

Plagues that shook the Roman Empire linked to cold, dry periods

A study reconstructing the climate of Italy during the Roman Empire based on marine sediments shows that three pandemics coincided with cooler, drier conditions

By [Alec Luhn](#) on January 26, 2024



A 7th-century outbreak of plague in Italy, painted by Josse Lieferinxe. The Walters Art Museum/SCIENCE PHOTO LIBRARY

Three pandemics in the Roman Empire coincided with abnormally cold and dry periods, suggesting that natural changes in climate may have contributed to Rome's decline.

[Kyle Harper](#) at the University of Oklahoma and his colleagues reconstructed the climate of southern Italy between 200 BC and AD 600 by analysing the remains of plankton in a sediment core from the Adriatic Sea.

The Roman state flourished and reached its greatest extent during the three centuries of relatively warm and wet weather beginning in 200 BC in what is now Italy. But the study found that this "Roman climate optimum" gave way around AD 130 to an era that was up to 3°C (5.4°F) colder and with more frequent droughts.

Especially frigid years corresponded with the Antonine Plague in 165-180 AD, which shook the empire and possibly killed Emperor Lucius Verus.

Another plunge in temperatures came during the Plague of Cyprian in 251-266, when the empire was splintering into three states ruled by warring generals and a rebel queen.

Then, after the fall of the Western Roman Empire in 476, one of the coldest periods in the past 2000 years heralded a wave of pandemics starting with the Plague of Justinian in the 540s. This may have contributed to the loss of much of Italy, the Balkans and the Middle East from the Eastern Roman Empire.

“The Roman Empire rises and falls and rises and falls,” says Harper. “There’s a series of episodes of very extreme crises in some cases. And I think the case is now overwhelmingly clear that both climate change and pandemic disease had a role in many of those episodes.”

While there are signs of these cold spells in tree rings from the northern Alps, the sediment core in this study, which was taken at the end of a current running along the entire eastern coast of Italy, offers the first clear evidence of them in the Roman heartland.

Warm-water plankton species declined in the sediment layers from these years, says co-author [Karin Zonneveld](#) at the University of Bremen in Germany. The team also saw a decrease in species that depend on nutrients deposited by rivers, indicating aridity.

Cooler, drier conditions may have disrupted harvests, weakening the immune systems of Roman citizens and encouraging the spread of disease through migration and conflict.

Before the Plague of Justinian, which was [caused by the same flea-borne bacteria](#) as the 14th-century Black Death, three massive volcanic eruptions dimmed the sun and launched the “Late Antique Little Ice Age”. Historical accounts from this time recorded crop failures.

“The sun gave forth its light without brightness, like the moon,” wrote the scholar Procopius in 536. “Men were free neither from war nor pestilence nor any other thing that brings death.”

While this new sediment record advances our understanding of Roman Italy, we don’t know enough about the rest of the empire to say climate change triggered or amplified the plagues, says [Timothy Newfield](#) of Georgetown University in Washington DC. He has argued that the [effects of the Plague of Justinian have been exaggerated](#).

“Whether these three Roman pandemics specifically brought down Rome is in my opinion hard to argue,” he says. “No one variable or two variables can be held accountable.”

But Harper says the study should raise questions about climate change in the Roman era, as well as our own: “It gives you perspective to understand that two to three degrees [Celsius] of change is absolutely enormous and puts tremendous strain on human societies.”

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