CHANGING CLIMATE

OUR FUTURE, OUR CHOICE

Augustine Eruption. 2006.
Credit: Cyrus Read, USGS via FLickr

Climate Change & Mass Extinctions

MUSEUM OF THE EARTH

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Introduction

Scientists say Earth is heading for a 6th mass extinction. What role has climate change played in past mass extinctions?

Life on Earth has already endured five mass extinction events throughout geologic history, often related to fluctuations in the planet's climate. In the face of thousands of species becoming endangered and extinct in the last century, scientists have suggested that we are in the midst of a sixth mass extinction. How has climate change has factored into past mass extinctions, and what is its effect on biodiversity loss today?

Ordovician Extinction: An Ice Age (440 million years ago)

This mass extinction occurred in the early diversification of animal life on Earth, when most life lived in the ocean. Ocean cooling associated with high-latitude glaciation was responsible for killing off 85% of species of marine organisms. The Ordovician cooling was brought on by changes in the carbon cycle resulting from mountain-building events. The ocean cooling led to sea level dropping, and habitat loss on shallow continental shelves, as well as in tropical oceans. The glacial interval, lasting about 20 million years, was then followed by a warm period and a change in ocean chemistry—possibly due to an increase in volcanic activity—that killed off some of the organisms that had survived the cool period.

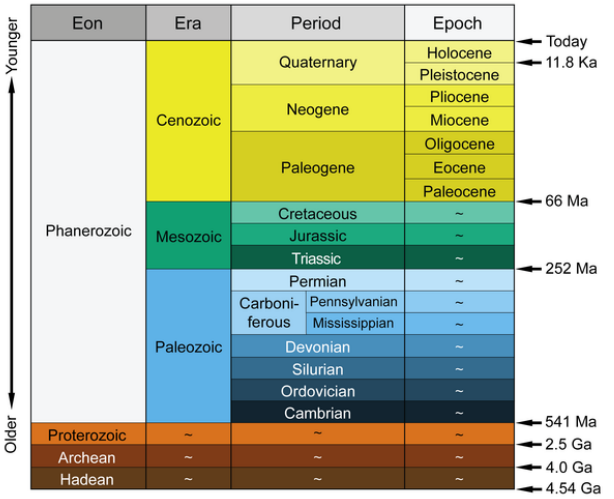
Devonian Extinction: Oxygen Shortage (370 million years ago)

Earth's second mass extinction took place in the midst of tetrapods occupying both sea and land, impacting about 75% of species. The cause of the extinction is still a subject of research, but the most likely cause seems to be ocean anoxia (a lack of oxygen in many parts of the ocean). Phytoplankton blooms due to large concentrations of nutrients associated with weathering caused by diversification of land plants led to bacterial decay, consuming much of the available oxygen and leaving "dead zones" in waters. Corals were severely impacted in this extinction and took millions of years to recover, a possible parallel to the effects of ocean acidification on corals in our oceans today.

Ordovician trilobite Pliomerops escoti Credit: Didier Descouens (CC BY-SA 4.0) via Wikimedia Commons

Permian Extinction: The Largest in Earth History (252 million years ago)

The Permian extinction was responsible for killing 95% of marine species and 70% of land species, and was caused by a mixture of a geologically rapid increase in temperatures, ocean anoxia, ocean acidification, and sulfide poisoning. High temperatures and poisoning are believed to be the result of massive volcanic eruptions in Siberia, some of which burned through extensive coal deposits, rapidly increasing greenhouse gasses in the atmosphere. This caused acidification of oceans, which accounts for the greater effect on marine species, but the extinction also impacted terrestrial animal and plant life.



Geologic Time Scale. Credit: PRI's Earth@Home Project

Volcanoes: The Culprit Again! Triassic Extinction (200 million years ago)

The leading suspect in this mass extinction is once again volcanic activity, as the large disappearance of species in the fossil record is accompanied by volcanic rock and igneous plumes found in these same rock layers. The activity appeared as a continuous eruption of magma over 40,000 years and a rifting of Pangea, the giant supercontinent that existed at the time. Evidence shows a similar series of events as in the Permian extinction: rising carbon dioxide, methane, and sulfur levels in the atmosphere that led to global heating as well as ocean acidification.

Asteroid Impact: Cretaceous Extinction (66 million years ago)

Famous for being the extinction that killed off the dinosaurs, the Cretacous extinction was likely caused by asteroid impact. Evidence of a huge impact crater was found in the Yucatan Peninsula, and high levels of iridium of extraterrestrial origin that do not appear in the lower sandstone layers from this time period have been found around the world.

Artist's conception of asteroid collision. Credit: NASA JPL via Wikimedia Commons

The Brink of a Sixth Mass Extinction

A 2019 United Nations report written by 400 experts from over 50 countries concluded that "around 1 million species already face extinction, many within decades, unless action is taken to reduce the intensity of drivers of biodiversity loss." [1] These drivers are habitat destruction by humans; direct exploitation of organisms, such as overfishing and pollution. Climate change and the greenhouse gas emissions that cause it are not the only threats to animal and plant life today, but they play a major role through ocean acidification, global heating of the sea and atmosphere, changes in rain and snowfall, sea level rise, and other changes that stress and threaten organisms around the world.

What can I do to protect wild animals and plants?

- Consume less and waste less, to do less environmental harm
- For what you do consume, try to buy products that are made in ways that minimize habitat destruction
- Advocate for policies that protect wildlife and habitat
- Get involved in local projects like planting milkweed for monarch butterflies or protecting sea turtle nesting sites on beaches
- Help children (and adults) spend time in nature, to build appreciation for the life in our world

[1] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages.

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