respect to mammals that reside in warm climatic conditions. This hypothesis explains that endothermic animals who have similar volumes also differ into a different part size which helps them to maintain temperature regulation.

*Fig. Body volume showing large extremities in (A) Warmer and (B) in Cooler climatic conditions*

### B. Bergmann's Rule

Postulated by the biologist, Christian Bergmann. This rule state that temperature affects the size and relative body proportion of different body parts. The

hypothesis says that birds and mammals which live in cold climatic conditions have a greater body size as compared to the animal living in warmer areas. According to Bergmann's standard, human population that lives near arctic poles are larger and heavier than the population of other places. This rule supports Allen rule.

*Fig. Polar bears, are much larger than spectacled bears, which live closer to the equator*

**C. Cope's Rule**

Given by American palaeontologist E.D. Cope, this rule states that population lineage has a tendency to increase their size of the body over the time of evolution; genealogies in population will increase over the time of evolution.



**D. Gloger's Rule**

This rule was postulated by zoologist Lambert Gloger and states that some mammals, birds and insects which lives in warm climatic condition are dark or have pigments in their skin as compared to the same species living in cool and dry climatic condition. This phenomenon is known as Gloger's rule. Some mammalian species including humans show an inclination towards darker skin in those inhabiting warm places.

Temperature also affects the absolute size of an organism. Formation of narrow wings in colder regions and broader wings in warmer regions. Example: The Song Sparrow *(Melospiza melodia).*

The Song Sparrow (*Melospiza melodia*) generally follows Gloger's rule of ecogeographic variation whereby birds that live in more humid environments tend to be more heavily pigmented

**E. Gause's Hypothesis**

Gause's law also known as the competitive exclusion principle states that if two species having same asset and overlapping niches, they will not be able to exist together (co-exist) in the same population steadily. In other words, in the same endeavour two contending species which have similar speciality only one emerges as acceptable while the other one will be driven out (outcompeted).

The classic experiment in support of this hypothesis was performed my Gause using two species of *Paramecium*, *P.caudatum and P.aurelia*. When cultured separately in yeast medium, *P.aurelia* was found to have a faster rate of increase than *P.caudatum*. When both species were added to the same culture vessel, *P.aurelia* dominated the mixture while *P.caudatum* eventually perished.



**F. Gordu's Rule**

This rule discusses the influence of temperature on the morphology of animals.

**G. Dollo's Law**

The law proposed by Louis Dollo, also known as the law of irreversibility, states that during the process of evolution if some complex traits are lost, they cannot come back, i.e. evolution is an irreversible process.

**H. Foster's Rule**

Given by Bristol Foster, this is also known as the island effect law. This rule states that little species get bigger in the wake of colonising island, as published in the Nature, in the article named *"Evolution of mammal in the island."*

**I. Hamilton's Rule**

Hamilton's rule is well known in evolutionary biology; and it is regarding natural selection prediction in situations where interaction occurs between genetic relatives. This rule says that natural selection favours success at genetic level not at reproductive level. This rule also state that population transfer their gene from one generation to another directly by their parents and indirectly by assisting reproduction of close relatives by altruistic behaviour (behaviour that benefits others at cost of one's own self).

**J. Lack's Principle**

This rule was proposed by David Lack. This principle tells that clutch size of each species of birds or any feathered creature has been altered and this alteration is done by common determinants which relate with large number of youths for which guardian can give enough food.

**K. Rensch's Rule**

This rule states that dimorphism of sexual size increases with body size in any taxa in which males are the larger sex and where body size decrease females are the larger. For instance, wings of birds in the colder regions are narrow & acuminate. Whereas, in the warmer regions broader wings are found.

**L. Jordon's Rule**

According to this rule, temperature influences the morphology of certain fishes. It has some relation with the number of vertebrae. In low and high-temperature water:

- Water of low temperature have more vertebrae than those of warmer water in fishes.
- Fish size, as well as the number of vertebrae, increase in colder areas compared to warmer.

**M. Blackman's Law of Limiting Factor (1905)**

When a process is conditioned as to its rapidity by several separate factors, the rate of the process is limited by the pace of its slowest factor.

**N. Lindeman's Law of Trophic Efficiency (the 10% Law)**

During transfer of organic food from one trophic level to the next, about 10% of the organic matter is stored as flesh, the remaining is lost during transfer or broken down in respiration.

**O. Shelford's Law of Tolerance**

The existence, abundance and distribution of a species in an ecosystem are determined by whether the levels of one or more physical or chemical factors fall within the range tolerated by that species. According to Shelford's law of tolerance, there are upper and lower threshold values on the gradient beyond which the species cannot survive. These points are the upper and lower limit of tolerance. The whole range over which the species is able to survive is the range of tolerance. Tolerance ranges differ for one species to another. The prefix steno and eury have been used for comparing the relative narrow and wide degree of tolerance, respectively of an organism to a given environmental factor.

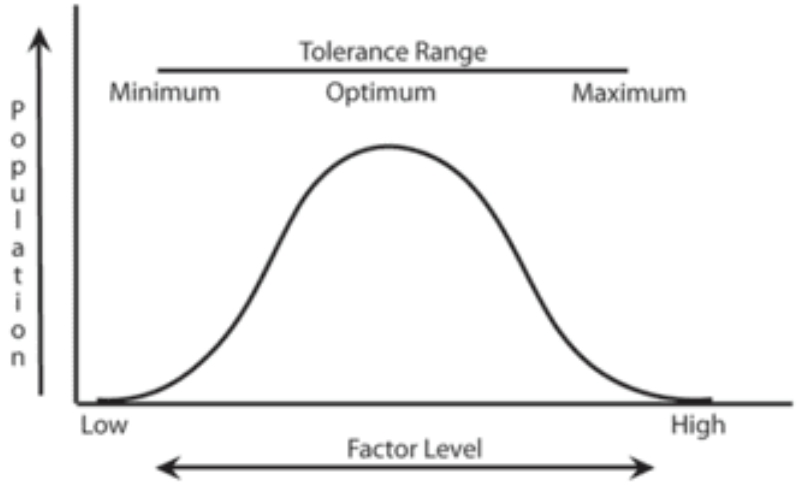


*Fig. The response of an organism to a range or gradient of an environmental factor (temperature, light and nutrient)*

**Examples:**

1. Stenohydric and euryhydric refer to narrow and wide tolerance respectively to water
2. Stenohaline and eurSyhaline refer to narrow and wide tolerance respectively to salinity
3. Stenophagic and euryphagic refer to narrow and wide tolerance respectively to food
4. Stenoecious and euryoecious refer to narrow and wide tolerance respectively to habitat selection

Mentor Guru