Environmental Case Study

Collapse of the Larsen B

In February 2002, a huge section of the Larsen B Ice Shelf along the Antarctic Peninsula coast suddenly disintegrated into thousands of icebergs (fig. 15.1). Over a 30-day period, about 3,250 km$^2$ (an area larger than Rhode Island) shattered in the largest single event in a 30-year series of ice shelf retreats in the peninsula. The total volume of ice released was 720 billion metric tons, or the equivalent of 29 trillion bags of party ice. Climatologists warn that this dramatic collapse could be a signal of global climate change and an omen of catastrophic events to come.

Ice shelves are thick slabs of ice that float on the ocean around much of Antarctica (fig. 15.2). They are fed by glaciers sliding down off inland mountains. The Larsen B shelf was about 220 m (720 ft) thick, or about as tall as a 50-story building. Based on studies of ice flow and sediment thickness beneath the ice shelf, scientists believe that it existed for hundreds, or perhaps thousands, of years.

Although much of Antarctica has gotten cooler in recent years, the Antarctic Peninsula, which juts out toward the tip of South America, has warmed about 2.5°C over the last half century. This warming has destabilized ice sheets around the peninsula, which have lost about 13,500 km$^2$ (5,200 m$^2$) over the past three decades. The Larsen A Ice Shelf, which lay just to the north of Larsen B, collapsed equally suddenly in 1995. Glaciologists speculate that pools of meltwater observed on the surface of the ice worked their way into cracks and crevasses, widening the gaps through freezing and thawing until the whole shelf abruptly collapsed. The next shelf to the south, the Larsen C, is now beginning to show similar meltwater ponds, and the giant Ross and Ronne Ice Shelves (each roughly the size of France) may be near the temperature limit for stability as well.

![Figure 15.1](image-url) In early 2002, a Rhode Island-sized section of the Larsen B ice shelf on the Antarctic Peninsula disintegrated into shards. Satellite images show 3,250 km$^2$ that collapsed into the ocean. Source: National Snow and Ice Data Center/University of Colorado/NOAA.
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Figure 15.2 The atmospheric processes that purify and redistribute water, moderate temperatures, and balance the chemical composition of the air are essential in making life possible. To a large extent, living organisms have created, and help to maintain, the atmosphere on which we all depend. © William P. Cunningham.

Ice shelf breakup has little direct consequence for global sea levels because floating ice displaces as much water as it contains. However, the shelves act as buttresses or braking systems for land-based glaciers. The Ross Ice Shelf, in particular, is the main outlet for several major glaciers draining the West Antarctic Ice Sheet, which contains enough water to raise sea level 5 m, if it were all to melt. As ice shelves disintegrate, glaciers slide down off the continent at an ever quickening pace, raising worries that rising sea levels could flood coastal areas home to billions of people. Recent studies have shown that every glacier on the Antarctic Peninsula is now sliding faster into the sea than it can be replenished. And, as we discussed in chapter 1, alpine glaciers everywhere in the world are retreating rapidly.

Antarctic warming is already having measurable effects on wildlife. Krill, which forms the basis for the entire marine food web, are declining because the algae they usually scrape off the undersides of ice sheets are disappearing. As krill decline, so do the whales and penguins that depend on them. Over the past 50 years, emperor and Adelie penguin populations have declined by at least 50 percent.

Are increasing temperatures in Antarctica and disintegrating ice shelves proof that human actions are causing global climate change? We can’t be sure. It’s possible that we’re now witnessing merely a normal climatic variation and ice shelf retreat that occurs on a longer time scale than our records cover. As you’ll learn in this chapter, however, events in Antarctica are only part of an ever increasing body of evidence that suggests we’re having a significant impact on global climate. Many scientists regard this issue to be the single most important environmental problem of our age.

To understand what all these observations may have to say about our future and how we should respond to the threat of changing climate, we have to know something about our atmosphere and how it produces local weather and global climate. We also need to be acquainted with the international politics of this crucial topic.