

# Antarctica during the Pandemic

AMY MAYER

## Scaled-back field season prioritizes infrastructure, precious climate data

**O**scar Schofield, a Rutgers University professor who is also a coprincipal investigator (PI) for the Palmer Antarctica Long-Term Ecological Research (LTER) site, was on a research cruise off the West Antarctic peninsula in February 2020 when he first saw news of the increasingly rapid spread of the novel coronavirus.

“We didn’t appreciate how big of an issue it was going to be at the time,” he remembered months later. But the end of the 2019–2020 austral (Southern Hemisphere) summer season was just a harbinger of the challenges to come. “It was a very difficult scenario getting the people out from Palmer station,” Schofield said. “At the end of the season, shutdowns had started happening, especially in a bunch of states, and so we felt very lucky to get everyone out.” Researchers at the site, on Anvers Island midway down the Antarctic Peninsula, study the polar marine biome.

Field research in Antarctica always requires months of planning. Everyone has to go through a rigorous medical evaluation and researchers have to package up their equipment and ship it to designated ports for transport arranged by the National Science Foundation (NSF). The logistics are so complicated that Schofield says he is typically home from the field no more than 3 weeks before it is time to start planning the next season. But in March 2020, with the virus raging,



*Polar regions are experiencing the effects of climate change more than other areas of the globe. Antarctic researchers have been hampered in their fieldwork by COVID-19 restrictions. Shown here is a giant iceberg near Charcot, part of the Palmer Antarctica Long-term Ecological Research site. Photograph: Beth Simmons (<https://creativecommons.org/licenses/by-sa/2.0/>).*

Antarctic researchers knew they were in for more uncertainty and surprises than usual.

“The clue for us was that our support information packages are usually due [to the NSF] early to mid-April,” said Michael Gooseff, lead PI of the McMurdo Dry Valleys LTER and a professor at the University of Colorado, “and without asking for it, we got an extension granted through May 1. And we thought, ‘Well, that’s not like them.’” Researchers at McMurdo focus

on aquatic and terrestrial ecosystems on Antarctica.

Program officers at the NSF, which funds most US Antarctic research, were working with international partners to assess fieldwork prospects on the continent during the pandemic. Eventually, they created a three-tiered system, says Karla Heidelberg, program director for the NSF’s Antarctic Organisms and Ecosystems Program in the Office of Polar Programs. While recognizing

that sending no one would jeopardize the infrastructure at the various stations, she says that the NSF determined early on that the 2020–2021 summer season would be greatly scaled back.

The LTER sites and other American research projects in Antarctica look at everything from penguins and seals to phytoplankton and nematodes to atmospheric conditions and glaciers. Polar regions are responding faster than other latitudes to global warming, so they are a focus of climate change research across many disciplines.

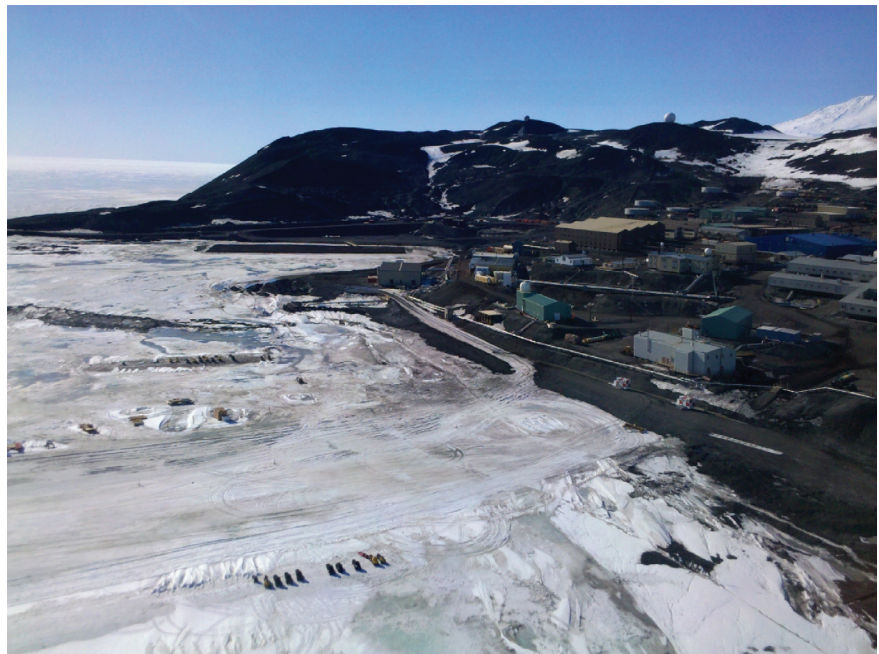
“We have 20 and 30 and 40 years of data that shows that climate change—or maybe a better word would be environmental change—is happening due to changing temperatures and ecosystems,” Heidelberg said. “So it’s a really important region of the globe to be studying these types of things.”

She says certain annual tasks, such as refueling the South Pole station, could not be skipped so they knew some people would have to be allowed onto the continent for the 2020–2021 season. The NSF determined tier one would be health and safety while maintaining infrastructure, Heidelberg says. Tier two included science work that would be accessible with a limited amount of support staff (think fewer helicopter pilots) and would potentially be most harmed by a missing year. After that, for tier three, the skeleton crew in the field did what it could to support other research.

“One team that did deploy studied seal births, and every year for 20 years they’ve been tagging baby seals,” Heidelberg said. “One year of missed data is a big deal because it creates more than a 1-year gap; you create an entire generational gap.”

Instead of close to 10 researchers, this year, just three students tagged seals and collected biometric data that will be used to estimate breeding and survival rates. The McMurdo LTER project did not get to send a single researcher.

“We have actually gotten some support to send a couple of technicians



*The US McMurdo Station in Antarctica as seen from a helicopter over the sea ice. Photograph: Rutgers University Center for Ocean Observation Leadership.*



*A pair of Adélie penguins performing an ecstatic display indicative of pair bonding between mates. Photograph: Geoff Gilbert.*

out to the field to do some work for us,” Gooseff said, as part of tier three. He chose a set of stream gauges on the Onyx River that the New Zealand Antarctic program set up in the 1960s

as a top-priority data set to maintain. “Of our 17 stream gauges, we said, ‘Could you just get these two going?’”

The researchers calculate discharge from the water height data





*Looking at the Mount Erebus summit from Fang Glacier. New Zealand researcher Charles Lee and his team hope to grow bacteria in situ on the volcano in a future field season. Pictured on the edge of this panorama are Matt Stott, Jon Tyler, and Ian McDonald. Photograph: Charles Lee.*

captured by the gauges, which rely on a tank of nitrogen gas. “We have to have that swapped out at a minimum,” he said, to keep capturing the data.

The streamflow data help scientists see how much freshwater enters certain lakes and what that means for aquatic life. “The differences in stream discharge year to year are a consequence of the weather for a given austral summer,” he said, and at the decadal scale, they are a function of climate.

### Antarctic access

New Zealand is the gateway country for researchers headed to McMurdo, while Chile is the departure point for Palmer. By October, New Zealand had practically eliminated community transmission of COVID-19, and Chile had become a global hotspot.

Deborah Steinberg, another co-PI for the Palmer LTER and a professor at the Virginia Institute of Marine Science, says that, for several months, it looked like the annual research cruise would happen, with quarantines ahead of departure, at gateway cities, and onboard the ship before setting sail. The crew would be smaller to allow for social distancing and single rooms. But the virus scuttled those plans.

“What killed... our cruise, is that the cases in Chile in early fall just started to skyrocket,” Steinberg said. Punta Arenas, the Chilean port city from which researchers depart, had



*Italian researcher Nicoletta Cannone, of the University of Insubria, has been doing research in Antarctica for two decades. Photograph: Courtesy of Nicoletta Cannone.*

little or no hospital capacity, she says, “and so [the NSF’s] concern was that, okay, ‘What if... somebody does get [COVID] on their way down and needs to be hospitalized?’ They can’t guarantee that there would be somewhere to put that person.”

“I have to admit, when I hung up the phone, I kind of teared up and got angry and all that stuff,” Schofield said. “But I do want to say that the agencies and the contractors really tried hard, and it was a difficult decision for everybody.”

A small land-based team did get to Palmer, allowing data collection for a

penguin study that has data back to the 1970s. The project has identified links between changing climate conditions and a decline in the Adélie penguin population. “We definitely prioritize the penguin sampling,” Steinberg said, “because that’s a really long time series.”

Italian researcher Nicoletta Cannone, of the University of Insubria, studies mosses, lichens, and vascular plants in the Arctic, the Alps, and Antarctica. She is especially concerned about the arrival of nonnative species that could threaten the fragile native vegetation of Antarctica.

Very close to the departure date for Italian scientists, her group expected to get some boots on the ground. Seven researchers were selected to go to Italy's Mario Zucchelli Station, including one from her group.

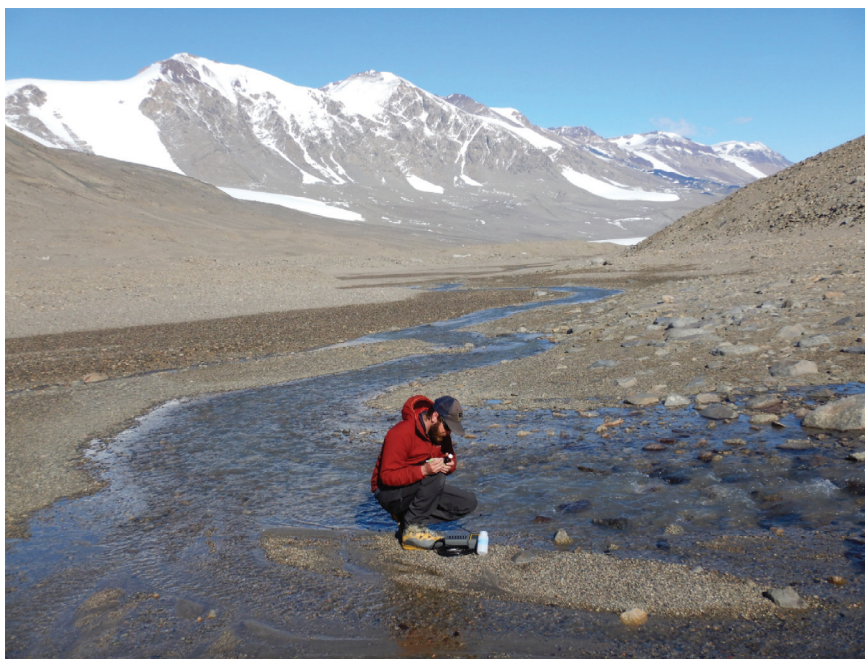
"The COVID impacted us in a very heavy way, because they made the medical examination, the test before departure, and unfortunately, our collaborator and another of the seven researchers were positive," she said. "So they couldn't depart, and we lost the Antarctic season."

She says three of the remaining travelers did some work for her group and sent back intriguing data from manipulation experiments she has had in place since 2014. The experiments involve placing temporary chambers on a plot to deliberately change the environmental effects. "When I saw the latest data, I realized that they are really working because we had an increase in soil temperature that is striking."

Cannone hoped the scientists would be able to get back out to take photos later in the season, but the tiny group was running itself ragged. "I don't know how many hours they slept during this period," she said.

### Built-in resiliency

Despite their disappointment about the much-reduced field season, many Antarctic researchers say they plan for delays and disruptions because they are common when working so remotely. "I would never design a project that if you missed one season's data then 10 years of data would be pointless," said Ian Hawes, a University of Waikato professor and leader of the New Zealand Antarctic Science Platform, who has been going to Antarctica for more than 40 years. "It's always a shame when you don't have those 10 years of data when you're looking for long-term trends, but you're looking for the mechanisms that underlie those trends, very often. And so if you miss one year's data then it shouldn't really be the end of the world. It's just frustrating."



*University of Colorado Boulder graduate student Joel Singley takes a water sample from Prisco Stream in the Dry Valleys.  
Photograph: Michael Gooseff.*

Hawes is both a terrestrial and marine researcher and contributes to big-picture questions about the impacts of climate change on the Ross Sea ecosystem. In recent years, for example, his interest in the dynamics of vertebrate populations led to experiments measuring the physical environment. He relies on data loggers.

Had they been able to deploy in late 2020, his team "would have been doing another run on revisiting those locations, recovering data loggers, getting the data out of them," he said. Hawes says New Zealand's approach to this COVID season was similar to that of the United States. "New Zealand did deploy a few people. It deployed everyone that was needed to maintain the station and it also deployed a number of technicians to manage ongoing instrument observations," he said.

New Zealand already had planned for significant construction at its Scott Base station this year, which Charles Lee, also of the University of Waikato, says helped minimize the impact of

COVID on his work. In the 2019–2020 season, he and his colleagues began a new project on Mount Erebus, funded through the Marsden Fund of the Royal Society of New Zealand with logistical support from Antarctica New Zealand.

"We basically think that there's some very strange microbial metabolism and energy acquisition methods associated with Mount Erebus, which is a very, very unusual volcanic habitat," he said. To learn more, Lee wants to grow microbes *in situ*. He and a small team trekked to Mount Erebus and determined the best way to drill a hole in a volcano. They would have gone back to drill more holes and get the experiment set up if they had gone in the 2020–2021 season. "Essentially not much has happened this year because of the canceled field season," Lee said. "Fortunately, we were able to identify the field season was going to be challenging very early on."

Lee says he did not bring in new graduate students or postdocs, and



with the Scott Base construction, his plans were already more modest than in previous years. He has two automatic weather stations at Cape Adare, another remote site, that he originally planned to visit this year. One of them is limping along, but the other one, which he has not seen for 4 years, continues to beam back basic climate data. Lee says he deliberately used equipment designed to last.

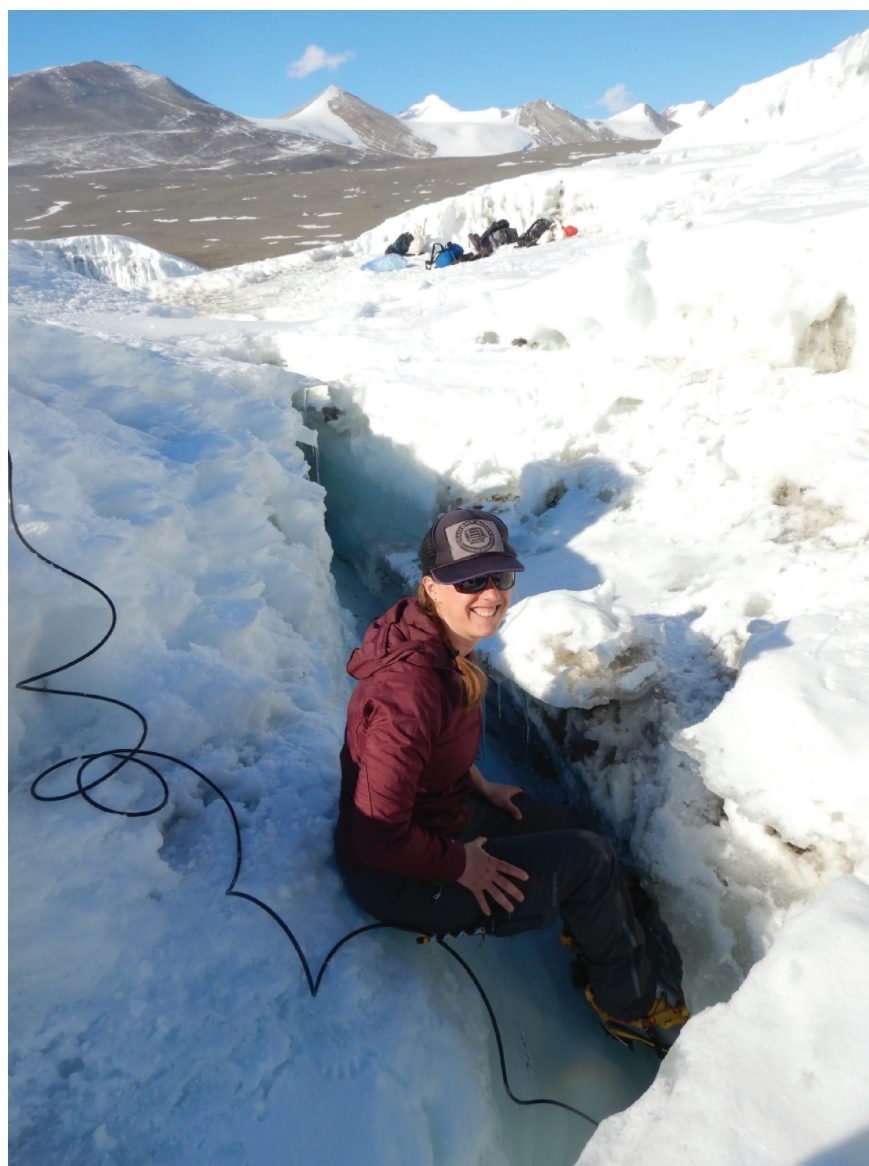
“Of course, that requires more investment and more planning up front,” he said, “but I think that has paid off.” Cannone says the Italian funding structure only allows for 2-year projects, which means she is always building in collaborations and overlapping projects so that disruptions, such as this lost season, are not devastating.

“It is not totally lost,” said Cannone, who has been working in Antarctica for two decades. “This is a survival strategy that we adopted since the beginning. Like a predator, if you have only one prey, you can die if the prey disappears. But if you have more, you can survive.”

### Students and funding

Survival as a professor can look a bit more comfortable, though, than surviving as a graduate student or postdoc. Brigham Young University professor Byron Adams is another PI for the McMurdo LTER, who studies soil biota in the Dry Valleys. (He recovered from a 3-week bout with COVID-19.) Although everyone on his team was disappointed that the pandemic mostly canceled their fieldwork, he says ancillary impacts disproportionately affect the students and postdocs.

Professors have steady incomes, whereas graduate students are often tied to a specific grant with an end date, and Adams recognizes that such precariousness left the students much more vulnerable. “You can’t just drop a grad student; that’s totally bogus,” Adams said. If a grant can be rejiggered to fund a student for an additional year, that may be a



**Graduate student Anna Bergstrom, then with the University of Colorado Boulder, works in a supraglacial stream, which is a small stream on top of a glacier. Some of the stream data sets the McMurdo Long-Term Ecological Research (LTER) project monitors go back to the 1960s.**  
**Photograph: Michael Gooseff.**

solution. But it likely means that, over the course of the grant, there will be one student position lost. Some departments may find funding for the student to teach or take on some other responsibilities to retain income during an unanticipated extra year. The students also have to modify their research to account for not doing fieldwork this year. “My

PhD student is shifting some of the objectives of his dissertation work,” Adams said.

New Zealand’s border closures kept the virus at bay but also locked out many graduate students and postdocs who would have joined Antarctic projects. Their absence hit the country’s research program budgets. “More than half of the grad students that we had

set up for projects this year were from overseas,” Hawes said. “Because the borders are closed, none of them were able to get in.”

Without international graduate students and postdocs, the researchers had to hire and deploy local technicians. “And a technician costs a lot more than a postgrad,” Hawes said, “and in some ways delivers much less because they’re involved only in the collection of the material and not the analysis.”

Meanwhile, Hawes says his funding agencies have allowed for time extensions on project deliverables but have not extended additional funds. “That’s still a pretty good deal,” he said. “We’re allowed to deliver our outputs late, but there’s no way of giving any more support to extend an extra year getting the data.”

Hawes says universities in New Zealand may be offering students a few extra months but not a full year to complete degrees. “They’ll have to spend a year doing either a little bit more literature research or more analysis of existing data, rather than having the full data that they were planning their thesis around,” he said.

Heidelberg says the NSF has tried to work with PIs to ensure grad students are taken care of. Although anyone could get a no-cost extension on a grant, she says additional funding requests needed to be well justified. “We were trying to reprioritize money to make sure they didn’t have to lay off a student or they didn’t have to lay off a postdoc,” she said. After all of the complications and challenges, Heidelberg’s biggest sense of loss is for the students. “We’ve delayed graduate students,” she said. “We’ve added stress to an already stressful situation.”

### Freezer dives

Still, time not spent in the field can further Antarctic climate change research in other ways.

“I kind of think of this past year as a reset, as a great opportunity to think



*The margin of the Canada Glacier where it meets Lake Fryxell, on the northern side of the Taylor Valley in Antarctica. Photograph: Michael Gooseff.*

outside the box for new technologies,” Heidelberg said. Some researchers are finding Antarctic projects they can do without a field season.

“That’s actually causing researchers to go back and do freezer dives for old samples,” she said, “and every once in a while you need to do that because it’s cost effective. It’s also good for science, so we’re not repeating similar science over and over again.”

Hawes is watching colleagues develop new innovations. He points to a group of New Zealand researchers who use boundary layer heat flux calculations, which they derive from airborne sensors, to understand how weather and climate affect surface melting of ice. Drones have typically been used to send out the sensors.

“They’re developing a pod, which goes on a helicopter, into which those sensors can be put,” Hawes said. If the new system works, the helicopters would be able to cover more area in less time. “The goal, then, is to do two or three seasons worth of

work in one or two seasons,” he said, “once we get access.” That could ultimately produce more robust science for less money, a pandemic silver lining.

### The first COVID winter

While most Antarctic scientists were in home offices from March to October—the dark austral winter months—some workers and researchers were able to go to the field and see the pandemic unfold from the one continent that had not yet been infected.

Lucas Graychase worked for a contractor managing building systems and arrived at McMurdo Station in late February 2020, one of the last groups in before COVID restrictions began. He says as leadership worked on preparations for the eventual arrival of new people, he kept hearing the words *fluid* and *dynamic*. A top order of business became sewing masks.

“A bunch of volunteers went to the craft room and over a period of,





***Scientists have been studying seal births in Antarctica for two decades. This past season, only three students collected the data, rather than the usual ten researchers. Photograph: Will McDonald.***

I think, 2 weeks, they made a little over 500, and they dispersed 2 to everybody on station,” Graychase said. He says people from every department helped. Then, everyone

practiced what it would be like when new arrivals burst their isolated bubble.

“We did a 2-day test 2 weeks before the scheduled first flight,” Graychase

said. “If you needed to go fill a water bottle in the hallway, you had to put a mask on. If you needed to use the bathroom, you had to put a mask on.” He says it felt more rigid than he was hearing people back home describe.

“Nobody wanted to be the organization that brought COVID to Antarctica,” he said, “so they went above and beyond with every plan.” Although everyone tried to prevent COVID-19 from arriving, in December 2020, Chile reported an outbreak on the continent. Heidelberg says it made her “super sad” to read the news, but she was not surprised. “It just happened,” she said, “and we knew it would.”

Despite the frustration and the uncertainty, researchers report that the overall scientific integrity of most studies remains intact, and the impacts are not devastating. Funding agencies and scientists expect they will again have delays and last-minute decisions for the 2021–2022 Antarctic summer field season. But Cannone sees one benefit the pandemic brought to Antarctic science.

“I would say that the only good thing of COVID is that tourists are now not coming to Antarctica,” she said. “Tourists are a very big threat. I understand that they pay a lot of money but the value of the nature that we can lose, the biodiversity that we can lose, is so big it is incommensurable. If you lose that you lose something that you cannot replace.”

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