



Racing Tren Maya

By Natalie van Hoose

Artist interpretation of Tren Maya traveling through the Yucatán Peninsula. Depicted in the background is the Temple of the Sun at Palenque Ruins in Chiapas, Mexico.

Archaeologists hasten to document discoveries during the construction of a 950-mile passenger rail line in the Yucatán Peninsula.



DOMINIQUE RISSOLO / UC SAN DIEGO

A team from UC San Diego and Mexico's National Institute of Anthropology and History (INAH) walk a stretch of cleared jungle in the Yucatán Peninsula. The path makes way for the passenger rail line Tren Maya.

Like many archaeologists who work in the Yucatán Peninsula, Dominique Rissolo has become accustomed to competing with the region's dizzying pace of development in his quest to document its remains.

People have lived in the peninsula, which encompasses three Mexican states and parts of Belize and Guatemala, for at least 13,000 years. It once formed the heart of the ancient Maya world. Peel back the forest with LiDAR technology, and virtually the entire territory lights up with evidence of human occupation—a treasure trove for archaeology. Over the past 30 years, however, the rapid expansion of tourism in the Yucatán Peninsula, particularly along the coast, has set archaeologists scrambling to conduct as much research as they can before the

rumble of bulldozers arrives. The entrance to one of Rissolo's cave study sites now lies in the middle of a Home Depot parking lot. "It becomes this kind of quixotic thing, where you're chasing around after caves and pyramids as they seemingly disappear from one day to the next, or are no longer accessible because of new housing developments, amusement parks, or golf courses," said Rissolo, a research scientist at the University of California San Diego.

Tren Maya, or the Maya Train, however, has triggered an archaeological race across the peninsula like no other. The train is a colossal infrastructure project, a nearly 950-mile rail loop snaking through the southeastern Mexican states of Chiapas, Tabasco, Campeche, Yucatán, and Quintana Roo. Designed to connect the region's major tourist stops, such as Chichén Itzá and

Tulum, Tren Maya is also bringing with it new train stations, hotels, museums, parks, and other attractions. It's one of the signature initiatives of President Andrés Manuel López Obrador, who is hastening to complete the project before his term ends in 2024. Sections of the railway will begin operation in December 2023. López Obrador's administration has billed the project as providing an infusion of jobs and economic growth to some of Mexico's most impoverished rural areas, many primarily occupied by people of Indigenous descent. The government also claims Tren Maya will help buttress protections for the peninsula's sensitive ecosystems and rich cultural heritage.

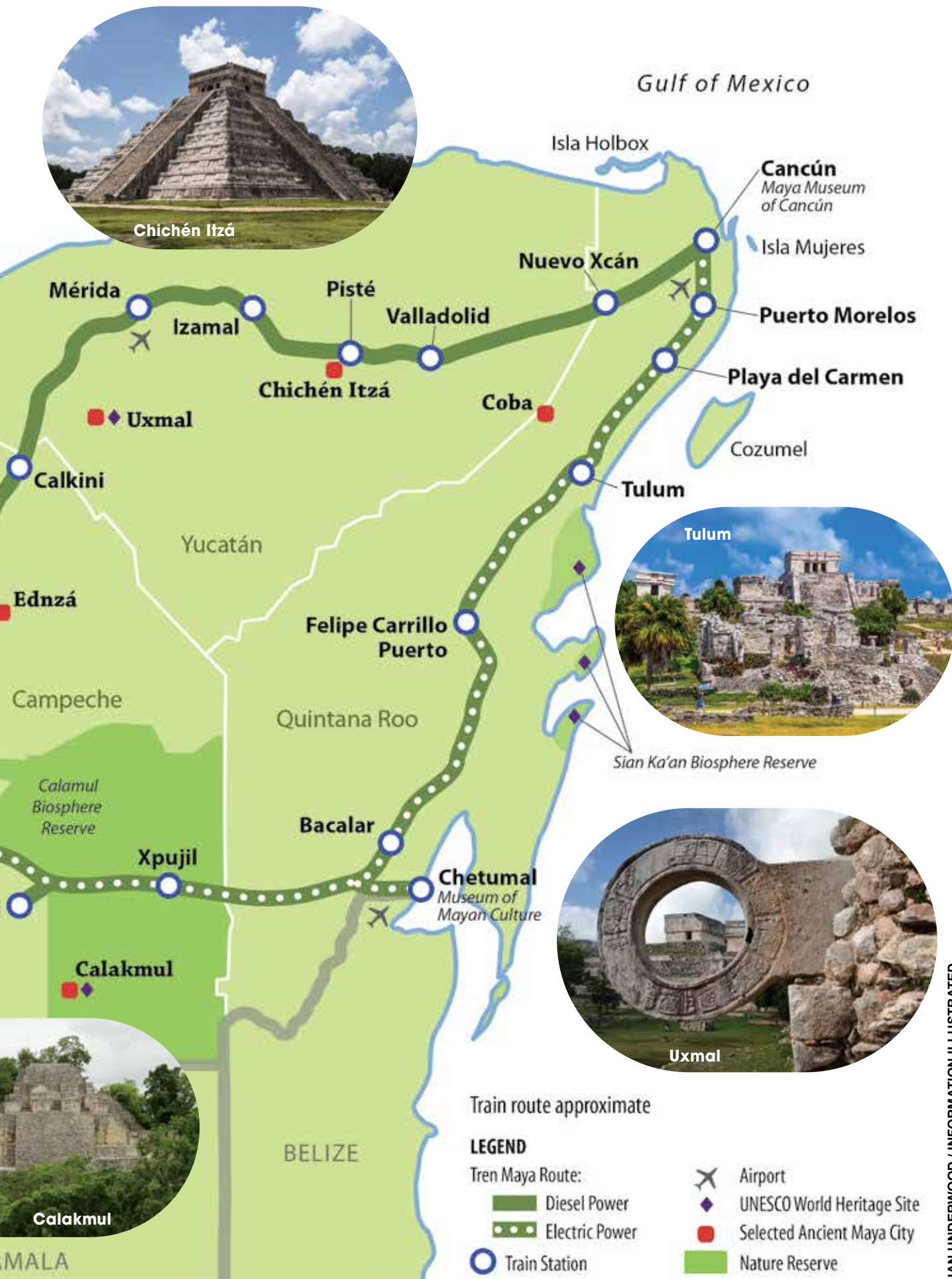
While some have welcomed the train, local activists say the government has neglected to meaningfully solicit the input and consent of Indigenous communities while hawking a folkloric version of Maya culture to tourists. They've fired back at the project's tagline of "Get on board!" with a slogan of their own: "*Este tren no es Maya*" or "This train isn't Maya." Meanwhile, scientists have joined Indigenous leaders in decrying the environmental destruction that has accompanied Tren Maya's construction. The rail line slices through the largest remaining tract of rainforest in the Americas and disrupts the region's fragile underground caves. Some, including the International Rights of Nature Tribunal, have accused the government of ecocide.

Tren Maya is also opening up parts of the peninsula's interior, which archaeologists thought would be less vulnerable to development, potentially putting valuable sites in the crosshairs. For those surveying and salvaging monuments and artifacts ahead of the train's construction, Tren Maya has proven to be the challenge of a lifetime.

The colossal task of assessing the archaeological remains that could be impacted by Tren Maya fell to the National Institute of Anthropology and History (INAH). These assessments are mandated by federal law, which regards all artifacts in Mexico, whether on public or private land, as national patrimony. INAH's archaeologists have well-established procedures for carrying out such analyses alongside infrastructure development, Rissolo said. But the scope and accelerated timeline of the Tren Maya project put it in a league of its own.

INAH has responded with an all-hands-on-deck approach led by Manuel Pérez Rivas, director of archaeological recovery. A flood of extra funding provided by Tren Maya enabled INAH to employ extra staff, and the institute also tapped international collaborators to work alongside it, Rissolo included. Decisions must be made quickly. In concert with ground-level surveys, INAH archaeologists and collaborators use aerial LiDAR, terrestrial laser scans, and photogrammetry to digitally document terrain in, alongside, and underneath the







INAH archaeologist Gabriel Quetz León studies ancient Maya handprints left behind in ochre inside a cave known as Las Manitas.

train's proposed path, reviewing the data with engineers who may choose to reroute the train around certain sites. INAH has protocols for monitoring the clearing of the train's right of way, which in some places cuts a 130-foot wide swath through dense jungle. The peninsula's topography can make for halting progress, said Scott McAvoy, a UC San Diego data scientist who captured LiDAR and photogrammetry data for INAH at the ancient Maya city of Chichén Itzá and in Quintana Roo. Below a thin layer of topsoil lies a porous karst landscape, sharp enough to shred McAvoy's boots. The limestone is often a brittle covering over the region's labyrinthine underground cave system and falls away into natural sinkholes, or cenotes. "Every few hundred yards, you hit a big hole in the ground," McAvoy said. "So constantly, they're having to make these decisions about how to proceed over this really difficult terrain."

The sheer amount of archaeological material, both above and below ground, presents another challenge. The Yucatán Peninsula has undergone pulses of urbanization and dispersal for

millennia. The landscape has witnessed the rise of Maya cities and superhighways; the migration of city-dwellers to the countryside; the bloody invasion of the Spanish; the lengthy 19th-century Caste War; and the displacement of small Indigenous homesteads by hacienda plantations. INAH scores its findings according to archaeological significance and makes choices about what must—and can—be preserved. By early September, archaeologists had documented and preserved more than 55,000 new monuments, nearly 1.25 million ceramic fragments, 1,925 artifacts, 1,339 pieces that are undergoing restoration, and 647 bones as a result of Tren Maya's construction. Their discoveries span palatial structures at the Maya city of Kabah to a circular stone "scorecard" depicting players competing in Chichén Itzá's ball games. But it's not possible to build on such a landscape without archaeological loss, said Traci Ardren, a professor of anthropology at the University of Miami, who has worked in the state of Yucatán since 1989. Such losses are not unique to Mexico: Ardren pointed to the Miami high-rises destined to cover

a 2,000-year-old settlement known as Tequesta, a site that has yielded more than one million artifacts in two years. “We have to understand that some sites will not be saved if development is supported,” Ardren said. “There’s really no difference in the way that Mexican archaeologists are handling that from the way it’s being handled here in Florida.”

The breakneck speed of Tren Maya’s construction, however, has some archaeologists, including Ardren, worried that corners are being cut to accommodate López Obrador’s deadline. Some sources said Tren’s Maya construction has been overseen in some areas by the Mexican military, which does not observe archaeological protocols.

Ardren has seen the construction firsthand. “I think the archaeologists that are working on the train project are doing an incredible job to save information ahead of the bulldozer,” she said. “But it is frantic. The pace...is too fast to be good archaeology and too fast to be safe.” While INAH holds regular press conferences to share its latest findings, “they are not saying how many things are destroyed,” said Héctor Hernández Álvarez, an archaeologist and professor of Mesoamerican studies at the Universidad Autónoma de Yucatán.

Hernández Álvarez is concerned that INAH is sacrificing best practices and, in some cases, ethics, due to the urgency of the project. Due to INAH’s hiring blitz, most of his former

students have worked on the Tren Maya project, with mixed results, he said. Some enthusiastically welcomed the opportunity to get fieldwork experience, while others resigned in frustration at what they observed. He fears Tren Maya may reshape INAH’s standards in the future, and he is concerned about labor conditions, lack of payment, and unethical practices. “Now I’m telling my new students that archaeology is going to change,” Hernández Álvarez said, adding that professors try to take a scientific, ethical approach. “And we try to teach them the best way we can, but in practice it’s another thing.” Digital tools are helping archaeologists swiftly capture and preserve archaeological information, but “there’s nothing that replaces careful excavation and having the time to do that,” Ardren said.

Rissolo said he sees INAH as responding to a rapidly developing situation in a measured, responsible way. “We just have to constantly come to terms with the fact that there’s never going to be a stasis,” he said. “There’s never going to be infinite time.”

The race to document the peninsula’s archaeological heritage has also led underground into its vast network of caves and cenotes, which have served as vital sources of water and shelter for people and animals since the Pleistocene. They were also sacred sites for the ancient Maya, who left behind shrines, altars, offerings, artwork, and stone-lined pathways. In these karstic environments, INAH archaeologists have found historical, archaeological, and paleontological evidence dating back at



Las Manitas cave houses ancient Maya handprints as well as an assemblage of other cave art.

least 40,000 years. Overseeing these recovery efforts with Pérez Rivas is Helena Barba-Meinecke, INAH's head of subaquatic archaeology. Before the Tren Maya project, Barba-Meinecke's team had identified about 25 archaeological sites and deposits in the Yucatán Peninsula over a period of 20 years. In the past two years, that number has tripled, thanks to funding from the train, she said. A particularly spectacular find was a submerged canoe hidden in a narrow, sealed cavity at the archaeological site of San Andrés. Dating to the eve of Spanish contact, the canoe was an offering: Archaeologists found it with a human foot bone and the remains of animals that play important roles in Mayan mythology, including armadillos. Barba-Meinecke's team will preserve the canoe in situ for now, but collected photogrammetry data to construct a digital replica. "Most likely, under the canoe, the offering will be larger and richer, so we need to do a surgeon's work, literally, to be able to dig underneath," she said. Archaeologists discovered other Maya offerings at San Andrés, in the tunnels of the walls within a karst hollow known locally as *rejoyada*. These included more than 40 ceramic vessels, a mural painting, and a stone stela.

To determine how close Tren Maya might run to archaeologically significant caves, Barba-Meinecke's team, with assistance from Rissolo and McAvoy, used a handheld spinning LiDAR puck known as Hovermap to capture intricate cave anatomy and relate it to the surface above. Hovermap enables the team to digitally map a cave while squeezing through crevices, climbing over boulders, or wading through pools. A cave that would take several weeks to survey with traditional methods can be scanned in a matter of hours, helping the team quickly relay information to construction crews. Still, Tren Maya's route passes uncomfortably

close to some of the region's most iconic caves, which researchers have yet to fully explore. Las Manitas, a cave north of Tulum in Quintana Roo, whose walls are stippled with ochre Maya handprints, lies about 20 feet below the railway, McAvoy said. Tren Maya will also run within about 165 feet of a renowned Post-Classic Maya shrine with an intact beam-and-mortar roof in the cave of Ocho Balas. It also veers close to Hoyo Negro, a gold mine of now-extinct animals such as gomphotheres and giant ground sloths and the former resting place of Naia, the most complete skeleton of the Americas' earliest humans. Archaeologists had hoped such caves would never be impacted by development, Rissolo said. "These are time capsules, and like any time capsule, you don't want to open it until you have the tools and the time to properly go through it," he said. "These sites are opening up and we have to quickly learn from them what we can."

To prevent the railway from resting directly atop particularly delicate or important caves, engineers have installed massive cement pilings to support elevated bridges. But some scientists say these pilings damage, rather than protect, the integrity of the caves. Fernanda Lases Hernández, a professor at the Universidad Nacional Autónoma de México who studies karst environments, was among a group of experts that objected to the government's plan to insert cement pilings in up to 40% of the region's caves. The government proceeded in spite of official requests to halt the pilings' installation, she said. Hundreds of pilings puncture caves in Tren Maya's Section 5 alone. "That is something I simply cannot believe," Lases Hernández said. She added that some cenotes, such as those at the cave of Dama Blanca, have been filled with rocks. The construction is not only



This submerged canoe was found hidden in a narrow, sealed cavity at the archaeological site of San Andrés. It dates to the eve of Spanish contact.



Archaeologists discover a notable representation of the god K'awiil in excavations of Section 7 of Tren Maya.

destroying the caves' paleontological, archaeological, and ecological value, but threatens one of the world's biggest freshwater aquifers, crucial to Mexico's water supply, she said.

The Yucatán Peninsula is also home to the largest remaining tropical forest in the Americas, which harbors a number of rare and endangered species, including jaguars, tapirs, scarlet macaws, and howler monkeys. Already shrinking due to the proliferation of ranches and industrial farms, the forest is further fragmented by the Tren Maya's path, which bisects Campeche's Calakmul Biosphere Reserve, one of the most extensive protected areas in Mexico.

Lases Hernández joined more than 300 Mexican researchers, lawyers, and activists in signing an open letter to President López Obrador in April 2022 opposing Tren Maya. The letter castigated the government for a lack of transparency, hurried planning, and proceeding without the consent of Indigenous communities. The train offered these communities precarious jobs while amplifying the region's social inequities, drug violence, pollution, and biodiversity loss, signees said. Fourteen INAH archaeologists also signed the letter. The concern of many scientists, Lases Hernández said, is that Tren Maya represents a reordering of the peninsula that will only bring more environmental degradation. "It's frustrating because it doesn't seem to be something that can be stopped," she said. "There is no political will to dialogue."

For some, Tren Maya represents the latest chapter in the exploitation of the peninsula's Indigenous inhabitants that began

500 years ago. Maya activists say the project will raise the local cost of living; further displace Indigenous people from their land; and commodify Maya culture. The heavy military presence that has accompanied the train's construction also stifles would-be protestors.

Jazmín Alhelí Chi Vázquez, who is from Mérida in Yucatán, identifies as a *tepche*, meaning "rebel" in Mayan. She said Indigenous communities function independently, and the decision of each to welcome or oppose the train is respected by the others. Communities that support the project tend to be those marginalized by colonialism in the past and are now dependent on the government for subsistence, she said. The much-promised jobs that Tren Maya offers Indigenous people are the lowest-paid and least-dignified positions, Alhelí Chi Vázquez said. "Historically, the Maya people have been used as cheap labor," she said.

At a September forum on the socio-environmental conflicts raised by Tren Maya, Wilma Esquivel Pat, a Maya activist from a community in Campeche, said that tourism has been touted as a solution to the Yucatán Peninsula's economic problems since the 1970s, but has only widened the gap between rich and poor. She pointed to the Riviera Maya, a stretch of all-inclusive luxury resorts on the coast of Quintana Roo, as an example. "In reality, they are still the masters, and we are the servants," Esquivel Pat said. "That's what they don't say: 'Yes, well, after I tried to take away your cornfield, to erase your memory, to make you a slave, now I am going to tell you that I will bring you a job.'" Alhelí Chi Vázquez said the region's enduring legacy of racism

and environmental destruction are more painful to her than the loss of Maya archaeological remains due to Tren Maya. She feels that outsiders view Maya culture as something from the distant past, rather than a living, evolving phenomenon. “It is true that these artifacts have value in how they tell the story of how we arrived here,” she said. “But at this point in the story, I do not want to be seen as something in a museum.”

For archaeologist Hernández Álvarez, Tren Maya raises the specter of Yucatán’s earliest rail system and the role it played in transforming the peninsula, concentrating wealth in the hands of a few and dismantling Indigenous ways of life. Hernández Álvarez studies the state of Yucatán’s “Gilded Age,” a period that lasted from 1873 to 1925. Spurred by innovations in agricultural machinery and hundreds of miles of new train tracks, this era saw the once-isolated Yucatán become the center of the global market for *henequén*, a fiber made into rope and twine to moor ships and bind crops. The region’s first train line was constructed in 1881 to transport henequén between Mérida, Yucatán’s capital, and the coastal port of Puerto Progreso for overseas export. The enormous profits of the Gilded Age led to the rise of an oligarchy of elite industrialists and landholders, some 40 families known as the “Divine Caste.” Meanwhile, Indigenous people were stripped of their homesteads and forced into hard labor on haciendas, which trapped workers in a form of indentured servitude, Hernández Álvarez said. The henequén industry abruptly collapsed after World War II with the introduction of synthetic fibers.

Today, Indigenous people are laying train tracks in the peninsula just as they did more than 100 years ago. After construction is complete, they will work menial jobs in the stations, hotels, and small businesses at touristic sites, Hernández Álvarez said. As in the Gilded Age, they will not be the principal beneficiaries of the train and the industry it supports. “They are not going to have any profit directly from the train, just the promise of development,” he said. “That’s one of the lessons from the past.”

Hernández Álvarez is salvaging what he can of the region’s first railway, traces of which are being erased by Tren Maya’s construction. The main Mérida station, where all lines once converged, has been torn down to make way for a new ecological park. On a recent walk along the old rail route, Hernández Álvarez saw the remnants of sleeper cars piled in a heap by the road, vestiges of Yucatán’s Gilded Age. “The other trains ended with nothing, just remains. Right now, they are the subject of archaeology.”

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The train's right of way in Section 5 cuts through the subtropical forest of the Yucatán Peninsula—a move opposed by some due to the area's biological sensitivity.

MIGUEL ANGEL GUILLERMO / SOSCENOTES