

CONTENTS

Introduction: Ecology, Evolution, Earth—and Us	1
1 All Life Is Extinct* <i>(*Almost. Biodiversity from the Birth of Earth to the Rise of Homo)</i>	14
2 A World Without Giants <i>(Carnage in the Ice Age)</i>	56
3 The Great Domesticator <i>(Making Homes for Animals in the Holocene)</i>	96
4 Civilizing Nature <i>(The Ecosystems of Cities and States)</i>	141
5 Windfall <i>(Oceans and Islands at the Dawn of Modernity)</i>	185
6 Raw Material, Cooked Planet <i>(Combustion, Carnivory, and the Modern World)</i>	236
7 The Human Earth <i>(Animal Life in the Anthropocene)</i>	287

X CONTENTS

<i>Acknowledgments</i>	345
<i>Appendix: Domesticated Animals</i>	347
<i>Notes</i>	351
<i>Bibliography</i>	383
<i>Index</i>	455

Introduction

ECOLOGY, EVOLUTION, EARTH—AND US

ONCE UPON A TIME, on an ocean far away, a ship capsized in a storm. The survivors washed ashore on an uncharted island. They found themselves in a strange land, teeming with animal life. Famished and desperate, the castaways started to hunt. But the creatures on this island were not just ordinary animals. Their ancestors had escaped human dominion by fleeing from the offspring of Adam. These animals prized their freedom, and they were offended to find themselves regarded as inferior. They quickly lodged a legal complaint, challenging the claims of human pre-eminence and laying out a bill of grievances against our species.

The charge sheet was long—and all too plausible. From the animals' perspective, humans brought little but violence and desolation. We put once-free creatures under the yoke of slavery and chased others into the remotest wilderness. In a frenzy for gold, we scoured caves and mountaintops and gouged pits deep into the earth. Our voracity was boundless, and it left no place untouched.

The “Case of the Animals Versus Man,” as this fable is known, is an attempt to view ourselves through the eyes of our animal companions. The thought experiment might feel modern, but in fact it was written a millennium ago, in Arabic. The “Case of the Animals Versus Man” reminds us that our impact on nature is not new and neither is our moral anxiety about it.¹

That same spirit animates this book, which is a history of humanity through the prism of our relationship with the rest of animal life. It asks

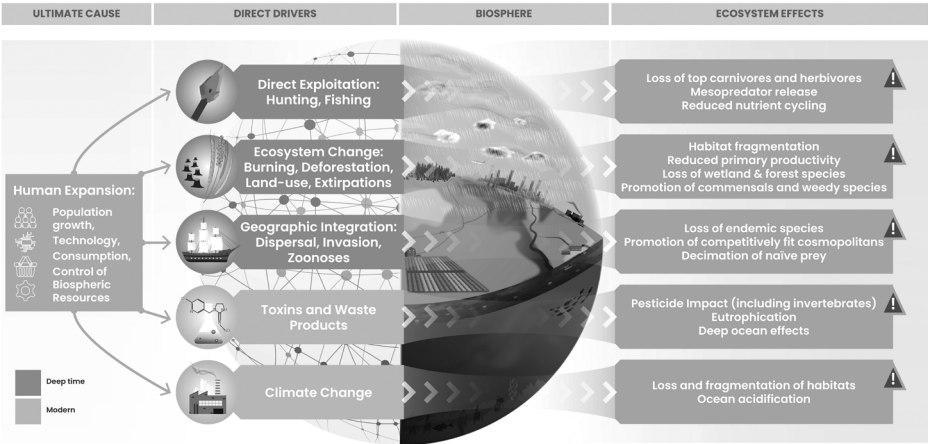


FIGURE 0.1. Drivers of biodiversity loss

one central question: Over the course of our past, what have we done to animal biodiversity on this improbably hospitable planet?²

It is a pressing question. It is arguably as consequential as any we face. The rate at which animals are going extinct today is faster than at any time since the age of the dinosaurs. We overhunt and overfish. We convert wild forest, wetland, and prairie into crop rows and pasture. We deploy billions of pounds of toxic pesticides each year. In our interconnected world, invasive species easily move across oceans and continents, to the detriment of native life. Now climate change looms as a wild card, compounding the challenge of survival on a planet out of tilt. Add it up and you have a crisis familiarly known as the *Sixth Extinction* (see figure 0.1).³

We know that our ascent is an existential threat to many of our fellow travelers. The last white rhinos or lonely pandas make photogenic icons of the biodiversity crisis. But the peril is both wider and more intimate than that. We all have some personal experience, subliminal maybe, of the changes that have transpired in the fleeting span of a human generation. Here on the southern plains, where I have lived virtually my whole life, it was not so long ago when the voices of wild turkeys and bobwhite quail were familiar; when a car ride left the

windshield festooned with grasshopper gizzards and legs; when my grandfather and I could catch gentlehearted horned lizards at will; when swarms of lightning bugs lit up the summer twilight, like luminescent popcorn. Now you rarely hear the thunderous gobble of the toms and almost never flush a covey of quail. The windshields stay eerily clean. My children have never seen a horned lizard. A lightning bug has become a thrillingly exotic sight.⁴

Small things—but ominous, like leaves wafting in the air before a storm. Change like this simply shouldn't be visible. As a historian, it is in my nature to wonder where things come from. *When did the biodiversity crisis start?* If we live on the cusp of something like a new mass extinction, *how did we get here?*

The bookshelf is already crowded with volumes that explore humanity's impact on the rest of the animal kingdom. Some focus on events of the very distant past, such as the disappearance of the megafauna at the end of the last Ice Age. Most take measure of the present, deploring the destruction around us. Yet in this scrum, there is no book that tries to tell the full story, to retrace our steps from savanna predators armed with stone tools to the planetary force we have become. Such a wide approach will mean sacrificing fine-grained detail, but this angle of view might render some of the larger patterns more visible, make scrutable the deep connections between past and present.⁵

The wide perspective is, in a sense, the argument. Human history is *ecological* history—a story about the web of life, about the energy that pours in from our sun and all the conversions, swaps, thefts, and murders that transpire before it dissipates as dull heat. Human history is also *evolutionary* history. The diversity we are presently undoing is the creation of eons, a grand experiment that we are changing on the go, upending the rules without quorum or consent. Human history is, finally, *Earth* history—a story about how one species commandeered a living planet. To see ourselves in true profile is to climb to the vantage point where these stories converge. We urgently need this perspective if we hope to obtain a full reckoning of what we have done, how we have done it, and what it means for our future as well as the planet's.

There Is No Sixth Extinction, and We Are in It

The idea of the Sixth Extinction is the offspring of somewhat improbable parentage. On one side is paleontology, the science of looking deep into the fossil record to understand the evolution of life. On the other is conservation biology, the science (and politics) of trying to protect biodiversity. The idea was born not so long ago, but like many an ambitious child, it has quickly outgrown the circumstances of its birth and taken on a life of its own.

Start with paleontology. Life on Earth is around four billion years old. Animals have been around for six hundred million years or so—or at least, that is how long they have been laying down body parts that turn into fossils. By the nineteenth century, naturalists had already noticed glaring discontinuities in the fossil record. Many, including Charles Darwin, believed the record was incomplete, gappy. There must be missing pages in the book of life, he thought, that would have documented the gradual course of evolutionary change. But over the latter half of the twentieth century, that view became untenable. Paleontology itself was transformed from the handmaid of geology or even an amateur sport (“a definite hobby”) into a serious science. Or rather, it reformed itself, and it did so by keeping count—by making careful measurements, by testing hypotheses. And as paleontology built bigger and better datasets, it became clearer that the apparent gaps were actual gaps, not just missing pages. The implications were, and still are, unsettling.⁶

Species come and species go. Extinction is normal, happening all around us, all the time. No species is forever. Background extinction, as it is called, is like the heartbeat of evolutionary history. The fossil record bears out the inevitability of this ordinary, drip-drip, shuffling-out-of-existence sort of extinction. But it also testifies that extinction rates have been wildly uneven over time. And over the course of the twentieth century, paleontologists established that in the long, jagged history of life, five episodes of extinction stood out, rising above the ordinary give-and-take of evolution. Five *mass* extinctions.⁷

A mass extinction is defined by the unnervingly strict criterion that the planet lost over 75 percent of all animal species living at the time, across

the entire globe and in roughly synchronous fashion. If background extinction is the heartbeat of evolutionary history, a mass extinction is more like catastrophic heart failure. As we'll see, each of the Big Five is distinct in character, but all are due to some suitably cataclysmic trigger: supervolcanoes, oceanic asphyxiation, collision with an asteroid bigger than Manhattan. Those gaps in the paleontological book of life came to seem like plot twists written by an author *non compos mentis*—whimsical, violent, but real.

Ideas have wings, and it didn't take long for others to turn paleontology into polemic. As early as 1992, the biologist E. O. Wilson argued that humans had initiated "the sixth great extinction," destroying biodiversity with a suddenness rivaling the worst catastrophes of the rock record. Three years later the conservationist Richard Leakey and the science writer Roger Lewin published a book titled *The Sixth Extinction*. It was a savvy stroke of scientific branding, a catchphrase that underscored the urgency of our predicament. It provoked other scientists to start taking the accusation seriously, to try to measure present rates of extinction and hold them up to the yardstick of the deep past. Then, in 2014, the journalist Elizabeth Kolbert published *The Sixth Extinction*, a gut-wrenching survey of the biodiversity crisis that further magnified the term's familiarity. The Sixth Extinction is now ubiquitous, in both the technical literature and public conversation. Hazardous material, that: a scientific concept with popular celebrity.⁸

Good-faith concerns about the label almost immediately emerged. For some it is sensationalist, and sensationalism is at odds with the sobriety requisite for good science. Tempers warm over the matter, as will happen when an idea is novel, urgent, and slippery. Some feel that "to deny (or even question) the Sixth Mass Extinction" is nefarious: It emboldens bad-faith skeptics and enables "ongoing destruction." The scientific problem is that humans have not *yet* caused a mass extinction comparable to those of the geological past. In fact, not even close. It should give us pause that those most familiar with the fossils often wince at the name. The question is really whether today's elevated extinction rate could, if it continues, eventually amount to a mass extinction. Extinction rates—past and present—are tricky to measure and

trickier to compare. Extrapolating them into the future is hardest of all, an uneasy combination of science and soothsaying.⁹

I confess to mixed feelings on the matter. In a sense this book is an extended conversation about the merits and limits of the idea. Each chapter tries to grapple with different facets of the issue from a historian's perspective, with a particular interest in the way our story has become entangled with the course of evolution. The Sixth Extinction is more of a provocation than a settled fact. That is exactly why it is good to think with.

When paleontologists firmly established the reality of rapid annihilation in the deep past, it did more than modify the way we understand extinction. It upended the way we understand evolution itself. Darwin, for instance, was a gradualist. "Natural selection can act only by taking advantage of slight successive variations; she can never take a leap, but must advance by the shortest and slowest steps." The gradualist model of evolution, in which natural selection drives the action, is still there in the history of life, dominant for long spells. But it is not the whole logic. Chance and randomness, meltdown and reboot—evolution is too unpredictable and jumpy, too hazardous to be only the survival of the fittest. There is resonance here with the patterns of human history. Empires rise and fall. There is a logic to it—the predictable strain of taxation, social conflict, geopolitical rivalry. But then a plague comes, like a wave toppling a sandcastle. Evolution, too, is a mix of the logical and illogical, the predictable and unpredictable.¹⁰

The fossil record is emphatic that the book of life is inscribed with the lingering traces of singular events. Whether or not it will amount to a mass extinction, the ascent of humanity to global ecological dominance *is* an event that will reverberate in evolutionary history, in deep time. The pertinent timescales baffle our intuition. When a geologist explains deep time to me, I feel like an ant contemplating the circumference of the planet. But we need the disorientation. The entire human career on Earth will someday lie buried, lithified, and squeezed thinner than a Communion wafer, and yet our striation will mark one of those before-and-after instants in the fossil record. The idea of the Sixth Extinction insists on this sobering perspective.

The value of perspective is also in highlighting contrasts. That we are not yet causing a mass extinction might be less reassuring than it first appears. Mass extinctions are measured in terms of taxonomic loss, such as species missing from one sequence to the next. But species diversity is only one way of keeping score. Within-species diversity (genetic variety), functional diversity (the variety of things organisms do), and the diversity of ecosystems themselves also count. To be sure, species do matter. They are to nature what instruments are to an orchestra: Take away the violins, and the symphony loses its richness. But the deeper loss is measured by the music itself, the webs of life, the intricate, tension-filled harmonies that make an ecosystem so much more than just the sum of its parts. For example, we ought to care about the survival of wild grassland as such, as a kind of superorganism with a life of its own, in addition to the little bluestem grass and Indian paintbrush, fritillary butterflies and prairie chickens, pronghorn and bison, and thousands of other species that comprise it.

Once we put *systems* on equal footing with *species*, the analogy with the geological record comes up short. Previous mass dyings were triggered by planetary catastrophes, and they entailed enormous losses in both biodiversity and biomass (the total weight of living things). Now, across the world, thick, wild, dynamic webs of life are being replaced by simpler, thinner, more homogeneous systems designed primarily to serve human needs. Biodiversity is crashing, but biomass is not in free fall—it is instead crammed into a vanishingly tiny number of over-stuffed genetic lines, a great homogenization. Our true legacy might be measured not only in the tally of extinct species but in the erasure of complex natural systems. Complex systems are a challenge to understand, and more so in the past tense. In this book I try to give them their due.¹¹

Scientific scruple requires admitting that the term *Sixth Extinction* is a rhetorical one—shorthand for “the contemporary biodiversity crisis whose exact dimensions are unknown and whose destiny is uncertain, to be measured by loss of species and homogenization of systems.” By the end of the book, I hope you will agree that the first great homogenization in the course of over half a billion years of animal

evolution is just as disconcerting as, and more unprecedented than, the sixth mass dying. In any case, the label of the Sixth Extinction is here to stay. It has helped spur research and public awareness, and there is something to be said for its lack of subtlety. This bluntness forces us to ask what it means that we have come to rank among the decisive events of Earth history.

The Nature of History and the History of Nature

This book is an effort to weave together insights gained from both natural science and human history—a scientific history, or historical science, as you please.¹²

Deep history is a way of looking at the human past staked on two commitments. The first is that we need the wide-angle view. The history of biodiversity in particular refuses to fit into our conventional ways of dividing up the past, which is perhaps why it has not received the attention from historians that it deserves. The last woolly mammoths died out while pharaohs sat on the throne in ancient Egypt—completing a process set in motion during the Ice Age. Patterns we might think of as modern really started in antiquity: The ancient Athenians who invented democracy already placed state bounties on wolves, an extermination campaign that would continue, with rifles and a poison called strychnine, into recent times. These are not just parallels or echoes or intriguing connections. They are threads of the same cloth.¹³

Studies of the biodiversity crisis often start counting extinctions around 1500 CE. That threshold has practical appeal: It marks the moment when Europeans became adept at crossing oceans, which quickened the pace of human impact. They also left a detailed record. Take the famous case of the dodo, a bird native to the island of Mauritius in the Indian Ocean (see figure 0.2). Although the dodo is a byword for obsolescence, these supersized ground pigeons were doing fine until the Portuguese showed up in the 1500s, followed by the Dutch. Hungry mariners salted them away for onward voyages. The cats, rats, pigs, and monkeys we carried to the island were hungry too. The bird was soon snuffed out. In fact, around *fifty* other less famous species of birds and reptiles native



FIGURE 0.2. Early European Observations in Mauritius. Engraving of Dutch camp from 1598 expedition led by Cornelisz van Neck; the large bird on the left is a dodo. (See Cheke and Hume 2008, 22–24; KB National Library of the Netherlands.)

to Mauritius also went extinct—many of them described by employees of the Dutch East India Company. Paradoxically, the same forces that pushed these animals into oblivion also rendered them countable.¹⁴

And yet to start only five centuries ago is to leave out too much of the story. Human-driven biodiversity loss began tens of thousands of years earlier, as our species emerged in Africa and then fanned across the globe. Even the past one hundred thousand years of human expansion is the blink of an eye in geological and evolutionary time. In a sense we are still living through the first wave of extinctions that followed our debut.

The second commitment of deep history is the conviction that the tools and terms of the natural sciences can help us understand the human condition. Deep history is an antidote to the reflexive habit of thinking of our story as something apart from the rest of nature. It puts human history inside the frame of natural history, within the streams of ecological, evolutionary, and Earth history.

The ecological view of the human past emphasizes the connectedness of human and natural systems. The biologist Barry Commoner summed

up the ecological way of looking at the world with what he called its “first law”: Everything is connected to everything else. It is simple but profound. *Ecology* is the study of organisms and their environment; its central theme is the flow of energy through the biosphere. The sun fuels photosynthesis in plants, and in turn, animals eat plants—as well as each other. The hunger for food and search for fuel are central themes in human history as well. Ecology reminds us to stay alert to their downstream effects and unintended consequences.¹⁵

Evolution is the study of how life changes. It includes Darwinian natural selection but is bigger and stranger than that—a saga of innovation and catastrophe too. Humans intervene in that story, most directly perhaps through the process of domestication—that is, the transformation of wild animals like wolves and aurochs and boar into dogs, cattle, and pigs. Our takeover of planet Earth has been a team effort, a kind of frenzied symbiosis, a revel where guests (invited and uninvited) swarm. Domestication represents, in the words of one scientist, “a discontinuity in the evolution of the biosphere.” And even for wild animals far from our houses, farms, and fields, our dominance has become a pervasive evolutionary force: Just ask the elephants that are rapidly evolving tusklessness, a lifesaving trait in a humanized world.¹⁶

Earth science is the study of our living planet in deep time. Four billion years of life, of incessant chewing and churning, have made Earth what it is. Our gentle atmosphere, the pillowy soil, the breathing oceans, and even the grainy rocks underfoot are products of the interactions between the living and the nonliving. The cycles that keep Earth in balance long seemed impervious to the ambitions of any single animal. Then, we came along. Humans have been nudging the Earth System for millennia. The mastery of fire, the Ice Age slaughter of megafauna, the flaming and felling of forests—incrementally, without any grand design, our ancestors showed a capacity to tinker with the planet’s metabolism. In modern times, by burning through stores of fossil energy and disrupting the flow of nutrients and chemicals, we have come to do much more than nudge. We are now agents of Earth System change.¹⁷

The Last Animal comprises seven chapters, spanning from our evolutionary origins to the present. It offers a version of our history in which the main themes are not kingdoms and empires and revolutions and wars but instead discoveries and innovations, changes in food procurement and energy systems. The book highlights a series of technological advances that gave us leverage over the rest of nature: the control of fire and projectile hunting weapons; the domestication of animals and plants; metallurgy and writing; transoceanic sail; steam power and industrial agriculture; chainsaws, bulldozers; and the ability to synthesize fertilizer, pesticides, and plastic. The aim is to understand how our Promethean progress unfolds inside nature—to stay true to the principle that everything is connected to everything else. Each chapter reflects on some of the limits of the Sixth Extinction as an idea while trying to keep a geological perspective on human history, to imagine what the future fossil record will say about us.

In painting with such a broad brush, choices about where to focus are inevitable; in trespassing across so many boundaries, more nuance would surely be welcome in some cases. The aim has been to write a global history. Here there is a gap between aspiration and reality, given the disproportionate amount of research on Euro-American cultures and, more gravely, my own limitations. Maybe these faults can be partly forgiven if the result is a richer sense of the backstory of one of the great challenges confronting our species. And it would be better still if these faults provoke correction and inspire further exploration.

Inevitably, our history confronts us with the paradox of human progress. We are innovators, good at solving problems in front of us. The solutions we contrive give us access to food and energy. But short-term benefits conceal long-term costs and carry unintended consequences. Each solution creates new problems to solve, new limits to transcend. A deep historical perspective helps us keep track of these otherwise invisible connections.

The goal in this book is not to issue judgments or recriminations. But history can help us see that little by little, over the course of our past, survival became excess. A band of Pleistocene hunters felling a mammoth to feed their families is one thing. A *concentrated animal feeding*

operation, where thousands of so-called animal units are fattened before slaughter, is another. They are strangely connected—but that does not mean they are equivalent. History resists simplistic judgments; if that is what you are shopping for, you are in the wrong aisle. But history can sharpen our sense of what progress has cost and perhaps stir us to imagine the long-term consequences of our own choices.

Seeing Ourselves

Others have made a compelling case for the significance of biodiversity. No need to retread that ground at length. In this book I approach the issue historically, but I will pause to state briefly two core convictions about why it matters. The first is starkly pragmatic: Our own fate is bound to the diversity of life around us. Biodiversity matters existentially. It feeds us and heals us. Thriving ecosystems provide the food we eat. They purify our water, and they replenish the soil that nourishes us. If we were to fray the world's food webs to the point of collapse, our species would be pulled under—or confronted with possibilities for human existence so bleak they are chilling.¹⁸

My second conviction is that biodiversity matters intrinsically. The sudden, permanent loss of a huge percentage of the only life we know of is aesthetically tragic. There is something inherently worthy in the Earth's webs of life that transcends any narrow human calculus. Every valley, every forest is its own composition. Beauty and mystery are in the music. As tall-grass prairies, old-growth temperate woodlands, mangrove swamps, neotropical forests, and other systems decline or disappear, we are permanently erasing entire styles from a repertoire hundreds of millions of years in the making. Imagine us having the power to pluck the colors out of the world one by one. The result would be a dreary monochrome, poorer and less vibrant—and not just to our eyes. As E. O. Wilson put it, mass extinction may be the folly that our descendants are least likely to forgive.¹⁹

In “The Case of the Animals Versus Man,” an owl whose eyes have seen the rise and fall of human civilization asks, “What do you find of the men who once ruled these lands? Broken graves, rotting bones left

behind, and the desolate trace of the dead!" Long after we are gone—turned to dust or fled to some other planet—the mark we leave on life's story will endure. Fittingly, our word "extinction" derives from an emphatic Latin verb, *extinguere*: to put out the fire for good, to quench utterly. Our monuments will crumble, and the paint will finally peel off the last canvas. But whatever life survives our reign will be different because we were here.²⁰

The goal of history—even scientific history—is ultimately humanistic: to help us know ourselves. The hope of this book is to capture the reflection of our history in deep time, to grapple with what it means to be an animal of such unwieldy influence. To see ourselves clearly and to face our challenges, we need a backward look. The living world with which we are familiar, on human scales of time, is already dimmed. To me, a lightning bug is both an enchanted personal memory *and* an object of scientific interest. It is disconcerting that, even for the next generation, fireflies—whose ancestors lit up the sky in the time of the dinosaurs—have become a rare sight. Your eyes calibrate to the fading light in a room, and our expectations adjust to a dimming natural world. Here is an effort to look into the glare of the deeper past.

INDEX

- aardvark (*Orycteropus crassidens*, extinct), 85
 Abilene, 263. *See also* Kansas
 Acclimatization Society, 98–99, 101, 137, 250, 274, 326, 327
Acropora palmata. *see* elkhorn coral
 Adam (biblical), 1, 144
 adaptation. *See* evolution
 Adriatic Sea, 198, 258
Aenocyon. *See* dire wolves
Aepyyceros spp. *See* impalas
 Africa (general), 9, 41–42, 45, 47, 49, 51, 55, 58–59, 61, 77, 80, 83–85, 92, 98, 117–18, 121, 128, 134, 138–39, 160–62, 164, 166, 170, 223, 257, 263, 280–81, 284, 294, 324, 331–34, 336–38; colonization, 231, 254, 280–81, 284, 331; domesticates, 98, 103, 106, 128, 146, 254, 257, 263; extinctions/extirpations, 77, 84–85, 117, 119, 121, 162, 164, 166, 170, 334, 337–38; invasives, 134, 270. *See also* East Africa; Great Lakes; North Africa; South Africa; sub-Saharan Africa; West Africa
 African forest elephant (*Loxodonta cyclotis*), 91, 162–64
 African giant buffalo (*Syncerus antiquus*, extinct), 85
 African Humid Period, 170
 African plate (tectonic), 97
 African savanna elephant (*Loxodonta africana*), 91, 162–64
 African societies, 118, 139, 146, 160. *See also* Bantu people; Maasai people
 African wild asses, 146
 Age of Discovery, 187, 189, 228, 231, 270, 280
 Age of Mammals, 15, 38, 40–41, 50, 58, 177, 276, 299
 Agricultural Revolution, 253
 agriculture, 95, 98, 101, 105, 109, 111–12, 115, 116–17, 120, 128–30, 132, 134, 136, 138–39, 140, 143–45, 147, 152, 154–55, 157, 159, 160–61, 163–65, 167–69, 174–75, 177–78, 180, 182, 189, 195, 209, 220, 227–29, 237–38, 249, 252, 253–54, 257–58, 262–63, 265, 266, 270, 272, 274–75, 281–82, 285, 288, 293, 294, 306, 308–10, 319–20, 325, 328, 331–35, 337; industrial, 11–12, 248, 254, 258, 265, 281, 283–84, 288; pests, 132–34, 136, 303, 308–9, 336. *See also* draft animals; fertilizers; livestock; pesticides; plantations; transport animals
 Ahab (fictional), 86, 185
 Ainu society, 120
 airplanes. *See* aviation
 Akkadian, 150
 Alabama, 267–68
 Alaska, 172, 185, 340–41
 albatrosses, 316, 320
 Albion (city), 218. *See also* Mauritius
 Aldabra giant tortoise, 50, 51
 Alexander, Karen, 329
 algae (general), 15, 316, 319–20, 322–23, 328. *See also* blue-green algae; zooxanthellae
 Algerian whip snakes, 227
Alice's Adventures in Wonderland, 217
 Allegheny River, 277
 alpacas, 101, 102, 113, 114, 115

- Alps, 154
 Alvarez, Luis, 38
 Alvarez, Walter, 38
 Amastridae, 229. *See also* snails
 Amazon (rainforest), 179, 294, 332, 333–36
 Amazon (river), 270
 Amazon Basin, 119, 340
 Amazonia, 161
 America. *See* United States
 American bison, 64, 78, 179–80, 237, 251, 279–81, 285–86, 340
 American Civil War, 263
 American lions (*Panthera atrox*, extinct), 78
 American minks, 273
 American Museum of Natural History, 17
 amphibians, 164, 171, 303. *See also* frogs
Amyntas spp. *See* earthworms
 Anatolia, 106, 138, 146
 anchovetas, 313, 324
 anchovies, 314
 Andalusia, 258
 Andean bear, 121
 Andes, 114–15
 Anglo-Saxon, 122
 animal products, 139, 148, 164, 181, 185–86, 189, 190, 192, 197, 206–7, 210, 234, 248, 249–50, 253–55, 257, 268, 277, 278–81, 283–85, 288, 293, 316–17, 336; baleen, 186, 191, 202, 204, 278, 321; blubber, 185–86, 191, 197, 203–5, 209, 278, 283, 332; glycerin, 283, 316; guano, 226, 281–84, 293; industrial production, 186, 203, 206–7, 209–11, 253, 277–78, 280, 282–85, 316–17; ivory, 92, 164, 166, 278, 280–81, 336; wool, 139, 148, 268
Anopheles. *See* mosquitos
 Antarctica, 177, 284, 298
 anteaters, 80
 antelope, 84, 99, 337–38. *See also* blue antelope; *Damaliscus hypsodont*; *Damaliscus niro*
 Anthropocene, 29–33, 40, 183–84, 223, 245, 287, 296–98, 304, 308, 312, 316, 319, 323, 331–33, 335–37, 341, 343
 Anthropocene Working Group, 292
 anthropology, 144
 antibiotics. *See* pharmaceuticals
Antidorcas australis, 85
Antidorcas bondi, 85
 ants (general), 6, 33, 267, 269–70, 273–74, 301, 303; extinct, 269; invasive, 267, 268, 269, 270, 271, 273, 274. *See also* army ants; longhorn crazy ant; pharaoh ant; red fire ants
 Apennine Mountains, 123
 aphids, 308–9
 Appalachian Mountains, 277
 aquaculture, 198, 201, 318, 323–28
 Arabia, 149, 217
 Arabian Peninsula, 149
 Arab sailors, 223
 arachnids. *See* spiders
 Arbuckle Mountains, 54
 archaeology, 53, 64–65, 68–69, 73–74, 76–77, 86, 97, 101, 106–8, 128, 130, 135–36, 141–46, 154, 169, 184, 197, 199, 335, 341
 Archangel (city), 278. *See also* Russia
 Arctic, 210, 323
 Arctic Ocean, 57, 189–91, 204, 208, 323
Arctodus. *See* giant short-faced bears
 Argentina, 172, 262, 266–67, 340
 Aristotle, 14, 118, 197
 armadillos, 80; extinct, 78. *See also* beautiful armadillo
 army ants, 64
 Artemis (god), 120
 Arthur (king), 121
 Asia (general), 45, 47, 60–61, 83, 109, 111, 124, 162, 197, 219, 222, 250, 254, 271, 278, 294, 317, 327, 334, 336–39; domesticates, 98, 103, 106, 109, 112, 146, 256; extinctions/extirpations, 47, 49, 60, 83, 119, 121, 124, 162, 172; invasives, 136. *See also* East Asia; Eurasia; South Asia; Southeast Asia; West Asia
 Asian black bears, 121
 Asian elephants (*Elephas maximus*), 91, 162, 163

- Asian jumping worms (*Amyntas* spp.), 273
Asian societies, 50. *See also* Ainu society;
 Botai people;
Asiatic mouflon. *See* mouflon
assassin bugs, 309
asses. *See* donkeys; wild asses
Assyria, 118, 146–47, 150, 156
Astor's American Fur Company, 279
Athenian people, 8
Athens, 110, 122
Atlantic Ocean, 50, 52, 59, 135, 188, 189, 202,
 204–5, 215, 231, 236, 258, 260, 278, 283, 313,
 324; extinctions/extirpations, 215, 313,
 315. *See also* North Atlantic
Atlantic Seaboard, 172, 280
Atlas Mountains, 162, 164
atlatls, 60
Augustine (saint), 121
auks (general), 290. *See also* great auks
aurochs (extinct), 63, 83, 85, 108, 111–12,
 157, 161; domestication, 10, 103, 108, 111,
 112, 325
Austin, Thomas, 274
Australasia, 115
Australia, 62, 81–82, 205, 219, 222, 226, 262,
 266, 275, 321; domesticates, 98, 115;
 extinctions/extirpations, 77, 81, 277;
 invasives, 81, 115, 274, 275–77. *See also*
 Tasmania; Victoria; Western Australia
Australian people, 205, 333
australopithecines, 42–44, 46
Australopithecus. *See* australopithecines
Austria, 258
automobiles, 132, 265, 273, 294, 317
aviation, 273, 274, 301, 329, 335
axes, 44, 55, 143, 146, 150, 154, 155, 156, 161,
 165, 183, 227, 246, 265.
Axum (city), 164. *See also* Ethiopia
babirusas, 62
Babylonian people, 150
Bacon, Francis, 187–88, 243
badgers, 126
Bahamas, 209
Bailey, Washington, 237
Bains, William, 48
Bakewell, Robert, 260–61
bald eagles, 66
Balearic Islands, 276
Baltic, 199, 320
bantengs, 112; domestication, 101, 113.
 See also cattle
Bantu people, 139, 160
Barau's petrels, 219
Barbados, 209
barley, 154
Basque people, 186, 202, 203, 204
Bastet (god), 128
bats, 15, 137, 217, 219, 224, 226, 227, 229, 281,
 301, 309
Bay of Biscay, 202
Beagle (ship), 19, 218
bears (general), 119–22, 164, 279, 309, 336,
 339, 340; extinct, 79, 119; hunting (by
 humans), 116, 119–22, 126, 254, 279;
 symbolism, 119–21. *See also* Asian black
 bears; black bears; brown bears; cave
 bears; giant pandas; giant short-faced
 bears; polar bears; spectacled bears
Beastly Tales, 333
Beast of the Gévaudan, 122
beautiful armadillo (*Dasypus bellus*), 78
beavers, 126, 170, 278, 279, 284, 342. *See also*
 giant beavers
bedbugs, 137
beef industry, 246–48, 251, 254, 256–67, 281,
 287, 332. *See also* cattle
bees (general), 33, 301, 303–5, 307, 309–10.
 See also honeybees
beetles (general), 64, 298, 301, 307, 309.
 See also dung beetles; fireflies; lady beetles
Belarus, 157
Bement, Lee, 64
Bengal tigers, 172
benthic. *See* oceans
Bering, Vitus, 208
Beringia, 62, 113, 231
Bering Island, 208

- Bering Sea, 322
 Bering Strait, 232
 bezoar ibexes, 106–8, 117
 Bhutan, 334
 Białowieża Forest, 157–61, 179; Dominator Oak, 158; Great Mamamuszi, 158; Jagiello Oak, 158
 Bible, 122, 127, 133, 141, 144, 146, 150, 227
 big cats (general), 42, 44, 79, 119, 121–22, 126, 164, 336; hunting (by humans), 117–18, 126, 336–37; symbolism, 121–22. *See also* Bengal tigers; cave lions; cheetahs; cougars; Florida panthers; jaguars; leopards; saber-tooth cats; saber-toothed tiger; scimitar cats; snow leopards; tigers
 Big Five. *See* mass extinctions
 bighorn sheep, 78
 biodiversity, 2–9, 12, 14, 23–26, 32, 35–38, 40, 45, 48–49, 54, 57, 77–82, 89, 92, 94, 95, 136, 138, 151, 153, 158, 162, 170–72, 176, 179–80, 184, 186–87, 192–93, 212, 214, 218–22, 232, 267, 269, 271–73, 291–92, 297, 303, 307, 312–13, 318, 334–35, 337, 340, 342; crisis, 2–8, 95, 143, 164, 300, 303; homogenization, 137, 138, 161, 178, 212, 231–32, 272, 332, 335, 342; hotspots, 158, 179, 186, 192–93, 213, 222, 227, 312, 334; on islands, 221–32, 269; latitudinal diversity gradient, 193; longitudinal diversity gradient, 193; loss, 165, 170, 198, 215, 220, 229–30, 232, 299, 334
 birds (general), 57, 72, 79, 91, 96, 99, 103, 132, 137, 138, 158, 159, 161, 164, 172, 194, 195, 198, 209, 211, 214, 216–28, 230, 273, 275, 281, 282, 301, 303, 309, 310, 316, 321, 323, 330, 332, 334, 340; extinct, 8, 9, 79, 82, 209, 212, 216–28, 230, 232, 290; invasive, 220, 276. *See also* albatrosses; auks; bald eagles; Barau's petrels; boobies; brown-headed cowbirds; chickens; Cooper's hawks; crows; dodos; ducks; egrets; eider ducks; Eskimo curlews; flycatchers; frigate birds; geese; goshawks; great auks; greater prairie chickens; griffon vultures; hawks; Labrador ducks; La Brea storks; lesser prairie chickens; Mariana mallards; noddies; ostriches; owls; parrots; passenger pigeons; penguins; petrels; pigeons; prairie chickens; quails; raptors; red-tailed hawks; Rodrigues solitaire; shearwaters; swallows; swifts; terns; turkeys; turtle doves; vultures; warblers; white-rumped vultures; white-backed woodpeckers; white-winged wood ducks; woodpeckers
 bison (general), 7, 66, 67, 86, 88, 90, 91, 93, 105, 174, 238, 284, 285, 293, 310, 340; extinct, 78. *See also* American bison; *Bison antiquus*; *Bison occidentalis*; buffalo (mammal, general); European bison; gaur; long-horned bison; steppe bison; wisent
Bison antiquus, 64–65, 78
Bison occidentalis, 78
 black bears (*Ursus americanus*), 78, 119
 Black Death, 136, 137, 249
 black rats (*Rattus rattus*), 134–36, 220, 223, 225
 black rhinoceroses, 161–62, 337
 Black Sea, 148, 320; invasives, 320
 blacktip reef sharks, 214, 316
 Blob. *See* climate change
 Blue Acceleration, 313
 blue antelope (*Hippotragus leucophaeus*, extinct), 85
 bluefin tunas, 322
 blue-green algae, 30, 194, 292, 319
 Blue Revolution, 328
 blue whales, 29, 202, 207, 283
 boar, 97, 108–10, 124, 126, 252; domestication, 10, 103, 105, 109, 325
 bobcats, 126, 175
 Bohemian Forest, 157
 Bonaparte, Napoleon, 218, 251
 Bond, James, 172
 Bonn, 68–70
 boobies (bird), 225

- Booming Ben (bird), 181, 182
 Borneo, 332, 333, 339
Bos. *See* cattle
 Boston, 181
 Botai people, 147
 Bowhead whales, 185, 189–92, 204–5, 215
 brachiopods, 193; extinct, 54
Brachyprotoma. *See* short-faced skunks
 Bradford, William, 116
 Brahmastra, 307
 brain coral, 311
 Brazil, 179, 266, 268, 332
 Breasted, James Henry, 106
 Brisbin, James, 263
 British Isles, 221, 272, 273. *See also* England;
 Great Britain; United Kingdom
 British people, 130, 205, 217, 277
 broadleaf forests. *See* forests
 brocket deer, 340
 Bronze Age, 134, 145, 148, 155–56, 162, 169,
 189, 196, 227
 brown bears (*Ursus arctos*), 78, 83, 119, 121,
 159, 340
 brown-headed cowbirds, 91
 brown rat (*Rattus norvegicus*), 135–36, 220
 brown tree snakes, 226–27
 Bruegel, Pieter, 63
 Brunswick-Altamaha Canal, 56, 59, 335
Bubalus arnee. *See* water buffalo
 Bubbly Creek. *See* Chicago River
 Buck, John Lossing, 250
 Buck, Pearl, 250
 Buckels, William, 199
 Buffalo (city), 341
 buffalo (mammal, general), 337–38. *See also*
 African giant buffalo; bison; water
 buffalo
 bugs. *See* insects; invertebrates; minifauna
 bulldozers, 11, 165, 333, 335
 Burke, Edmund, 341
 butterflies (general), 179, 301, 304–5, 307,
 309. *See also* caterpillar; fritillary
 butterflies
 Butterfly Monitoring Scheme, 305
 Byron (poet), 186
 cachalot, 207
 Caesar, Julius, 111, 130, 157, 161, 165, 198
 Cairo, 165
 California, 171, 233, 235–36, 260, 289
 California Gold Rush, 260
 Cambodia, 129, 333–34, 336
 Cambrian, 31
 camelids, 115. *See also* alpacas; camels;
 guanacos; llamas; vicuñas
 camels, 170; domestication, 101, 103, 146,
 148, 149; extinct, 79, 94, 148, 335. *See also*
 dromedary camels
 Canada, 66, 125, 285, 299, 313. *See also* Grand
 Banks
 canids, 59, 61, 68, 79, 126. *See also* coyotes;
 dholes; dire wolves; dogs; foxes; hoary
 foxes; jackals; maned wolves; wild dogs;
 wolves
Canis lupus. *See* wolves
 Cape buffalo, 64
 Cape of Good Hope, 188
 cape zebras (*Equus capensis*, extinct), 84
 capybaras, 80, 340; extinct, 80
 caracals, 126
 Carboniferous Period, 241, 244, 283, 301
 Caribbean, 51, 172, 189, 209, 214, 223, 229,
 260, 310, 322; colonization, 209, 229, 260;
 extinctions/extirpations, 209; invasives,
 189, 229, 260
 Caribbean monk seals (*Monachus tropicalis*,
 extinct), 209
 Caribbean societies, 209. *See also* Carib
 people; Taíno people
 caribou, 67, 78
 Carib people, 209
 Carolinas, 180
 carps, 201, 324, 326
 Carré, Ferdinand, 265
 cars. *See* automobiles
 Carson, James, 246

- Carson, Rachel, 304
 Cartwright, Edmund, 211
 Cartwright, George, 211
 Caspian Sea, 148
Castoroides. *See* giant beavers
 Caterpillar (corporation), 333
 caterpillars (insect, general), 308. *See also*
 butterflies; moths; silkworms; tobacco
 hornworms
 catfish, 324
 cats, 8, 68, 100, 103, 127–30, 224, 230, 275–76;
 domestication, 100, 103, 128, 130; invasive,
 8, 128, 181, 224, 230, 275–76. *See also*
 American lions; Bengal tigers; big cats;
 bobcats; caracals; cave lions; cheetahs;
 cougars; felids; Florida panthers; Iberian
 lynx; jaguars; leopards; lions; lynx;
 saber-tooth cats; saber-toothed tiger;
 scimitar cats; snow leopards; tigers;
 wildcats
 cat snakes, 227
 cattle (general), 73, 127, 231, 236, 237, 238,
 247, 252, 254–58, 262–63, 266, 268, 301,
 325, 329–30, 334; dairy, 112, 257, 258, 261,
 325, 330; domestication, 10, 83, 99, 101,
 104, 111–17, 139, 148, 178, 251, 252, 258,
 261–62, 265–66, 288, 294, 325, 332;
 invasive, 174, 178, 231, 236, 237, 260, 262,
 266, 285, 334; meat/beef, 112, 113, 177, 237,
 243, 246, 259; taurine cattle, 112, 113, 257,
 266; zebu cattle, 83, 112, 113, 257, 266.
 See also aurochs; bantengs; beef industry;
 Cape buffalo; cattle drive; gaur; gayal;
 musk oxen; oxen; water buffalo; yaks
 cattle drive, 236, 237, 257, 260, 262, 263, 266
 Caucasus, 106, 108
 cave bears (extinct), 83
 cave lions (extinct), 83, 117
 cave paintings/drawings, 62, 83, 84, 85, 111,
 147; wall art (depicting extinct species),
 165, 170
 Cedar Mountains, 162
 Celtic people, 257
 Cenozoic, 40, 57–58, 87, 91, 153
 centipedes, 309
 Central Africa, 160, 162, 333, 336, 337
 Central America, 119, 161, 170, 340
 Central Atlantic Magmatic Province, 37
 cerrado. *See* grasslands
 cervids, 71, 79. *See also* deer; elk; moose;
 reindeer
Cetotherium (extinct), 202
 Chagos Archipelago, 224; invasives, 224–25
 chainsaws, 11, 165, 266, 333
 Charlemagne, 111
 Chase, Andrew, 265
 cheetahs, 337
 Cheke, Anthony, 219
 Chesapeake Bay, 320
 Cheyenne people, 237
 Chicago, 254, 255, 265. *See also* Union
 Stockyards
 Chicago River, 265
 Chicken of Tomorrow contest, 289
 chickens, 7, 127–29, 287–93; broiler
 chickens, 129, 288–91; domestication, 101,
 103, 128–30, 138, 247–48, 251, 288–90, 319,
 325; industrial agriculture, 129, 247, 248,
 251, 287–91, 319; invasive, 130, 231; meat,
 130, 249–50, 289, 291, 328
 Chihuahua (state), 285
 Childe, V. Gordon, 145
Childe Harold's Pilgrimage, 186
 Chile, 324
 chimpanzees, 41, 42, 44, 84, 164
 China, 49, 50, 109, 111, 133, 135, 148, 159, 162,
 163, 168–69, 188, 201, 231, 250, 252–53, 256,
 279, 320, 327, 333, 338; domesticates, 109,
 111, 148; extinctions/extirpations, 163;
 people, 325
 Chincha Islands, 281–82
 chinchillas, 101, 113
 Church of England, 144
 cicadas, 133
 Cincinnati, 254
 Cipriani, Leonetto, 236, 237, 260, 262

- cities (as places, general), 145, 149, 151, 165,
182, 196, 251, 253, 257–58, 261, 270, 280,
299; as ecosystems, 126, 141, 253, 269,
270–71
- civets, 49
- clams, 316, 320
- Clausewitz, 64
- Cleopatra, 164
- Cleveland, 326
- climate change, 2, 33, 37, 38, 41, 49, 58–59, 66,
73, 76–77, 80–88, 93–94, 105, 107, 146, 151,
153, 160, 170, 182–83, 221, 227, 232, 291,
318–19, 321–23, 335–36, 337; the Blob, 323.
See also dead zones
- Clovis people, 74
- Clupea harengus*. *See* herrings
- coal. *See* fossil fuels
- Cobbett, William, 250
- co-burial (humans with other species), 69,
70, 128, 130
- cod (*Gadus morhua*), 189, 200–202, 210, 288,
313–15, 323
- Cold War, 35, 317
- Coleman, Jon, 116
- collared peccaries, 340
- colonization (ecological), 23, 27–28, 32, 34,
36, 45, 136, 161, 219, 270, 272, 340
- colonization (human), 109, 189, 223–24, 228,
231, 258, 262–63, 331; of Africa, 161, 231,
254, 280, 281, 284, 331; by Americans, 213,
227, 285; of Asia, 119; of Australia, 274,
275; by Eurasians, 178; by Europeans, 8, 9,
111, 115–16, 119, 124, 139, 146, 154, 161,
170–71, 180–81, 188, 201, 204, 209, 217,
219–20, 223, 228–29, 230, 253, 260, 270,
274, 277, 278–79, 281, 313, 340; invasive
species spread by, 98, 99, 115, 181, 213,
220–31, 258, 260, 263, 271, 273, 274, 275,
276, 332; of islands, 98, 209, 214, 220–25,
229–30, 260, 276; of North America, 78,
113, 116, 124, 146, 161, 165, 170–74, 178, 181,
231, 260, 277, 285, 313, 340; by Polyne-
sians, 214, 224, 229; resource extraction
by colonists, 189, 205, 220, 228–31, 235,
237, 262, 278–84, 310, 313, 331–32; of South
America, 113, 116, 146, 161, 231, 260, 332,
340
- Colorado, 16, 23, 65, 174
- Colorado River, 167
- Columbian Exchange, 231
- Columbia University, 17, 22
- Columbidae*, 217. *See also* dodos; pigeons;
Rodrigues solitaire; turtle doves
- Columbus, Christopher, 51, 160, 209, 229,
231, 260
- Column of Trajan, 156
- comb jellies (general), 193, 320; invasive,
320
- commensalism, 70, 127, 128–37, 228
- Commoner, Barry, 9, 10, 90
- Commoner's law, 10, 11, 90, 115, 292
- Common Era, 155
- common nightcrawlers (*Lumbricus
terrestris*), 273
- communications technologies (general),
46–48, 145, 149, 187, 277, 284, 295. *See also*
printing press; symbolic language;
writing
- Conference on Genetics, Paleontology, and
Evolution, 22
- Congo Basin, 332, 335–36
- Congo River, 92, 270
- Connecticut, 181, 280, 289
- conservation, 162, 174–76, 181, 187, 211, 214,
220, 222, 233, 277, 286, 299, 311, 314, 316–18,
321, 329, 334–41; keystone species, 285;
umbrella species, 175
- Cook, James, 229
- Cooper's hawks, 175
- Cooper site, 64, 65
- copepods, 194
- coral reef, 28, 53, 193, 197, 212–14, 226, 232,
310–23, 343; bleaching, 321–22; fossilized,
17, 54. *See also* brain coral; elkhorn coral;
pillar coral; staghorn coral; stony corals
- corn, 95, 154, 176, 248, 252, 254, 288

- Corn Belt, 256
corvids, 48. *See also* crows
Costa Rica, 334
Coste, Victor, 326
cougars, 78, 80, 340
cow-nosed rays, 316
cows. *See* cattle
coyotes, 68, 91, 126–27, 175
crab-eating macaque, 221
crabs (general), 214, 217, 311, 319. *See also*
 snow crabs
Cretaceous, 38–39, 50, 56, 171
crickets, 64, 151
crinoids, 54
crocodiles, 37; extinct, 228. *See also* Nile
 crocodiles
crocodilians (order Crocodylia), 171, 172.
 See also crocodiles; Nile crocodiles
crops. *See* domesticated plants
Crosby, Alfred, 43–44, 231
Cross Timbers, 25, 73
crows, 48, 137, 342
crustaceans (general), 318. *See also*
 copepods; crabs; krill; shrimp; wood lice
Crutzen, Paul, 245, 291, 292
Cuba, 229–30
Cuernavaca, 291
Cullen, William, 264–65
cuscuses, 98
Cushman, Gregory, 282–83
Cuvier, Georges, 20
Cyprus, 96, 98, 128, 221, 224; extinctions/
 extirpations, 224; human arrival, 96–98;
 invasives, 97, 128, 270. *See also* Kyrenia
 Mountains
Dacia, 156
dairy. *See* cattle
Dall's sheep, 78
Damaliscus hypsodont (extinct), 85
Damaliscus niro (extinct), 85
dams, 167–71
Danish people, 257
Danube River, 157
Danubian Plains, 258
Dark Ages, 159
Darwin, Charles, 4, 6, 17–21, 26, 29, 68, 80,
 104, 178, 193, 216, 218, 222, 273, 284;
 Darwinian, 10, 21. *See also*
 Neo-Darwinism
dead zones, 319–20. *See also* climate change
Deccan Traps, 217
decolonization, 331
deep time, 13, 16, 19, 144, 165, 175, 226,
 272–73, 291–92, 318, 342–43
deer (general), 71, 80, 105, 116, 124, 126, 170,
 178, 279, 336; extinct, 78, 83–84; invasive, 97,
 98, 220, 270. *See also* brocket deer; fallow
 deer; Javan rusa; marsh deer; mule deer;
 pampas deer; red deer; white-tailed deer
deer-pigs. *See* babirusas
deforestation, 10, 121, 129, 132, 137–38, 143,
 145, 146, 150–66, 172, 176, 182, 189, 220,
 227, 229, 238, 239, 266, 284, 293, 294, 297,
 299, 332, 333, 334, 335; rates of, 165, 227,
 294, 334
de Guzmán, Nuño, 260
Democratic Republic of the Congo, 336
Demographic Transition, 244
Denisovans (extinct), 47, 48, 60, 83. *See also*
 Homo
Denmark, 258
desert locusts (*Schistocerca gregaria*), 133
deserts (ecosystem), 24, 58, 169
de Villalobos, Gregorio, 260
Devonian, 301
dholes, 79
Diamond, Jared, 139
Dias, Bartolomeu, 188
Dickens, Charles, 216
Dillard, Annie, 309
dinosaurs (extinct), 13, 33, 35–40, 50, 56–57,
 80, 130, 177, 201, 217, 242, 299, 303. *See also*
 pterosaurs; *Sauronithoides*; *Tyrannosau-*
 rus rex; velociraptors
Diprotodon (extinct), 81–82

- dire wolves (extinct), 78, 79
 Dishley Society, 261
 dodos (*Raphus cucullatus*, extinct), 8, 9,
 216–21, 290
 dogs, 59, 61, 66–73, 88–89, 104, 229, 331;
 domestication, 10, 59, 66–73, 88, 100,
 102–5, 115, 229; invasive, 113, 229. *See also*
 canids; coyotes; dholes; dire wolves;
 foxes; hoary foxes; jackals; maned
 wolves; wild dogs; wolves
 dolphins (general), 194, 316. *See also* vaquita
 porpoises; whales
 Domebo Canyon, 73, 76, 86, 88
 domesticated animals (general), 67, 72,
 99–105, 117, 124, 128, 132, 138–39, 141, 146,
 148–49, 178, 231, 248, 294. *See also*
 alpacas; bantengs; camels; cats; cattle;
 chickens; chinchillas; dogs; donkeys;
 ducks; elands; ferrets; fish; foxes; gayal;
 geese; gerbils; goats; Guinea pigs;
 guppies; hamsters; honeybees; horses;
 llamas; mice; minks; musk oxen;
 ostriches; pigeons; pigs; quails; rabbits;
 reindeer; sheep; silkworms; turkeys;
 water buffalo; yaks
 domesticated plants (general), 95, 101, 103,
 105, 111, 115, 154, 178, 248–50, 272, 294, 332.
 See also barley; corn; millet; rice;
 soybeans; sugarcane; wheat
 domestication, 10, 67–72, 88, 95–117, 127, 129,
 134, 138–40, 146, 149, 163, 178, 228, 246, 251,
 257, 290, 325, 328, 331; commensal pathway,
 102, 103; cross-species adoption model,
 70; directed pathway, 103; prey pathway,
 102, 109, 114; self-domestication model,
 70; syndrome, 104–5. *See also* domesti-
 cated animals; domesticated plants
 donkeys, 101, 103–4, 146, 147, 148
 Donne, John, 241
 draft animals, 115, 132, 138–40, 148, 155,
 257–58, 260, 330
 draining (of wetlands), 165–72, 176, 184, 294,
 299, 338
 dromedary camels, 85
 ducks (general), 101; domestication, 101,
 103, 113, 115, 211. *See also* eider ducks
 dugongs, 208, 318
 dung beetles, 308
 Düsseldorf, 304
 Dust Bowl, 174
 Dutch East India Company, 9, 253
 Dutch people, 8, 188, 199–200, 204–5, 220,
 258, 260. *See also* Netherlands
 dwarf elephants (*Palaeoloxodon cypristes*,
 extinct), 96–97, 224
 Ea. *See* Enki
 Earth history, 3, 8, 9, 37, 54, 101, 144, 273, 291,
 292, 296, 329, 341
 Earth science, 10
 Earth System, 10, 30, 36, 93, 101, 115, 184,
 292–303, 322
 Earth time, 39, 222, 245, 333, 342
 earthworms (general), 273, 308; invasive,
 273. *See also* Asian jumping worms;
 common nightcrawlers
 East Africa, 139, 164, 170, 280–81, 332
 East Anglia, 199
 East Asia, 138, 201–2, 252
 East Coast (United States), 56, 181, 320
 Eastern Europe, 339–40
 eastern gray squirrels (*Sciurus carolinensis*),
 134, 273
 Eastern Seaboard (United States). *See* East
 Coast
 East Indies, 41, 220
 ecological history, 3, 9, 35, 55, 101, 144, 151,
 220, 221, 237, 245, 246, 269
 ecologists. *See* ecology
 ecology, 9–10, 26, 33, 39, 42, 47–48, 50,
 55–56, 58, 63–65, 68, 72, 85–86, 88, 91, 127,
 130, 144, 145, 152, 154, 162, 167, 188, 196,
 198, 206, 211–12, 220–23, 227–29, 231, 240,
 245, 257, 262–65, 267, 271, 277, 279,
 282–85, 293, 296, 307, 314, 328, 341–42.
 See also Commoner's law

The Ecology of Invasions by Animals and Plants, 271

ecosystem engineers, 311–12, 316
 ecosystem functions, 24, 53, 89–95, 126, 151, 159, 162, 166, 171, 176–84, 192, 198, 207, 214–16, 225, 230, 237, 279, 285, 301, 308–12
 ecosystems, 12, 24, 32, 42, 45, 51, 55, 61, 80, 90–95, 119, 126, 141, 149, 152, 157, 158–59, 162, 170–71, 175–76, 178–79, 180–81, 184, 197, 227–30, 233, 237, 272, 275–76, 279, 284–85, 292, 300, 305, 307, 310, 319, 323, 329, 334, 342. *See also* cities; deserts; forests; grasslands; islands; mountains; oceans; wetlands
 Eden, Frederick, 249
 Ediacaran, 31
 egrets, 127
 Egypt, 8, 128, 130, 133, 147, 164, 165, 166, 271; extinctions/extirpations, 166, 170
 Egyptian people, 128
 eider ducks, 210
 elands, 101
 Eldey Island, 211
 El Dorado, 236
 Eldredge, Niles, 22–23
 electricity, 239, 243–47, 257, 280, 284, 288–89, 295–96, 300
 elephants (general), 10, 41, 56, 78, 83, 84, 90–94, 97, 111, 162–64, 218, 233, 280, 281, 284, 332–39; hunting (by humans), 164, 280–81; taming, 163. *See also* African forest elephant; African savanna elephant; Asian elephants; dwarf elephants; *Elephas hysudrindicus*; gomphotheres; mammoths; mastodons; stegodonts
Elephas hysudrindicus, 83
Elephas hysudrindicus. *See* elephants
Elephas maximus. *See* Asian elephants
 Eliot, T.S., 336
 elk, 67, 78, 126, 157, 161, 340
 Elk City, 341
 elkhorn coral (*Acropora palmata*), 310–11

El Niño, 322
 Elton, Charles, 271
 endangered species, 158, 172, 179, 187, 197, 217, 230, 316, 321, 329, 334, 337, 338. *See also* conservation; International Union for Conservation of Nature (IUCN): IUCN red list
 Endangered Species Act, 317
 end-Pleistocene extinctions. *See* Late Quaternary Megafaunal Extinction
 energy consumption, 296, 321
 England, 186, 199, 228, 238–42, 249, 253–54, 260, 274. *See also* British Isles; Great Britain; United Kingdom
 English people, 204, 211, 249, 250, 254, 257, 260, 341
 Enki, 182
 Enkidu, 150–51
 Enlightenment, 192, 205, 210, 242
 Enlil, 150–51, 182
 Entomologischer Verein Krefeld, 304
 Eocene, 39, 58
Epic of Gilgamesh, 142, 143, 148, 150–51, 155, 157–59, 182
 equids, 83, 94. *See also* asses; donkeys; horses; mules; Przewalski's horses; zebras
Equus capensis. *See* cape zebras
Equus mauritanicus. *See* Saharan zebras
Equus spp., 146
 ermines, 278–79
 Eskimo curlews, 172
Essay on the Principle of Population, 240
 Ethiopia, 164, 169
 Euphrates River, 151, 162
 Eurasia, 61, 70, 73, 74, 97, 124, 139, 159, 178, 179, 189, 278; domesticates, 147–48, 178; extinctions/extirpations, 77, 83, 124
 Eurasian people, 178. *See also* Sintashta people
 Europe, 45, 47, 53, 62, 69, 84, 111, 117, 120, 122, 130, 133, 135, 138, 139, 146, 154, 156–61, 187, 188, 192, 199, 201–2, 223, 239, 243, 258, 260,

- 261, 262, 278, 279, 281, 282, 305, 309, 320, 325, 334, 339, 340; conservation, 123, 156, 158, 187, 220; domesticates, 98, 106, 111, 130, 146, 228, 253, 258, 260, 261, 274–76; extinctions/extirpations, 47, 111, 117, 121–23, 159, 339–40; invasives, 135, 136, 138, 272, 273. *See also* Eastern Europe; Western Europe
- European bison, 157, 159, 339, 340
- European societies, 8, 9, 11, 53, 62, 69, 86, 98, 111, 115, 116, 119–24, 139, 157, 158, 180, 187, 189, 201, 208, 220, 250, 276–80, 325. *See also* Anglo-Saxon; Basque people; British people; Celtic people; colonization; Danish people; Dutch people; English people; French people; German people; Greek people; Lithuanian aristocracy; Norman people; Portuguese people; Romans; Russian people; Spanish people
- European Union, 307
- European wild asses (extinct), 83
- eutrophication, 319, 320
- Evelyn, John, 238–44
- Evelyn, Mary, 244
- Evelyn, Richard, 244
- evolution, 6, 8, 10, 16–60, 67, 68, 70, 86, 88, 90, 100–101, 103, 116, 117, 130, 133, 145, 165, 175, 177, 186, 187, 190–93, 198, 199, 201, 209, 210, 217–19, 222, 224, 231, 251, 258, 266–68, 271, 273, 275–76, 278, 288–90, 295, 299–301, 306, 308, 321, 329, 341–42; coevolution, 309–10, 325; convergent, 209. *See also* domestication; natural selection; speciation
- extinct animals (general), 7, 20, 25, 28, 39, 57, 60, 62, 76, 77, 78, 80, 83, 84, 86, 90, 108, 137, 144, 161, 170, 180, 187, 207, 208, 209, 224, 229, 230, 232, 267, 276, 277, 285, 290, 299, 329; birds (general and specific), 8, 9, 79, 82, 172, 180, 181, 182, 209, 212, 216, 217, 219, 220, 221, 223, 224, 225, 226, 227, 228, 230, 232, 290; fish (general and specific), 212; invertebrates (general and specific), 54, 224, 229, 269, 299, 300, 305, 341; mammals (general and specific), 3, 8, 11, 47, 48, 49, 52, 56, 57, 59, 60, 62, 63, 66, 69, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 108, 117, 119, 132, 147, 148, 161, 162, 164, 166, 170, 208, 209, 223, 224, 227, 228, 277, 335, 336, 338, 341; reptiles (non-avian, general and specific), 8, 9, 13, 25, 53, 79, 82, 201, 219, 223, 224, 228, 230, 301. *See also* extinction; Late Quaternary Megafaunal Extinction; mass extinctions; Sixth Extinction
- extinction, 4, 6, 8, 13, 14, 16, 17, 18, 20, 21, 22, 25, 27, 33, 34, 41, 48, 49, 57, 78, 80, 81, 83, 84, 86, 87, 92, 94, 95, 108, 112, 121, 159, 161, 164, 170, 171, 182, 184, 187, 192, 201, 207, 208, 209, 215, 219, 225, 229, 230, 232, 233, 237, 246, 267, 269, 272, 277, 280, 285, 286, 291, 299, 305, 312, 316, 317, 329, 334, 340, 341; background, 4, 5, 27, 342; debt, 285; human caused, 5, 7, 8, 9, 76, 77, 80, 82, 83, 86, 87, 88, 92, 96, 164, 166, 171, 181, 207, 208, 209, 212, 220, 224, 227, 228, 229, 230, 233, 297; pseudoextinction, 27; rates of, 2, 4, 5, 17, 22, 26, 34, 35, 49, 187, 228, 233, 335, 342; size-selective, 57, 76, 87, 88, 93; stochastic, 211. *See also* extinct animals; Late Quaternary Megafaunal Extinction; mass extinctions; Sixth Extinction
- Falconer, Hugh, 53, 75
- fallow deer, 97
- Far East (Russia), 338
- farming. *See* agriculture
- felids (general), 126. *See also* American lions; Bengal tigers; big cats; bobcats; caracals; cave lions; cheetahs; cougars; Florida panthers; Iberian lynx; jaguars; leopards; lions; lynx; saber-tooth cats; saber-toothed tiger; scimitar cats; snow leopards; tigers; wildcats
- Felipe Ángeles International Airport, 335

- ferrets, 101; invasive, 276
- Fertile Crescent, 106, 109, 112, 128
- fertilizers, 11, 44, 111–12, 115, 252, 257, 281, 285, 320; synthetic, 243, 267, 293, 295, 319
- Fifth Dynasty (Egypt), 165
- Finland, 72, 119, 120
- fin whales, 207
- fire (technology), 11, 30, 39, 43–48, 52, 55, 60, 65, 73, 87, 89, 112, 153, 154, 155, 159, 161, 184, 192, 209, 227, 236, 237, 238, 240, 241, 244–45, 247, 264, 296, 321. *See also* internal combustion; steam power
- firearms, 116, 206, 278, 280, 317, 336. *See also* projectile weapons
- fireflies (general), 13, 179, 297–305; big dippers (*Photinus pyralis*), 298; extinct, 299, 300
- First Crusade, 150
- First Fleet, 115, 274, 276
- fish (general), 63–64, 103, 171, 194–95, 198, 201, 214, 216, 311, 313, 318–28; domestication, 248, 251, 325; extinct, 212. *See also* anchovetas; anchovies; carps; catfish; cod; Galápagos damsel; groupers; guppies; herrings; jacks; mackerels; Mauritius green wrasse; menhaden; minnows; moray eels; ocean sunfish; rays; salmon; sardines; sea bass; sharks; skates; suckerfish; swordfish; tilapia; triggerfish; trout; tunas
- Fisher, Ronald, 21
- fish event horizon, 199
- fishing/fisheries, 189, 192, 195–201, 210, 212, 214, 229, 249, 258, 312–20, 324, 327; bycatch, 316; commercial extraction, 196–201, 288, 312–24, 328; Dutch people, 188, 199, 200, 204, 205, 258
- fleas, 137
- Fleming, Ian, 172
- floods, 143, 159, 169, 170, 172, 182, 242; myths/stories, 182, 184, 233
- Flores, Dan, 286
- Flores Island, 136
- Florida, 171, 210
- Florida bear (extinct), 79
- Florida Keys, 310–11
- Florida panthers, 172
- Florissant, 16, 23
- flycatchers, 309
- Folsom people, 64
- food chains. *See* food webs
- food webs, 90, 94, 115–16, 126–27, 159, 161, 167, 170, 172, 176, 190, 193–98, 200–201, 206, 208, 212, 214–19, 221–22, 224, 226–27, 248, 272–76, 293, 308, 309, 315, 316, 319, 320, 321, 323, 342; bottom-up regulation, 227, 293, 309–10, 318, 320, 328; brown food web, 308; top-down regulation, 91, 126, 159, 198, 208, 273, 275, 276, 309, 314, 316, 318–19, 328
- Ford, Henry, 265
- forestry, 157, 238, 265
- forests (ecosystem), 2, 10, 12, 16, 24–25, 44, 58–59, 83, 89, 92–93, 119, 122, 126, 129, 132, 138, 143, 145, 150–82, 216, 219, 227, 230, 253, 254, 272, 277, 284, 292, 310, 331–36, 340, 343; broadleaf, 153, 157, 180; Cross Timbers, 25, 73; jungles, 332; rainforests, 12, 41, 80, 153, 161, 162, 179, 284, 294, 298, 312, 332–33; taiga, 24, 153, 278
- fossil fuels, 184, 189, 207, 239, 240, 241–42, 244–47, 253, 263, 268, 277, 280, 283, 285, 296, 301, 321, 333
- fossils, 4–6, 10–11, 16, 17, 20, 22, 23, 27, 31, 34–36, 49–63, 75–80, 90, 95–96, 138, 143, 144, 229, 233, 285, 287, 290–91, 297, 303, 313, 321, 341–42
- foxes (general), 59, 126, 175, 278, 279, 309; domestication, 104; invasive, 276. *See also* hoary foxes
- Foy, Sven, 207
- France, 99, 122–23, 157, 186, 243, 249, 251, 294, 325, 326, 340
- Freese, Barbara, 244–45
- French people, 217–18, 250, 277, 278, 325
- frigate birds, 225
- fritillary butterflies, 7, 180
- frogs (general), 220, 334; invasive, 220

- Frost, Robert, 151
 Fry, William H., 326
Fumifugium, or, The inconveniencie of the aer and smoak of London, 241
 Funk Island, 211

Gadus morhua. *See* cod
 Galápagos damsel (extinct), 212
 Galápagos Islands, 222; extinctions/extirpations, 212
Gallus gallus. *See* red jungle fowl
 Ganj Dareh, 106
 Garlick, Theodatus, 326
 Gaul, 111, 157
 gaur, 112; domestication, 112
 gayal, 112; domestication, 101, 112–13
 gazelles, 99, 105, 138. *See also* goitered gazelles; mountain gazelles
 geese, 101, 217; domestication, 101, 211
 Geirfuglasker, 211
Geological Evidences of the Antiquity of Man, 144
 geology, 4, 6, 11, 16, 17, 18–22, 35, 38–40, 48, 56, 90, 95, 144, 152, 179, 182–86, 193, 211, 217, 221, 224, 231, 241–44, 284, 285, 290–97, 318, 321, 329, 335, 341–42
 Georgia (state), 56, 59, 75–76, 79, 335
 gerbils, 101
 German people, 157, 317, 325
 Germany, 68–69, 304, 340
 giant African land snails, 271
 giant anteaters, 80, 179, 340
 giant beavers (*Castoroides*, extinct), 79
 giant pandas, 83
 giant short-faced bears (*Arctodus*, extinct), 79
 giant squids, 206
Gigantopithecus (extinct), 49
 Gilgamesh, 143, 145, 150–51, 155, 159, 182–84
 giraffes, 64, 84, 138, 170, 337–38
 Gladstone, William, 141–42
 Global North, 331
 Global South, 331
 global warming. *See* climate change
 glyptodonts (extinct), 80
 goats (domestic), 101–8, 111, 115, 117, 254; invasive, 97, 224, 231
 GOE. *See* Great Oxygenation Event
 goitered gazelles, 105
 gomphotheres (extinct), 78, 80, 91
 Gondwana, 224
 gorillas, 84, 164, 334, 337
 goshawks, 181
 Gould, Stephen Jay, 15, 22–23
 Goulson, David, 303, 305
 Grand Banks (Canada), 313
Grapes of Wrath, 174
 grasshoppers, 133, 179
 grasslands (ecosystem), 12, 24, 25, 42, 58, 59, 79, 80, 83, 93, 112, 114, 117, 119, 133, 143, 147, 148, 153, 162, 173–82, 237–38, 256, 260, 266, 269, 285; cerrado, 179, 180; llanos, 179; pampas, 179, 262; Phumdi, 25; plains, 59, 73, 88, 114, 122, 179, 181, 218, 262, 340; prairies, 2, 12, 24, 25, 58–59, 65–66, 73, 86, 89, 91, 173–82, 216, 237, 260, 262, 263, 279, 281, 284–86, 294, 298, 318; savannahs, 25, 41, 49, 51, 58, 92, 178–79, 248, 280, 284, 338; shrublands, 114, 178; steppe, 45, 69, 73, 93, 139, 147, 148, 178, 179, 337; Terai, 25; tundra, 24, 67, 93, 176
 gray whales, 196, 205, 215
 Great Acceleration, 293–97, 312–15, 320–21, 327, 331, 334, 336, 338, 340
 great apes. *See* primates
 great auks (*Pinguinus impennis*, extinct), 209, 210, 211, 278
 Great Barrier Reef, 321–22
 Great Britain, 121, 122, 158, 191, 205, 239, 249, 257, 261, 272–73, 281, 283; extinctions/extirpations, 122; invasives, 272–73. *See also* British Isles; England; United Kingdom
 Great Cedar Forest, 150, 155, 157, 184
 Great Divergence, 189, 245
 Greater Antilles, 229–30
 greater prairie chickens, 180–81. *See also* lesser prairie chickens; prairie chickens

- Great Hinckley Hunt, 116–17
 Great Lakes (Africa), 162
 Great Northern Expedition, 208
 Great Oxygenation Event (GOE), 30, 296
 Great Plains (United States), 25, 179, 262–63
 great white sharks, 64, 66, 194
 Great Zimbabwe, 149
 Greece, 118, 197
 Greek people, 197
 Greenland, 177, 185, 189, 204
 Green Revolution, 294, 328
 green turtles, 51
 Grevy's zebras, 338
 griffon vultures (general), 329
 grizzly bears. *See* brown bears
 ground sloths (extinct), 56, 62, 78, 94
 groupers, 314
 Grove, Richard, 220
 Guadalupe, 230
 Guam, 226
 guanacos, 80, 114, 178; domestication, 114
 Guano Age, 281
 Guano Islands Act, 282
 guinea pigs, 101, 113–14
 Gulf of California, 167, 316
 Gulf of Mexico, 320
 gunpowder, 187, 283. *See also* firearms
 guppies, 101
Gyps spp. *See* griffon vultures
- Haber-Bosch process, 293, 319
 Hadrian (emperor), 156
 Hammerhead sharks, 316
 hamsters, 101
 hares, 67, 103
 Harrington's mountain goat (*Oreamnos harringtoni*), 78
 Harris, Marvin, 112
Harry Potter, 334
 hartebeests, 170
 Hawaii, 212, 214, 217, 219, 221, 229; colonization, 229; invasives, 229; Leeward Islands, 214; Windward Islands, 214
- hawks, 181
 heath hens. *See* prairie chickens
 Hebei, 250
 hedgehogs, 309
Henry Astor (ship), 234–35
 Hercules, 117
 Hercynian Forest, 111, 157
 herrings (*Clupea harengus*), 198–201, 313
 Himalayas, 25, 53, 75, 112, 121
 Hinckley, 116–17. *See also* Great Hinckley Hunt
 Hinduism, 249
 Hippopotami (*Hippopotamus amphibius*), 83–84, 97, 165–66, 169–70, 201, 228, 336, 338; symbolism, 166. *See also* pygmy hippopotami
Hippopotamus amphibius. *See* hippopotami
Hippotragus leucophaeus. *See* blue antelope
 Hispaniola, 229–30
 Hittite society, 146
 hoary foxes, 179
 Hoffman, Richard, 199
 Holocene, 40, 85–86, 94–95, 101–2, 105, 107, 112, 117, 119, 126, 128, 132, 138, 139, 147, 151, 153–54, 161–62, 164, 182–84, 195, 223, 229, 273, 291, 292, 296, 331, 336–38
 Holocene-Anthropocene transition, 337
 Holt, Benjamin, 333
 Homer, 117
Homo (genus), 42–49, 54–59, 60, 85; *Homo erectus*, 42–49, 55; *Homo floresiensis*, 136; *Homo habilis*, 42. *See also* Denisovans; Neanderthals
Homo neanderthalensis. *See* Neanderthals
 honeybees, 10
 horned lizards, 268
 horses (general), 43, 69, 72, 86, 146, 231, 236; domestication, 72, 86, 99, 103, 108, 132, 138–39, 146–49, 178, 295; extinct, 79–80, 84, 94, 108, 147, 335; invasive, 178, 231, 285. *See also* Przewalski's horses
 Hot Spring (city), 75
 houseflies, 127, 130–32

- house mice (*Mus musculus*), 134, 220, 223;
 - invasive, 134
- hoverflies, 305
- Huastec people, 260
- Hubei, 256
- Hudson, Henry, 204
- Hudson's Bay Company, 279
- human-mediated biological dispersal. *See*
 - invasion; invasive animals (general);
 - invasive plants
- Humbaba, 150, 151
- Hume, David, 264
- Hume, Julian, 9, 52, 219
- humpback whales, 207, 283
- Hungary, 258
- Huningue, 325–26
- hunting (by humans), 64–73, 77, 80, 82,
 - 85–88, 95, 97, 99, 105–7, 109, 111, 114–17,
 - 122, 126, 138, 140, 154, 161, 162, 165, 166, 169,
 - 174, 181, 194, 197–98, 208–10, 220, 222, 224,
 - 229, 237, 248, 273–79, 316, 333, 335–38, 340;
 - blitzkrieg, 77, 82, 85, 87; bounties, 116, 122,
 - 124, 300; commercial exploitation, 185,
 - 186, 192, 196, 198, 201–9, 216, 222, 278, 279,
 - 280, 281, 283, 285, 286, 293, 317, 318, 336;
 - with dogs, 72, 73; with fire, 154, 161;
 - subsistence, 195, 202, 209, 222, 251, 280,
 - 317, 336, 341. *See also* bears; big cats;
 - elephants; mammoths; megafauna;
 - whaling; wolves
- Huxley, Julian, 21, 186
- Hydrodamalis gigas*. *See* Steller's sea cow
- hyenas (general), 83, 336, 342. *See also*
 - spotted hyenas
- hypoxia, 319–20
- Iberá wetlands, 340
- Iberia, 128, 275
- Iberian lynx, 172
- ibexes (general), 103, 105–8, 140, 143. *See also*
 - bezoar ibexes
- Ice Age. *See* Pleistocene
- Iceland, 202, 211, 318
- impalas (*Aepyceros* spp.), 85
- imperialism. *See* colonization
- Inca people, 149
- India, 25, 86, 117, 119, 129, 134, 163, 164,
 - 168–69, 217, 270, 307, 329–31, 334, 339;
 - extinctions/extirpations, 163. *See also*
 - Keoladeo National Park
- Indian Ocean, 8, 51, 212, 217, 225, 322;
 - invasives, 225
- Indian rhinoceroses, 162, 339
- Indonesia, 62, 98, 136, 222, 332, 338;
 - invasives, 98. *See also* Flores Island
- Indo-Pacific (region), 322
- Industrial Revolution, 113, 159, 183, 206, 248,
 - 272, 280; First, 237–45, 251, 253, 273, 278,
 - 280–85, 295, 305–6; Second, 239, 273–84,
 - 295, 300, 306, 317
- Indus Valley, 134
- insect apocalypse, 300, 304–5
- insecticides. *See* pesticides
- insects (general), 91, 99, 137, 158, 161, 192,
 - 297–310, 332; extinct, 300, 305. *See also*
 - agriculture; aphids; ants; assassin bugs;
 - bedbugs; bees; beetles; butterflies;
 - caterpillar; cicadas; crickets; fireflies;
 - fleas; houseflies; hoverflies; lice;
 - locusts; midges; mosquitos; moths;
 - praying mantises; termites; tsetse flies;
 - wasps
- Intergovernmental Science-Policy Platform
 - on Biodiversity and Ecosystem Services
 - (IPBES), 151, 269
- internal combustion, 239, 295, 313, 317, 333.
 - See also* fire; fossil fuels; steam power
- International Geosphere Biosphere
 - Programme (IGBP), 291
- International Mineralogical Association,
 - 296
- International Union for Conservation of
 - Nature (IUCN), 186, 187, 212; IUCN Red
 - List, 187, 212, 305
- International Whaling Commission, 191, 318
- Inuit people, 249

- invasion (biological), 133, 231, 232, 267–77,
320; rates of, 270, 272–73. *See also* invasive
animals; invasive plants
- invasive animals (general), 2, 98–99, 137,
177–78, 213, 220, 224, 229–32, 262, 267–77;
spread by colonization, 98, 99, 115, 181,
213, 220, 223–31, 258, 260, 263, 271–75, 276,
332. *See also* ants; birds; cats; cattle;
cuscuses; dogs; earthworms; ferrets;
foxes; frogs; goats; horses; houseflies;
house mice; minks; monkeys; pigs;
invasive plants; rabbits; rats; reptiles;
sheep; snails; snakes; squirrels
- invasive plants, 213, 271, 272, 276
- invertebrates (general), 158, 179, 219–20,
224, 226, 297–310, 320, 334; extinct, 224,
300. *See also* centipedes; comb jellies;
insects; jellyfish; millipedes; snails;
spiders; sponges; worms
- Iran, 106–7, 148, 162. *See also* Zagros
Mountains
- Ireland, 231
- Irish elk, 63, 83
- Iron Age, 122, 130, 145, 155
- Isabella* (ship), 191
- Ishmael, 185, 232
- islands (as locations), 137, 185–86, 189, 208,
214, 216–18, 221–23, 227, 231–32, 281–84;
continental, 221; as ecosystems, 186,
208–9, 213, 217–33, 276, 284; oceanic, 221,
223
- Isle Royale, 70
- Israel, 165
- Italy, 121, 123, 154, 156, 157, 258, 340
- Ivoryton, 280–81
- jackals, 59, 68, 126
- jacks, 214
- Jackson, Andrew, 50
- Jackson, Jeremy, 329
- Jacobi, Stephan Ludwig, 325
- jaguars (*Panthera onca*), 78, 80, 119–20, 164,
179, 336, 340
- Jamaica, 209, 229
- Japan, 120, 124, 299, 317, 318; extinctions/
extirpations, 124
- Java, 339
- Javan rhinoceroses, 162, 339
- Javan rusa (*Rusa timorensis*), 98, 220
- Jefferson, Thomas, 78
- jellyfish (general), 53, 311, 315, 320–21
- Jerusalem, 150
- Jonathan (tortoise), 50–51
- Jones, Ryan, 316–17
- Jones-Miller site, 65
- Journal of a Voyage to the Northern
Whale-Fishery*, 185, 191
- The Jungle*, 265
- jungles. *See* forests
- Jura (mountains), 157
- Jurassic, 50, 56, 299
- kangaroos, 99, 137–38; extinct, 81
- Kansas, 16, 23, 35, 174, 263
- Kansas Geological Survey, 16
- Kavango-Zambezi Transfrontier Conserva-
tion Area, 338
- Kazakhstan, 147
- Keddy, Paul, 167
- Kenya, 337–38
- Keoladeo National Park, 329
- killer whales. *See* orcas
- Kinsella, John, 333
- Kiowa people, 286
- Kipling, Rudyard, 254–55
- Kolbert, Elizabeth, 5
- Kolpochoerus* (extinct), 85
- Krakatoa, 206
- Krefeld study, 304–5. *See also* Entomolo-
gischer Verein Krefeld
- Kremlin, 233
- krill, 194
- Krzemionki (museum), 154
- Kyrenia Mountains, 96
- Labrador (region), 203
- Labrador ducks (extinct), 172
- La Brea storks (extinct), 79, 290

- La Brea Tar Pits, 75
- lady beetles, 309
- ladybug. *See* lady beetles
- Lake Superior, 70
- Lake Theo, 65
- Lampyridae. *See* fireflies
- land-use change, 150–84, 220, 224, 227–28,
237, 238, 253, 262, 263, 266, 269, 272, 285,
294, 299, 305, 318, 323, 328–37
- Laos, 333–34
- Lascaux, 63
- Last Glacial Maximum (LGM), 69
- last universal common ancestor (LUCA), 29
- late Holocene rainforest crisis, 160
- Late Quaternary Megafaunal Extinction, 57,
76–77, 84–95, 161, 297, 341
- Latin America, 294
- Leakey, Richard, 5
- Lebanon, 150
- Leguat, François, 51–52
- lemurs, 227
- Lenten, 325
- leopards, 49, 336
- leopard snakes, 227
- Leopold, Aldo, 167
- Lepidodendron* (extinct), 241
- lesser prairie chickens (*Tympanuchus pallidicinctus*), 91, 173–76, 180–82, 290
- Levant, 106, 149, 151, 162, 164–65
- Levasseur, Émile, 243
- Lewin, Roger, 5
- Lewis, Sara, 298, 300
- Libya, 164
- lice, 41
- Lightning* (ship), 274
- lightning bugs. *See* fireflies
- Lingulata* spp. *See* brachiopods
- Linnaeus, Carl, 14, 41, 271
- lions (*Panthera leo*), 49, 64, 83, 84, 117–21,
127, 170, 336–37; symbolism, 118–19, 121.
See also American lions; cave lions
- Lithuanian aristocracy, 158
- livestock (general), 104, 109, 111–13, 116, 122,
124, 126, 132, 139–40, 149, 155, 157, 176–78,
180, 231, 236, 246, 248, 253, 260, 263,
265–66, 269–70, 275, 288, 294, 325, 328,
330, 332, 336. *See also* draft animals;
transport animals
- Livyatan melvillei* (extinct), 202
- lizards (general), 64, 219, 230; extinct,
223–24, 230. *See also* horned lizards
- llamas, 101, 102, 113–15; extinct, 79
- llanos. *See* grasslands
- Locusta migratoria*. *See* migratory locusts
- locusts (general), 132–34. *See also* desert
locusts; migratory locusts
- London, 141, 199, 241, 245, 262–63
- longhorn crazy ant, 270–71
- long-horned bison (extinct), 56
- Lopez, Barry, 125
- Los Angeles, 75
- Louis XV, 122
- Loxodonta africana*. *See* African savanna
elephant
- Loxodonta cyclotis*. *See* African forest
elephant
- Lubbock, John, 144
- LUCA. *See* last universal common ancestor
- Lumbricus terrestris*. *See* common
nightcrawlers
- Lyell, Charles, 19, 20, 39, 40, 56–57, 59, 68,
75–76, 79, 144, 182, 292, 297
- lynx (general), 41, 126, 159, 339. *See also*
Iberian lynx
- Maasai people, 118
- macaques, 127
- MacArthur, Robert, 26, 222
- mackerels, 322
- Maclura pomifera*. *See* Osage orange
- Macrauchenias* (extinct), 80–81
- Madagascar, 218–19, 223, 225, 227; extinc-
tions/extirpations, 227–28
- Madeira, 223
- Maine, 181
- maize. *See* corn
- Malaysia, 332, 334
- Maldives, 219

- Malta, 227; invasives, 227
- Malthus, Thomas Robert, 18–20, 26, 240;
Malthusian, 26, 28, 35
- mammals (general), 219, 220, 224, 229,
275–76, 294, 303, 309, 338; extinct, 79, 82,
228, 229, 277
- mammoths (extinct), 8, 11, 47, 56–57, 59, 66,
69, 73–76, 78, 83, 88, 90–91, 93–94, 162,
335–36; hunting (by humans), 74, 89,
335–36
- manatees, 194, 208, 318
- maned wolves, 179, 340
- mangrove swamps. *See* wetlands
- Manhattan, 5, 218
- Māori, 154
- Mariana mallards (extinct), 290
- marine worms, 193
- marsh deer, 340
- marshes. *See* wetlands
- martens, 61, 279
- Martha's Vineyard (island), 181
- Martin, Paul S., 77
- Maryland, 181, 300
- Mascarenes, 217–21; colonization, 217, 220;
conservation, 220; extinction/extirpa-
tion, 221; invasives, 220, 221, 223
- Mascarenhas, Pedro, 217
- Massachusetts, 116, 181, 185, 205
- Massachusetts Bay Colony, 124
- mass extinctions, 3, 4, 5, 6, 7, 12, 17, 26–30,
35–40, 50, 53, 54, 77, 82, 93, 95, 137, 153,
186, 207, 297, 303, 305, 341, 342; end-
Cretaceous (K-T), 38, 40, 58, 303;
end-Devonian, 36; end-Ordovician, 36,
54; end-Permian, 36, 37, 54, 153, 303;
end-Triassic, 37. *See also* Sixth Extinction
- mastodons, 56, 59, 66, 78–80, 89, 91, 94, 162
- Maui, 218
- Maurice, Prince of Orange, 217
- Mauritius, 8, 9, 217–20, 228; colonization of,
9, 217–20; extinctions/ extirpations, 9,
212, 217–20; invasives, 8, 220
- Mauritius green wrasse, 212
- May, Robert, 14
- Maya people, 149, 170
- Mayr, Ernst, 22
- McCarthy, Cormac, 122
- McDonald's, 249
- McNeill, John, 206, 237, 281, 324
- McPhee, John, 16
- meat consumption (modern), 248–51,
258–59, 262, 265, 267, 281, 283, 285–87,
289, 291, 309, 317, 323, 325–28, 332, 335
- meat production (industrial), 238, 245–67,
286–91, 294, 317, 325–26, 328, 332
- Mech, David, 70, 71
- Mediterranean, 156, 162, 178, 196, 198, 210,
223, 227; invasives, 134, 227, 276
- Mediterranean monk seal, 196–97, 209
- Medusa (mythological), 307
- megafauna, 3, 49, 51, 53, 55, 56–57, 62, 64, 70,
73–95, 97–98, 117, 132, 161–62, 164, 167,
170, 201, 212, 215–16, 224, 233, 280–81, 297,
310, 335–41; hunting (by humans), 10, 49,
53, 57, 62–69, 73, 76, 80, 82–83, 88, 97–98,
117, 162, 165, 169, 174, 201, 208, 216, 224,
232–33, 237, 251, 279–81, 285–86, 336, 337,
338, 341
- Megalochelys* (extinct), 53
- Megalonyx jeffersonii* (extinct). *See* ground
sloths
- Megalotragus priscus* (extinct), 85
- Meltzer, David, 87
- Melville, Herman, 185, 206–7, 233
- Mendel, Gregor, 21; Mendelian, 21
- menhaden, 324
- Mesoamerica, 115, 119
- Mesoamerican societies, 115. *See also*
Huastec people; Maya people; Nahua
people
- Mesopotamia, 106, 134, 141, 143, 145, 168–69
- Mesozoic, 37, 57, 95, 130
- metallurgy (technology), 11, 44, 122, 124,
138, 145, 148, 154–55, 159–61, 165, 182, 238,
242, 278, 327
- Methusaleh, 158

- Metridiochoerus* (extinct), 85
- Mexico, 67, 119, 260, 277, 291, 310, 340. *See also*
Felipe Ángeles International Airport
- Mexico City, 75, 335
- mice (general), 134. *See also* house mice
- microplastics, 321
- Middle Ages, 111, 121–22, 158, 188, 191, 198,
217, 257, 260, 278, 325; High Middle Ages,
159
- Middle East, 130
- Middle Passage, 254
- midges, 301
- Midwest, 300
- migratory locusts (*Locusta migratoria*), 133
- millet, 111, 129, 162
- millipedes, 308
- Ming Dynasty, 133, 163
- minifauna (general), 300, 318. *See also*
insects; invertebrates
- mining, 239, 242, 260, 277, 281–84, 294, 335
- minke whales, 207
- minks (general), 61, 279; domestication,
101; invasive, 273. *See also* American
minks
- minnows, 63
- Miocene, 39, 40, 58–59
- Mississippi Basin, 320
- Mississippi River, 170–71, 320
- moas (extinct), 224–25, 290
- Mobile (city), 267
- Moby-Dick*, 185, 207, 232–33
- modern growth (human), 240, 244–45, 277,
293, 296, 331
- moles, 41, 309
- Momaday, N. Scott, 286
- Monachus tropicalis*. *See* Caribbean monk
seals
- Mongolia, 128, 135, 147, 178, 180
- monkeys (general), 72, 137, 151; invasive, 8,
221, 224. *See also* crab-eating macaque;
macaques; vervet monkeys
- Monongahela River, 277
- Montana, 66
- moose, 67, 71–72, 78, 157, 159
- moray eels, 198
- Moriceau, Jean-Marc, 122
- Morocco, 133, 164
- Moscow, 278
- mosquitos (*Anopheles* spp.), 85, 301
- moths (general), 301–2, 309. *See also*
caterpillar; silkworms; tobacco
hornworms
- mouflon (*Ovis gmelini*), 103, 108
- mountain bongos, 338
- mountain gazelles, 105
- mountain goats, 78
- mountain lions. *See* cougars
- mountains, 1, 17, 47, 54, 55, 214, 218, 236, 283,
294, 340; as ecosystems, 25, 83, 88, 106,
114, 122, 124, 218, 327, 340
- Mount Lebanon, 156
- Mount Vernon, 78, 254
- mule deer, 78
- mules, 236
- Musca domestica*. *See* houseflies
- Muscovy Company, 204
- musk oxen, 67, 78; domestication, 101
- muskrats, 278–79
- Mus musculus*. *See* house mice
- mussels, 321
- mustelids (general), 61, 126. *See also*
badgers; martens; minks; raccoons;
skunks; weasels; wolverines
- mutualism, 95, 99, 127, 130
- Nahua people, 260
- Namibia, 338
- Nantucket, 233–36
- natural selection, 6, 10, 18–23, 27. *See also*
evolution; speciation
- Nature Conservancy, 213
- Neanderthals (extinct), 47, 52, 60, 83.
See also *Homo*
- Near East, 117–19, 138, 139, 148, 156;
domesticates, 128, 130, 148; extinctions/
extirpations, 121

- Neo-Darwinism, 21–23
- Neolithic, 159
- Neolithic Revolution, 145, 324–25
- neonicotinoids, 307
- Nepal, 334
- Netherlands, 9, 200, 233, 258, 260, 304, 340;
domesticates, 258–61; extinctions/
extirpations, 305
- Newell, Norman D., 16–23, 27, 34, 35
- New England, 151, 205, 206, 235
- Newfoundland, 201–2, 211
- New Guinea, 62, 81, 222–23
- Newhouse, Sewall, 124–25
- New Jersey, 181
- New Mexico, 62, 175
- New Spain, 231
- Newton, Isaac, 238, 243; Newtonian, 295
- New World, 81, 102, 113, 114, 115, 116, 119, 134,
146, 169, 170, 180, 231, 254, 277, 331, 332
- New York, 17, 124, 136, 262
- The New York Times*, 304
- New Zealand, 154, 224, 227, 262, 266;
extinctions/extirpations, 224
- Nile crocodiles, 165, 170
- Nile River, 165, 169–70, 270, 327
- Nile Valley, 147, 170
- Nineveh, 142
- Noah (biblical), 141, 184, 233
- Nobel, Alfred, 283
- noddies, 225
- nonnative species. *See* invasive animals
(general); invasive plants
- Normann, Wilhelm, 317
- Norman people, 273
- North Africa, 134, 164
- North America, 49, 56, 57, 59, 62, 64, 74,
77–81, 86, 89, 91, 113, 119, 133, 149, 160, 170,
173, 177–79, 231, 260, 261, 277–79, 284–85,
340; domesticates, 98, 103, 113, 178;
extinctions/extirpations, 57, 77–79, 86, 117,
119–21, 124, 147, 172, 268–69, 285; invasives,
113, 115, 117, 130, 134, 136, 174, 177–78, 181,
231, 236–37, 260, 262, 267–69, 285. *See also*
Central America; Mesoamerica
- North American societies, 50, 64, 78, 161,
174, 205, 237, 251, 277, 333. *See also*
Cheyenne people; Clovis people;
Folsom people; Huastec people;
Inuit people; Kiowa people; Maya
people; Nahua people; Tsuut’ina
people
- North Atlantic, 189, 201, 210
- North Atlantic Fish Revolution, 201
- North Atlantic right whale (*Eubalaena
glacialis*), 196, 202, 204–5, 215
- North Pacific, 208, 279
- North Sea, 199
- Norway, 318
- Nuestra Señora de Atocha* (ship), 310
- nutrient runoff, 319–20, 328
- oceans (ecosystem), 24, 171, 185–86, 189–216,
222, 226, 231, 233, 284, 310–29, 342;
benthic, 193, 206; pelagic, 193; seagrass
meadows, 318–19, 323. *See also* Arctic
Ocean; Atlantic Ocean; Indian Ocean;
Pacific Ocean
- ocean sunfish, 323
- Odysseus, 109
- Ohio (state), 116–17
- Ohio River, 277
- Ohio Valley, 254, 263, 277
- oil (petroleum). *See* fossil fuels
- Oklahoma (state, greatest), 54, 64–65, 73,
76, 174, 256, 263, 268, 286, 298, 341
- Old Kingdom, 169
- Old World, 55, 60, 77, 83, 103, 111, 113, 115, 121,
128, 130, 135, 147, 148, 149, 162, 173, 180, 231,
233
- Oligocene, 40, 58
- Oneida community, 124–25
- On the Origin of Species*, 216
- Oppian, 195–96
- orangutans, 164, 334
- orcas, 44, 64, 194
- Ordovician, 54
- Oreamnos harringtoni*. *See* Harrington’s
mountain goat

- Oriental Despotism* (book), 168
Orycteropus crassidens. *See* armadillo
(*Orycteropus crassidens*, extinct)
oryx, 170
Osage orange (*Maclura pomifera*), 89, 92
ostriches, 101, 178; domestication, 101
otters, 49, 208, 278–79; extinct, 49
Ovis gmelini. *See* mouflon
owls, 12, 159, 334
oxen, 79, 94
oysters, 320
- Pacific Ocean, 136, 162, 188, 193, 205, 212, 215,
234, 235, 281–83, 316, 323. *See also* North
Pacific
Palaeoloxodon cypriotes. *See* dwarf elephants
paleobiology, 22, 32, 34–35, 77–78
Paleocene, 40, 58
Paleolithic, 206
paleontologists. *See* paleontology
paleontology, 4, 6, 17, 22, 25, 31, 35–36, 39, 49,
51–52, 54, 76, 90, 106, 117, 138, 143, 144,
297, 303, 341–42
Paleozoic, 31–32, 37, 54, 300, 311
Palestine, 119
palm oil, 284, 331–32, 334
Palmyra Atoll, 212–13, 221; invasives, 213
pampas. *See* grasslands
pampas deer, 179, 340
pampatheres (extinct), 78, 80, 94
Pan (god), 106
Pangea, 36–37, 231, 241
pangolins, 334, 336
Pantanal, 340
Panthera atrox. *See* American lions
Panthera leo. *See* lions
Panthera onca. *See* jaguars
Panthera tigris. *See* tigers
panthers. *See* cougars; Florida panthers
Pánuco, 260
Papin, Denis, 243
parasitism, 127, 137
Paris, 136, 138
parrots, 230
passenger pigeons (extinct), 290
Patagonia, 340
Patterson, Buck, 73–74
Paul (apostle), 227
peccaries (general), 340; extinct, 79. *See also*
collared peccaries
pelagic. *See* oceans
penguins, 209, 211
Pennsylvania (state), 54, 181
Pennsylvanian Period, 277
Pequod (ship, fictional), 185
Permian, 54, 241
Persian Gulf, 106
Peru, 268, 281–82, 324
The Pesticide Manual, A World Compendium,
308
pesticides, 2, 11, 269, 295, 300, 304–8. *See also*
neonicotinoids
Peter (saint), 127
petrels, 219, 316; extinct, 209. *See also* Barau's
petrels
petroleum. *See* fossil fuels
Phalanger orientalis. *See* cuscuses
Phanerozoic, 300
Phanourios minor. *See* pygmy hippopotami
pharaoh ant, 271
pharmaceuticals, 295, 328–31
Philadelphia (city), 277
Phillips, John, 40
Phocoena sinus. *See* vaquita porpoises
Photinus pyralis. *See* fireflies
Photuris spp. *See* fireflies
Phumdi. *See* grasslands
pigeons (general), 101, 127, 137, 151, 217, 342;
domestication, 101, 103. *See also* passenger
pigeons
pigs, 108, 249, 252–55; domestication, 10,
100–111, 115, 117, 246–56, 288, 294, 319, 325;
extinct, 85; invasive, 8, 97–98, 108, 109,
221, 224, 229, 270. *See also* babirusas;
Kolpochoerus; *Metridiochoerus*; peccaries;
pork industry; Sulawesi warty pig
Pilgrims, 205
pillar coral, 311

- Pinguinus impennis*. *See* great auks
- Pissarro, Camille, 137
- Pittsburgh, 277
- plains. *See* grasslands
- plantations, 161, 209, 228, 231, 238, 254, 284, 332, 335, 338
- plastics, 11, 44, 243, 293, 294, 295, 313, 320–21.
See also microplastics
- Platte River, 236, 237
- Pleistocene, 11, 40, 49, 53, 56–98, 102, 105–7, 109, 111, 113–14, 117, 119, 124, 147, 153–54, 185, 195–96, 223–24, 232, 237, 249, 272, 280, 290–91, 335–36, 340–41
- Pleistocene-Holocene transition, 336
- Pliny the Elder, 157, 164, 197
- Pliocene, 40, 58–59
- Plymouth Colony, 116
- Poland, 154, 157
- polar bears, 66, 78, 337
- Polynesia, 223; domesticates, 98
- Polynesian rat (*Rattus exulans*), 136, 224, 229
- Polynesian societies, 224
- Pompeii, 164
- pond sliders, 51
- pork industry, 256, 265, 287
- Porkopolis. *See* Cincinnati
- Port Louis, 217
- Portugal, 52
- Portuguese people, 8, 217, 223, 270
- prairie chickens, 7, 91, 173–82, 290. *See also* Booming Ben; greater prairie chickens; lesser prairie chickens
- prairie dogs, 91
- prairies. *See* grasslands
- Prakash, Vibhu, 329
- Pratt, Phineas, 280
- praying mantises, 309
- Pre-Historic Times*, 144
- primates (general), 92, 132, 164, 192, 334, 336.
See also chimpanzees; *Gigantopithecus*; gorillas; *Homo*; orangutans
- Princeton University, 22
- printing press, 187–88
- proboscideans (extant). *See* elephants
- proboscideans (extinct), 78, 83, 92, 164.
See also dwarf elephants; *Elephas hysudrindicus*; gomphotheres; mammoths; mastodons; stegodonts
- projectile weapons (general and specific), 11, 47, 55, 60, 64–66, 69, 71–73, 76, 87, 89, 165, 185, 189–90, 203–7, 232. *See also* firearms
- pronghorns, 7, 78, 91; extinct, 78
- Proteus (god), 188, 197
- Przewalski's horses, 147–48
- pseudoextinction, 27
- pterosaurs (extinct), 301. *See also* dinosaurs
- Ptolemies (dynasty), 164
- Puerto Rico, 229–30
- pumas. *See* cougars
- pygmy hippopotami (*Phanourios minor*, extinct), 96–97, 224
- Pyne, Stephen, 240
- Qing dynasty, 253
- quails, 2–3, 101; domestication, 101, 103
- Quammen, David, 222
- Queequeg, 207
- Ra (god), 128
- Rabbit-Proof Fence, 275
- rabbits, 103, 116, 245, 273–78; domestication, 101, 103–4, 254, 274; invasive, 224, 273–76; symbolism, 293
- raccoons, 32, 126–27, 137, 175, 279
- railroads, 56, 237, 243, 254, 263–67, 273–74, 283–85
- rainforests. *See* forests
- Ramsay, David, 242
- ranching. *See* agriculture
- Raphus cucullatus*. *See* dodos
- raptors (birds, general), 329
- rats (general), 8, 127, 134–37, 220, 223, 230, 233, 331; invasive, 8, 88, 134–37, 181, 213, 220, 223, 230. *See also* black rats; brown rat; Polynesian rat
- Rattus* spp., *see* rats

- Raup, David, 25, 35
 Ravenscroft site, 65
 rays (fish, general), 316. *See also* cow-nosed rays
 red deer, 159
 red fire ants (*Solenopsis invicta*), 267–71, 274
 red jungle fowl (*Gallus gallus*), 103, 129–30, 138, 288, 325
 Red River, 54, 89, 263
 Red Sea, 164
 red squirrels, 273
 red-tailed hawks, 175
 reforestation, 161, 334
 refrigeration, 243, 248, 264–66
 reindeer, 69, 157, 161; domestication, 101
 Rembrandt, 258–59
 Remus, 123
 Renaissance, 188
 reptiles (general, non-avian), 132, 137, 164, 171, 217, 219–20, 224, 226, 230, 303; extinct, 8, 9, 79, 82, 224, 230; invasive, 220. *See also* crocodilians; lizards; snakes; turtles
Resolution (ship), 189
The Retreat of the Elephants, 163
 Réunion, 217–19
 Rhine River, 157, 161, 304
 rhinoceroses (general), 83–84, 99, 137, 161–62, 164, 334, 336, 339; extinct, 83–84. *See also* black rhinoceroses; Indian rhinoceroses; Javan rhinoceroses; Siberian unicorn; *Stephanorhinus*; Sumatran rhinoceroses; white rhinoceroses; woolly rhinoceroses
 rice, 95, 111, 129–30, 154, 162, 176, 182, 252, 295
 Richardson, Benjamin Ward, 245–46, 251, 289
 Richard the Lionheart, 121
 rinderpest, 258, 263
 rivers (general), 167–69, 170–71, 277, 294, 319, 332
 Rocky Mountains, 121, 236, 262
 rodents (general), 68, 91, 128, 129, 134–37, 226, 309, 340; extinct, 94, 223. *See also* beavers; capybaras; Guinea pigs; hamsters; mice; rats; squirrels; voles
 Rodrigues, Diogo, 217
 Rodrigues Island, 51–52, 217–18
 Rodrigues solitaire (extinct), 217
 Rogers, Will, 73
 Roman Empire, 149, 155–56, 159–60, 164, 166, 169, 196–98, 253, 272, 276, 280
 Romans, 149, 158, 164, 189, 196, 197, 249, 250, 253, 273, 325
 Rome, 199, 278
 Romulus, 123
 Roosevelt, Theodore, 173
 rosy wolf snail, 220
 Rothschild, Walter, 100
 Round Island, 219
 Royal Polytechnic Institute, 245
 Royal Society of London for Improving Natural Knowledge, 238, 242–43
 Ruby site, 65
 Ruddiman, William, 183
Rusa timorensis. *See* Javan rusa
Rusingoryx (extinct), 85
 Russell, Dale, 39–40
 Russia, 37, 208, 278; extinctions/extirpations, 279. *See also* Far East; Soviet Union
 Russian people, 158, 278–79
 saber-tooth cats (general, extinct), 49, 63, 80, 91. *See also* saber-toothed tiger; scimitar cats
 saber-toothed tiger (*Smilodon*, extinct), 57, 79
 sable, 278–79
 Sadd El-Kafara, 169
 Sagan, Carl, 39
 Saglio, Henry, 289
 Sahara, 58, 84–85, 146, 149, 170
 Saharan zebras (*Equus mauritanicus*, extinct), 84
 Sahlins, Marshall, 139
 Sahul, 61, 81–83; extinctions, 81
 saiga, 79, 94, 337

- sailing, 96–97, 186, 188, 189, 201–5, 212,
227–28, 231, 234, 253, 270, 311, 315;
transoceanic, 11, 115, 187–89, 202–6, 212,
217, 220–21, 228, 231, 237, 253, 270, 274,
277–78, 283, 310, 313. *See also* ships
- Saint Helena, 50, 209
- Saint-Hilaire, Isidore Geoffroy, 98–99, 103,
113, 137, 250
- Saint Louis, 236
- Saint Petersburg, 199
- salmon, 324, 327–28
- San Francisco, 235, 236
- Saqqara, 165–66
- sardines, 313, 324
- Sauronithoides* (extinct), 39
- savannahs. *See* grasslands
- Savery, Thomas, 242
- scallops, 316
- Scheidel, Walter, 145
- Schistocerca gregaria*. *See* desert locusts
- Schulze-Makuch, Dirk, 48
- Schwarzwald, 157
- Scientific Revolution, 188
- scimitar cats (extinct), 66, 83
- Sciurus carolinensis*. *See* eastern gray
squirrels
- Scleractinia (order). *See* stony corals
- Scoresby, William, 185, 189–91, 207
- Scotland, 75, 122, 128, 257, 261; domesticates,
261; extinctions/extirpations, 122
- sea anemones, 311
- sea bass, 327
- seagrass meadows. *See* oceans
- seals (general), 64, 194–95, 197, 209, 337.
See also Caribbean monk seals;
Mediterranean monk seal
- seas. *See* oceans
- sea turtles, 316
- sea urchins, 193, 208
- Sebald, W.G., 245
- Séguin, Ron, 40
- sei whales, 207
- Sepkoski, Jack, 34–35
- Seth, Vikram, 333
- Seven Years' War, 277
- Seville, 258
- Seychelles, 219
- Shakespeare, William, 241
- Shantui (corporation), 333
- sharks (general), 127, 194, 214, 216, 315–16.
See also blacktip reef sharks; great white
sharks; hammerhead sharks; whitetip
sharks
- shearwaters, 225
- sheep (domestic), 101–2, 104, 108, 111, 115–17,
137, 178, 246, 254, 258, 261, 268, 274;
invasive, 174, 178, 231, 274
- shifting baseline syndrome, 298, 313
- Shipman, Pat, 69
- ships, 156, 186, 188, 191, 196, 199–200, 203–6,
220–23, 227–28, 232, 237–38, 266–68, 270,
273, 274, 313, 315; whalers, 185, 191, 203–5,
219, 225, 234–36, 278, 281. *See also* Beagle;
Henry Astor; Isabella; Lightning (ship);
Nuestra Señora de Atocha; Pequod;
Resolution; sailing; Swan; USS Palmyra
- short-faced skunks (*Brachyprotoma*,
extinct), 79, 86
- shrews, 309
- shrimp, 314, 318, 324
- shrublands. *See* grasslands
- Siam, 99
- Siberia, 70, 279
- Siberian Traps, 37
- Siberian unicorn (extinct), 83
- Sigismund III, 112
- Silent Spring*, 304
- Silk Roads, 148
- silkworms, 101
- Silurian, 301
- Sinclair, Upton, 265
- Sintashta people, 148
- sirenians, 208. *See also* dugongs; manatees;
Steller's sea cow
- Sixth Extinction, 2, 4–8, 11, 28, 48, 54–57, 95,
138, 151, 184, 186–87, 233, 297, 300, 341–43
- Skaggs, Jimmy, 265
- skates (fish), 316

- skunks (general), 126–27. *See also* short-faced skunks
- Slaughtered Ox* (painting), 258–59
- slavery, 228, 231, 243, 254, 331
- slave trade. *See* slavery
- Sloane, Hans, 209
- sloths (general), 80. *See also* ground sloths
- Smeerenburg, 204
- Smilodon*. *See* saber-toothed tiger
- Smith, Adam, 264
- Smith, Felisa, 88, 90
- Smith, George, 141–42
- Smith, John Maynard, 46
- snails (general), 219, 308, 311; invasive, 220, 271. *See also* rosy wolf snail
- snakes (general), 219, 226–27, 230; extinct, 219, 230; invasive, 226–27. *See also* Algerian whip snakes; brown tree snakes; cat snakes; leopard snakes; western whip snakes
- snow crabs, 322
- snow leopards, 66, 83, 337
- Society of Biblical Archaeology, 141
- Solenopsis invicta*. *See* red fire ants
- Solomon, 150
- Solon, 122
- Sotheby's, 210
- South Africa, 128
- South America, 62, 72–74, 81, 113–15, 119, 149, 160–61, 178–79, 231, 260, 262, 266, 268–69, 282, 310, 340; domesticates, 103, 113, 114, 115, 266; extinctions/extirpations, 77, 80, 119–21, 147, 172, 178; invasives, 113, 115, 130, 134, 178, 231, 260, 266, 270, 332, 334
- South American societies, 115, 161, 282. *See also* Inca people; Maya people
- South Asia, 257, 270, 330
- South Australian Parliament, 275
- South Dakota, 75
- Southeast Asia, 129, 136, 162, 221, 226, 332, 333, 335–36, 339
- South Korea, 128, 251
- Southwest (United States), 67, 90, 119
- Soviet Union, 317
- soybeans, 288, 334
- Spain, 258, 260, 310
- Spanish people, 260, 270
- speciation, 17, 21–23, 25, 27, 33–39, 41, 56–59, 81, 97, 100–101, 201–2, 219, 222, 276, 335; island dwarfism, 96; marine mammal gigantism, 202; rates of, 26, 36. *See also* domestication; evolution; natural selection
- spectacled bears, 80; extinct, 79
- sperm whales, 185, 194, 202, 205–7, 216, 235
- spiders (general), 64, 137, 308–9
- Spilhaus, Athelstan, 193
- Spilhaus Projection, 193–94
- sponges (animal), 31, 53
- Sporormiella*, 82–83
- spotted hyenas, 49, 84
- springboks, 85. *See also* *Antidorcas australis*; *Antidorcas bondi*
- squids, 322
- squirrels (general), 278; invasive, 273. *See also* eastern gray squirrels; red squirrels
- Sri Lanka, 163, 225, 339
- stable isotope analysis, 58, 66, 77, 249
- Stafford County, 16
- staghorn coral, 311
- starfish, 193
- The State of the Poor*, 249
- steam power, 11, 239, 242–45, 268, 273–74, 280, 291, 333. *See also* fire; fossil fuels; internal combustion
- stegodonts (*Stegodon* spp., extinct), 83, 92
- Steller, Georg Wilhelm, 208
- Steller's sea cow (*Hydrodamalis gigas*, extinct), 208
- Stephanorhinus* (extinct), 85
- steppe. *See* grasslands
- steppe bison (extinct), 83
- Stihl, Andreas, 333
- Stone Age, 145, 154, 207, 313
- stony corals (order Scleractinia), 311
- Stuart, A. J., 84
- Sturtevant, Simon, 241

- Subcommission on Quaternary Stratigraphy, 292
- subfossils. *See* fossils
- sub-Saharan Africa, 160, 162, 170, 332
- suckerfish, 127
- Sudan (rhinoceros), 337
- sugarcane, 154, 176, 189, 209, 228, 248, 260, 268
- Sulawesi (island), 62
- Sulawesi warty pig (*Sus celebensis*), 62, 98
- Sumatra, 332, 333, 339
- Sumatran rhinoceroses, 162, 334, 339
- Sumerian people, 143, 150
- Sus celebensis*. *See* Sulawesi warty pig
- Svalbard, 204
- swallows (birds), 309
- swamps. *See* wetlands
- Swan* (ship), 191
- Swift, Gustavus, 265
- swifts (birds), 309
- swordfish, 315
- Sylvia, or a Discourse of Forest-Trees and the Propagation of Timber*, 238, 240
- symbolic language, 60, 145. *See also* communications technologies; writing
- Syncerus antiquus*. *See* African giant buffalo (extinct)
- synthetic chemistry, 239, 295–96, 300, 306–7, 316, 327
- Syria, 164
- Szathmáry, Eörs, 46
- taiga. *See* forests
- Taino people, 209, 229
- tapirs, 80, 336, 340; extinct, 79, 83, 94
- Tasmania, 62, 82, 223
- taurine cattle. *See* cattle
- termites, 33, 303, 308
- terns, 225
- terrapins. *See* turtles
- Testudines. *See* turtles
- Texas, 65, 78, 175, 260, 263; West Texas, 17
- Thailand, 129
- Theory of Island Biogeography*, 222
- therapsids (general), 37
- Thompson, Ken, 272
- Thutmose I, 164
- Ti, 165, 166
- tigers (*Panthera tigris*), 44, 83, 119, 164, 334, 336, 338–39; extinct, 338. *See also* Bengal tigers
- Tigris River, 162
- tilapia, 324, 327
- tobacco hornworms, 306
- Tokyo, 136
- Toledo, 186
- tortoises. *See* turtles
- toxodont (extinct), 78, 94
- trains. *See* railroads
- Trans-Amazonian Highway, 332
- transport animals, 146–49, 178
- transportation technologies (general), 239, 248, 254, 262–63, 265, 273–74, 317, 335. *See also* automobiles; aviation; railroads; sailing; ships; transport animals; travois; wheels
- travois, 72. *See also* transportation technologies
- Triassic, 37, 50, 311
- triggerfish, 321
- trilobites (extinct), 54, 341
- trout, 324–25, 327
- tsetse flies, 86, 92
- Tsuut'ina people, 66
- Tudors, 122
- Tuileries, 233
- tunas (general), 194, 214, 314–16. *See also* bluefin tunas
- tundra. *See* grasslands
- Turkey (country), 96
- turkeys (birds), 101, 116; domestication, 101, 103, 113, 115
- turtle doves, 151
- turtles (general), 48–57, 195, 198, 214, 216, 230, 321, 334; extinct, 53, 228, 230. *See also* Aldabra giant tortoise; green turtles; *Megalochelys*; pond sliders; sea turtles

- Tympanuchus pallidicinctus*. *See* lesser prairie chickens
- Tyrannosaurus rex* (extinct), 74, 205
- Unilever, 331–32
- Union Stock Yard and Transit Company, 265
- Union Stockyards (Chicago), 254
- United Kingdom, 305. *See also* British Isles; Great Britain
- United Nations Educational, Scientific, and Cultural Organization (UNESCO), 158, 186. *See also* World Heritage sites
- United States, 25, 56, 125, 126, 161, 170, 171, 174, 180, 202, 228, 233, 234, 237, 250, 254, 256, 261, 262–63, 265, 269, 280–82, 285, 287, 298–99, 307, 316, 320, 323, 326, 336, 340. *See also* East Coast; Great Plains; Southwest; West
- University of Kansas, 16
- University of New Mexico, 90
- University of Wisconsin, 288
- Urban Revolution, 145, 149
- ursids. *See* bears
- Ursus americanus*. *See* black bears
- Ursus arctos*. *See* brown bears
- Uruguay, 266
- Uruk, 143, 184
- U.S. *See* United States
- U.S. Department of Agriculture (USDA), 289
- USS *Palmyra* (ship), 212
- Utah, 75
- Utnapishtim, 141, 182, 184
- van Beneden, Pierre-Joseph, 127
- van Neck, Cornelisz, 9
- Vantress, Charles, 289
- vaquita porpoises (*Phocoena sinus*), 316
- velociraptors, 32
- Venice, 258
- Veracruz, 260
- vervet monkeys, 127
- Victoria (Australia), 274
- vicuñas, 114
- Vietnam, 333–34, 338
- Vigne, Jean-Denis, 115–16
- Vikings, 223
- voles, 273
- von Ranke, Leopold, 144
- Vosges, 157
- vultures (general), 329–31. *See also* griffon vultures; white-rumped vultures
- Wales, 257
- wallabies, 99
- Wallace, Alfred Russel, 20, 76, 95, 222, 284–85
- walruses, 204
- warblers, 158
- War of the Pacific, 282
- Washington, George, 78, 254
- Wasmann, Erich, 270
- wasps (general), 33, 64, 301, 303, 309
- water buffalo (*Bubalus arnee*), 112; domestication, 101, 112–13; extinct, 83
- Watson, Hugh, 261
- Watt, James, 291
- weasels, 126
- West (United States), 90, 121, 124, 237, 283
- West Africa, 139, 324, 332
- West Asia, 252, 257
- Western Australia, 323
- Western Europe, 305, 340
- western whip snakes, 227
- West Indies, 41, 209
- wetlands (ecosystem), 2, 12, 24, 45, 138, 143, 165–72, 176, 178, 180, 182, 269, 277, 294, 340; mangrove swamps, 12, 24, 318; marshes, 93, 145, 166, 176, 258; swamps, 166–67, 277
- Wetterer, James, 271
- whalebone. *See* animal products: baleen
- whale fall, 216
- whale pump, 216
- whaler. *See* ships

- whales (general), 64, 93, 165, 185–86, 189–92, 196, 201–5, 215, 217, 232–34, 284, 316–17, 321, 446; as food, 201–2, 317, 332; as trade goods, 202–7, 234, 257, 283–84, 316–17, 332. *See also* blue whales; bowhead whales; cachalot; *Cetotherium*; dolphins; fin whales; gray whales; humpback whales; *Livyatan melvillei*; minke whales; North Atlantic right whale; orcas; sei whales; sperm whales; vaquita porpoises
- whaling, 185, 189, 191, 196, 201–9, 216, 219, 233–36, 281, 283, 316–18
- wheat, 95, 154, 176, 248, 268, 294, 303
- wheels, 139, 145, 148
- White, Sam, 253
- white-backed woodpeckers, 159
- white rhinoceroses, 162, 337
- white-rumped vultures, 329–30
- White Sands, 62
- white-tailed deer, 71, 78, 88, 91
- whitetip sharks, 315–16
- white-winged wood ducks, 172
- Whitman, Walt, 78
- Whittaker, Robert, 223
- Wichita Mountains, 286
- wild asses (general), 146. *See also* African wild asses; European wild asses
- wildcats, 126, 128
- wild dogs, 170
- wildebeests, 170, 338
- Williams, Michael, 153
- Wilson, Edward O., 5, 12, 23, 26, 222, 267
- Wind River Range, 121
- Windsor Castle, 233
- wisent. *See* European bison
- Wittfogel, Karl August, 168
- Władysław II Jagiełło, 158
- The Wonderful Century*, 284
- wood lice, 308
- woodpeckers (general), 159, 309. *See also* white-backed woodpeckers
- woolly rhinoceroses (extinct), 62, 83
- wolverines, 126
- wolves (*Canis lupus*), 8, 24, 43–44, 59, 64–72, 78, 83, 88, 108, 121–26, 140, 159, 336, 339–41; attacks (on humans), 122; domestication, 10, 59, 66, 69, 103, 134; environmental impacts of, 88, 126; extirpation, 24, 122–23; hunting/persecution of (by humans), 8, 67, 108, 116, 121–26, 254, 336. *See also* Beast of the Gévaudan
- World Heritage sites, 158
- World War I, 157, 274, 283
- World War II, 213, 226, 271, 293, 313, 317, 333
- worms (general), 273, 308. *See also* Asian jumping worms; common nightcrawlers; earthworms; marine worms
- Wrangham, Richard, 42
- writing (technology), 11, 143–45, 149, 277
- Wyoming, 65, 121
- xenarthrans (general), 80. *See also* anteaters; armadillos; glyptodonts; ground sloths; pampatheres; sloths
- yaks, 112; domestication, 101, 112, 113
- Yale University, 16
- Yangtze River, 320
- Yarmouth, 199
- Yellowstone National Park, 126, 155
- Zacatecas, 260
- Zagros Mountains, 106, 108
- zebras, 84, 99–100, 137, 146, 338; extinct, 84. *See also* cape zebras; Grevy's zebras; Saharan zebras
- zebu cattle. *See* cattle
- Zeder, Melinda, 99, 102
- zooplankton (general), 194, 321. *See also* copepods; krill
- zooxanthellae, 322. *See also* coral reef
- Zygomaturus* (extinct), 81–82