# Sweet in Tooth and Claw Stories of Generosity and Cooperation in the Natural World

#### Kristin Ohlson

#### **Notes**

# **Chapter One**

- P 9. Angela Davis's comment about optimism is from her book, *Freedom Is a Constant Struggle* (Chicago: Haymarket Books, 2016).
- P. 11. The nineteenth-century poet Alfred Tennyson penned the phrase "red in tooth and claw" in his poem "In Memoriam A.H.H." (1850), which marked the tragic death of a friend.
- P. 15. Robin Wall Kimmerer has discussed the honorable harvest in many venues, including in this article in *Yes!* magazine. "The 'Honorable Harvest': Lessons from an Indigenous Tradition of Giving Thanks," <a href="https://www.yesmagazine.org/issue/good-health/2015/11/26/the-honorable-harvest-lessons-from-an-indigenous-tradition-of-giving-thanks.">https://www.yesmagazine.org/issue/good-health/2015/11/26/the-honorable-harvest-lessons-from-an-indigenous-tradition-of-giving-thanks.</a>
- P. 23. Suzanne Simard, "How Trees Talk to Each Other," June 29, 2016, <a href="https://www.ted.com/talks/suzanne\_simard\_how\_trees\_talk\_to\_each\_other?language=en;">https://www.ted.com/talks/suzanne\_simard\_how\_trees\_talk\_to\_each\_other?language=en;</a> Camille Defrenne and Suzanne Simard, "The Secret Language of Trees," July 2, 2019, <a href="https://www.ted.com/talks/camille\_defrenne\_and\_suzanne\_simard\_the\_secret\_language\_of\_trees?language=en.">https://www.ted.com/talks/camille\_defrenne\_and\_suzanne\_simard\_the\_secret\_language\_of\_trees?language=en.</a>
- P. 23. Suzanne Simard, "From Tree to Shining Tree," an interview by Robert Krulwich, *Radiolab*, July 30, 2016, https://www.wnycstudios.org/podcasts/radiolab/articles/from-tree-to-shining-tree.
- P. 24. Suzanne Simard, The Mother Tree Project, https://mothertreeproject.org/.
- P. 24. NASA discusses the dangers of drier forests in Jessica Merzdorf, "A Drier Future Sets the Stage for More Wildfires," *NASA Global Climate Change, Vital Signs of the Planet,* July 9, 2019.

https://climate.nasa.gov/news/2891/a-drier-future-sets-the-stage-for-more-wildfires/.

- P. 24. Climate Central discusses heat-stressed forests in Michael D. Lemonick, "Climate Change Stress Killing Forests, and Why It Matters," September 9, 2012, <a href="https://www.climatecentral.org/news/climate-change-stress-killing-forests-and-why-it-matters-14960/">https://www.climatecentral.org/news/climate-change-stress-killing-forests-and-why-it-matters-14960/</a>.
- P. 24. Central Sierra Environmental Resource discusses the damage caused by clearcutting, <a href="https://www.cserc.org/local-issues/forests/clearcuts-and-logging-issues/">https://www.cserc.org/local-issues/forests/clearcuts-and-logging-issues/</a>.
- P. 24. According to Greenpeace, the carbon emissions from deforestation comprise a fifth of global emissions, higher than those from transportation. World Economic Forum, "Saving the

Forests Could Have the Same Carbon Cutting Effect as Taking Every Car in the World Off the Roads," December 1, 2017, <a href="https://www.weforum.org/agenda/2017/12/saving-forests-would-cut-carbon-emissions-as-much-as-taking-every-car-in-the-world-off-the-road/">https://www.weforum.org/agenda/2017/12/saving-forests-would-cut-carbon-emissions-as-much-as-taking-every-car-in-the-world-off-the-road/</a>.

- P. 26. In much of North America, agricultural crop diversity is giving way to hundreds of acres of one or two crops. Dan Nosowitz, "Only One Region Has Better Crop Diversity Now than 34 Years Ago," *Modern Farmer*, September 23, 2015, <a href="https://modernfarmer.com/2015/09/crop-diversity-study/">https://modernfarmer.com/2015/09/crop-diversity-study/</a>; Timothy M. Bowles, et al., "Long-Term Evidence Shows that Crop-Rotation Diversification Increases Agricultural Resilience to Adverse Growing Conditions in North America," *One Earth*, March 20, 2020, <a href="https://www.sciencedirect.com/science/article/pii/S2590332220300889">https://www.sciencedirect.com/science/article/pii/S2590332220300889</a>.
- P. 26. The problems with monoculture tree plantations. Jean-Michel Carnus et al., "Planted Forests and Biodiversity," *Journal of Forestry*, March 2006, <a href="https://www.fs.fed.us/research/publications/misc/63352\_2006\_Carnus%20et%20al\_Planted%20forests%20&%20biodiversity\_JoF.pdf">https://www.fs.fed.us/research/publications/misc/63352\_2006\_Carnus%20et%20al\_Planted%20forests%20&%20biodiversity\_JoF.pdf</a>; Jeremy Hance, "Monoculture Tree Plantations Are "Green Deserts," Not Forests, Say Activists," September 29, 2008, <a href="https://news.mongabay.com/2008/09/monoculture-tree-plantations-are-green-deserts-not-forests-say-activists/">https://news.mongabay.com/2008/09/monoculture-tree-plantations-are-green-deserts-not-forests-say-activists/</a>.
- P. 31. Some 90 percent of land plants are colonized by mycorrhizal fungi. F.A.A. Feijen et al., "Evolutionary Dynamics of Mycorrhizal Symbiosis in Land Plant Diversification," *Scientific Reports 8*, July 16, 2018, <a href="https://www.nature.com/articles/s41598-018-28920-x">https://www.nature.com/articles/s41598-018-28920-x</a>.
- P. 31. Ectomycorrhizal fungi in forests. Ian C. Anderson and John W. G. Cairney, "Ectomycorrhizal Fungi: Exploring the Mycelial Frontier," *FEMS Microbiology Reviews 31*, no. 4 (July 2007), https://academic.oup.com/femsre/article/31/4/388/2398987.
- P. 31. Arbuscular mycorrhizal fungi. Naheeda Begum et al., "Role of Arbuscular Mycorrhizal Fungi in Plant Growth Regulation: Implications in Abiotic Stress Tolerance," *Frontiers in Plant Science*, September 19, 2019, <a href="https://www.frontiersin.org/articles/10.3389/fpls.2019.01068/full.">https://www.frontiersin.org/articles/10.3389/fpls.2019.01068/full.</a>
- P. 31. Early understanding of the role of mycorrhizal fungi in ecosystems. David M. Wilkinson, "The Evolutionary Ecology of Mycorrhizal Networks," *Oikos 82*, no. 2 (June 1998): 407–10, <a href="https://www.jstor.org/stable/3546985?seq=1.">https://www.jstor.org/stable/3546985?seq=1.</a>
- P. 31. Mutualism defined: *Encyclopedia of Ecology*, s. v. "mutualism," 2008, <a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/mutualism#:~:text=Mutualism%20is%20defined%20as%20an,survival%20of%20the%20interacting%20populations.">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/mutualism#:~:text=Mutualism%20is%20defined%20as%20an,survival%20of%20the%20interacting%20populations.</a>
- P. 32. Suzanne Simard's original study of carbon transfer through mycorrhizae. Simard et al., "Net Transfer of Carbon between Ectomycorrhizal Tree Species in the Field," *Nature 388* (August 1997): 579–82, <a href="https://www.nature.com/articles/41557">https://www.nature.com/articles/41557</a>.
- P. 33. The evolution of fungal networks. David M. Wilkinson, "Mycorrhizal Evolution," *Trends in Ecology and Evolution*, February 2001, <a href="https://www.cell.com/trends/ecology-">https://www.cell.com/trends/ecology-</a>

- evolution/comments/S0169-5347(00)02071-1; Michael Gross, "The Success Story of Plants and Fungi," *Current Biology* 29, no. 6 (March 18, 2019): R183–R185, https://www.sciencedirect.com/science/article/pii/S0960982219302611.
- P. 34. Fungi harvest minerals from rock. Jennifer Frazer, "The World's Largest Mining Operation Is Run by Fungi," *Scientific American*, November 5, 2015, <a href="https://blogs.scientificamerican.com/artful-amoeba/the-world-s-largest-mining-operation-is-run-by-fungi/">https://blogs.scientificamerican.com/artful-amoeba/the-world-s-largest-mining-operation-is-run-by-fungi/</a>; Karin Pritsch and Jean Garbaye, "Enzyme Secretion by ECM Fungi and Exploitation of Mineral Nutrients from Soil Organic Matter," *Annals of Forest Science 68* (2011): 25–32, <a href="https://link.springer.com/article/10.1007/s13595-010-0004-8">https://link.springer.com/article/10.1007/s13595-010-0004-8</a>.
- P. 36. Complex tree talk through mycorrhizal connections. "Inter-plant Communication through Mycorrhizal Networks Mediates Complex Adaptive Behaviour in Plant Communities," *AoB Plants* 7, May 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4497361/.
- P. 37. Plants benefit from their connection through mycorrhizae, even when scientists can't determine why. Floridan Walder et al., "Mycorrhizal Networks: Common Goods of Plants Shared under Unequal Terms of Trade," *Plant Physiology* 159, no. 2 (June 2012): 789–97, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3375941/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3375941/</a>.
- P. 37. Trees can build partnerships with hundreds of fungal species. Kevin Beiler et al., "Architecture of the Wood-Wide Web: *Rhizopogon* spp. Genets Link Multiple Douglas-Fir Cohorts," *New Phytologist* 185, no. 2 (October 29, 2009): 543–53, <a href="https://nph.onlinelibrary.wiley.com/doi/full/10.1111/j.1469-8137.2009.03069.x.">https://nph.onlinelibrary.wiley.com/doi/full/10.1111/j.1469-8137.2009.03069.x.</a>
- P. 41. Salmon runs leave a nitrogen impact on the land. Jan J. Verspoor et al., "Persistent Ecological Effects of a Salmon-Derived Nutrient Pulse on Stream Invertebrate Communities," *Ecosphere* 2, no. 2 (February 17, 2011): 1–17, <a href="https://esajournals.onlinelibrary.wiley.com/doi/10.1890/ES10-00011.1#i2150-8925-2-2-art18-Peterson1; Anna Kusmer," There's Something Very Fishy about These Trees," *KQED Deep Look*, September 16, 2017, <a href="https://www.kqed.org/science/1915421/theres-something-fishy-about-these-trees-deep-look.">https://www.kqed.org/science/1915421/theres-something-fishy-about-these-trees-deep-look.</a>
- P. 41. All living things need nitrogen. Claire Gillespie, "Why Is Nitrogen Important for Living Things?," *Sciencing*, April 10, 2018, <a href="https://sciencing.com/why-nitrogen-important-living-things-4609019.html">https://sciencing.com/why-nitrogen-important-living-things-4609019.html</a>.
- P. 42. Red alder trees and their bacterial partners collect nitrogen for the forest. Steven S. Perakis and Julie C. Pett-Ridge, "Nitrogen-Fixing Red Alder Trees Tap Rock-Derived Nutrients," in *Proceedings of the National Academy of Sciences of the United States of America* 16, no. 11 (February 25, 2019): 5009–14, <a href="https://today.oregonstate.edu/news/nitrogen-fixing-trees-%E2%80%9Ceat%E2%80%9D-rocks-play-pivotal-role-forest-health.">https://today.oregonstate.edu/news/nitrogen-fixing-trees-%E2%80%9Ceat%E2%80%9D-rocks-play-pivotal-role-forest-health.</a>
- P. 42. Lichen adds nitrogen to the forest floor. Jade A. Marks et al., "Response of the Nitrogen-Fixing Lichen *Lobaria pulmonaria* to Phosphorus, Molybdenum, and Vanadium," *Ecosphere* 6,

- no. 9 (September 25, 2015): 1–17, https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/ES15-00140.1.
- P. 46. Nitrogen-fixing bacteria in poplar leaves. Sharon L. Doty et al., "Variable Nitrogen Fixation in Wild *Populus*," *PLOS* ONE, May 19, 2016, <a href="https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0155979.">https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0155979.</a>
- P. 48. Plants' bacterial partners can make them more salt tolerant. Dilfuza Egamberdieva et al., "Salt-Tolerant Plant Growth Promoting Rhizobacteria for Enhancing Crop Productivity of Saline Soils," *Frontiers in Microbiology*, December 18, 2019, https://www.frontiersin.org/articles/10.3389/fmicb.2019.02791/full.

### **Chapter Two**

- P. 58. Butterflies from the Lycaenidae family sometimes "cheat" their mutualist ant partners. Naomi E. Pierce et al., "The Ecology and Evolution of Ant Association in the Lycanidae (Lepidoptera)," *Annual Review of Entomology* 47 ( January 2002): 733–71, <a href="https://www.annualreviews.org/doi/abs/10.1146/annurev.ento.47.091201.145257?journalCode=e">https://www.annualreviews.org/doi/abs/10.1146/annurev.ento.47.091201.145257?journalCode=e</a> nto.
- P. 60. Some orchid varieties "cheat" pollinators. M. Shrestha et al., "Rewardlessness in Orchids: How Frequent and How Rewardless?," *Plant Biology* 22, no. 4 (March 17, 2020): 555–61, <a href="https://onlinelibrary.wiley.com/doi/10.1111/plb.13113">https://onlinelibrary.wiley.com/doi/10.1111/plb.13113</a>; Giovanni Scopece et al., "Pollination Efficiency and the Evolution of Specialized Deceptive Pollination Systems," *The American Naturalist* 175, no. 1 (January 2010), <a href="https://www.journals.uchicago.edu/doi/10.1086/648555">https://www.journals.uchicago.edu/doi/10.1086/648555</a>.
- P. 63. The nitrogen-fixing mutualism between leguminous plants and bacteria has been around for some sixty million years. Rocky Putra et al., "Overlooked Interactions between the Leguminous Plant and Silicon: Concepts, Contexts and Consequences," EGU General Assembly 2021, online, April 19–30, 2021, <a href="https://meetingorganizer.copernicus.org/EGU21/EGU21-13562.html?reply">https://meetingorganizer.copernicus.org/EGU21/EGU21-13562.html?reply</a>.
- P. 68. The fortunes of ordinary people plummeted after the Industrial Revolution. Clark Nardinelli, "Industrial Revolution and the Standard of Living," *Econlib Encyclopedia*, <a href="https://www.econlib.org/library/Enc/IndustrialRevolutionandtheStandardofLiving.html">https://www.econlib.org/library/Enc/IndustrialRevolutionandtheStandardofLiving.html</a>.
- P. 68. Thomas Malthus, *An Essay on the Principle of Population* (London: J. Johnson, in St. Paul's Church-yard, 1798), accessed online at Econlib Books, <a href="https://www.econlib.org/library/Malthus/malPop.html">https://www.econlib.org/library/Malthus/malPop.html</a>.
- Pp. 68 and 69. Nineteenth-century philosopher Herbert Spencer coined the term *survival of the fittest* after reading Darwin. Herbert Spencer, "Andrew Carnegie: The Richest Man in the World," *PBS American Experience*,

https://www.pbs.org/wgbh/americanexperience/features/carnegie-herbert-spencer/; https://www.britannica.com/science/survival-of-the-fittest.

- Pp. 68 and 69. Malthus's influence on Charles Darwin. *PBS Evolution*, "Darwin and Malthus, <a href="https://www.pbs.org/wgbh/evolution/library/02/5/l\_025\_01.html">https://www.pbs.org/wgbh/evolution/library/02/5/l\_025\_01.html</a>; University of California at Berkeley Museum of Paleontology, "Thomas Malthus (1766–1834)," <a href="https://ucmp.berkeley.edu/history/malthus.html">https://ucmp.berkeley.edu/history/malthus.html</a>; *PBS Evolution*, Excerpt from Charles Darwin, *The Autobiography of Charles Darwin*, pp. 119–121, <a href="https://www.pbs.org/wgbh/evolution/educators/course/session2/explain\_c\_pop1.html">https://www.pbs.org/wgbh/evolution/educators/course/session2/explain\_c\_pop1.html</a>.
- P. 69. David Graeber, "What's the Point If We Can't Have Fun?," *The Baffler*, January 2014, https://thebaffler.com/salvos/whats-the-point-if-we-cant-have-fun.
- P. 73. Peter Kropotkin, *Memoirs of a Revolutionist* (Boston and New York: Houghton Mifflin, 1899), <a href="https://theanarchistlibrary.org/library/petr-kropotkin-memoirs-of-a-revolutionist">https://theanarchistlibrary.org/library/petr-kropotkin-memoirs-of-a-revolutionist</a>.
- P. 77. Peter Kropotkin, *Mutual Aid: A Factor of Evolution*, 1902, <a href="https://theanarchistlibrary.org/library/petr-kropotkin-mutual-aid-a-factor-of-evolution.">https://theanarchistlibrary.org/library/petr-kropotkin-mutual-aid-a-factor-of-evolution.</a>
- P. 88. An appraisal of Richard Dawkins's *The Selfish Gene* on the thirtieth anniversary of its publication. Dan Sperber, "Evolution of the Selfish Gene," *Nature* 441 (2006): 151–52, <a href="https://www.nature.com/articles/441151a">https://www.nature.com/articles/441151a</a>.
- P. 89. An appraisal of Richard Dawkins's *The Selfish Gene* on the fortieth anniversary of its publication. Adam Rutherford, "'As Long As We Study Life, It Will Be Read': the Selfish Gene Turns 40," *Guardian*, May 2016, <a href="https://www.theguardian.com/science/2016/may/29/selfish-gene-40-years-richard-dawkins-doideas-stand-up-adam-rutherford">https://www.theguardian.com/science/2016/may/29/selfish-gene-40-years-richard-dawkins-doideas-stand-up-adam-rutherford</a>.
- P. 93. Lynn Margulis's obituary. Bruce Weber, "Lynn Margulis, Evolution Theorist, Dies at 73," *New York Times*, November 2011, <a href="https://www.nytimes.com/2011/11/25/science/lynn-margulis-trailblazing-theorist-on-evolution-dies-at-73.html">https://www.nytimes.com/2011/11/25/science/lynn-margulis-trailblazing-theorist-on-evolution-dies-at-73.html</a>.
- P. 95. Paper by Lynn Margulis (then going by the name Lynn Sagan) arguing that multicellular organisms arose via symbiosis. "On the Origin of Mitosing Cells," *Journal of Theoretical Biology* 14, no. 3 (March 1967): 255–74, <a href="https://pubmed.ncbi.nlm.nih.gov/11541392/">https://pubmed.ncbi.nlm.nih.gov/11541392/</a>.
- P. 95. An appraisal of Lynn Margulis's career. Andrew H. Knoll, "Lynn Margulis, 1938–2011," in *Proceedings of the National Academy of Sciences of the United States of America* 109, no. 4 (January 20, 2012): 1022, <a href="https://www.pnas.org/content/109/4/1022">https://www.pnas.org/content/109/4/1022</a>.
- P. 96. Kelly Clancy, "Survival of the Friendliest," *Nautilus*, March 17, 2017, https://nautil.us/issue/46/balance/survival-of-the-friendliest.
- P. 98. Relaxed selection among cyanobacteria. Elizabeth Pennisi, "Meet the Obscure Microbe That Influences Climate, Ocean Ecosystems, and Perhaps Even Evolution," *Nature*, March 9, 2017, <a href="https://www.sciencemag.org/news/2017/03/meet-obscure-microbe-influences-climate-ocean-ecosystems-and-perhaps-even-evolution.">https://www.sciencemag.org/news/2017/03/meet-obscure-microbe-influences-climate-ocean-ecosystems-and-perhaps-even-evolution.</a>

- P. 98. The Black Queen hypothesis. Michael Marshall, "Black Queen Tells Microbes to Be Lazy," *New Scientist*, March 27, 2012, <a href="https://www.newscientist.com/article/dn21629-black-queen-tells-microbes-to-be-lazy/">https://www.newscientist.com/article/dn21629-black-queen-tells-microbes-to-be-lazy/</a>.
- P. 99. The Red Queen hypothesis. Claire Benjamin, "Classic Lewis Carroll Character Inspires New Ecological Model," *Illinois IGB*, July 30, 2014, <a href="https://www.igb.illinois.edu/article/classic-lewis-carroll-character-inspires-new-ecological-model">https://www.igb.illinois.edu/article/classic-lewis-carroll-character-inspires-new-ecological-model</a>.

### **Chapter Three**

- P. 102. "Manuscript with Typed Notes for World Flight," Amelia Earhart Papers, George Palmer Putnam Collection, Purdue University, <a href="https://earchives.lib.purdue.edu/digital/collection/earhart/id/2348">https://earchives.lib.purdue.edu/digital/collection/earhart/id/2348</a>.
- P. 103. Use of the "sky hook" to collect atmospheric microbial samples. Ann M. Womack et al., "Biodiversity and Biogeography of the Atmosphere," *Philosophical Transactions of the Royal Society of London* 365, no. 1558 (November 27, 2010): 3645–53, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2982008/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2982008/</a>.
- P. 104. In the late 1600s, people were fascinated by discoveries of living things too small for the human eye to see. Nick Lane, "The Unseen World: Reflections on Leeuwenhoek (1677) 'Concerning Little Animals'," *Philosophical transactions of the Royal Society B*, April 19, 2015, <a href="https://royalsocietypublishing.org/doi/10.1098/rstb.2014.0344">https://royalsocietypublishing.org/doi/10.1098/rstb.2014.0344</a>.
- P. 106. German microbiologist Robert Koch discovered that a bacterium was connected to anthrax in cattle. Steve M. Blevins and Michael S. Bronze, "Robert Koch and the 'Golden Age' of Bacteriology," *International Journal of Infectious Diseases* 14, no. 9 (September 2010): e744–e751, https://www.sciencedirect.com/science/article/pii/S1201971210023143.
- P. 106. Louis Pasteur was fascinated by airborne microorganisms. Fred C. Meier and Charles A Lindbergh, "Collecting Micro-Organisms from the Arctic Atmosphere: With Field Notes and Material," *Scientific Monthly* 40, no. 1 (January 1935): 5–20, <a href="https://www.jstor.org/stable/15761?seq=1.">https://www.jstor.org/stable/15761?seq=1.</a>
- P. 107. Microbes live in thermal vents. Sara Mynott, "Hot Stuff! Life on a Hydrothermal Vent," *Scitable* by *Nature*, June 25, 2013, <a href="https://www.nature.com/scitable/blog/saltwater-science/hot\_stuff\_life\_on\_a.">https://www.nature.com/scitable/blog/saltwater-science/hot\_stuff\_life\_on\_a.</a>
- P. 107. Microbes live in sulfuric ponds. Abdelaziz Belila et al., "Sulfur Bacteria in Wastewater Stabilization Ponds Periodically Affected by the 'Red-Water' Phenomenon," *Applied Microbiology and Biotechnology* 97, no. 1 (February 23, 2012): 379–94, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3536956/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3536956/</a>.
- P. 107. Microbes live in ice sheets. Catherine Jex, "Bacteria Thrive on Methane Deep beneath the Antarctic Ice Sheet," *ScienceNordic*, August 2017, <a href="https://sciencenordic.com/animals-and-">https://sciencenordic.com/animals-and-</a>

plants-climate-denmark/bacteria-thrive-on-methane-deep-beneath-the-antarctic-ice-sheet/1448111.

- P. 107. Microbes live at the bottom of the ocean. Elizabeth Pennisi, "Scientists Pull Living Microbes, Possibly 100 Million Years Old, from beneath the Sea," *Science*, July 28, 2020, <a href="https://www.sciencemag.org/news/2020/07/scientists-pull-living-microbes-100-million-years-beneath-sea">https://www.sciencemag.org/news/2020/07/scientists-pull-living-microbes-100-million-years-beneath-sea</a>.
- P. 111. Carl Woese revolutionized biology by introducing a new way to classify organisms. "The Scientist Who Scrambled Darwin's Tree of Life," *New York Times Magazine*, August 2018,

https://www.nytimes.com/2018/08/13/magazine/evolution-gene-microbiology.html.

- P. 112. Many many microbes. Nicholas Bakalar, "Earth May Be Home to a Trillion Species of Microbes," *New York Times*, May 23, 2016, <a href="https://www.nytimes.com/2016/05/24/science/one-trillion-microbes-on-earth.html">https://www.nytimes.com/2016/05/24/science/one-trillion-microbes-on-earth.html</a>.
- P. 120.— Many many viruses. Jim Robbins, "Trillions upon Trillions of Viruses Fall from the Sky Each Day," New York Times, April 13, 2008, https://www.nytimes.com/2018/04/13/science/virosphere-evolution.html.
- P. 120. Most viral infections are not harmful, and sometimes they add valuable DNA to their hosts. Rafi Leztzer, "An Ancient Virus May Be Responsible for Human Consciousness," *Live Science*, February 2, 2018, <a href="https://www.livescience.com/61627-ancient-virus-brain.html">https://www.livescience.com/61627-ancient-virus-brain.html</a>.
- P. 120. Placentas in mammals developed from an ancient viral infection. Carrie Arnold, "The Viruses That Make Us Human," *Nova*, September 28, 2016, <a href="https://www.pbs.org/wgbh/nova/article/endogenous-retroviruses/">https://www.pbs.org/wgbh/nova/article/endogenous-retroviruses/</a>.
- P. 123. Our gut microbiota are dynamic and essential. Alessia Visconti et al., "Interplay Between the Human Gut Microbiome and Host Metabolism," *Nature Communications*, October 23, 2019, https://www.nature.com/articles/s41467-019-12476-z.
- P. 125. The skin microbiota helps with healing. Marjana Tomic-Canic, "Skin Microbiota and Its Interplay with Wound Healing," *American Journal of Clinical Dermatology* 21 (September 2020): 36–43, https://link.springer.com/article/10.1007/s40257-020-00536-w.
- P. 126. Estimating the bounty of our microbiota. Ron Sender et al., "Revised Estimates for the Number of Human and Bacteria Cells in the Body," *PLOS Biology*, August 19, 2016, https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1002533.
- P. 126. How large is the human gut? Herbert F. Helander and Lars Fändriks, "Surface Area of the Digestive Tract–Revisited," *Scandinavian Journal of Gastroenterology* 49, no. 6 (June 2014): 681–9, <a href="https://pubmed.ncbi.nlm.nih.gov/24694282/">https://pubmed.ncbi.nlm.nih.gov/24694282/</a>.

- P. 126. Babies get their first dose of microbes during birth. Sarah DeWeerdt, "How Baby's First Microbes Could Be Crucial to Future Health," *Nature*, March 2018, <a href="https://www.nature.com/articles/d41586-018-02480-6">https://www.nature.com/articles/d41586-018-02480-6</a>.
- P. 128. Breast milk nourishes the infant microbiota. Ed Yong, "How Breast Milk Engineers a Baby's Gut (and Gut Microbes), *National Geographic*, February 2014, <a href="https://www.nationalgeographic.com/science/article/how-breast-milk-engineers-a-babys-gut-and-gut-microbes">https://www.nationalgeographic.com/science/article/how-breast-milk-engineers-a-babys-gut-and-gut-microbes</a>; Lieke W. J. van den Elsen, "Shaping the Gut Microbiota by Breastfeeding: The Gateway to Allergy Prevention?," *Frontiers in Pediatrics*, February 2019, <a href="https://www.frontiersin.org/articles/10.3389/fped.2019.00047/full.">https://www.frontiersin.org/articles/10.3389/fped.2019.00047/full.</a>
- P. 128. A child's gut microbiome stabilizes by the age of three. Ashley York, "Microbiota Succession in Early Life," *Nature*, June 17, 2019, <a href="https://www.nature.com/articles/d42859-019-00010-6">https://www.nature.com/articles/d42859-019-00010-6</a>.
- P. 128. The contents of our microbiota shift constantly. Georg K. Gerber, "The Dynamic Microbiome," *Federation of European Biochemical Societies Letters* 588, no. 22 (November 17, 2014): 4131–39,
- https://www.sciencedirect.com/science/article/pii/S0014579314001574#:~:text=While%20our%20genomes%20are%20essentially,%2C%20illnesses%2C%20and%20medical%20treatments.
- P. 128. Some microbes in our gut exude byproducts that support other members of the gut microbiota. Mari C. W. Myhrstad et al., "Dietary Fiber, Gut Microbiota, and Metabolic Regulation—Current Status in Human Randomized Trials," *Nutrients* 12, no. 3 (March 2020): 859, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7146107/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7146107/</a>.
- P. 129. There is a cascade of bad reactions when we eat simple sugars. Reetta Satokari, "High Intake of Sugar and the Balance between Pro- and Anti-Inflammatory Gut Bacteria," *Nutrients* 12, no. 5 (May 2020): 1348, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7284805/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7284805/</a>; Dina Fine Maron, "Sweet 'n Sour: A Common Sugar May Help Pathogens Conquer the Human Gut," *Scientific American*, June 26, 2013, <a href="https://www.scientificamerican.com/article/sweet-n-sour-common-sugar/">https://www.scientificamerican.com/article/sweet-n-sour-common-sugar/</a>.
- P. 130 A slew of physical ills are tied to disturbances and lack of diversity in the gut microbiota. Chen Song et al., "Simulated Spatial Radiation Impacts Learning and Memory Ability with Alterations of Neuromorphology and Gut Microbiota in Mice," *RSC Advances* 27, 2020, <a href="https://pubs.rsc.org/en/content/articlelanding/2020/ra/d0ra01017k#!divAbstract">https://pubs.rsc.org/en/content/articlelanding/2020/ra/d0ra01017k#!divAbstract</a>; Juliana Durack and Susan V. Lynch, "The Gut Microbiome: Relationships with Disease and Opportunities for Therapy," *Journal of Experimental Medicine* 216, no. 1 (January 2019): 20–40, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6314516/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6314516/</a>; Elizabeth Svoboda, "Could the Gut Microbiome Be Linked to Autism?," *Nature*, January 29, 2020, <a href="https://www.nature.com/articles/d41586-020-00198-y">https://www.nature.com/articles/d41586-020-00198-y</a>.
- P. 132. The average person in industrialized societies spends 90 percent of their time indoors. United State Environmental Protection Agency, "What Are the Trends in Indoor Air Quality and Their Effects on Human Health?", <a href="https://www.epa.gov/report-environment/indoor-air-quality">https://www.epa.gov/report-environment/indoor-air-quality</a>.

- P. 132. Dogs' impact on the human microbiota. Ashley E. Kates et al., "Household Pet Ownership and the Microbial Diversity of the Human Gut Microbiota," *Frontiers in Cellular and Infection Microbiology*, no. 10 (February 28, 2020): 73, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7058978">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7058978</a>.
- P. 132. Comparing the microbiota of people eating a modern Western diet to that of people eating traditional diets. Carlotta De Filippo et al., "Impact of Diet in Shaping Gut Microbiota Revealed by a Comparative Study in Children from Europe and Rural Africa," in *Proceedings of the National Academy of Sciences of the United States of America* 107, no. 33 (August 2, 2010): 14691–96, <a href="https://www.pnas.org/content/107/33/14691">https://www.pnas.org/content/107/33/14691</a>.
- P. 135. The population of pore-forming bacteria fluctuates in the human gut. Hilary P. Browne et al., "Culturing of 'Unculturable' Human Microbiota Reveals Novel Taxa and Extensive Sporulation," *Nature* 553 (May 2016): 543–6, <a href="https://www.nature.com/articles/nature17645">https://www.nature.com/articles/nature17645</a>.
- P. 136. Changes in diet and proximity to nature can effect changes in the microbiota. Kelly V. Ruggles et al., "Changes in the Gut Microbiota of Urban Subjects during an Immersion in the Traditional Diet and Lifestyle of a Rainforest Village," *mSphere* 3, no. 4 (August 29, 2018), <a href="https://pubmed.ncbi.nlm.nih.gov/30158281/">https://pubmed.ncbi.nlm.nih.gov/30158281/</a>; Marja I. Roslund et al., "Biodiversity Intervention Enhances Immune Regulation and Health-Associated Commensal Microbiota among Daycare Children," *Science Advances* 6, no. 42 (October 14, 2020), <a href="https://www.science.org/doi/10.1126/sciadv.aba2578">https://www.science.org/doi/10.1126/sciadv.aba2578</a>.
- P. 137. The healthfulness of being out in nature may stem from encountering more diverse microbial life. Graham A. Rook, "Regulation of the Immune System by Biodiversity from the Natural Environment: An Ecosystem Service Essential to Health," in *Proceedings of the National Academy of Sciences of the United States of America* 110, no. 46 (November 12, 2013): 18360–7, <a href="https://pubmed.ncbi.nlm.nih.gov/24154724/">https://pubmed.ncbi.nlm.nih.gov/24154724/</a>.
- P. 139. Some bacteria have a healthful impact even when they just pass through our guts. Victoria C. Adams et al., "*Mycobacterium vaccae* Induces a Population of Pulmonary CD11c Cells with Regulatory Potential in Allergic Mice," *European Journal of Immunology* 34, no. 3 (February 25, 2004): 631–8, <a href="https://onlinelibrary.wiley.com/doi/full/10.1002/eji.200324659">https://onlinelibrary.wiley.com/doi/full/10.1002/eji.200324659</a>.
- P. 140. The elderly lose microbial diversity in their guts when they move into long-term care. John P. Haran et al., "The Nursing Home Elder Microbiome Stability and Associations with Age, Frailty, Nutrition and Physical Location," *Journal of Medical Microbiology* 67, no. 1 (January 2018): 40–51, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5884962/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5884962/</a>.

#### **Chapter Four**

P. 145. – Tracking the health of Lahontan cutthroat trout: Western Native Trout Initiative, <a href="https://westernnativetrout.org/lahontan-cutthroat-trout/">https://westernnativetrout.org/lahontan-cutthroat-trout/</a>.

- P. 151. The memoir, "A Long Dust on the Desert," by Carolyn Dufurrena, includes memories from the nineteenth century of now-desiccated Nevada with full creeks. *Range*, Spring 2020, <a href="http://rangemagazine.com/features/spring-20/range-sp20-long">http://rangemagazine.com/features/spring-20/range-sp20-long</a> dust on desert.pdf.
- P. 154. Tamzen Donner of the ill-fated Donner Party wrote of "botanizing" along creeks. C. F. McGlashan, *A History of the Donner Party* (San Francisco and Reno: A. Carlisle & Co., 1922), <a href="http://www.books-about-california.com/Pages/History">http://www.books-about-california.com/Pages/History</a> of Donner Party/Donner Party chapter 02.html.
- P. 157. After field observations, Allan Savory had an epiphany that well-managed cattle could have a positive impact on the land. C. J. Hadley, "The Wild Life of Allan Savory," *Range*, Fall 1999, http://www.rangemagazine.com/archives/stories/fall99/allan savory.htm.
- P. 159. In one study, cattle grazing maintained open water in creeks, to the benefit of native fish. Astrid Kodric-Brown and James H. Brown, "Native Fishes, Exotic Mammals, and the Conservation of Desert Springs," *Frontiers in Ecology and the Environment*, December 1, 2007, <a href="https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/070002.">https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/070002.</a>
- P. 159. The Bureau of Land Management changed grazing practices near an Oregon stream, with positive watershed impact. Wayne Elmore, "Twenty-One Years—The Ever-Changing Tale of Oregon's Bear Creek," *Range*, October 1998, <a href="http://www.rangemagazine.com/archives/stories/spring98/stories">http://www.rangemagazine.com/archives/stories/spring98/stories</a> 21 years.htm.
- P. 163. The Hudson Bay Company sanctioned beaver extermination to create a "fur desert" to thwart rival trading companies. Jennifer Susan Ott, "Clearing the Country: A History of the Hudson Bay Company's Fur Desert Policy" (master's thesis, University of Montana, 1997), <a href="https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=2828&context=etd.">https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=2828&context=etd.</a>
- P. 167. Rancher Cliven Bundy has had a long-running conflict with federal agencies. Christi Turner, "Timeline: The BLM vs. Cliven Bundy," *High Country News*, May 12, 2014, <a href="https://www.hcn.org/issues/46.8/the-blm-vs-cliven-bundy-timeline/">https://www.hcn.org/issues/46.8/the-blm-vs-cliven-bundy-timeline/</a>.
- P. 168. Cliven Bundy's interview with CNN: interview by Bill Weir, *CNN Politics*, April 25, 2014, <a href="https://www.cnn.com/videos/politics/2014/04/25/cnn-tonight-intv-bundy-federal-government.cnn">https://www.cnn.com/videos/politics/2014/04/25/cnn-tonight-intv-bundy-federal-government.cnn</a>.
- P. 168. The federal government's case against the Bundys is dismissed in 2018 and loses its appeal in 2020. Ken Ritter, "US Appeals Court Denies Bid to Resurrect Bundy Standoff Case," *AP News*, August 6, 2020, <a href="https://apnews.com/article/u-s-news-cliven-bundy-trials-jay-bybee-las-vegas-1a387febe5c80da2dcdcf307f22cc9b0">https://apnews.com/article/u-s-news-cliven-bundy-trials-jay-bybee-las-vegas-1a387febe5c80da2dcdcf307f22cc9b0</a>.
- P. 168. The Bundys are still grazing cattle on public land without paying to do so. Jennifer Yachnin, "Bundy to Biden: Stay Away from My Cattle," *Politico Greenwire*, January 15, 2021, <a href="https://www.eenews.net/stories/1063722595">https://www.eenews.net/stories/1063722595</a>.

- P. 171. Agee and Vicki Smith work with government agencies to manage their cattle differently. Mike Cothern, "A Respite in the Wilderness: Nevada's Cottonwood Ranch," *Magicvalley.com*, August 1, 2019, <a href="https://magicvalley.com/outdoors/a-respite-in-the-wilderness-nevadas-cottonwood-ranch/article\_16e62ca2-243f-57b0-a58f-9b40a1c8c246.html">https://magicvalley.com/outdoors/a-respite-in-the-wilderness-nevadas-cottonwood-ranch/article\_16e62ca2-243f-57b0-a58f-9b40a1c8c246.html</a>.
- P. 172. The Shoesole Resource Management Group. <a href="http://neecd.org/shoesole/">http://neecd.org/shoesole/</a>.
- P. 172. Former Forest Service forest supervisor Bob Chadwick offers lessons in collaboration and conflict resolution. "Managing Wholes: Beyond Conflict to Consensus: An Introductory Learning Manual," <a href="https://managingwholes.com/chadwick.htm/">https://managingwholes.com/finding-new-ground/</a>.
- P. 173. The Forest Service and the Bureau of Land Management build upon Chadwick's insights with consensus-building workshops. "BUILDING CONSENSUS & FINDING SHARED SOLUTIONS: For Implementation of the US Forest Service and Bureau of Land Management Sage-Grouse Plan Amendments," Workshop Report, November 29–December 1, 2016,

 $\underline{https://sagebrusheco.nv.gov/uploadedfiles/sagebrusheconvgov/content/About/nccn\_workshop\_re\_port.pdf.}$ 

P. 176. – Shoesole's model of rancher-agency-scientist consensus inspires the Stewardship Alliance of Northeast Elko. Robin Boies, "Confessions of a Collaborator: Shoesole and Stewardship Alliance of Elko, Northeast Elko County, Nevada," *Human-Wildlife Interactions* 11, no. 3 (Winter 2017): 327–38,

https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1407&context=hwi.

### **Chapter Five**

- P. 180. Rodale Institute white paper on regenerative organic agriculture. "Regenerative Organic Agriculture and Climate Change: A Down-to-Earth Solution to Global Warming," <a href="https://rodaleinstitute.org/wp-content/uploads/rodale-white-paper.pdf">https://rodaleinstitute.org/wp-content/uploads/rodale-white-paper.pdf</a>.
- P. 180. Corn is America's largest crop, with nearly 92 million acres under cultivation. Thomas Capehart and Susan Proper, "Corn Is America's Largest Crop in 2019," US Department of Agriculture, July 29, 2021, <a href="https://www.usda.gov/media/blog/2019/07/29/corn-americas-largest-crop-2019">https://www.usda.gov/media/blog/2019/07/29/corn-americas-largest-crop-2019</a>; Jonathan Foley, "It's Time to Rethink America's Corn System," *Scientific American*, March 5, 2013, <a href="https://www.scientificamerican.com/article/time-to-rethink-corn/">https://www.scientificamerican.com/article/time-to-rethink-corn/</a>.
- P. 182. Entomologist Jonathan Lundgren left an initially promising career at the US Department of Agriculture to become an independent scientist working directly with farmers after friction with the agency. Steve Volk, "Was a USDA Scientist Muzzled Because of His Bee Research?," *Washington Post Magazine*, March 3, 2016, <a href="https://www.washingtonpost.com/lifestyle/magazine/was-a-usda-scientist-muzzled-because-of-was-a-usda-scientist-was-a-usda-scientis

his-bee-research/2016/03/02/462720b6-c9fb-11e5-a7b2-5a2f824b02c9 story.html.

- P. 183. Research shows neonicotinoid-coated seeds provide little benefit to farmers. Spyridon Mourtzinis et al., "Neonicotinoid Seed Treatments of Soybean Provide Negligible Benefits to US Farmers," *Scientific Reports* 9, September 2019, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6733863/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6733863/</a>.
- P. 184. American farmers spend millions on pesticides fighting the corn rootworm. Ian Berry, "Pesticides Make a Comeback," *Wall Street Journal*, May 21, 2013, https://www.wsj.com/articles/SB10001424127887323463704578496923254944066.
- P. 186. Lundgren's 2012 paper shows that neonicotinoid pesticides don't help farmers increase yields. M. P. Seagraves and Jonathan Lundgren, "Effects of Neonicitinoid Seed Treatments on Soybean Aphid and Its Natural Enemies," USDA Agricultural Research Service, *Journal of Pest Science* 85, no. 1 (July 1, 2011): 125–32, https://www.ars.usda.gov/research/publications/publication/?seqNo115=268542.
- P. 186. Lundgren's 2015 paper shows that neonicotinoid pesticides harm monarch butterflies. Jacob R. Pecenka and Jonathan Lundgren, "Non-Target Effects of Clothianidin on Monarch Butterflies," *Naturwissenschaften* 102, no. 3-4 (April 2015): 19, <a href="https://pubmed.ncbi.nlm.nih.gov/25839080/">https://pubmed.ncbi.nlm.nih.gov/25839080/</a>.
- P. 186. Lundgren files a scientific integrity report with the US Department of Agriculture, alleging that his work and communication with the media were being disrupted, and later, a whistleblower suit arguing that he was being unfairly disciplined to suppress his science. Volk, "Was a USDA scientist muzzled," <a href="https://www.washingtonpost.com/lifestyle/magazine/was-a-usda-scientist-muzzled-because-of-his-bee-research/2016/03/02/462720b6-c9fb-11e5-a7b2-5a2f824b02c9">https://www.washingtonpost.com/lifestyle/magazine/was-a-usda-scientist-muzzled-because-of-his-bee-research/2016/03/02/462720b6-c9fb-11e5-a7b2-5a2f824b02c9</a> story.html.
- P. 190. There are more than 4½ billion acres (1.87 billion hectares) of croplands around the world. US Geological Survey, "New Map of Worldwide Croplands Supports Food and Water Security," <a href="https://www.usgs.gov/news/new-map-worldwide-croplands-supports-food-and-water-security">https://www.usgs.gov/news/new-map-worldwide-croplands-supports-food-and-water-security</a>.
- P. 190. For every pound of corn harvested in Iowa, more than a pound of topsoil is lost; for every pound of soybeans, two to three pounds of topsoil are lost. Didi Pershouse, "Why Communities Should Invest in Regenerative Agriculture and the Soil Sponge," *Medium*, April 2, 2019, <a href="https://didipershouse.medium.com/why-communities-should-invest-in-regenerative-agriculture-and-the-soil-sponge-431c27c8b34b">https://didipershouse.medium.com/why-communities-should-invest-in-regenerative-agriculture-and-the-soil-sponge-431c27c8b34b</a>; Brian Gelder et al., "The Daily Erosion Project—Daily Estimates of Water Runoff, Soil Detachment, and Erosion," *Earth Surface Properties and Landforms* 43, no. 5 (November 18, 2017): 1105–17, <a href="https://onlinelibrary.wiley.com/doi/full/10.1002/esp.4286">https://onlinelibrary.wiley.com/doi/full/10.1002/esp.4286</a>.
- P. 191. Chemical fertilizers poison our waters by altering the balance of microbial life there: nitrogen pouring into the Gulf of Mexico prompts the growth of algae, which suck oxygen from the water, causing a massive dead zone for fish and other living things. US Environmental Protection Agency, "The Effects: Dead Zones and Harmful Algal Blooms," <a href="https://www.epa.gov/nutrientpollution/effects-dead-zones-and-harmful-algal-blooms">https://www.epa.gov/nutrientpollution/effects-dead-zones-and-harmful-algal-blooms</a>.

- P. 191. Phosphorus and nitrogen from chemical fertilizers pour into Lake Erie prompting the growth of cyanobacteria, which squirt toxins into the drinking water. Alexandra Sifferlin, "Toledo's Contaminated Water: Here's What Went Wrong," *Time*, August 4, 2014, <a href="https://time.com/3079516/toledos-contaminated-water-heres-what-went-wrong/">https://time.com/3079516/toledos-contaminated-water-heres-what-went-wrong/</a>.
- P. 191. The total annual cost of erosion from agriculture in the United States is about \$44 billion per year. Dede Sulaeman and Thomas Westhoff, "The Causes and Effects of Soil Erosion and How to Prevent It," World Resources Institute *Insights*, February 7, 2020, <a href="https://www.wri.org/insights/causes-and-effects-soil-erosion-and-how-prevent-it">https://www.wri.org/insights/causes-and-effects-soil-erosion-and-how-prevent-it</a>.
- P. 191. On a global scale, the annual loss of *75 billion tons of topsoil* costs the world about \$400 billion per year. Asmeret Asefaw Berhe, "Mechanisms of Soil Organic Matter Stabilization in Eroding Landscapes," Natural Resource Conservation Services, <a href="https://www.nrcs.usda.gov/Internet/FSE\_DOCUMENTS/nrcs142p2\_050812.pdf">https://www.nrcs.usda.gov/Internet/FSE\_DOCUMENTS/nrcs142p2\_050812.pdf</a>.
- P. 194. According to a 2018 report in the *Proceedings of the National Academy of Sciences*, agricultural land has lost 113 billion tons of carbon, with the most dramatic losses occurring in the last 200 years. Global Agriculture, "World's Soils Have Lost 133bn Tons of Carbon, New Research Shows," August 29, 2017, <a href="https://www.globalagriculture.org/whats-new/news/en/32738.html">https://www.globalagriculture.org/whats-new/news/en/32738.html</a>; "Correction for Sanderman et al., Soil Carbon Debt of 12,000 Years of Human Land Use," in *Proceedings of the National Academy of Sciences of the United States of America* 115, no. 7 (February 5, 2018): E1700, <a href="https://www.pnas.org/content/115/7/E1700.">https://www.pnas.org/content/115/7/E1700.</a>
- P. 194. Even as degraded as the world's soils are, though, they still store some 3,000 billion metric tons of carbon, according to soil biochemist Asmeret Asefaw Berhe. Every year, 4.7 billion metric tons of carbon dioxide—half of what human activity releases into the atmosphere every year—are absorbed by soil, plants, and the seas, and most of it sticks in the soil. "A Climate Change Solution That's Right under Our Feet," *TED Talk 2019*, <a href="https://www.ted.com/talks/asmeret\_asefaw\_berhe\_a\_climate\_change\_solution\_that\_s\_right\_under our\_feet?language=en#t-591133.">https://www.ted.com/talks/asmeret\_asefaw\_berhe\_a\_climate\_change\_solution\_that\_s\_right\_under our\_feet?language=en#t-591133.</a>
- P. 195. According to some estimates, 70 percent of the developing world's food is actually produced by small farmers, not megafarms. Vincent Ricciardi et al., "How Much of the World's Food Do Smallholder Produce?" *Global Food Security* 17 (June 2018): 64–72, <a href="https://www.sciencedirect.com/science/article/pii//S2211912417301293#:~:text=It%20has%20been%20widely%20reported,food%20crops%20than%20larger%20farms%20.">https://www.sciencedirect.com/science/article/pii//S2211912417301293#:~:text=It%20has%20been%20widely%20reported,food%20crops%20than%20larger%20farms%20.</a>
- P. 200. Crop rotation was a practice encouraged in the early 1900s by African American scientist George Washington Carver, who wanted to help poor farmers overcome the debilitating effect of cotton plantation monocultures. Peter Duncan Burchard, "George Washington Carver: For His Time and Ours," National Park Service Special History Study, 2005, <a href="https://www.nps.gov/gwca/learn/management/upload/GWC-For-His-Time-Ours-Spec-History-Study.pdf">https://www.nps.gov/gwca/learn/management/upload/GWC-For-His-Time-Ours-Spec-History-Study.pdf</a>.

- P. 200. During the Nixon administration, government started pushing farmers into industrial-style production: Tom Philpott, "A Reflection on the Lasting Legacy of 1970s USDA Secretary Earl Butz," *Grist*, February 8, 2008, https://grist.org/article/the-butz-stops-here/.
- P. 200. Carver also urged the planting of cover crops, including the nitrogen-boosting peanut. Phil Edwards, "George Washington Carver Cared about Sustainable Farming Before It Was Cool," *Vox*, July 13, 2015, <a href="https://www.vox.com/2015/7/13/8948477/george-washington-carver.">https://www.vox.com/2015/7/13/8948477/george-washington-carver.</a>
- P. 200. The physical disturbance of tillage damages the communities of mycorrhizal fungi that support and connect plant communities. Xingli Lu et al., "Effect of Tillage Treatment on the Diversity of Soil Arbuscular Mycorrhizal Fungal and Soil Aggregate-Associated Carbon Content," *Frontiers in Microbiology*, December 6, 2018, <a href="https://www.frontiersin.org/articles/10.3389/fmicb.2018.02986/full#:~:text=In%20addition%2C%20tillage%20could%20change,1987%3B%20Kabir%2C%202005">https://www.frontiersin.org/articles/10.3389/fmicb.2020.01363/full</a>. Your et al., "Microbial Communities Associated with Long-Term Tillage and Fertility Treatments in a Corn-Soybean Cropping System," *Frontiers in Microbiology*, June 25, 2020, https://www.frontiersin.org/articles/10.3389/fmicb.2020.01363/full.
- P. 202. One of the many studies of the ubiquitous herbicide glyphosate (Roundup) showed that more than 90 percent of pregnant women in a small sample from Indiana had glyphosate in their urine and that higher concentrations were associated with earlier deliveries. S. Parvez et al., "Glyphosate Exposure in Pregnancy and Shortened Gestational Length: A Prospective Indiana Birth Cohort Study," *Environmental Health*, March 9, 2018, <a href="https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0367-0.">https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0367-0.</a>
- P. 202. When exposed to nitrogen fertilizer for a number of years, the bacteria that "fix" nitrogen undergo genetic changes that make them less beneficial for host plants. Dylan J. Weese et al., "Long-Term Nitrogen Addition Causes the Evolution of Less Cooperative Mutualists," *Evolution*, January 6, 2015, <a href="https://onlinelibrary.wiley.com/doi/full/10.1111/evo.12594">https://onlinelibrary.wiley.com/doi/full/10.1111/evo.12594</a>.
- P. 205. The year after the term *colony collapse disorder* was coined to describe the widespread death and decline of honeybees, Brett Adee lost 44 percent of his bees. Stephanie Strom, "A Bee Mogul Confronts the Crisis in His Field," *New York Times*, February 16, 2017, <a href="https://www.nytimes.com/2017/02/16/business/a-bee-mogul-confronts-the-crisis-in-his-field.html">https://www.nytimes.com/2017/02/16/business/a-bee-mogul-confronts-the-crisis-in-his-field.html</a>.
- P. 206. Bee scientists at Pennsylvania State University have found residue from more than one hundred pesticides in beehives. Jim Frazier et al., "Pesticides and Their Involvement in Colony Collapse Disorder," *Bee Health*, August 20, 2019, <a href="https://bee-health.extension.org/pesticides-and-their-involvement-in-colony-collapse-disorder/">https://bee-health.extension.org/pesticides-and-their-involvement-in-colony-collapse-disorder/</a>.
- P. 206. Bayer/Monsanto claims that glyphosate (Roundup) does not harm bees. Bayer Global, "Glyphosate's Role in Preserving the Environment and Biodiversity," <a href="https://www.bayer.com/en/glyphosate/glyphosate-environment-biodiversity">https://www.bayer.com/en/glyphosate/glyphosate-environment-biodiversity</a>.

- P. 206. The makers of glyphosate (Roundup) have long claimed that the herbicide does not harm animals, but recent research shows that it causes high mortality in bumblebees. Edward A. Straw et al., "Roundup Causes High Levels of Mortality Following Contact Exposure in Bumble Bees," *Journal of Applied Ecology* 58, no. 6 (April 6, 2021): 1167–76, https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.13867.
- P. 206. Glyphosate—the active ingredient in Roundup—targets an enzyme found only in plants and microorganisms, but that may impact the health of plants and animals (like humans) because they have a mutualistic relationship with microbiota. Lyydia Leino et al., "Classification of the Glyphosate Target Enzyme (5-enolpyruvylshikimate-3-phosphate Synthase) for Assessing Sensitivity of Organisms to the Herbicide," *Journal of Hazardous Materials*, April 2021, <a href="https://www.biorxiv.org/content/10.1101/2020.05.27.118265v1.full#:~:text=The%20biochemica/1%20target%20enzyme%20for,plants%20and%20fungi%207%2C8">https://www.biorxiv.org/content/10.1101/2020.05.27.118265v1.full#:~:text=The%20biochemica/1%20target%20enzyme%20for,plants%20and%20fungi%207%2C8</a>.
- P. 206. Brian Bienkowski, "Active Ingredient in Monsanto's Roundup Hurts Honey Bee Guts," *Environmental Health News*, September 25, 2018, <a href="https://www.ehn.org/monsanto-herbicide-roundup-hurts-bees-2607605097.html">https://www.ehn.org/monsanto-herbicide-roundup-hurts-bees-2607605097.html</a>; Erick V. S. Motta et al., "Glyphosate Perturbs the Gut Microbiota of Honey Bees," *Applied Biological Sciences* 115, no. 41 (September 24, 2018): 10305–10, <a href="https://www.pnas.org/content/115/41/10305.">https://www.pnas.org/content/115/41/10305.</a>
- P. 211. The benefits and caveats of integrating animals into regenerative agriculture. Virginia Gewin, "A New Study on Regenerative Grazing Complicates Climate Optimism," *Civil Eats*, January 6, 2021, <a href="https://civileats.com/2021/01/06/a-new-study-on-regenerative-grazing-complicates-climate-optimism/">https://civileats.com/2021/01/06/a-new-study-on-regenerative-grazing-complicates-climate-optimism/</a>.
- P. 211. Scientists have recently concluded that wild African landscapes like the Mara Serengeti were dramatically shaped by the work of ancient herders and their cattle, sheep, and goats, resulting in today's rich grasslands and wildlife hotspots. Washington University in St. Louis, "Ancient Livestock Dung Heaps Are Now African Wildlife Hotspots," *Newswise*, August 27, 2018, <a href="https://www.newswise.com/articles/ancient-livestock-dung-heaps-are-now-african-wildlife-hotspots?sc=dwhr&xy=5028860">https://www.newswise.com/articles/ancient-livestock-dung-heaps-are-now-african-wildlife-hotspots?sc=dwhr&xy=5028860</a>; Fiona Marshall et al., "Ancient Herders Enriched and Restructured African Grasslands," *Nature* 561 (August 29, 2018): 387–90, <a href="https://www.nature.com/articles/s41586-018-0456-9">https://www.nature.com/articles/s41586-018-0456-9</a>.
- P. 212. Claire LaCanne and Jonathan Lundgren's 2018 study comparing regenerative and conventional cornfields gave the imprimatur of science to the kind of success many regenerative farmers have reported for years. "Regenerative Agriculture: Merging Farming and Natural Resource Conservation Profitably," *PeerJ* 6, February 26, 2018, <a href="https://peerj.com/articles/4428/">https://peerj.com/articles/4428/</a>.
- P. 216. A study in Germany found that children who grew up on farms with animals had more robust immune systems compared to those who grew up in urban areas without pets. Till S. Böbel et al., "Less Immune Activation Following Social Stress in Rural vs. Urban Participants Raised with Regular or No Animal Contact, Respectively," in *Proceedings of the National Academy of Sciences of the United States of America* 115, no. 20 (April 30, 2018): 5259–64, <a href="https://www.pnas.org/doi/10.1073/pnas.1719866115">https://www.pnas.org/doi/10.1073/pnas.1719866115</a>.

- P. 217. Tommy Fenster's thesis on regenerative almond production. "Defining Regenerative Farm Systems & the Effects of Regenerative Almond Production Systems on Soil Health, Biodiversity, Almond Nutrition, and Profit" (master's thesis, California State University, East Bay, May 2021), <a href="https://scholarworks.calstate.edu/downloads/7d279016p">https://scholarworks.calstate.edu/downloads/7d279016p</a>.
- P. 220. Some seeds last in the soil for hundreds of years or more. Shen Miller, "A Little Green Shoot Sprouts from a Seed 1,288 Years Old," *New York Times*, November 19, 1995, <a href="https://www.nytimes.com/1995/11/19/us/a-little-green-shoot-sprouts-from-a-seed-1288-years-old.html">https://www.nytimes.com/1995/11/19/us/a-little-green-shoot-sprouts-from-a-seed-1288-years-old.html</a>.
- P. 225. The craftsmanship of seed saving has been gradually lost among the vast majority of the nation's farmers, as industry took control of this most basic and precious agricultural resource. Jack Kloppenburg, "Seeds, Sovereignty, and the Vía Campesina: Plants, Property, and the Promise of Open Source Biology" (paper prepared for the Workshop on Food Sovereignty: Theory, Praxis and Power, November 17–18, 2018), <a href="https://dces.wisc.edu/wp-content/uploads/sites/128/2013/08/2008-Seeds-and-Sovereignty.pdf">https://dces.wisc.edu/wp-content/uploads/sites/128/2013/08/2008-Seeds-and-Sovereignty.pdf</a>; Tove Danovich, "Gardening Is Important, but Seed Saving Is Crucial," *Civil Eats*, April 21, 2020, <a href="https://civileats.com/2020/04/21/gardening-is-important-but-seed-saving-is-crucial/">https://civileats.com/2020/04/21/gardening-is-important-but-seed-saving-is-crucial/</a>.
- P. 225. Over the millennia, farmers have created distinct varieties by selecting and breeding seeds found in open-pollinated fields. Jack Kloppenburg Jr. and Daniel Lee Kleinman, "Seed Wars: Common Heritage, Private Property, and Political Strategy," *The Socialist Review*, no. 95 (September/October 1987): 7–41, <a href="https://dces.wisc.edu/wp-content/uploads/sites/128/2013/08/1987-Seed-Wars.pdf">https://dces.wisc.edu/wp-content/uploads/sites/128/2013/08/1987-Seed-Wars.pdf</a>.
- P. 228. Four massive monopolies are estimated to control over 60 percent of the world's seeds. Philip H. Howard, "Global Seed Industry Changes Since 2013," December 31, 2018, <a href="https://philhoward.net/2018/12/31/global-seed-industry-changes-since-2013/">https://philhoward.net/2018/12/31/global-seed-industry-changes-since-2013/</a>.
- P. 228. Continuing concentration in the world's seed conglomerations. Katie O'Reilly, "Say Hello to Big Seed," *Sierra*, June 8, 2018, <a href="https://www.sierraclub.org/sierra/say-hello-big-seed-monsanto-bayer-merger">https://www.sierraclub.org/sierra/say-hello-big-seed-monsanto-bayer-merger</a>; Doug Gurian-Sherman, "Why Seed Company Mergers Matter in a Warming World," *Civil Eats*, January 21 2016, <a href="https://civileats.com/2016/01/21/why-seed-company-mergers-matter-in-a-warming-world-syngenta-monsanto/">https://civileats.com/2016/01/21/why-seed-company-mergers-matter-in-a-warming-world-syngenta-monsanto/</a>.
- P. 229. Farmers have a hard time finding older varieties of seeds that suit their needs; commodity farmers have a hard time finding seeds that are not GMO and/or are not coated with pesticides. Penn State, "Pesticide Seed Coatings Are Widespread but Underreported," *Science Daily*, March 17, 2020, <a href="https://www.sciencedaily.com/releases/2020/03/200317215632.htm">https://www.sciencedaily.com/releases/2020/03/200317215632.htm</a>.
- P. 229. The pesticides coating crop seeds can taint the nectar, pollen, and tissues of cover crops and leach into the water table. Larissa Walker and George Naylor, "Pesticide Seed Coatings: No Good for Farmers and Bees," *The Hill*, July 9, 2015, <a href="https://thehill.com/blogs/congress-blog/economy-budget/247292-pesticide-seed-coatings-no-good-for-farmers-and-bees/">https://thehill.com/blogs/congress-blog/economy-budget/247292-pesticide-seed-coatings-no-good-for-farmers-and-bees/</a>; Center for Food Safety, "Hidden Costs of Toxic Seed Coatings" (fact sheet, June 2015), <a href="https://www.centerforfoodsafety.org/files/neonic-factsheet">https://www.centerforfoodsafety.org/files/neonic-factsheet</a> 75083.pdf.

- P. 230. Like humans and every other complex organism, plants have a dynamic microbiota. Pankaj Trivedi et al., "Plant–Microbiome Interactions: From Community Assembly to Plant Health," *Nature Reviews Microbiology* 18 (August 2020): 607–21, <a href="https://www.nature.com/articles/s41579-020-0412-1">https://www.nature.com/articles/s41579-020-0412-1</a>.
- P. 230. Each plant's relationship with its microbial partners begins in the seed, which hosts a small population of microorganisms. Eric B. Nelson, "The Seed Microbiome: Origins, Interactions, and Impacts," *Plant and Soil* 422 (2018): 7–34, <a href="https://link.springer.com/article/10.1007/s11104-017-3289-7">https://link.springer.com/article/10.1007/s11104-017-3289-7</a>.
- P. 231. Even as corn has changed over centuries of domestication, modern varieties still seem to host the same core microbiota in their seeds. Vanessa L. Brisson et al., "Impacts of Maize Domestication and Breeding on Rhizosphere Microbial Community Recruitment from a Nutrient Depleted Agricultural Soil," *Scientific Reports* 9, October 2019, <a href="https://www.nature.com/articles/s41598-019-52148-y">https://www.nature.com/articles/s41598-019-52148-y</a>; A. Fox, "Corn's Ancestor Could Help It Go Green," *EOS*, January 4, 2018, <a href="https://eos.org/articles/corns-ancestor-could-help-it-go-green;">https://eos.org/articles/corns-ancestor-could-help-it-go-green;</a>; David Johnston-Monje and Manish N. Raizada, "Conservation and Diversity of Seed Associated Endophytes in *Zea* across Boundaries of Evolution, Ethnography and Ecology," *PLOS ONE*, June 3, 2011, <a href="https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0020396.">https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0020396.</a>
- P. 231. Microbes help growing plants in several ways. "Modern Tomatoes Can't Get Same Soil Microbe Boost as Ancient Ancestors," *Purdue University Agricultural News*, January 2021, <a href="https://www.purdue.edu/newsroom/releases/2021/Q1/modern-tomatoes-cant-get-same-soil-microbe-boost-as-ancient-ancestors.html">https://www.purdue.edu/newsroom/releases/2021/Q1/modern-tomatoes-cant-get-same-soil-microbe-boost-as-ancient-ancestors.html</a>; "How Soil Microbes Help Plants Resist Disease," <a href="https://agrilifetoday.tamu.edu/2020/04/06/how-soil-microbes-help-plants-resist-disease/">https://agrilifetoday.tamu.edu/2020/04/06/how-soil-microbes-help-plants-resist-disease/</a>.
- P. 233. Farmers face debt and stress. "America's Farmers Face Multiplying Pressures," *Economist*, September 20, 2020, <a href="https://www.economist.com/united-states/2020/09/20/americas-farmers-face-multiplying-pressures">https://www.economist.com/united-states/2020/09/20/americas-farmers-face-multiplying-pressures</a>; US Department of Agriculture Economic Research Service, *Farm Sector Income & Finance: Highlights from the February 2022 Farm Income Forecast*, February 4, 2022, <a href="https://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/highlights-from-the-farm-income-forecast/">https://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/highlights-from-the-farm-income-forecast/</a>.
- P. 233. Farmers are among the populations most likely to commit suicide. Cora Peterson et al., "Suicide Rates by Industry and Occupation—National Violent Death Reporting System, 32 States, 2016," Centers for Disease Control and Prevention *Morbidity and Mortality Weekly Report* 69 (2020): 57–62, <a href="https://www.cdc.gov/mmwr/volumes/69/wr/mm6903a1.htm">https://www.cdc.gov/mmwr/volumes/69/wr/mm6903a1.htm</a>; Debbie Weingarten, "Why Are America's Farmers Killing Themselves?" *Guardian*, December 11, 2018, <a href="https://www.theguardian.com/us-news/2017/dec/06/why-are-americas-farmers-killing-themselves-in-record-numbers.">https://www.theguardian.com/us-news/2017/dec/06/why-are-americas-farmers-killing-themselves-in-record-numbers.</a>
- P. 239.— The Organic Seed Alliance's participatory plant breeding toolkit. "OSA Publishes Participatory Plant Breeding Toolkit," June 7, 2012, <a href="https://seedalliance.org/2012/osa-publishes-participatory-plant-breeding-toolkit/">https://seedalliance.org/2012/osa-publishes-participatory-plant-breeding-toolkit/</a>.

- P. 239. The Northern Organic Vegetable Improvement Collaborative. "Welcome to NOVIC: The Northern Organic Vegetable Improvement Collaborative," Organic Seed Alliance, July 16, 2010, <a href="https://seedalliance.org/2010/welcome-to-novic-the-northern-organic-vegetable-improvement-collaborative/">https://seedalliance.org/2010/welcome-to-novic-the-northern-organic-vegetable-improvement-collaborative/</a>.
- P.239. The organic sweet corn breeding project at Atina and Martin Diffley's farm. <a href="https://organicfarmingworks.com/sweet-corn-breeding-project/">https://organicfarmingworks.com/sweet-corn-breeding-project/</a>.
- P. 240. "Participatory Plant Breeding of 'Who Gets Kissed?' Sweet Corn," November 11, 2014, <a href="https://www.highmowingseeds.com/blog/who-gets-kissed-corn/">https://www.highmowingseeds.com/blog/who-gets-kissed-corn/</a>; <a href="https://seedalliance.org/wp-content/uploads/2017/04/NOVIC">https://seedalliance.org/wp-content/uploads/2017/04/NOVIC</a> Goal 1 flyer WGK 2017March Screen.pdf.

### **Chapter Six**

- P. 252. Edward O. Wilson, "Setting Aside Half the World for the Rest of Life" (keynote address to the Science for Parks, Parks for Science conference, University of California, Berkeley, March 25–27, 2015), <a href="https://www.youtube.com/watch?v=o3ys5Us1dRs.">https://www.youtube.com/watch?v=o3ys5Us1dRs.</a>
- P. 254. Norman Borlaug, considered to be the father of the so-called Green Revolution. Justin Gillis, "Norman Borlaug, Plant Scientist Who Fought Famine, Dies at 95," *New York Times*, September 13, 2009, <a href="https://www.nytimes.com/2009/09/14/business/energy-environment/14borlaug.html">https://www.nytimes.com/2009/09/14/business/energy-environment/14borlaug.html</a>.
- P. 254–257. What kind of agriculture best supports the rest of nature? Fred Pearce, "Sparing vs Sharing: The Great Debate over How to Protect Nature," *Yale Environment 360*, December 3, 2018, <a href="https://e360.yale.edu/features/sparing-vs-sharing-the-great-debate-over-how-to-protect-nature.">https://e360.yale.edu/features/sparing-vs-sharing-the-great-debate-over-how-to-protect-nature.</a>
- P. 254. German chemist Fritz Haber figures out how to synthesize nitrogen, used in both agriculture and munitions. Claudia Flavell-While, "Fritz Haber and Carl Bosch—Feed the World," *Chemical Engineer*, March 1, 2010, <a href="https://www.thechemicalengineer.com/features/cewctw-fritz-haber-and-carl-bosch-feed-theworld/">https://www.thechemicalengineer.com/features/cewctw-fritz-haber-and-carl-bosch-feed-theworld/</a>.
- P. 257. Agriculture covers 37 percent of the world's land mass. "Land Use in Agriculture by the Numbers," Food and Agriculture Organization of the United Nations *News*, May 7, 2020, <a href="https://www.fao.org/sustainability/news/detail/en/c/1274219/">https://www.fao.org/sustainability/news/detail/en/c/1274219/</a>.
- P. 257. By one estimate, the world already grows enough food to feed 1 billion people, which is the estimate of the world's possible peak population. Eric Holt-Giménez et al., "We Already Grow Enough Food for 10 Billion People ... and Still Can't End Hunger," *Journal of Sustainable Agriculture* 36, no. 6 (July 24, 2012): 595–98, <a href="https://www.tandfonline.com/doi/abs/10.1080/10440046.2012.695331">https://www.tandfonline.com/doi/abs/10.1080/10440046.2012.695331</a>.

- P. 257. A third of the world's food production is wasted. World Food Programme, "5 Facts about Food Waste and Hunger," June 2, 2020, <a href="https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger">https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger</a>.
- P. 258. Farmers who are on the industrial production treadmill suffer; the problem for them is often overproduction, which results in lower prices despite all their hard work. Jason Ruffing, "A Century of Overproduction in American Agriculture" (master's thesis, University of North Texas, August 2014),

https://digital.library.unt.edu/ark:/67531/metadc700066/m2/1/high\_res\_d/thesis.pdf.

- P. 258. John Vandermeer's blog post about the sharing versus sparing debate. "Ideology and the Landsparing versus Landsharing Debate," September 10, 2011, http://johnvandermeer.blogspot.com/2011/09/ideology-and-landsparing-versus.html.
- P. 258. Ivette Perfecto, John Vandermeer, and Angus Wright, *Nature's Matrix: Linking Agriculture, Biodiversity Conservation, and Food Sovereignty*, 2nd edition (n.p.: Routledge Taylor & Francis Group, 2019), <a href="https://www.routledge.com/Natures-Matrix-Linking-Agriculture-Biodiversity-Conservation-and-Food/Perfecto-Vandermeer-Wright/p/book/9780367137816">https://www.routledge.com/Natures-Matrix-Linking-Agriculture-Biodiversity-Conservation-and-Food/Perfecto-Vandermeer-Wright/p/book/9780367137816</a>.
- P. 260. Coffee is an understory plant native to Africa—first discovered in Ethiopia, although scholars think its beans were first roasted in fifteenth-century Yemen to make a beverage that allowed Sufi monks to stay up all night and pray. Giorgio Milos, "Coffee's Mysterious Origins," *Atlantic*, August 6, 2010, <a href="https://www.theatlantic.com/health/archive/2010/08/coffees-mysterious-origins/61054/">https://www.theatlantic.com/health/archive/2010/08/coffees-mysterious-origins/61054/</a>.
- P. 260. Coffee has been grown in Latin America since the late eighteenth century. Tori Avey, "The Caffeinated History of Coffee," *PBS Food*, April 8, 2013, <a href="https://www.pbs.org/food/the-history-coffee/">https://www.pbs.org/food/the-history-coffee/</a>.
- P. 260. The bulk of the world's biodiversity and poverty is in the tropics. Andrew Balls, "Why Tropical Countries Are Underdeveloped," *Digest*, no. 6, June 2001, <a href="https://www.nber.org/digest/jun01/why-tropical-countries-are-underdeveloped">https://www.nber.org/digest/jun01/why-tropical-countries-are-underdeveloped</a>; Jennifer L. Cohen et al., "The Geography of Poverty Hotspots," Brookings Institution, September 24, 2019, <a href="https://www.brookings.edu/blog/future-development/2019/09/24/the-geography-of-poverty-hotspots/">https://www.brookings.edu/blog/future-development/2019/09/24/the-geography-of-poverty-hotspots/</a>.
- P. 260. In the 1980s, international lending agencies had started to pressure countries in northern Latin America to modernize their coffee production to help service their debts. The United States, through its development agency, USAID, provided \$81 million to finance this modernization. Robert A. Rice, "A Place Unbecoming: The Coffee Farm of Northern Latin America," *Geographical Review* 89, no. 4 (October 1999): 554–79, <a href="https://www.jstor.org/stable/216102.">https://www.jstor.org/stable/216102.</a>

- P. 260. Farmers were encouraged to "intensify production," eliminating the polycultures of traditional coffee plantations and raising monocultures with the help of chemical fertilizers and other inputs. Matrix, 535.
- P. 264. Ivette Perfecto and colleagues find that birds benefit coffee plantations. "Greater Predation in Shaded Coffee Farms: The Role of Resident Neotropical Birds," *Ecology* 85, no. 10 (October 1, 2004): 2677–81, <a href="https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/03-3145">https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/03-3145</a>.
- P. 265. Islands have lower levels of biodiversity. Sedeer el-Showk, "Island Biogeography in the Era of Humans," *Scitable by Nature Education*, September 29, 2014, <a href="https://www.nature.com/scitable/blog/accumulating-glitches/island-biogeography">https://www.nature.com/scitable/blog/accumulating-glitches/island-biogeography in the era/.</a>
- P. 267. Island biodiversity is maintained by recolonization from other islands—which happens all the time—balancing out local extinctions, which also happen all the time. Robert H. MacArthur and Edward O. Wilson, *The Theory of Island Biogeography* (Princeton, NJ: Princeton University Press, March 2001), <a href="https://press.princeton.edu/books/paperback/9780691088365/the-theory-of-island-biogeography">https://press.princeton.edu/books/paperback/9780691088365/the-theory-of-island-biogeography</a>.
- P. 267. Wildlife corridors themselves aren't an answer to the biodiversity crisis, as predators often figure out that prey is funneled into the corridor and lie in wait for them. Lesley Evans Ogden, "Do Wildlife Corridors Have a Downside?" *BioScience* 65, no. 4 (April 2015): 452, <a href="https://academic.oup.com/bioscience/article/65/4/452/255152.">https://academic.oup.com/bioscience/article/65/4/452/255152.</a>
- P. 268. In a 2017 study of 63 German preserves, researchers detected steep declines of flying insects over 27 years. Frank Jordans, "Where's the Buzz? German Study Finds Dramatic Insect Decline," AP *News*, October 29, 2017, https://apnews.com/article/f1126438d2d24f89aa0d4e328250b257.
- P. 273. Coffee leaf rust spread from East Africa, wiped out coffee production in Ceylon in the late nineteenth century, and finally detonated in Central America in the 1980s. Jeff Koehler, "Coffee Rust Threatens Latin American Crop; 150 Years Ago, It Wiped Out an Empire," NPR *The Salt*, October 16, 2018, <a href="https://www.npr.org/sections/thesalt/2018/10/16/649155664/coffee-rust-threatens-latin-american-crop-150-years-ago-it-wiped-out-an-empire">https://www.npr.org/sections/thesalt/2018/10/16/649155664/coffee-rust-threatens-latin-american-crop-150-years-ago-it-wiped-out-an-empire</a>.
- P. 273. Some experts think climate change helped coffee leaf rust get a foothold in Central America. Maryn McKenna, "Coffee Rust Is Going to Ruin Your Morning," *Atlantic*, September 16, 2020, <a href="https://www.theatlantic.com/science/archive/2020/09/coffee-rust/616358/">https://www.theatlantic.com/science/archive/2020/09/coffee-rust/616358/</a>.
- P. 275. DNA analysis determined that one hundred fungal species populated a sample of coffee leaf rust, including thirteen from fungal families that act as parasites of other fungi. Timothy Y. James et al., "Identification of Putative Coffee Rust Mycoparasites via Single-Molecule DNA Sequencing of Infected Pustules," *Applied and Environmental Microbiology*, January 2016, https://journals.asm.org/doi/pdf/10.1128/AEM.02639-15.
- P. 277. Helda Morales and Ivette Perfecto undertook a study of traditional methods of pest control among Maya farmers in Guatemala, but they say they don't have pest problems.

"Traditional Knowledge and Pest Management in the Guatemalan Highlands," *Agriculture and Human Values* 17 (March 2000) 49–63, https://link.springer.com/article/10.1023/A%3A1007680726231.

- P. 278. Ivette Perfecto and John Vandermeer point out that some farmers have such an intimate relationship with their landscape that they do "precision agriculture"—albeit based on recognizing the particularities of their own land and respecting the relationships among the living things there. "The Agroecological Matrix as Alternative to the Land-Sparing/Agriculture Intensification Model," in *Proceedings of the National Academy of Sciences of the United States of America* 107, no. 13 (March 30, 2010): 5786–91, <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2851926/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2851926/</a>.
- P. 282. Trees resorb some of the nutrients from leaves before they let them drop. BEC Crew, "Here's the Real Reason Leaves Change Colour in the Fall," October 26, 2015, <a href="https://www.sciencealert.com/watch-here-s-the-real-reason-leaves-change-colour-in-the-fall?limitstart=1">https://www.sciencealert.com/watch-here-s-the-real-reason-leaves-change-colour-in-the-fall?limitstart=1</a>.
- P. 282. Leaves decompose faster in a polyculture with shade trees like Finca Irlanda than in a monoculture. Lauren Schmitt and Ivette Perfecto, "Coffee Leaf Litter Decomposition: Short Term Home-Field Advantage in Shaded Coffee Agro-ecosystems," *Applied Soil Ecology* 161, no. 2 (May 2021): 103854,

https://www.researchgate.net/publication/348354794\_Coffee\_leaf\_litter\_decomposition\_Short\_t erm home-field advantage in shaded coffee agro-ecosystems.

# **Chapter Seven**

- P. 292.— Timber monocultures are a gross simplification of a formerly complex landscape. Lisa Bramen, "Beyond the Timber Wars," *Nature Conservancy*, August/September 2015, <a href="https://www.nature.org/en-us/magazine/magazine-articles/beyond-the-timber-wars/">https://www.nature.org/en-us/magazine/magazine-articles/beyond-the-timber-wars/</a>.
- P. 293. In the last third of the twentieth century, environmentalists battled government and private industry to protect nature in what are often called "the spotted owl wars." Ian McCluskey, "Last Call: Tracking the Sound of the Spotted Owl's Extinction," *OPB*, June 20, 2020, <a href="https://www.opb.org/article/2020/07/27/last-call-tracking-the-sound-of-the-spotted-owls-extinction/">https://www.opb.org/article/2020/07/27/last-call-tracking-the-sound-of-the-spotted-owls-extinction/</a>.
- P. 297—By one estimate, some two-thirds of all wildlife species use broken, dead trees (called snags) or fallen wood for food or habitat. George Wuerthner, "In Praise of Dead Trees," *Counterpunch*, December 24, 2018, <a href="https://www.counterpunch.org/2018/12/24/in-praise-of-dead-trees/">https://www.counterpunch.org/2018/12/24/in-praise-of-dead-trees/</a>.
- P. 297. The importance of leaving dead trees in place. Melissa J. Santiago and Amanda D. Rodewald, "Dead Trees as Resources for Forest Wildlife" (fact sheet, Ohio State University Extension School of Natural Resources), <a href="https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/0/90535/files/2020/09/OSU-Fact-Sheet-Dead-Trees-for-Wildlife.pdf">https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/0/90535/files/2020/09/OSU-Fact-Sheet-Dead-Trees-for-Wildlife.pdf</a>.

- P. 299. According to Mark Kurlansky's *Salmon: A Fish, the Earth, and the History of Their Common Fate*, Indigenous populations used to catch a lot of fish for consumption as well as trade. (Ventura, CA: Patagonia, 2020), 154, <a href="https://www.patagonia.com/product/salmon-a-fish-the-earth-and-the-history-of-their-common-fate-hardcover-book/BK835.html">https://www.patagonia.com/product/salmon-a-fish-the-earth-and-the-history-of-their-common-fate-hardcover-book/BK835.html</a>.
- P. 299. Indigenous populations didn't destroy the ecological health of the overall landscape that supports the salmon life cycle, as did the white people who displaced them. Kurlansky, *Salmon*, 194.
- P. 299. Salmon are especially sensitive to warmer-than-average waters even before they hatch—one study showed that Chinook salmon hatch earlier and emerge less developed in warmer water. Abby E. Fuhrman et al., "Chinook Salmon Emergence Phenotypes: Describing the Relationships between Temperature, Emergence Timing and Condition Factor in a Reaction Norm Framework," *Ecology of Freshwater Fish* 27, no. 1 (March 3, 2017): 350–62, <a href="https://onlinelibrary.wiley.com/doi/abs/10.1111/eff.12351.">https://onlinelibrary.wiley.com/doi/abs/10.1111/eff.12351.</a>
- P. 299. Ranchers turned lowland forests into fields, opening creeks and streams to the daily glare. Kurlansky, *Salmon*, 196.
- P. 299. Trappers removed millions of beaver, those useful rodents that add ponds, oxbows, and other complexity to waterways and slow the water down so that it can penetrate the surrounding landscape. Ben Goldfarb, *Eager: The Surprising Secret Lives of Beavers and Why They Matter* (White River Junction, VT: Chelsea Green Publishing, 2018), <a href="https://www.bengoldfarb.com/eager">https://www.bengoldfarb.com/eager</a>.
- P. 302. The many advantages of woody debris in streams. Penn State Extension, "Benefits of Large Woody Debris in Streams," March 1, 2021, <a href="https://extension.psu.edu/benefits-of-large-woody-debris-in-streams">https://extension.psu.edu/benefits-of-large-woody-debris-in-streams</a>.
- P. 303. Salmon return to the creeks and streams where they were born, where they lay and fertilize eggs in special nests called redds. Colton Dixon, "Redd Ed," *Sea Grant California*, December 13, 2018, https://caseagrant.ucsd.edu/blogs/redd-ed.
- P. 306. Whirling disease has been found in Oregon's eastern waterways, but not yet in the state's coastal rivers or creeks. Oregon Department of Fish and Wildlife, "Whirling Disease and Oregon's Trout and Salmon," <a href="https://www.dfw.state.or.us/fish/diseases/whirling.asp.">https://www.dfw.state.or.us/fish/diseases/whirling.asp.</a>
- P. 306. Whirling disease is caused by *Myxobolus cerebralis*, a member of a family of microscopic parasitic animals called myxozoans that are related to jellyfish and coral. Kalila Morsink, "It's All in the (Jellyfish) Family," *Smithsonian Ocean*, August 2017, <a href="https://ocean.si.edu/ocean-life/invertebrates/its-all-jellyfish-family.">https://ocean.si.edu/ocean-life/invertebrates/its-all-jellyfish-family.</a>
- P. 306. –Scientists have discovered a myxozoan that steals nutrients so effectively from its host that it does not need oxygen—the first such animal known to scientists. Dayana Yahalomi et al., "A Cnidarian Parasite of Salmon (Myxozoa: *Henneguya*) Lacks a Mitochondrial Genome," in

- Proceedings of the National Academy of Sciences of the United States of America 117, no. 10 (February 24, 2020): 5358–63, https://www.pnas.org/doi/10.1073/pnas.1909907117.
- P. 312. Fisheries biologist Dan Bottom discusses the importance of estuaries to salmon survival. "Increasing Salmon Populations by Restoring the Estuary," National Oceanic and Atmospheric Administration, September 27, 2018, <a href="https://www.youtube.com/watch?v=u0t70IMWeJw">https://www.youtube.com/watch?v=u0t70IMWeJw</a>.
- P. 313. Marlon Brando bought Teti<sup>4</sup>aroa, once the private reserve of Tahitian royalty. Klara Glowczewska, "The Brando Is the Ultimate Luxury Resort—But What It Really Wants to Do Is Save the Planet," *Town & Country*, September 20, 2017, https://www.townandcountrymag.com/leisure/travel-guide/a12437187/brando-resort/.
- P. 314. Teti'aroa, Tahiti, and the rest of the Society Islands archipelago are bits of land that are the most distant from the world's landmasses—so distant that they were the last to be settled by humans. Nicholas St. Fleur, "How Ancient Humans Reached Remote South Pacific Islands, *New York Times*, November 1, 2016, <a href="https://www.nytimes.com/2016/11/02/science/south-pacific-islands-migration.html">https://www.nytimes.com/2016/11/02/science/south-pacific-islands-migration.html</a>.
- P. 314. NASA's images of Teti'aroa from the air. https://www.earthobservatory.nasa.gov/images/37008/tetiaroa-island-french-polynesia.
- P. 314. The first Europeans to stumble upon Teti'aroa may have been three deserters from the historic HMS *Bounty*, in 1789. James Russell and Lucie Faulquier, "Tetiaroa Rat and Seabird Survey 7th–13th July 2009," https://www.stat.auckland.ac.nz/~jrussell/files/rep/Tetiaroa Jul09 en.pdf.
- P. 314. Teti'aroa was gifted to a Canadian dentist in 1904. Brendan Riley, "Solano Chronicles: Marlon Brando Closed Deal for South Pacific Island in Vallejo," *Solano Times-Herald*, August 5, 2019, <a href="https://www.timesheraldonline.com/2019/08/05/solano-chronicles-marlon-brando-closed-deal-for-south-pacific-island-in-vallejo/">https://www.timesheraldonline.com/2019/08/05/solano-chronicles-marlon-brando-closed-deal-for-south-pacific-island-in-vallejo/.</a>
- P. 317. Reef-building corals have a mutualistic relationship with photosynthetic algae. National Ocean Service, "Zooxanthellae ... What's That?," <a href="https://oceanservice.noaa.gov/education/tutorial\_corals/coral02\_zooxanthellae.html">https://oceanservice.noaa.gov/education/tutorial\_corals/coral02\_zooxanthellae.html</a>.
- P. 317. Coral are the backbone of important underwater ecosystems. Peter K. Swart, "Coral Reefs: Canaries of the Sea, Rainforests of the Oceans," *Nature Education Knowledge* 4, no. 3 (2013): 5, <a href="https://www.nature.com/scitable/knowledge/library/coral-reefs-canaries-of-the-sea-rainforests-97879685/">https://www.nature.com/scitable/knowledge/library/coral-reefs-canaries-of-the-sea-rainforests-97879685/</a>.
- P. 321. Scientists have determined that the bacteria living in a mucus layer over the coral reefs defend the coral. Kim B. Ritchie, "Regulation of Microbial Populations by Coral Surface Mucus and Mucus-Associated Bacteria," *Marine Ecology Progress Series* 322, September 20, 2006, <a href="https://www.int-res.com/articles/feature/m322p001.pdf">https://www.int-res.com/articles/feature/m322p001.pdf</a>; Kim B. Ritchie and Garriet W. Smith, "Microbial Communities of Coral Surface Mucopolysaccharide Layers," in *Coral Health and*

- *Disease*, eds. E. Rosenberg and Y. Loya (Berlin, Heidelberg: Springer, 2004), https://link.springer.com/chapter/10.1007/978-3-662-06414-6 13.
- P. 321. Viral infections can sometimes confer benefits to their host organisms in a roundabout way—one example is that people carrying the herpes virus are protected against some other infections. Erik S. Barton et al., "Herpesvirus Latency Confers Symbiotic Protection from Bacterial Infection," *Nature* 447, no. 7142 (May 17, 2007): 326–9, <a href="https://pubmed.ncbi.nlm.nih.gov/17507983/">https://pubmed.ncbi.nlm.nih.gov/17507983/</a>.
- P. 322. Coral are only mobile in their larval stages, then anchor themselves to a reef. Some researchers think they are guided there by bacteria. Jennifer Sneed, "Microbes Help Corals Pick a Home and Settle Down," *Smithsonian*, July 2014, <a href="https://ocean.si.edu/ocean-life/plants-algae/microbes-help-corals-pick-home-and-settle-down.">https://ocean.si.edu/ocean-life/plants-algae/microbes-help-corals-pick-home-and-settle-down.</a>
- P. 323. Nitrogen in agricultural fertilizer—and even in human waste, from all the nitrogen-fertilized produce we eat—is a huge problem for coral reefs. Lu Wang et al., "Corals and Their Microbiomes Are Differentially Affected by Exposure to Elevated Nutrients and a Natural Thermal Anomaly," *Frontiers in Marine Science*, March 28, 2018, <a href="https://www.frontiersin.org/articles/10.3389/fmars.2018.00101/full.">https://www.frontiersin.org/articles/10.3389/fmars.2018.00101/full.</a>
- P. 324. Coral bleaching has become more frequent as climate change raises the temperature of the seas. Daisy Dunne, "Severe Coral Reef Bleaching Now 'Five Times More Frequent' than 40 Years Ago," *Carbon Brief Marine Life*, January 4, 2018, <a href="https://www.carbonbrief.org/severe-coral-reef-bleaching-now-five-times-more-frequent-than-40-years-ago/">https://www.carbonbrief.org/severe-coral-reef-bleaching-now-five-times-more-frequent-than-40-years-ago/</a>.
- P. 324. The Great Barrier Reef experienced an unprecedented back-to-back bleaching in 2016 and 2017. Australian Institute of Marine Science, "Coral Bleaching Events," <a href="https://www.aims.gov.au/docs/research/climate-change/coral-bleaching/bleaching-events.html">https://www.aims.gov.au/docs/research/climate-change/coral-bleaching/bleaching-events.html</a>.
- P. 327. A conservation group's plan to exterminate rats on Teti'aroa and rebuild the native seabird population. Tetiaroa Society Programs, "Tetiaroa Atoll Restoration Project—TARP," March 2020, <a href="https://www.tetiaroasociety.org/programs/conservation/tetiaroa-habitat-restoration-program">https://www.tetiaroasociety.org/programs/conservation/tetiaroa-habitat-restoration-program</a>.
- P. 327. The loss of large animals in the ocean ecosystem disrupts life all the way down to the microscopic life at its foundation. Deron E. Burkepile and Rebecca Vega Thurber, "The Long Arm of Species Loss: How Will Defaunation Disrupt Ecosystems Down to the Microbial Scale?" *BioScience* 69, no. 6 (June 2019): 443–54,

https://academic.oup.com/bioscience/article/69/6/443/5487941.

### **Chapter Eight**

P. 332. – The plummeting populations of insects around the world. Damian Carrington, "Plummeting Insect Numbers 'Threaten Collapse of Nature," *Guardian*, February 10, 2019, <a href="https://www.theguardian.com/environment/2019/feb/10/plummeting-insect-numbers-threaten-collapse-of-nature.">https://www.theguardian.com/environment/2019/feb/10/plummeting-insect-numbers-threaten-collapse-of-nature.</a>

- P. 336. Green roofs are one of the great environmental trends taking place around the world. John Rayner, "Green Roofs and Walls—a Growth Area in Urban Design," *The Conversation*, March 19, 2014, <a href="https://theconversation.com/green-roofs-and-walls-a-growth-area-in-urban-design-23911.">https://theconversation.com/green-roofs-and-walls-a-growth-area-in-urban-design-23911.</a>
- P. 336. More than 80 percent of Americans live in cities. United States Census, "Urban Area Facts," <a href="https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/uafacts.html">https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/uafacts.html</a>.
- P. 336. More than half of the world's people live in urban areas. Katharina Buchholz, "How Has the World's Urban Population Changed from 1950 to Today?" *World Economic Forum*, November 4, 2020, <a href="https://www.weforum.org/agenda/2020/11/global-continent-urban-population-urbanisation-percent/">https://www.weforum.org/agenda/2020/11/global-continent-urban-population-urbanisation-percent/</a>.
- P. 336. In 1960, twice as many people lived in the country as in the cities. Hannah Ritchie and Max Roser, "Urbanization," *Our World in Data*, revised November 2019, <a href="https://ourworldindata.org/urbanization#:~:text=Here%20we%20see%20that%20in,equal%20at%203.33%20billion%20each.">https://ourworldindata.org/urbanization#:~:text=Here%20we%20see%20that%20in,equal%20at%203.33%20billion%20each.</a>
- P. 336. Development continues voraciously, with the United States losing some four thousand acres every day—three acres per minute—to new streets and homes and businesses. Abigail Derby Lewis et al., "Does Nature Need Cities? Pollinators Reveal a Role for Cities in Wildlife Conservation," *Frontiers in Ecology and Evolution*, June 21, 2019, <a href="https://www.frontiersin.org/articles/10.3389/fevo.2019.00220/full.">https://www.frontiersin.org/articles/10.3389/fevo.2019.00220/full.</a>
- P. 337. A grassroots group mounted a campaign to declare London a National Park City, a recognition that even though around 8.6 million people live there, a whopping 47 percent of the city is physically green, including ancient woodlands and meadows, parks, and newly created wetlands, as well as private gardens. London mayor Sadiq Khan signed a charter proclaiming this new status in 2019. David Goode, "London: A National Park City," *The Nature of Cities*, August 16, 2015, <a href="https://www.thenatureofcities.com/2015/08/16/london-a-national-park-city/">https://www.thenatureofcities.com/2015/08/16/london-a-national-park-city/</a>; "London Becomes the World's First National Park City" (press release, London National Park City, July 15, 2019), <a href="https://www.nationalparkcity.london/press/24-media/130-london-becomes-the-world-s-first-national-park-city/">https://www.nationalparkcity.london/press/24-media/130-london-becomes-the-world-s-first-national-park-city/</a>.
- P. 339. In one study, researchers found a higher diversity of native bees in several American cities than in nearby rural areas. Damon M. Hall et al., "The City as a Refuge for Insect Pollinators," *Conservation Biology* 31, no. 1 (September 14, 2016): 24–9 https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.12840.
- P. 340. Biologist Edward O. Wilson coined the word *biophilia* to describe humans' desire to be with nature. *NOVA*, "A Conversation with E. O. Wilson," March 31, 2008, https://www.pbs.org/wgbh/nova/article/conversation-eo-wilson/.

- P. 342. More than fifty years ago, Singapore began evolving into a "garden city." HistorySG, ""Garden City' Vision Is Introduced," May 11, 1967, https://eresources.nlb.gov.sg/history/events/a7fac49f-9c96-4030-8709-ce160c58d15c.
- P. 342. Cities are typically hotter than the surrounding countryside. Gerald Mills, "Why Are Cities Warmer than the Countryside?" *The Conversation*, January 25, 2016, <a href="https://theconversation.com/why-are-cities-warmer-than-the-countryside-53160">https://theconversation.com/why-are-cities-warmer-than-the-countryside-53160</a>.
- P. 344. Heat is the leading cause of weather-related death in the United States. US Environmental Protection Agency, "Climate Change Indicators: Heat-Related Deaths," October 2021, https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths.
- P. 344. A dense urban tree canopy offers protection from heat, creating shaded surfaces that can be a whopping 20 to 45 degrees Fahrenheit cooler than unshaded surfaces. Even green roofs extend their cooling effect to the sidewalk below. US Environmental Protection Agency, "Using Trees and Vegetation to Reduce Heat Islands," July 2021, <a href="https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands">https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands</a>.
- P. 344. Other benefits of urban greenery. *Nature Conservancy*, "How Urban Trees Can Save Lives," October 30, 2016, <a href="https://www.nature.org/en-us/what-we-do/our-insights/perspectives/how-urban-trees-can-save-lives/">https://www.nature.org/en-us/what-we-do/our-insights/perspectives/how-urban-trees-can-save-lives/</a>.
- P. 344. Even small pockets of urban greenery in swales and rain gardens can absorb large amounts of stormwater. Alessio Russo and Giuseppe T. Cirella, "Biophilic Cities: Planning for Sustainable and Smart Urban Environments," *Academia*, 2017, <a href="https://www.academia.edu/32154958/Biophilic\_Cities\_Planning\_for\_Sustainable\_and\_Smart\_Urban\_Environments.">https://www.academia.edu/32154958/Biophilic\_Cities\_Planning\_for\_Sustainable\_and\_Smart\_Urban\_Environments.</a>
- P. 345. The many benefits of green roofs. National Park Service Technical Preservation Services, "Green Roof Benefits," <a href="https://www.nps.gov/tps/sustainability/new-technology/green-roofs/benefits.htm#:~:text=The%20study%20looked%20at%20a,come%20from%20reduced%20energy%20costs.">https://www.nps.gov/tps/sustainability/new-technology/green-roofs/benefits.htm#:~:text=The%20study%20looked%20at%20a,come%20from%20reduced%20energy%20costs.</a>; Bruce Dvorak, ed., *Ecoregional Green Roofs: Theory and Application in the Western US and Canada*, Springer.com, 2021, <a href="https://link.springer.com/book/10.1007/978-3-030-58395-8">https://link.springer.com/book/10.1007/978-3-030-58395-8</a>.
- P. 345. Scientists have found that merely seeing trees through a window helped surgical patients recover more quickly and need fewer painkillers. R. S. Ulrich, "View through a Window May Influence Recovery from Surgery," *Science* 224, no. 4647 (April 27, 1984): 420–1. <a href="https://pubmed.ncbi.nlm.nih.gov/6143402/">https://pubmed.ncbi.nlm.nih.gov/6143402/</a>.
- P. 345. Plants release chemicals that boost our immune systems. Clemens G. Arvay, *The Biophilia Effect: A Scientific and Spiritual Exploration of the Healing Bond between Humans and Nature* (Louisville, CO: Sounds True, 2018): 10; Q. Li et al., "Effect of Phytoncide from Trees on Human Natural Killer Cell Function," *International Journal of Immunopathology and Pharmacology* 22, no. 9 (October–December 2009): 951–9, <a href="https://pubmed.ncbi.nlm.nih.gov/20074458/">https://pubmed.ncbi.nlm.nih.gov/20074458/</a>.

- P. 345. People around the world are picking up on the Japanese practice of forest bathing. Bum Jin Park et al., "The Physiological Effects of Shinrin-yoku (Taking in the Forest Atmosphere or Forest Bathing): Evidence from Field Experiments in 24 Forests across Japan," *Environmental Health and Preventive Medicine* 15, no. 1 (January 2010): 18–26, <a href="https://pubmed.ncbi.nlm.nih.gov/19568835/">https://pubmed.ncbi.nlm.nih.gov/19568835/</a>.
- P. 346. The benefits of living in urban areas with more vegetation. Shankar Vedantam et al., "Our Better Nature: How the Great Outdoors Can Improve Your Life," NPR *Hidden Brain*, September 10, 2018, <a href="https://www.npr.org/2018/09/10/646413667/our-better-nature-how-the-great-outdoors-can-improve-your-life">https://www.npr.org/2018/09/10/646413667/our-better-nature-how-the-great-outdoors-can-improve-your-life</a>; Frances E. Kuo and William C. Sullivan, "Environment and Crime in the Inner City: Does Vegetation Reduce Crime?" *Environment and Behavior* 33, no. 3 (May 2001): 343–67

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.644.9399&rep=rep1&type=pdf; Melissa R. Marselle et al., "Urban Street Tree Biodiversity and Antidepressant Prescriptions," *Scientific Reports* 10, article no. 22445, December 2020, https://www.nature.com/articles/s41598-020-79924-5.

- P. 350. The case for "daylighting" New York's Tibbetts Brook. Van Cortlandt Park Alliance, "Daylighting Tibbetts Brook," <a href="https://vancortlandt.org/programs-overview/daylighting-tibbetts-brook/">https://vancortlandt.org/programs-overview/daylighting-tibbetts-brook/</a>, "Imagining the Day Lighting of Tibbetts Brook," November 2019, <a href="https://www.riverkeeper.org/news-events/events/nyc-events/imagining-the-day-lighting-of-tibbetts-brook/">https://www.riverkeeper.org/news-events/events/nyc-events/imagining-the-day-lighting-of-tibbetts-brook/</a>; Biohabitats, "Tibbetts Brook Stream Daylighting," <a href="https://www.biohabitats.com/project/tibbetts-brook-stream-daylighting/">https://www.biohabitats.com/project/tibbetts-brook-stream-daylighting/</a>.
- P. 351. Bob Braine's estuary tattoos. *CALL // City as Living Laboratory*, "Estuary Tattoos by Bob Braine at Car Free Earth Day," April 2018, <a href="https://www.cityaslivinglab.org/events/carfreeearthday">https://www.cityaslivinglab.org/events/carfreeearthday</a>.
- P. 359. Organizers of Naturehood estimate—based on a study in *Biological Conservation*—that if all the private gardens in the United Kingdom became nature-friendly, this would create a wildlife haven of over 430,000 hectares—more than four times as large as all the United Kingdom's national nature reserves combined. Zoe G. Davies et al., "A National Scale Inventory of Resource Provision for Biodiversity within Domestic Gardens," *Biological Conservation* 142, no. 4 (April 2009): 761–71, https://www.sciencedirect.com/science/article/abs/pii/S000632070800476X?via%3Dihub.
- intps://www.sciencedirect.com/science/article/aos/pii/S000032070800470X!via703Dinuo.
- P. 363. New York City's Nature Goals. NYC Nature Goals 2050, "Declaration of Rights to New York City Nature," <a href="https://naturegoals.nyc/">https://naturegoals.nyc/</a>; The Nature of Cities.
- P. 363. The National Wildlife Federation calls upon cities to make three policy changes that would turn tens of thousands of acres of urban landscapes into habitat for wildlife. Patrick Fitzgerald, "Cities Need Urban Wildlife Plans to Combat the Extinction Crisis," *National Wildlife Federation's Blog*, June 19, 2019, <a href="https://blog.nwf.org/2019/06/cities-need-urban-wildlife-plans-to-combat-the-extinction-crisis/">https://blog.nwf.org/2019/06/cities-need-urban-wildlife-plans-to-combat-the-extinction-crisis/</a>.

- P. 365. Park ranger Pam Trass extols the reappearance of wildlife after Pinellas County, Florida, established no-mow zones in less-used sections of the county's parks. "No Mow Zones," Pinellas County Parks & Preserves, https://www.youtube.com/watch?v=Qc7l1uN8\_8k&list=PL0BD737D9C3FDD658&index=15.
- P. 371. The BQGreen is a massive endeavor to create a "park out of thin air" by extending a concrete platform over the Brooklyn-Queens Expressway. "You're Invited! NBK Parks Will Host BQGreen Panel 12/08" (press release, Friends of BQGreen), <a href="https://bqgreen.org/en/category/updates/">https://bqgreen.org/en/category/updates/</a>.
- P. 372. Cities are creating green spaces over highways. Martha T. Moore, "More Cities Are Banishing Highways Underground—and Building Parks on Top," *PEW Stateline*, April 2, 2018, <a href="https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2018/04/more-cities-are-banishing-highways-underground-and-building-parks-on-top.">https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2018/04/more-cities-are-banishing-highways-underground-and-building-parks-on-top.</a>
- P. 372. Moss piglets live just about everywhere scientists look, including in the tops of city trees. Editors, *Encyclopedia Britannica*, s. v. "Tardigrade," <a href="https://www.britannica.com/animal/tardigrade">https://www.britannica.com/animal/tardigrade</a>.
- P. 374. Certain species of lizards living in urban areas have developed longer limbs with bigger toe pads so that they can skitter up slick walls and poles. Washington University in St. Louis, "Hot Time in the City: Urban Lizards Evolve Heat Tolerance," *Science* Daily, March 20, 2020, <a href="https://www.sciencedaily.com/releases/2020/03/200310094231.htm">https://www.sciencedaily.com/releases/2020/03/200310094231.htm</a>.
- P. 377. Stormwater is a witches' brew of chemicals. US Environmental Protection Agency, "Stormwater Runoff," <a href="https://www3.epa.gov/region9/water/npdes/stormwater-feature.html">https://www3.epa.gov/region9/water/npdes/stormwater-feature.html</a>.
- P. 379. When beavers kept disrupting an engineered wetland designed to absorb urban stormwater, the city's watershed scientist suggested a two-year study to test whose design cleaned the stormwater better—the beavers' or the engineers'. Katie Holzer et al., "Who Does It Best? Engineers vs. Beavers in a Stormwater Treatment Facility," City of Gresham, Oregon, <a href="https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1098&context=uerc">https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1098&context=uerc</a>; presented at Urban Ecosystem Research Consortium of Portland/Vancouver, February 11, 2019, <a href="https://pdxscholar.library.pdx.edu/uerc/2019/presentations/7/">https://pdxscholar.library.pdx.edu/uerc/2019/presentations/7/</a>.