ZOOLOGY

6TH SEM (CC-XIV) UNIT -7

Mass extinctions causes and effects

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Although the best-known cause of a mass extinction is the asteroid impact that killed off the non-avian dinosaurs, in fact, volcanic activity seems to have wreaked much more havoc on Earth's biota. Volcanic activity is implicated in at least four mass extinctions, while an asteroid is a suspect in just one. And even in that case, it's difficult to disentangle how much of the end-Cretaceous extinction was caused by the asteroid and how much was caused by the steady ooze of lava that was blanketing most of India at around the same time.

While multiple causes may have contributed to many mass extinctions, all the hypothesized causes have two things in common: they cause major changes in Earth systems — its ecology, atmosphere, surface, and waters — at rapid rates. Here are some hypothesized causes for each of Earth's biggest mass extinctions:

End-Ordovician:
- Beginning of glacial cycles on Earth, and corresponding changes in sea level
- Changes in atmospheric and oceanic chemistry relating to the rise of the Appalachian mountains

End-Devonian extinction:
- Climate change, possibly linked to the diversification of land plants
- Decrease in oxygen levels in the deep ocean

End-Permian extinction:
- Volcanic activity
- Climate change
- Decrease in oxygen levels in the deep ocean
- Changes in atmospheric chemistry
- Changes oceanic chemistry and circulation

End-Triassic extinction:
- Volcanic activity

End-Cretaceous extinction:
- Asteroid impact
- Volcanic activity
- Climate change
- Changes in atmospheric and oceanic chemistry

The K-T extinction

The most recent of the Big Five is the most familiar one—the cataclysm that ended the Age of Dinosaurs. The end-Cretaceous or Cretaceous-Tertiary extinction event, otherwise known as K-T, killed off all dinosaurs save birds roughly 65 million years ago, as well as roughly half of all species on the planet, including pterosaurs.

Not only did mammals sweep across the planet after K-T, but sharks expanded across the seas, explained American Museum of Natural History vertebrate paleontologist Jack Conrad.

"Throughout the Age of Dinosaurs, you always had these large reptile carnivores dominating the water, such as ichthyosaurs, mosasaurs and plesiosaurs," Conrad explained. "Only after they die do you see big sharks

becoming really prevalent. You probably wouldn't have seen orcas or blue whales either had reptile dominance of the seas not gone by the wayside."

Although research suggests the planet was on the verge of environmental upheaval before the K-T extinction event, the straw that broke the dinosaur's back is widely thought to have been an impact with an asteroid or comet. Still, a number of researchers contend evidence commonly linked with such an impact, such as the metal iridium, which is rare on the Earth's crust, could also be caused by the massive volcanic eruptions at the Deccan Flats in India, another popular contender for the dinosaur-killing catastrophe.

The Triassic-Jurassic extinction

The end-Triassic, or Triassic-Jurassic extinction event about 200 million years ago is thought by many to possibly have set dinosaurs on the path to their 135-million-year domination of much of life on Earth. It also ended life for roughly half of all species. Until this disaster, mammal-like creatures known as therapsids were actually more numerous than the ancestors of the dinosaurs, known as archosaurs.

The Permian-Triassic extinction

The largest of the Big Five was the end-Permian or Permian-Triassic extinction event roughly 250 million years ago, which eliminated as much as 95 percent of the planet's species. Before this extinction, marine animals were mostly filter feeders stuck in place on the seafloor, such as crinoids or "sea lilies." Afterward, the seas became far more complex with mobile creatures such as snails, urchins and crabs.

The most likely final trigger for the end-Permian was again massive volcanism, this time at the Siberian Traps, which spewed as much as 2.7 million square miles (7 million square kilometers) of lava out, an area nearly as large as Australia.

The late Devonian extinctions

The late Devonian extinction events were actually two sharp pulses of death about 360 million years ago, each just 100,000 to 300,000 years apart.

Each pulse was accompanied by a massive drop in temperature, with the steaming seas of the Devonian—surface temperatures of which were about 93 degrees F (34 degrees C)—dropping to about 78 degrees F (26 degrees C), "and marine organisms would not have liked that at all," McGhee said. As to what caused these cold snaps, the ever-popular suspects are ash and dust kicked up by either astronomical impacts or massive volcanism.

At that time, plants had made it onto land, as had spiders, scorpions and similar creatures. Right before the extinction events, the first proto-amphibians made it onto shore. However, the invasion of the so-called elpistostegalians—distant relatives of the coelacanth—got wiped out by these extinction events. **The**

Ordovician-Silurian extinctions

The earliest of the Big Five, the end-Ordovician or Ordovician-Silurian extinction events some 444 million years ago, are reckoned by many to be the second largest.

These also consisted of a pair of die-offs, apparently involving massive glaciation and a resulting fall in sea levels. The cause of this glaciation remains a mystery, but one idea was that land plants actually caused it, pulling so much carbon dioxide out of the atmosphere that global cooling resulted, McGhee explained.

Even though the end-Ordovician led to a huge loss of life, in a way it actually had very little impact on the persistence of lineages. Although the four other Big Five extinction events led to huge changes in which animals rose to prominence, the same animals that dominated before the end-Ordovician dominated afterward.

The Holocene Extinction

The Holocene is a geologic time period that began with the end of the Ice Age about 11,700 years ago. Since then, the world has been changing very rapidly. In fact, it may be changing too rapidly for many species to keep up. There are five mass extinctions in Earth's history, in which more than 50% of species died out, and many scientists believe that we are entering the sixth.

Evidence for the Sixth Mass Extinction

Extinction is a perfectly normal phenomenon. Species either die out or evolve into something new over time. From the fossil record, we can tell that the average rate of extinction per year throughout Earth's history is around 1 species per million species. That means that we can expect anywhere between 10 and 100 species to go extinct every year. This is called **background extinction rate**.

If plants and animals go extinct all the time, why are we suddenly becoming so concerned by it? It's natural, right? Unfortunately, extinctions in the modern world are occurring on a much higher scale than the expected background extinction rate. Take mammals, for example. From the geologic record, we know that the average lifespan of a mammalian species is about 1 million years before it goes extinct or evolves. In the last 400 years, however, 89 species of mammals have gone extinct. That's almost 45 times the background extinction rate.

Mammals aren't alone, there were loss of genetic diversity across vertebrates, invertebrates, plants, fungi, and other living things, the extinction rate compounds somewhere between 1,000 and 10,000 times the normal rate. A wide-ranging 2017 study looked at almost half of all known vertebrate species and found that roughly a third are decreasing in population size and range. Another study found that 3,000 different species had all lost half their populations since 1970. If this keeps up, 30-50% of all species in the world could be in danger of extinction by the middle of the century.

Likely Causes

Humans have increased in population and distribution faster and more efficiently than practically any other living thing in the history of the planet. This has impacted the **Anthropocene Extinction** because it's being caused by our actions. In fact, scientists estimate that 99% of currently endangered species are at risk due to human impacts on the environment.

As humans spread, we require more space for our physical dwellings and to produce our food. That's billions of acres no longer being used by other species. Studies have found that in mammals alone, about half of all species lost 80% or more of their distribution range between 1900 and 2015. The more space we use, the less there is for other living things.

Beyond that, humans have been pumping carbon dioxide into the air at exponentially increasing rates since the Industrial Revolution. The vast majority of studies show a clear link between rates of carbon emissions and changes in global temperatures. This, in turn, has severely impacted many habitats. Amphibians, which are highly susceptible to changes in climate, pollution, and loss of habitat may be the most affected with an extinction rate up to 45,000 times the normal background rate.

K-T Extinction

Cretaceous-Tertiary Mass Extinction

Probably the best-known mass extinction event took out all the dinosaurs on Earth. This was the fifth mass extinction event, called the Cretaceous-Tertiary Mass Extinction, or K-T Extinction for short. Although the Permian Mass Extinction, also known as the "Great Dying," was much larger in the number of species that went extinct, the K-T Extinction is the one most people remember because of public fascination with dinosaurs.

The K-T Extinction divides the Cretaceous Period, which ended the Mesozoic Era, and the Tertiary Period at the start of the Cenozoic Era, which we currently live in. The K-T Extinction happened around 65 million years ago, taking out an estimated 75% of all living species on Earth at the time. Many people know that land dinosaurs were casualties of this major mass extinction event, but numerous other species of birds, mammals, fish, mollusks, pterosaurs, and plesiosaurs, among other groups of animals, also went extinct.

Asteroid Impacts

The main cause of the K-T Extinction is well documented: an unusually high number of extremely large asteroid impacts. Evidence can be seen in various parts of the world in layers of rock that can be dated to this time period. These rock layers have unusually high levels of iridium, an element not found in large amounts in the Earth's crust but is very common in space debris such as asteroids, comets, and meteors. This universal layer of rock has come to be known as the K-T boundary.

By the Cretaceous Period, the continents had drifted apart from when they were one supercontinent called Pangaea in the early Mesozoic Era. The fact that the K-T boundary can be found on different continents indicates the K-T Mass Extinction was global and happened quickly.

'Impact Winter'

The impacts weren't directly responsible for the extinction of three-quarters of the Earth's species, but their residual effects were devastating. Perhaps the biggest issue caused by the asteroids hitting Earth is termed "impact winter." The extreme size of the space debris vaulted ash, dust, and other matter into the atmosphere, essentially blocking out the Sun for long periods of time. Plants, no longer able to undergo photosynthesis, began to die off, leaving animals with no food, so they starved to death.

It's also thought that oxygen levels declined due to the lack of photosynthesis. The disappearance of food and oxygen affected the largest animals, including land dinosaurs, the most. Smaller animals could store food and needed less oxygen; they survived and thrived once the danger passed.

Other major catastrophes caused by the impacts included tsunamis, earthquakes, and possibly increased volcanic activity, yielding the devastating results of the Cretaceous-Tertiary Mass Extinction event.

Some scientists believe that in the early 21st century, we are in the middle of the sixth major mass extinction event. Because these events often span millions of years, it's possible that the climate changes and Earth changes—physical changes to the planet—that we are experiencing will trigger the extinction of several species and in the future will be seen as a mass extinction event.