

## News in focus

hand to curb its spread. So although scientists are concerned – because any new viral behaviour is worrying – they are not panicking.

Unlike SARS-CoV-2, which spreads through tiny airborne droplets called aerosols, monkeypox is thought to spread from close contact with bodily fluids, such as saliva from coughing. That means a person with monkeypox is likely to infect many fewer close contacts than is someone with SARS-CoV-2, Hooper says. Both viruses can cause influenza-like symptoms, but monkeypox also triggers enlarged lymph nodes and eventually causes distinctive fluid-filled lesions on the face, hands and feet. Most people recover from monkeypox in a few weeks, without treatment.

On 19 May, researchers in Portugal uploaded the first draft genome of the monkeypox virus that was detected there to an online database, and other genomes have since followed. Gustavo Palacios, a virologist at the Icahn School of Medicine at Mount Sinai in New York City, emphasizes that more data are still needed before many conclusions can be drawn.

What researchers can tell from these preliminary genetic data is that the strain of the monkeypox virus detected so far is related to a viral strain predominantly found in West Africa. This strain causes milder disease and has a lower death rate – about 1% in poor rural populations – compared with the one that circulates in Central Africa (which can have a death rate of up to 10%). But exactly how much the strain causing the current outbreaks differs from the one in West Africa – and whether the cases popping up in various countries are linked to one another – remains unknown.

Answers to those questions could help researchers to determine whether the sudden uptick in cases stems from a mutation that allows monkeypox to transmit more readily than it did in the past, and whether each of the outbreaks traces back to a single origin, says Raina MacIntyre, an infectious-diseases epidemiologist at the University of New South Wales in Sydney, Australia. Unlike SARS-CoV-2, a rapidly evolving RNA virus whose variants have regularly eluded immunity from vaccines and previous infection, monkeypox is caused by a relatively large DNA virus. DNA viruses are better at detecting and repairing mutations than are RNA viruses, which means it's unlikely that the monkeypox virus has suddenly mutated to become adept at human-to-human transmission, MacIntyre says.

### 'Deeply concerning'

Still, for monkeypox to be detected in people with no apparent connection to one another suggests that the virus might have been spreading silently – a fact that Andrea McCollum, an epidemiologist who heads the poxvirus team at the US Centers for Disease Control and Prevention in Atlanta, Georgia, calls "deeply concerning".

Unlike SARS-CoV-2, monkeypox rarely goes unnoticed when it infects a person, in part because of the skin lesions it causes. If monkeypox could spread asymptotically, it would be especially troubling, because that would make the virus harder to track, McCollum says.

Another puzzle is why almost all of the case clusters include men aged 20–50, many of whom are men who have sex with men (MSM). Although monkeypox isn't known to be sexually transmitted, sexual activity certainly constitutes close contact, Rimoin says. The most likely explanation for this unexpected pattern of transmission, MacIntyre says, is that the virus was coincidentally introduced into an MSM community, and has continued circulating there. Scientists will have a better idea of the origin of the outbreaks and the risk factors for infection once an epidemiological investigation, which could take weeks, is complete.

### Containment strategies

Scientists have been keeping an eye on monkeypox ever since an eradication campaign for smallpox wound down in the 1970s. Once smallpox was no longer a threat, thanks to worldwide vaccinations, public-health officials stopped recommending smallpox inoculation – which also kept monkeypox

at bay. With each year that has passed since smallpox's eradication, the population with weakened or no immunity to these viruses has grown, MacIntyre says.

There have been a few monkeypox outbreaks since then. The Democratic Republic of the Congo, for example, has been grappling with the virus for decades, and Nigeria has been experiencing a large outbreak, with over 500 suspected and more than 200 confirmed cases, since 2017, when the country reported its first case in some 40 years.

Public-health authorities are not powerless against monkeypox. As a precaution against bioterrorism, countries such as the United States maintain a supply of smallpox vaccines. However, these probably wouldn't be deployed on a large scale to tackle monkeypox, McCollum says. Health-care workers would probably instead use a method called ring vaccination to contain the spread of the virus: this would vaccinate the close contacts of people who have been infected with monkeypox, to cut off any routes of transmission.

On the basis of the data that she has seen so far, McCollum thinks the current outbreaks probably won't necessitate containment beyond ring vaccination. "Even in areas where monkeypox occurs every day," she says, "it's still a relatively rare infection."

## 'MIND BLOWING' ANCIENT SITES UNCOVERED IN THE AMAZON

The urban centres are the first to be discovered in the region, challenging archaeological dogma.

By Freda Kreier

**M**ysterious mounds in the southwest corner of the Amazon Basin were once the site of ancient urban settlements, scientists have discovered<sup>1</sup>. Using remote-sensing technology to map the terrain from the air, they found that, starting about 1,500 years ago, ancient Amazonians built and lived in densely populated centres, featuring 22-metre-tall earthen pyramids, that were encircled by kilometres of elevated roadways.

The complexity of these settlements is "mind blowing", says team member Heiko Prümers, an archaeologist at the German Archaeological Institute, headquartered in Berlin.

"This is the first clear evidence that there were urban societies in this part of the

Amazon Basin," says Jonas Gregorio de Souza, an archaeologist at the Pompeu Fabra University in Barcelona, Spain. The study adds to a growing body of research indicating that the Amazon – long thought to have been pristine wilderness before the arrival of Europeans – was home to settlements and agriculture well before that. The discovery was published on 25 May in *Nature*<sup>1</sup>.

### A shift in thinking

Humans have lived in the Amazon Basin – a vast river-drainage system roughly the size of the continental United States – for around 10,000 years. Researchers had thought that before the arrival of Europeans in the sixteenth century, all Amazonians lived in small, nomadic tribes that had little impact on the world around them. And although early European visitors described a landscape filled

with towns and villages, later explorers were unable to find these sites.

By the twentieth century, archaeologists had yet to confirm the rumours, and argued that the Amazon's nutrient-poor soil would have been unable to support large-scale agriculture, and that it would have prevented tropical civilizations – similar to those found in Central America and southeast Asia – from arising in the Amazon. By the 2000s, however, archaeological opinion was beginning to shift. Some researchers suggested<sup>2</sup> that unusually high concentrations of domesticated plants, along with patches of unusually nutrient-rich soil that could have been created by people, might indicate that ancient Amazonians had shaped their environment.

The hypothesis gained steam when, in 2018, archaeologists reported<sup>3</sup> hundreds of large, geometric mounds that had been uncovered because of deforestation in the southern Amazon rainforest. These structures hinted at ancient organized societies capable of thriving in one location for years – but direct evidence of settlements was still lacking.

In 1999, Prümers began studying a set of mounds in the Bolivian part of the Amazon Basin, outside the thick rainforest. There, a multitude of tree-covered mounds rise above a lowland area that floods during the rainy season.

Previous digs had revealed that these 'forest islands' contained traces of human habitation, including the remains of the mysterious Casarabe culture, which appeared in around AD 500. During one excavation, Prümers and his colleagues realized that they had found what looked like a wall, indicating that a permanent settlement had once occupied the area. The researchers also found graves, platforms and other indications of a complex society. But dense vegetation made it difficult for them to use conventional methods to survey the site.

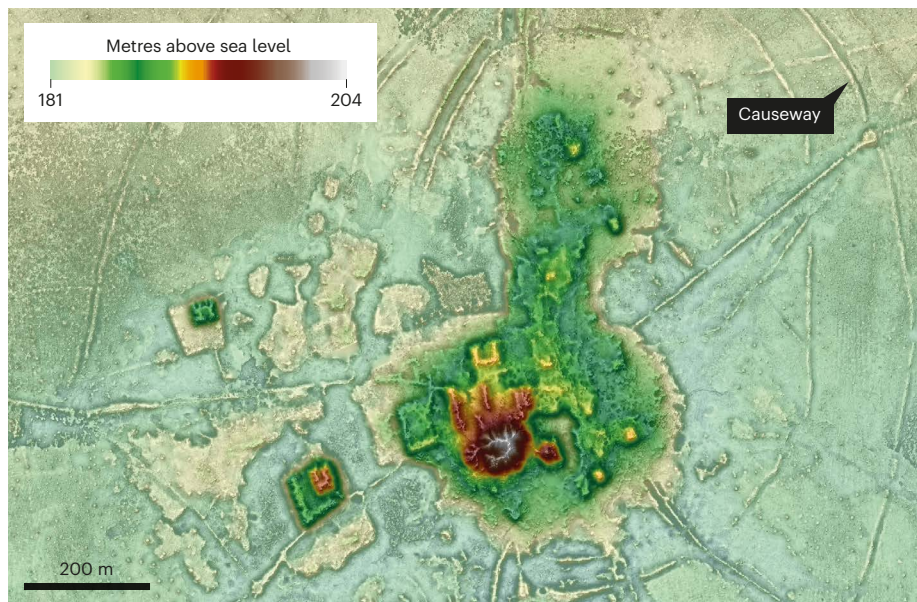
## What lies beneath

By the 2010s, a technique called lidar – a remote-sensing technology that uses lasers to generate a 3D image of the ground – had come into vogue with archaeologists. In 2012, a lidar survey of a valley in Honduras helped lead to the rediscovery of an ancient pre-Columbian city rumoured to exist in the area. The jungle had completely overtaken the settlement since it was abandoned in the fifteenth century, making it all but impossible to see from the air without lidar.

Prümers and his colleagues took advantage of lidar in 2019, when they flew a helicopter equipped with the technology over six areas near sites confirmed to have been occupied by the Casarabe people. The team got more than it bargained for, with lidar revealing the size and shape of 26 settlements, including 11 the researchers hadn't been looking

## THE SETTLEMENT BENEATH

Dense vegetation hid this ancient urban centre from view. Researchers unveiled it using a remote-sensing technique called lidar. The site in Bolivia, called Cotoca, had earthen pyramids (largest shown in red), terraces and elevated roads (causeways), and was occupied by the Casarabe culture between AD 500 and 1400.



for – a monumental task that would have taken 400 years to survey by conventional means, Prümers says.

Two of the urban centres each covered an area of more than 100 hectares – 3 times the size of Vatican City. The lidar images revealed walled compounds with broad terraces rising 6 metres above the ground. Conical pyramids made of earth towered above one end of the terraces (see 'The settlement beneath'). People probably lived in the areas around the terraces and travelled along the causeways that connected the sites to one another.

"We have this image of Amazonia as a green desert," Prümers says. But given that civilizations rose and thrived in other tropical areas,

he notes, "Why shouldn't something like that exist here?"

## Mysteries remain

Why these settlements were abandoned after 900 years is still a mystery. Radiocarbon dating has revealed that the Casarabe disappeared in around 1400.

Prümers points out that lidar images revealed reservoirs in the settlements, perhaps indicating that this part of the world wasn't always wet – an environmental shift that might have driven people away. However, consistent pollen records reveal<sup>4</sup> that maize (corn) was grown in the area continuously for thousands of years, indicating that sustainable agricultural practices were in use.

At the very least, the discovery of long-lost Amazonian societies "changes the general perspective people have of Amazonian archaeology", says Eduardo Neves, an archaeologist at the University of São Paulo in Brazil. Present-day logging and farming in the Amazon Basin are almost certainly destroying important archaeological sites that have yet to be discovered, he says, but a growing interest in Amazonian archaeology could lead to the protection of vulnerable places.

These discoveries also counter the narrative that Indigenous peoples were passive inhabitants of the Amazon Basin before the arrival of Europeans. "The people who lived there changed the landscape forever," Neves says.



**Researchers uncovered ancient urban centres on forested mounds in the Bolivian Amazon Basin.**

1. Prümers, H., Betancourt, C. J., Iriarte, J., Robinson, M. & Schaich, M. *Nature* <https://doi.org/10.1038/s41586-022-04780-4> (2022).
2. Neves, E. G. & Heckenberger, M. J. *Annu. Rev. Anthropol.* **48**, 371–388 (2019).
3. de Souza, J. G. et al. *Nature Commun.* **9**, 1125 (2018).
4. Carson, J. F. et al. *Holocene* **25**, 1285–1300 (2015).