Natural Selection and Modern Evolutionary Synthesis

Natural selection is one of the central mechanisms of evolutionary change and is the process responsible for the evolution of adaptive features. The credits for this astonishing breakthrough must be given to the man known as the father of evolution and heredity Charles Darwin which set out his theory of evolution in 1859. Natural selection is one of the principals that govern heredity. The former refers broadly to the fact that evolution has occurred such that organisms living today are different from their ancestors. Natural selection is the evolutionary process that explains the match, or fit, between features of organisms and the environments where they live. This principle dictates that if evolution was elucidated as a car, and then the theory of natural selection would be its engine. The theory states that it's the nature that controls and select organisms, which tend to have favorable characteristics for survival while at the same eliminating species that are inferior. This research paper looks at Darwin's four main ideas of evolution, its relationship to the current problem of antibiotics resistance in bacteria, and its description in terms of "modern evolutionary synthesis" of the 20th century.

Darwin's theory is significantly a very important landmark in the process of evolution and origin of species. The principle is regarded as the key to the formation of new and superior species from old and existing ones. This is to say that nature selects superior traits, which are transmitted to the offspring in a manner that is independent on the other. The major explanation behind the theory is that one superior allele tends to be dominant over the others, blending a genetic makeup and traits that influence a certain trait segregate during organism growth and development. There are many "evolutionary forces." Natural selection is specifically the conception of fitter species and traits surviving and reproducing. It is impossible to imagine evolution without natural selection. It was originally thought of as the primary mechanism of evolution and is still conceived of as the dominant driving force of change in the modern evolutionary synthesis. Natural selection may be thought of as molding or guiding evolution. It does this in several ways. Directional selection is when the environment drives one allele out of dominance in a population. Disruptive selection selects for the two extreme expressions of a trait. Stabilizing selection is when the extremes are less adaptive and intermediate phenotypes work better. There would be no theory of evolution without natural selection. It is a necessary process of change for the synthesis.

While some controversy surrounds evolution as it applies to human populations, Darwin's theory applies to all organic species. The basic principles of evolution are simple and seem obvious to the modern reader. However, prior to Darwin, no scientist had put all the pieces together.

1. Variation in Populations: In every species there is variation. This variability occurs even

between related individuals. Siblings vary in color, height, weight and other characteristics. Other characteristics rarely vary, such as number of limbs or eyes. The observer must be careful when making generalizations about a population. Same populations show more variation than others, particularly in geographically isolated areas such as Australia, the Galapagos, Madagascar and so forth. Organisms in these areas may be related to those in other parts of the world. However, due to very specific conditions in their surroundings, these species evolve very distinct characteristics.

2. Inherited Traits: Each species has traits determined by inheritance. Inherited traits passed from parents to offspring determine the characteristics of the offspring. Inherited traits that improve the odds of survival are more likely to be passed on to subsequent generations. Of course, some characteristics, like weight and muscle mass, may also be affected by environmental factors such as food availability. But, characteristics developed through environmental influences will not be passed on to future generations. Only traits passed by genes will be inherited. For example, if an organism inherits the genes for a larger skeletal mass but lack of nutrition prevents the individual from growing to that size, and if the individual survives and reproduces, the genes for the larger skeleton will be passed on.
3. Offspring Compete: Most species produce more offspring each year than the environment can support. This high birth rate results in competition among the members of the species for the limited natural resources available. The struggle for resources determines the mortality rate within a species. Only the surviving individuals breed and pass on their genes to the next generation.
4. Survival of the Fittest: Some individuals survive the struggle for resources. These individuals reproduce, adding their genes to the succeeding generations. The traits that helped these organisms to survive will be passed on to their offspring. This process is known as “natural selection.” Conditions in the environment result in the survival of individuals with specific traits which are passed through heredity to the next generation. Today we refer to this process as “survival of the fittest.” Darwin used this phrase, but he credited a fellow biologist, Herbert Spencer as its source.

Bacteria grow and multiply fast and can reach large numbers. When bacteria multiply, one cell divides into two cells. Every time the bacterium goes through this process there is a chance (or risk, depending on the end result) that errors occur; so-called mutations. These mutations are random and can be located anywhere in the DNA. While some mutations are harmful to the bacteria, others can provide an advantage given the right circumstances. Here, Darwin’s theory of natural selection comes in. If a mutation gives the bacterium an advantage in a particular environment, this bacterium will grow better than its neighbors and can increase in numbers – it is selected for. Mutations are one way for bacteria to become resistant to antibiotics. Some spontaneous mutations (or genes that have been acquired from other bacteria through horizontal gene transfer) may make the bacterium resistant to an antibiotic. If we were to treat the bacterial population with that specific antibiotic, only the resistant bacteria will be able to multiply; the antibiotic selects for them. These bacteria can now increase in numbers and the end result is a population of mainly resistant bacteria. The process of natural selection of resistant bacteria. Antibiotics kills sensitive bacteria, but any resistant bacterium will survive. When the competition from other bacteria are gone, these resistant bacteria can increase in number. It is important to understand that selection of antibiotic resistant bacteria can occur anywhere an antibiotic is present at a selective concentration. When we treat an infection, selection can occur at any site in the body to which the antibiotic reaches. Thus, the antibiotic can select for resistance genes and mechanisms in both pathogenic bacteria and in commensal bacteria living in the body that have nothing to do with the infection in question. By using narrow-spectrum antibiotics (when possible), the risk of selecting for antibiotic resistance in the commensal flora decreases.

Adaptation by natural selection has been central to biology ever since Darwin presented the idea more than 150 years ago. When coupled to theories of mutation and inheritance, it explains how organisms become fit to their environments. Microbiologists were, on the whole, slower to accept the generality of this theory than those who studied plants and animals. Following critical experiments that disentangled the effects of mutation and selection in microorganisms, and given their short generations and large populations, experimental evolution has become a highly productive approach in microbiology. Some of the experiments test specific hypotheses, while others are open-ended and explore broad questions. New technologies enhance the power of experimental evolution, which may in turn provide new opportunities for applied studies in biotechnology and medicine. As evolutionary biology continues to generate fascinating ideas and questions, experimental evolution offers one approach for examining new ideas and questions.