CONCLUSION

Earth Household

In this book we've explored the Carnivore Way by following the footsteps of the large carnivores. We've seen how the animals whose stories I've shared are teaching us the importance of coexisting with them and the wildness they bring to this earth. Their lessons are really important because, right now, our world is at greater risk than ever. In the Anthropocene epoch, our growing human population, need for food and fuel (e.g., natural gas), and the warming planet are creating a hemorrhage of extinction. We're losing species at the rate of 6 percent per decade, primarily due to human degradation of ecosystems.[1] Large carnivores, which touch everything in the web of life, create biodiverse, healthy ecosystems. Richer in species, ecosystems that contain large carnivores will be more resilient to change, and therefore will better enable humans to live sustainably, capably, and happily on this planet.

To begin with, large carnivores are teaching us that they need lots of space, and that national parks aren't enough to meet their fundamental needs for food and a mate. During an eighteen-month period, Pluie, a young radio-collared wolf (*Canis lupus*), traveled an area that encompassed more than 40,000 square miles, crossing more than 30 legal jurisdictions, including two Canadian provinces and

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several US states. In her hegira, she showed us that carnivores need connected landscapes that transcend political boundaries, and that thinking about conservation on a continental scale is essential for them and other wild animals in order for us to help them maintain their genetic diversity and resilience. Pluie inspired conservationists and scientists to find continental-scale solutions, using the science of corridor ecology.[2] Other animals, such as bear 64 in Banff National Park, have taught us that solutions such as the Bow Valley wildlife crossings really do work. The Highway 1 overpasses there enable bear 64, her cubs, and other animals to find safe passage over four lanes of heavy vehicle traffic, thereby linking wildlife populations that this road had fragmented.

Large carnivores are showing us that their wildness serves a real ecological purpose. Throughout the Carnivore Way, wolves, lynx (*Lynx canadensis*), and other carnivores are teaching us about how rewilding nature by bringing them back from the brink of extinction is as necessary to the exchange of energy in food webs as the bottom-up flow of soil nutrients. By creating trophic cascades—top-down food web relationships in which apex predators affect their prey, which in turn affects the prey species' consumption of food—wolves and other apex predators increase ecosystem health. For example, lynx prey on snowshoe hares (*Lepus americanus*), which eat willows (*Salix* spp.). By reducing snowshoe hare numbers, lynx indirectly create healthier willows, and these healthier willows can provide better habitat for songbirds. But in addition to the actual, direct acts of predation, these predator–prey relationships can have indirect effects related to fear. In Glacier National Park, for example, fear of wolves makes elk (*Cervus elaphus*) more alert. To avoid getting attacked by wolves, elk must move around more and avoid spending time in aspen (*Populus tremuloides*) stands that have burned and become filled with deadfall. The downed trees in these burned stands make it difficult for elk to run to escape wolves. In Glacier, burned stands now contain thickets of aspen saplings growing vigorously above the reach of elk. Thus, together with fire, wolves are helping aspen flourish.

The animals in this book are also teaching us that without connected corridors and adequate regulatory mechanisms, they may go extinct. That we have

any carnivores left at all today is due to the web of environmental laws that protect them. This imperfect web provides the framework for wildlife conservation across the three nations in the Carnivore Way: Canada, the United States, and Mexico. In Canada, the Species at Risk Act (SARA) protects species from extinction. However, Canadian citizens have very limited ability to hold their federal government legally accountable for this law's enforcement. In the United States, we have the Endangered Species Act (ESA), one of the most powerful environmental laws in the world due to its substantive nature. US citizens dissatisfied with this law's implementation can sue the government. However, the ESA is cumbersome and expensive to apply. For example, as of 2013, it had taken one and a half decades to create a lynx recovery plan, two decades to protect the wolverine (*Gulo gulo*), and four decades to fully protect the jaguar (*Panthera onca*) and create a recovery plan. While successes such as the wolf in the Northern Rocky Mountains (NRM) demonstrate that this law works, we have failures, such as the case of the Mexican wolf (*C. l. baileyi*) in the southwestern United States, which, due to illegal killing by humans, hasn't reached the modest recovery threshold of 100 animals despite almost two decades of conservation efforts. Of all three nations, Mexico has the weakest environmental laws. But even there, people are making headway in conserving carnivores, such as the jaguar, with government support of private land stewardship. Tribal law sustains the rich cultural heritage and traditions of Canadian First Nations, US Native Americans, and Mexican indigenous people. In the US and to a lesser extent in Canada, Native Americans and First Nations, which have legal sovereignty as nations per the US and Canadian federal governments, are also wrestling with modern natural-resources problems, such as grizzly bear (*Ursus arctos*) depredation on livestock calves and energy development on their lands. In Mexico, since the aboriginal people do not have standing there, they are not as actively involved in natural-resources management from a federal perspective.

A single, vibrant thread runs through all these lessons about connectivity, food web relationships, and environmental law: *coexistence*. Carnivore conservation is about coexistence, defined as our human ability to share landscapes with big, fierce animals that are sometimes our competitors for food. In or-

der for coexistence to succeed, we need collaboration. And like food web effects in ecosystems, collaboration works from the top down *and* from the bottom up. Well-established, continental-scale collaborative efforts, such as Y2Y and Wildlands Network, or newer organizations, such as the Western Wolf Coalition and the Western Landowners Alliance (a group of rural private landowners with a shared vision of conserving biodiversity), are helping us to coexist with carnivores. For example, Y2Y has led corridor-ecology conservation campaigns to create more-connected landscapes for grizzly bears. Large environmental organizations such as Defenders of Wildlife have led collaborative efforts that include government agencies and stakeholders. Such work helped bring wolves back to Yellowstone and then reduced conflict outside the park by compensating ranchers for livestock losses due to wolf depredation. Bottom-up grassroots efforts, such as the Blackfoot Challenge, and smaller environmental groups like Conservation Northwest, Cascadia Wild, Living with Wolves, the National Wolf Watchers Coalition, Wolves of the Rockies, and dozens more, are creating a groundswell that's helping human communities live more peacefully with large carnivores.

But beyond collaboration, the other necessary ingredient for coexisting with large carnivores (or with any living beings) has to do with ethics—how we see our relationship with the environment. Michael Nelson and John Vucetich define an ethic as "a belief about what is right or wrong, good or bad." This means that an ethic tells us what we ought or ought not do. With regard to carnivores, an ethic might be: "We ought to prevent carnivore extinction." Such statements, simple as they seem at first glance, rapidly take us deep into the realm of environmental philosophy.[3]

For example, let's say that we agree that we ought to prevent carnivore extinction. Then how we go about applying this ethic depends on why we care about carnivores. Is it for their value to humans as a product (e.g., for their pelts)? Is it for their value to humans in that they create healthier, more-resilient ecosystems? Or do we care about carnivores for their *intrinsic value*, i.e., simply because they're living beings with feelings? What I've described above represents the continuum of how people who want to conserve carnivores may feel

about them from an ethical perspective. And therein lies the source of all of the debates about carnivore management described in this book, from grizzly bears to wolverines to jaguars.

Nelson and Vucetich cite two famous conservationists, Gifford Pinchot and Aldo Leopold, to illustrate the spectrum described above. Pinchot, named the first chief of the US Forest Service in 1905, created the concept of wise use of resources. He wrote, "There are just two things on the material earth, people and resources." Here he was referring to the *instrumental value* of nature, as something that exists purely for human use and exploitation. Between 1910 and 1948, Leopold, who created the science of wildlife biology, was among the first to recognize that carnivores matter due to the ecological benefits that accrue from them. His seminal land-ethic statement—"A thing is right if it tends to preserve the integrity, stability, and beauty of the biotic community; it is wrong otherwise"—addresses the middle of the spectrum (that living things have value because they create healthier ecosystems). Further, he stated that "A land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for fellow members, and also respect for the community as such." This can be interpreted as meaning that all living beings have intrinsic value, and so they should be conserved. Leopold's words spurred the environmental movement of the 1960s, which begat environmental laws such as the ESA.[4]

Several factors have shaped our relationship with wildlife in America. First, in the sixteenth century, Europeans—most of whom hadn't been allowed to hunt freely in the nations from which they originated—colonized what is now Canada, the United States, and Mexico. During European colonization, humans depended on hunting wild meat for sustenance far more than we do today. And in settling the New World, one of the first rules Europeans established was that, unlike in Europe, where often only royalty and landed gentry had the right to hunt, in North America, everyone should have free access to hunting. Furthermore, everyone should be allowed to bear firearms. These democratic ideas, eventually became the foundation for managing wildlife as a renewable, harvestable resource in all three nations. However, giving European settlers the

unrestricted right to hunt resulted in a hunting free-for-all that lasted 400 years and caused widespread ecological damage.[5]

Lacking hunting regulations (e.g., how many animals could be killed, for what purpose, and when), and perceiving North America as a limitless land of plenty, we proceeded to hunt many species to extinction. *Market hunting*, defined as hunting wild animals in high volume for commercial gain, eliminated many species. As settlers advanced westward, they left a wake of extinction, including elk in the Midwest, bison (*Bison bison*) on the plains, beavers (*Castor canadensis*) in the Rocky Mountains, and large carnivores just about everywhere. In 1887, this wildlife plunder inspired Theodore Roosevelt, George Bird Grinnell (who founded the first Audubon Society), and others to create the Boone and Crockett Club, a hunter/sportsmen's organization. They wanted to halt market hunting and implement ethical principles for wildlife conservation that included hunting for recreation and sport. And in very short order, Boone and Crockett Club members, who were men of influence, created and passed some of the first US environmental laws. This included the Lacey Act of 1900, which prohibited the interstate transport of birds and other wildlife. This law ended market hunting, because people were no longer able to trade and distribute large amounts of dead game or their byproducts, such as feathers. By the 1910s, hunting as a conservation tool, which meant managing wildlife to increase the amount of harvestable game (by improving habitat and killing predators), had become the norm.[6]

In 2001, Canadian wildlife ecologist Valerius Geist and his colleagues created the North American Model of Wildlife Conservation. Based on principles in place since Roosevelt's era, the North American Model represented the first time these ideals were articulated in an integrated manner. Today, state and provincial wildlife management agencies strongly adhere to the North American Model.[7] It contains seven principles:

1) wildlife is a public trust (i.e, all wildlife are owned by citizens and managed for them by the government);
2) markets for game should be eliminated;
3) wildlife should be allocated by law (via hunting regulations);

4) wildlife should only be killed for legitimate purposes;
5) wildlife is an international resource;
6) wildlife should be managed with science-based policy; and
7) hunting should be a democratic process, with everyone having free access to wildlife.[8]

Working from these tenets, we can gauge successful conservation of a wildlife species by our ability to hunt it.

In every chapter of this book, we have looked at how management practices, be they creating connected corridors across roads for wildlife, setting hunting policy for cougars (*Puma concolor*), or using trophic cascades concepts to restore forests, are being applied in order to conserve carnivores. We have seen big successes, such as wolf recovery in the NRM, but we have also seen setbacks, such as the current policy of hunting NRM wolves (which no longer have ESA protection) down to the lowest level possible, using North American Model-based state wolf-management plans. This example demonstrates that for carnivores to truly recover, we need to rethink the North American Model.

Nelson and his colleagues suggest that the North American Model contains flawed logic. It attributes wildlife conservation entirely to hunters. Geist and others point out that we have wildlife today because hunters, such as Roosevelt, created a conservation vision to sustain wildlife. Others in the hunting community agree that hunting has led to the development of environmental virtue. However, the North American Model doesn't acknowledge the huge contributions to wildlife conservation that have come from outside the hunting community. For example, John Muir, who in the late 1800s advocated preserving nature, changed the way Americans envisioned their relationship to the natural world. This shift caused people to support protecting landscapes such as the Yosemite Valley and the animals that made their homes there.[9]

In the North American Model, Geist and his colleagues argue from a purely instrumental perspective that wildlife should be managed ethically, like a crop, so that human hunters reap the benefits. Nelson and others indicate that the North American Model doesn't specify how this is to be achieved, which means it can be used to justify wolf slaughter via aerial gunning in order to increase

huntable caribou (*Rangifer tarandus*), for example. The North American Model calls for science-based management, but whose science is "best science"? It calls for the end of market hunting, but doesn't acknowledge that hunting today is a highly commercialized endeavor (e.g., $20,000 guided grizzly bear hunts). Finally, the North American Model focuses solely on conserving wildlife for hunting purposes. Yet in the United States, only 6 percent of citizens hunt. I'm part of that 6 percent. But in a democracy, basing wildlife management on a hunting paradigm that doesn't address the needs or desires of the non-hunting public (the vast majority of Americans) is wrong if, as the North American Model states, all wildlife is owned by all citizens jointly.[10]

In any discussion about large carnivore conservation with managers at federal and state levels, the North American Model comes up. The purpose of large carnivore conservation, managers say, is to recover a species like the grizzly bear so that we can hunt it. Yet recovering and conserving the grizzly bear, which has the lowest reproductive rate of any large mammal, and then allowing it to be hunted, is wrong ecologically. And in light of what we know about trophic cascades, recovering an animal like the wolf, removing its ESA protection, and then hunting it down to a bare legal minimum (e.g., ten breeding pairs per state in the NRM) is also wrong scientifically. And if you believe grizzly bears and wolves have intrinsic value, then you also could argue that such carnivore-management strategies are unethical.

Science tells us that if we want to have a healthy world, we need to conserve the carnivores.[11] Doing so necessitates creating a new model for coexistence. This means developing a contemporary land ethic, one that takes us beyond the North American Model and seeing wildlife as a crop or a renewable resource.

Leopold died unexpectedly of a heart attack at the age of 61. In the posthumously published *A Sand County Almanac*, he presents the land ethic—essentially a fledgling environmental philosophy. He'd probably planned to spend another twenty years refining his ideas about how humans could live more rightly on this earth. Instead he left us a powerful, albeit incomplete, roadmap for moving forward with conservation.[12]

We'll never know what Leopold would do today, given the threats we face that were unknown in his era, such as climate change. However, a contemporary

land ethic would flesh out the bones of Leopold's ideas with what we now know about how the world works (corridors, trophic cascades) and how rapidly we're losing life on our planet, especially native species and taxa such as carnivores and pollinators that help create healthier biota. Such an ethic would provide a more inclusive way of coexisting with nature—one that leads to healthy ecosystems and thriving populations of animals, including carnivores, with which humans would live ethically and peacefully.[13] Such an ethic wouldn't preclude hunting, for humans have hunted animals for food since the early Paleolithic period (2.6 million years ago), and Leopold himself was an avid hunter. According to ethicist Charles List, a new wildlife conservation model would mean redefining hunting as a practice in which we don't treat animals like a crop to be harvested, and in which we exercise more restraint and respect for the animals that we hunt. In creating such a model, we'd consider not indiscriminately hunting carnivores.[14]

Is this vision of a more ethical relationship with carnivores attainable? To find out, I needed to journey deeper into wildness than I'd gone before, to a place where people are living very peacefully and respectfully with bears and wolves.

It took four flights on progressively smaller aircraft, the last one a seaplane, plus two trips on small boats, the last one a sailboat, and six days to travel the 900 miles as the raven (*Corvus corax*) flies to the Great Bear Rainforest in coastal British Columbia from my northwest Montana home. For much of this journey there were no cell phone or Internet connections, and—more importantly—no roads.

I ventured into the Great Bear Rainforest to learn new lessons about coexistence. This meant going there in autumn, at the height of the salmon run, when pinks (*Oncorhynchus gorbuscha*), chums (*O. keta*), Coho (*O. kisutch*), and sockeye (*O. nerka*), their bodies battered, bloody, and egg-heavy, instinctively find their way back to the coastal streams in which they were born. They lay their eggs in gravel beds and die, providing a feast for the bears (*Ursus* spp.), wolves, and bald eagles (*Haliaeetus leucocephalus*) that show up in droves to feed on this bounty, as they have throughout the ages. Word was that humans in this

place had returned to a much older way of coexisting with carnivores. Indeed, Canadian bear expert Charlie Russell had come here to spend several years living with wild bears.

This remote Canadian temperate rainforest covers 21 million coastal acres from the north end of Vancouver Island to the British Columbia–Alaska border. Mostly mantled by nearly impenetrable western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and Sitka spruce (*Picea sitchensis*) forests, 5 million acres of this ecoregion are protected. These discontinuous *conservancies*, as they're called, resulted from a collaboration between the eighteen First Nations who have territories in this ecoregion, the Nature Conservancy, Pacific Wild, conservationist Ian McAllister, and the provincial government. These sanctuaries are closed to logging, mining, gas-well drilling, and the hunting of bears and wolves. Since a prime tree here can be worth $10,000 when cut down, such protection is no small feat. Only accessible by boat or seaplane, these conservancies lie scattered like emeralds flung from a giant's fist across 250 miles of ragged coastline.

I sailed into this rainforest on the Ocean Light II, a 71-foot ketch, with Jenn Broom, the boat's owner, as well as Captain Chris Turloch and biologist Jim Halfpenny. My other companions included my husband Steve and several friends. Chris expertly navigated the boat deep within a maze of fjords. Breeching humpback whales (*Megaptera novaeangliae*) and killer whales (*Orcinus orca*) relentlessly hunting Steller sea lions (*Eumetopias jubatus*) filled these coastal waters. Along wave-scoured islands, amid the spill of sea foam across curving shores, and in estuaries where the mouths of rivers met the sea, we looked for bears—and found them.

Both grizzly bears and black bears (*U. americanus*) live in this rainforest. They partition themselves spatially by species, to avoid conflict. Grizzly bears only inhabit some islands, and black bears only inhabit others, which makes life simpler. This area also contains the largest population of Kermode bears (*U. a. kermodei*)—a very rare subspecies of black bear also known as the Spirit Bear, due to its white fur. Approximately 400 Kermode bears live here.

On the sixth day of our journey, Chris took us to Khutze Bay, a grizzly bear–dominated estuary. We set anchor and spent the night, the steady patter

of rain on the deck lulling us to sleep in our cozy berths. At first light, we set out from the sailboat in a small Zodiac inflatable boat. Keeping the outboard engine purring on low throttle to avoid disturbing the wildlife, we cruised slowly up the Khutze Inlet, seeing bald eagles and gulls everywhere. Chris stopped the boat against a seagrass-covered shore, and waited. It didn't take long.

Two figures emerged from the mist, walking toward us: a huge, beautiful grizzly bear mother and her tiny cub of the year. They stopped at the shore, 30 yards from us, where the bear mother immediately got down to business. She put her face into the water and swiftly pulled out what must have been a twenty-pound Coho salmon, its silver body flopping around, and passed it to her cub. The cub chewed on it a bit, and then dropped the slippery fish. She found the cub two other equally hefty salmon, which the cub promptly fumbled. The third one threw the cub off balance, and both salmon and cub ended up in the water, where the fish swam off.

Before joining her cub in the water for more fishing lessons, the bear mother's eyes met mine, mother to mother, a classic "What's a mother to do?" expression on her face. I know how it is, I thought, returning her look—I'm a mother too. In her body language, especially in the relaxed eye contact she made, this was a *very* different bear from any I'd experienced in Katmai and my wild Montana home. And she prompted me to think about what coexistence really means.

Until now, my hundreds of meetings with bears, while peaceful, typically consisted of both of us consciously trying to minimize conflict. These accidental meetings often occurred while I measured aspens, or walked in the forest on my land. In these meetings, the bears usually didn't face me, instead passing me in profile without overtly acknowledging my presence, the better to avoid trouble. The Khutze bear mother brought up things beyond the pale. Was coexistence once very different from how we experience it today? Was the calm communion I experienced with her anything like the way our relations with bears once were? And if so, when did our relations with bears and the other carnivores go so wrong?

On the eighth day, we made our way to Gribbell Island, a 70-square-mile islet between the Inside Passage and the Douglas Channel. This lush, wedge-

Figure C.1. Grizzly bear mother in Khutze Inlet, Great Bear Rainforest, British Columbia. (Photo by Cristina Eisenberg.)

shaped island contains a lot of bears and wolves, but no human settlements. In fact, it provides home to the largest known concentration of Kermode bears.

The only way that one can set foot on Gribbell Island is with the permission of the Gitga'at, a Tsimshian First Nations band that controls access to this land. The Tsimshian live in coastal British Columbia, along mainland inlets and estuaries, and on islands. In their mythology, they and the other First Nations in coastal British Columbia consider themselves related to bear, wolf, raven, and killer whale, and don't hunt these animals. So it makes perfect sense that today the Gitga'at serve as gatekeepers to one of the most ecologically sensitive bear sites in North America.

Lead Gitga'at guide Marven Robinson met us as we clambered out of the Zodiac at low tide onto a slick-rock intertidal slope dappled with sea stars the color of pink grapefruit. Sturdily built and in his mid-forties, he wore chest-high waders and rain gear, a baseball cap on his head. He led us through an opening

Figure C.2. Bear mask carved out of western red cedar by Haida artist Jimmy Jones. (Photo by Cristina Eisenberg.)

in an alder (*Alnus rubra*) thicket, along a narrow, fern-edged trail toward the island's wild core. He'd grown up in this rainforest, in the nearby mainland village of Hartley Bay (pop. 200), which is accessible only by sea, so he knew this island and its bears intimately. As a child, like others of his band, Marven was brought up to respect bears and not hunt them. From the mid-1800s to the late 1990s, outsiders came to Gribbell Island and the surrounding region to hunt bears—the bigger the better. They especially came for trophy spirit bears hunts. Two decades ago, Marven was one of the people instrumental in getting this place and its bears protected. These days he guides people into Gribbell Island to raise awareness of bear conservation.

In a light rain, we followed the trail along the crest of a ravine that paralleled a narrow creek. Mist fingered the cedars, spruce, and alders that grew right up to the stream in this verdant rainforest. Moss clung to every surface. Raven gronks echoed through the forest nave. Faint wolf howls came from far

upstream. About one mile up the trail, Marven took us down through the woods to the stream, to a viewing platform suspended on stilts, where we could sit out of the rain and watch bears. However, he had other plans for me. He took me down to the creek, below the platform.

"Sit here," he said, "and wait." Then he left.

I sat and waited. I don't know how long I waited. This primeval creek felt like a place out of time. Over the sound of creek water flowing on rocks, I heard the wanton cries of pileated woodpeckers (*Dryocopus pileatus*) marking their turf, and the husky chitter of pacific wrens (*Troglodytes pacificus*) foraging in the understory. The water churned with salmon bodies, mostly gleaming Cohos and dun-colored pinks, their humped backs protruding above the water's surface. Occasionally an electric-red sockeye finned upstream through the Medusa tangle of other species of salmon, all fighting the current to lay their eggs. Dead salmon, mission accomplished, littered the streambanks and lay washed up on rocks. From time to time, ravens swooped down from their perches to scavenge these dead fish.

Eventually a figure emerged from the woods, like an apparition. The big, black bear steadily approached the streambank, moving as if in slow motion. I sat there, spellbound. That bear, the local dominant male, was called Scarface. Battle-scarred (hence his name) and still in his prime, his body rippled with muscle and fat. Moving gracefully for such a large animal, he stopped about fifteen feet from me.

Chris talked to the bear. "Good to see you," he said. "You've been eating well."

The bear turned to face me and looked at me with soft, nutmeg-colored eyes. And in those long moments when our eyes met, there was no "us" and "them." Just "we"—two living beings here on this creek at the height of the salmon spawn, meeting in peace. Then he broke our gaze, looked intently into the fish-filled water, opened his massive jaws, and lunged faster than I thought a creature his size capable of moving. In less than two of my fast heartbeats, he pulled out a 30-pound Coho salmon. He sat there and calmly devoured the fish: first the roe, then the firm flesh, followed by the head. After he finished, he looked at me again, his eyes still soft, a crimson gobbet of salmon meat clinging

Figure C.3. Black bear fishing at creek on Gribbell Island, Great Bear Rainforest, British Columbia. (Photo by Cristina Eisenberg.)

to his chin. Then he turned away and departed the way he'd come, walking with loose-limbed grace atop a sway-backed mossy red cedar log that had fallen into the creek long ago. He jumped off the log and vanished into the forest understory, the alders and salmonberry bushes (*Rubus spectabilis*) rustling with his passing.

I sat there for a long while, unable to speak, taking in deep lungfuls of rainforest air and the comingled scents of wet cedar and rotting salmon—life and death. Marven brought people here, to this ursine inner sanctum, because he believed that we need to look into these bears' eyes to feel that connection, living being to living being, in order to want to do something to protect them from threats such as a proposed gas pipeline.

The bear mother and Scarface had shown me how it once was, between us and wild creatures sharp of tooth and claw, long before we thought we knew everything and could grow forests and elk like we grow cabbages (to paraphrase Leopold badly). When he wrote, "To keep every cog and wheel is the first precaution of intelligent tinkering," Leopold was referring to the importance of

saving large carnivores.[15] Today part of intelligent tinkering, also known as ecological restoration, involves acknowledging that you can't go back, you can only go forward, striving to create healthier ecosystems that preserve essential processes such as predation.[16] So while we can't quite re-create the close relations we may once have had with living things, such as what I experienced in the Great Bear Rainforest, we can envision a world in which we base our relationships with carnivores on respect, rather than fear. A world where we allow them to fulfill their ecological roles as much as possible. A world where we give them room to roam, so that their benefits cascade through whole ecosystems.

Sharing this earth with thriving, healthy carnivores comes down to coexistence. The problem is that *coexistence* means different things to different people. We've seen that to some people, coexistence means keeping carnivore numbers as low as possible short of extermination, in order to produce more moose (*Alces alces*). Via the North American Model of wildlife conservation, this means coexisting with bears, wolves, cougars, and other carnivores on *our* terms, not theirs. Conversely, some define coexistence as protecting every carnivore, completely and always. Realistically, in our fragmented, modern world, coexistence lies somewhere between these two perspectives. And while sometimes it seems like we're very far from achieving such a vision, there are now more large carnivores than there have been in over 100 years in more places than we could have imagined twenty years ago. This gives me hope.

Knowing there are places like Khutze Inlet and Gribbell Island, where bears and humans can just *be*, means that eventually we'll get this right. I'll never find full answers to the questions the bear mother inspired as she looked at me calmly, mother to mother. But she and Scarface taught me that there's no separation here. To me these bears and the other carnivores are walking reminders of why the word *ecology* comes from the Greek work *oikos*—"house." For we're all threads in the same cloth of creation, and we dwell in this Earth household together.[17]

Notes

Introduction

1. Michael Parfitt, "The Hard Ride of Route 93," *National Geographic* 182, no. 6 (1992): 42–69.
2. Aldo Leopold, *A Sand County Almanac: And Sketches Here and There* (New York: Ballantine, 1986), xvii.
3. Ibid., 197.
4. William J. Ripple, James A. Estes, Robert L. Beschta, Christopher C. Wilmers, Euan G. Ritchie, Mark Hebblewhite, Joel Berger, et al., "Status and Ecological Effects of the World's Largest Carnivores," *Science* 343, no. 6167 (2014), 1241484.
5. Aldo Leopold, *Round River*, ed. Luna B. Leopold (Oxford: Oxford University Press, 1993), 146–47.
6. Lionel E. Jackson and Michael C. Wilson, "The Ice-Free Corridor Revisited," *Geotimes* 49, no. 2 (2004): 16–19.
7. David M. Theobold et al., "Connecting Natural Landscapes Using a Landscape Permeability Model to Prioritize Conservation Activities in the United States," *Conservation Letters* 5, no. 2 (2011): 123–33.

Chapter 1: Large Carnivores and Corridor Ecology

1. Tanya Shenk, *Post-Release Monitoring of Lynx (*Lynx canadensis*) Reintroduced to Colorado* (Fort Collins, CO: Colorado Division of Wildlife, 2011).

DOI 10.5822/ 978-1-61091-208-2,

2. Paul Beier, "Dispersal of Juvenile Cougars in Fragmented Habitat," *Journal of Wildlife Management* 59, no. 2 (1995): 228–37.
3. Katie Moriarty et al., "Wolverine Confirmation in California after Nearly a Century: Native or Long-Distance Immigrant?" *Northwest Science* 83, no. 2 (2009): 154–62.
4. Charles C. Chester, "Yellowstone to Yukon, North America," in *Climate and Conservation: Landscape and Seascape Science, Planning, and Action,* ed. Jodi A. Hilty, Charles C. Chester, and Molly S. Cross (Washington, DC: Island Press, 2012), 240–52.
5. John L. Weaver, *The Transboundary Flathead: A Critical Landscape for Carnivores in the Rocky Mountains*, Working Paper No. 18 (Bozeman, MT: WCS, 2001), 7–10; Ben Long and the Crown of the Continent Ecosystem Education Consortium, *Crown of the Continent: Profile of a Treasured Landscape* (Dallas, TX: Scott Publishing, 2002).
6. Weaver, ibid.
7. Charles C. Chester, *Conservation across Borders: Biodiversity in an Interdependent World* (Washington, DC: Island Press, 2006), 20–23.
8. Chester, "Yellowstone to Yukon, North America," 240–52.
9. Weaver, *The Transboundary Flathead*, 43–47; also, see the Flathead Wild website: www.flathead.ca/, accessed November 26, 2013.
10. Robert A. Watt, interview by Cristina Eisenberg, August 30, 2012, Waterton Lakes National Park, AB.
11. Grizzlies are protected in Alberta but not British Columbia, as we shall see in chapters 3 and 4. Other species of large carnivores are not protected in Alberta or British Columbia and can be killed by humans legally.
12. Alberta Fish and Wildlife Division, *Management Plan for Wolves in Alberta* (Edmonton, AB: Forestry, Lands, and Wildlife; Fish and Wildlife Division, 1991).
13. Barb Johnston, interview by Cristina Eisenberg, December 4, 2012, Waterton Lakes National Park, AB.
14. Adam T. Ford, Anthony P. Clevenger, and Kathy Rettie, "The Banff Wildlife Crossings Project: An International Public-Private Partnership," in *Safe Passages: Highways, Wildlife, and Habitat Connectivity*, ed. Jon P. Beckmann et al. (Washington, DC: Island Press, 2010), 157–72; Elizabeth Kolbert, *Field Notes from a Catastrophe: Man, Nature, and Climate Change* (New York: Bloomsbury, 2006), 183–89.
15. Chester, "Yellowstone to Yukon, North America," 240–52; Karsten Heuer, *Walking the Big Wild: From Yellowstone to the Yukon on the Grizzly Bear's Trail* (Toronto, ON: McClelland and Stewart, Ltd., 2004), ix–xiv.
16. Reed F. Noss et al., "Conservation Biology and Carnivore Conservation in the Rocky Mountains," *Conservation Biology* 10, no. 4 (1996): 949–63.

17. Wendy Francis, interview by Cristina Eisenberg, September 3, 2012, Banff, AB.
18. Karsten Heuer, interview by Cristina Eisenberg, July 6, 2012, Banff National Park, AB.
19. John Davis, interview by Cristina Eisenberg, November 8, 2013, Seattle, WA.
20. Michael Soulé, interview by Cristina Eisenberg, January 5, 2013, Paonia, CO.
21. Michael E. Soulé and John Terborgh, *Continental Conservation: Scientific Foundations of Regional Reserve Networks* (Washington, DC: Island Press, 1999).
22. Jodi A. Hilty, interview by Cristina Eisenberg, January 30, 2013, Bozeman, MT.
23. Tracy Lee, Michael Quinn, and Danah Duke, "A Local Community Monitors Wildlife along a Major Transportation Corridor," in *Safe Passages*, 277–92; see also: Michael Proctor et al., "Population Fragmentation and Inter-Ecosystem Movements of Grizzly Bears in Western Canada and the Northern United States," *Wildlife Monographs* 180 (2012): 1–46.
24. John L. Weaver, *Conservation Value of Roadless Areas for Vulnerable Fish and Wildlife Species in the Crown of the Continent Ecosystem, Montana*, Working Paper No. 40 (Bozeman, MT: WCS, 2011); John L. Weaver, *Safe Havens, Safe Passages for Vulnerable Fish and Wildlife: Critical Landscapes in the Southern Canadian Rockies, British Columbia and Montana*, Conservation Report No. 6 (Toronto, ON: WCS Canada, 2013); John L. Weaver, *Protecting and Connecting Headwater Havens: Vital Landscapes for Vulnerable Fish and Wildlife Southern Canadian Rockies of Alberta* (Toronto, ON: WCS Canada, 2013).
25. Clayton D. Apps et al., *Carnivores in the Southern Canadian Rockies: Core Areas and Connectivity Across the Crowsnest Highway*, Report No. 3 (Toronto, ON: WCS Canada, 2007); Anthony Clevenger et al., *Highway 3: Transportation Mitigation for Wildlife and Connectivity in the Crown of the Continent Ecosystem* (Bozeman, MT: Western Transportation Institute, 2010).
26. Weaver, *Safe Havens, Safe Passages*, 3–7.
27. John L. Weaver, interview by Cristina Eisenberg, February 21, 2013, St. Ignatius, MT.
28. Proctor et al., "Population Fragmentation and Inter-Ecosystem Movements of Grizzly Bears"; Jodi A. Hilty, interview by Cristina Eisenberg, January 30, 2013, Bozeman, MT.
29. Anthony Clevenger, interview by Cristina Eisenberg, October 9, 2012, Canmore, AB.
30. Anthony P. Clevenger and Adam T. Ford, "Wildlife Crossing Structures, Fencing, and Other Highway Design Considerations," in *Safe Passages*, 17–50; Anthony P. Clevenger and Jack Wierzchowski, "Maintaining and Restoring Connectivity in Landscapes Fragmented by Roads," in *Connectivity Conservation*, ed. Kevin R. Crooks and M. Sanjayan (Cambridge, UK: Cambridge University Press, 2006), 502–35.

31. Anthony P. Clevenger and Nigel Waltho, "Factors Influencing the Effectiveness of Wildlife Underpasses in Banff National Park, Alberta, Canada," *Conservation Biology* 14 (2000): 47–56.
32. Michael A. Sawaya, Anthony P. Clevenger, and Steven T. Kalinowski, "Demographic Connectivity for Ursid Populations at Wildlife Crossing Structures in Banff National Park," *Conservation Biology* 27, no. 4 (2013): 721–30.
33. Anthony Clevenger, interview by Cristina Eisenberg, October 9, 2012, Canmore, AB.
34. Brian Walker and David Salt, *Resilience Thinking: Sustaining Ecosystems and People in a Changing World* (Washington, DC: Island Press, 2006), 12–14.
35. Proctor et al., "Population Fragmentation and Inter-Ecosystem Movements of Grizzly Bears"; John L. Weaver, interview by Cristina Eisenberg, February 21, 2013, St. Ignatius, MT; Walker and Salt, *Resilience Thinking.*
36. Jodi A. Hilty, William Z. Lidicker Jr., and Adina M. Merenlender, *Corridor Ecology: The Science and Practice of Linking Landscapes for Biodiversity Conservation* (Washington, DC: Island Press, 2006), 54–60.
37. John L. Weaver, Paul C. Paquet, and Leonard F. Ruggiero, "Resilience and Conservation of Large Carnivores in the Rocky Mountains," *Conservation Biology* 10, no. 4 (1996): 964–76.
38. Weaver, *Safe Havens, Safe Passages*, 32.
39. Wendy Francis, interview by Cristina Eisenberg, September 3, 2012, Banff, AB.
40. Kevin Van Tighem, interview by Cristina Eisenberg, September 5, 2012, Banff, AB.

Chapter Two: The Ecological Role of Large Carnivores

1. Daniel H. Pletscher et al., "Population Dynamics of a Recolonizing Wolf Population," *Journal of Wildlife Management* 61, no. 2 (1997): 459–65.
2. Robert A. Watt, *Wildlife Reports, Waterton Lakes National Park* (Waterton, AB: Parks Canada, 1980–2009).
3. Robert R. Ream et al., *Population Dynamics and Movements of Recolonizing Wolves in the Glacier National Park Area*, Annual Report (Missoula, MT: University of Montana, 1990).
4. Eliot Fox and Kevin Van Tighem, *The Belly River Wolf Study, Six-Month Interim Report* (Waterton Lakes, AB: Waterton Lakes National Park, 1994); Robert A. Watt, interview by Cristina Eisenberg, August 30, 2012, Waterton Lakes National Park, AB.
5. Joel S. Brown, John W. Laundré, and Mahesh Gurung, "The Ecology of Fear: Optimal Foraging Game Theory and Trophic Interactions," *Journal of Mammalogy* 80, no. 2 (1999): 385–99; John W. Laundré, Lucina Hernandez, and Kelly B. Altendorf,

"Wolves, Elk, and Bison: Re-Establishing the 'Landscape of Fear' in Yellowstone National Park," *Canadian Journal of Zoology* 79 (2001): 1401–9.

6. Robinson Jeffers, "The Bloody Sire," in *The Selected Poetry of Robinson Jeffers* (Palo Alto, CA: Stanford University Press, 2002), 563–64.
7. Robert T. Paine, "A Note on Trophic Complexity and Species Diversity," *The American Naturalist* 103 (1969): 91–93; Robert T. Paine, "Food Webs: Linkage, Interaction Strength, and Community Infrastructure," *Journal of Animal Ecology* 49 (1980): 667–85.
8. Brown et al., "The Ecology of Fear," 486–99.
9. Olaus J. Murie, "Field Notes: Mammals, *Cervus Canadensis*" (Shepherdstown, WV: USFWS Archives, 1926–1954), 417–98; Aldo Leopold, "Deer Irruptions," *Wisconsin Conservation Bulletin* 8 (1943): 3–11.
10. Nelson G. Hairston, Frederick E. Smith, and Lawrence B. Slobodkin, "Community Structure, Population Control, and Competition," *American Naturalist* 94, no. 879 (1960): 421–25.
11. Charles Elton, *Animal Ecology*, 2d ed. (Chicago: University of Chicago Press, 2001), 101–45.
12. Paine, "A Note on Trophic Complexity and Community Stability," 91–93.
13. Michael Soulé et al., "Strongly Interacting Species: Conservation Policy, Management, and Ethics," *Bioscience* 55, no. 2 (2005): 168–76.
14. Wolves most often dig their dens into the root balls of conifers, using the larger roots to create stability. In this particular case, the conifer used was a spruce; however, it was impossible for me to identify the actual species of spruce. In the Crown of the Continent Ecosystem, there are three species of spruce, and all hybridize frequently. Because of this hybridization, identifying spruce by species can only be done via DNA analysis.
15. Cristina Eisenberg, *Complexity of Food Web Interactions in a Large Mammal System* (dissertation, Oregon State University, 2012).
16. William W. Murdoch, "'Community Structure, Population Control, and Competition'—A Critique," *American Naturalist* 100, no. 912 (1966): 219–26.
17. James A. Estes et al., "Trophic Downgrading of Planet Earth," *Science* 33, no. 6040 (2011): 301–6.
18. Charles Darwin, *The World of Charles Darwin*, vol. 16: *The Origin of Species 1876* (New York: NYU Press, 2010).
19. Aldo Leopold, "The Research Program," in *Transactions of the Second North American Wildlife Conference* (1937): 104–7.
20. William J. Ripple et al., "Trophic Cascades among Wolves, Elk, and Aspen on Yellowstone National Park's Northern Range," *Biological Conservation* 102 (2001): 227–34.

21. Cristina Eisenberg, S. Trent Seager, and David E. Hibbs, "Wolf, Elk, and Aspen Food Web Relationships: Context and Complexity," *Forest Ecology and Management* (2013): 70–80.
22. Estes et al., "Trophic Downgrading of Planet Earth"; Oswald J. Schmitz, Peter A. Hamback, and Andrew P. Beckerman, "Trophic Cascades in Terrestrial Systems: A Review of the Effects of Carnivore Removals on Plants," *American Naturalist* 155 (2000): 141–53.
23. Donald Strong, "Are Trophic Cascades All Wet? Differentiation and Donor Control in Speciose Systems," *Ecology* 73 (1992): 745–54; Mark Hebblewhite et al., "Human Activity Mediates a Trophic Cascade Caused by Wolves," *Ecology* 86 (2005): 2135–44.
24. Matthew Kauffman, Jedediah F. Brodie, and Erik S. Jules, "Are Wolves Saving Yellowstone's Aspen? A Landscape-Level Test of a Behaviorally Mediated Trophic Cascade," *Ecology* 91 (2010), 2742–55.
25. The Waterton and Saint Mary Valleys in Glacier National Park have had fires in recent times but none in the aspen communities I studied during the years of my research (2007–11). There were attempts to set some prescribed burns in my Waterton Valley study plots. With one exception these fizzled out. The one fire that did take off resulted in a postdoctoral research project for me that is still underway as I write this, but that was not part of my doctoral research; see: Eisenberg, *Complexity of Food Web Interactions*, 134–80.
26. Eisenberg, *Complexity of Food Web Interactions*, 87–133.
27. Tony K. Ruth and Kerry Murphy, "Cougar–Prey Relationships," in *Cougar Ecology and Conservation*, ed. Maurice Hornocker and Sharon Negri (Chicago: University of Chicago Press, 2010), 138–62; cougars have been found to kill adult elk regularly in northeast Oregon, but frequent cougar predation on adult elk has not been reported in other places. Cougar predation on elk is not fully understood (e.g., under what circumstances it does or does not take place), despite many studies on cougar predation.
28. Charles J. Krebs et al., "What Drives the Ten-Year Cycle of Snowshoe Hares?" *BioScience* 51, no. 1 (2001): 25–35.
29. Aldo Leopold, *Round River*, ed. Luna B. Leopold (Oxford: Oxford University Press, 1993), 147.
30. Soulé et al., "Ecological Effectiveness"; Cristina Eisenberg et al., "Wolf, Elk, and Aspen Food Web Relationships," 70–80.
31. Edward O. Wilson, *The Diversity of Life* (Cambridge, MA: Belknap Press of Harvard University Press, 1992); Elizabeth Kolbert, *Field Notes from a Catastrophe: Man, Nature, and Climate Change* (New York: Bloomsbury, 2006), 183–89.
32. William Obadiah Pruitt and Leonid M. Baskin, *Boreal Forest of Canada and Russia* (Sofia, Bulgaria: Pensoft Publishers, 2004), 1–167.

33. W. D. Billings and H. A. Mooney, "The Ecology of Arctic and Alpine Plants," *Biological Review* 43 (1968): 481–529.
34. Robert L. Beschta and William J. Ripple, "Rapid Assessment of Riparian Cottonwood Recruitment: Middle Fork John Day River, Northeastern Oregon," *Ecological Restoration* 23, no. 3 (2005): 150–56.
35. Charles C. Schwartz, Albert W. Franzmann, Richard E. McCabe, *Ecology and Management of the North American Moose* (Boulder, CO: University Press of Colorado, 2007).
36. Charles Krebs et al., "Terrestrial Trophic Dynamics in the Canadian Arctic," *Canadian Journal of Zoology* 81 (2003): 827–43.

Chapter Three: Crossings

1. Robert B. Keiter and Harvey Locke, "Law and Large Carnivore Conservation in the Rocky Mountains of the U.S. and Canada," *Conservation Biology* 10, no 4 (1996): 1003–12.
2. Charles Chester, *Conservation across Borders: Biodiversity in an Independent World* (Washington, DC: Island Press, 2006), 14–52.
3. Richard West Sellars, *Preserving Nature in the National Parks: A History* (New Haven, CT: Yale University Press, 1997), 3–5; Raul Valdez et al., "Wildlife Conservation and Management in Mexico," *Wildlife Society Bulletin* 34, no. 2 (2006): 270–82.
4. Peyton Doub, *The Endangered Species Act: History, Implementation, Successes, and Controversies* (Boca Raton, FL: Taylor and Francis, 2013), 3–14.
5. Aldo Leopold, *A Sand County Almanac: And Sketches Here and There* (New York: Ballantine, 1986); Rachel Carson, *Silent Spring* (New York: Houghton Mifflin, 1962).
6. Kieran F. Suckling and Martin Taylor, "Critical Habitat and Recovery," in Dale D. Goble, J. Michael Scott, and Frank Davis, eds., *The Endangered Species Act at Thirty*, vol. 1: *Renewing the Conservation Promise* (Washington, DC: Island Press, 2006), 75–89.
7. 16 U.S.C. §1532(6); 16 U.S.C. §1532(20); http://ecos.fws.gov/tess_public/pub/boxScore.jsp, accessed March 1, 2013.
8. Douglas Honnold, Managing Attorney, EarthJustice Legal Defense Fund, interview by Cristina Eisenberg, January 22, 2013, San Francisco, CA; Holly Doremus, "Lessons Learned," *The Endangered Species Act at Thirty*, 195–207.
9. D. Noah Greenwald, Kieran F. Suckling, and Martin Taylor, "The Listing Record," *The Endangered Species Act at Thirty*, 51–67.
10. Doub, *The Endangered Species Act*, 208–32.
11. 16 U.S.C. §1532 (3)(6).

12. Douglas Honnold, Managing Attorney, EarthJustice Legal Defense Fund, interview by Cristina Eisenberg, January 22, 2013, San Francisco, CA.
13. Ibid.
14. Ibid.
15. Doub, *The Endangered Species Act*, 52–57.
16. USFWS, *The Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho: Final Environmental Impact Statement* (Denver, CO: USFWS, 1994).
17. USFWS, "Final Rule to Identify the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and to Revise the List of Endangered and Threatened Wildlife," CFR Part 17, *Federal Register* 74, no. 62 (April 2, 2013), 15123.
18. Doub, *The Endangered Species Act*, 174–76; Keiter and Locke, "Law and Large Carnivore Conservation in the Rocky Mountains of the US and Canada," 1003–12.
19. Jamie Benidickson, *Environmental Law*, 3d ed. (Ottawa: Irwin Law, 2009), 316–19.
20. S.C. 2002, c. 29 § 2(1).
21. Benidickson, *Environmental Law*, 100–17.
22. Raul Valdez et al., "Wildlife Conservation and Management in Mexico," 270–82; Environmental Law Institute, *Decentralization of Environmental Protection in Mexico: An Overview of State and Local Laws and Institutions* (Washington, DC: Environmental Law Institute, 1996).
23. Eric T. Freyfogle and Dale D. Goble, *Wildlife Law: A Primer* (Washington, DC: Island Press, 2009), 164–83.
24. Benidickson, *Environmental Law*, 41–44, 218.
25. Rachel Rose Starks and Adrian Quijada-Mascarenas, "A Convergence of Borders: Indigenous Peoples and Environmental Conservation at the US-Mexico Border," in *Conservation of Shared Environments: Learning from the United States and Mexico*, ed. Laura Lopez-Hoffman et al. (Tucson: University of Arizona Press, 2009), 54–70.
26. Reed F. Noss, "From Endangered Species to Biodiversity," in Kathryn A. Kohm, ed., *Balancing on the Brink of Extinction: The Endangered Species Act and Lessons for the Future* (Washington, DC: Island Press, 1991), 236.
27. Randall C. Archibold, "Border Plan Will Address Harm Done at Fence Site," *New York Times*, January 16, 2009, www.nytimes.com/2009/01/17/us/17border.html?ref=borderfenceusmexico, accessed December 15, 2012.
28. Richard R. Frankham, Jonathan D. Ballou, David A. Briscoe, *Introduction to Conservation Genetics* (Cambridge, UK: Cambridge University Press, 2010).
29. Brian P. Segee and Ana Cordova, "A Fence Runs through It," in *Conservation of Shared Environments*, 241–56.

30. Brad McRae et al., "Habitat Barriers Limit Gene Flow and Illuminate Historical Events in a Wide-Ranging Carnivore, the American Puma," *Molecular Ecology* 14 (2005): 1965–77.
31. Melanie Culver et al., "Connecting Wildlife Habitats across the US-Mexico Border," in *Conservation of Shared Environments*, 83–99; Ana Cordova and Carlos A. de la Parva, "Transboundary Conservation between the United States and Mexico: New Institutions or a New Collaboration?" in *Conservation of Shared Environments*, 279–92.
32. Aldo Leopold, "Foreword" (original foreword to *A Sand County Almanac*), Aldo Leopold Archives, University of Wisconsin, unpublished manuscripts, 10-6, Box 16.
33. Wallace Stegner, *The Sound of Mountain Water* (New York: Penguin Books, 1969), 153.

Chapter 4: Grizzly Bear

1. Timothy Rawson, *Changing Tracks: Predators and Politics in Mt. McKinley National Park* (Fairbanks, AK: University of Alaska Press, 2001).
2. Adolph Murie, *The Grizzlies of Mount McKinley* (Seattle: University of Washington Press, 1981); Rawson, *Changing Tracks*.
3. Bruce N. McLellan, Chris Servheen, and Djuro Huber (IUCN SSC Bear Specialist Group), "*Ursus arctos*," in *IUCN Red List of Threatened Species*, v. 2012.2 (2008), www.iucnredlist.org, accessed March 18, 2013; Paul Schullery, *Lewis and Clark among the Grizzlies* (Helena: Falcon Guides, 2002), 41–54; Robert H. Busch, *The Grizzly Almanac* (New York: Lyons Press, 2000), 9–14.
4. Kevin Van Tighem, *Bears: Without Fear* (Toronto: Rocky Mountain Books, 2013), 64.
5. Pierpont Morgan Library Manuscript MS M871 (Plinus Segundus Gaius, between 830 and 840).
6. John Craighead, Jay Sumner, and John Alexander Mitchell, *The Grizzly Bears of Yellowstone: Their Ecology in the Yellowstone Ecosystem* (Washington, DC: Island Press, 1995), 383–84; Van Tighem, *Bears: Without Fear*, 176.
7. Craighead et al., *The Grizzly Bears of Yellowstone*, 155–92; John L. Weaver, Paul C. Paquet, and Leonard F. Ruggiero, "Resilience and Conservation of Large Carnivores in the Rocky Mountains," *Conservation Biology* 10, no. 4 (1996): 964–76.
8. David J. Mattson, "Use of Ungulates by Yellowstone Grizzly Bears (*Ursus arctos*)," *Biological Conservation* 181 (1997): 161–77; John S. Waller and Richard D. Mace, "Grizzly Bear Habitat Selection in the Swan Mountains, Montana," *Journal of Wildlife Management* 61, no. 4 (1997): 1032–9.

9. George V. Hilderbrand et al., "The Importance of Meat, Particularly Salmon, to Body Size, Population Productivity, and Conservation of North American Brown Bears," *Canadian Journal of Zoology* 77 (1999): 132–38; David J. Mattson, Bonnie M. Blanchard, and Richard R. Knight, "Food Habits of Yellowstone Grizzly Bears," *Journal of Applied Ecology* 34 (1991): 926–40.
10. David J. Mattson, Bonnie M. Blanchard, and Richard R. Knight, "Yellowstone Grizzly Bear Mortality, Human Habituation, and Whitebark Pine Seed Crops," *Journal of Wildlife Management* 56, no. 3 (1992): 432–42; Katherine C. Kendall and Robert E. Keane, "Whitebark Pine Decline: Infection, Mortality, and Population Trends," in *Whitebark Pine Communities: Ecology and Restoration*, ed. Diana F. Tomback, Stephen F. Arno, and Robert E. Keane (Washington, DC: Island Press, 1996), 221–42.
11. Van Tighem, *Bears: Without Fear*, 69–70.
12. Richard D. Mace et al., "Landscape Evaluation of Grizzly Bear Habitat in Western Montana," *Conservation Biology* 13, no. 2 (1999): 367–77; John Waller and Christopher Servheen, "Effects of Transportation Infrastructure on Grizzly Bears in Northwestern Montana," *Journal of Wildlife Management* 69 (2005): 985–1000.
13. Chris Wilmers et al., "Resource Dispersion and Consumer Dominance: Scavenging and Wolf- and Hunter-Killed Carcasses in Greater Yellowstone USA," *Ecology Letters* 6 (2003): 996–1003; Rolf O. Peterson, "Temporal and Spatial Aspects of Predator-Prey Dynamics," *Alces* 39 (2003): 215–32.
14. Sandra E. Tardiff and Jack A. Stanford, "Grizzly Bear Digging: Effects on Subalpine Meadow Plants in Relation to Mineral Nitrogen Availability," *Ecology* 79, no. 7 (1998): 2219–28.
15. Gordon W. Holtgrieve, Daniel E. Schindler, and Peter K. Jewett, "Large Predators and Biogeochemical Hotspots: Brown Bear (*Ursus arctos*) Predation on Salmon Alters Nitrogen Cycling in Riparian Soils," *Ecological Research* 24, no. 5 (2009): 1125–35.
16. Tracy I. Storer and Lloyd P. Tevis Jr., *California Grizzly* (Berkeley, CA: University of California Press, 1996) ; Busch, *The Grizzly Almanac*, 14–15; David J. Mattson, and Troy Merrill, "Extirpations of Grizzly Bears in the Contiguous United States, 1850–2000," *Conservation Biology* 16, no. 4 (2002): 1123–36.
17. Mattson and Merrill, "Extirpations of Grizzly Bears in the Contiguous United States," 1123–36.
18. USFWS, *Grizzly Bear Recovery Plan* (Missoula, MT: USFWS, 1993); USFWS, "Grizzly Bear Recovery," www.fws.gov/mountain-prairie/species/mammals/grizzly/, accessed March 27, 2013.
19. Michael Lang, *Bears: Tracks through Time* (Banff, AB: The Whyte Museum of the Canadian Rockies, 2010), 80–87.

20. Jeff Gailus, *The Grizzly Manifesto: In Defense of the Great Bear* (Vancouver, BC: Rocky Mountain Books, 2010); Alberta SRD, "Wildlife Species Status," www.srd.alberta.ca/FishWildlife/SpeciesAtRisk/GeneralStatusOfAlbertaWildSpecies/GeneralStatusOfAlbertaWildSpecies2010/SearchForWildSpeciesStatus.aspx, accessed September 28, 2012; Steve Michel, "Living with Wildlife," www.youtube.com/watch?v=2M5M2jR2VaQ, accessed November 21, 2013.
21. Kerry Gunther, interview by Cristina Eisenberg, September 18, 2012, Mammoth, WY.
22. Miguel Llanos, "Grizzly Mauls Man to Death at Denali; Bear Shot," *NBC News*, August 25, 2012.
23. Stephen Herrero, interview by Cristina Eisenberg, December 5, 2012, Calgary, AB.
24. Steven Michel, interview by Cristina Eisenberg, October 9, 2012, Banff National Park, AB; Herrero, *Bear Attacks: Their Causes and Avoidance* (Guilford, CT: Lyons Press, 2002), 41.
25. Herrero, *Bear Attacks*; Van Tighem, *Bears: Without Fear*.
26. Charlie Russell, interview by Cristina Eisenberg, August 21, 2012, The Hawks Nest, Waterton, AB.
27. Steven Michel, interview by Cristina Eisenberg, October 9, 2012, Banff National Park, AB; Kerry Gunther, interview by Cristina Eisenberg, September 18, 2012, Mammoth, WY; John Waller, Glacier National Park ecologist, e-mail dated April 5, 2013.
28. Glacier National Park Archives, case incident record, August 1, 1976.
29. Details on Timothy Treadwell's work with bears and the events that led to his death are provided in the Nick Jans book, *The Grizzly Maze* (New York: Plume, 2005); details about Treadwell's disregard of advice was further provided by Charlie Russell, interview by Cristina Eisenberg, August 21, 2012, The Hawks Nest, Waterton, AB.
30. Craig Boddington, *Fair Chase in North America* (Missoula, MT: The Boone and Crockett Club, 2004).
31. Cathy Ellis, "Famous Grizzly Sow Defies Odds," *Rocky Mountain Outlook*, July 28, 2011.
32. Van Tighem, *Bears: Without Fear*, 69–70.
33. Steven Michel, interview by Cristina Eisenberg, October 9, 2012, Banff National Park, AB.
34. Ibid.
35. Katherine C. Kendall et al., "Demography and Genetic Structure of a Recovering Grizzly Bear Population," *Journal of Wildlife Management* 73, no. 1 (2009): 3–17; John Waller, Glacier National Park ecologist, e-mail dated April 5, 2013.
36. John Waller, Glacier National Park ecologist, e-mail dated April 5, 2013.

37. USFWS, *Final Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area* (Missoula, MT: USFWS, 2007); USFWS, *Grizzly Bear Recovery Plan, Supplement: Habitat-Based Recovery Criteria for the Yellowstone Ecosystem* (Missoula, MT: USFWS, 2007); USFWS, *Grizzly Bear Recovery Plan, Supplement: Revised Demographic Recovery Criteria for the Yellowstone Ecosystem* (Missoula, MT: USFWS, 2007).
38. Douglas Honnold, interview by Cristina Eisenberg, January 22, 2013, San Francisco, CA.
39. Kerry Gunther, interview by Cristina Eisenberg, September 18, 2012, Mammoth, WY.
40. USFWS, *Grizzly Bear Recovery Plan, Supplement.*
41. David J. Mattson, "Sustainable Grizzly Bear Mortality Calculated from Counts of Females with Cubs-of-the-Year: An Evaluation," *Biological Conservation* 81 (1997): 103–11; USFWS, *Grizzly Bear Recovery Plan, Supplement: Proposed Application Protocol for Yellowstone Grizzly Bear Demographic Recovery Criteria* (Missoula, MT: USFWS, 2013).
42. Daniel F. Doak and Kerry Cutler, "Re-evaluating Evidence for Past Population Trends and Predicted Dynamics of Yellowstone Grizzly Bears," *Conservation Letters* (2013) DOI: 10.1111/conl.12048.
43. Christopher Servheen, interview by Cristina Eisenberg, February 20, 2013, Missoula, MT; Michael Proctor et al., "Population Fragmentation and Inter-Ecosystem Movements of Grizzly Bears in Western Canada and the Northern United States," *Wildlife Monographs* 180 (2012): 1–46.
44. Christopher Servheen, interview by Cristina Eisenberg, February 20, 2013, Missoula, MT; Kerry A. Gunther et al., "Grizzly Bear–Human Conflicts in the Greater Yellowstone Ecosystem, 1992–2000," *Ursus* 15 (2004): 10–22.
45. Susan Clark, Murray B. Rutherford, and Denise Casey, eds., *Coexisting with Large Carnivores: Lessons from the Greater Yellowstone* (Washington, DC: Island Press, 2005).
46. Peter H. Kahn Jr. and Patricia H. Hasbach, eds., *The Rediscovery of the Wild* (Cambridge, MA: MIT Press, 2013); Peter H. Kahn, "Cohabitating with the Wild," *Ecopsychology*, March 2009: 38–46.

Chapter 5: Wolf

1. L. David Mech et al., *The Wolves of Denali* (Minneapolis, MN: University of Minnesota Press, 1998), 159–74.
2. Tom Meier, interview by Cristina Eisenberg, July 12, 2012, Denali, AK.
3. NPS, *Revisiting Leopold: Resource Stewardship in the National Parks* (Washington, DC: National Park Service, 2012); Douglas W. Smith, interview by Cristina Eisenberg, January 30, 2013, Bozeman, MT.

4. Timothy Rawson, *Changing Tracks: Predators and Politics in Mt. McKinley National Park* (Fairbanks, AK: University of Alaska Press, 2001), 206–24.
5. Adolph Murie, *The Wolves of Mount McKinley* (Washington, DC: National Park Service, 1944); Rawson, *Changing Tracks*, 237.
6. Mech et al., *The Wolves of Denali*; Gordon Haber and Marybeth Holleman, *Among Wolves* (Fairbanks, AK: University of Alaska Press, 2013); Vic Van Vallenberghe, *In the Company of Moose* (Mechanicsburg, PA: Stackpole Books, 2004).
7. Ronald Nowak, "Wolf Evolution and Taxonomy," in *Wolves: Behavior, Ecology, and Conservation*, ed. L. David Mech and Luigi Boitani (Chicago: University of Chicago Press, 2003), 239–50; Garry Marvin, *Wolf* (London: Reaktion Books, 2012), 13–14.
8. Stuart M. Chambers et al., "An Account of the Taxonomy of North American Wolves from Morphological and Genetic Analyses," *North American Fauna* 77 (2012): 1–67.
9. L. David Mech, *The Wolf* (Minneapolis, MN: University of Minnesota Press, 1970), 11–12; Rolf O. Peterson and Paolo Ciucci, "The Wolf as a Carnivore," in *Wolves: Behavior, Ecology, and Conservation*, 112–13; Kevin Van Tighem, *The Homeward Wolf* (Toronto: Rocky Mountain Books, 2013), 14.
10. Murie, *The Wolves of Mount McKinley*; Haber and Holleman, *Among Wolves*, 31–58; Jane M. Packard, "Wolf Behavior: Reproductive, Social, and Intelligent," in *Wolves: Behavior, Ecology, and Conservation*, 53–55.
11. Diane K. Boyd and Daniel H. Pletscher, "Characteristics of Dispersal in a Colonizing Wolf Population in the Central Rocky Mountains," *Journal of Wildlife Management* 63 (1999): 1094–1108.
12. Mech and Boitani, "Wolf Social Ecology," 31; Packard, "Wolf Behavior," 46; Douglas W. Smith, e-mail to author dated January 9, 2014.
13. Douglas W. Smith and Michael K. Phillips, "Northern Rocky Mountain Wolf (*Canis lupus nubilus*)," in *Endangered Animals: A Reference Guide to Conflicting Issues*, ed. Richard P. Reading and Brian Miller (Westport, CT: Greenwood Press, 2000); Kyran E. Kunkel et al., "Factors Affecting Foraging Behavior of Wolves in and near Glacier National Park, Montana," *Journal of Wildlife Management* 68 (2004): 167–78.
14. Vanessa Renwick, *Hunting Requires Optimism* (multi-media installation), www.odoka.org/the_work/, accessed April 18, 2013.
15. Douglas W. Smith, e-mail to author dated January 9, 2014.
16. Olaus J. Murie, "Field Notes: Mammals, *Cervus Canadensis*" (Shepherdstown, WV: USFWS Archives, 1926–1954), 417–98; Aldo Leopold, *A Sand County Almanac: And Sketches Here and There* (New York: Ballantine, 1986), 135.
17. Nelson G. Hairston, Frederick E. Smith, and Lawrence B. Slobodkin, "Community Structure, Population Control, and Competition," *American Naturalist* 94, no. 879 (1960): 421–25.

18. Rick McIntyre, ed., *War Against the Wolf: America's Campaign to Exterminate the Wolf* (Stillwater, MN: Voyageur Press, 1995).
19. USFWS, *The Reintroduction of Gray Wolves to Yellowstone National Park and Central Idaho: Final Environmental Impact Statement* (Denver, CO: USFWS, 1994); USFWS, *Reintroduction of the Mexican Gray Wolf within Its Historic Range in the Southwestern US, Final Environmental Impact Statement* (Washington, DC: USFWS, 1996).
20. Douglas W. Smith, e-mail to author dated January 9, 2014.
21. Edward Bangs et al., "Managing Wolf–Human Conflict in the Northwestern United States," in *People and Wildlife: Conflict or Coexistence*, ed. Rosie Woodroffe, Simon Thirgood, and Alan Rabinowitz (Cambridge, UK: Cambridge University Press, 2005), 340–56; USFWS, "U.S. Fish and Wildlife Service, State Agencies Release 2012 Annual Report for Northern Rocky Mountain Wolf Population" (media release), April 13, 2013.
22. David Parsons, interview by Cristina Eisenberg, September 25, 2012, Albuquerque, NM.
23. USFWS, "Mexican Wolf Blue Range Reintroduction Project Statistics," www.fws.gov/southwest/es/mexicanwolf/MWPS.cfm, accessed April 4, 2013; Paul Paquet et al., *Mexican Wolf Recovery: Three-Year Program Review* (Washington, DC: USFWS, 2001).
24. Mark E. McNay, "Wolf–Human Interactions in Alaska and Canada: A Review of the Case History," *Wildlife Society Bulletin* 30 (2002): 831–43.
25. Douglas W. Smith, e-mail dated April 22, 2013.
26. USFWS, "Final Rule to Identify the Northern Rocky Mountain Population of Gray Wolf as a Distinct Population Segment and to Revise the List of Endangered and Threatened Wildlife," CFR Part 17, *Federal Register* 74, no. 62 (April 2, 2013): 15123; John Vucetich, interview by Cristina Eisenberg, April 16, 2013, Corvallis, OR.
27. John Horning, interview by Cristina Eisenberg, September 23, 2012, Santa Fe, NM; David Parsons, interview by Cristina Eisenberg, September 25, 2012, Albuquerque, NM.
28. USFWS, "Mexican Wolf Blue Range Reintroduction Project Statistics," www.fws.gov/southwest/es/mexicanwolf/MWPS.cfm, accessed April 4, 2013.
29. David Parsons, interview by Cristina Eisenberg, September 25, 2012, Albuquerque, NM.
30. Amaroq Weiss, interview by Cristina Eisenberg on April 23, 2013, Petaluma, CA.
31. USFWS, "Removing the Gray Wolf (*Canis lupus*) from the List of Endangered and Threatened Wildlife and Maintain Protections for the Mexican Wolf (*Canis l. baileyi*) by Listing It as Endangered," CFR Part 17, *Federal Register* 78, no. 91 (October 2, 2013): 60813–15.

32. The use of terms such as *take* to mean killing, *liberal* to refer to widespread killing, or *harvest* to mean killing an animal takes us into environmental ethical terrain. Some believe that because animals are living, sentient beings, it is unethical to use such language to refer to killing them. In this book, when referring to laws and public policies I adhere to the language used in these documents, but in my review and analysis I try to use common language (e.g., *killing* or *hunting* instead of *take*) for clarity and to acknowledge the ethical questions raised (or obscured) by terminology.
33. Alaska Department of Fish and Game, "Species Account: Wolf (*Canis lupus*)," www.adfg.alaska.gov/index.cfm?adfg=wolf.main, accessed April 4, 2013; ADFG, *Intensive Management Protocol* (Anchorage, AK: ADFG, 2011).
34. Bob Hayes, *Wolves of the Yukon* (Smithers, BC: Bob Hayes, 2010), 248–59.
35. John Vucetich and Michael Nelson, "What Are Sixty Warblers Worth? Killing in the Name of Conservation," *Oikos* 116 (2007): 1267–78.
36. Rick McIntyre, interview by Cristina Eisenberg, September 16, 2012, Silver Gate, MT; Norm Bishop, interview by Cristina Eisenberg, November 25, 2012, Bozeman, MT.
37. P. J. White, Kelly M. Proffitt, and Thomas O. Lemke, "Changes in Elk Distribution and Group Sizes after Wolf Restoration, *American Midland Naturalist* 167 (2012): 174–87.
38. Douglas W. Smith et al., *Yellowstone Wolf Project: Annual Report, 2011* (Yellowstone National Park, WY: NPS, Yellowstone Center for Resources, 2012).
39. Scott Creel and Jay J. Rotella, "Meta-Analysis of Relationships Between Human Offtake, Total Mortality, and Population Dynamics of Gray Wolves (*Canis lupus*)," *PloS ONE* 5, no. 9 (2010): 1–7, e12918.
40. Layne Adams et al. "Population Characteristics and Harvest Dynamics of Wolves in the Central Brooks Range," *Wildlife Monographs* 170 (2008): 1–25; Todd Fuller, L. David Mech, and Jean F. Cochrane, "Wolf Population Dynamics," in *Wolves: Behavior, Ecology, and Conservation,* 183–84.
41. Creel and Rotella, "Meta-Analysis of Relationships Between Human Offtake, Total Mortality, and Population dynamics of Gray Wolves"; Dennis L. Murray et al., "Death from Anthropogenic Causes Is Partially Compensatory in Recovering Wolf Population," *Biological Conservation* 143 (2010): 2514–24.
42. Douglas W. Smith, interview by Cristina Eisenberg, January 30, 2013, Bozeman, MT.
43. Haber and Holleman, *Among Wolves.*
44. Rick McIntyre, interview by Cristina Eisenberg, September 16, 2012, Silver Gate, MT; Douglas W. Smith, e-mail dated April 22, 2013.
45. Bridget Borg, interview by Cristina Eisenberg, July 18, 2013, Denali, AK; www.nps.gov/dena/naturescience/wolfviewing.htm, accessed December 3, 2013.

46. Jane Goodall, "The Last Wolves?," *Washington Post*, January 5, 2014, www.washingtonpost.com/opinions/the-last-wolves/2014/01/03/621c5d26-71bb-11e3-8def-a33011492df2_gallery.html, accessed January 19, 2014.
47. Van Tighem, *The Homeward Wolf*.
48. Carter Niemeyer, *Wolfer* (Boise, ID: Bottlefly Press, 2010).
49. Louise Liebenberg, "Managing Our Predators on Our Northern Alberta Ranch," *Shepherd* 56, no. 9: 26–27.
50. Steve Clevidence interview by Cristina Eisenberg, February 19, 2013, Stevensville, MT.
51. Olivier LaRoque, "The Wolves Are Back" (dissertation, McGill University, 2013).

Chapter 6: Wolverine

1. Douglas H. Chadwick, *The Wolverine Way* (Ventura, CA: Patagonia Books, 2010), 47, 235–36.
2. Jeffrey P. Copeland and Richard E. Yates, *Wolverine Population Assessment in Glacier National Park: Comprehensive Summary Update* (Missoula, MT: USDA Forest Service, Rocky Mountain Research Station, 2008).
3. Eric Tomasik and Joseph A. Cook, "Mitochondrial Phylogeography and Conservation Genetics of Wolverine (*Gulo gulo*) of Northwestern North America," *Journal of Mammalogy* 86, no. 2 (2005): 386–96.
4. W. Christopher Wozencraft, "Order Carnivora," in *Mammal Species of the World: A Taxonomic and Geographic Reference*, ed. Don E. Wilson and DeAnn M. Reeder (Baltimore, MD: Johns Hopkins University Press, 2005), 601–19.
5. Vivian Banci, "Wolverine," in *The Scientific Basis for Conserving Forest Carnivores*, General Technical Report RM-254, ed. Leonard F. Rugiero et al. (Fort Collins, CO: USDA Forest Service, 1994), 99–127.
6. Audrey J. Magoun et al., "Modeling Wolverine Occurrence Using Aerial Surveys of Tracks in Snow," *Journal of Wildlife Management* 71, no. 7 (2007): 2221–29.
7. Robert A. Long et al., *Noninvasive Survey Methods for Carnivores* (Washington, DC: Island Press, 2008).
8. Robert Inman et al., *Greater Yellowstone Wolverine Program*, Progress Report (Bozeman, MT: WCS, 2009).
9. Jeffrey P. Copeland, "Seasonal Habitat Associations of the Wolverine of Central Idaho," *Journal of Wildlife Management* 71, no. 7 (2007): 2201–12; Evelyn L. Bull, Keith B. Aubry, and Barbara C. Wales, "Effects of Disturbance on Forest Carnivores of Conservation Concern in Eastern Oregon and Washington," *Northwest Science* 75 (2001): 180–84; John Krebs, Eric C. Lofroth, and Ian Parfitt, "Multiscale Habitat Use by Wolverines in British Columbia," *Journal of Wildlife Management* 71, no. 7

(2007): 2180–92; Jeffrey P. Copeland et al., "The Bioclimatic Envelope of the Wolverine (*Gulo gulo*): Do Climatic Constraints Limit Its Geographic Distribution?" *Canadian Journal of Zoology* 88 (2011): 233–46.

10. Inman et al., *Greater Yellowstone Wolverine Program*, Progress Report 2009; Copeland and Yates, *Wolverine Population Assessment in Glacier National Park*; Jens Person, "Female Wolverine (*Gulo gulo*) Reproduction: Reproductive Costs and Winter Food Availability," *Canadian Journal of Zoology* 83 (2005): 1453–59; John L. Weaver, Paul, C. Paquet, and Leonard F. Ruggiero, "Resilience and Conservation of Large Carnivores in the Rocky Mountains," *Conservation Biology* 10, no. 4 (1996): 964–76.
11. Audrey J. Magoun and Jeffrey P. Copeland, "Characteristics of Wolverine Reproductive Den Sites," *Journal of Wildlife Management* 62, no. 4 (1998): 1313–20.
12. Copeland and Yates, *Wolverine Population Assessment in Glacier National Park*.
13. Robert M. Inman et al., "Spatial Ecology of Wolverines at the Southern Periphery of Distribution," *Journal of Wildlife Management* 76, no. 4 (2011): 778–92.
14. William F. Wood et al., "Potential Semiochemicals in Urine from Free-Ranging Wolverines (*Gulu gulo Pallas*, 1780), *Biochemical Systematics and Ecology* 37, no. 5 (2009): 574–78.
15. Robert Inman et al., "Wolverine Makes Extensive Movements in the Greater Yellowstone Ecosystem," *Northwest Science Notes* 78, no. 3 (2004): 261–66; Katie Moriarty et al., "Wolverine Confirmation in California after Nearly a Century: Native or Long-Distance Immigrant?" *Northwest Science* 83, no. 2 (2009): 154–62; Inman et al., *Greater Yellowstone Wolverine Program*, Progress Report, 2009.
16. Eric C. Lofroth et al., "Food Habits of Wolverine *Gulo gulo* in Montane Ecosystems of British Columbia," *Wildlife Biology* 13 (2007): 31–37.
17. John Krebs et al., "Synthesis of Survival Rates and Causes of Mortality in North American Wolverines," *Journal of Wildlife Management* 68, no. 3 (2004): 493–502.
18. John Lee and Allen Niptanatiak, *Ecology of the Wolverine on the Central Arctic Barrens: Progress Report, Spring 1993* (Yellowknife, NT: Department of Renewable Resources, 1993); Robert M. Inman et al., "Wolverine Space Use in Greater Yellowstone," in *Wildlife Conservation Society, Greater Yellowstone Wolverine Program, Cumulative Report* (Bozeman, MT: WCS, 2007).
19. Maurice G. Hornocker and Howard S. Hash, "Ecology of the Wolverine in Northwest Montana," *Canadian Journal of Zoology* 59 (1981): 1286–1301.
20. James D. Keyser, *Indian Rock Art of the Columbia Plateau* (Seattle and London: University of Washington Press, 1992).
21. Environment BC, "Furbearer Management Guidelines," www.env.gov.bc.ca/fw/wildlife/hunting/regulations/1214/docs/trapping_Section.pdf, accessed May 5, 2013.

22. Eric C. Lofroth and Peter K. Ott, "Assessment of the Sustainability of Wolverine Harvest in British Columbia, Canada," *Journal of Wildlife Management* 71, no. 7 (2007): 2193–2200; Robert M. Inman et al., "Wolverine Harvest in Montana: Survival Rates and Spatial Considerations for Harvest Management," in *Greater Yellowstone Wolverine Program, Cumulative Report, May 2007* (Ennis, MT: Wildlife Conservation Society, 2007), 85–97.
23. TWS, "Final Position Statement, Traps, Trapping, and Furbearer Management, March 2010," http://joomla.wildlife.org/documents/positionstatements/09-Trapping.pdf, accessed May 11, 2013; FWP, "Trapping and Furbearer Management in Montana," http://fwp.mt.gov/hunting/trapping/, accessed April 28, 2013.
24. Douglas Chadwick, interview by Cristina Eisenberg, Whitefish Montana, September 15, 2014.
25. USFWS, "12-Month Finding on a Petition to List the North American Wolverine as Endangered or Threatened," 50 CFR Part 17, Federal Register 72, no. 107 (June 5, 2007): 31048–9; 16 U.S.C §1532 (3)(20); Doub, *The Endangered Species Act*, 208–32.
26. Inman et al., "Spatial Ecology of Wolverines." While a DPS is defined by Congress as a population of a species that is endangered or threatened, a DPS is tied to a specific geographic location. In order to be recognized, a DPS must be formally defined by USFWS. This definition is posted as a "rule" in the *Federal Register.* Until that has been done, any existing population of an endangered or threatened species does not have legal standing.
27. USFWS, "Initiation of Status Review of the North American Wolverine in the Contiguous United States," 50 CFR Part 17, *Federal Register* 75, no. 72 (April 15, 2010): 19591–92.
28. CDOW, Draft Plan to Reintroduce Wolverine (*Gulo gulo*) to Colorado (Denver, CO: CDOW, 2010); USFWS, "Threatened Status for the Distinct Population Segment of the North American Wolverine," CFR Part 17, *Federal Register* 78, no. 23 (February 4, 2013): 7864–90.
29. Eric C. Lofroth and John Krebs, "The Abundance and Distribution of Wolverines in British Columbia, Canada," *Journal of Wildlife Management* 71, no. 7 (2007): 2159–69; Environment BC, "Furbearer Management Guidelines"; Alberta SRD, "Species Summary: Wolverine (*Gulo gulo*)," http://srd.alberta.ca/FishWildlife/SpeciesAtRisk/SpeciesSummaries/documents/Wolverine_May_03.pdf, accessed May 5, 2013.
30. IUCN, "IUCN Red List Wolverine," www.iucnredlist.org/details/9561/0, accessed April 26, 2013.
31. Copeland et al., "The Bioclimatic Envelope of the Wolverine," 233–46.
32. Intergovernmental Panel on Climate Change, *Fourth Assessment Report: Climate Change 2007* (Cambridge, UK: Cambridge University Press, 2007).

33. Copeland et al., "The Bioclimatic Envelope of the Wolverine"; Jedediah F. Brodie and Eric Post, "Nonlinear Responses of Wolverine Populations to Declining Winter Snowpack," *Population Ecology* 52 (2010): 279–87.
34. Chris Cegleski et al., "Genetic Diversity and Population Structure of Wolverine (*Gulo gulo*) Populations at the Southern Edge of their Current Distribution in North America with Implications for Genetic Viability," *Conservation Genetics* 7 (2006): 197–211.
35. Chadwick, *The Wolverine Way*, 137–77.
36. Jodi A. Hilty, William Z. Lidicker Jr., and Adina M. Merenlender, *Corridor Ecology: The Science and Practice of Linking Landscapes for Biodiversity Conservation* (Washington, DC: Island Press, 2006), 54–60.
37. Ibid., 100–111.
38. Robert M. Inman et al., "Wolverine Reproductive Rates and Maternal Habitat in Greater Yellowstone," in *Greater Yellowstone Wolverine Program, Cumulative Report May 2007* (Ennis, MT: Wildlife Conservation Society, 2007), 65–84; Mark L. Packila et al., "Wolverine Food Habits in Greater Yellowstone," in *Greater Yellowstone Wolverine Program, Cumulative Report May 2007* (Ennis, MT: Wildlife Conservation Society, 2007), 121–28; Mark L. Packila et al., "Wolverine Road Crossings in Western Greater Yellowstone," in *Greater Yellowstone Wolverine Program, Cumulative Report May 2007* (Ennis, MT: Wildlife Conservation Society, 2007), 103–20.
39. Robert M. Inman, *Wolverine Ecology and Conservation in the Western United States* (dissertation, Swedish University of Agricultural Sciences, Uppsala, 2013), 145 pp.
40. Copeland and Yates, *Wolverine Population Assessment in Glacier National Park.*
41. Anthony Clevenger, interview by Cristina Eisenberg, October 9, 2012, Canmore, AB.
42. Chadwick, *The Wolverine Way*, 269.

Chapter 7: Lynx

1. Mark O'Donoghue et al., "Behavioral Responses of Coyotes and Lynx to the Snowshoe Hare Cycle," *Oikos* 82, no. 1 (1998): 169–83 (describes lynx ambush strategies for hunting snowshoe hares).
2. Douglas A. Maguire, Charles B. Halpern, and David L. Phillips, "Changes in Forest Structure Following Variable-Retention Harvests in Douglas Fir–Dominated Forests," *Forest Ecology and Management* 242, no. 2 (2007): 708–26.
3. John R. Squires et al., "Seasonal Resource Selection of Canada Lynx in Managed Forests of the Northern Rocky Mountains," *Journal of Wildlife Management* 74, no. 8 (2010): 1648–60.

4. USFWS, "Determination of Threatened Status for the Contiguous US Distinct Population Segment of the Canada Lynx and Related Rule; Final Rule," CFR Part 17, *Federal Register* 65, no. 58 (March 24, 2000): 16052; USDA Forest Service, *Northern Rockies Lynx Amendment Draft Environmental Impact Statement* (Missoula, MT: USDA Forest Service, 2004); Mathieu Basille et al., "Selecting Habitat to Survive: The Impact of Road Density on Survival in a Large Carnivore," *PLoS ONE* 8, no. 7 (2013): e65493. doi:10.1371/journal.pone.0065493.
5. Hal Salwasser, "Ecosystem Management: A New Perspective for National Forests and Grasslands," in *Ecosystem Management: Adaptive Strategies for Natural Resources Organizations in the Twenty-First Century* (Levittown, PA: Taylor and Francis, 1999), 85–96.
6. Leonard F. Ruggiero et al., "Species Conservation and Natural Variation among Populations," in *Ecology and Conservation of Lynx in the United States,* ed. Leonard F. Rugiero et al. (Boulder, CO: University Press of Colorado, 2000), 109.
7. Adolph Murie, *A Naturalist in Alaska* (Tucson, AZ: University of Arizona Press, 1961), 14–17.
8. Garth Mowat, Kim G. Poole, and Mark O'Donoghue, "Ecology of Lynx in Northern Canada and Alaska," in *Ecology and Conservation of Lynx in the United States*, 267.
9. John R. Squires et al., "Hierarchical Den Selection of Canada Lynx in Western Montana," *Journal of Wildlife Management* 72, no. 7 (2008): 1497–1506.
10. John R. Squires and Leonard F. Ruggiero, "Winter Prey Selection of Canada Lynx in Northwestern Montana," *Journal of Wildlife Management* 71, no. 2 (2007): 310–15.
11. Paul C. Griffin and L. Scott Mills, "Sinks without Borders: Snowshoe Hare Dynamics in a Complex Landscape," *Oikos* 118 (2009): 1487–98.
12. Benjamin T. Maletzke et al., "Habitat Conditions Associated with Lynx Hunting Behavior during Winter in Northern Washington," *Journal of Wildlife Management* 72, no. 7 (2008): 1473–78.
13. Charles Elton, *Animal Ecology,* 3d edition (Chicago: University of Chicago Press, 2002), 135; Murie, *A Naturalist in Alaska*, 14–28; Stan Boutin et al., "Population Changes of the Vertebrate Community during a Snowshoe Hare Cycle in Canada's Boreal Forest," *Oikos* 74 (1995): 69–80; Charles J. Krebs et al., "Impact of Food and Predation on the Snowshoe Hare Cycle," *Science* 269, no. 5227 (1995): 1112–15.
14. Garth Mowat, Brian G. Slough, and Stan Boutin, "Lynx Recruitment during a Snowshoe Hare Population Peak and Decline in Southwest Yukon," *Journal of Wildlife Management* 60, no. 2 (1996): 441–52.
15. Karen E. Hodges, "Ecology of Snowshoe Hares in Southern Boreal and Montane Forests," in *Ecology and Conservation of Lynx in the United States,* 163–206;

Dennis L. Murray, Todd D. Steury, and James D. Roth, "Assessment of Canada Lynx Research and Conservation Needs in Southern Range: Another Kick at the Cat," *Journal of Wildlife Management* 72, no. 7 (2008): 1463–72.

16. Kevin S. McKelvey, Keith B. Aubry, and Yvette K. Ortega, "History and Distribution of Lynx in the Contiguous United States," in *Ecology and Conservation of Lynx in the United States,* 207–64.
17. Steven W. Buskirk, Leonard F. Ruggiero, and Charles J. Krebs, "Habitat Fragmentation and Interspecific Competition," in *Ecology and Conservation of Lynx in the United States*, 83–100; Gary M. Koehler et al., "Habitat Fragmentation and the Persistence of Lynx Populations in Washington State," *Journal of Wildlife Management* 72, no. 7 (2008): 1518–24; John L. Weaver, *The Transboundary Flathead: A Critical Landscape for Carnivores in the Rocky Mountains,* Working Paper No. 18 (Bozeman, MT: Wildlife Conservation Society, 2001).
18. Rugiero et al., *Ecology and Conservation of Lynx in the United States.*
19. USFWS, "Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx; Final Rule," CFR Part 17, *Federal Register* 74, no. 36 (February 25, 2009): 8615.
20. Tanya M. Shenk, "Post-Release Monitoring of Lynx Reintroduced to Colorado" (Fort Collins, CO: Colorado Parks and Wildlife, 2009), 1–55.
21. Jacob S. Ivan, "Monitoring Canada Lynx in Colorado Using Occupancy Estimation: Initial Implementation in the Core Lynx Area" (Fort Collins, CO: Colorado Parks and Wildlife, 2011), 10–20; Michael K. Schwartz et al., "DNA Reveals High Dispersal Synchronizing the Population Dynamics of Canada Lynx," *Nature* 415, no. 31 (2002): 520–22.
22. University of Montana, "Climate Change Hurting Hares: White Snowshoe Hares Can't Hide on Brown Earth," *Science Daily*, March 6, 2009, www.sciencedaily.com/releases/2009/02/090224220347.html, accessed July 6, 2013.
23. Laura Prugh, interview by Cristina Eisenberg, July 16, 2013, Fairbanks, AK
24. Gary R. Bortolotti, "Natural Selection and Coloration: Protection, Concealment, Advertisement, or Deception?" in Geoffrey E. Hill and Kevin J. McGraw, eds., *Bird Coloration*, vol. 2 (Cambridge, MA: Harvard University Press, 2006), 3–35; L. Scott Mills, Marketa Zimova, Jared Oyler, Steven Running, John T. Abatzoglou, and Paul M. Lukacs, "Camouflage Mismatch in Seasonal Coat Color Due to Decreased Snow Duration," *Proceedings of the National Academy of Sciences* 110, no. 18 (2013): 7360–65.
25. Laura Prugh, interview by Cristina Eisenberg, July 16, 2013, Fairbanks, AK.
26. McKenzie et al., "Climatic Change, Wildfire, and Conservation;" John R. Squires et al., "Combining Resource Selection and Movement Behavior to Predict Corridors for Canada Lynx at their Southern Range Periphery," *Biological Conservation* 157 (2013): 187–95.

27. Laura Prugh et al., "The Rise of the Mesopredator," *BioScience* 59 (2009): 779–91; William J. Ripple et al., "Can Restoring Wolves Aid in Lynx Recovery?" *Wildlife Society Bulletin* 35, no. 4 (2011): 514–18.
28. John W. Laundré, Lucina Hernandez, and Kelly B. Altendorf, "Wolves, Elk, and Bison: Re-Establishing the 'Landscape of Fear' in Yellowstone National Park," *Canadian Journal of Zoology* 79 (2001): 1401–9.
29. Ripple et al., "Can Restoring Wolves Aid in Lynx Recovery?"
30. John R. Squires et al., "Missing Lynx and Trophic Cascades in Food Webs: A Reply to Ripple et al.," *Wildlife Society Bulletin* 36, no. 3 (2012): 567–71; Jarod Merkle, Daniel R. Stahler, and Douglas W. Smith, "Interference Competition between Gray Wolves and Coyotes in Yellowstone National Park," *Canadian Journal of Zoology* 87 (2009): 56–63; Hodges, "Ecology of Snowshoe hares in Southern Boreal and Montane Forests," 163–206.
31. Squires et al., "Missing Lynx and Trophic Cascades in Food Webs."
32. Laura Prugh, interview by Cristina Eisenberg, July 16, 2013, Fairbanks, AK.
33. Ripple et al., "Can Restoring Wolves Aid in Lynx Recovery?"
34. USFWS, "Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx; Final Rule," CFR Part 17, *Federal Register* 74, no. 36 (February 25, 2009): 8615; USDA Forest Service, *Northern Rockies Lynx Amendment* (2004).

Chapter 8: Cougar

1. William J. Ripple and Robert L. Beschta, "Trophic Cascades in Yellowstone: The First 15 Years after Wolf Reintroduction," *Biological Conservation* 145 (2011): 205–13.
2. Aldo Leopold, *A Sand County Almanac: And Sketches Here and There*, 2d ed. (Oxford: Oxford University Press, 1968).
3. Kristin Nowell and Peter Jackson, *Wild Cats: Status Survey and Conservation Action Plan* (Cambridge, UK: IUCN, 1996), 131.
4. Melanie Culver, "Lessons and Insights from Evolution, Taxonomy, and Conservation Genetics," in *Cougar Ecology and Conservation*, ed. Maurice Hornocker and Sharon Negri (Chicago: University of Chicago Press, 2010), 28–30.
5. Steve Pavlick, "Sacred Cat," in *Listening to Cougar*, ed. Mark Bekoff and Cara Blessley Low (Boulder, CO: University of Colorado Press, 2007).
6. Jaguars can be larger, but within the Carnivore Way jaguars and cougars can be similar in size; see: Robert H. Bush, *The Cougar Almanac* (Guilford, CT: Lyons Press, 2004), 26–33.
7. Ibid.
8. Kenneth A. Logan and Linda L. Sweanor, "Behavior and Social Organization of a Solitary Carnivore," in *Cougar Ecology and Conservation*, 105-17.

9. John W. Laundré and Lucina Hernandez, "The Amount of Time Female Pumas *Puma concolor* Spend with Their Kittens," *Wildlife Biology* 14, no. 2 (2008): 221–27.
10. Becky M. Pierce et al., "Migratory Patterns of Mountain Lions: Implications for Social Regulation and Conservation," *Journal of Mammalogy* 80, no 3 (1999): 986–92.
11. Linda L. Sweanor, Kenneth A. Logan, and Maurice G. Hornocker, "Cougar Dispersal Patterns, Metapopulation Dynamics, and Conservation," *Conservation Biology* 14, no. 3 (2000): 798–809.
12. Cougar Management Guidelines Working Group, *Cougar Management Guidelines* (Bainbridge Island, WA: WildFutures, 2005), 11–25; Nowell and Jackson, *Wild Cats*, 131.
13. Ibid.
14. John W. Laundré, "Summer Predation Rates on Ungulate Prey by a Large Keystone Predator: How Many Ungulates Does a Large Predator Kill?" *Journal of Zoology* 275 (2008): 341–48; Kenneth A. Logan and Linda L. Sweanor, *Desert Puma: Evolutionary Ecology and Conservation of an Enduring Carnivore* (Washington, DC: Island Press, 2001), 322–27; John W. Laundré, Lucina Hernandez, and Susan G. Clark, "Impact of Puma Predation on the Decline and Recovery of a Mule Deer Population in Southeastern Idaho," *Canadian Journal of Zoology* 84 (2006): 1555–65.
15. Paul Beier, "A Focal Species for Conservation," in *Cougar Ecology and Conservation,* 178–79; Logan and Sweanor, *Desert Puma,* 341–58.
16. Cougar Management Guidelines Working Group, *Cougar Management Guidelines*, 63–70.
17. Tony K. Ruth and Kerry Murphy, "Cougar–Prey Relationships," in *Cougar Ecology and Conservation*, 138–62; Kyran E. Kunkel et al., "Winter Prey Selection by Wolves and Cougars in and near Glacier National Park, Montana," *Journal of Wildlife Management* 63 (1999): 901–10; Mark Elbroch, *Annual Report, Garfield-Mesa Lion Project* (2012).
18. Cougar Management Guidelines Working Group, *Cougar Management Guidelines*, 63–70.
19. John W. Laundré, *Phantoms of the Prairie: The Return of Cougars to the Midwest* (Madison, WI: The University of Wisconsin Press, 2012); John W. Laundré and Lucina Hernandez, "Winter Hunting Habitat of Pumas *Puma concolor* in Northwestern Utah and Southern Idaho," *Wildlife Biology* 9, no. 2 (2003):123–29.
20. Paul Beier et al., "Mountain Lion (*Puma concolor*)," in *Urban Carnivore Ecology*, ed. Stanley D. Gehrt, Seth P. D. Riley, and Brian L. Cyper (Baltimore, MD: Johns Hopkins University Press, 2010), 177–89; Brian N. Kertson et al., "Cougar Space Use and Movements in the Wildland-Urban Landscape of Western Washington," *Ecological Applications* 21, no. 8 (2011): 2866–81; John W. Laundré et al., "Evaluating Potential Factors Affecting Puma *Puma concolor* abundance in the Mexican Chihuahuan Desert," *Wildlife Biology* 15 (2009): 207–12.

21. Kristin Nowell and Peter Jackson, *Wild Cats*, 131.
22. Laundré, *Phantoms of the Prairie*; Daniel Thompson and John A. Jenks, "Dispersal Movements of Subadult Cougars from the Black Hills: The Notions of Range Expansion and Recolonization," *Ecosphere* 1, no. 4 (2010): 1–11; Michelle A. Larue, "Cougars Are Recolonizing the Midwest: Analysis of Cougar Confirmations during 1990–2008," *Journal of Wildlife Management* 76, no. 7 (2012): 1364–69.
23. Sue Morse, "Keeping Track," http://keepingtrack.org/, accessed June 30, 2013; UCSC Puma Project, http://santacruzpumas.org/, accessed June 30, 2013.
24. Harley G. Shaw et al., *Puma Field Guide* (New Mexico: Puma Network, 2007), 17.
25. Cougar Management Guidelines Working Group, *Cougar Management Guidelines,* 5–9.
26. Arturo Caso et al., *Puma concolor*, in *IUCN Red List of Threatened Species*, Version 2012.2, www.iucnredlist.org, accessed June 15, 2013.
27. Catherine M. S. Lambert et al., "Cougar Population Dynamics and Viability in the Pacific Northwest," *Journal of Wildlife Management* 70, no. 1 (2006): 2456–64; Hilary S. Cooley et al., "Source Populations in Carnivore Management: Cougar Demography and Emigration in a Lightly Hunted Population," *Animal Conservation* 12 (2009): 321–28.
28. Philip A. Stephens, William J. Sutherland, and Robert P. Freckleton, "What Is the Allee Effect?" *Oikos* (1999): 185–90; Paul Beier, "Dispersal of Juvenile Cougars in Fragmented Habitat," *Journal of Wildlife Management* 59, no. 2 (1995): 228–37; Paul Beier, "Determining Minimum Habitat Areas and Habitat Corridors for Cougars," *Conservation Biology* 7, no. 1 (1993): 94–108.
29. Hugh S. Robinson et al., "Sink Populations in Carnivore Management: Cougar Demography and Immigration in a Hunted Population," *Ecological Applications* 18, no. 4 (2008): 1028–37; John W. Laundré and Susan G. Clark, "Managing Puma Hunting in the Western United States: Through a Metapopulation Approach," *Animal Conservation* 6 (2003): 159–70.
30. Kevin R. Crooks and Michael E. Soulé, "Mesopredator Release and Avifaunal Extinctions in a Fragmented System," *Nature* 400 (1999): 563–66.
31. William J. Ripple and Robert L. Beschta, "Linking Cougar Decline, Trophic Cascades, and Catastrophic Regime Shift in Zion National Park," *Biological Conservation* 133 (2006): 397–408.
32. William J. Ripple and Robert L. Beschta, "Trophic Cascades Involving Cougar, Mule Deer, and Black Oaks in Yosemite National Park," *Biological Conservation* 141 (2007): 1249–56.
33. Rolf Peterson, interview by Cristina Eisenberg, April 29, 2008, Michigan Technological University, Houghton, MI; Doug Smith, interview by Cristina Eisenberg, November 4, 2008, Yellowstone National Park.

34. Cristina Eisenberg, *Complexity of Food Web Interactions in a Large Mammal System* (dissertation, Oregon State University, Corvallis, OR, 2012).
35. L. Mark Elbroch and Heiko Wittmer, "Table Scraps: Inter-Trophic Food Provisioning by Pumas," *Biology Letters* 8, no. 5 (2012): 776–79.
36. Beier, "A Focal Species for Conservation," 177–78; Kyran Kunkel et al., "Assessing Wolves and Cougars as Conservation Surrogates," Paper 1157, USDA National Wildlife Research Center, Staff Publications (2013).
37. Paul Beier, "Cougar Attacks on Humans in the United States and Canada," *Wildlife Society Bulletin* 19, no. 4 (1991): 403–12; Linda L. Sweanor and Kenneth A. Logan, "Cougar–Human Interactions," in *Cougar Ecology and Conservation,* 190–205.
38. David Mattson, Kenneth Logan, and Linda Sweanor, "Factors Governing Risk of Cougar Attacks on Humans," *Human–Wildlife Interactions* 5, no. 1 (2011): 135–58.
39. Steven Michel, interview by Cristina Eisenberg, October 9, 2012, Banff National Park, AB.
40. Joel Berger, "Fear, Human Shields, and the Redistribution of Prey and Predators in Protected Areas," *Biology Letters* 3, no. 6 (2007): 620–23.
41. David J. Mattson and Susan G. Clark, "The Discourses of Incidents: Cougars on Mt. Elden and in Sabino Canyon, Arizona," *Policy Sci* 45 (2012): 315–43; David J. Mattson and Susan G. Clark, "People, Politics, and Cougar Management," in *Cougar Ecology and Conservation,* 190–205.
42. Beier, "Dispersal of Juvenile Cougars in Fragmented habitat;" Beier, "A Focal Species for Conservation," 188–89; Claire C. Gloyne and Anthony P. Clevenger, "Cougar *Puma concolor* Use of Wildlife Crossing Structures on the Trans-Canada Highway in Banff National Park, Alberta," *Wildlife Biology* 7, no. 2 (2001): 117–24; Christopher C. Wilmers et al., "Scale-Dependent Behavioral Responses to Human Development by a Large Predator, the Puma," *Plos One* 8, no. 4 (2013): 1–11.
43. Tucker Murphy and David W. Macdonald, "Pumas and People: Lessons in the Landscape of Tolerance from a Widely Distributed Field," in *Biology and Conservation of Wild Felids*, ed. David W. Macdonald and Andrew J. Loveridge (Oxford: Oxford University Press, 2010), 431–52.

Chapter 9: Jaguar

1. David E. Brown and Carlos A. Lopez Gonzalez, *Borderland Jaguars* (Salt Lake City, UT: University of Utah Press, 2001), 1–3.
2. Ibid., 125–28.
3. Kristin Nowell and Peter Jackson, *Wild Cats: Status Survey and Conservation Action Plan* (Cambridge, UK: IUCN, 1996), 118–19.
4. Brown and Lopez Gonzalez, *Borderland Jaguars*, 29–32.

5. Ibid., 4–5.
6. Nowell and Jackson, *Wild Cats,* 118–19; Emil B. McCain and Jack L. Childs, "Evidence of Resident Jaguars (*Panthera onca*) in the Southwestern United States and the Implications for Conservation," *Journal of Mammalogy* 89, no. 1 (2008): 1–10.
7. Alan Rabinowitz, *Jaguar: One Man's Struggle to Establish the World's First Jaguar Preserve* (Washington, DC: Island Press, 2000), 8; Alan Rabinowitz, "The Present Status of Jaguars (*Panthera onca*) in the Southwestern United States," *Southwestern Naturalist* 44, no. 1 (1999): 96–100.
8. David E. Brown, ed., *Biotic Communities: Southwestern United States and Northwestern Mexico* (Salt Lake City, UT: University of Utah Press, 1994), 101–4.
9. Since most jaguars occur in Central and South America, where they tend to be larger, this makes the average size of the species significantly larger than cougar average size, despite the fact that the northern jaguar is similar in size to the cougar.
10. Brown and Lopez Gonzalez, *Borderland Jaguars*, 21–25.
11. Kevin L. Seymour, "*Panthera onca*," *Mammalian Species* 340 (1989): 1–9.
12. Nowell and Jackson, *Wild Cats*, 118–19.
13. Harley Shaw, "The Emerging Cougar Chronicle," in *Cougar Ecology and Conservation*, 17–26.
14. Carlos A. Lopez Gonzalez and Brian J. Miller, "Do Jaguars (*Panthera onca*) Depend on Large Prey?" *Western North American Naturalist* 62, no. 2 (2002): 218–22; Fernando Cesar Cascelli de Azevedo, "Food Habits and Livestock Depredation of Sympatric Jaguars and Pumas in the Iguaçu National Park Area, South Brazil," *Biotropica* 40, no. 4 (2008): 494–500.
15. Lane Simonian, *Defending the Land of the Jaguar: A History of Conservation in Mexico* (Austin, TX: University of Texas Press, 1995), 154–56; Eric W. Sanderson et al., "Planning to Save a Species: The Jaguar as a Model," *Conservation Biology* 16, no. 1 (2002): 58–72.
16. Rabinowitz, "The Present Status of Jaguars (*Panthera onca*) in the Southwestern United States."
17. Arturo Caso et al., *Panthera onca*, in *IUCN Red List of Threatened Species*, Version 2013.1, www.iucnredlist.org, accessed on August 3, 2013.
18. Brown and Lopez Gonzalez, *Borderland Jaguars*, 138–40; USFWS, "Designation of Critical Habitat for Jaguar."
19. Rabinowitz, "The Present Status of Jaguars (*Panthera onca*) in the Southwestern United States"; Kurt A. Menke and Charles L. Hayes, "Evaluation of the Relative Suitability of Potential Jaguar Habitat in New Mexico" (Santa Fe, NM: New Mexico Department of Game and Fish, 2003); James R. Hatten et al., "A Spatial Model of Potential Jaguar Habitat in Arizona," *Journal of Wildlife Management* 69, no. 3 (2005): 1024–33.

20. Melissa Grigione et al., "Neotropical Cats in Southeast Arizona and Surrounding Areas: Past and Present Status of Jaguars, Ocelots, and Jaguarundis," *Mastozoologia Neotropical* 14, no. 2 (2007): 189–99; Octavio C. Rosas-Rosas and Louis C. Bender, "Population Status of Jaguars (*Panthera onca*) and pumas (*Puma concolor*) in Northeastern Sonora, Mexico," *Acta Zoologica Mexicana* 28, no. 1 (2012): 86–101.
21. Alan Rabinowitz and Kathy A. Zeller, "A Range-Wide Model of Landscape Connectivity and Conservation for the Jaguar," *Biological Conservation* 143 (2010): 939–45, Alan Rabinowitz, *An Indomitable Beast: The Remarkable Journey of the Jaguar* (Washington, DC: Island Press, 2014, *in press*).
22. Randall C. Archibold, "Border Plan Will Address Harm Done at Fence Site," *New York Times*, January 16, 2009, www.nytimes.com/2009/01/17/us/17border.html?ref=borderfenceusmexico, accessed December 15, 2012; Melissa Grigione et al., "Identifying Potential Conservation Areas for Felids in the USA and Mexico: Integrating Reliable Knowledge across an International Border," *Oryx* 43, no. 1 (2009): 78–86; Octavio Rosas-Rosas et al., "Habitat Correlates of Jaguar Kill-Sites of Cattle in Northeastern Sonora, Mexico," *Human-Wildlife Interactions* 4, no. 1 (2010): 103–11.
23. Aldo Leopold, *A Sand County Almanac: And Sketches Here and There*, 2d ed. (Oxford: Oxford University Press, 1968), 143.
24. Brian Miller et al., "Using Focal Species in the Design of Nature Reserve Networks," *Wild Earth* Winter (1998/99): 81–92.
25. Sandra M. C. Cavalcanti and Eric M. Gese, "Kill Rates and Predation Patterns of Jaguars (*Panthera onca*) in the Southern Pantanal, Brazil," *Journal of Mammalogy* 91, no. 3 (2010): 722–36.
26. Brown and Lopez Gonzalez, *Borderland Jaguars*, 67–77; Rabinowitz, "The Present Status of Jaguars (*Panthera onca*) in the Southwestern United States."
27. Will Rizzo, "Return of the Jaguar," *Smithsonian*, December 2005; Jeremy Voas, "Cat Fight on the Border," *High Country News*, October 15, 2007; Janay Brun, interview by Cristina Eisenberg, August 11, 2013.
28. Janay Brun, interview by Cristina Eisenberg, August 11, 2013.
29. Ibid.
30. Dennis Wagner, "Cover-Up amid Celebrations," *Arizona Republic*, December 10, 2012.
31. AZGFD information on the Macho B investigation can be found on the Arizona Game and Fish Department website, http://www.azgfd.gov/w_c/jaguar/MachoB.shtml, accessed August 24, 2013.
32. Tony Davis, "Was Arizona Jaguar Macho B's Euthanasia Unnecessary?" *Arizona Star*, March 31, 2009.
33. Janay Brun, interview by Cristina Eisenberg, August 11, 2013.

34. Dennis Wagner, "Cover-Up amid Celebrations," *Arizona Republic*, December 10, 2012.
35. Dennis Wagner, "Web of Intrigue Surrounds Death of Jaguar Macho B," *Arizona Republic*, December 12, 2012.
36. Janay Brun, "Truth or Consequence," *Three Coyotes* 1, no. 2 (2011).
37. Hatten et al., "A Spatial Model of Potential Jaguar Habitat in Arizona."
38. Menke and Hayes, "Evaluation of the Relative Suitability of Potential Jaguar Habitat in New Mexico."
39. Michael Robinson, "Suitable Habitat for Jaguars in New Mexico" (Tucson, AZ: Center for Biological Diversity, 2005).
40. Jim Nintzel, "Jaguar Spotted in the Santa Rita Mountains," *Tucson Weekly*, December 20, 2012.
41. USFWS, "Preliminary Strategy for Jaguar Recovery Is Completed" (Tucson, AZ: USFWS, April 19, 2012).
42. USFWS, "Designation of Critical Habitat for Jaguar"; Grigione et al., "Neotropical Cats in Southeast Arizona and Surrounding Areas."
43. Alan Rabinowitz, "Jaguars Don't Live Here Anymore," *New York Times*, January 25, 2010; Rabinowitz and Zeller, "A Range-Wide Model of Landscape Connectivity and Conservation for the Jaguar."
44. Michael J. Robinson, "Comment to USFWS on Proposed Rule to Designate Critical Habitat for the Jaguar," Center for Biological Diversity, October 12, 2012.
45. Kurt Menke, interview by Cristina Eisenberg, August 7, 2013.
46. Rabinowitz, *Jaguar: One Man's Struggle to Establish the World's First Jaguar Preserve*, xiv.
47. Grigione et al., "Identifying Potential Conservation Areas for Felids in the USA and Mexico"; Northern Jaguar Project, www.northernjaguarproject.org/, accessed August 3, 2013.
48. Kathy Zeller, *Jaguars in the New Millennium Data Set Update: The State of the Jaguar in 2006* (New York: Wildlife Conservation Society, 2007).
49. Octavio C. Rosas-Rosas and Raul Valdez, "The Role of Landowners in Jaguar Conservation in Sonora, Mexico," *Conservation Biology* 24, no. 2 (2010): 366–71.
50. Tony Davis, "Mexican Rancher Struggles to Shift from Cattle to Conservation," *High Country News*, April 20, 2012; Cynthia Lee Wolf, interview by Cristina Eisenberg, Columbia Falls, MT, August 8, 2013.

Conclusion: Earth Household

1. Edward O. Wilson, *The Diversity of Life* (Cambridge, MA: Belknap Press of Harvard University Press, 1992).

2. Michael E. Soulé and John Terborgh, *Continental Conservation: Scientific Foundations of Regional Reserve Networks* (Washington, DC: Island Press, 1999).
3. Michael P. Nelson and John A. Vucetich, "Environmental Ethics and Wildlife Management," *Human Dimensions of Wildlife Management*, ed. Daniel J. Decker, Shawn J. Riley, and William F. Siemer (New York: Johns Hopkins University Press, 2012), 223–37.
4. Ibid.; Aldo Leopold, *A Sand County Almanac* (New York: Ballantine, 1986), 240, 262.
5. Peter Matthiessen, *Wildlife in America*, 3d ed. (New York: Viking, Compass, 1967); Thomas R. Dunlap, *Saving America's Wildlife* (Princeton, NJ: Princeton University Press, 1988).
6. Thomas R. Dunlap, *Saving America's Wildlife* (Princeton, NJ: Princeton University Press, 1988), 10–14, 38.
7. Michael P. Nelson et al., "An Inadequate Construct? North American Model: What's Flawed, What's Missing, What's Needed," *Wildlife Professional* (Summer 2011): 58–60.
8. Valerius Geist, Shane P. Mahoney, and John F. Organ, "Why Hunting Has Defined the North American Model of Wildlife Conservation," *Transactions of the North American Wildlife and Natural Resources Conference* 66 (2001): 175–83.
9. Charles List, *Hunting, Fishing, and Environmental Virtue* (Corvallis, OR: Oregon State University Press, 2013); Steven J. Holmes, *The Young John Muir: An Environmental Biography* (Madison, WI: University of Wisconsin Press, 1999).
10. Michael P. Nelson, interview by Cristina Eisenberg, Corvallis, Oregon, April 23, 2013; John A. Vucetich, interview by Cristina Eisenberg, Corvallis Oregon, April 16, 2013; Nelson et al., "An Inadequate Construct."
11. Estes et al., "Trophic Downgrading of Planet Earth," *Science* 33, no. 6040 (2011): 301–6.
12. J. Baird Callicott, *Companion to* A Sand County Almanac*: Interpretive and Critical Essays* (Madison, WI: University of Wisconsin Press, 1987).
13. Dave Foreman, *Rewilding North America: A Vision for Conservation in the 21st Century* (Washington, DC: Island Press, 2004).
14. List, *Hunting, Fishing, and Environmental Virtue.*
15. Aldo Leopold, *Round River*, ed. Luna B. Leopold (Oxford: Oxford University Press, 1993).
16. Robert Jonathan Cabin, *Intelligent Tinkering: Bridging the Gap between Science and Practice* (Washington, DC: Island Press, 2011).
17. Gary Snyder, *Earth House Hold* (New York: New Directions, 1969).

Glossary

adaptive management A science-based approach to resource management that acknowledges uncertainty and that views policy and management decisions as testable hypotheses, to be revised in light of new information.

additive mortality A situation where harvest by humans (e.g., through hunting of a species) will cause a population of that species to decline in greater numbers than it would if it were not harvested.

Anthropocene The geological epoch that began with the Industrial Revolution in the late seventeenth century; characterized by human modification of ecosystems, a growing human population, and a growing extinction rate. Also called the Age of Man.

background extinction The normal rate of extinction, usually one to five species per year.

biodiversity The variety of living organisms at all levels of organization, including genetic, species, and higher taxonomic levels; the variety of habitats and ecosystems, as well as the processes occurring therein.

biome A complex biotic community characterized by distinctive plant and animal species and maintained under the climatic condition of the region.

biomass The total mass of living matter within a given area.

biota Plants and animals, comprising all the organisms in an ecosystem.

C. Eisenberg, *The Carnivore Way: Coexisting with and Conserving North America's Predators,* 287
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biotic Relating to or caused by living organisms.

boreal Relating to the northern regions; pertaining to the northern forests, below the Arctic Circle.

bottom-up control Regulation of food web components in an ecosystem by either primary producers (plants) or by limits to the input of nutrients.

browsing Feeding on the leaves, branches, or shoots of woody plant species such as shrubs and trees.

carrying capacity In reference to animal populations, the maximum population level that can be supported by habitat without damage to the population or deterioration of the fitness of the species (e.g., through malnutrition, increase in disease). Population ecologists also refer to this as *K*. There are also *social* and *economic* carrying capacities, which are the population densities a species can achieve in places subject to multiple human land uses.

circumboreal Throughout all boreal regions worldwide.

climate Weather conditions over time, 30 years being a typical increment for measurements.

climate change Change in the mean of one or more measures of climate (e.g., precipitation, temperature) over an extended period of time, typically decades.

community In ecology, this refers to a group of different types of organisms that coexist. Additionally, a community is usually characterized by its dominant plant species (e.g., an "aspen community"). Community types are formally based on dominant tree species, or, in non-forested areas, on dominant grass species. Ecologists defined and standardized these community types in the 1920s and 1930s.

community ecology The study of the structure of communities and how they vary in time and space in response to physical and biotic factors.

compensatory mortality A situation where harvest by humans (e.g., through hunting of a species) does not cause the population of that species to decline further than it normally would if it were not harvested.

competition A non-trophic (food web) interaction between two species that has negative consequences for both.

connectivity A measure of the ability of organisms to move among separated patches of suitable habitat; can be viewed at various spatial scales.

consumers A term used in community ecology for herbivores.

control A group of experimental subjects or an area not exposed to the treatment being applied or investigated, to be used for comparison.

corridor An area of habitat that connects wildlife populations separated by human activities such as roads, natural-resources extraction, or development, and thus allows for genetic exchange between these separate populations.

critical habitat According to the Endangered Species Act, the ecosystems upon which endangered and threatened species depend for survival.

delisting The process by which US Fish and Wildlife Service removes a species from the list of threatened and endangered plant and animal species.

deme A local population, part of a metapopulation.

density-dependent factors Factors whose effects on a population change in relative intensity as population density changes, such as factors that affect the birth rate or mortality of a species. Such factors typically include predation.

distinct population segment According to the Endangered Species Act, a population of a species designated for protection.

dominant species Species whose influences result from their great abundance and account for most of the biomass in a community, and are thus primary components of community structure.

ecological integrity The ability of an ecosystem to self-correct after a disturbance and return to the state normal for that system.

ecological restoration Assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. The goal of this process is to emulate the structure, function, diversity, and dynamics of the specified ecosystem, but not necessarily to return it to an earlier condition.

ecological extinction The reduction of a species to such low abundance that, although still present in the community, it no longer interacts significantly with other species.

ecologically effective population In conservation biology, a population of a *keystone species* of sufficient density and distribution to cause a trophic cascade; in population ecology, the breeding females of a species in a population.

ecology The study of biotic communities, the living organisms they contain, and these organisms' abundance and relationships with each other and with their environment.

ecoregion A relatively large area of land or water that contains a geographically distinct assemblage of natural communities.

ecotone The border between two different ecosystems or habitat types, such as where field and forest meet.

empirical Derived from experiment and observation rather than theory; based on data.

endemic Any localized process or pattern, but usually applied to a highly localized or restrictive geographic distribution of a species.

fecundity Potential reproductive ability of a species or a population; functions as a measure of the fitness of a species or population.

feedback A phenomenon in which a system's output modifies input to the system, thus becoming self-perpetuating in its dynamics. Feedback loops can be positive or negative. In a positive feedback loop, for example, the presence of a specific pollinator that only pollinates a particular plant species increases the amount of that plant species, which then increases the population of that pollinator.

flagship species A charismatic species with broad popular appeal. Flagship species can function as ambassadors that advance conservation, because they engage people in caring about conservation. The sea otter (*Enhydra lutris*) is an example of a flagship species.

focal species A species whose requirements for survival represent factors important to ecosystem function. Scientists and managers pay attention to focal species because, due to budget limitations, they can't pay attention to all species, and also because focal species can represent broad ecological issues.

food web The structure of observable trophic (food-related) linkages in a community.

forb A broad-leaved herb that is not a grass, especially one growing in meadow, prairie, or field environments.

fragmentation The transformation of a continuous habitat into habitat patches that usually vary in size and configuration.

grazing Feeding on herbaceous plants in a field or pasture.

Green World Hypothesis A hypothesis suggesting that the world's abundance of plant biomass results from top predators controlling their herbivore prey, via predation, thereby having an indirect effect on vegetation, enabling it to grow.

habitat The dwelling place of an organism or community, which provides the necessary conditions for its existence.

habitat fragmentation The disruption of extensive habitats into isolated and small patches; often applied to forested habitats that have been fragmented by agricultural development or logging.

herbaceous plants Plants whose leaves and stems die down to soil level at the end of the growing season.

herbivore A plant-eating organism.

herbivory A form of predation in which an organism, known as an *herbivore*, consumes plants.

heterogeneous Consisting of dissimilar elements; diverse. In ecology, this term is used to refer to landscape, ecosystem, or community structure.

heuristic A teaching method in which students make discoveries on their own, i.e., learning by doing.

indicator species A species that demonstrates how an ecosystem is functioning. Indicator species are usually only present under a certain set of circumstances. Wildlife managers often use indicator species as a shortcut to monitoring a whole ecosystem.

indirect effects The effects of a species on other species, often through trophic interactions; also called *secondary effects*.

intensive management Wildlife management with the objective of reducing the population of a species to the lowest possible level above extinction. Typically applied to large carnivore management to boost prey populations for hunting by humans.

irruption A sudden, explosive increase in population numbers, which will exceed *carrying capacity* if not limited or controlled; often involves an exponential increase in population size in the absence of predation.

keystone species A species whose impacts on its community or ecosystem are large, and much larger than would be expected from the species' abundance.

landscape ecology The branch of ecology that studies the interactions among different biotic community types on a relatively large scale.

listing The process by which US Fish and Wildlife Service puts a species on the list of threatened and endangered plant and animal species.

matrix The various different biotic communities that surround habitat patches, which can influence metapopulations.

megafauna Species with adults weighing more than 100 pounds.

mesopredators Medium-sized predators, such as coyotes, raccoons, and foxes, which often increase in abundance when larger predators are eliminated.

meta-analysis The process of analyzing research in a specific area of inquiry by comparing and combining the results of several earlier independent but related studies.

metapopulation A large population of animals made up of smaller populations (also called *demes*), which ideally can interbreed and move freely among each other's ranges.

Natural Selection A process theorized by Charles Darwin as the principal mechanism for the evolution of species, by which organisms best adapted to their environment survive, and which shapes traits in all organisms.

net primary production Also called NPP, the energy flow in ecosystems and a measure of biomass, or ability of things to grow. Its components are energy flow via sunlight, moisture, and photosynthesis.

niche The position or role of a species in an ecosystem. Popularly defined as a species' "job."

order of magnitude A tenfold change in number that represents one exponential level, plus or minus; a hundredfold change represents a second exponential level, etc.

paradigm An established pattern of thought, often applied to a dominant ecological or evolutionary viewpoint; e.g., during earlier decades, the dominant paradigm in ecology held that biotic communities underwent orderly, predictable development after a catastrophic disturbance such as a volcanic eruption or severe fire.

permafrost Permanently frozen soil, sediment, or rock that remains at or below freezing for at least two years, generally occurring in North America in Alaska, the Yukon, and northern Canada, between the latitudes of 60° N and 68° N. However, permafrost also occurs in patches in the subalpine and alpine zones in mountainous regions at lower latitudes.

permeability With regard to landscape ecology, the ability of a land area to allow the passage of animals.

persistence The capacity of a population to live for 100 years or longer.

phenology The scientific study of flowing, breeding, migration, and other periodic biological phenomena as they relate to climate.

philopatry The propensity of an adult animal to remain near its point of origin, i.e., within its maternal home range.

Pleistocene An epoch of the Quaternary period, also known as the Ice Age, extending from the end of the Pliocene, some 1.64 million years ago, to the beginning of the Holocene, approximately 10,000 years ago.

recruitment Survival of juveniles (plants or animals) for a period sufficient for them to reach adulthood.

recruitment gap Missing age classes in a tree community due to chronic herbivory.

release Habitat expansion or density increase of a species when one or more competing species are absent.

resilience The ability of systems to react to a disturbance by recovering rapidly, while still maintaining the same ecological characteristics and relationships among organisms.

scale The magnitude of a region or process. Refers to both size, e.g., a relatively small-scale patch or a relatively large-scale landscape, and time, e.g., relatively rapid ecological succession or slow evolution of species.

secondary effects The effects of population loss of a species upon other species, often through trophic interactions; also called *indirect effects*.

sink An area where numbers of a particular species may decline sharply, possibly due to a variety of causes, but often due to habitat fragmentation and human development.

source-sink dynamics A conceptual model used in ecology to describe how changes in habitat quality may affect local population dynamics of species. Good habitat causes the local population of a species to grow, creating a *source*; poor habitat causes the local population of a species to decline, creating a *sink*.

speciation The process of species formation.

species diversity The proportional distribution of species, i.e., species abundance. See *species richness*.

species richness The simplest measure of biodiversity, species richness refers to the number of species in the site being sampled. It does not consider the abundance of individual species.

speciose Containing many species; high in overall biodiversity.

stochastic Random; used particularly to describe any random process, such as mortality, or events attributable to extreme weather, disease, or causes beyond human control.

strongly interacting species Species having a large effect on the other species with which they interact. A communities or ecosystem may have many strong interactors, occurring at all trophic levels. This general term can include *keystone species*.

succession The natural, sequential change of species composition in a community in a given area.

symbiosis A close relationships between at least two species.

sympatric Species that live in the same area at the same time, but do not interbreed.

taiga Sparse forests characteristic of the northern half of the boreal biome, which are comprised mainly of spruce.

taxa A group or category of species, such as genus, family, or order.

top-down control Regulation of lower food web components by an apex predator.

transect A line through an area being used to sample and monitor organisms or conditions.

trophic Of or pertaining to food, as in a trophic level of a food web.

trophic cascade A condition in which the presence of an apex predator causes direct (mortality-driven) and indirect (fear-driven) effects on its primary prey (an herbivore), and that in turn causes this prey species to reduce its impact on the vegetation that it eats, enabling plants to grow and provide habitat for other species.

tundra The treeless zone between the Arctic Ocean and the beginning of the treeline. The soil is frozen here year-round; consequently, it supports only low-lying vegetation.

umbrella species A species that requires a large area for its existence; protection of such a species offers protection to other species that share the same habitat.

ungulate A hoofed mammal.

watershed The land area draining into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine.

woody plants Plants that contain woody fiber (called *lignin*) in their tissues, particularly in their stems. Woody species are usually perennial trees and shrubs.

vagility The ability of an organism to move; generally applied to species and population dynamics.

About the Author

Cristina Eisenberg conducts trophic cascades research that focuses on wolves in Rocky Mountain ecosystems. She also studies how fire interacts with apex predator effects in forest communities. She holds a PhD in forestry and wildlife from Oregon State University, where she teaches ecological restoration and public policy. She is a Smithsonian Conservation Biology Research Associate, a Boone and Crockett Club Professional Member, and an Aldo Leopold scholar. Dr. Eisenberg has authored multiple peer-reviewed scientific and literary journal articles and several book chapters. Her first book, *The Wolf's Tooth: Keystone Predators, Trophic Cascades, and Biodiversity*, was published in 2010 by Island Press. When she is not teaching, she lives in northwest Montana in a remote valley where the large carnivores outnumber the humans.

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Index

Note: Drawings, figures, and tables are indicated by the letter d, f, or t following the page number.

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