

► Arnulfo Blanco García, a restoration ecologist at the Michoacan University of San Nicolás de Hidalgo in Morelia. “I’ve seen it impact my youth, the economy, people’s quality of life,” he says. “This is never going to end.”

The black market for petrol is driving violence near the Large Millimeter Telescope (LMT), says David Hughes, an astronomer at the National Institute of Astrophysics, Optics and Electronics (INAOE) and director of the telescope. Fuel pipelines pass very close to Sierra Negra, and the area has become more dangerous as Mexico’s drug cartels have moved in to tap the pipelines and sell the stolen petrol.

But the damage caused by drug-related violence cuts across scientific fields. On 28 January, Blanco García got a phone call from one of his collaborators in Tierra Caliente, an area disputed by feuding drug cartels. Community members who worked with Blanco García had received death threats from local gangs who wanted them to stop monitoring populations of military macaws (*Ara militaris*), a vulnerable species of parrot. The cartels felt the research had focused too many curious eyes on the area.

“I cried out of frustration,” Blanco García says. He was supposed to visit his colleagues in late January, but now he’s not sure when he’ll return.

International collaborations have also suffered. Three years ago, Bryan Fry, a venom researcher at the University of Queensland in St Lucia, Australia, and his Mexican colleagues had to stop visiting a cave at their field site near Cuernavaca, where they were studying vampire bats (*Desmodus rotundus*). A drug-trafficking route runs through the area, and fighting

between cartels and the military made fieldwork extremely dangerous, especially at night.

The team was studying a peptide in the bats’ venom that could have medical applications, such as helping to heal reattached body parts or transplanted tissue. The researchers wanted to search for variations of the peptide that could act more quickly and last longer, but that meant they needed to study more bats.

Fry and his colleagues can’t return to the cave near Cuernavaca, so he is considering shifting his fieldwork to Costa Rica. But getting the permits to start searching for the right cave can take up to two years. “It’s an inconvenience for me,” Fry says. “But for Mexican researchers it’s absolutely heartbreaking; their country is being denied to them.”

Mariela Fuentes Ponce, an agronomist at the Metropolitan Autonomous University in Mexico City, had spent four years helping Indigenous communities in the southwestern state of Guerrero to improve their farming practices. But after soldiers detained one of her colleagues and falsely accused him of being involved with drug traffickers, or narcos, in 2016, Fuentes Ponce abandoned the project out of safety concerns. She lost all of her data and never saw the results of her work.

HOPING FOR CHANGE

Still, some scientists have tried to work around the violence. Many do what Luis David Alcaraz, a microbial-genomics researcher at the National Autonomous University of Mexico in Mexico City calls “road biology”, in which researchers take samples along the main highways to avoid risky encounters in

more isolated areas. “The narcos stripped us of our exploratory vein,” Alcaraz says.

Landscape ecologist Camilo Alcántara, of the University of Guanajuato, says his team is relying less on field measurements and more on satellite images to study land-use changes. But remote measurements can take them only so far. At some point, Alcántara says, “your models end up being pure speculation”.

Mexico’s government is also trying different strategies to address the drug-related violence. President Andrés Manuel López Obrador announced on 30 January that Mexico’s war on drugs had ended and that, in a bid for peace, his administration would no longer prioritize capturing cartel leaders. But researchers are sceptical that this will work.

“We’re waiting for the authorities to help us do our jobs,” says Alberto Carramiñana, an INAOE astrophysicist who works at the High-Altitude Water Cherenkov Observatory (HAWC), which detects high-energy cosmic and γ -rays in a search for supernovae and neutron-star collisions. The observatory and the LMT are neighbours, and HAWC researchers were barred from visiting the telescope on 9 January over safety concerns.

On 7 February, government officials said they expected that the LMT and HAWC would return to normal operations in a couple of weeks with help from state authorities. But for security reasons, they declined to give details during a press conference on how this would be accomplished.

“Ultimately, what we want to do is go back and better understand the Universe,” says Carramiñana. ■

OCEANOGRAPHY

Antarctic voyage to explore ocean long hidden by ice

German research team hopes to observe underwater ecosystem changing in real time.

BY QUIRIN SCHIERMEIER

Scientists are setting out to explore a marine realm that was hidden from the Sun for more than 100,000 years.

In July 2017, a giant iceberg broke off from the Larsen C ice shelf east of the Antarctic Peninsula, revealing a large swathe of ocean that had lain in darkness beneath the ice.

The newly exposed sea bed might hold clues to the evolution and mobility of marine life and its response to climate change.

A team led by Boris Dorschel, chief scientist of a 45-strong international team on board the

German research icebreaker *Polarstern*, set off from Chile this week to explore for the first time the sea that the ice had concealed. The ship left port on Monday from Puntas Arenas, where it had been loaded for the nine-week expedition.

But the remote area is hard to reach, and severe weather could make it challenging to conduct research there.

“It’s thrilling to explore one of the last white spots on Earth,” says Dorschel, who is based at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, Germany. “But it’s a nerve-racking affair, too. Local

weather and ice conditions might interfere any time.”

The 5,800-square-kilometre chunk of ice that calved from Larsen C in 2017 has since drifted some 200 kilometres northwards.

WHAT LIES BENEATH

Scientists are keen to explore what species might have thrived under the ice, and how the ecosystem has coped with the sudden change. The first attempt to do so failed last year, when sea ice up to 5 metres thick forced the *James Clark Ross* vessel, operated by the British Antarctic Survey (BAS), to turn back

GRAVITATIONAL WAVES

LIGO set for major upgrade

Plan could double its detecting power.

BY DAVIDE CASTELVECCHI

Spotting gravitational waves is due to become an almost hourly event in the next decade. Starting around 2023, the Laser Interferometer Gravitational-Wave Observatory (LIGO) will undergo its most significant upgrade since 2015, UK and US funding agencies said on 14 February.

The US National Science Foundation is contributing US\$20.4 million to the Advanced LIGO Plus (or ALIGO+) project, and UK Research and Innovation is providing another £10.7 million (US\$13.7 million), with a small contribution from Australia. The upgrades at LIGO's sites in Hanford, Washington, and Livingston, Louisiana, will include the addition of a 300-metre-long, high-vacuum optical cavity. That will help scientists to manipulate the quantum properties of the lasers at the heart of LIGO's detection system, and cut down noise.

LIGO first operated from 2002 to 2010, and restarted in 2015 after extensive upgrades. Its first detection — of gravitational waves from the merger of two black holes — came later that year. It has now bagged ten black-hole mergers, plus one merger of two neutron stars.

The observatory has undergone periodic improvements, and is about to reopen after an upgrade designed to increase its sensitivity by 50%. But the ALIGO+ upgrades will be more drastic, allowing LIGO to detect neutron-star mergers that occur within 325 megaparsecs (around 1 billion light years) of Earth, says Ken Strain, a physicist at the University of Glasgow, UK. That would nearly double the design sensitivity of 173 megaparsecs that LIGO expects to reach before the ALIGO+ upgrade. LIGO can already spot black holes billions of parsecs away; by 2022, it should detect about one merger per day. The ALIGO+ upgrade should push that to one every few hours.

The changes will enhance the quality of detections, not just their frequency, said former LIGO director Barry Barish at a press conference in Washington DC. Reducing noise will enable researchers to tell how black holes spun before they merged, which can provide clues to their history. "It gives you the ability to measure things you can't do now," said Barish, a physicist at the California Institute of Technology in Pasadena who shared the 2017 Nobel Prize in Physics. ■



The icebreaker and research ship *Polarstern* set sail for Antarctica from Chile on Monday.

in February 2018. "We were close," says Katrin Linse, a BAS marine biologist in Cambridge, who led the foiled expedition. "And it was a devastating day when the captain decided to turn round."

Linse is unable to take part in this year's cruise, but members of her team are on board. In her Cambridge office — 13,000 kilometres from Puntas Arena — she nervously studies maps of sea ice every day, hoping that the route will be clear.

Conditions look favourable: the ice that stopped the BAS expedition is now drifting out of the Weddell Sea, a Southern Ocean region between the Antarctic Peninsula and mainland Antarctica to the east.

In January, a team on board the South African research vessel *Agulhas II* anchored at a site 200 kilometres north of where the iceberg broke off. It took ocean and sea-floor samples there, but sea-ice conditions and other research priorities meant it didn't go further south. The *Polarstern* will now attempt to advance farther south, to the site where the iceberg calved.

The *Polarstern*, operated by the Alfred Wegener Institute, is Germany's flagship polar-explorer vessel and one of the best-equipped research icebreakers in the world. Satellite imagery and renaissance flights by its two helicopters will guide the ship through the pack ice — ice floating in the sea, formed by smaller pieces freezing together — which can be abundant even in southern summer months, when the extent of sea ice is close to its annual minimum.

UNDER A SOUTHERN SUN

If ice and weather conditions allow, the team could reach the site from Chile in just a few days. The scientists would then have several weeks of southern summer to extensively sample ocean fauna and chemistry, and to

map the uncharted sea bed. "We'll work around the clock to collect as much data as possible," says Dorschel. "We've tools on board which should provide a perfect view of the ocean and the sea floor."

As well as standard water-sampling tools, the scientists will use a small, remotely operated vehicle for underwater exploration, and a towed ocean-floor observation system for optical and acoustic surveys of deep-sea topography and habitats. The team suspects that a deep-sea ecosystem such as that observed in the Weddell Sea evolved in the darkness beneath the ice.

That ecosystem could change significantly within a few years if new species colonize the area. Isotopic analysis of tissue from species such as gastropods and bivalves could reveal whether the food web has already changed since the iceberg broke off, because chemical signatures in animals' tissues hold clue to their diets.

UNTOUCHED BY HUMAN HANDS

Samples collected in the pristine area, completely unaffected by commercial fishing or other human activities, would be an invaluable resource for biodiversity researchers. The data could help scientists to address questions relating to how marine communities develop, and how quickly new species colonize previously ice-covered areas, says Linse.

Rapidly rising temperatures in the air and ocean around the Antarctic Peninsula, a hot-spot of global climate change, add urgency to such research: any changes in species composition and food-web structure following the disappearance of ice might shed light on the fate of polar ecosystems in a warming world.

"Here's a unique opportunity to find out how vulnerable or resilient marine life is to rapid environmental change," Linse says. "This is exciting science for us all — I hope very much that it can be done." ■