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***SHORT NOTE***

# Genetics of Evolution and Its Environmental Phenomenon

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**Abstract**
The aim of this short note is to outline the importance and the purpose of genetic evolution. Content analysis method is used in this paper. This short note generally discusses how genetic evolution aids organisms-coming from various backgrounds with numerous unique characteristics-to survive extinction. The paper mainly focuses on the diverse evolutionary concepts behind the continuance of species and their populations, despite the drastic changes that repeatedly take place in their surrounding environment. The study, therefore, found how the environment and natural selection cause adaptive evolution among species. Thus, it provides understanding of the survival mechanism of the species in their habitats.
***Keywords:*** *Adaptation, Evolution, Selection, Speciation, Population*

**Abstrak**
Tujuan kajian ini adalah untuk menggambarkan pentingnya tujuan evolusi genetik. Kaedah analisis kandungan digunakan dalam kajian ini. Secara amnya akan dibincangkan bagaimana evolusi genetik membantu organisma - berasal dari pelbagai latar belakang dengan pelbagai ciri unik - untuk kekal hidup dalam kepupusan. Kajian ini memfokuskan pada pelbagai konsep evolusi di sebalik kelangsungan spesies dan populasi, walaupun terdapat perubahan drastik yang berulang kali terjadi di persekitaran. Oleh itu, kajian mendapati bagaimana persekitaran dan pemilihan semula jadi menyebabkan evolusi adaptasi di antara spesies. Oleh itu, ia memberikan pemahaman mengenai mekanisma kelangsungan hidup spesies di habitatnya.
***Katakunci:*** *Adaptasi, Evolusi, Pemilihan, Penspesiesan, Populasi*

## Introduction

Genetic evolution has been a topic of interest since antiquity. The science behind it has been questioned and simultaneously answered time and again. To put it in simpler terms, genetic evolution is the study of where variation in genes take place because of evolutionary changes (Frantz et al., 2020). The question is, where do these changes take place that results in novel characteristics of the organisms? To give an easy answer, it can be said that it takes place in the genes of the organisms. This question is also answered by the concept of evolution. The evolutionary concept is very fascinating. It gives a broad idea of the apprehension of genetic evolution. Evolutionary concepts clear the confusion about the survival of living organisms, amidst the shift in time that challenges their survival conditions.

Ever since the revolutionary Darwinian Theory came out, numerous scientists have come to play the role of investigating the concept of evolutionary genetics. It is known that the changes in frequencies of genotype, and also how the genes evolve within populations are held responsible for evolution. The changes that take place can be behavioural or heritable physical, also temporary or permanent, giving selective advantages to the species

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(Zalta et al., 2005). However, this is alsoimportant to note that not all changes act in favour of the species. Some changes may cause them to die or reduce their chances of living.

The evolutionary changes can be described in terms of "micro-evolution" and "macro-evolution". In the long term, micro-evolutionary changes surge to a macro-evolutionary pattern, by which higher taxonomic groups are characterized (Zalta et al., 2005). A seminal study by Zalta et al. (2005) shows that these two types of evolution come into existence because of four important evolutionary forces (mutation, natural selection, random genetic drift, and gene flow). The eventual source- that results in variations of genes within populations- is the mutation. Moreover, within a precise number of populations, mutational variation arises because of random genetic drift and natural selection. Aside from that, natural selection also forms a crucial reason for adaptation of organisms, adjusting the organism and the environment, or preserving genetic information, for a coon's age, in the midst of mutation and drift. When natural selection is studied in-depth, it talks about the ecological genetics, which -in turn- talks about the "phenotypic patterns observed in nature" (Zalta et al., 2005).

Morphological adaptation is often seen among populations of species. Orr (2005) states that a good amount of genetic changes are involved in morphological evolution. Among these, some particular variation has larger effect- either on the phenotype, or fitness- than the others. Furthermore, Orr's study in 2005 (cited in Fisher, 1930) declares that when a population moves towards a phenotype that best fits the present environment, their adaptation can then be characterized. For example, Darwin's observations and conclusions, on the evolution of the finches of the Galapagos Islands, were a true eye-opener about the claim that natural selection leads to adaptation. Darwin previously recorded the various forms and adaptations of these finches and speculated on their relationship to mainland species. When his research was conducted in the form of a phylogenetic tree, it was detected thatthe finches that arrived on the Galapagos island, multiplied over time, colonised other islands, and branched out into new species and forms, in order to adapt with their respective ecological niche (predominantly according to the types of food availability). And strong evidence regarding this matter was found when Rosemarie and Peter Grant were later studying finches on the islands. They found out that when there was severe food depletion, only a few numbers of finches with specific beak types had a selective advantage over the others (Grant & Rosemary, 2006). It was deduced that only the finches with specific beak types were able to survive longer than others. And the generations after, thatbeak shape became common. Thus, it is safe to say that genetic variation plays a crucial role in the survival of the fittest fight. This short note will embroil the wide range of evolutionary concepts- such as genomic structural evolution of a species, the genetic groundwork of speciation and adaptation, and selection leading to hereditary changes within populations- and implement the gravity of how they provide advantages to the living organisms.

Evolution of genomic structure of a species alleviates their chances of extinction. Genomic configuration of species has been believed to evolute according to their surroundings, as its main goal is to adjust and adapt. Such a phenomenon can be seen in hermaphroditism. Hermaphroditism is where one individual has both the male and female sex organs, such as snails, worms, fish and flowers. These types of organisms can self-fertilize; they do not need partners to reproduce. Ghiselin (2016) argues that, only under a few conditions, self-fertilization occurs: (a) when searching a mate is hard; (b) where one gender has more advantage at being higher or lower quantity than the others; or c) when there are small populations that are genetically isolated. It was also believed that pre-Darwinian workers took this circumstance for granted, as they believed that it cut out the need for a mate. However, Ghiselin (2016) made the case that even though "selfing" might be detrimental at some level, it is still better to self-fertilize than not to reproduce at all. Even though hermaphroditism makes an individual prone to selfing, it is not clearly explained in this paper how this hermaphroditism condition takes place in the first place. The paper has also not shone a light on the

matter of explaining the illustration of how the state of hermaphroditism is shifted to the separation of sexes, or vice versa (Ghiselin, 2016).

In essence, an animal's reproductive system is organised in such a way that it aggrandizes the probability of passing the genetic material to the next generation to reproduce. The structure of the population, the differences in the density of population, the gene flow, and various other circumstances play a major role in shaping an animal as a hermaphrodite. To look on the bright side, in small, isolated populations, hermaphrodites can be saved from the deleterious consequences of drift and such related phenomena (Ghiselin, 2016).

To explain even more clearly about genomic evolution, another example (Vonk et al., 2013) of snake venom and its dynamic evolution and adaptation is elucidated. Snakes use venoms to catch preys. They are limbless predators, and their venoms are toxic proteins. The snake venomhas been of great intrinsic biological interest for drug discovery, to understand the physiological pathways of vertebrates, and also to estimate how poisonous a snake bite can be to humans. This fundamental and detailed study on king cobra genome was demonstrated to examine venom evolution. Sequencing and comparing with other vertebrates were carried out. The results of this experiment provided an exclusive view of the origin and evolution of snake venom. Furthermore, it also unfolded "multiple genome-level adaptive responses to natural selection in this complex biological weapon system" (Vonk et al., 2013).

**The genetic basis of speciation leading to adaptation**

So far, it has been explained how a population can alleviate their chances of extinction in their habitat, caused by natural selection, via transformation of their genomic structures. Now, a deeper context of the previously explained matter will be discussed here. The genetic basis of speciation will give a more in-depth idea on how these organisms acclimate and survive the changes around them.

One enthralling case is where zooplankton showed rapid, local adaptation behaviour when the predator pressure around them changed, especially in the absence of neutral genetic changes. In easier terms, zooplankton eggs have this characteristic of going through a "resting stage", where the diapausing eggs can be found in an inert state. This fact was considered revolutionary in the studies of species adaptation, as this state could last for centuries, providing a unique opportunity of rebuilding the genetic history of natural populations. A significant study by Cousyn et al. (2001) used fish as the predation pressure, and water-flea Daphnia as the subject. Fish were used as they are known to have an unyielding effect on the structure of the community of zooplankton and their evolution as a population. The study chiefly focused on studying the quantitative trait of the subject by using phototactic behaviour (observing movement of the subject around the light) in presence of fish kairomone (a chemical released by fish to fight against the prey). In the experiment, when water-flea Daphnia was studied, it was revealed that when there was a "variable and well documented levels of fish predation over the past 30 years", the differentiation in genetic construction, through time, was superior for the studied behavioural trait than for the neutral genes (Cousyn et al., 2001). It implemented a strong proof that natural selection, indeed, was the propulsive force that drives the observed and rapid evolutionary changes in the zooplankton behaviour.

**Genetic evaluation due to other reasons**

Two more paradigms will be portrayed to further clear the concept of genetic evolution and how it leads to speciation and adaptation. Number one is how the construction of a niche causes genetic evolution. What is a niche construction, to begin with? According to Day et al., (2003), it refers to "the capacity of organisms to construct, modify, and select important components of their local environments, such as nests, burrows, pupal cases, chemicals, and nutrients." Naturally, a population builds its surroundings according to its own living preference. This study made the case that many scientists considered it as an evolutionary process, as organisms not only affect the nature of their own world, but also determine the kind of selection pressure that they-and their descendants-

are unsealed to. The experiment also established that natural selection and niche construction interact in a reciprocal manner, where the presence of the natural selection determines the arrangement and construction of the niche done by the organisms. This study also stated that adaptation is scrutinized as a mechanism by which natural selection progressively sculpts the living things, in its habitat, to be well-fitting to the environment. Moreover, in many situations, the offspring can be affected by the changes brought by the niche construction -done by the ancestors- as the successors not only inherit genes from their parents, but also from the altered niche construction- previously made by their genetic or ecological ancestors. It goes without saying that there are considerable amount of evidences proving that the change in ecological arrangement- by niche construction carried out by individuals of a population- for their own benefit, regularly modifies selection pressures, which in turn has some type of effects on the offspring, along with the other types of species in that similar habitat. This phenomenon is continuous, evidencing the diversification we witness in our environment (Day et al., 2003).

Second example is where it is experimented if sex chromosomes have any impact on the susceptibility to influeza virus infection by the two different sexes. Krementsov et al. (2017) declared that looking into sex and gender should be mediated when displaying the means contributing to sex differences in health and diseases. Previously it was hold that only because of the male sex hormones, testosterone, males were more prone to being affected with influenza A virus than females. Nonetheless, nowadays, scientists are intrigued to research if the sex chromosomes also play a crucial part in this matter. This critical study set forth that there was genetic variation in chromosome Y, that certainly had a control and influence on the perceptivity of the male mice, which were under experiment, to the influenza A virus.

**Conclusion**

It can be comprehended that more than one factor can administer the behaviour of a species, be it either environmental or genetic. Living organisms are bound to change and evolute, because nature itself is a dynamic phenomenon and never becomes static. Even though mother nature has its own way of challenging the survival of living things, evolutionary wizardry always acts as the knight in shining armour, accommodating the individuals in their habitats, giving its utmost effort to defend them and proliferate their chances in the succession of life and death. As this short note focuses on the genetics of evolution and its environmental phenomenon, the second part of this paper, which is now in preparation, addresses the Islamic understanding of genetics of evolution, which shades more light on this subject through and within the Islamic teachings.

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