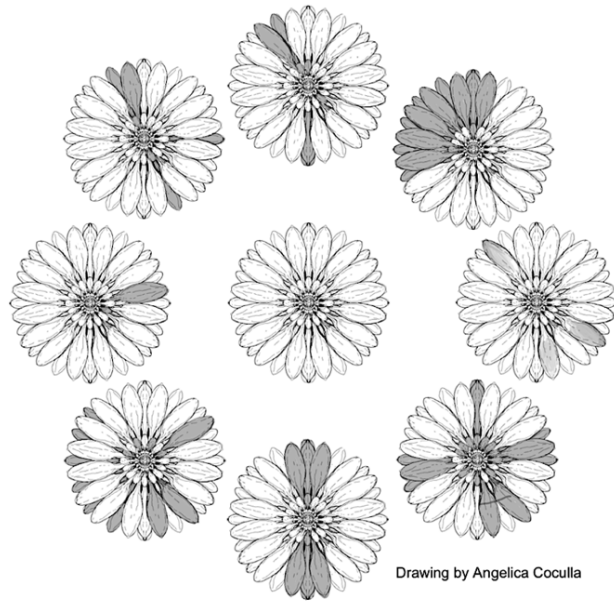


What evolution is.

By Lars Eicholt

Named after the book „What evolution is“ (2002) by evolutionary biologist Ernst Mayr (1904-2005), this column aims to inform on concepts, theories and philosophical currents in the field of evolution.

The Neutral Theory of Molecular Evolution



Drawing by Angelica Coculla

One of the most significant ideas in evolutionary theory is the Neutral Theory of Molecular Evolution. First proposed by Japanese biologist Motoo Kimura in the 1960s, this theory suggests that most genetic mutations are neither advantageous nor harmful to an organism. Instead, they are "neutral," meaning they have no significant impact on the organism's survival or reproductive success.

According to the Neutral Theory, the majority of genetic variation in a population is due to the random accumulation of neutral mutations over time. While some mutations may be beneficial and provide an advantage for survival, others may be harmful and reduce an organism's chances of survival. However, those mutations with an influence on fitness are relatively rare, and the vast majority of mutations have no significant effect on the organism's fitness. Kimura's theory significantly challenges the traditional view of evolution, which suggests that the survival of the fittest is the driving force behind evolution. Instead, the Neutral Theory suggests that chance plays a more significant role in the evolution of species than previously thought until then. It also suggests that genetic drift, the random changes in the frequency of genetic variants within a population, is a more powerful force than natural selection in shaping the genetic makeup of a population over time. Random drift can thereby lead to the loss of genetic diversity and the fixation of certain alleles over time, especially in small populations. In small populations, random fluctuations can have a greater impact on the frequency of alleles because there are fewer individuals carrying those alleles. This means that chance events, such as the death or reproduction of a few individuals, can have a disproportionate effect on the overall genetic makeup of the population.

While the Neutral Theory has been the subject of much debate and criticism, it has also been supported by a significant body of evidence. Researchers have found that the pattern of molecular evolution observed in many species is consistent with the predictions of the Neutral Theory. For example, long-term evolution experiments with bacterial and yeast populations to study the dynamics of genetic drift and natural selection have shown that neutral mutations accumulate in these populations over time and that the rate of accumulation is consistent with the neutral theory of molecular evolution. In some cases, they have also observed the fixation of neutral mutations that do not affect the fitness of the organisms. This evidence suggests that the Neutral Theory is an essential tool for understanding the genetic diversity of life on our planet. The Neutral Theory of Molecular Evolution is a critical concept that has revolutionized our understanding of the evolutionary process and highlights how chance plays a significant role in the evolution of life.