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Evolution in a window-frame

Nature seems to have tried out evolution in a small model, says S.Ananthanaryanan.

This is not like a manufacturer developing a ***prototype*** or a designer working with a ***scale model***, but more like the industry providing a ***working model*** to showcase the main product.

Ecology and evolution

Evolution is nature's built-in provision for adaptation. As conditions change, some individuals in a species, due to slight, individual, genetic variations, are marginally more able to withstand the change than others. These individuals then thrive, while the others are left a little behind. Over time, the better adapted genetic variation, howsoever small to start with, dominates resources and grows, while others either migrate, modify behaviour or go extinct.

Through this simple process of ***selection***, the entire thread of evolution, from the early single celled organisms to the variety and sophistication of modern plant and animal kingdoms can be traced. The English naturalist Charles Darwin observed wildlife and collected fossils from all over the world during a 5-year voyage aboard the HMS Beagle and was able to work out the pattern of evolution, across different environments and over the ages recorded in fossil remains.

Later developments in genetics and molecular biology soon established Darwin's principle of natural selection as the clear explanation for evolution and the present age has progressed to ***fast-forward*** creation of new variants with the help of radiation or genetic engineering. The basis for faith in the theory of evolution, however, is still the data collected from over the world and by deduction from fossil records.

Modeling

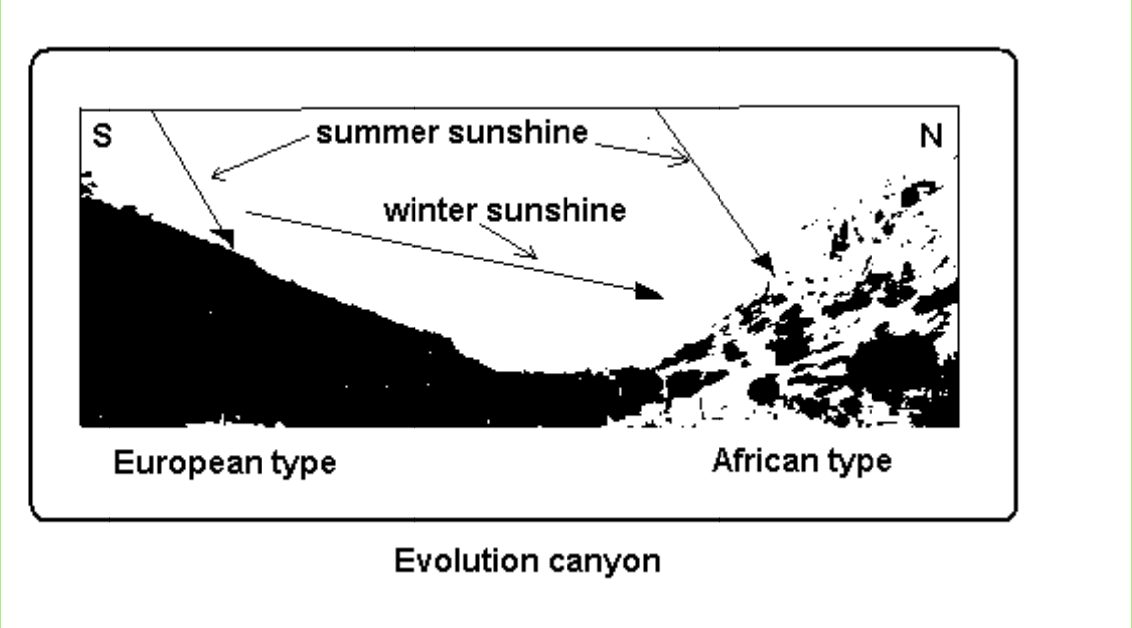
In fields like geology or architecture, we are able to create laboratory size models to study the way the real life versions would behave, or at least to view at one spot the way things work over large distances. An example of this kind of modeling is the wind tunnel, where the behaviour of a full size aircraft is studied with the help of a model a hundredth the size.

The working of evolution or the way biodiversity arises, however, cannot be studied by convenient lab size models. In the case of biodiversity, there have been studies in farms of a few hectares of how biodiversity helps ecosystems hold out against adverse conditions. At the Cedar Creek Natural History Area, Minnesotta, a ten year study started in 1995 used a six hectare field to show that having many species living together gave them resilience against weeds or periods of drought. But studies involving distribution of species would need hundreds of kilometers and there have not been any studies at such a scale.

Nature's own lab

But there is natural topographic curiosity, in a valley near Mount Carmel in Israel, where opposite slopes display dramatically different climatic conditions. And right there, separated by just a hundred meter strip, there is evidence of separation of varieties of plants and animal species, evolving to match local condition which are different but still so small a distance apart.

This remarkable site, which is known by the name '***evolution canyon'***, is a formation, some 3-5 million years old, which divides Mount Carmel in the East-West direction, down to the Mediterranean Sea. The slopes are separated by only a hundred metres at the bottom and by four hundred metres at the top. Situated at a latitude of nearly 32˚ in the Northern hemishpere, the northern slope, which is south facing, receives sunlight most of the year, while the opposite slope, which faces the north, is in the shade and receives only slanting sunlight even in the summer. The northern slope receives nearly eight times the sunlight, is generally warmer and has greater night-day temperature difference. Thus, despite the same kind of soil and rainfall, the northern slope has open park type shrub vegetation, and is dominated by Savanah-like African grassland. The southern slope, on the other hand, has Southern European or Mediterranean vegetation and is climatically less stressful.



Evolution canyon

The remarkable thing is the difference in the kind of insect and animal species that are found in the two regions. The South facing slope is found to abound in distinct varieties of dorsophilia flies and also bacteria which show clear genetic adaptation to the differing conditions on the two slopes. The clear divergence of drosophilia occupying the two regions is considered to represent an early stage of ecological speciation, where divergent natural selection drives accumulation of genetic differences and reproductive isolation.

The peer reviewed journal, ***PLoS ONE*** has carried a paper by a group of researchers in the University of Haifa, Israel of a study of the speciation of ***scorpions*** on the two sides of Evolution Canyon. Scorpions have the quality of being able to withstand arid and hot conditions and to conserve water for long periods of time. Hence they thrive in hot parts of the world. The study by

Shmmuel Raz and colleagues at Haifa finds this global distribution reproduced at the local level. Out of some two hundred specimens of six varieties of scorpions studied, it was found that there was a spread of species that inhabited only the hot, ‘African’ zone, while the mild, ‘European’ zone had markedly less diversity in scorpion varieties.

The finding has been described as a striking instance of evolutionary dynamics within a compact area, separated by a short distance. The site, in Mount Carmel, Israel, has been selected by UNESCO as a ***world heritage site***, for preservation of the remarkable ecological feature that it displays.