

JAMES GRITZ/GETTY

AND THEN THERE WERE NONE

Seven centuries ago, tens of thousands of people mysteriously fled their homes in the American Southwest. Archaeologists are trying to work out why.

BY RICHARD MONASTERSKY

Vultures carve lazy circles in the sky as a stream of tourists marches down a walkway into Colorado's Spruce Canyon. Watching their steps, the visitors file along a series of switchbacks leading to one of the more improbable villages in North America — a warren of living quarters, storage rooms, defensive towers and ceremonial spaces all tucked into a large cleft in the face of a cliff.

When ancient farmers built these structures around the year 1200, they had nothing like the modern machinery that constructed the tourist walkway. Instead, the residents had to haul thousands of tonnes of sandstone blocks, cut timber and other materials down precarious paths to build the settlement, known as Spruce Tree House, in Mesa Verde National Park.

"Why would people live here? That's an

important question. It's not an easy place to reach," says Donna Glowacki, an archaeologist now at the University of Notre Dame in Indiana, as she walks among the ruins. Even more perplexing is what happened after they settled there. The villagers occupied their cliffside houses for just a short time before everyone suddenly picked up and left. So did all the other farmers living in the Four Corners region of the American Southwest, where the modern states of Colorado, New Mexico, Utah and Arizona meet (see 'Turbulent times').

All together, nearly 30,000 people disappeared from this area between the mid-1200s and 1285, making it one of the greatest vanishing acts documented in human history. What had been one of the most populous parts of North America became almost instantly a ghost land.

Archaeologists have long puzzled over what drove these farmers, the ancestors of the Pueblo people, from their homes and fields. "That is one of the iconic problems of southwestern — and world — prehistory," says archaeologist Mark Varien, who is executive vice-president of the Crow Canyon Research Institute in Cortez, Colorado. Early scholars blamed

Cliff Palace, a Pueblo dwelling in Mesa Verde National Park, was a thriving village in the 1200s.

nomads, the ancestors of the Apache and Navajo, for violently displacing the farmers. Over the past couple of decades, the main explanation has shifted to climate — a profound drought and cold snap that hit in the 1270s.

But a series of studies by Glowacki, Varian and other researchers reveals a much more complex answer. The scientists have used detailed archaeological analysis, fine-grained climatic reconstructions and computer models to simulate how ancestral Pueblo families would have responded to their environment. The interdisciplinary strategy has enabled the researchers to examine prehistoric societal changes at a level unattainable in most other regions. “We have enormous detail on this archaeologically. Unparalleled detail,” says Steve Lekson, an archaeologist at the University of Colorado Boulder.

The emerging picture is one of a society rocked by troubles until it eventually toppled. More than a century before the Mesa Verde villages emptied out, political disruptions and a monster drought destabilized the entire ancestral Pueblo world. Thousands of people moved into the Mesa Verde region from nearby areas, straining the agricultural capacity of the landscape and eroding established cultural traditions. This led to violent conflicts that further undermined the society, spurring some people to leave. When another drought hit in the late 1200s, the remaining population departed en masse.

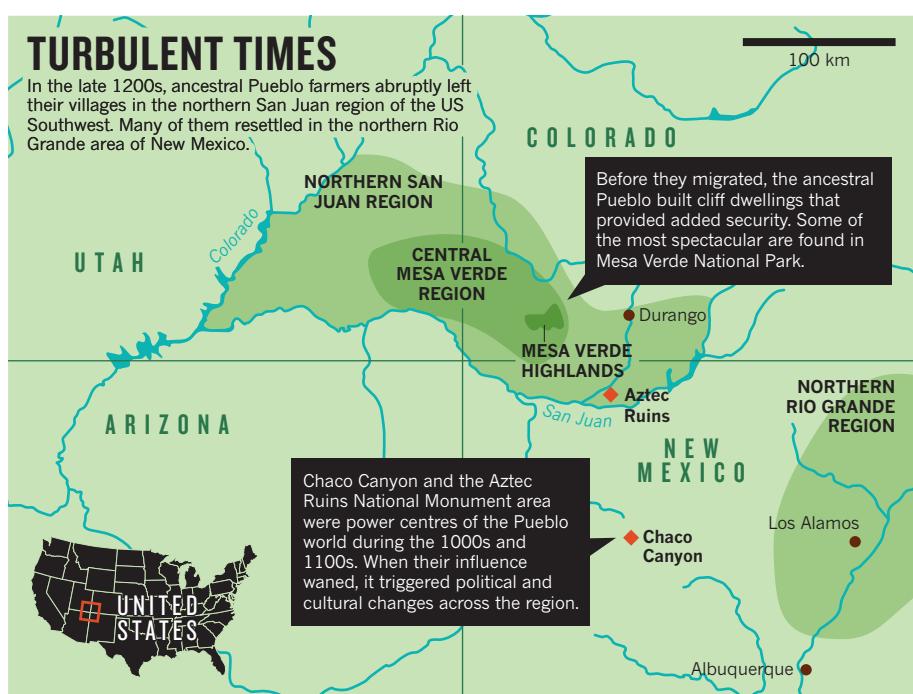
Political instability, cultural conflict, violence, overcrowding and drought. Many of the challenges encountered by the ancestral Pueblo seem all too familiar in 2015, as hundreds of thousands of migrants flee from the Middle East and Africa towards Europe. When Glowacki looks at the events of more than seven centuries ago at Spruce Tree House, she sees many similarities. “There was a splintering that went on and an implosion of this political system. It was a rejection, them saying, ‘We can’t live that way anymore. There has to be a better way.’”

STONE WORK

It was chance that first carried Glowacki into the world of the ancestral Pueblo. Before starting graduate school, she ended up in a summer job as a ranger at Mesa Verde National Park, where she fell for the landscape and its archaeology. She has spent the past 23 years, on and off, researching the region’s ancient populations.

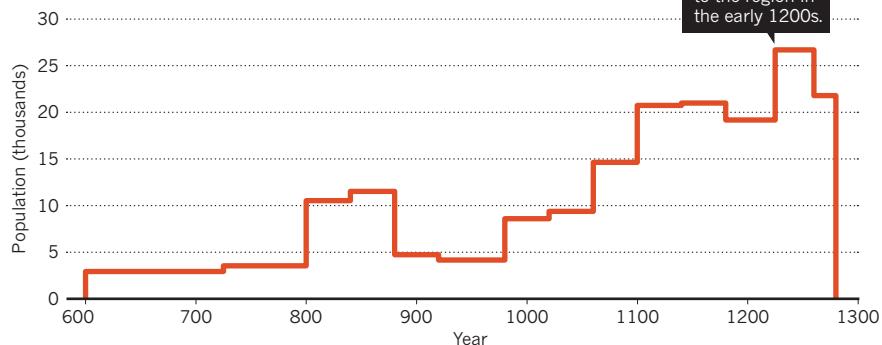
At Spruce Tree House, Glowacki pulls out a map showing the latest results of an architectural analysis that she is helping the park to carry out. The work is laborious — researchers sometimes sit in front of a wall of sandstone blocks for days, studying the mortar and rocks to work out how the structure was first built and then altered over time.

Gradually, a history of the village has taken shape, showing that people assembled the first set of rooms in the alcove around the year



ALL GONE

Population data for the central Mesa Verde region show massive migration away from the area in the late 1200s.



1200, and added more right up until the last residents abandoned the site around 85 years later. The researchers can narrow construction dates to within a year or two by analysing tree-ring patterns in the wooden support beams in the ceilings and then matching them to an established tree-ring chronology for the region.

Despite the tedious nature of the work, Glowacki says that it never loses its appeal. “There are rooms that are fully intact, and you can stand in them — and they were built in the 1240s. In this country, being able to stand in something that was built at that time is really pretty magical.”

The cliff dwellings were a last resort for the park’s prehistoric Pueblo residents. When farmers first arrived in the region around AD 600, they settled on the fertile highlands above the canyons, which gave them easier access to their fields. But by 1200, something began to force them over the edge into the giant alcoves that naturally form in the sandstone cliffs.

Insights into that shift are emerging thanks

to a major interdisciplinary effort called the Village Ecodynamics Project (VEP), which launched in 2002. Funded by the US National Science Foundation, the nearly US\$2.5-million initiative is assessing how social and environmental factors influenced the populations of prehistoric Pueblo farmers from about 600 to 1300, says Tim Kohler, the VEP’s principal investigator and an archaeologist at Washington State University in Pullman.

In one strand of research, the team drew on the rich history of archaeology in the region to compile a database of 18,000 prehistoric sites, which allowed them to measure the population and how it shifted over time¹. With such a massive database, the researchers could look at population changes in narrow time bands averaging about 40 years (see ‘All gone’).

“There are not many places in the world where archaeologists can look at changes in such discrete slices of time,” says Varien, who is a co-principal investigator of the VEP. The analysis¹ suggested that people started leaving the Mesa Verde region at least 15 years before

the drought hit. "It looks as though the final depopulation began with a trickle and ended with a flood," says Scott Ortman, an archaeologist at the University of Colorado Boulder who developed the model for the project's population analysis.

Another part of the VEP looked at how the farmers fed themselves. The researchers used temperature and precipitation estimates from tree-ring data to create a model of where the communities could have grown maize (corn) each year, which was their main source of food. The calculations of this 'maize niche' did a good job of explaining how many people settled in different regions, says Kohler.

The team's latest data show that when growing conditions improved, the population density spiked, more than doubling in some regions. But one place defied that pattern: Mesa Verde National Park. When farming became easier, people actually moved out of that area. And, paradoxically, when times grew tough, more people moved in.

Kohler and his colleagues suggest that these movement patterns have to do with topography. The park stands higher than the surrounding landscape, so it gets more precipitation. And because the highlands tilt to the south, cold air drains off, leaving Mesa Verde warmer than the surrounding lowlands. So when the region faced drought or a cold spell, farmers congregated in the more-reliable Mesa Verde area — something researchers had not appreciated before now, says Kohler. "People have been working in this area for 100 years, and I don't think they ever realized it," he says of such a climate pattern.

VIRTUAL REALITY

The VEP researchers have also conjured up a virtual version of the past. The team constructed a computer model of the landscape and then seeded it with households that could grow maize, hunt, collect water and wood and move to new sites if they failed to secure enough resources. By comparing the simulations to the archaeological record, the researchers can examine factors that might have driven ancient populations to migrate. "It's really a new way of doing archaeology," says Varien.

Kohler says that he sometimes switches on the graphics during a simulation to watch the behaviour of the dots that represent households. Scattered randomly at first, they scurry around until their inhabitants can harvest enough resources. Then, they form into settlements, which grow rapidly to a point when they can no longer sustain themselves — and so the households move again. But there is a limit to how much Kohler can watch. "Even on modern, fast processors, when the agents get into the thousands, it slows down and it's no longer fun," he says.

By comparing the simulations to the actual population data, the researchers discovered² some interesting discrepancies during the

1100s and 1200s. In the model, the farmers spread out farther across the landscape than they actually did in reality. So something seems to have caused the real ancestral Pueblo to huddle together more tightly than expected.

Kohler and his colleagues wondered whether fear might have been a factor. To find out, they surveyed the archaeological literature and tracked levels of violence in the area through time by tallying how many skeletons had broken arm bones, fractured skulls or other signs consistent with acts of aggression. Some had apparently died in massacres, and there was even evidence of cannibalism at certain sites.

Between 600 and 1000, the Mesa Verde region was relatively peaceful, but rates of violence rose in the mid-1000s and spiked again in the late 1200s, right before the ancient Pueblo left, the researchers reported last year³. "What we found was that people were more clumped up than the model predicted precisely in times when there was a lot of violence on the landscape," says Kohler.

There has been some scepticism among archaeologists about the use of agent-based modelling, but Kohler says that it has been useful in this case: the inconsistency between the simulations and the real data prompted the researchers to look at violence in a new way. "That disjunction identifies for us interesting questions," he says.

"IT GOT REALLY BAD AND REALLY NASTY, AND THEY WANTED TO GET AWAY FROM IT."

Most researchers think that the majority of violent acts occurred within ancestral Pueblo communities: one village attacking another over food resources or neighbours turning on each other. More than half the skeletons from some periods bore signs of trauma. "They are one of the most violent societies we've ever studied," says Kohler.

But not all of their troubles came from within. Some unusual-looking projectile points have turned up at massacre sites that date to just before the Pueblo people left the Mesa Verde region, so invading nomads might have had a role in forcing the farmers from their homes.

In the next stage of the VEP project, researchers plan to look at how food shortages might have contributed to violence. The new version of the agent-based model is more sophisticated than the last, allowing households to form social groups that compete with each other for access to agricultural lands. Leaders can emerge, fighting can erupt between groups and people can migrate away from Mesa Verde to an area farther south in New Mexico, where many ancestral Pueblo are thought to have resettled.

This all amounts to a huge step up in

processing, so the team will graduate to a supercomputer for future simulations, which are planned for later this year or early next year. Nothing of this scale has been done before in the field, says Kohler. "Archaeologists do not have the reputation of being users of high-performance computing environments," he says. "But I don't think we'll be the end of the road for this kind of work."

Among the ruins at Spruce Tree House, Glowacki takes a different approach. As a collaborator on the VEP project, she does not discount the importance of drought and short growing seasons. But she focuses on some of the other factors that also stressed the ancestral Pueblo society.

The signs are in the houses that fill the Spruce Canyon alcove. The architectural-documentation project has taught Glowacki that the residents there updated their homes just as much as people in New York or London today. "Even when they were living there, they were making changes and adding walls and doors and doing all of this remodelling."

CULTURE CLASH

Some of these alterations point to dramatic events. In the mid-1200s, structures associated with one of the founding families were burned: fire damage can be seen in one room and in a kiva, a circular depression that served as the family's ceremonial space. The fire does not

seem to be accidental, Glowacki says. Rather, it could have been part of a ritual changeover in ownership or it might reflect someone forcing out one of the original clans. "At the very least, that suggests there were some significant changes in the clans or families that were using the structures — or in part of the leadership there."

Other rooms in the alcove were also burned, including a tower that may have served as a defensive structure. Taken together, the architectural evidence provides a detailed view of friction in the village, she says. "There was some sort of conflict and people left, presumably, and new people came in and remade these spaces."

Around the Pueblo region, there are many signs of cultural change leading up to and during the 1200s. Glowacki, along with some other archaeologists, thinks that such adjustments had to do with shifting political allegiances in that part of the world.

During the mid-1000s and early 1100s, the centre of power among the Pueblo people was located about 150 kilometres south of the Mesa Verde area, in New Mexico's Chaco Canyon.



In Spruce Tree House, a ladder leads down into a sunken ceremonial space known as a kiva.

ROBERT JENSEN/MESA VERDE NAT'L PARK

In the 1100s, an extension of the Chaco political order rose up at a site now called Aztec Ruins National Monument, midway to Mesa Verde. The Chaco–Aztec culture was socially stratified, with massive residences in which the elites lived. Smaller versions of the elite ‘great houses’ have been found in villages to the north, which reveals the broad influence of the Chaco–Aztec political order.

Then, an awful drought between 1130 and 1150 apparently weakened that order, and new types of practice emerged. In the Mesa Verde region, some communities built more-inclusive spaces, such as open plazas, and they removed the roofs from some large kivas, allowing broader participation in rituals⁴.

The changes in public and ceremonial spaces demonstrate the waning influence of the Chaco–Aztec polity, which had previously unified the Pueblo world. “What is happening is you have this dissolution and splintering,” Glowacki says. That may have contributed to the increased violence and served to drive farmers from their highland villages towards the more-secure alcoves along the cliff faces.

These political upheavals may also partially explain why people started to abandon the Mesa Verde area decades before the drought of the mid-1270s hit. The combination of political instability, social upheaval and then a rotten climate was too much to take, she says. “It got really bad and really nasty, and they

wanted to get away from it.”

Kohler sees parallels with the collapse of the classic Mayan civilization in the ninth century, as well as with events in the Middle East today. In the case of the Mesa Verde exodus, researchers can look in detail not only at why and when people left, but also at what happened afterwards. “We need to understand migration streams better,” he says. “We have the advantage of the long view.”

FINDING PEACE

Whatever forced the Pueblo to uproot themselves, tens of thousands of people left the Four Corners region in search of something better. And many apparently found what they were looking for. When the exodus began, the ancestral Pueblo migrated in several different directions: some to the southwest into Arizona and some to southern New Mexico. Archaeologists have long suspected that many settled along the Rio Grande river in northern New Mexico, a couple of hundred kilometres southeast of the Mesa Verde region. That hypothesis is supported by population data, which show that the Rio Grande region became more crowded; VEP studies⁵ have indicated that between 1250 and 1300, the population in this area swelled from 8,000 to 18,000 people. By the early decades of the 1300s, it was close to 25,000, Ortman says.

When they settled in their new home,

the Mesa Verde people made a clear break from their former lives. Analysis by Kohler, Ortman and their colleagues³ shows that rates of violence were much lower than before. And the Pueblo made social changes as well. “The migrants do not appear to be trying to continue with the society and traditions of the Four Corners. They were trying to leave them behind,” says Ortman. The Pueblo villages that grew up after 1300 reflect a much more communal type of society, in which multiple families shared kivas and residents gathered in open ceremonial spaces.

There was also a political change, says Lekson, who has studied the elite residences at Chaco Canyon and Aztec Ruins. “They shucked off all the nobles and the kings, and they never had them again. They figured out how to run villages without that apparatus.”

Even today, southwestern Pueblo villages continue to embrace an egalitarian society. Ortman finds inspiration in the evolution of Pueblo culture after the collapse. “Pueblo people had to create those values and institutions that reflect them as a result of their past struggles,” he says.

And that system has been remarkably successful. Pueblo villages have retained their culture and languages to a much stronger degree than most other Native American communities, he says. “Some of the Pueblos that emerged after the Mesa Verde migration have been able to withstand 500 years of European colonization,” says Ortman. “One could say that those communities have weathered European colonization better than almost any other society in the world — certainly within the United States.”

At Spruce Tree House, Glowacki has seen how strong those traditions still are. Just a few weeks earlier, she took part in a workshop that included some teachers who are Pueblo and who demonstrated how they grind maize. Even that mundane chore took on spiritual dimensions as the teachers made offerings to their ancestors who once inhabited the cliff dwelling. To the modern Pueblo, the centuries-old structures are not abandoned ruins but still echo with the spirits of those who came before.

“It was a really beautiful moment,” says Glowacki. “What I think makes Pueblo culture really interesting and perhaps unique is the long arc of Pueblo history. There’s a lot we can learn about how a society faces really difficult times, adversities — and fundamentally reorganizes and transforms their culture.” ■

Richard Monastersky is a features editor for Nature.

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