Introduction

Insects hold great importance in the ecosystem. They frst appeared in the Devonian period, 419 million years ago (Jouault et al. 2022). They make up most of terrestrial diversity (Basset et al. 2019) and constitute more than half of all known animal species (Montagna et al. 2019). They have the highest species-level diversity of any group of animals (Schachat et al. 2019). While many people have negative perceptions of insects due to their role in spreading disease, they are also highly important to humans. There are aesthet] k U ɔ

insect were preserved. Most insect fossils are from fossil assemblages known as Lagerstättes, where vast numbers of insects were preserved. However, the distribution of Lagerstättes is inconsistent across space and time (Schachat et al. 2020). For example, most Permian Lagerstättes were in North America and Eurasia (Prevec et al. 2022), despite there likely being a high diversity of insects in tropical areas (Kehoe et al. 2021). Overall, Permian sites were also globally rare compared to other time periods (Prevec et al. 2022). While there is a rich insect fossil record, it is biased towards smaller insects of concentrated times and location, which presents challenges with relying on it fully to measure extinctions.

There are issues with comparing fossils to current insect populations to measure extinction. First, temporal population trends are extremely difcult to fnd in fossils. They are also difcult to observe in living insects due to observation errors, environmental variability, and short life cycles (Fox et

1996). This paper will compare the causes, severity, and efects of the End-Permian insect mass extinction to the current insect mass extinction.

There are issues with measuring insect extinctions because there are biases regarding the study of insects. Scientists do not tend to research insect extinctions and usually study vertebrate extinctions. When they do study insect extinctions, there is a bias towards medium-sized insects and towards the frst and last occurrences of higher-level taxa (Schachat et al. 2020). The International Union for the Conservation of Nature (IUCN) Red List depends solely on the measures of population decline over the most recent ten years or three generations, whichever is longer. Since insect generation times are so fast, there is a bias by the start of the year (Fox et al. 2019). There is also a bias as to where insects are being studied. Most insects that are recorded are from islands since they are easier to search completely (Dunn et al. 2005). Tropical countries are losing the most insects, but they are not participating in most of the studies. There is also a lack of communication between various insect researchers. Most countries do not work together on studies (Valentine-Neto et al. 2021). The biases about studying insect extinctions and the fow of information make it difcult to quantify exac served in their entirety. Their size also infuences which body parts of the

The Permian mass extinction causes compared to the current mass extinction

There have been fve prior mass extinctions. These mass extinctions were all due to climate change that caused warming or cooling of at least 5°C. The climate changes were triggered by diferent causes such as glaciation, volcanic eruption, or asteroid impact. Both the Permian insect mass extinction and the modern insect mass extinction were caused by climate change, but what led to that change was diferent. The Permian mass extinction event occurred 251 million years ago and took place over the course of 60,000 years (Song et al. 2021). The mass extinction event was caused by climate change triggered by the eruption of the Siberian traps. The eruption led to massive amounts of carbon dioxide and sulfuric dioxide being released into the atmosphere. As a result of this there was ocean acidifcation and anoxia as well as acid rain. There was partial destruction of the ozone layer, and wildfres added additional carbon dioxide to the atmosphere (Zhao et al. 2021). Prior to the mass extinction event, there was gradual warming by approximately 12°C that led to initial environmental degradation (Gliwa et al. 2022). During the mass extinction, the climate warmed rapidly by about 10 °C (Song et al. 2021). Global warming caused entomofaunas as well as fora in the Northern Hemisphere to be displaced poleward. Cockroaches, which did not extend northwards beyond the semi-arid zone, reappeared from earlier epochs in more poleward zones. This shift is refected in fossil deposits (Shcherbakov et al. 2007). The extinction of taxon from the Permian may be due to the turnover of fora or competition from new types of insects that diversifed due to the diversifcation of plants (Zhang et al. 2022). During the late Permian, gymnosperm dominated forests collapsed and were replaced by other biomes (Zhao et al. 2021). These changes in foral assemblages were likely the strongest drivers of insect responses during the Permian extinction (Jouault et al. 2022). The Permian mass extinction was a global warming event which triggered the movement of foral assemblages, and therefore insects.

The sixth mass extinction is considered to have begun possibly as far back as 200,000 to 45,000 years ago or as recently as the nineteenth century during the industrial revolution (Cowie et al. 2022). Based on the predicted rates of extinction, the criteria for mass extinction will be reached by amphibian, bird, and mammalian standards in around 240 to 540 years (Barnosky et al. 2011). If insect extinctions were included this date would likely be sooner. The mass extinction event was also caused by climate change. This climate change was caused primarily by human activities. Due to burning fossil fuels, and at a faster pace since the Industrial Revolution, more carbon dioxide has been released into the atmosphere. Ag-event was also caused by cli20he event was also caused by cli33ld event was also caus

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