

NATURAL SELECTION

Darwinian and Neo-Darwinian view

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Basic information

The theory of natural selection as the guiding force of organic evolution was initially proposed by **Charles Darwin** and **Alfred Wallace** in 1858 and later popularized in Charles Darwin's book "**On the Origin of Species by Means of Natural Selection**" (The Preservation of Favoured Races in the Struggle for Life), published in 1859.

This concept of natural selection is based on two deductions derived from the following four observations:

Observation I

- All organisms tend to leave **more offspring** than are needed to replace them when they die.

Observation II

- The number of individuals within each species remains approximately **constant** over time.

Deduction I

- Considering the above two observations, then not all individuals survive and/or not all individuals who survive leave offspring.

Observation III

- All the individuals of a species are **not alike**.

Observation IV

- Characteristics of **certain individuals** are passed from **parent to offspring**.

Deduction II

- As the individuals within a species are different, then certain kind of individuals having characteristics beneficial to them under the complex and varying conditions of

life are more successful in the struggle for existence, and so have a better chance of survival and reproduction.

- Such individuals are said to be naturally selected and the frequency of their characteristics is increased from generation to generation while being transferred from parent to offspring.

Darwinian concept of natural selection

- It appears to be a process or a mechanism in which a certain non-random subset of the population was best able to cope with and propagate in immediate environmental constraints or was able to utilize available resources more successfully in the given environment (the 'best adapted' or 'fittest').
- In other words natural selection leads to perpetuation of those considered 'fit' in the existing environmental conditions with the elimination of 'unfit' ones.
- Consequently, successive generations of a population are always composed of individuals whose parents appeared 'fit' (performed best) in the past.
- Darwinian fitness is, thus, measured by the ability of an individual to survive and reproduce in the given environment.
- Fitness, more appropriately, is a post-factum description of how well an organism did in passing on its genetic material under the particular condition and in relation to others in its population over the considered time span.
- "Differential survival" (Survival of the fittest) leading to "differential reproduction" (those who survive will reproduce) is the basic postulate of the Darwinian view of natural selection.

Darwinism to neo-Darwinism

- Darwin had no idea how variations in characteristics originate among the individuals of a population and how characteristics are passed from parent to offspring, i.e. Darwin knew nothing about the genetic basis of variations and the pattern of their inheritance.
- After the rediscovery of Mendelian principles in 1900, a number of scientists notably **Ronald Fisher, Sewall Wright, JBS Haldane, Theodosius Dobzhansky**

and **Ernst Mayr** successfully integrated Darwin's theory of evolution with genetics during 1920 to 1940, leading to reformulation of the Darwin's theory of natural selection as neo-Darwinism.

- It has redefined the Darwin's original postulates of natural selection in the light of findings in genetics but did not substantially alter or contradict its basic theme.
- It however, included '**population**' instead of 'species' as the basic unit of evolution on which the natural selection operates.

Neo-Darwinian concept of natural selection

- Origin of new alleles by mutation and reshuffling of genes (alleles) into new combinations by recombination cause variation in characteristics (phenotypes) among the individuals of a population.
- The individuals that survive and reproduce or who reproduce the most are those having alleles and allelic combinations that best adapt them to their environment. In other words, genotypes better adapted for survival will reproduce preferentially and so will pass their genes to the future generation.
- Hence, the alleles associated with higher fitness (adaptiveness) increase in frequency from one generation to the next.
- Environment eliminates those genotypes less fit or unfit for survival but encourages the 'survival of the fittest'.
- Selection, therefore, determines which alleles/genotypes will be passed to the next generation by virtue of the relative advantage they show when expressed as phenotype.

Concluding remarks

- Selection, in new- Darwinian concept, stands for differential reproductive success of genotypes in a given environment.
- It can be seen as means to increase or decrease the spread of an allele within the gene pool and is further characterized by its invariable encouragement of genes that assure highest level of adaptive efficiency between the population and its environment.
- It is therefore, a creative force which encourages the multiplication of adaptive genotypes in the population in a differential manner.
- Natural selection, however, has nothing to do with ‘struggle for existence’ either interspecific or intraspecific, as was considered in Darwin’s original theory.
- Selection, therefore, favours differential reproduction of genes as the carriers of a given genotype in a population contribute differently to the gene pool of the succeeding generations, ultimately leading to change in the gene pool of the population from one generation to next.
- Fitness can, therefore, be characterized as the relative capacity of carriers of a given genotype who transmit their genes to a gene pool of the generation to follow.
- According to the neo-Darwinian concept, the gene pool of the population forms the stage of evolution and provides the matrix for the operation of natural selection.
- Therefore, neither individuals or genes evolve, rather the fundamental unit of evolution is population or its gene pool. Individuals or genes are selected for or against but the gene pools evolve.
- Conclusively we can say that the meaning of natural selection has undergone a radical change from Darwinism to neo-Darwinism. However, the basic nature and role of natural selection has continued to be Darwinian even today.
- In neo-Darwinism, it is the potential of different genotype to contribute differently, to the gene pool of next generation through differential reproduction of genes.
- In Darwinism, it is the process of the elimination of less fit/unfit individuals through struggle for existence. However struggle never exists, only differential reproduction occurs.

TYPES OF SELECTION

There are three types of selection process occurring in populations which are described as **stabilizing**, **directional** and **disruptive**.

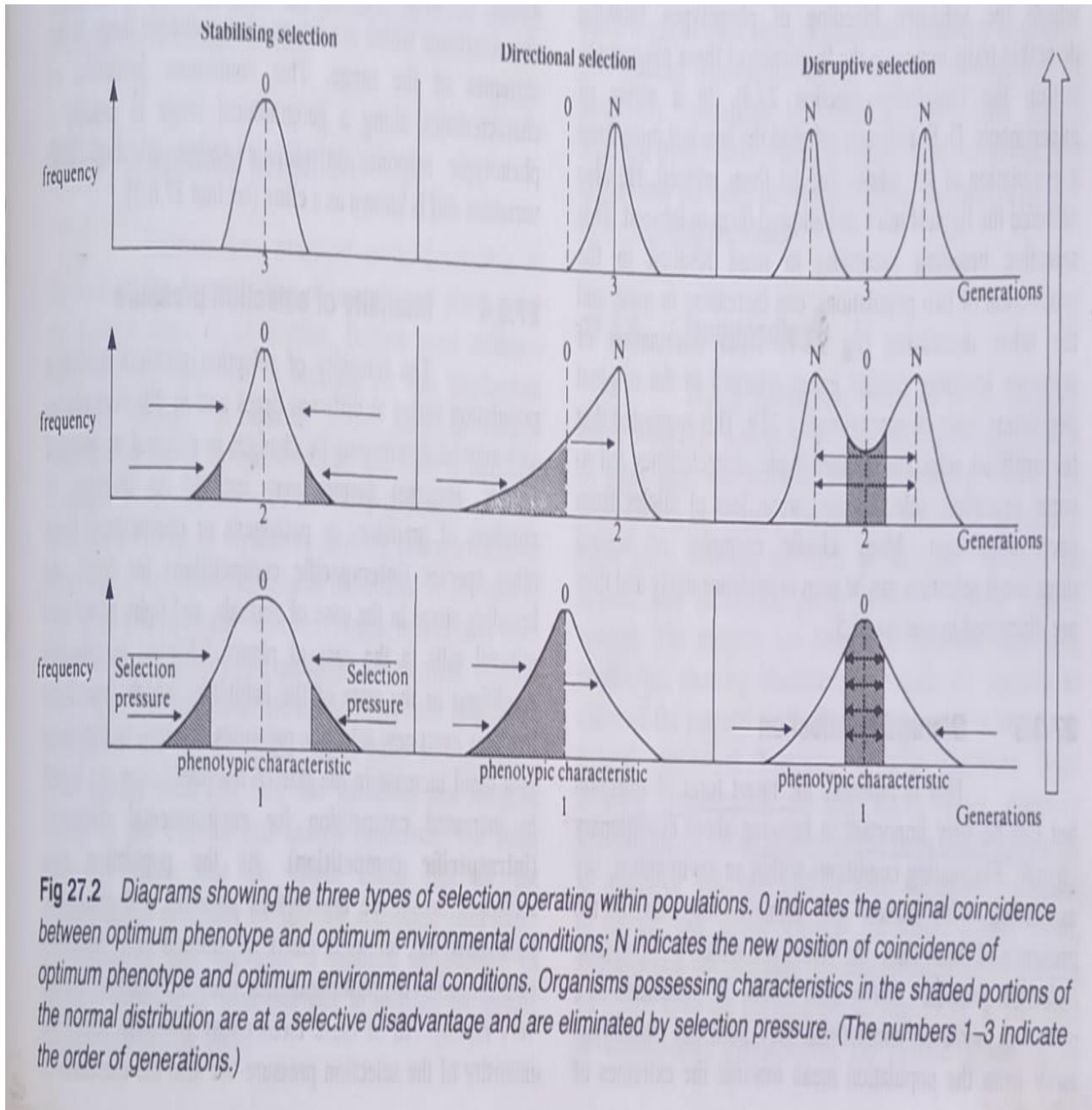


Fig 27.2 Diagrams showing the three types of selection operating within populations. 0 indicates the original coincidence between optimum phenotype and optimum environmental conditions; N indicates the new position of coincidence of optimum phenotype and optimum environmental conditions. Organisms possessing characteristics in the shaded portions of the normal distribution are at a selective disadvantage and are eliminated by selection pressure. (The numbers 1-3 indicate the order of generations.)