Paradise Lost:
How Climate Change and Pollution Could Wreak Havoc in Antarctica?

Antarctica is a land of peace and science, and we hope it remains that way, for our environment matters more than any other thing. Effects of a collapsed Antarctica could be catastrophic.

Located farthest from the human civilisation and endowed with extreme weather, Antarctica remains the last paradise for inquisitive explorers and scientists. In December 2016, I was among the fortunate few who were selected for a long and eventful voyage to Antarctica that would last for the next four months.

One of my active research interests is how species disperse in response to climate change. The idea is that because of climate change, both Continental Antarctica as well as the surrounding Southern Ocean are getting warm, and therefore species that are restricted to warm subtropical and temperate waters might get dispersed to expand their range to Antarctica. There are also chances that some non-native seaweeds might have got introduced to the Antarctic coasts.

I visited both of India’s Antarctic stations – Bharati Station at Larsemann Hills and Maitri Station at Schirmacher Oasis. Both of these stations are located in East Antarctica and are approximately 3000 km apart.

While most of these islands of Larsemann Hills remained unpolluted, presence of human arrival is obviously visible everywhere. In the islands and in the peninsulas, on close inspection most of the peaks have place markings underneath these stones. At some locations, concrete plaques with markings of coordinates and the organisations can also be spotted. Places around Broknes Peninsula and Manning Island remain the worst polluted places in Larseman Hills.

On a walking trail from Progress-1 station all the way to Progress-2 and Zhongshang one can see the perils of human activities; at many locations one can spot discarded oil barrels, thick metallic ropes, metal scraps, and even mattresses and cans of beers. In the manning island, I spotted beer cans at several places. I also spotted a container...
Rubbish everywhere with scrap metals inside, littered near Lake Folding, Manning Island. Terrible state of affairs that require immediate attention.

At one summit overlooking Progress-2 station, I saw a giant crucifix made out of rubbish; a product of human artistry, nevertheless despicable in this pristine continent. The crucifix, just like those all-faith prayer rooms in our stations, disenchanted me. Pax Antarctica remains the only continent that has escaped religious indoctrination, and thanks to which there were no conflicts yet. This encroachment of religion would make Antarctica just like anywhere else on the earth. I wish the ATS (Antarctic Treaty System) bans all forms of religion from this continent!

Schirmacher Oasis is one of the most heavily polluted regions of Antarctica. Scrap metals can be found everywhere; I found fuel barrels and even containers on top of hillocks. Burst balloons (that were being launched frequently to study the atmosphere) can be found almost everywhere one goes.

What surprised me most during my entire expedition was a “greenifying” Antarctica. Green growth of moss can be found at several patches on the islands and oases. I also found a green moss *Schistidium antarctici* at these areas. This moss is an endemic plant found only in Antarctica. A few years ago a well-cited paper analysed nitrogen isotopes of this moss and made a startling discovery; the isotope that these plants contain is N-15, an isotope generally found only in animals, unlike N-14, the normal isotope found in plants and soils. N-15 isotope in this moss suggests that the nitrogen is obtained from penguin excrements. The authors could corroborate this hypothesis by finding coprolites (fossilised faeces) of penguins at every place this moss grows! If you find this moss anywhere, you can reasonably be sure that this area once had been a penguin rookery, perhaps tens of thousands of years ago.

At several locations in the Antarctic glaciers I could find pink ice algae. The pink or watermelon algae (*Chlamydomonas nivalis*) is quite interesting; its massive blooms sometimes cover large areas of the glaciers. The algae is known to cause glacial melting directly and indirectly; directly, for it melts the ice in order for it to complete its life cycle, and indirectly, for it masks the white colour of snow (as it colours the glacier pink), and thereby reduces the albedo effect. Albedo effect is the reflecting power of white surfaces, especially the ice sheet; it reflects most of the energy and UV from the sunlight back to the atmosphere. However, when the white colour is masked by pink, the energy from sunlight gets trapped, accelerating the melting of the ice.

Perhaps the most unusual finding that I made in Larseman Hills is the presence of large invasive seaweed *Laminaria* throughout the coastlines of several islands, especially Twin Island. This seaweed, commonly known as Kelp, has never been reported in continental Antarctica. The most plausible cause for its introduction is via research vessels. Twin Island sits on the mouth of a narrow bay that cuts into Brokness Peninsula, where three research stations are situated – China’s Zhongshan, Russia’s Progress-2 and Romania’s Law-Racovita.
At several locations in the Antarctic glaciers I could find pink ice algae. Its massive blooms sometimes cover large areas of the glaciers. The algae is known to cause glacial melting directly and indirectly; directly, for it melts the ice in order for it to complete its life cycle, and indirectly, for it masks the white colour of snow.

Of course, Antarctica is changing, and our last paradise is on the way to being irrevocably lost. The Earth had a ‘little ice age’ in the 17th century; since then our planet is getting warmed up at an alarming rate of 0.02°C per year, which had never been the case in known history. It is now estimated that up to 90% of that increased atmospheric temperature gets trapped in the world’s oceans. Oceans get heated up particularly in the tropics, and the salty warm water travels pole-wards where the higher density (due to higher salinity) forces it to sink straight down the ocean along with the temperature – a process called ‘salt water subduction’. Naturally, global warming significantly increases this pole-ward flow of warm polar waters, causing tremendous increases in the world’s ocean currents. Another major effect is that warm waters reaching the poles directly melt the floating ice there (sea ice as well as ice-shelves).

A large hole in the ozone layer had been detected over Antarctica in 1985 by scientists from the Halley Station of British Antarctic Survey. Since the ozone protects life on Earth from harmful UV rays from the Sun like an umbrella, with the ozone layer gone, UV rays reach the Earth’s surface unhindered causing cancer and other problems. Fortunately, thanks to the stringent environmental measures since
What surprised me most during my entire expedition was a “greenifying” Antarctica. Green growth of moss can be found at several patches on the islands and oases. I also found a green moss Schistidium antarctici at these areas. This moss is an endemic plant found only in Antarctica.

Dr. Felix Bast

(Antarctic Treaty System), which effectively means we abide to the ATS condition of restraining from any future territorial claims there. Again with ATS in force, commercial exploitation for natural resources (oil and natural gas, for instance) as well as bio-prospecting there are prohibited.

In addition, the scientific consensus is that the oil trapped inside Ross and Ronnie Ice Shelves (only areas where oil is detected, both are far away from Indian stations as well) are too insignificant and that a commercial-scale exploitation is unworkable.

The short-term effect of changing climate is predicted to be an Antarctica that is getting greener. As the continent can sustain vegetation only at the ice-free oases, resulting plant resources there will be negligible, quite unlike that of tundra like Siberia (Siberia is expected to become an agricultural heartland in the near future).

The long-term effect is bleaker; collapse of Antarctic ice sheet and the continent, which many say is more imminent. It is more important for our nation to enter into diplomatic dialogues at the international arena to thwart this catastrophe at any cost for our ‘strategic’ national interest. Rising seawater will have huge repercussions for our national economy with a number of our highly populated coastal cities including our financial capital Mumbai predicted to be engulfed by the sea.

Effects of a collapsed Antarctica could be catastrophic. Let us not forget the spirit of the Germans who plucked everything including their flag post and left their Georg Forster station – next to India’s Maitri Station – from Schirmarcher Oasis in 1996. Of course, science should not function as a political placeholder for Antarctica. Antarctica is the land of peace and science, and we hope it remains that way, for our environment matters more than any other thing.

Dr. Felix Bast is a popular science writer and a scientist in the Centre for Plant Sciences, Central University of Punjab, Mansa Road, Bathinda-151001, Punjab; Email: felix.bast@gmail.com