Down To Earth

ONE LOSS TOO MANY

The ascendency of humans has unleashed the sixth mass extinction. Every species lost will only hasten the processes of annihilation

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Down To Earth
SCIENCE AND ENVIRONMENT FORTNIGHTLY

CSE, founded in 1980, is a public interest research and advocacy organisation based in New Delhi. CSE researches into, lobbies for and communicates the urgency of development that is both sustainable and equitable.
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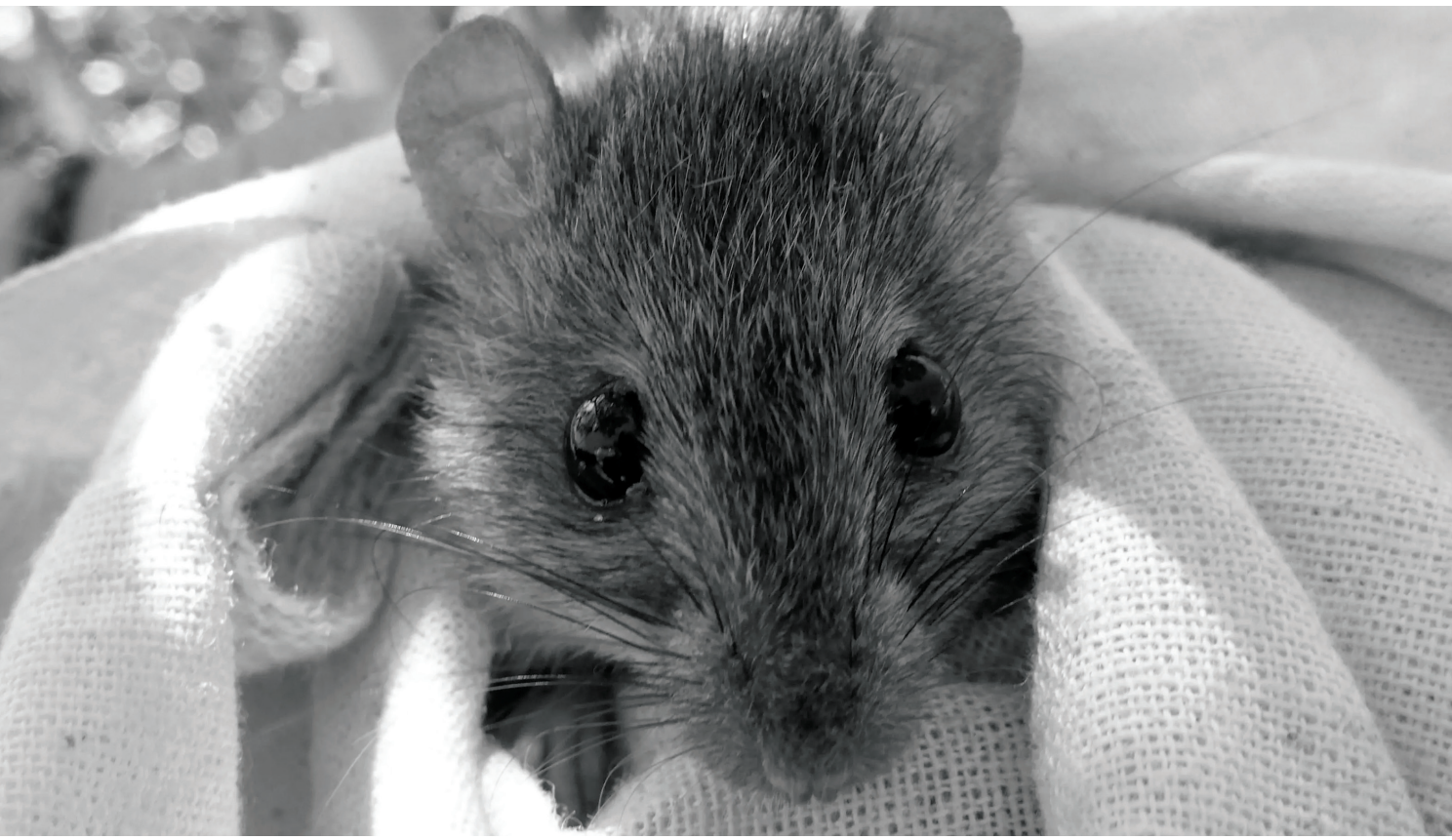


PREFACE

CONNECTEDNESS OF BEINGS

Extinction of one species can trigger a sequence that causes the end of others. The process is often quick and indiscernible

On February 19, 2019, Australia's environment minister announced name of the first species to have gone extinct due to human-induced climate change—Bramble Cay melomys (*Melomys rubicola*)—a small brown rat belonging to Class Mammalia of the Animal Kingdom. The rodent was found in Bramble Cay, a small vegetable coral key in Australia's extreme north.

The minister only made official what the world had speculated for long. The rodent, which dug furrows in herd fields and among strandline plants, was feared to have been extinct for some time. The government of Australia's Queensland province reported the species to be extinct in June 2016. Any member of the species had not been seen for about a decade. Some researchers, though, maintained that there was still an outside chance of its survival. It was placed in the IUCN (International Union for Conservation of Nature) Red List of Threatened Species. "The Bramble Cay melomys was a little brown rat. But it was our little brown rat and it was our responsibility to make sure it persisted. And we failed," Tim Beshara, federal policy director for the Wilderness Society, told the country's Senate, reported news agency Xinhua. A five-year

Cutting of palm trees ended the 20,000-strong human population in Easter Island of the Pacific Ocean within just 1,400 years. Humans settled here in 400 AD, sbut when Dutch travellers arrived in 1722 all they found was a grassy wasteland

plan to save the species was introduced in 2008, he added. The plan, however, did not lend due importance to the immediate risk.

Australia has been the theatre of several extinctions, be it megafauna (including giant marsupials like diprotodon) of pre-historical time or the more recent cases since the advent of European colonisers. Varieties of emu, like the dwarf emu and black emu, vanished in the 1820s, less than half a century after Arthur Phillip's First Fleet landed in Sydney in 1788. Since then, scores of birds, reptiles, amphibians and mammals have gone extinct. They range from beings as small as sterlings and parrots to those as big as the Tasmanian tiger, with kangaroos, bandicoots, frogs and a whole lot of other animals in between.

It reminds one of another historical human escapade in triggering extinction. The story of Easter Island in the Pacific Ocean is the perfect parable for extinction. This 165 square kilometre island had fertile soil and mild climate. Humans settled there in 400 AD and, through the centuries, the population became as high as 20,000, estimate archaeologists. But when Dutch travellers reached there in 1722, they found a grassy wasteland, with hundreds of very large sculptures strewn all over. What had happened?

At its peak, Easter Islands' dense forests had hundreds of massive endemic palm trees. The islanders used them to make fishing boats and to drag, position and erect the huge sculptures the Dutch travellers saw. Soon, the islanders had cut one palm too many. The available trees had shrunk to stumps. Unable to make canoes, they stopped going to the sea. By 1400 AD, fishing stopped. The people began eating the island's animals: porpoises, seabirds, land birds, rats and seals. The delicacies were cooked in ovens fired by wood from the forests. As meals increased, animals and forests vanished. The disappearance of birds brought pollination to a halt. Then, cannibalism became the islanders' only option. They ate and killed each other and turned the island bare again in just 1,400 years.

CHAPTER 1

BLINDING CHANGE

Some 1 million animal and plant species face extinction and thousands will become extinct within decades

Evolution and extinction are intimately linked to each other, but never before have had we witnessed such a rapid change in biodiversity. "The Global Assessment Report on Biodiversity and Ecosystem Services", the first such assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) released in 2019, shows that the current rate and scale of extinction is unprecedented and is being caused primarily by humans. "Nature is declining globally at rates unprecedented in human history—and the rate of species extinctions is accelerating with grave impacts on people around the world now likely," says the report. Some 1 million animal and plant species face extinction and thousands of these would become extinct within decades, the report says.

About 40 per cent of the planet's amphibian species are threatened with extinction. Since 1900, the number of native species in most of the land-based habitats have declined by 20 per cent. A total of 680 vertebrate species have been pushed into extinction since the 16th century, while 9 per cent of all domesticated breeds of mammals used for food and agriculture went extinct by 2016. About 1,000 more such breeds are under threat of extinction. "Almost 33 per cent of reef-forming corals and more than a third of all marine mammals are threatened," the assessment report says.

"The Global Assessment Report on Biodiversity and Ecosystem Services" is the first-ever such comprehensive report. It took three years for a group of 145 expert authors from 50 countries to prepare the report, based on more than 15,000 scientific and government

ONE LOSS
TOO MANY

documents. It primarily analyses the impact of economic development on nature and ecosystems. “Ecosystems, species, wild populations, local varieties and breeds of domesticated plants and animals are shrinking, deteriorating or vanishing. The essential, interconnected web of life on Earth is getting smaller and increasingly frayed,” says Josef Settele, who co-chaired the assessment.

On the human-induced loss in ecosystems, the assessment is precise. Three-quarters of the land-based environment and about two-thirds of the marine environment has been significantly altered by human actions. Nearly 75 per cent of all freshwater resources are used for crop and livestock rearing activities. The impacts are equally scary. For example, productivity in 23 per cent of global land has reduced due to land degradation. “Up to $577 billion in annual global crops are at risk from pollinator loss and 100-300 million people are at increased risk of floods and hurricanes because of loss of coastal habitats and protection,” says the assessment. The decline would continue till 2050, it warns.

CHAPTER 2

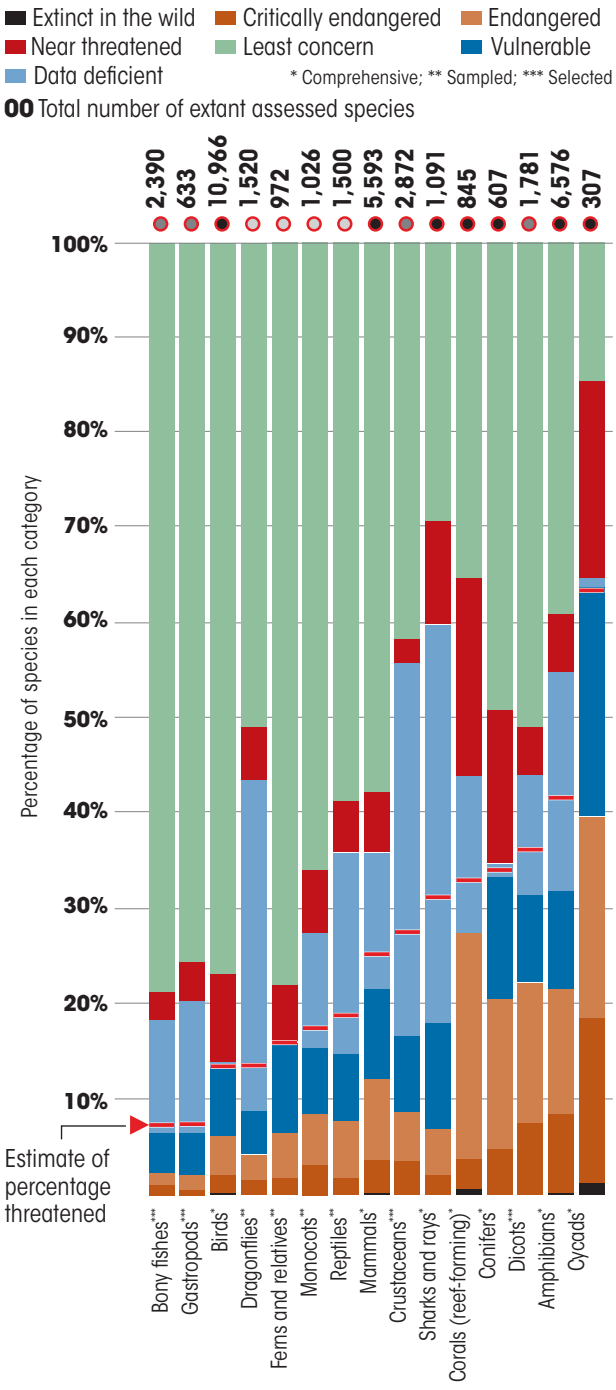
NO CONTINENT SPARED

Earth has lost a staggering 150,000 to 260,000 species since the year 1500, with the loss being reported on all continents and ecosystems

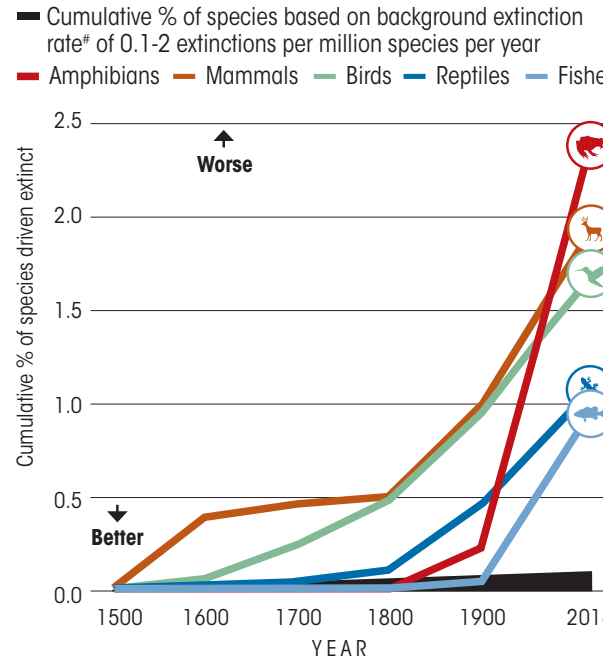
In January 2022, Robert Cowie, research professor at the Pacific Biosciences Research Center, at the University of Hawaii in Manoa, along with other scientists, brought out a massive assessment of the state of invertebrates that constitute 95 per cent of the known animal species. Cowie and his collaborators found that since the year 1500, "Earth could already have lost between 7.5 and 13% of the two million known species on Earth—a staggering 150,000 to 260,000 species." The World Wildlife Fund's (WWF's) "Living Planet Report 2020" says the Asia Pacific region lost 45 per cent of its vertebrate population in four-and-half decades, while the average global loss was 68 per cent. The biennial report, prepared jointly by WWF and Zoological Society of London, was based on the global dataset analysed between 1970 and 2016. The report tracked almost 21,000 populations of mammals, birds, fish and reptiles globally to reach its conclusions. It showed the loss of vertebrate population was the highest in the Caribbean and Latin America (94 per cent), followed by Africa (65 per cent), with Europe and Central Asia showing the least loss (24 per cent).

The loss could be higher than the global average in India, which had lost 12 per cent of its wild mammals, 19 per cent of its amphibians and 3 per cent of its birds over the past five decades. Of about 0.1 million animal species recorded in the country till December 2019, about 6,800 are vertebrates. Among these, nearly 550 are in the critically endangered, endangered and vulnerable categories, according to the Zoological Survey of India, the country's premier organisation in zoological research, under the Union Ministry of Environment, Forest and Climate Change.

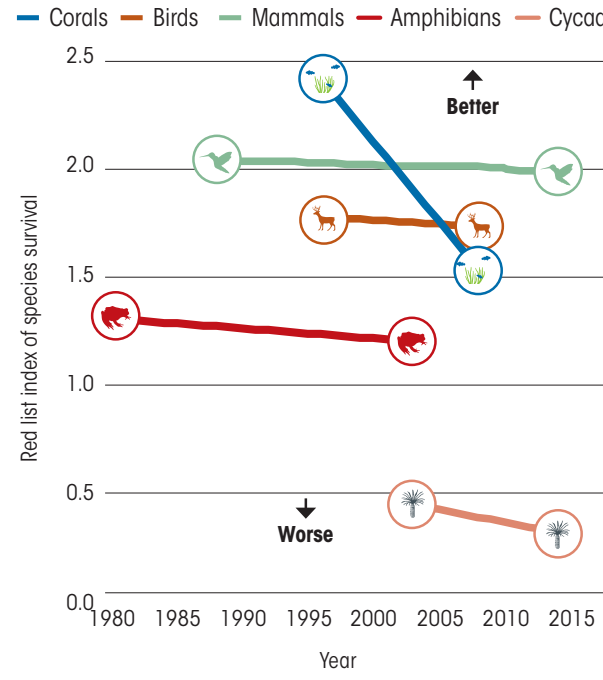
CURRENT GLOBAL EXTINCTION RISK IN DIFFERENT SPECIES GROUPS



Extinctions since 1500



Fall in species survival since 1980



A species exists for around 1 million years before it goes extinct. This is called the background extinction rate and is expressed as "one species extinction per million species-years". Source: "The Global Assessment Report on Biodiversity and Ecosystem Service", IPBES, 2019

The "Living Planet Report 2020" points out five major reasons behind the biodiversity loss across the planet: changes in land and sea use (habitat loss and degradation), overexploitation of species, invasive species and disease, pollution and climate change. In the Asia Pacific region, including India that is experiencing loss of species higher than the global average, habitat degradation is the biggest trigger, followed by species overexploitation, invasive species and disease. The role of pollution and climate change is proportionately higher at 16 per cent.

The loss of biodiversity is on land, water and air, across all continents, and indicates mass extinction. It afflicts all ecosystems—from land to oceans, from sea surface to the yet-to-be-fully-explored seafloors, from forests to desert, and from swamps to rivers. Scientists have been bringing out studies to declare extinction of species almost on a daily basis, which made clear that the planet is hurtling towards mass extinction.

In freshwater bodies like lakes and rivers that occupy less than 1 per cent of the planet's surface but host 25 per cent of all vertebrate species, making them the densest biodiversity hosts, one in three fish species is on the verge of extinction. Freshwater fishes account for over half of the world's total fish species. The International Union for Conservation of Nature's (IUCN's) Global Species Programme and Species Survival Commission are assessing the state of extinction among freshwater fish. "The fact that freshwater biodiversity is declining at twice the rate of that of terrestrial or marine species, is not just an alarming statistic for the environment, it is also highly concerning for people's health and job security," says James Dalton, director, IUCN Global Water Programme. "Freshwater fisheries provide the main source of protein for 200 million people across Asia, Africa and South America, as well as jobs and livelihoods for 60 million people. And yet here we are, documenting more declines on our watch," Dalton says. Populations of migratory freshwater fish have fallen by

76 per cent since 1970 and large freshwater species, such as the catfish, by a catastrophic 94 per cent.

On December 9, 2021, IUCN revealed that 16 per cent of the 6,016 species of dragonflies and damselflies are at risk of extinction. In South and Southeast Asia, which includes India, the situation is even worse because a quarter of all species are under threat of extinction. IUCN attributes this extinction of small creatures to the fast-declining freshwater breeding grounds. The decline was due to rapid urbanisation and clearing of wetlands and rainforests to make way for cash crops. "Globally, these ecosystems are disappearing three times faster than forests," says Bruno Oberle, IUCN Director General. "Marshes and other wetlands may seem unproductive and inhospitable to humans, but in fact they provide us with essential services. They store carbon, give us clean water and food, protect us from floods, as well as offer habitats for one in ten of the world's known species."

Losing species at such alarming rate had far-reaching consequence on the landmass. Some 300 million years ago, trees started sprouting on the planet. This was an evolution that made food possible for us. Most of our food crops originated from these trees. Every fifth tree species was used by humans for food, fuel and medicines, among other uses. In 2021, Marseille, France, hosted the World Conservation Congress—held every four years and regarded as the largest such congregation—during which conservationists heard with shock the findings of a study: "Over 70 wild relatives of some of the world's most important crops are threatened with extinction." The findings, published in the journal *Plants, People, Planet*, assess 224 plants closely related to maize,

The fact that freshwater biodiversity is declining at twice the rate of terrestrial or marine species is not just an alarming statistic for the environment, it is also highly concerning for people's health and job security

potato, bean, squash, chilli pepper, vanilla, avocado, husk tomato and cotton crops. According to this paper, 35 per cent of these wild species are on extinction mode. The genetic materials from these wild varieties are still used to develop new crops, resilient to changing climate and other needs. Without these trees, we will lose biodiversity altogether disabling us from evolving food crops varieties.

Every year, the Earth is stripped of 100 million trees to meet the timber needs from natural sources. In just the last three centuries, global forest areas have shrunk by 40 per cent. They store 50 per cent of the world's terrestrial carbon and provide a buffer from extreme weather, such as hurricanes and tsunamis. In 2021 the Botanic Gardens Conservation International, a charity based in London, published its five-year assessment called "State of the World's Trees". The assessment evaluates 60,000 tree species and finds that 30 per cent are at the risk of extinction. Extinction in the plant kingdom is "twice the number of threatened tree species globally than threatened mammals, birds, amphibians and reptiles combined". Over 440 tree species are on the brink of extinction, meaning they have fewer than 50 individuals remaining in the wild, the report reveals. These species are found all over the world, from the Mulanje cedar in Malawi, with only a few remaining individuals on Mulanje Mountain, to the Menai white beam found only in North Wales, which have only 30 trees remaining.

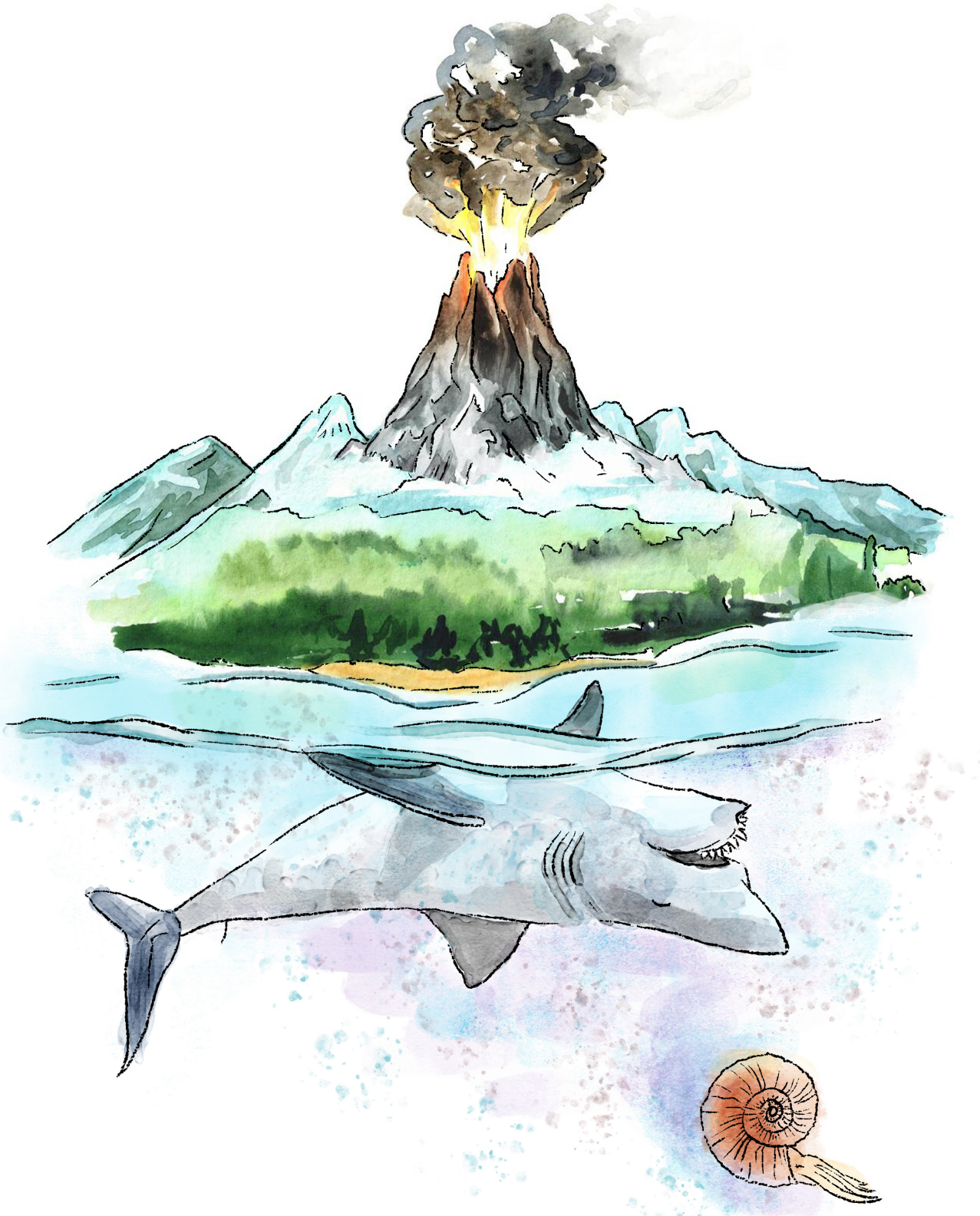
CHAPTER 3

HOW MUCH HEAT CAN OCEANS TAKE

These heat sinks have neutralised global warming so far, but the rise in sea temperature threatens marine, terrestrial life

Scientists Justin Penn and Curtis Deutsch have simulated the climate change events that led to the Permian extinction, which wiped out most of the life under the oceans some 250 million years ago. The two scientists from Stanford University in the US believe the event holds clues to how the current climate crisis is impacting the oceans. The Permian period (298.9 million to 252.2 million years ago) was a time before the dinosaurs ruled the planet. The oceans were 10°C warmer than they are now, and oxygen levels were 80 per cent lower. During the period, land masses collided to form the arid supercontinent Pangaea. The massive Panthalassic Ocean, which covered much of Earth, was home to many sponge and coral species, ammonites (tiny shelled organisms), brachiopods (invertebrate animals closely related to starfish), and *fusulinid foraminifera* (single-celled organisms closely associated with modern amoebas). Reptiles began to flourish. Sharks and bony fish thrived.

Towards the end of the period, a series of volcanic eruptions in the present-day central Siberia region injected massive amounts of greenhouse gases into the atmosphere. The uncontrolled greenhouse gas emissions triggered climatic changes. This sounded the death knell for the flourishing and diverse life forms. Roughly 96 per cent of marine species and 70 per cent of land species went extinct. Scientists refer to this period as the "Great Dying". "Climate change that happened at the end of the Permian era is similar to the one that is unfolding now," says Deutsch. To reach this conclusion, Penn and Deutsch first simulated the earth systems on a supercomputer, which represented the climatic



conditions 250 million years ago. Next, they developed the ecophysiological model to map out how species were distributed from surface to deep sea and from the equatorial waters to the poles. The team shortlisted 61 living species types. They then warmed up the climate by 2-10°C to see how these species responded. "Some species will have to leave because it got too hot or the oxygen got too low. Some species from the tropics can move into polar waters because they are more welcoming," says Deutsch.

Life has bounced back since the Permian extinction. Oceans are the planet's largest ecosystem, accounting for 95 per cent of all space available for life and hosting 90 per cent of the planet's total species. Beneath the oceans lies a world that is vast, diverse and elusive. Mountain ranges, hydrothermal vents that resemble terrestrial hot springs and volcanoes rise from the seafloor. The landscape is dotted with trenches, which go as deep as 11,000 m. The oceans are home to organisms of all sizes and shapes: from microorganisms to the blue whale.

But how climate change would impact or is already impacting the oceans usually draws a long and uncertain reaction. This is because we have never explored the oceans enough to know the impacts with certainty. The average depth of the oceans is 3,700 m, and 80 per cent of the areas have not been explored at all. The exact number of species that live in the ocean is unknown; 91 per cent of the species are yet to be classified. As they popularly say, we know more about the surface of the moon than our sea floor.

What we know with certainty is that the oceans modulate the global climate and control the planetary temperature, and thus the weather

The oceans modulate global climate and control the planetary temperature, and thus the weather events like rain, storms, cyclones, floods and droughts. Human lives are intimately tied to the oceans

events like rain, storms, cyclones, floods and droughts. Human lives are intimately tied to the oceans. About 50-80 per cent of the oxygen produced on Earth can be traced back to the sea. These saltwater bodies support the livelihoods of 3 billion people, according to the United Nations. Also, ocean currents—the continuous movement of water—have an essential role. Acting as conveyor belts, they transport warm water from the equators to the pole and cooler waters from the poles to the equators. Upwelling currents allow the vertical movement of water, pushing cold, nutrient-rich water from the ocean depths to the surface, which is critical for fisheries. But the most important role the oceans play is that of a carbon sink: four-fifths of the global carbon cycle is circulated through them. According to the Fifth Assessment Report of the UN Intergovernmental Panel on Climate Change (IPCC) in 2014, the oceans have absorbed more than 90 per cent of the global warming created by humans since the 1970s. This means that without the oceans, the global average temperatures would have jumped by almost 56°C.

The oceans have a carrying capacity to do their job as a carbon and heat sink. Over the years, they have been heating up. The global sea surface temperature is roughly 1°C higher than what it was 140 years ago. Life in the oceans is intimately linked to the level of sea surface temperature. Changes in ocean temperatures and currents will lead to alterations in climate patterns around the world. Ocean heat content reached a record high in 2021 when the upper 2,000 m of the ocean absorbed 235 zettajoules heat. The sum of the energy used by humans across the world in a single year is about 0.5 zettajoules. The oceans were fairly stable until about the 1980s, after which the top 500 m began to warm. Warming up to a 1,000 m depth became evident after about 1988. The heat reached 1,500 m in the late 1990s. And warming at 2,000 m depth has been evident since about 2005. "So, it took 25 to 30 years for the warming to penetrate to about 2 km below the surface. We see that the heat is gradually creeping down," says Kevin Trenberth, distinguished scholar at the National Center for Atmospheric Research in Colorado.

State of flux

In the past three decades, the top 2,000 m of the oceans have warmed up due to climate change

Going back to Justin Penn and Curtis Deutsch's seminal work on the oceans and climate change simulation experiment, the scientists, in 2018, initiated another study: what does climate change mean for the future? This time, they used a dozen earth-system models to make their simulations more accurate. They increased the temperatures to see how the species distributions changes. What they found was alarming: if emissions continue to climb and temperatures reach around 4.9°C by the end of this century, close to 40 per cent of marine genera could perish by 2300 and 8 per cent by 2100. The global average temperature in the current Anthropocene era is already up by 1.1°C since pre-industrial times. If the world continues on its current path of high greenhouse gas emissions, it will rise by 5°C by 2100.

Warming oceans impair water movement, which leads to poor exchange of oxygen between the surface waters and deeper waters. This results in oxygen minimum zones and dead zones in the ocean. The ideal oxygen levels in the oceans should be between 7 and 8 milligrams per litre (mg/l). Marine organisms start to leave their homes when the levels drop to 4 mg/l. Regions with oxygen concentrations below 2 mg/l are hypoxic or low oxygen zones. And those with less than 0.2 mg/l of oxygen are called anoxic. Globally, about 1.15 million sq km of the sea floor is exposed to oxygen concentrations of less than 0.7 mg/l. "There's evidence that the oxygen minimum zones are getting bigger globally due to global warming," says Raleigh Hood, professor at the University of Maryland Center for Environmental Science, US. He has studied the Indian Ocean basin throughout his career. "The Arabian Sea is the poster child of oxygen minimum zones. It covers 20 per cent of the area, going as deep as 800 m," he says.

While certain organisms like myctophids, popularly called lantern fish due to their light-emitting organs, have adapted to living in low-oxygen zones, it has forced most marine organisms that breathe oxygen to set up bases elsewhere. There is more trouble.

Bacteria that use oxygen as fuel can switch to nitrate or nitrite. They are called denitrifying bacteria. When their metabolism changes, it can have a big impact on the chemical properties of the ocean. These bacteria will start to release nitrogen gas, which will then enter the atmosphere and alter the global nitrogen cycle, Hood says. Ocean oxygen levels are expected to drop by an average 3-4 per cent by 2100 overall due to climate change and increased nutrient discharges, according to the International Union for Conservation of Nature (IUCN). The impacts include decreased biodiversity, shifts in species distributions, displacement or reduction in fishery resources and expanding algal blooms driven by the overgrowth of microscopic algae or algae-like bacteria.

While losing oxygen, the oceans are also turning acidic as they soak up more carbon dioxide (CO_2). The term "ocean acidification" was coined in 2003 after researchers suspected that acidic waters could take a toll on coral reefs and other organisms whose skeletons or shells are made of calcium carbonate. Acidification corrodes calcium. In 2012, scientists announced that the shells of oysters and crabs were thinning. They published these results in a report titled "Ocean Acidification: From Knowledge to Action".

When seawater absorbs CO_2, a series of chemical reactions occur, eventually releasing hydrogen ions into the water. Before the preindustrial era, the ocean pH was 8.2. It is now 8.1. The pH scale is logarithmic, and a 0.1-unit reduction corresponds to a 30 per cent increase in acidity. If we continue on our current trajectory, the pH could further drop to around 7.8, suggest

The global sea surface temperature is roughly 1°C higher than what it was 140 years ago. Life in the oceans is linked to the level of sea surface temperature. Changes in ocean temperatures will lead to alterations in climate patterns around the world

estimates. The open ocean surface pH is now the lowest it has been for at least 26,000 years, according to IPCC.

Species are already travelling poleward at a rate of 59 km per decade on average, according to the IPCC's "Climate Change 2022: Impacts, Adaptation and Vulnerability". The North Atlantic right whale, for example, is moving northwards as waters warm and food availability dwindles. "It used to feed in the Bay of Fundy, which is between the Canadian provinces of New Brunswick and Nova Scotia. These endangered giants seem to have abandoned the Bay of Fundy and moved elsewhere. Fish, lobsters, oysters, and certain crabs are also migrating to more suitable waters," says Andrea Buchholz, a marine ecologist at the Fisheries and Marine Institute, Memorial University of Newfoundland, Canada. The white-beaked dolphins, discovered in the cooler waters of the North Atlantic Ocean in 1846, have also moved to north-western waters from the southern areas between 1991 and 2017 due to warming oceans. Their population has dwindled over the years. Similarly, female sperm whales are unable to conceive at their normal rate because of their exposure to warm sea surface temperature for long periods. High temperatures take a toll on the survival rates of mammals and increase stress levels. As species move to newer waters, they are likely to encounter new pathogens, scientists warn.

On the deep seafloors, believed to be the harshest habitat, the extinction process is setting in. Elin A Thomas, a doctoral candidate at Queen's University, UK, researching the state of species in the hydrothermal vents, says this ecosystem is yet to be studied and species fully identified. "Our research found that of the 184 species (of molluscs) assessed, 62 per cent are listed as threatened: 39 are critically endangered, 32 are endangered and 43 are vulnerable." In the Indian Ocean vents, 100 per cent molluscs were already listed as critically endangered, Thomas says.

CHAPTER 4

MASS EXTINCTION?

All evidence and calculations indicate that the planet is witnessing its sixth mass extinction

The history of life on Earth is a random collation of the evolution, multiplication and extinction of new species. Of the 4 billion species that have evolved over the last 3.5 billion years, 99 per cent have disappeared in a series of extinctions, estimates Michael Novacek, senior vice president and provost of science at the American Museum of Natural History, in his 2001 research book *The Biodiversity Crisis: Losing What Counts*. New species have evolved after each bout of mass extinction. Scientists have tracked extinctions since the Cambrian period that began some 540 million years ago, when life forms diversified exponentially triggering the start of what we now call biodiversity. The Earth has experienced five mass extinctions so far; one every 100 million years on average. Each extinction period has lasted from 50,000 to 2.76 million years.

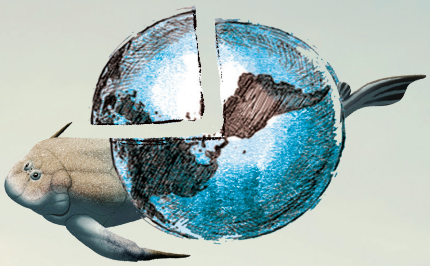
Are we currently experiencing the sixth mass extinction? Robert Cowie believes so. "Drastically increased rates of species extinctions and declining abundances of many animal and plant populations are well documented, yet some deny that these phenomena amount to mass extinction," he says. In the 1980s, scientists defined mass extinction as "any substantial increase in the amount of extinction (lineage termination) suffered by more than one geographically wide-spread higher taxon during a relatively short interval of geologic time, resulting in an at least temporary decline in their standing diversity". The "short interval of geologic time" is further defined as a period less than 2.8 million years.

Fossil records and extinction studies suggest a species exists for around 1 million years before it goes extinct. This is called the background extinction rate, and is expressed as "one species

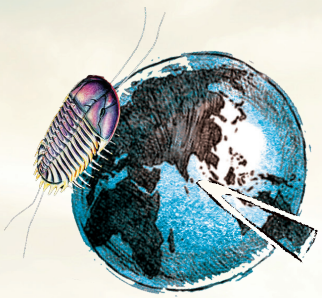
GOOD WHILE IT LASTED

Earth is losing species at an unprecedented rate, which, many believe, is the planet's sixth mass extinction. Since the biodiversity loss this time is the doing of humans, the event also marks the beginning of the Anthropocene Epoch, a self-aggrandising nomenclature that highlights our disproportionate and irreversible impacts on the surroundings

1st Extinction
The Ordovician Era
443 million years ago
85% of all species went extinct Reasons: An "ice age" followed by a rapid warming



2nd Extinction
The Devonian Age
374 million years ago
75% of all species went extinct
Reasons: Fluctuating sea levels, altering global cooling and warming, drop in CO2 concentration and periods of low oxygen



3rd Extinction
The Permian Age
250 million years ago
95% of all species went extinct
Reasons: An asteroid hit the planet, filling the air with pulverised particles, leading to inhabitable climate conditions

4th Extinction
The Late Triassic Age
200 million years ago
80% of all species went extinct
Reasons: Some colossal geological activity in the today's Atlantic Ocean that resulted in high CO2, global warming and acidified oceans

5th Extinction
Cretaceous Period
65 million years ago
76% of all species went extinct
Reasons: Meteor crash in the Yucatan peninsula in Mexico, high volcanic activity

6th Extinction
The Holocene Epoch
About 99% of the planet's species have been lost in the previous five mass extinctions Ongoing
Reasons: Anthropogenic factors like climate change and introduction of invasive plant species

extinction per million species-years". It is used to establish whether an extinction rate is unusual. "If we use the same approach to estimate today's extinctions per million species-years, we come up with a rate that is between 10 and 10,000 times higher than the background rate," academics Frédérik Saltré and Corey J A Bradshaw of Flinders University, Australia, say in a 2019 article in *The Conversation*. Some scientific studies infer that given the current rapid rates, a mass extinction period could also be reached in just 240 to 540 years.

A July 2019 update to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species shows that more and more species assessed are under threat of extinction. The IUCN Red List assesses 105,732 species, breaking the 100,000 species barrier, making it the largest such assessment of its kind. "This update clearly shows how much humans around the world are overexploiting wildlife," says Grethel Aguilar, the acting director general of IUCN. According to the new updated list, 28,338 species are under threat of extinction.

Such is the loss of biodiversity that nature has started failing to provide its most crucial benefit to us: supporting our quality of life. Scientists have identified 18 categories of contributions—from cleaning air and water and sequestering carbon to pollinating crops—that ensure quality of life for humans. In the last 50 years, nature has failed to contribute in 80 per cent of these categories.

The world may miss the Sustainable Development Goals' (SDG) target by a wide margin if humans do not act to protect the natural order: close to 80 per cent—35 of 44—assessed targets of the UN-mandated SDGs would remain unmet, with biodiversity loss impacting the goals related to poverty, hunger, health, water, cities, climate, oceans and land (SDGs 1, 2, 3, 6, 11, 13, 14, and 15).The current trajectories used for conserving and sustainably using nature and achieving sustainability, such as those embodied in

the Aichi Biodiversity Targets and the 2030 Agenda for Sustainable Development, would remain unachieved. Although there has been a progress in the implementation of various policies and actions to conserve nature and manage it more sustainably, they are not sufficient to stem the direct and indirect drivers of deterioration.

We are yet to identify all the species that make our planet their home. Scientists have been discovering new species almost every day, but we do not have a 'final' list of species yet. Peer-reviewed papers suggest the estimate of total species in the world ranges from three million to over 100 million. Of these, taxonomists may have managed to identify and name only about 1.7 million. According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), every year, descriptions of 10,000 to 15,000 new species are published. For its 2019 Assessment, the IPBES used a figure of 8.1 million animal and plant species estimated till 2011.

"Biodiversity and nature's contributions to people are our common heritage and humanity's most important life-supporting 'safety net'. But our safety net is stretched almost to breaking point," says Sandra Díaz, a professor of ecology at the National University of Córdoba, Argentina, who also contributed to the IPBES assessment. "The diversity within species, between species and of ecosystems, as well as many fundamental contributions we derive from nature, are declining fast, although we still have the means to ensure a sustainable future for people and the planet."

CHAPTER 5

THE AGE AND RAGE OF HUMANS

The rapid, all-pervasive loss of biodiversity is driven by human-induced climate change and invasive species

The ongoing sixth mass extinction is different from the previous similar events. While the earlier extinctions were triggered by the planet's warming, the ice age or even volcanic eruptions, the current one is being driven by just one species—*Homo sapiens*, or us. In 2017, a total of 15,364 scientist signatories from 184 countries warned in a paper in the journal *BioScience* that humans had unleashed the sixth mass extinction "wherein many current life forms could be annihilated or at least committed to extinction by the end of this century". From an evolutionary perspective, this phase is not just drastic but also unique, for the simple fact that it revolves around one super colonising species.

We will be the first *Homo sapiens* to witness the Earth entering a new geologic epoch named after us. In May 2019, scientists voted for declaring the descent of the new epoch, named the Anthropocene, or the Age of the Humans. A 34-member panel called the Anthropocene Working Group—set up by the Sub-Commission on Quaternary Stratigraphy, a part of the International Commission on Stratigraphy that oversees the geologic time chart—would soon formally put a proposal to its parent body to declare the new age for the planet.

This will mark the end of the current epoch called Holocene, which his started 12,000 to 11,500 years ago. This age tentatively coincides with humans adopting settled agriculture after a change in the planet's climate.

The planet was looking at a new geography, demography and ecosystem as the Palaeolithic Ice Age came to an end. Glaciers melted, mammoths and woolly rhinoceroses could not survive the warm climate, new forests came up in vast areas, and humans decided to quit food gathering and hunting for a more settled life. The rising temperature reduced the Ice Age's harsh cold. This led to a growth in human population. Perhaps this epoch was meant for them.

But within thousands of years, humans have completely taken over the planet, its geography and ecosystems, so much so that a new epoch has to be designated to mark this surge. Of the 34 members of the Anthropocene Working Group, 29 supported the proposal to declare mid-20th century as the beginning of the epoch. In the intense debate over this time period, scientists argued that the new epoch started with the industrial revolution that led to industrial production, discovery of chemicals and the cascading effects on natural systems. Scientists are now scoping for sites to look for evidence of human interventions in our ecosystems that can be used to declare the start of the Anthropocene.

They are specifically looking at radionuclide from the first nuclear weapons tests in 1945 that have scattered across the globe, becoming part of the earth's soil, water, plants and glaciers, and thus leaving everlasting human imprints. "The stratigraphic evidence overwhelmingly indicates a time-transgressive Anthropocene with multiple beginnings rather than a single moment of origin," says Matt Edgeworth, an archaeologist at the University Of Leicester, UK, and a member of the Anthropocene Working Group. In 2016, for the first time, the International Geological Congress held in Cape Town, South Africa, informally voted for declaring this new epoch.

In 2018, scientists from the University of Leicester, UK, proposed the "broiler chicken" as the marker of the human impacts on the planet to be used for declaring the Anthropocene. Their study

published in the *Royal Society Open Science* journal found that the broiler chicken does not have any connection to its ancestors, the jungle fowl that originated in India and spread across the planet. "Until now, no individual taxa have been suggested as distinct and characteristic new morphospecies representing this change. Here we show that the domestic broiler chicken is one such potential marker," the research paper says, adding, "Human-directed changes in breeding, diet and farming practices demonstrate at least a doubling in body size from the late medieval period to the present in domesticated chickens, and an up to fivefold increase in body mass since the mid-twentieth century. Moreover, the skeletal morphology, pathology, bone geochemistry and genetics of modern broilers are demonstrably different to those of their ancestors. Physical and numerical changes to chickens in the second half of the twentieth century, i.e. during the putative Anthropocene Epoch, have been the most dramatic, with large increases in individual bird growth rate and population sizes. Broiler chickens, now unable to survive without human intervention, have a combined mass exceeding that of all other birds on Earth; this novel morphotype symbolizes the unprecedented human reconfiguration of the Earth's biosphere."

As a species, humans' dominance and destruction of the ecosystem is disproportionate. Let's look at a unique experiment, a census exercise of unprecedented scale and proportions. It involved deciphering the composition of 550 gigatonnes of biomass—the total biomass distributed in all the kingdoms of life on Earth—to understand the structure and dynamics of the biosphere. The work of scientists Ron Milo and Yinon M. Bar-On of Israel's Weizmann Institute of Science, the results of this biomass

The hotter the environment, the faster the rate of living, which, in turn, leads to accelerated ageing and a shorter lifespan. The theory is critical to understanding factors that contribute to extinctions

census were released in 2019. The startling findings brought out not only the devastating changes in the planet's biodiversity, but also the impacts of the Anthropocene on it. "It is definitely striking—our disproportionate place on Earth," remarks Ron Milo while unveiling the census results. According to the planet's "first" biomass census, 7.6 billion humans account for just 0.01 per cent of all biomass on Earth. Now, contrast this with many other species that we barely acknowledge: bacteria, for instance, account for 13 per cent of the total biomass; plants, for 83 per cent; and all other forms of life, just around 5 per cent.

The census found unmistakeable signs of irreversible human impacts. Humans, say scientists, have been responsible for the annihilation of 83 per cent of all wild mammals and half of the plants on Earth. Humans have not only been the reasons for extinction of species, but they also decide which species may survive and thrive. "Of the birds left in the world, 70 per cent are poultry chickens and other farmed birds. And of the mammals, 60 per cent are livestock, 36 per cent are pigs, and a mere 4 per cent are wild," say the census findings. Ron explains: "When I do a puzzle with my daughters, there is usually an elephant next to a giraffe next to a rhino. But if I was trying to give them a more realistic sense of the world, it would be a cow next to a cow next to a cow and then a chicken." He adds: "The biomass of humans and the biomass of livestock (dominated by cattle and pigs) far surpass that of wild mammals." Similarly, "the biomass of domesticated poultry (dominated by chickens) is about threefold higher than that of wild birds," says Ron.

Nick Longrich, senior lecturer in evolutionary biology and palaeontology, University of Bath, UK, says the migration of *Homo sapiens* out of Africa and the arrival of modern humans led to the extinction of other human species. Nine human species lived on Earth 300,000 years ago. "By 10,000 years ago, they were all gone. The disappearance of these other species resembles a mass extinction. But there's no obvious environmental

catastrophe—volcanic eruptions, climate change, asteroid impact—driving it. Instead, the extinctions' timing suggests they were caused by the spread of a new species, evolving 260,000-350,000 years ago in Southern Africa: *Homo sapiens*," he says in a November 2019 article in *The Conversation*. His reasoning? "Humans reproduce exponentially, like all species. Unchecked, we historically doubled our numbers every 25 years. And once humans became cooperative hunters, we had no predators. Without predation, controlling our numbers and little family planning beyond delayed marriage and infanticide, populations grew to exploit the available resources," he says in the article.

Hence, the concept of a "natural environment" no longer makes sense, as there is nothing on this planet, animate or inanimate, that humans have not tinkered with. There is no doubt that *Homo sapiens*, by virtue of its far superior brain, is the most successful species on Earth. A good measure of our domination is the way we have colonised the entire planet in the last 12,000 years. Much

as we may laud ourselves for our ingenuity and enterprise, this spectacular triumph has come at a very heavy cost, the dire impact of which is beginning to dawn on us only now. Two of the most alarming results have been the changing climate and large-scale extinction of species. Extinction, in fact, has emerged as a word that is perhaps the most repeated one today, when we talk about biodiversity—and never before has humankind been witness to such a rapid change in biodiversity.

In 21 countries with detailed records, the numbers of invasive alien species has risen by an average of 70 per cent since 1970. This combination of declining endemic species and the spread of already widespread species (humans purposefully or unwittingly transport species around the world) drive "biotic homogenisation"—a convergence of biological communities across regions that blurred the patterns on life's rich tapestry. According to the Convention on Biological Diversity: "Invasive alien species are species whose introduction and/or spread outside their natural past or present distribution threaten biological diversity." These species are found in, or known to, impact animals, plants, fungi and microorganisms, and can affect all types of ecosystems. The old story of invasive alien species wreaking havoc on local biodiversity has a new villain and geography: the marine invasive alien species and the islands in the Asia-Pacific. What scares global conservationists and biodiversity experts is that the world does not know enough about these destructive marine invasive alien species to prepare a strategy for their elimination.

Invasive alien species have spread across and populated faster. They have been regarded as the most serious drivers of biodiversity loss across the Asia-Pacific region. While agriculture-intensive areas and urban clusters are the usual victims, such attacks mostly happen on islands and around coastlines. For the Asia-Pacific region, this poses a serious threat to local livelihoods. The freshwater ecosystems in the region support close to 28 per cent of aquatic and semi-aquatic species. Around

37 per cent of these species are threatened by overfishing, pollution, infrastructure development and invasive alien species.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019 assessment highlights the spread of marine invasive alien species that are yet to be studied well. "There is also increasing evidence that marine invasive alien species constitute an extremely serious, but less well understood, threat to fisheries, coral reefs and the overall functioning of marine ecosystems and food webs in the Asia-Pacific region," it says. Recently, the journal *New Scientist* reported that waters around the Galapagos Islands "have been invaded by more alien species than previously thought". There have been widespread reports of oceanic islands being invaded by invasive alien species.

In its report, "Climate Change 2022: Impacts, Adaptation and Vulnerability", the Intergovernmental Panel on Climate Change (IPCC) had, for the first time, mentioned the extinctions taking place due to climate change. "In terrestrial ecosystems, 3 to 14% of species assessed will likely face very high risk of extinction at global warming levels of 1.5°C, increasing up to 3 to 18% at 2°C, 3 to 29% at 3°C, 3 to 39% at 4°C, and 3 to 48% at 5°C," warns IPCC, reflecting other similar forecast. Species had evolved while the Earth experienced extreme colder and warmer periods.

For more than a century, aging has been explained by the rate of metabolism—the faster the body functions and the sooner it reproduces, the shorter the lifespan. But is it so? In a study published in 2020, researchers from the Queen's University Belfast and Tel Aviv University did not find any correlation between the

Humans have been responsible for annihilation of 83 per cent of Earth's wild mammals and half of the plants. They are not only the reason for extinction of species, but also decide which species may survive

rate of living and lifespan. Their expansive sample study, rather, found a "huge" impact of global warming on the life expectancy of cold-blooded species such as reptiles and amphibians. A warmer climate indeed shortened the lifespan of such species, pushing them towards faster extinction.

Researchers from the two varsities analysed metabolism of 4,100 land vertebrate species from across the world. "Over 100 years old, until now the theory had not been tested at a global scale with all land vertebrates and there were limitations with the range of species the theory was tested on," says a press release by Queen's University Belfast. The study, published in the journal *Global Ecology and Biogeography*, found the rate of ageing "in cold-blooded organisms including amphibians and reptiles are linked to high temperatures". The researchers had proposed an alternative hypothesis to the "rate of living": The hotter the environment, the faster the rate of living, which, in turn, leads to accelerated aging and a shorter lifespan. The findings can be critical to understand factors contributing to extinctions, especially at the modern times of a worldwide decline in biodiversity, says Daniel Pincheira-Donoso, a co-author of the study and a lecturer at the School of Biological Sciences at Queen's University. "Now we know that the life-expectancy of cold-blooded vertebrates is linked to environmental temperatures, we could expect to see their lifespans further reduced as temperatures continue to rise through global warming," Pincheira-Donoso says.

The team's findings mean that cold-blooded species are more vulnerable to global warming and faster extinction. "Indeed, if increasing ambient temperatures reduces longevity, it may make these species more prone to go extinct as the climate warms," says Gavin Stark, a lead author of the study at Tel Aviv University.

The current period of human-induced warming is turning out to be a situation which organisms may find unadaptable. For nearly all the planet's surface, the warmest period of the last 2,000 years was

experienced in the late 20th century and in the first two decades of the 21st century. The current warming is 1.2°C above the pre-industrial levels. This means, from the evolutionary perspective, humans are already moving out of the Holocene environment that ensured the right temperature for us to evolve and take up farming. The IPCC report had reiterated that "in the coming 50 years, 1 to 3 billion people are projected to experience living conditions that are outside of the climate conditions that have served humanity well over the past 6000 years". It says half of all species are moving towards the poles or to a higher elevation to adapt to the new planetary climate. At the sea, due to the warming, species have travelled pole-ward at the rate of 59 km per decade on average.

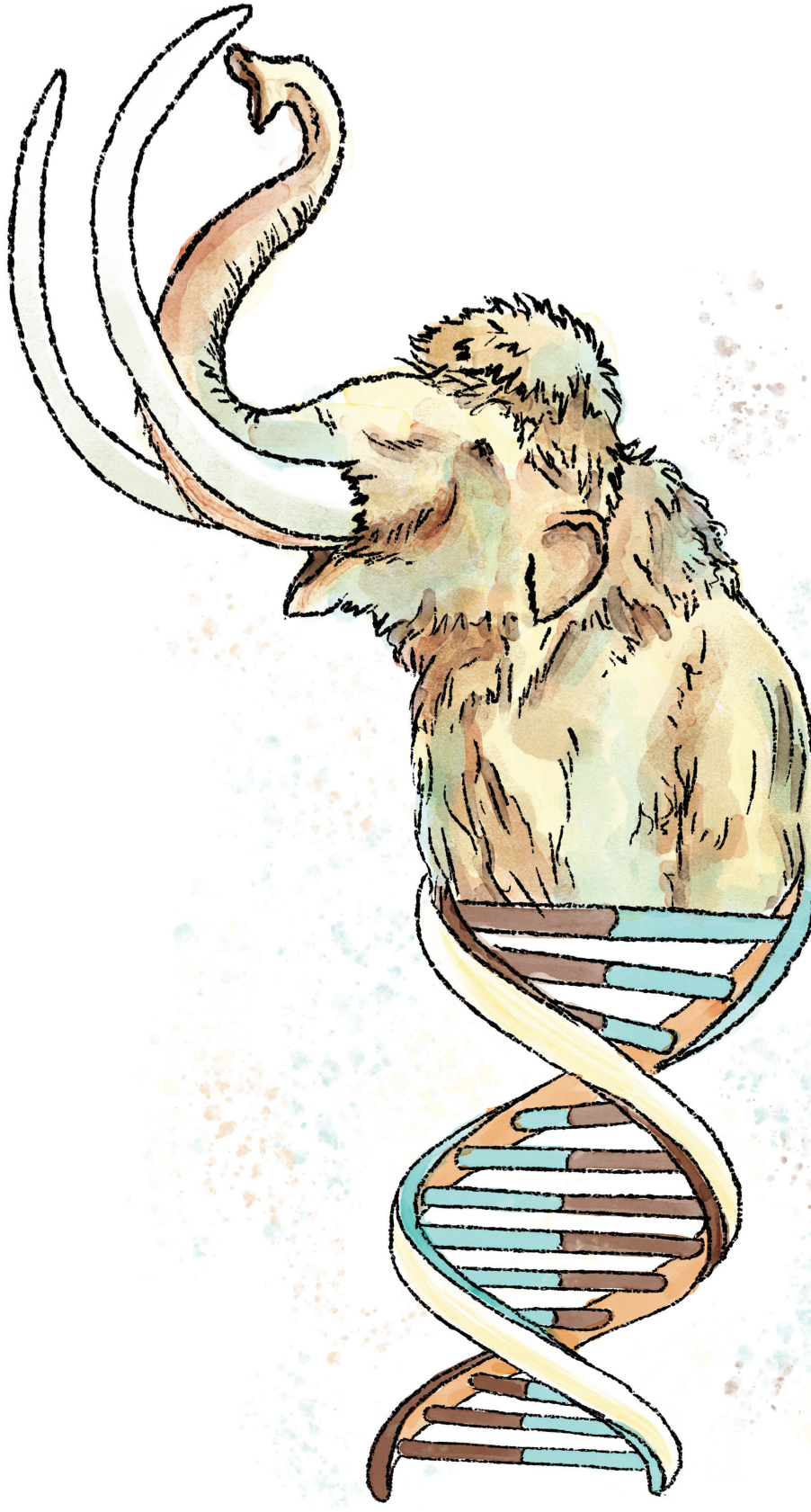
CHAPTER 6

WHAT IF THE LAZARUS RETURNS

Scientists continue to draw up secret plans to bring extinct species back to life

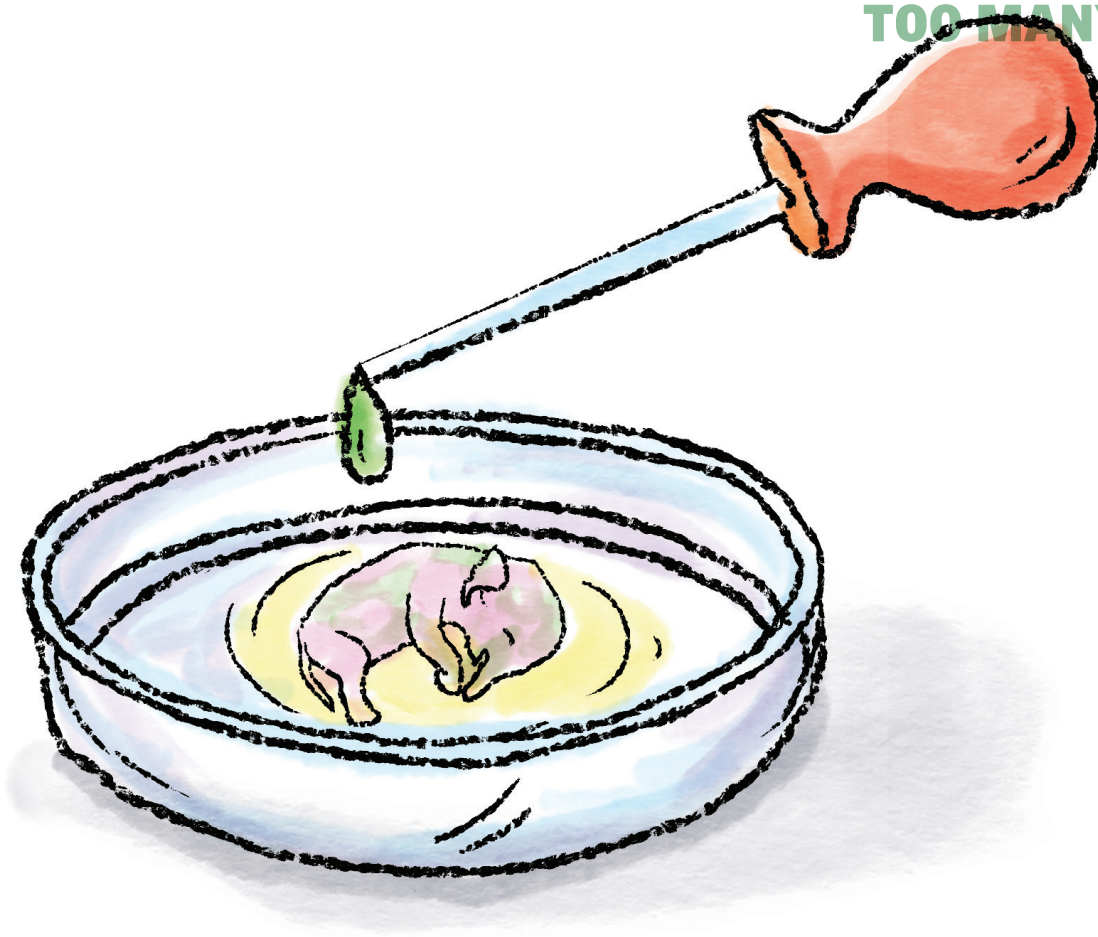
In September 2016, high up on the mountains of the New Guinea Island, scientists were thrilled to find, on camera traps, 15 members of a wild dog species not seen in the wild for over half a century. Long labelled a living fossil (about 200 species survive in captivity), the highland wild dog is the most primitive living canine. News of its sightings was soon followed by reports that some people had "plausibly" seen a Tasmanian tiger, a dog-like marsupial predator that disappeared more than 80 years ago, in northern Queensland, prompting a scientific expedition in its quest.

It is bewildering, in a happy way no doubt, that in this age of the modern panopticon—satellite eyes, scientific expeditions and wildlife photographers—creatures as large as the highland wild dog or the Tasmanian tiger could go under the radar for so long. Imagine, for a moment, that the Asiatic cheetah, which once graced the Indian grasslands and whose last three representatives were murdered in 1947 by the Maharaja of Surguja, a notorious serial killer of big cats, in present-day Chhattisgarh, were similarly found lurking in the forests of central India! (India plans to have a few of them translocated from Africa to Madhya Pradesh on September 17, 2022.) Wish as we may, and we all do, that the highland wild dog is not a freak lost-and-found case, the truth is that the planet is in the throes of The Sixth Great Mass Extinction, which, scientists reckon, has already wiped out hundreds of species, like the Tasmanian tiger, the woolly mammoth, the sabre-toothed tiger, and the steppe bison, to name just a few of the charismatic ones.



But if some maverick scientists are to be believed, it might yet be possible to resurrect them (or something like them, at least) by doing some genetic hocus-pocus on their dead DNA, intact or broken. Luck is on the side of the Asiatic cheetah. For, while it may have disappeared from India for good, about 100 of its cousins still survive, albeit precariously, in Iran. This means if it could be cloned, Yuz, as this symbol of grace and agility is known in Persian, may yet be seen sprinting again in the Indian grasslands. Now such claims, especially about reviving the bygones, may smack of audacity, even hubris, but armed with a new cutting-edge genetic toolbox, scientists can now do stuff with the basic genetic material that would have seemed fantastic just a decade ago. They can now extract highly tattered DNA from bones and hair of extinct species, decode its grammar cheaply and rapidly, and play around with the genetic structure of living species.

De-extinction, as the revival of extinct species is called, is probably many years away, but the first few experiments have shown promise. Or, so its apologists would like us to believe. In 2009, a team of Spanish and French scientists successfully cloned the Pyrenean ibex, also known as the bucardo, in the womb of a surrogate, albeit the calf died within minutes. In 2013, Australian scientists claimed that they had managed to create embryos of an extinct frog, called the Lazarus, by stitching DNA from its frozen cell into the genetic fabric of a living species. The most glamorous of the de-extinction projects is, without doubt, the woolly mammoth, an ancestor of the modern Asian elephant that roamed the tundra steppes in Russia and North America about 12,000 years ago but which gradually disappeared about 4,000 years ago, thanks, presumably, to climate change and the arrival of a hunter extraordinaire called *Homo sapiens*. This shaggy beast enjoyed a different kind of revival by way of its celluloid avatar, Manny, in the *Ice Age* animation series. But piecing it together in the lab is a different ball game altogether, not very different from solving a jigsaw puzzle several of whose pieces



are either missing or altered. It turns out that you can remake the woolly mammoth in more ways than one. Some scientists like Akira Iritani of Kyoto University in Japan believe that they can clone the hairy tusker by extracting operative cells from its frozen relic. Akira had claimed that he would clone the mammoth by 2016 but there is no sign of it yet.

Most people imagine that freezing something protects it against decay. True, and, to be sure, most of the mammoth remains—eyes, teeth, hair, blood—are preserved in a frozen state. However, unless one adds an anti-freeze substance to it, like they do now with stuff such as sperms, eggs, dead bodies and seeds that need to be frozen to be stored for a long time, water in the tissues turns into ice, and as it expands it ransacks the cell's delicate scaffolding. Barring a rare exception in 2008 when Japanese scientists claimed to have cloned mice from brain cells frozen for over 16 years—a feat yet to be replicated—all attempts to clone a frozen cell have so far come to naught. Harvard University's George Church, one of the most

vocal champions of de-extinction, is convinced that the Japanese scientists are barking up the wrong tree. He is instead trying to identify genes linked to particular traits of the mammoth, such as genes that made it shaggy or protected it against glacial cold, and then sew them into an Asian elephant's genome. He claims that he is just a couple of years away from creating the first hybrid mammoth embryo.

Woolly mammoth may have become the poster boy of de-extinction, but work is in progress on other species too, notably the heath hen and the passenger pigeon, both extinct birds from North America. Revive and Restore, a non-profit started by Stewart Brand, author of *Whole Earth Discipline: An Ecopragmatist Manifesto*, to boost de-extinction projects, lists many extinct species that could be revived, as well as endangered species that may be restored with genetic assistance. For all the euphoria over de-extinction, we will never be able to revive a lost species with full fidelity. At best, science can smuggle some of the lost traits of an extinct organism into its nearest relative, and hope that it would be viable in the wild. As Beth Shapiro, a specialist on ancient DNA at the University of California, Santa Cruz, explains in *How to Clone a Mammoth*, "by engineering these extinct traits into living organisms...we can reestablish inte ractions between species that were lost when one species went extinct...This—the resurrection of ecological interactions—is, in my mind, the real value of de-extinction technology."

But critics find such arguments facile, even naïve. Besides being expensive, quixotic and unpredictable, they say, de-extinction is a Trojan horse that will eventually weaken the will of the public as well as the state to protect endangered species and habitats. Moreover, there are uncomfortable ethical questions like whether an ill-equipped resurrected lost species would be able to survive in an alien environment; or, whether it is conscionable to exploit the already endangered Asian elephant as surrogate to create a pseudo mammoth. Some argue that if we are not able to protect

the habitats of existing species, how will we accommodate de-extinct species. Anticipating this problem, Sergey Zimov, a geophysicist with the Russian Academy of Sciences, set up in 1988 the Pleistocene Park in Siberia to welcome resurrected mammoths as and when they arrive. But, surely, this solution cannot possibly apply to most parts of the world where humans are constantly in conflict with wildlife.

De-extinctionists, on the other hand, argue that in the Anthropocene, where humans have altered the planet irreversibly, the old-school idea that it is enough to preserve habitats to protect species is no longer tenable. As M R O'Connor writes in his *Resurrection Science*, "returning to a prelapsarian state of untouched wilderness, if one ever truly existed, is impossible". With old distinctions between human and animal, wild and domestic, freedom and captivity, and ethics and conservation ethics withering away, the discipline of conservation biology appears to be in a crisis. So when Edward Wilson in his latest book *Half-Earth* demanded that half the planet be converted into wilderness, critics attacked him for disregarding the rights of displaced communities.

De-extinction probably represents one extreme in a spectrum of new ideas about how to reimagine nature in the Anthropocene. To name a few notable others, genetically retrofitting a species so that it can adapt to climate change; rewilding, which involves restoring ecosystems by reintroducing keystone species that once graced them; creating new, more resilient hybrids; and replacement ecology, in which ecosystems that cannot be restored to their original condition are turned into homes for alien species.

The most glamorous of the de-extinction projects is the woolly mammoth that disappeared about 4,000 years ago, thanks, presumably, to climate change and the arrival of a hunter extraordinaire called *Homo sapiens*

Stewarded by such ideas, the earth might look like a very different place 25 years from now—cheetahs, lions, panthers and tigers sharing the same home; Asian elephants roaming the forests of Europe and North America; woolly mammoths and steppe bison rambling in Siberia and North America; cities punctuated by micro forests; islands, such as New Zealand, purged of all predators; and, even if quite implausibly, the expression "as dead as a dodo" going extinct. All said and done, the ethical question that looms large upon all of us is whether humans should be writing the script for nature's stories.

No easy answers there, not at least now, especially in a post-truth world. We can only hope against hope that the world 25 years from now will be a less precarious place for all Earthlings. The strike rate of successful wildlife conservation initiatives remains poor. In fact, more species are included in the near extinction and other endangered categories each year. That's why the latest Red List report of the International Union for Conservation of Nature (IUCN) has come as a breather for four key species.

The Giant Panda (*Ailuropoda melanoleuca*) has moved from the more alarming "endangered" category to the "vulnerable" category; the Tibetan Antelope (*Pantholops hodgsonii*) from being "endangered" to "near threatened"; the Greater Sticknest Rat (*Leporillus conditor*) from "vulnerable" to "near threatened"; and, the Bridled Nailtail Wallaby (*Onychogalea fraenata*) from "endangered" to "vulnerable". Their populations have increased significantly, and they offer critical conservation lessons. These successes have been attributed to stringent conservation measures adopted by governments. Take for instance the Giant Panda, whose numbers dropped to under 1,000 in 1970s. Found only in China's Sichuan, Shaanxi and Gansu provinces, the pandas were close to extinction due to habitat fragmentation and their inability to find food, bamboo, in winters. They were forced to confine themselves

to narrow strips of land, where they had to face new threats—they were being poached for their skins and panda cubs were caught and trained for Chinese circuses.

The Chinese government implemented various strategies—it created 67 protected panda reserves and started captive breeding programmes. Initiatives such as the Natural Forest Protection Project and Grain for Green Project increased bamboo plantations, and under the "Rent-a-Panda" programme, pandas were rented for up to US $1 million a year, and the money generated was used to fund conservation programmes. "These projects also checked soil erosion and restored bamboo forests by reconverting farmlands to bamboo forests, thereby restoring the natural habitats for the pandas in the wild," said Li Yang Chen, founder of Panda Conservation Trust. Laws were also enacted, including the Regulation on Protecting Ecological Environment of Qinling Mountains in 2007 to secure their habitat, as well as a penal code, under which poachers could be punished with a 10-year jail sentence or even death. Currently, there are more than 2,050 pandas.

The Tibetan Antelope, also known as chiru, was being slaughtered mercilessly for wool for decades, as the wool cannot be sheared or combed. It takes three to five hides to make a shawl out of their wool. "In Kashmir, the expensive shawls were presented as a form of dowry," said Kangana Kaul, a Srinagar-based wildlife researcher. When their numbers dipped to less than 65,000 in the 1990s, the Chinese and the Indian governments banned the trade and curbed poaching. The Chinese government also created 33 migration passages for the antelopes. Their population increased to 100,000-150,000.

Endemic only to Australia, the Bridled Nailtail Wallaby is considered to be the marsupial species with the strongest immune system, which can survive even the deadliest of viruses. Habitat destruction in the form of agricultural expansion was the primary

reason for its decimation. It was regarded as pest and killed, or hunted for its fur. The Australian government launched the Species Recovery Programme, which involved the preservation of existing populations in national parks, identifying and mapping critical habitats, checking the risk of predators by monitoring fox and feral cat populations in the protected areas."The species was pushed to extinction with barely a hundred individuals left in the early 2000s. Their population has increased to about 1,200 individuals," says Philip Stevenson, a Queensland-based biologist and secretary of the Native Wildlife Conservation and Research Foundation of Australia.

"With the introduction of herbivores such as sheep, cattle and rabbits for human benefits, the Greater Sticknest Rat had to fight a losing battle for habitat. And then there were severe droughts too," said Stevenson. To secure their habitats, the Australian government created a hub in Franklin Island, Cairns City, and initiated captive breeding programmes. The captive-bred rodents have been successfully reintroduced into the wild. The success of these conservation strategies to revive the populations of these four key species should enable us to learn and implement an integrated approach for each case, as nearly 23,930 species are one step close to extinction.

Earth has lost a staggering 150,000 to 260,000 species since the year 1500. Some 1 million animal and plant species face extinction, and thousands will become extinct within decades. All evidence and calculations indicate that the planet is witnessing its sixth mass extinction driven by humans

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