ATMOSPHERE OF HOPE

SEARCHING FOR SOLUTIONS TO THE CLIMATE CRISIS

TIM FLANNERY

Grove Press
New York

Versions of the Afterword originally appeared in the *Sydney Morning Herald* ("The Great Barrier Reef is losing its adjective and it's our fault") and in the *New Daily* ("Tim Flannery: the biggest surprise from the Paris Climate Meeting")

First published in Australia in 2015 by The Text Publishing Company

First published by Grove Atlantic, October 2015

FIRST PAPERBACK EDITION, October 2016

Printed in the United States of America

ISBN 978-0-8021-2565-1
eISBN 978-0-8021-9092-5

Grove Press
an imprint of Grove Atlantic
154 West 14th Street
New York, NY 10011

Distributed by Publishers Group West

groveatlantic.com

16 17 18 19 10 9 8 7 6 5 4 3 2 1

CHAPTER FOUR

How Are the Animals Doing?

We'll lose more species of plants and animals between 2000 and 2065 than we've lost in the last 65 million years.

PAUL WATSON

MORE than 20 years ago, biologists Richard Leakey and Roger Lewin announced that the twenty-first century would be the age of the sixth great extinction.[1] A few years later, climate scientists were warning that, on the current trajectory, two or three out of every five living species may become extinct as a result of global warming. Recent studies have come up with different estimates, making this an area of active scientific debate. But there is no doubt that the current rate of extinction is far higher than the average for Earth, and that many species are imperilled by climate change and other factors. So where is the danger looming closest?

The world's greatest coral reef—Australia's Great Barrier Reef—stretches about 2300 kilometres along the continent's north-east coast, encompassing an area roughly half the size of Texas. Those who have dived its pristine reaches know firsthand that it

is one of Earth's natural wonders—a place of exceptional beauty and diversity.

Despite the scientific warnings, a decade ago I found it difficult to believe—even to comprehend—that the world's coral reefs might be on the brink of collapse. The Great Barrier Reef had endured for millions of years, and was protected under law, so I reasoned that surely it was well positioned to survive. I can see now how naïve I was in believing that it might withstand the multipronged onslaught our species has unleashed on it.

In the 1960s and 1970s mining the reef for fertilisers and drilling it for oil were proposed. These threats led to the reef's legal protection. Yet it's now clear that, despite a ban on drilling, fossil fuels have been conducting a lethal stealth attack on the reef. The first intimations came in the 1970s, when areas of coral turned white, then died. Coral bleaching—as the phenomenon is known—occurs when underwater heatwaves stress the coral polyps, causing them to eject the algae living in their tissues, and so turn white. Without algal partners the coral polyps cannot grow the bony skeleton that forms the reef. Indeed they cannot even properly feed themselves. Over a period of weeks the coral polyps slowly starve, then die. When added to the threat of ocean acidity, the attack is devastating. So it is that heat and acid, from atmospheric CO_2 caused by burning fossil fuels, are killing the reef. And it is happening fast.

The reef's current champion is Dr Charlie Veron of the Australian Institute of Marine Science. He says he saw his first bleached coral—a ten-centimetre square patch—off Palm Island in the early 1980s. Now he says, it's 'horrible to see—corals that

are four, five, six hundred years old—die' from the heat.[2] For the reef, Veron says, catastrophic global warming has already arrived.

A century ago, a pioneer of coral reef science William Saville-Kent made a photographic record that provides a poignant historic benchmark of the Great Barrier Reef's decline. He was always careful to keep some landmark in the background, so the locations of his photographs can still be traced. We see that a delightful coral garden of a century ago is today a scene of utter devastation. In 2012 a study revealed that half of the Great Barrier Reef has already been killed.[3] Not all the damage has been done by acid and heat, yet, as the years go by, these emerge as the overwhelming culprits.

At the rate at which we are currently burning fossil fuels, the world will be around 4°C warmer by 2100 than it was in 1800. A decade ago I dared to hope that the reef might survive. Certain strains of zooxanthellae (the algae that live in coral polyps) that can tolerate higher temperatures would spread, I thought, helping the coral to live. Or the reef might migrate southwards. A recent study has dashed my hopes. It shows that, if the Great Barrier Reef were to keep pace with a 4°C rise in temperature, its complex ecosystems would need to migrate southwards at the rate of 40 kilometres per year. Yet corals seem unable to migrate at rates greater than 10 kilometres per year. If we do nothing, global warming will simply outpace the reef.[4]

Even if we slow the rate of change, the damage will be monumental. Scientists foresee that 'the majority of existing coral reef ecosystems are likely to disappear if the average global temperature rises much more than about 1.5°C above the pre-industrial level.[5] Through inaction over the past decade we've already assured

that global temperatures will rise more than 1.5°C, and even the Paris meeting is aiming only to limit warming to 2°C. It fills me with despair to admit it, but my beloved Great Barrier Reef is doomed. My head tells me what my heart won't. If we exert ourselves to the utmost to reduce CO_2 pollution, the reef may still be able slowly to grow, and even to remain beautiful in patches. But, as an extensive ecosystem, it must be counted among the living dead.

The growing scientific certainty that Australia's Great Barrier Reef, along with many other coral reefs worldwide, will be destroyed by climate change this century is just one example of a natural world imperilled by growing heat and acid. The polar regions are warming faster than anywhere else on earth, and their biodiversity is being strongly affected. For almost everyone who is not an Arctic ecologist, the story of its biodiversity is encapsulated in the fate of the polar bear. Indeed, the creature has become the poster child of climate change.

There was a time when polar bears seemed to feature on the cover of every publication dealing with our climate. Unsurprisingly, it wasn't long before the sceptics began to argue that the story was a beat-up. The great white bear was doing fine, they asserted, and the scientists were simply out to feather their own nests with grant money. Inconveniently for the sceptics, anecdotal but eye-catching stories about the bears, which suggested they were in trouble, kept grabbing headlines. Bears were found drowned at sea, apparently while trying to swim hundreds of kilometres from land to the retreating sea ice edge. And they began hanging around settlements to scavenge, leading to all sorts of run-ins with people.

Recently, tales of cannibalism, usually of male polar bears killing and eating cubs, have hit the news, along with stories of bears eating goose eggs, or climbing near vertical cliffs to feed on guillemots. Bears have even been seen engaging in long-distance chases of reindeer.[6] For animals that predominantly feed on seals, which they catch by waiting beside their breathing holes in the ice, such behaviours are unusual, to say the least. But they do not constitute hard evidence that the bears are starving *en masse*.

News of the 'pizzly'—a polar bear hybrid with a brown bear—is another phenomenon that raised eyebrows. It suggests that the great white bears are travelling far south, or that brown bears are journeying north. There is a concern that the polar bear might eventually hybridise itself out of existence.

To scientists, such anecdotes and rare cases are interesting, but are side issues when it comes to estimating the creatures' chances of survival. The factor that will decide the fate of the bears, they say, is habitat. And for polar bears that means sea ice of about a year old. If the sea ice doesn't last that long, seals don't breed there, or if they do the seal pups drown. And if the ice is more than three years old, it becomes too thick for the seals to make breathing holes in, and so is unsuitable for them.

In the decade preceding 2012, the Arctic sea ice was shrinking even faster than the computer models had predicted. But in 2013 and 2014, as a result of colder winters, there was some recovery—a 12 per cent increase in ice extent above its all-time low in 2012. It's now clear that the main factor controlling the sea ice is temperature, rather than wind and waves, which some previously thought influential. Cold winters will doubtless recur in the future as part

of natural variability, but the trend is clear. Warm conditions are predominating, and as a result the ice is melting fast.

Already some populations of bears in the southern reaches of the species' range are starving and failing to reproduce. The southernmost population—in Hudson Bay—has declined from 1200 to 800 in recent years. This is not without precedent. Thirteen thousand years ago the great white bears thrived in southern Scandinavia. But they disappeared at the end of the ice age, when the ice in the area melted too early in the spring or failed to form at all.

A 2010 report by the polar bear specialist group at the International Union for the Conservation of Nature found that eight of the 19 sub-populations are estimated to be in decline, while one is increasing. The other sub-populations are so poorly studied that their status is not known—which is hardly surprising given the remote habitat and rareness of the creatures.[7] The population that is increasing inhabits Davis Strait, between Greenland and Baffin Island in Canada. There, it's so cold that in times past the sea ice often survived for years, becoming too thick for the seals to use. A warming climate is now providing an increase in one-year-old ice in the area—ideal for seals and therefore polar bears.

So controversial is the fate of the polar bear that the 2010 report attracted immediate criticism.[8] Polar bear expert Mitch Taylor, who is much quoted in the media, does not accept the climate science linking the burning of fossil fuels with Arctic ice melt. He says that the Inuit tell him that polar bears have never been so abundant. But this may be because a decrease in hunting is helping some populations, or starvation might be bringing bears closer to settlements

where they are more readily noticed. As happens with many sceptics, his comments are often given disproportionate weight by the media in the pursuit of 'balanced' reporting.

Taylor's arguments are frequently linked with observations about the difficulty of estimating the size of polar bear populations. Estimates are often vigorously disputed by climate-change deniers, by hunters (who want quotas increased) or by others with their own agendas. It's clear that research on polar bear numbers has become as politicised as climate change itself. Indeed, as the writer Jon Mooallem comments in his book *Wild Ones*, the debate about the future of the polar bear has become exceptionally bitter, and the waters are now so muddied by misinformation that the general public is confused about whether the bears are endangered or not.[9]

But the facts remain indisputable. Polar bears feed on seals, which need one-year-old sea ice that survives long enough for them to breed on, and overall the Arctic sea ice is melting fast.[10] The bears of Davis Strait may thrive for some decades yet, but if we keep up the current rate of CO_2 emissions, the warming must eventually threaten them as well. Areas now dominated by three-year-old ice, will give way to thinner ice, which will in turn give way to open sea. The most rigorous study predicting the fate of the polar bears was made in 2007 by a team from the US Geological Survey.[11] Based on the rate of melting of the sea ice, it foresaw that the bears would become extinct everywhere, except perhaps in the Arctic Archipelago, towards the end of the twenty-first century.

At the southern end of the Earth, penguins take the place of polar bears as climate-change icons, and the penguins inhabiting the western side of the Antarctic Peninsula have experienced

some of the most rapid climate change ever recorded. Over the past 50 years, the average temperature in the region has increased 7°C, and the sea-ice season has shortened by about 100 days since 1978.[12]

The Adélie penguins of the Palmer area of the Antarctic Peninsula are the subjects of long-term study, making their fate as a consequence of climate change the most thoroughly understood of any polar species. The Adélies feed on krill, which take seven years to reach sexual maturity, and which depend on ice to feed. With both ice cover and krill on the decline, the Adélie population has plummeted by more than 80 per cent. In 2012 only 2411 breeding pairs remained, down from 15,202 in 1974. Gentoo penguins, which feed on other prey in the open ocean, are now colonising the area.[13] Studies reveal that abrupt, climate-related changes have upset an ancient stability. One of the five Adélie penguin colonies in the area, which had been in existence for at least 500 years, vanished in 2007, probably as a result of increased snowfall due to the warming, which covered their nests and young, as well as a food shortage due to sea ice loss.[14]

Many other ecological changes are being felt on the Antarctic Peninsula; for example, the kinds of organisms found on the sea floor are changing, and whale and seal numbers are shifting. Not all of this is being driven by warming, but it is a very important factor in altering these ecosystems. So profound are these changes that ecologists believe that the biodiversity of the Antarctic Peninsula will never recover to what it was just 50 years ago.

If changes at the poles have unfolded pretty much as the scientists predicted, what about the 'third pole', the icy peaks of Earth's more temperate regions? Earth's alpine regions harbour

exceptional biodiversity. From rhododendron bushes that look like moss mounds to birds of paradise, they are home to species found nowhere else on Earth. And, on peaks not sufficiently high to provide a true alpine habitat, upper montane forests that support unique species are vulnerable in a warming world. All the creatures residing in such habitats are effectively stranded on mountaintops. As Earth warms, they have nowhere to go.

In 2003, Steve Williams, a scientist from James Cook University, predicted that the lemuroid ringtail possum, among other mountain-dwelling species inhabiting the world-heritage wet tropics area of far northern Queensland, would be driven to extinction by climate change.[15] The population most immediately vulnerable lives on Mount Lewis in far northern Queensland. It tends to have white fur rather than the normal sombre grey-brown. With their luxuriant, pure white coat, black eyes and long bushy tail, the Mount Lewis lemuroids are astonishingly beautiful. They are susceptible to climate change both because their habitat is restricted, and because they are acutely sensitive to heat stress, being unable to tolerate more than four or five hours of exposure to temperatures above 30°C. The danger lies not in the slowly increasing average temperature, but in extreme events. Like all of Australia, the rainforests of northeast Queensland are now subject to unprecedented heatwaves.

In 2005, a heatwave hit Mount Lewis and the population of lemuroids crashed. The possums were once so abundant that spotlight searches had usually logged one individual per hour of searching, but in the three years after 2005 repeated lengthy searches failed to spot a single individual. But then, in 2009, three

lemuroids—all of the brown rather than the white form—were seen on Mount Lewis during a spotlighting survey. And that, I'm grieved to say, was the last recorded sighting.

In researching this book I was perplexed at how difficult it was to find up-to-date information on the Mount Lewis lemuroid. The Department of Environment and Heritage's protection for the species mentions climate change as a 'suggested' threat, while a recent management strategy for the national park that includes Mount Lewis makes only the briefest mention of the possum and no mention at all of climate change. On coming to power in 2012, the conservative Queensland state government sacked or moved almost the entire staff of the Office of Climate Change, and prepared to close most of the state's climate change and renewable energy programs. I have been told by disgruntled staff of the Queensland Parks and Wildlife Service that they were directed not to mention climate change in official documents. It's hard to avoid the feeling that the public is being kept in the dark about the fate of the lemuroid ringtail possum.

Elsewhere in the world the fate of mountain-dwelling species sensitive to heat is clearer. The American pika, a small mammal related to rabbits and hares, has adapted to life in mountainous areas that rarely get above freezing. They can die when exposed to temperatures as mild as 25°C. American pikas occupy alpine habitats in Colorado, Oregon, Washington, Idaho, Montana, Wyoming, Nevada, California and New Mexico, as well as western Canada.[16] Rising temperatures have already driven them to extinction in over one-third of their previously known habitat in Oregon and Nevada, while in the Great Basin (the arid region between

the Rocky Mountains and California's Sierra Nevada) they have recently disappeared from eight of 25 mountain locations where they were documented in the early 1900s. Nationally, their situation is now so dire that the US Fish and Wildlife Service is considering the pika for protection under the Endangered Species Act. Some pikas living at lower elevation gain a survival advantage by eating their own faeces, which allows them greater access to nutrients in mosses that they can eat in cooler areas to avoid foraging in open, warmer areas for more nutrient-rich food.[17] But, despite their unusual strategy, it's possible that pikas will be the first mammals to become extinct in the US due to climate change.

The conifer forests of eastern North America are among the habitats being hardest hit by climate change, with some suffering up to 87 per cent mortality from changes stemming from the warming trend.[18] The mountain pine bark beetle is a well-known villain, having devastated conifer forests from New Mexico to British Columbia. With 88 million hectares of forest infested, and 70–90 per cent mortality rates for infested trees, these creatures, which are the size of a grain of rice, are rapidly altering entire ecosystems. The reason for this is warmer winters, which allow the beetles to extend their breeding season. And the problem is not confined to North America. Related species in the 200-strong pine-beetle family are devastating forests across the northern hemisphere.

Bushfires influenced by climate change are also permanently transforming some North American conifer forests into grassland, while drought and increases in water demand from heat-stressed trees are all adding to environmental mortality. As the forests die, so too will the myriad creatures that live in them.

There is one facet of the sixth extinction where climate change is not the sole culprit. Among the most dismal catastrophes to have struck the natural world in recent decades is the disappearance of many species of frogs and toads. About one third of all known 4740 species of frogs and toads are under threat, and in 2010 the International Union for the Conservation of Nature red list reported 486 species as critically endangered.[19] Up to 122 species are likely to have become extinct since 1980. Back in 2005 the cause of this calamity was unclear. Today, courtesy of new research, we know the spread of the chitrid fungus, which attacks the skins of amphibians, was the primary cause of many, but not all, amphibian declines. In *The Weather Makers*, I said that the extinction of Costa Rica's golden toad (*Bufo periglenes*) resulted from climate change. The latest studies support this, indicating 'medium confidence' (better than even chance) that climate change was the primary cause in this instance.[20]

So is the sixth extinction, as documented by Elizabeth Kolbert,[21] happening? In mid-2014 a detailed study was published that confirmed that the current global rate of extinction is about 1000 times greater than the 'normal' or background extinction rate.[22] The study makes the point that over the first decade of this century habitat loss was the single most important factor, while invasive species and climate change were also strong influences, but that as the century progresses, the influence of climate change will increase. It's still early days, but the climate scientists warning of overall species loss of 20 per cent or more as a result of the destabilising climate may yet prove to be correct.

Afterword

A FEW weeks ago I dived the Great Barrier Reef, near Port Douglas. It was one of the saddest days of my life. I am haunted by what I've seen. And infuriated.

I had come with hope, for some recovery at least from the largest coral bleaching event on record. But what I found was worse than I could have imagined. The Great Barrier Reef is losing its adjective.

Most of the reef's usually vibrant staghorn and plate corals are covered with an ugly green slime. Even some of the massive stony corals—the hardiest of all—are scarred with the tell-tale white of bleaching. The reef's diverse and stunning fish population are starving.

A green turtle passes by. As the dead reef breaks down, its habitat will be eroded to rubble. And climate change is affecting the species in other ways. Rising seas have massively degraded its most important nesting site—Raine Island in the northern Great Barrier Reef. Those same rising waters caused, around 2011, the first mammal extinction brought about directly by climate change, when the entire habitat of the Bramble Key melomys (a native rodent unique to the Great Barrier Reef) was destroyed by saltwater intrusion.

As I reflected on my dive, I realised that I had been looking into the future. Because of el Nino, this year global temperatures rose

by a third of a degree to 1.2C above the pre-industrial average. By the 2030s, this year's conditions will be average.

This great organism, the size of Germany and arguably the most diverse place on earth, is dying before our eyes. Having watched my father dying two years ago, I know what the signs of slipping away are. This is death, which ever-rising temperatures will allow no recovery from.

Unless we act now.

In December 2015, representatives from 195 nations arrived in Paris for the United Nations Climate Change Conference, technically known as COP 21—the twenty-first annual session of the 'Conference of the Parties' at an international climate convention. By the end of the conference, those nations had come together to sign the first universal, legally blinding global climate deal. It was a historic moment. And one of the biggest surprises of the climate meeting was the decision to include an ambition of capping the global temperature rise at 1.5°C, rather than the originally anticipated target of 2°C.

From a climate perspective, a world in which temperature rises are limited to 1.5°C is much preferable. It's possible that some of the Arctic ice cap may survive, and also, if the rise is gradual enough that some coral, maybe even on Australia's Great Barrier Reef, could adapt to the permanently warmer conditions, and that sea-level rise would be limited to a metre, if temperatures can be limited to 1.5°C.

In the wake of the Paris meeting, however, countries will be left pondering the actions required to do their part in limiting temperatures to 1.5°C. In the case of Australia and America, the

actions required are often inconsistent with current policy and rhetoric.

The drastic nature of the actions required from all countries becomes evident from the fact that there is already enough greenhouse gas in the air to take temperatures to around 1.5°C by mid-century.

In carbon budget terms, we are already out of budget to reach a 1.5°C target.

Because we cannot immediately end the use of fossil fuels, if Australia and other nations are serious about reaching a 1.5°C target, they will need to cut emissions with unprecedented speed, as well as investing in third-way technologies to draw down whatever we put into the atmosphere in the future.

Because we don't yet have any technologies operating at a scale sufficiently large to draw down the amounts of CO_2 required, it makes sense to avoid putting as much greenhouse gas into the atmosphere as we can in the first place.

Whatever the pathway each nation chooses to honor its intention to limit temperature rise to 1.5°C, it will in most cases involve a dramatic shift in policy. And that shift cannot be delayed, because reaching a 1.5°C target is barely within our grasp in 2016.

A few years of inaction would make it entirely unreachable.

—Tim Flannery, 2016

Adapted from "The Great Barrier Reef is losing its adjective and it's our fault" in the Sydney Morning Herald *(Australia) and from "Tim Flannery: the biggest surprise from the Paris Climate Meeting" in the* New Daily *(Australia)*