Iterative Evolution: Repetition or Resurrection?

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Abstract

While many species have gone extinct with time, there are many species which have re evolved from a last known common ancestor with similar body modifications. A case of evolutionary convergence iterative evolution is the repeated evolution of a specific trait or body plan from the same ancestral lineage at different points in time over multiple generations. This could happen due to intrinsic and extrinsic constrains. Iterative evolution facilitates natural selection, while ensuring the organism survives against all obstacles. The best way to describe it would be that natural selection would take place depending on a number of factors. Scientists, are still debating whether iterative evolution is a process of resurrection or one of repetition. The main causes of iterative evolution can be attributed to similar environmental challenges and similar opportunities. The most recent case of iterative evolution was reported recently in the Aldabra Rail.

Introduction

A unique case of evolutionary convergence, iterative evolution occurs within the same clade and not between separate different clades. Similar to parallelism in evolution, morphological traits that follow iterative evolution share identical developmental paths to each other. Iterative evolution can be defined as the repeated evolution of a specific trait or body plan from the same ancestral lineage over multiple generations at different points in time. In severe incidents, iterative evolution can occur in convergent taxa with the same living ancestor. The repeated disappearance and re appearance of the same morphological traits has been reported in different taxonomic groups such as ammonites (Yacobucci, 2015), turtles (Parham and Pyenson, 2010) and canids (Van Valkenburgh, 1991).

Iterative evolution has been difficult to represent phylogenetically as it is difficult to regroup convergent morphologies using traditional phylogenetic methods based on morphology. Based on the different cases reported iterative evolution can be either due to intrinsic factors like behaviour, development or genetics or extrinsic factors such as ecological and environmental constrains or a combination of both. By extension, iterative evolution is hypothesized to be closely associated with faunal turnover, due to it causing the severe restriction and minimization of phylogenetic lineages and their subsequent evolutionary radiation (Whittingham *et al*., 2020).

Faunal turnover events are likely to experience major morphological shifts, aided by alterations in developmental timing. If these events are accompanied by significant intrinsic or extrinsic constrains, it can result in the iterative evolution of certain morphological traits. By analysing evolutionary patterns, we are able to get a better understanding of the causes behind iterative evolution within a clade.

Reported cases of Iterative Evolution

An example of iterative evolution amongst marine life would be ammonites which were spiral shelled relatives of squids. The organisms which inhabited deeper seas often had thick shells in order to cope with the pressure found at such depths. However, due to the receding sea levels, some of these organisms developed thinner shells due to compression enabling them to inhabit shallow waters with faster currents. When the sea levels went down completely, the ammonites with thinner shells perished due to habitat destruction. However, the thick shelled ammonites continued to sustain and would eventually repopulate again with the thin shelled variant.

Bats and birds both have the capability to fly but possess different structural and genetic mechanisms. In the Indian Ocean, a chicken sized flightless bird, the Aldabra Rail resides (*Dryolimnas cuiveri aldabranus*). The lack of flying capability was found to be due to weak muscles and assymetrical feathers aided by the absence of large predators on the island. This bird was found to be a descendant of the white throated rail (*Dryolimnas cuiveri*). Hume and Martill in 2019, reported about how the Aldabra rail might have evolved separately in two incidents.

The Atoll region was submerged intermittently over a period of 400,000 years with the islands disappearing completely from 136,000 to 118,000 years ago. The first set of bones belonging to the flightless Aldabra bird was found at a site on Ile Picard Island which dated the fossilized remains to more than 136,000 years ago. However, on a separate island Grand Terre in the Atoll region, fossilized remains were discovered which were found to be from 100,000 years ago. The fossilized remains from both sites were compared and both were found to be similar to the current day white throated rail. The findings indicated that the Aldabra rail was able to adapt twice, independently due to external conditions.

Iterative evolution can also explain the adaptive behaviour of seas cows over 26 million years. A study was performed which analysed three species of sea cows over three historical timelines in Florida, India and Mexico. Although there was overlapping of several ecomorphological traits, it was reported that each co existing species had a dominant trait. It was reported that the species from each area had developed specific morphological traits to help them survive the specific conditions of their habitat.

Conclusion

While iterative evolution cannot bring back species from the dead, it can lead to re-emergence of species that possess similar morphological traits to their predecessors. A consequence of natural selection, it ensures survival of the fittest while the species adapts to the changing environmental conditions around them. In the coming years due to changing climatic conditions, we might witness more cases of iterative evolution taking place.

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