

The 6th mass extinction –an alarming news!

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What is mass extinction?

The extinction of a large number of species within a relatively short period of geological time known as mass extinction.

What is background extinction?

The extinction of species is inevitable in the evolutionary history of species. It is an ongoing natural occurrence. The regular extinction of species through natural process known as **background extinction**

- The earth has only experienced five mass extinctions in its 4.5 billion year history.
- About 99.9% of all species that ever existed on earth are now extinct.
- The earth is on the verge of a sixth mass extinction is extremely alarming news.

Triggers of mass extinction:-

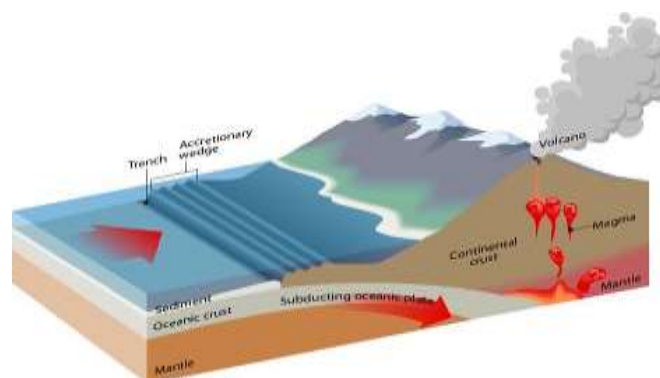
Bolides impacts: The end-cretaceous mass extinction at 65 Mya is largely believed to have been caused by asteroid impact on earth with other indirect impact like stratospheric ozone depletion, nitric acid formation, anoxia, fire and destruction of food chain. It is believed to be the trigger of the dinosaur extinction.



Volcanic eruption: Volcanic ash on entering into earth's atmosphere block sunlight and heat radiation. It affect directly on primary production and entire food web.



Plate tectonics: Movement of the continents into some configuration can cause or contribute to extinctions in several ways: by initiating or ending ice ages, by changing ocean and wind currents and thus altering climate etc.



Opening vs closing of equatorial Ocean passages Sea level fluctuation related to glaciations & de-glaciation: Glaciation binds water and lowers sea levels. Life adapted to warm temperature and continental shelf during high sea

level become hard to survive and go extinct. Reverse situation would be noticed during the period of de-glaciation. After melting it creates a hostile condition for life due to release of chemicals, metals, ions and gases.

Anoxia in oceans & atmosphere: During Turonian time huge scale volcanic deposition of iron in oceans resulted in algal boom which after decomposition resulted an anoxic condition in water and death of biota.



Global cooling: It is one of the primary cause of extinction on earth .Cooling could be the result of biological factors, geological factors or an exploding comet.

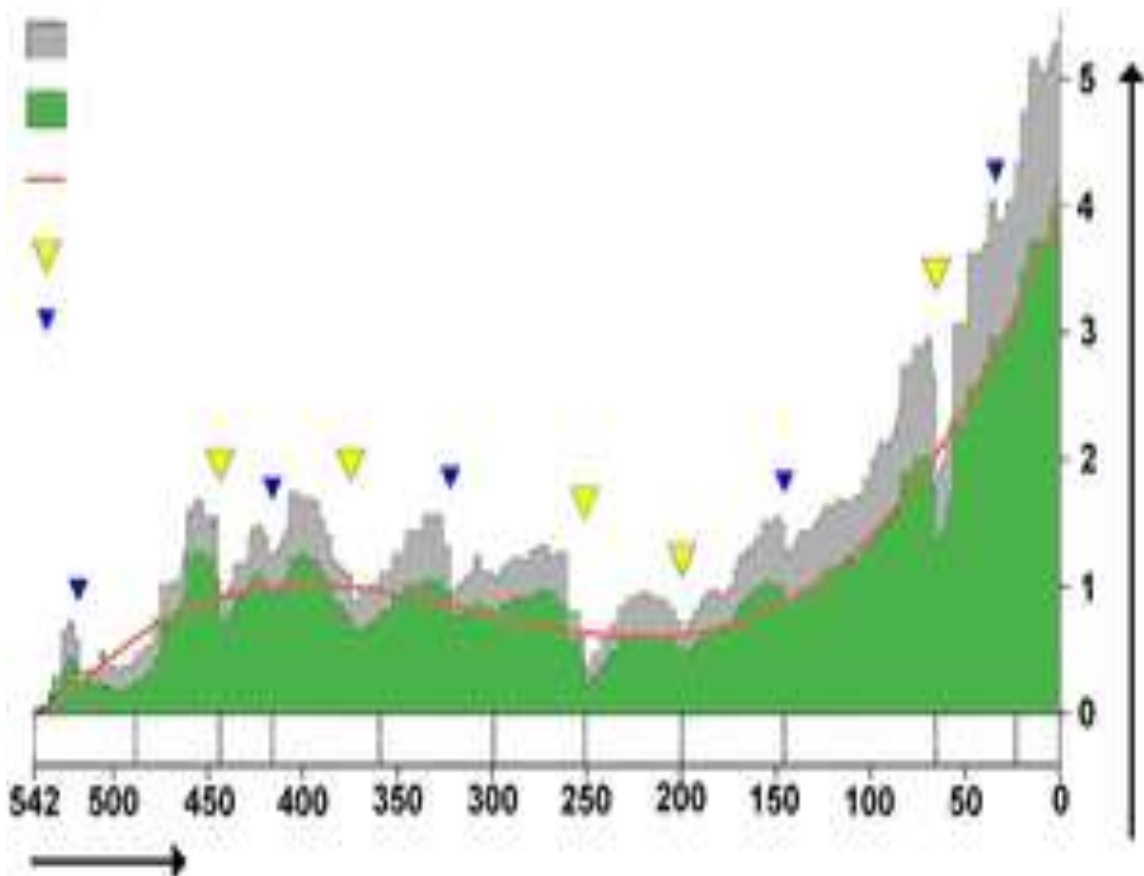
Gamma-ray bursts from some nearby supernova explosions: Ordovisian mass extinction is believed to have been caused by such gamma-ray burst.



Past five extinction events :-

Period	Extinction	Date	Possible causes
Holocene	Holocene extinction event	10,000 BCE — Ongoing	Humans
Paleocene	Cretaceous–Paleocene extinction event	66 Mya	Bolide impact at Chicxulub site at Yucatan Peninsula in Mexico.
Jurassic	Triassic–Jurassic extinction event	201 Mya	Volcanic eruption, increased CO ₂ concentration, anoxia.
Triassic	Permian–Triassic extinction event	252 Mya	Volcanism, biggest mass extinction, death of 96% of all species.
Devonian	Late Devonian extinction	375-360 Mya	Bolide impact
Ordovician	Ordovician–Silurian extinction events	450-440 Mya	Global cooling and sea level Gamma-ray burst.

- All genera
- "Well-defined" genera
- Trend line
- ▼ "Big Five" mass extinctions
- ▼ Other mass extinctions Million years ago



↑ Thousands of genera
 → Patterns in frequency

Extinction Mediated by human:-

The sixth extinction started & is continuing in two extinction spasm, both mediated by human beings.

Stage 1- Started about 50,000 years ago when humans started dispersal out of Africa. As they came in contact with various species on their migration path, human beings left a trail of killings of native biota.

Stage 2- It was initiated about 13,000 years ago with the beginning of agriculture. The discovery of life saving drugs and more assured food supply helped in exponential rise of human population.

Extrinsic Drivers of Extinction:-

- **Habitat loss:** One of the biggest drivers of habitat loss on earth is deforestation. It is estimated that 70% of the earth's land animals and plants live in forest ecosystem. Loss of habitat poses one of the greatest threats to species biodiversity.
- **Pollution :** Contamination from industry, runoff from farms, trash from land fills, airborne pollutants all have adverse effects on wild life.
- **Invasive species :** Invasive species have caused hundreds of extinction by competing with native species for food and other resources, predation, alteration of habitat. In many cases natural selection favors the invasive species and the native species goes extinct **eg -** *phytophthora cinnamon*, *Lantana camera*, *Aedes albopictus*, *Lates niloticus*, Indian Myna bird (*Acridotheres tristis*) domestic cat (*Felis catus*) .
- **Climate change :** The burning of fossil fuels release green house gases into our atmosphere that intensify the earth's natural green house effect. The global average temperature has increased by more than 1.4°F over the last century causing sea level rise, more intense weather patterns and climatic shift. Extinction of amphibians in Costa Rica is due to a disease

caused by a chytrid fungi (*Batrachochytrium dendrobatidis*) – which has aggravated by climate change. Eg Golden toad of Costa Rica extinct since around 1989. Amphibians are now most endangered vertebrate group having existed for more than 300 million years through three other mass extinctions.

The worldwide decline of corals is also due to recent climate change. The corals are highly sensitive to sea surface temperature. When the temperature increases the symbiotic zooxanthellae algae photosynthesizes at a greater rate and produces more oxygen which through series of metabolic steps produces toxic. In order to survive corals eject the algae, losing colour and source of nourishment. Large scale coral bleaching was observed in Indonesia during EL Nino event of 1980s.



Golden toad



Brain coral

- **Ocean Acidification:** Higher levels of CO₂ in sea water make it acidic which in turn affects calcification. Since the beginning of the industrial revolution, surface water pH has decreased by 0.1 pH units-30% increase in ocean acidity. Coral reefs may be the first ecosystem to go extinct in the Anthropocene. Many reefs are in decline due to the effects of ocean acidification.
- **Biotic Homogenization:** It is the process by which species invasions and extinctions increase the genetic, taxonomic or functional similarity of two or more locations over a specified time interval.

- **Overkill:** Several rhinoceros species are on the edge of extinction due to demand for their horns. The baiji river dolphin was declared functionally extinct in 2006. It was the first cetacean to go extinct due to human activities. Overfishing, habitat destruction, boat traffic, dam building and pollution all likely played a role in the species demise.



Fate of Indian one- horned rhinoceros in Assam



Baiji river dolphin

Present rate of extinction:-

The rate of extinction has increased many folds over the background rate at Holocene times. Such as –

- ❖ The current rate of amphibian extinction is 211 times the rate of their back ground extinction and if all the threatened species go extinct, the rate would be as high as 25000 to 45000 times greater
- ❖ Global Coral monitoring network reports that 20% of global coral reefs are degraded to a state that is beyond recovery
- ❖ IUCN (2009) estimated that between 10,000-20,000 freshwater species are either extinct or at threatened with extinction. This number is so high that it is comparable to extinction rate observed at transitions between geological epochs like pleistocene-to-holocene.

- ❖ IUCN (2009) Red List of Threatened species (version 2010.4) contains 55,926 species and 33% of these (18,351) are known to be threatened species.

Evolutionary importance of extinction :-

- ✓ Loss of large number of species in mass extinction results in vacating many different niches.
- ✓ This provides opportunities for new species to evolve in those vacant niches.
- ✓ All mass extinction events were followed by diversification of biodiversity.
- ✓ The rise of mammals following extinction of dinosaurs and diversification of angiosperms in vacated niches of gymnosperms.
- ✓ The extinction of reef builders at end Ordovician extinction event helped to release huge amount of calcium from the reefs into the oceans.
- ✓ The development of species with bony structure in Devonian was made possible due to abundant supply of this calcium.
- Extinction itself promotes biotic interchange such as competition for food & space –“The struggle for existence” – which promote evolution.
- It sometimes accelerated the evolution of life on earth.

The evolutionary response to mass extinction is slow on human time scales, difficult to predict owing to contingencies of post extinction conditions, including the identity and evolutionary dynamics of the survivors and geographically heterogenous.

Evidence we have started an Anthropocene:-

1. Increased levels of climate warming CO₂ in the atmosphere at the fastest rate for 66m years, with fossil fuel burning pushing levels from 280 ppm before the industrial revolution to 400ppm and rising today.

2. Put too much plastic in our water ways and oceans which leave identifiable fossil records for future generation to discover.
3. Double the nitrogen and phosphorus in our soils in the past century with our fertilizer use.
4. Left a permanent marker in sediment and glacial ice with air borne particles such as black carbon from fossil fuel burning.
5. Pused extinction rates of animals and plants far above the long term average. The earth is on course to see 75% of species become extinct in the next few centuries if current trends continues.

Possible Ways to Stop the 6th Mass Extinction:

- ❖ **Stop burning fossil fuels:** Burning fossil fuels and chopping down rainforests is heating up the atmosphere.
- ❖ **'Extinction crisis is real'**- spread the words to people.
- ❖ **Stop overfishing:** Overfishing has wiped out 90% of the big fish from the sea and caused near extinction of many species. So eat fish from only healthy fisheries. Some researchers suggest that by 2050 there could be more plastic than fish in the ocean by weight.
- ❖ **Less consumption of meat:** If lands now used to grow crops for livestock were instead used to grow crops eaten directly by people there would be 50%-70% more calories for human need. It is enough to feed more than a billion more people than we are feeding today and would prevent plowing over rain forests to make more farms.
- ❖ **Stop using products derived from threatened species:** Many species like rhinoceros, tigers, snow leopard and Pangolins are used in traditional medicines. But studies have shown to have no health value. So international law has been banned the trade of endangered species and have listed the names of endangered species in a websites. People should keep in mind that if poaching going on then it will kill all wild elephants

on earth within just 20 more years. So stop buy anything made from ivory or from any other product derived from threatened species.

- ❖ **Buy products from companies committed to using sustainably produced palm oil in their products:** Palm oil is an ingredient in many foods, cosmetics and soaps. To make way for palm oil plantation, tropical forests which harbor upto 2/3 of all land species are rapidly being cut down. Those companies have committed not to using oil that originates from deforested landscape. We should buy product from that companies.
- ❖ **Enjoy nature:** Spend weekend or vacation exploring a national or state park or similarly biodiversity-rich place. That will remind us why preventing the “**Sixth Mass Extinction**” is so important. The reasons people have for wanting to keep species alive are diverse, ranging from “**ecosystem services**” — like pollinating crops, keeping soils fertile or fueling local economies — to moral imperatives. But one of the most compelling reasons is that places with lots of species simply make people happy when they visit them. This is not surprising from a biological perspective — the human species evolved with a multitude of other species around us, and on a deep genetic level, biodiversity is home.
- ❖ **Conservation initiatives:** Conservation initiatives are taken all over the world for quite some time with mixed amount of success. These initiatives range from launching species specific programs to building protected area networks. In the year 2008 IUCN red list reported 40 species that benefited from such programme as indicated by improvement in their conservation status. Pink pigeon, Mauritius Kestrel, Fody and **Parakeet** in Mauritius, **Lear’s Macaw** in Brazil, **Elephants** in Africa are examples of successful conservation initiatives in last 20 years. The 2008 IUCN reports shows 223 species changed their conservation status:

40 species became less threatened, whereas 183 species become more threatened.

“If we are concerned with avoiding the loss of particular functional groups, or with maximizing the potential source pool for evolutionary recovery, then bio-disparity measures may provide a more appropriate assessment, beyond sheer number of taxa, of how priorities should be set.” Jablonski (1995)