Extinction

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The History of Life on Earth Fossils of organisms that were different from anything alive today had been documented as early as the 17th century, but it was not until the early 19th century that scientists began to recognize that the successive layers of fossil bearing rocks were like successive pages in the history of life on earth. Although this recognition gave rise to the birth of the field of paleontology, the idea of complete global extinction of a species had yet to be fully accepted. At that time, it remained viable to argue that our knowledge of the world was limited, therefore scientists considered the possibility that organisms known only from fossils might still live on in some unexplored portion of earth. When Charles Darwin published "On the Origin of Species" in 1859, the concept of the extinction of species was becoming more accepted, but the cause of extinctions remained a mystery. Continuous extinction was integral to Darwin's theory of natural selection, as he viewed it as a logical result of the evolution of species that were more competitive, better predators, or more fit than their ancestors in another way. Therefore, the ancestors had gone extinct to be replaced by their superior descendants. The only illustration Darwin included in his book is of an early phylogenetic tree, which he referred to on multiple occasions to support his argument for extinction being a by-product of evolution. Every living organism comes to existence, prevails for some period of time, and eventually perishes. The same is true for species as well, hence the ultimate fate of all species is extinction. A species goes extinct when it can no longer survive and reproduce in its environment and cannot move to a new one. It is estimated that over 99% of all species that have ever existed have gone extinct, with most having an average "lifespan" of 1-10 million years. Extinction can be gradual due to slow environmental changes or an inability to compete with an emergent species, or it can be sudden due to catastrophic events, habitat destruction, pollution, or overhunting. Extinction on a Large Scale Mass extinctions, or extinction events, are large worldwide decreases in biodiversity, when rates of extinction exceed rates of speciation. Mass extinctions are generally caused by geological or astronomical events, such as volcanic eruptions, changes in atmospheric composition, sea level rise or fall, global cooling and warming, and asteroid impacts. Five major mass extinction events have been identified and have been used to subdivide geologic time into distinct eras or periods that are nested within eras. When multiple species go extinct very abruptly they disappear from the fossil record, providing a metric for the end of a given subdivision of the geologic time scale and the beginning of a new time period. The Permian-Triassic Extinction The largest mass extinction, the Permian-Triassic extinction, also known as "The Great Dying" or the "Permian-Triassic disaster" took place approximately 252 million years ago at the end of the Permian period, driving over 90% of all species to extinction1. Another well-known mass extinction is the Cretaceous-Palaeogene (K-Pg) or Cretaceous-Tertiary (KT) Extinction, which occurred approximately 66 million years ago2. While the cause of the K-Pg extinction has been widely debated, consensus has settled on an asteroid impact on the Yucatan Peninsula of Mexico as the most important cause of the event. This massive impact led to geologic instability in certain areas, leading to earthquakes, significant amounts of volcanic activity, as well as dramatic sea level rise. In addition, it also triggered massive fires, which in turn filled the air with a thick layer of ash, smoke, and dust, blocking out the sun and leading to a period of global cooling. The timing of the asteroid impact follows the massive volcanic eruptions that caused the formation of the Deccan Traps, in west-central India. These eruptions happened over an interval of as long as 30,000 years and began before the asteroid impact. They caused the largest volcanic formation on earth that covers an area of over 200,000 square miles. These eruptions would have also caused sustained climate change and hence are seen as either an alternative cause to the asteroid impact or an augmentation of the environmental disruptions that followed the impact. Global Loss of Species K-Pg event is most famous for the extinction of dinosaurs; however, dinosaurs were not the only taxa affected - approximately 75% of all species went extinct during this event. Nevertheless, not all taxa were affected equally, and some later benefitted from the opening of previously occupied niches2. Mammals and amphibians were both part of the latter group. While diversity was lost during the extinction, these two taxa lost diversity at a lower rate than many other taxa and both groups underwent an adaptive radiation following the demise of other large tetrapods, such as the archosaurs. Of the Archosaurs, only the lineages that led to birds and crocodiles survived. Hence, non-avian dinosaurs are not observed past the K-Pg boundary in the fossil record, and they are believed to have died out quickly and completely due to their lack of ability to take shelter and their reliance on carnivorous diets. The fossil record for insects shows wide swings at the start of the Paleogene. It is possible this variation is due to the imperfection of the fossil record and some stages were more prone to preserving fossils than others. It is also known, however, that insects experienced similar trends to other taxa, decreasing immediately following the K-Pg extinction and then rebounding. A high point at the Thermal Maximum can also be observed for this taxon. Osteichthyes, or the bony fish, also experience an irregular pattern of diversity. Deep water marine fossils in particular are difficult to find, which could contribute to this irregularity, however it is worth noting that the highest diversity of bony fish is at the Thermal Maximum. Shallow seas are thought to have experienced the worst effects during the extinction event due to the larger impact of sea level rise and reduced photosynthesis compared to other marine habitats. Molluscs experienced a huge decline following the K-Pg extinction and these numbers are not regained by the end of the Paleogene. Echinodermata and Crustacea experience similar levels of decline, however these numbers may also be affected by the lack of fossilizing structures in both of these groups. Some scientists have suggested that we entered a new geologic era known as Anthropocene, along with the "Sixth Mass Extinction"1-2. This suggestion is based on the global changes as well as the high rate of global extinction as a result of human activity including overhunting, pollution, habitat destruction, invasive species, and climate change. Because the current extinction is caused by human activity, it is unlike the other mass extinctions, which have largely resulted from astronomical and geological processes. The current rate of extinction is up to 100 times higher than it is expected to have been without human influence and it is likely higher, considering species that have not yet been discovered. Considering the rate of Anthropocene extinction is equal to or greater than those associated with the earlier mass extinction events, rapid action is required to reverse the huge losses to vulnerable populations. References Benton, Sarda Sahney and Michael J. Recovery from the most profound mass extinction of all time. Proc Biol Sci. 2008, Vol. 275 , (1636) 759-765. Thomas John Dixon Halliday, Paul Upchurch, and Anjali Goswami. Eutherians experienced elevated evolutionary rates in the immediate aftermath of the Cretaceous-Palaeogene mass extinction. Proc Biol Sci. 2016, Vol. 283, (1833) 20153026. Barnosky AD, Matzke N, Tomiya S, Wogan GO, Swartz B, Quental TB, Marshall C, McGuire JL, Lindsey EL, Maguire KC, Mersey B, Ferrer EA. Has the Earth's sixth mass extinction already arrived? Nature. 2011, Vol. 471, (7336) 51-7. Madliger CL, Franklin CE, Hultine KR, van Kleunen M, Lennox RJ, Love OP, Rummer JL, Cooke SJ. Conservation physiology and the quest for a 'good' Anthropocene. Conserv Physiol. 2017, Vol. 5, (1) cox003

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